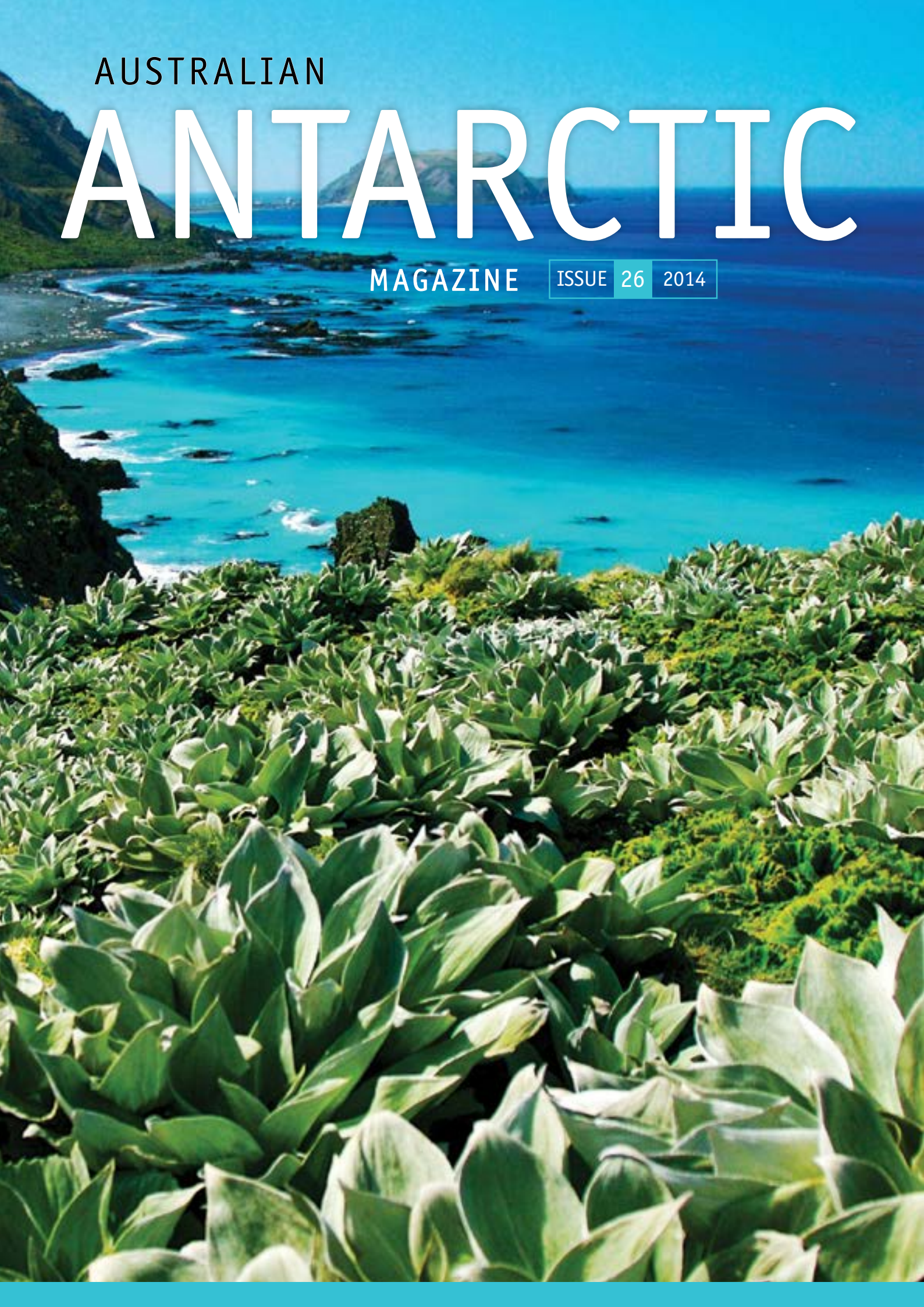


AUSTRALIAN

# ANTARCTIC

MAGAZINE

ISSUE 26 2014





The Australian Antarctic Division, a Division of the Department of the Environment, 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 Antarctic national interests are to:

- Preserve our sovereignty over the Australian Antarctic Territory, including our sovereign rights over the adjacent offshore areas.
- Take advantage of the special opportunities Antarctica offers for scientific research.
- Protect the Antarctic environment, having regard to its special qualities and effects on our region.
- Maintain Antarctica's freedom from strategic and/or political confrontation.
- Be informed about and able to influence developments in a region geographically proximate to Australia.
- Derive any reasonable economic benefits from living and non-living resources of the Antarctic (excluding deriving such benefits from mining and oil drilling).

*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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**Australian Government**  
**Department of the Environment**  
Australian Antarctic Division

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### ABOUT THE COVER

Reminiscent of a tropical island rather than a subantarctic one, this image of Macquarie Island shows an east coast slope covered with silver-leaf daisy (*Pleurophyllum hookeri*), looking north towards the station. The photo was taken in 2007 by Frederique Olivier, who has spent 14 seasons working in Antarctica and the subantarctic, as a scientist, photographer, expedition guide, voyage manager, commercial skipper, media producer and camera operator. A successful conclusion to the pest eradication project (page 1) will ensure the World Heritage values of this beautiful island are preserved.



# Pests eradicated from Macquarie Island

Macquarie Island researchers will no longer wake to the night time scrabbings of rodents around their field huts, with the pests now officially eradicated from the island.

The seven year, \$25 million eradication project, funded by the Australian and Tasmanian governments, ended in April this year, with Tasmania Parks and Wildlife Service project manager, Keith Springer, declaring that no rabbits, rats or mice had been detected for the past two and a half years.

A ceremony was held in Hobart on the return of the 12-strong hunting team, including 11 hunting dogs and their handlers, who had spent the past 13 months scouring the 12 785 hectare island for signs of survivors, after an extensive baiting program in 2011.

Already the flora and fauna on the World Heritage listed island is bouncing back, with tussock grasses providing cover for seabird chicks, and megaherbs returning in all their lush, green glory. Some bird species, previously restricted to breeding on offshore rockstacks, such as blue petrels and Antarctic terns, have begun to recolonise the main island. The cause of much of the island's erosion and deadly landslides has also been removed.

While the news is good, ecologists say it could take up to 20 years before a new ecological equilibrium is reached and the end result is not always predictable. Reports from other island eradication projects indicate that even in the same archipelago, different plant species can respond quite differently to the removal of pest species. However it is clear that significant ecological improvement is the main story from islands where pests are removed.

'It is exciting to see an ecosystem which suffered significant degradation due to pest species, for more than 100 years, firmly on the road to recovery, and it will be just as fascinating to see how the landscape recovery evolves in the coming decades,' Mr Springer said.

The eradication program eliminated some 150 000 rabbits from the island in the first year. The release of calicivirus culled numbers initially (in 2011), followed by an aerial baiting program targeting surviving rabbits, as well as rats and mice. Australian- and New Zealand-trained dogs were then brought in to help hunters to finish the job – finding just eight adult survivors of the aerial baiting, plus a single litter of kittens.

'After the baiting, the island was divided into six hunting blocks, with teams of two hunters dispatching rabbits using detection dogs, spotlighting, burrow fumigation and trapping,' Mr Springer said.

'In 2013 two New Zealand rodent dog handlers and their three rodent detection dogs joined the team specifically looking for evidence of any surviving rats and mice, and found none.'

The project has generated global interest as it is the first time that rabbits, rats and mice have been eradicated all at the same time, from an island the size of Macquarie Island.

With the island now free of pests, the key is to prevent a reintroduction of pests from ships' cargo. In 2013 the Australian Antarctic Division opened its new biosecurity facility on the Hobart waterfront. The facility has vermin traps, impenetrable walls and fumigation areas and staff use rodent detector dogs to screen all cargo destined for Antarctica and the subantarctic. On Macquarie Island, rodent and insect traps are laid around the station during and after voyages.

WENDY PYPER

*Corporate Communications, Australian Antarctic Division*



1. The hunting dogs and their handlers spent most days and nights walking the island in difficult weather conditions. Seven springer spaniels, four labradors, a border terrier cross and three New Zealand rodent detection dogs were chosen for their work ethic, adaptability, and tolerance to the cold and wet. Here, Gary Bowcock walks the island with Joker and Tama.

2. The tourist boardwalk at Sandy Bay in 2005.

3. The tourist boardwalk at Sandy Bay in 2013 as the tussock grasses bounce back from grazing pressure.

All photos courtesy of the Tasmania Parks and Wildlife Service.

# Hard core science

An ice core climate record spanning the past 2000 years was retrieved from the remote heart of Antarctica this past summer by an international team of scientists and deep field operators.



JEAN JACQUES OLIVIER

About two tonnes of ice core sections, drilled over five weeks at Aurora Basin, 500 km inland from Casey station, made the long sea journey to Hobart in a refrigerated container onboard the *Aurora Australis* in February.

The ice cores will now be transferred to Australian and international ice core laboratories for analysis of atmospheric gases, particles and other chemical elements that were trapped in snow as it fell and compacted to form ice.

Leader of the Aurora Basin ice core drilling project, Dr Mark Curran, of the Australian Antarctic Division, said the 2000 year core will help fill a gap in the international science community's knowledge by providing annual climate records prior to and during the industrial era.

'We used a Danish Hans Tausen drill to extract our main ice core, which is 303 m long and spans the past 2000 years,' Dr Curran said.

'We also used two other smaller drills to extract 116 m and 103 m cores, spanning the past 800 to 1000 years, to obtain extra ice for large volume chemical analyses.

'Using a variety of scientific tests on each core, we'll be able to obtain information about the temperature under which the ice formed, storm events, solar and volcanic activity, sea ice extent, and the concentration of different atmospheric gases over time.'

The effort to retrieve the cores began with a 1300 km traverse from the French Antarctic station, Dumont d'Urville. Over 15 days, the nine-person French and Australian traverse team hauled 30 tonnes of cargo for the ice core camp, including an ice core drill, tents, food and scientific equipment.

Australian Antarctic Division climate program leader and ice core driller, Dr Tas van Ommen, and Aurora Basin Field Leader, Sharon Labudda, travelled with the French-led traverse, during which they experienced temperatures as low as -34°C. Once at the Aurora Basin site the traverse team set up part of the camp and prepared a skiway for the first group of scientists to arrive by air about 10 days later.

'When the ice core camp was in full swing, we had a team of about 16 people at a time working on the drilling, processing and packaging the cores, digging snow pits and setting up and maintaining equipment and the camp site,' Dr van Ommen said.

A highlight of the team's work was obtaining a 300 year temperature record from the main ice core using a field-based 'laser spectrometer'. In the past, scientists used laboratory-based techniques to measure temperature, which could take up to two years to complete.

'This field-based technology speeds up our core analysis and also acts as an insurance, should anything happen to the ice core — at least we walk out of the field with some data,' Dr Curran said.

'But most importantly, the spectrometer allowed us to see the summer and winter snowfall variations in the ice. This detailed seasonal information is exactly what we wanted.

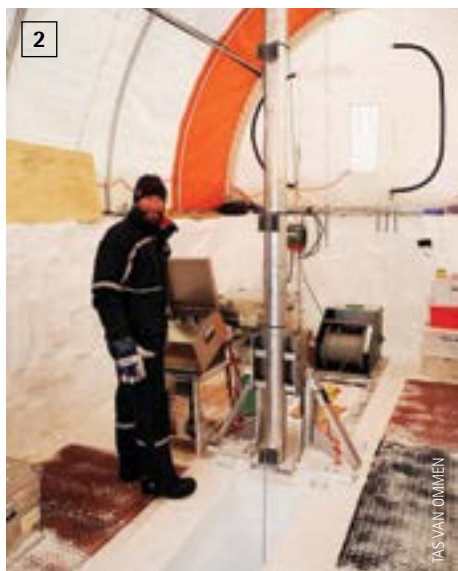
'There are only a handful of records with comparable resolution that extend to 2000 years from the whole of Antarctica, and this is only the second one in this sector of East Antarctica. The other one is our record from Law Dome.'

The team also extracted old air from 'firn', or unconsolidated ice, in the drill holes, and measured concentrations of atmospheric gases, such as methane and carbon dioxide, that had been trapped in the ice since the 1980s.

Field Leader Sharon Labudda said one of the most challenging operational aspects of the project was poor flying weather.

'The weather was worse than we anticipated and there were 18 days between flights in the middle of the season,' she said.

'I was in constant contact with Casey station for weather updates. Depending on those updates, Mark and I set dates for the completion of the



TAS VAN OMMEN



3



TAS VAN OMMEN

1. A 15 day French-led traverse transported equipment for the Aurora Basin ice drilling camp 1300 km from the French station Dumont d'Urville, to the deep field camp site.
2. Dr Simon Sheldon from the University of Copenhagen operates the Danish Hans-Tausen drill used to extract the 303 m, 2000 year ice core.
3. The Aurora Basin camp site from the air. The longer tents house ice core drilling and processing equipment and communal areas, while the smaller polar pyramid tents were the sleeping quarters for the team.
4. Aurora Basin Science Leader, Dr Mark Curran, with part of the 2000 year ice core.
5. Australian Antarctic Division ice core scientist Dr Andrew Moy with the Picarro laser spectrometer. The spectrometer measures oxygen isotopes (different nuclear forms of oxygen:  $^{16}\text{O}$  and  $^{18}\text{O}$ ) which provide a record of the atmospheric temperature at the time the ice formed.

4



TONY FLEMING

project goals, while ensuring we had sufficient time to pack up the whole camp and send it back to Casey by air.'

The cores were also flown back to Casey and stored in a refrigerated container at  $-20^{\circ}\text{C}$ . The container was then transferred to the ship for the 3500 km journey home.

Despite difficult weather conditions and some minor equipment issues, Dr Curran said the Aurora Basin project achieved all its scientific goals and demonstrated Australia's capability to run an internationally collaborative project in an unexplored area of Antarctica.

The project paves the way for a more ambitious drilling expedition to collect a one million year old ice core.

'The Australian Antarctic Territory and Aurora Basin, particularly, has some of the thickest and likely the oldest ice in Antarctica,' Dr Curran said.

'The results from this project will contribute to the international search for a drilling site for one million year old ice. Such an ice core would help us understand what caused a dramatic shift in the frequency of ice ages about 800 000 years ago, and further understand the role of carbon dioxide in climate change.'

5



TONY FLEMING

The Aurora Basin project involves 15 partner organisations contributing from six nations: Australia, China, Denmark, France Germany and the United States of America.

WENDY PYPER

*Corporate Communications, Australian Antarctic Division*

# Historical temperature reconstructions show hemispheric differences

Climate scientists have found that temperature variations in the northern and southern hemispheres over the past 1000 years are not as synchronised as previously thought, with implications for future climate modelling.

The research, published in *Nature Climate Change* in April, found that Southern Hemisphere temperature fluctuations over the past millennium showed marked differences to that of the more intensively studied Northern Hemisphere.

Until now, it was thought that Southern Hemisphere climate mirrored that of the north as a result of external factors that affect climate, such as solar radiation, greenhouse gases and volcanic eruptions.

However, Australian Antarctic Division climate program leader, Dr Tas van Ommen, who was involved in the internationally collaborative research, said 'internal' ocean-atmosphere dynamics, which differ in both hemispheres, had more of an influence on Southern Hemisphere climate than previously thought.

'Our analyses suggest that models may be underestimating the role of internal ocean-atmosphere dynamics in driving short-term climate variability, particularly in the ocean-dominated south. So while model projections may capture the long-term influence of external climate forces, they would be missing the full impact of short-term variations — up to a few decades long — above or below this trend,' Dr van Ommen said.

'This means that some of the warming or cooling phases previously attributed to both hemispheres, did not occur in the south.'

The team, led by Swiss researcher Raphael Neukom, reconstructed yearly temperature variations using an extensive database of terrestrial and oceanic palaeoclimate 'proxy' records from the Southern Hemisphere. Proxies are physical records that were influenced by the climate in which they formed — in this case the team used tree rings, marine and lake sediments, ice cores, corals and cave structures, as well as documented climate records from post-1970s.

'Our proxy records came from more than 300 individual sites, nearly doubling the number of records considered in the most advanced previous reconstruction attempt,' said study co-author Dr Tessa Vance, of the Antarctic Climate & Ecosystems Cooperative Research Centre.

'This allowed us to develop a well verified Southern Hemisphere temperature reconstruction for every year of the past millennium.'

The team compared this to an independent Northern Hemisphere temperature reconstruction. They found that both the northern and southern hemispheres shared an extended cold period between 1571 and 1722 (known as the 'Little Ice Age'), but there were differences in the existence, timing and phase of warm and cold periods throughout the rest of the millennium.

The most striking difference was the absence in the Southern Hemisphere of the Medieval Warm Period, between 950 and 1250 AD.

'This means that the Medieval Warm Period, which was previously observed in Northern Hemisphere-centric reconstructions of temperature, is not, as is often suggested, a worldwide phenomenon,' Dr Vance said.

'In fact, there is no globally synchronised warm phase during the pre-industrial era, between 1000 and 1850.

However, since the 1850s both hemispheres have experienced synchronous warming, with modern warming extremes evident from 1979 in more than 90% of the proxy records used.

The new temperature reconstructions for the Southern Hemisphere suggest that data from the Northern Hemisphere alone are insufficient to characterise global scale temperature anomalies, trends and extremes.

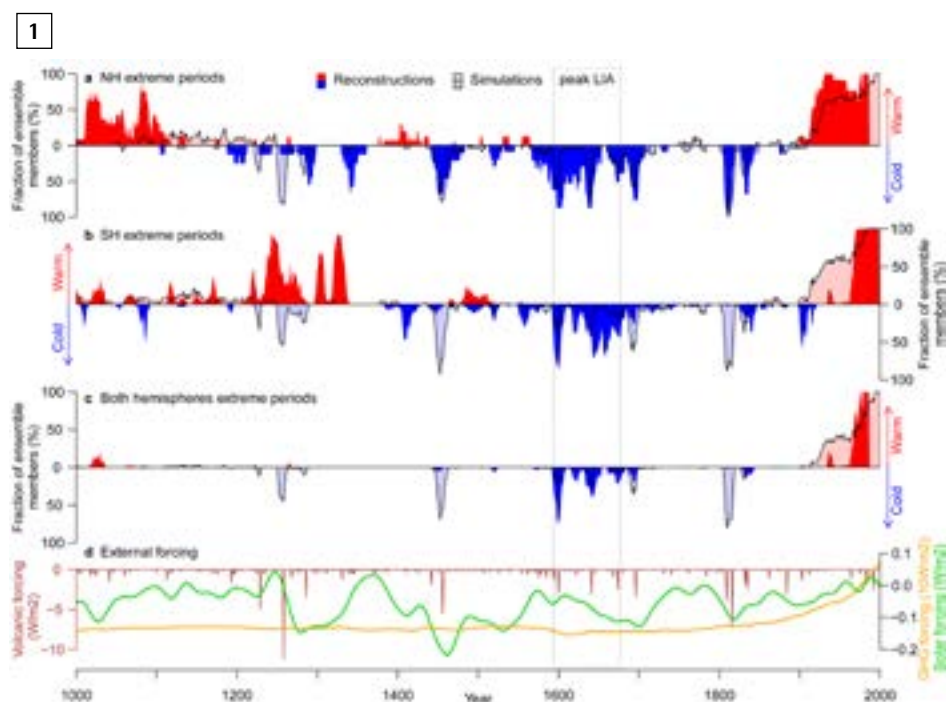
These findings need to be factored into future climate simulations to ensure the most robust predictions for regional and hemispheric climate.

'Analyses targeting periods where climate model simulations and reconstructions differ, will be necessary to identify weaknesses in both proxy- and model-based representations of the Earth's climate system,' Dr van Ommen said.

'Other studies of Southern Hemisphere climate are also needed to gain a better understanding of inter-hemispheric differences.'

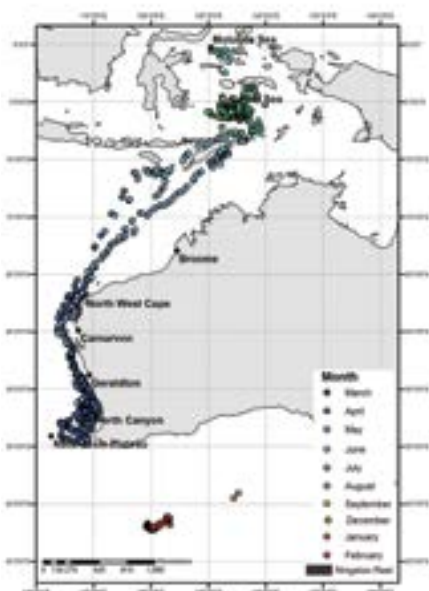
WENDY PYPER

Corporate Communications, Australian Antarctic Division



# Mapping the migratory route of pygmy blue whales

Satellite tagging of pygmy blue whales\* off Australia's west coast has identified their migratory route along the Australian coastline to Indonesia.



AAD/PLOS ONE

The research will allow environmental managers and industry to assess what impacts human activities might have on these gigantic animals during their more than 10 000 km round-trip migration.

Australian Antarctic Division marine mammal scientist and research leader, Dr Mike Double, said the published migratory movements could be used in a precautionary way, to identify and manage risks within the pygmy blue whale migratory range, such as vessel traffic, oil and gas field locations and increased ambient noise from development, shipping and fishing.

'This is particularly important, as pygmy blue whales were targeted by commercial and illegal whalers prior to the moratorium on whaling, and we don't know if the population has recovered subsequently,' Dr Double said.

Eleven pygmy blue whales (*Balaenoptera musculus brevicauda* – a subspecies of blue whale) were tagged in April 2009 and March 2011 within the Perth Canyon off the coast of Western Australia. The tags transmitted to the Argos satellite system from between eight and 308 days. All the whales travelled north after tagging, except one, which remained in the tagging location for eight days, before its tag failed. Throughout the tracking period, each whale covered some 3000 km, moving at about 22 km per day.

Australian Antarctic Division co-researcher, Dr Virginia Andrews-Goff, said the tagged whales travelled within about 100 km of the west Australian coastline throughout March and April, until they reached the North West Cape peninsula, about 1200 km from the Perth Canyon.

'They continued to travel north during May, about 240 km offshore, and by June they were travelling through the Savu and Timor seas,' Dr Andrews-Goff said.

'They stopped within the Banda and Molucca seas, just south of the equator, and remained there until September. This timing suggests these seas are important feeding and calving grounds for this subspecies.'

One tag continued to transmit intermittent location information in December and February, by which time the whale had migrated to a region south of the Great Australian Bight.

'These 11 satellite tracks line up closely with blue whale positional information collected by researchers both pre- and post-whaling, through sightings, strandings, acoustic recordings and mark-recapture,' Dr Andrews-Goff said.

However the research team said acoustic calls had also been recorded well to the west of the tracked migratory route, within subantarctic waters and potentially Antarctic waters, indicating multiple migration routes or 'elasticity' in migratory behaviour. This behaviour may be related to changes in prey availability.

Research collaborator Curt Jenner, Managing Director of the Centre for Whale Research in Western Australia, said the study highlights the need for ongoing conservation and management efforts in both Australian and Indonesian waters.

'When migratory animals routinely cross international borders, international cooperation is needed to implement conservation strategies that use information on habitat use and movement patterns,' he said.

'A combined approach by industry and managers when accounting for the movements of the pygmy blue whale utilising Australian and Indonesian waters will allow the recovery of this previously exploited species.'

*\*Pygmy blue whales reach about 24 m in length and are slightly smaller than their Antarctic blue whale cousins, which grow to about 31 m in length.*

WENDY PYPER

Corporate Communications, Australian Antarctic Division

1. These figures show the warm and cold periods reconstructed from proxy records (red and blue) in the Northern Hemisphere (a) and Southern Hemisphere (b). Model simulations (pale colours) are also superimposed over the reconstructions. The Medieval Warm Period (950–1250AD) is apparent in the Northern Hemisphere reconstruction, while in the Southern Hemisphere there was an extended warm phase between 1200 and 1350. Both hemispheres then experienced a long-term cooling trend, with the peak of the Little Ice Age from 1594–1677. Since the 1970s both hemispheres have experienced synchronised warming extremes. Figure c shows simultaneous extreme periods in both hemispheres. Some of the model simulation results deviate from the reconstructions at times when external forcings (volcanic eruptions, solar radiation, greenhouse gases) were more extreme (d), as a result of the models' over-emphasis on these forcings. The axis 'fraction of ensemble members' refers to the number of proxy records that show the warming or cooling trend. (First published in *Nature Climate Change* doi:10.1038/NCLIMATE2174).

2. This map shows the migration of 11 pygmy blue whales from where they were tagged, in the Perth Canyon, to their northern-most destination in the Banda and Molucca seas in Indonesia, about five months later. One whale was tracked on its return migration between September and February to the Subtropical Front (approximately 40°S). PLOS ONE doi: 10.1371/journal.pone.0093578.



# The laws of whaling

The recent International Court of Justice ruling in Australia's favour, over the lawfulness of Japan's program of 'scientific whaling' in the Southern Ocean, sets a powerful example of how complex environmental and technical disputes can be resolved using legal mechanisms

Four years ago, Australia instituted proceedings against Japan in the International Court of Justice, challenging the legality of its large-scale program of whaling in the Southern Ocean – the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA II).

This 'Special Permit' refers to Article VIII of the 1946 International Convention for the Regulation of Whaling, which enables Contracting Governments to issue special permits to its nationals to 'kill, take and treat whales for purposes of scientific research'.

The Article operates as an exception to the obligations under the Convention, including the global moratorium on commercial whaling, which was established under the Convention in 1986 to regulate coastal and pelagic whaling.

The International Whaling Commission (IWC) established a mechanism for its Scientific Committee to review and provide advice on proposed research programs under Article VIII. Whilst Contracting Governments must heed this advice, the issuing of special permits is ultimately a decision for the Contracting Government concerned. However, the Contracting Government must still act in accordance with Article VIII; a point expressly confirmed by the Court.

Despite disagreements within the IWC Scientific Committee over Japan's research – including the need for lethal catches, inconsistent methods used for sample size selection, and the scientific output of the program – Japan has pursued JARPA II since 2005, issuing special permits to catch up to 850 minke whales and 50 each of humpback and fin whales.

One of Australia's expert witnesses during the court case, Australian Antarctic Division Chief Scientist, Dr Nick Gales, said that machinations within the IWC's Scientific Committee weakened the scientific review process.

'Criticisms were often dismissed as politically motivated or matters of opinion, rather than serious scientific commentary, making many scientists reluctant to take sides,' he said.

One of the main disagreements was that lethal research was not required to obtain the scientific information sought by JARPA II. Australia and others had built a significant body of research on the use of non-lethal technology, including satellite tagging, biopsy sampling, photographic identification and acoustic tracking, to obtain much of the scientific information sought by the Japanese program. Based on this research, Australia was able to build a strong case to challenge the legality of JARPA II.

On 31 March 2014, the International Court of Justice issued its judgment (<http://www.icj-cij.org/docket/files/148/18136.pdf>), in which it determined that JARPA II was illegal. It concluded that 'the special permits granted by Japan for the killing, taking and treating of whales in connection with JARPA II are not "for the purposes of scientific research" pursuant to Article VIII, paragraph 1, of the Convention'.

In its reasoning, the court shifted its focus away from the technical detail of whether Japan's program was 'scientific research'.

'Instead, the Court considered whether the activities were "for purposes of scientific research", by examining if the program's design and implementation were reasonable to achieve its stated objectives,' Dr Gales said.

The Court concluded that JARPA II used lethal sampling on a greater scale than was reasonable, given its research objectives. The Court pointed to Japan's failure to consider non-lethal alternatives and to problems with how Japan set the sample sizes.

'In the end, Japan couldn't defend why they were taking up to 850 minke whales,' Dr Gales said.'

The ruling provides an example of how complex environmental and technical disputes involving scientific principles might be resolved in a legal setting. By using a test for 'reasonableness' the Court avoided differences in scientific opinion, policy or philosophy.

'The exploitation of scientific uncertainty and complexity to advance non-science agendas is a common feature of environmental disputes where science informs the law,' Dr Gales said.

'The Court's independent approach, based on the non-technical principle of reasonableness, represents an ideal model for resolving such disputes.'

*Article written by Wendy Pyper, with assistance from the Australian Antarctic Division Science Branch and Attorney General's Department.*

1. Minke whales were the main target of the Japanese Whale Research Program.





# Next generation toothfish management tools

Antarctic scientists and the Australian fishing industry have received \$1.2 million from the Fisheries Research and Development Corporation (FRDC) to develop the next generation of management tools for the Patagonian toothfish fishery on the Kerguelen Plateau.

The funding secures a three-year collaboration between the Australian Antarctic Division, the Institute for Marine and Antarctic Studies (University of Tasmania), Austral Fisheries Pty Ltd, Australian Longlining Pty Ltd, and the Muséum National d'Histoire Naturelle in France.

The international venture, worth \$1.6 million in total, will tackle the complicated problem of ensuring sustainable fishing of Patagonian toothfish — whose habitat spans both French and Australian fishing zones — across the entire subantarctic Kerguelen Plateau.

Principle Investigator for the project and Australian Antarctic Division fisheries scientist, Dr Dirk Welsford, said that there was increasing evidence that Patagonian toothfish are part of a 'metapopulation' that spans both countries' Exclusive Economic Zones (EEZs).

'This means it's important that France and Australia combine and analyse their data on toothfish stocks — their movement, behaviour, biology and ecology — to ensure that stock assessment models capture fisheries data that spans these boundaries, rather than simply data obtained from within them,' Dr Welsford said.

The new project will develop tools (mathematical models for assessing stock status) to enable resource managers and decision makers in both countries to better understand the impacts of harvesting toothfish in their respective EEZs.

The project will also provide data that enhances the current understanding of the biology and ecology of Patagonian toothfish in the Kerguelen Plateau region, and determine the ages of fish that are being caught by the fishery. This will help refine strategies for maintaining the reproductive success of the stock.

'Our fishery is changing from mainly trawling to mainly longlining, and each method captures different sized and aged fish,' Dr Welsford said.

'This project aims to modernise our assessment methods to take account of these changes and to develop new technologies and methods to maintain best practice in sustainable fisheries management in the region.'

The project builds on a long history of collaboration between Australia and France, who have been working together to eliminate illegal fishing in the Kerguelen Plateau region for more than a decade. Government and industry

initiatives directed by both countries and through the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), saw illegal activity within the EEZ boundaries decline to zero in 2007.

In 2012 the Australian toothfish fishery received the Marine Stewardship Council tick of approval, confirming that the fishery is successfully implementing the principles of global best practice. In April 2013 the fishery again received recognition for its sustainable practices with a 'best choice' label from the Monterey Bay Aquarium's Seafood Watch program.

Today, the Patagonian toothfish fishery is worth over \$25 million a year and constitutes one of the largest catches of toothfish in the Southern Ocean.

WENDY PYPER

*Corporate Communications, Australian Antarctic Division*

1. A new Patagonian toothfish project will develop technologies and methods to maintain best practice in sustainable fisheries management across the Kerguelen Plateau.

# Potential diamond-bearing rocks discovered in Antarctica

Rare volcanic rocks that are the source of the world's diamonds have been discovered in Antarctica.

In 1989, University of Tasmania PhD student Geoff Nichols discovered some unusual boulders in a glacial moraine in the Prince Charles Mountains of East Antarctica, where he was sampling and mapping the rock types of the region.

Twenty four years later, modern technology and expertise united to conclusively identify his samples as rare volcanic rocks known as 'kimberlite' – the source of most of the world's diamonds.

The discovery was reported in the journal *Nature Communications* in December 2013, by an Australian team that included Dr Nichols and Chief Investigator, Dr Greg Yaxley, a petrologist at the Australian National University.

'These rocks represent the first reported occurrence of genuine kimberlite in Antarctica,' Dr Yaxley said.

'They are of great scientific and commercial importance, as they are the most deeply derived, direct samples of the Earth's interior, and they are the major hosts of diamond, sometimes in economic abundance.'

Kimberlites are formed by the melting of the earth's mantle under extreme pressure, at about 200 km depth, and in the presence of gaseous 'volatiles' such as water, carbon dioxide and methane. The gas-filled rocks ascend rapidly and violently to the surface during volcanic activity, sometimes incorporating diamonds into their structure along the way. Their name comes from the South African town of Kimberley, famous for a late 19th century diamond rush.

Like the diamonds they sometimes carry, kimberlites are rare, often occurring in small outcrops less than 100 m across, and mostly restricted to 'cratonic regions' – ancient parts of the continents that are geologically stable. But they occur on every continent. In Australia they've been found in parts of South Australia, northwest Western Australia and the Northern Territory.

'It's not surprising that Antarctica has kimberlites; they're just very difficult to find,' Dr Yaxley said.

When Dr Nichols first collected the rocks, it was not immediately apparent that they were kimberlites, but he knew that they were likely generated within the deep mantle. Preliminary work on the rocks suggested they were geochemically related 'carbonatites'. Later work by University of Tasmania Earth Science Professor, Vadim Kamenetsky, suggested they were 'carbonate-bearing picrites'.

'Only the latest more detailed textural, mineralogical and geochemical analysis, and the specialised expertise of each co-author, enabled us to conclusively categorise the rocks as bona fide kimberlites,' Dr Nichols said.

'Kimberlite has a very specific mineralogy and chemistry, and we were able to use optical and electron microscopy and whole rock geochemistry to confirm its identity.'

Radiometric dating showed the rocks are some 120 million years old.





'The Antarctic kimberlites were located at the margin of a major Antarctic transcontinental rift, the Lambert Graben, which may have reactivated when the Indian and Australia-Antarctica plates separated during the Cretaceous period, 145 million to 66 million years ago,' Dr Yaxley said.

'This movement along the rift would have caused a little bit of deep melting, resulting in the eruption of these kimberlites.'

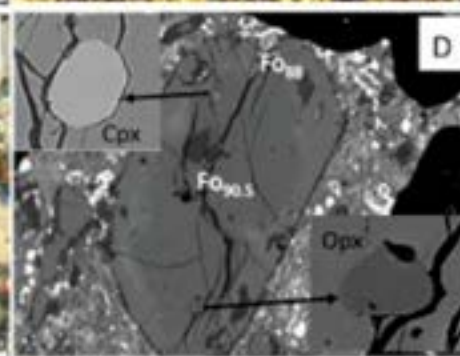
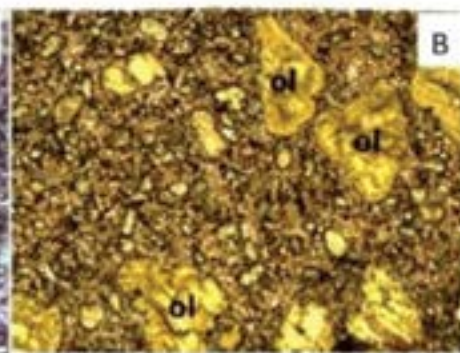
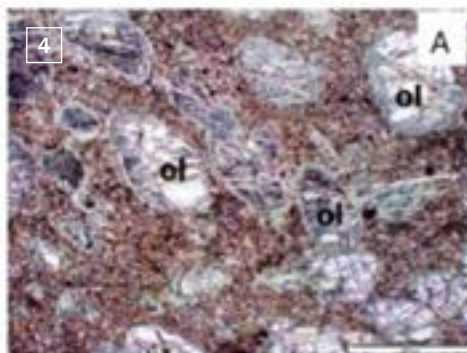
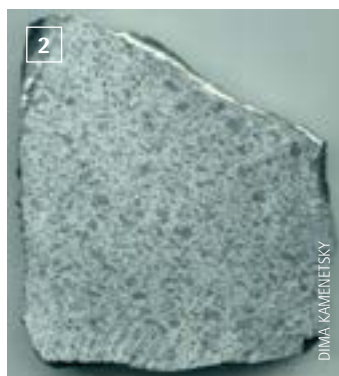
The discovery is scientifically interesting as it provides another connection between continents that were once joined together in the supercontinent, Gondwana.

'The age of the Antarctic kimberlites overlaps with many kimberlites from other world-wide localities, extending a vast Cretaceous, Gondwanan kimberlite province, for the first time, into Antarctica,' Dr Yaxley said.

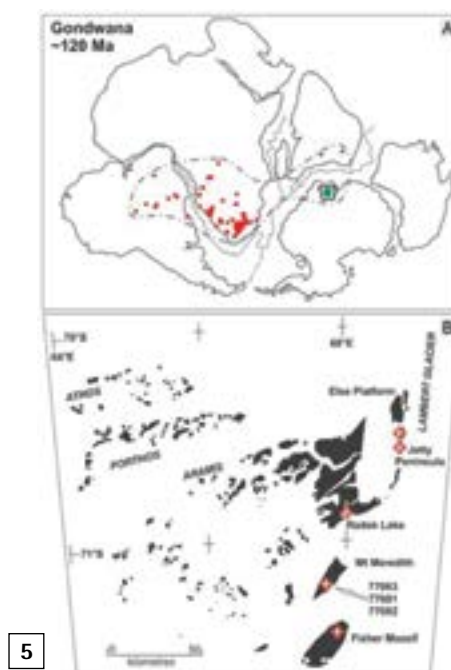
The study is an example of how geological research can play an important role in understanding Antarctica's place in the world, including its geological, geomorphological and climate history. Mining and other non-scientific activities relating to Antarctica's mineral resources are strictly prohibited under the Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol).

WENDY PYPER

Corporate Communications, Australian Antarctic Division



1. A diamond in a kimberlite.
2. The cut surface of the Antarctic kimberlite sample collected by Geoff Nichols.
3. The site from which the Antarctic kimberlite samples were recovered, on the flanks of Mt Meredith, looking across the Lambert Glacier. Former PhD student, Dr Geoff Nichols' trip to the region was supported by the Australian Antarctic program.
4. The study authors used optical and electron microscopy to identify the specific mineralogy of the Antarctic kimberlites. Figures A, B and C are light photomicrographs of the Antarctic kimberlites with their crystal structures marked (ol – olivine, phl-phlogopite, cc-calcite, pr-perovskite). Figure D is an electron image of an olivine crystal (Fo) containing rock-forming silicate minerals clinopyroxene (Cpx) and orthopyroxene (Opx). These minerals are actually fragments of the upper mantle through which the kimberlite rapidly moved on its way to eruption. First published in *Nature Communications* 4: 2921, doi: 10.1038/ncomms3921.
5. The first examples of Antarctic kimberlites were found at Mt Meredith in the Prince Charles Mountains in 1989 (green dot on figure 'A'), by former University of Tasmania PhD student Geoff Nichols. The discovery extends a vast Cretaceous Gondwanan kimberlite province (dashed line in 'A') into Antarctica. Red dots show the location of other Cretaceous kimberlite deposits. Figure 'B' shows the location of samples taken from Mt Meredith and other nearby Cretaceous rocks running parallel to the Lambert Graben in which the Lambert Glacier flows. (*Nature Communications* 4: 2921, doi: 10.1038/ncomms3921).



# Polar ecosystems vulnerable to increased sunlight

Small changes in the timing of polar sea ice retreat that allow more sunlight to reach sea floor communities, could fundamentally change sea floor biodiversity and ecosystem function.

1

Research by Australian Antarctic Division and University of New South Wales (UNSW) scientists, published in *Global Change Biology* in November 2013, predicts biodiversity in some areas of the polar sea floor could be reduced by as much as one third, within decades, as the poles warm.

Already, warming temperatures and changing wind patterns have led to an increasing number of ice-free days over summer in parts of Antarctica and the Arctic, exponentially increasing the amount of light reaching sea floor communities.

This exponential increase in light is due to the Earth's tilt at high latitudes, such that the sun is above the horizon for considerably longer in summer than winter. As a result, early melt that brings the date of ice loss closer to the summer solstice, when sunlight is at its maximum, greatly increases the annual sunlight exposure of sea floor ecosystems.

In shallow Antarctic coastal waters, this may cause unique invertebrate-dominated communities that are adapted to dark conditions, to be replaced by less biodiverse algal beds, which thrive in light. Invertebrates such as sponges, sea squirts and worms perform important functions such as filtering water, recycling nutrients and providing food for fish and other creatures.

Senior Australian Antarctic Division scientist and a coordinator of the research, Dr Martin Riddle, said the study demonstrates a simple mechanism for a 'non-linear tipping point', where relatively small changes in the environment have major effects on the ecosystem.

'The Intergovernmental Panel on Climate Change Fourth Assessment Report identified thresholds, step-changes and nonlinear interactions as key uncertainties in predicting climate change impacts on polar ecosystems,' Dr Riddle said.

'Because of the abrupt state change from liquid to ice, polar regions were thought to be particularly vulnerable to this type of nonlinear response. However, until now, no clear examples of the effect on ecosystems have been demonstrated.

'Our research has shown that even a slight shift in the date of the annual sea ice departure could cause light reaching sea floor communities to exceed a threshold or tipping point, leading to widespread ecosystem shifts.'

The research team found evidence of such impacts during a study at seven shallow-water sites around Casey station between 1998 and 2004.

The team used light meters to measure seasonal light variation on the sea floor at depths of up to 10 m and they photographed the coast at noon every day for two and a half years, to determine sea ice cover. They also measured the growth rates and light sensitivity of algae under

different light conditions and surveyed species living on sub-tidal boulders, to see how sea floor communities varied with ice cover.

'We found that areas that currently lose ice about two months after the summer solstice in late December, are on the cusp of a tipping point,' Dr Riddle said.

'If ice breakout occurs only slightly earlier, algae will be able to invade areas now dominated by invertebrates.'

The team also found that the structure of communities living on boulders on the sea floor was strongly related to sea ice duration.

'The combined cover and diversity of most invertebrates declined steeply as sea ice duration shortened, while algae thrived,' Dr Riddle said.

'Such regime shifts have been observed in the Arctic, where macroalgae abruptly invaded rocky reef habitats during a period of gradual sea ice reduction.

'About one third of the species we sampled could be locally extinct once the coast is regularly ice free for more than half the year.'

While the research demonstrates the vulnerability of shallow water polar marine ecosystems, a similar process may apply to other ecosystems that are seasonally covered by ice or snow, including Antarctic land and lake ecosystems, and alpine regions. Offshore ocean ecosystems, where light penetration to the sea floor is limited by depth, may instead experience phytoplankton proliferation.



2

UNSW marine biologist and lead author of the research paper, Dr Graeme Clark, said such enhanced primary production could have flow-on effects to higher trophic levels, stimulating populations of species that use plants and algae for food and/or habitat.

'Changes in phytoplankton abundance, for example, may affect whales, krill, and other planktivores,' he said.

'The complexity of ecosystems makes it difficult to predict the full gamut of repercussions, but it is clear that early ice loss will pave the way for light-loving species at the expense of dark-dwellers.'

WENDY PYPER

*Corporate Communications, Australian Antarctic Division*

1. Dr Martin Riddle collects data on seaweed, under the sea ice at Casey.
2. Seaweeds dominate the sea floor where sea ice melts.
3. Antarctic invertebrates, such as these ones living on and around a boulder under the sea ice, thrive in low light.
4. This instrument, called an Octopam, was custom built to measure the light requirements of Antarctic seaweeds.

3

ANDREW TABOR

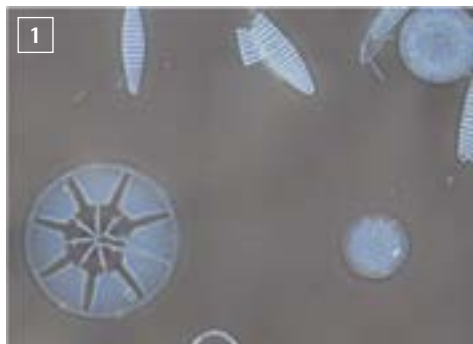
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JOHN RUNCE

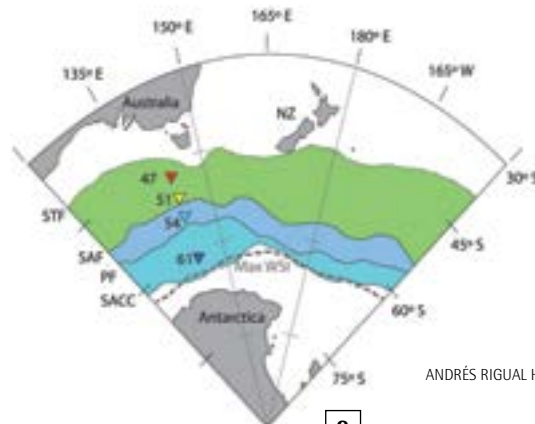
# Diatoms have that sinking feeling

Phytoplankton fluxes to the interior of the Southern Ocean contribute to the drawdown of atmospheric carbon to the deep ocean. But which species are involved and where do they come from?

A new project aims to find out.



ANDRÉS RIGUAL-HERNÁNDEZ, MACQUARIE UNIVERSITY



ANDRÉS RIGUAL HERNÁNDEZ, MACQUARIE UNIVERSITY

Diatoms are a supremely successful group of microscopic phytoplankton with an ability to metabolize silica to construct their intricate, yet robust skeletons, known as frustules. This group of ancient unicellular plants are considered the base of the Southern Ocean food web as they are responsible for 75% of its annual primary production, through photosynthesis, at the ocean's surface. Through photosynthesis, diatoms draw in atmospheric carbon dioxide to convert into sugars for cell function and reproduction. The frustule of the diatom, aside from providing an enclosure for cell contents, also provides protection to the cell from zooplankton predation. However, there is a trade-off between strengthening the frustule and staying afloat within the sun-lit, wind-mixed, surface waters.

Diatoms can sink rapidly from the surface waters through 'heavy' aggregations of cells, natural cell death and large mixing events of surface waters to deeper levels. Most commonly though, they are consumed by predators and repackaged into 'lead-balloon' faecal pellets. By sinking away from the surface waters, diatoms contribute significantly to the drawdown of atmospheric carbon into the deep ocean. Their frustules can also be preserved in the sediments in such numbers that they can tell us the story of the water masses in which they lived. However, despite their importance in past and present Antarctic ecosystems and the carbon cycle, our knowledge of the ecology and distribution of diatoms in the Southern Ocean remains generalised at best.

In 1997 Professor Tom Trull, then at the Antarctic Cooperative Research Centre in Hobart, initiated a 10 year time-series sediment trap program in the Southern Ocean, to determine the origin, composition and fate of 'particulate

organic matter' (fine particle remains of living organisms) reaching the ocean interior. Sediment traps were deployed at four sites (the Subantarctic Zone, Subantarctic Front, Polar Front Zone and Antarctic Zone – see map) and programmed to capture particles reaching different depths of the water column (e.g. 1000 to 3800 m). This research showed that particulate organic carbon export in the Subantarctic Zone and Polar Front Zone is large in comparison to many other regions of the world ocean. This observation supports the idea that the Southern Ocean is one of the world's largest sinks for atmospheric carbon dioxide.

Now a new research team, funded by the Australian Antarctic Division and Macquarie University, is investigating the diversity, seasonality and distribution of diatoms in the Southern Ocean. Using sediment samples recovered between 1997 and 2007, the research team is focusing on documenting the diatom flora dwelling in the major hydrological areas of the Australian Sector of the Southern Ocean, to determine which species and seasonal communities are significant to the atmospheric carbon draw-down.

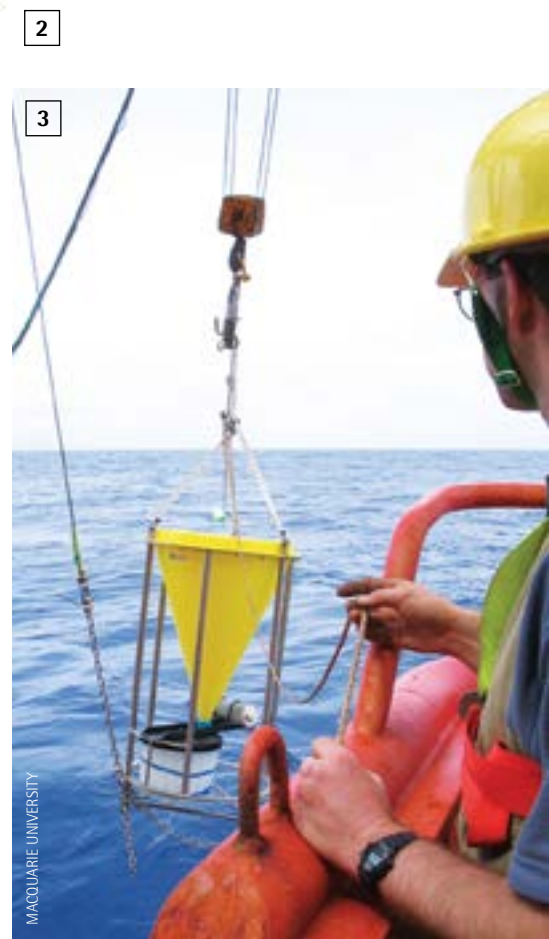
This study will provide us with the missing link between the biochemical and zooplankton studies conducted during the 10 year time series, by providing evidence of species succession and interannual variability of the major primary producers amongst Southern Ocean diatoms.

ANDRÉS RIGUAL-HERNÁNDEZ<sup>1</sup>,  
LEANNE ARMAND<sup>1</sup>, JESSICA WILKS<sup>1</sup>,  
TOM TRULL<sup>2</sup> and STEPHEN BRAY<sup>3</sup>

<sup>1</sup> Department of Biological Sciences, Macquarie University

<sup>2</sup> CSIRO Marine and Atmospheric Research

<sup>3</sup> Antarctic Climate and Ecosystems Cooperative Research Centre



MACQUARIE UNIVERSITY

1. A diatom assemblage captured by one of the traps (61 degrees south) as viewed under phase contrast illumination on a light microscope.
2. This map shows the fronts and regions of the Southern Ocean and the location of the sediment traps deployed in 1997 for the 10 year time series (coloured triangles). (STF – Subtropical Front, SAF – Subantarctic Front, PF – Polar Front, SACC Southern Antarctic Circumpolar Current).
3. A time-series sediment trap being deployed by Mr Stephen Bray.



# New breeding behaviour discovered in emperor penguins

Satellite imagery and aerial surveys have revealed a previously unseen breeding behaviour amongst emperor penguins in Antarctica, with four colonies found to be rearing their chicks on ice shelves.

Emperor penguins were thought to breed mainly on sea ice attached to the continent (known as 'fast ice'), putting them at risk from climate-related changes to sea ice thickness, extent and duration.

However, scientists from the British Antarctic Survey, Australian Antarctic Division and the University of California, confirmed their breeding activity on ice shelves in the journal *PLOS ONE* in January this year.

The four colonies were discovered on the West Ice Shelf and Shackleton Ice Shelf in East Antarctica, the Nickerson Ice Shelf in West Antarctica and the Larsen C Ice Shelf on the Antarctic Peninsula.

'Emperor penguins have previously been considered sea ice obligate species, with 44 of the 46 colonies located on sea ice, and the other two small colonies located on land,' the study authors wrote.

'Of the colonies found on ice shelves, two are newly discovered, and these have been recorded on shelves every season that they have been observed. The other two have been recorded both on ice shelves and sea ice in different breeding seasons.'

Australian Antarctic Division penguin ecologist and co-author of the paper, Dr Barbara Wienecke, said it was not clear whether the breeding behaviour was a new phenomenon associated with recent climate change or one that had always existed but was not previously documented. Regardless, the discovery has implications for population modelling of the species, as it could mitigate some of the consequences of sea ice loss.

'Breeding on ice shelves may be an adaptation employed by emperor penguins when sea ice conditions are poor, but this is only possible where emperor penguins have access to the top of an ice shelf. This is not the case at all colony sites,' Dr Wienecke said.



FREDERIQUE OLIVIER

1. New research shows emperor penguins do breed on ice shelves.



'Of the four colonies we observed, three were located in areas with marginal sea ice conditions. 'Potential benefits, and whether these are permanent or temporary, need to be considered and understood before further attempts are made to predict the population trajectory of this species.'

Recent estimates suggest the emperor penguin population (about 238 000 breeding pairs) will halve by 2052 as sea ice declines, with the complete loss of more northerly colonies above 70° South. This led the IUCN to re-list the species from 'Least Threatened' to 'Near Concern'.

Dr Wienecke cautioned that even if the study reflects an adaptive response to a warming environment, the penguins will still face changes in the Antarctic food web and increased predation and competition, which will affect breeding success and survival rates. Ice shelves

also pose a number of risks, including a lack of shelter, exposure to katabatic winds and possible calving of the ice front.

The discovery opens up other questions such as how do emperor penguins access the ice shelves, does the breeding cycle differ on ice shelves compared to fast ice, and what is the energetic cost of reaching the top of an ice shelf? It also invites questions of other species.

'This previously unknown and surprising behaviour recorded in such an iconic animal suggests that other species may also be capable of unpredicted or unknown behavioural adaptations in a future warming world,' the study authors conclude.

WENDY PYPER

Corporate Communications, Australian Antarctic Division

1. WorldView2 image of the Shackleton Ice Shelf colony in 2012. Four main sub-colonies are visible on top of the ice shelf about 5 km from the ice cliff. Groups of penguins and their tracks can be seen moving to and from the ice edge. First published in *PLOS ONE* 9 (1). doi:10.1371/journal.pone.0085285.
2. Emperor penguins on the edge of the Larsen Ice Shelf near the Jason Peninsula late in the breeding season. The larger group is on the ice shelf, while the smaller group has moved onto the fast ice. Earlier in the season, satellite imagery showed that the whole colony was located on the ice shelf.
3. Emperor penguin chicks huddle against a blizzard at Auster Rookery.





# Volcanoes provided ice-age refuge for Antarctic biodiversity

Antarctic volcanoes and other geothermal areas may have provided a refuge for biodiversity through past ice ages, according to new research published in March in *Proceedings of the National Academy of Sciences*.

Australian Antarctic Division spatial ecologist, Dr Aleks Terauds, and Australian National University evolutionary biologist, Dr Ceridwen Fraser, led the research, which showed that species richness is greater close to volcanoes, and decreases with distance.

It is the first time scientists have provided hard evidence to support a long-held hypothesis that geothermal areas could provide a toe-hold for life during the Last Glacial Maximum, about 20 000 years ago, when the continent was more heavily glaciated than today.

'Geothermal activity could have maintained ice free areas during the last ice age, providing a substrate for organisms to live on,' Dr Terauds said.

'Importantly, this substrate would have remained exposed over centuries, allowing time for organisms to evolve and disperse.

'If this hypothesis is true, we would expect to see more species closer to volcanoes and a subset of the same species further away.'

To find out, Drs Terauds and Fraser, along with colleagues from Australia, New Zealand and the UK, used nearly 39 000 records of Antarctic species to model and compare the biodiversity of volcanic sites with non-volcanic sites on both the Antarctic peninsula and continental Antarctica.

The species records, which were collected over decades by many researchers, were grouped broadly into plants (mostly mosses), fungi (mostly lichens) and invertebrates (such as mites, tardigrades and springtails).

Sixteen Antarctic volcanoes are known to have been active since the last ice age, forming three general clusters on the northern Antarctic Peninsula, Marie Byrd Land (West Antarctica) and Victoria Land (East Antarctica). Geothermal areas associated with these active craters could have included heated ground and ponds, steam fields, fumaroles and ice caves formed by steam.



Nine of these volcanic sites were selected for the analyses, along with a region of 'hot rocks' (naturally occurring radioactive granites) in the Larsemann Hills.

A range of non-geothermal sites were also selected around the continent, based on the location of good biodiversity records. All volcanic and non-volcanic sites were located within 200 km of the coast, to remove any variations due to altitude.

Dr Terauds then used a suite of models to look for patterns of species richness within a 100 km radius of each site.

'We wanted a big buffer around the geothermal site to incorporate both the potential glacial refuge and areas within the unassisted dispersal range of most taxa,' he said

The models accounted for variables that could affect biodiversity, including temperature, geographic location, sampling bias and the size of the geothermal area.

The study authors saw a clear geothermal effect on species richness on the Antarctic Peninsula for plants and fungi, but not for invertebrates — most likely because peninsula records for invertebrates are poor.

'On continental Antarctica, there were clear geothermal effects on all species groups; with more species closer to the geothermal sites,' Dr Fraser said.

'These results support our hypothesis that species have been expanding their range and gradually moving out from volcanic areas since the last ice age.'

While there are still many questions to be answered, the study authors said that geothermal regions may represent diversity 'hotspots' in Antarctica, providing a focus for future conservation efforts, as human-induced environmental changes continue to affect Antarctica.

WENDY PYPER

Corporate Communications, Australian Antarctic Division

1. Clouds of volcanic steam well upwards on the Antarctic South Sandwich Islands.
2. Mosses and other life forms thrive around this volcanic fumarole on the Antarctic South Sandwich Islands.

# How old is that humpback whale?

Unlike humans, humpback whales have no laugh lines, grey hairs or sagging skin to give away their age.



1

ANDREA POJANOWSKI

Once the whales are about one year old, their size and external features do not change reliably as they age. As they can live for up to 95 years, accurate age estimates are important to scientists studying the animals' biology and population dynamics.

Now scientists have developed the first DNA-based test for estimating the age of humpback whales, based on recent advances in human medicine.

The non-lethal test looks at age-related changes in the DNA of skin samples that can be collected from live whales using biopsy darts.

The research, published in *Molecular Ecology Resources* in March, was conducted by the Australian Antarctic Division, in collaboration with the Center for Coastal Studies in the United States, and the Australian Genome Research Facility.

Australian Antarctic Division molecular biologist Dr Simon Jarman, said the new test relied on changes in the 'DNA methylation' of genes involved in the ageing process. DNA methylation is a biochemical process where a methyl group (CH<sub>3</sub>) is added to specific DNA building-blocks. This process alters the expression of genes.

'We've long known that DNA methylation is involved in processes like sex determination and the development of many cancers, but it has only recently been shown to be involved in the ageing process,' Dr Jarman said.

'We used information on age-associated DNA methylation in human and mouse genes, to identify similar gene regions in humpback whales. We then developed an assay using three of the most informative methylated genes, which estimates age with a high level of precision.'

Estimating age is important for monitoring the recovery of whale populations following commercial whaling. When combined with genetic information about the relatedness of individuals in a population (parents, siblings, offspring), age data improves methods for estimating the size of whale populations. It is also critical to understanding how biological characteristics of whales change with age.

Age estimates in live whales have been made by analysing lipid (fat) profiles from blubber samples. However, lipid profiles vary depending on the whales' diet, which varies depending on their foraging range. Scientists can also identify whales through unique markings on their tail flukes. If a whale's fluke was photographed when it was a calf, its age can be easily calculated on future sightings.

Scientists have tried to estimate the age of dead humpback whales using growth layers in a waxy structure within the animals' ears. However the method is unreliable and can't be used on live whales.

'Our new DNA methylation-based test provides a minimally invasive and more reliable test that does not kill the whale, that is less labour intensive than photographic identification, and that can be used on any humpback whale found in any ocean,' Dr Jarman said.

'Almost everyone who studies humpback whales collects biopsy sample for population genetic analysis, so this method also fits into established sampling programs.'

The test does need to be 'calibrated' for the species being studied. For example, for this study the research team used a population of 40 humpback whales of known age, ranging from a few weeks to 30 years, living in the Gulf of Maine in the United States.

The 'humpback epigenetic age assay' was conducted on skin biopsies from these whales to establish its accuracy.





ANDREA POLANOWSKI

2

'We found this test to be more accurate than other non-lethal methods of ageing whales and it was also very good at determining the age order of a parent and its offspring,' Dr Jarman said.

'We can now use this test on any humpback whale anywhere in the world. We'll have to calibrate it again for other whale species, but we already have a lot of individual pilot whales and sperm whales of known age, from strandings, and there are monitored populations of southern right whales in South America and killer whales in the north Atlantic.'

Dr Jarman hopes to extend the test to seabirds, in particular penguins, to study age-specific mortality and fertility.

For wildlife biologists, the test is an exciting application of technology that has been more recently associated with human forensic settings — such as age estimation from corpses or blood stains at crime scenes.

No whales were harmed in the course of this research.

WENDY PYPER

*Corporate Communications, Australian Antarctic Division*

1. A humpback whale spyhopping.
2. Humpback whales can be identified by unique markings on their tail flukes.
3. The ages of these two whales are impossible to tell visually. However, the new DNA methylation-based test on skin biopsy samples will provide scientists with an accurate estimation of their age.

3



ANDREA POLANOWSKI

# Elephant seal population decrease linked to polar vortex

The ozone hole and changes in atmospheric circulation are implicated in a decrease in southern elephant seal abundance on Macquarie Island, according to new Australian research published in *Proceedings of the Royal Society B* in March.



DAVID BARRINGHAUS

Australian Antarctic Division researcher Mr John van den Hoff, in collaboration with the University of Tasmania, Department of Primary Industries, Parks, Water and Environment, and the University of New South Wales, counted breeding female seals on the island's isthmus every year, between 1988 and 2011. The isthmus counts form part of a broader long-term monitoring program, set up following the discovery in the mid-1980s that the seal population had already substantially decreased since early Antarctic Division surveys in the 1950s.

During the research team's study, the entire island's female seal population decreased by 25% from a high of 22 640 in 1988 to 17 228 in 2009, when the last whole island census was undertaken. The most likely cause is thought to be related to changes in the seals' foraging habitat and subsequent food availability.

'The long-term decrease in seal numbers has coincidentally occurred at a time when winter sea ice duration, extent and concentration south of Macquarie Island has been increasing, resulting in broad- and local-scale physical changes in their foraging habitats,' Mr van den Hoff said.

'Adult female elephant seals tend to avoid sea ice but they need access to high quality foraging grounds over the Antarctic continental shelf. This access diminishes as winter approaches and sea ice extends northwards. As the animals are

faithful to their individual feeding areas, any variability or persistent change in foraging area quality could affect their future survival and breeding success.'

To find out whether changes in the sea ice environment was a factor in the seals' decline, the team looked for correlations between the decline and an index of atmospheric variability known as the Southern Annular Mode (SAM). The 'SAM anomaly' describes the north-south movement of the westerly wind belt (the polar vortex) that circles Antarctica. In its 'positive' phase, the westerly wind belt contracts towards Antarctica, resulting in stronger, colder westerly winds, which can increase sea ice duration and extent. A persistent increase in the SAM index over the past 30 years is attributed to the ozone hole over Antarctica.

The team found that the biggest annual declines in seal numbers occurred three years after a strong positive SAM. These events were also associated with increased winter sea ice duration of up to 60 days over the seals' continental shelf foraging grounds.

'Given that adult females avoid sea ice, we think an earlier sea ice advance, in March-April, could prevent pregnant females accessing the continental shelf and the higher quality prey, such as krill, available there,' Mr van den Hoff said.

'A later ice retreat in spring would also extend the period of exclusion from the same shelf foraging areas.'

Pregnant seals need to feed on high quality prey to boost their fat reserves for the coming winter and for lactation when their pup is born. The amount of fat accumulated determines the seal's ability to feed her pup, the pup's subsequent size at weaning, and its ability to survive the first two years of life.

As juvenile female seals reach reproductive age about three years after birth, the reduced survival of these animals, born after a year of increased sea ice duration, accounts for the three-year lag between positive SAM signals and decreases in seal numbers.

In the future, changes in the open waters of the Southern Ocean, including warming, and a southward shift in the ocean fronts, could also negatively affect Macquarie Island seals — with seals needing to travel further to reach frontal foraging grounds that may also have altered prey availability and quality.

'As both warming of the Southern Ocean and the positive SAM phase shift are predicted to continue as long as the ozone hole remains open and greenhouse gas emissions continue to increase, we can expect further changes in the structure and function of the Southern Ocean ecosystem,' the study authors said.





JOHN VAN DEN HOFF



NARELLE CAMPBELL

'These changes will affect high-order predator populations, some of whom will prosper while others struggle.'

The news is not all bad for southern elephant seals in other parts of Antarctica, with populations on the West Antarctic Peninsula increasing as sea ice in the region declines. However it is still too early to say whether elephant seals will be climate change 'winners' or 'losers'.

'The continued collection of high quality count data, such as that for the Macquarie Island seal population, will enable us to establish clearly how climate variability and change will affect elephant seal populations world-wide,' Mr van den Hoff said.

WENDY PYPER

Corporate Communications, Australian Antarctic Division



KELLY SMITH

1. An increased winter sea ice duration of up to 60 days, over elephant seals' continental foraging grounds, was associated with a persistent increase in the Southern Annular Mode or 'polar vortex'.
2. The amount of fat accumulated by a pregnant elephant seal determines her ability to feed her pup, the pup's subsequent size at weaning, and its ability to survive the first two years of life.
3. Southern elephant seals on Macquarie Island.
4. Elephant seal populations are declining on Macquarie Island.



# Counting elephant seals from space

Satellite imagery has been used to count elephant seals on Macquarie Island, demonstrating the application of the technique on animals living in remote locations that are difficult to distinguish from their environment.



JAMES DOUBE

Scientists from the Institute for Marine and Antarctic Studies (IMAS) and the Australian Antarctic Division used a Geo-Eye-1 satellite image of elephant seals lying on a dark, volcanic-sand beach on The Isthmus of Macquarie Island. The image was captured on 10 October 2011 on the same day that an on-ground census of the seals was being undertaken by expeditioners on the island.

Australian Antarctic Division researcher Mr John van den Hoff said the team processed the image and used simple image viewing software to count the number of female seals on the beach.

'Counting females is the standard way of quantifying population size in elephant seals,' Mr van den Hoff said.

'While adult males could not be differentiated from females on the satellite image, there is typically only one male per 50 females, so it's unlikely that including males in the counts would significantly affect the overall population counts. Newborn and nursing pups are also small and dark and poorly visible, so it's unlikely they were counted.'

Female elephant seals are grey/brown in colour and aggregate in harems on the dark, sandy beaches of the island. Despite this 'cryptic colouration', individual seals were detectable.

After three counts from the satellite image, the average number was compared to counts made on the ground on the same day.

'We found no statistically significant difference between satellite and ground counts for the total number of harems, the total number of seals at The Isthmus or the number of seals per harem,' Mr van den Hoff said.

While there was a small variance in the numbers between the satellite image and ground counts, these were likely due to an inability to distinguish seals from similar sized rocks, and from animals casting shadows onto adjacent seals in the tightly packed breeding harems. These differences could be resolved by obtaining images on other days during the breeding season, by improving the contrast and sharpness of images, or by increasing the number of re-counts from the images.

IMAS marine and Antarctic scientist, Dr Clive McMahon, said the study demonstrated that remotely sensed images can be reliably used to count elephant seals on remote islands. This opens up the possibility of counting larger populations of the animals on other islands that are rarely visited and for which population trend data are difficult to obtain, such as South Georgia and Heard Island.

Remote sensing has previously been used to count Weddell seals and southern right whales, and its increasing demonstration as a viable research technique could see it extended to counting large terrestrial animals such as zebra, camels, elephants, bison and other grazing herds that occur in open terrain.

'This technique could revolutionise how animals are counted, to establish population trends and growth rates, which is especially important in light of the current biodiversity crisis,' Dr McMahon said.

WENDY PYPER

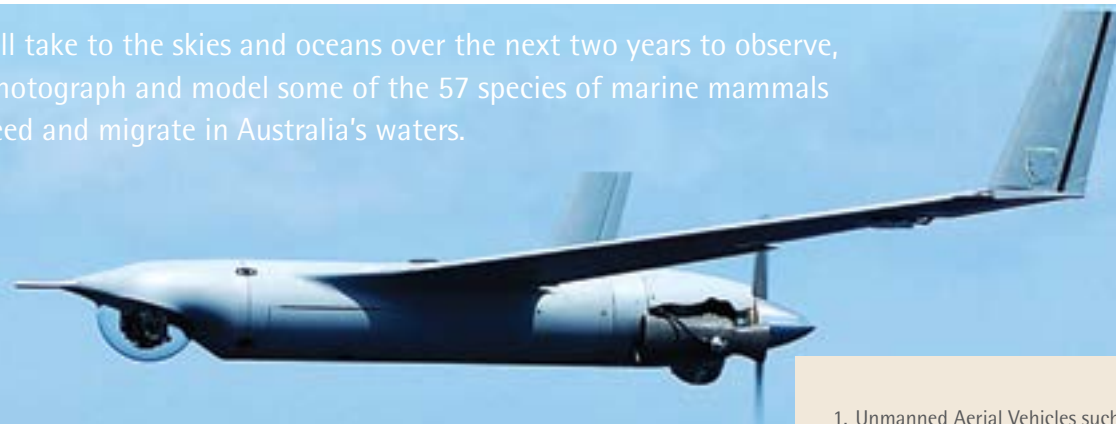
Corporate Communications, Australian Antarctic Division

1. These elephant seals on Macquarie Island blend in well with their environment, but they can still be counted from space.
2. This satellite image of The Isthmus, Macquarie Island, was obtained from the Geo-Eye-1 satellite on 10 October 2011. Female southern elephant seals can be seen congregating in harems on the beach (inset). Individuals within these harems are large enough (2.5 m long) to count. (Image: *PLOS ONE* Vol 9, No 3; doi: 10.1371/journal.pone.0092613)



# \$1.6 million for marine mammal research

Scientists will take to the skies and oceans over the next two years to observe, track, tag, photograph and model some of the 57 species of marine mammals that live, breed and migrate in Australia's waters.



1. Unmanned Aerial Vehicles such as this ScanEagle will be used to survey dugongs from the air.
2. Satellite tagging of blue whales in southern Australia will identify overlap between the whales' movements and human activities.
3. Researchers at the University of Queensland will assess the recovery of the East Australian humpback population.

1

Projects funded under a \$1.6 million research grants scheme, announced in April, include dugong surveys using state-of-the-art Unmanned Aerial Vehicles, satellite tagging of blue whales, and development of a system to simulate the hearing abilities of endangered marine fauna, which will help to determine safe limits of underwater noise pollution.

In total the 2013–14 round of the Australian Marine Mammal Centre (AMMC) Grants Scheme will support 21 high calibre, two-year research projects, focused on the conservation management of threatened Australian and regional marine mammal species and their populations.

The scheme, administered by the Department of the Environment's Australian Antarctic Division in Hobart, supports research using non-lethal techniques to improve our understanding of the impact of human activities on marine mammals and provide information on their population structure, distribution and abundance, and the threats they face.

The projects will provide invaluable information and advice to underpin Australia's marine mammal conservation and policy initiatives. Recipients include many of Australia's internationally recognised marine mammal scientists.

Among the grants are:

- \$98 000 for scientists at Macquarie University to develop aerial methods to monitor southern right whale populations in south-east Australia.
- \$100 000 for scientists at James Cook University to provide accurate estimates of dugong abundance and distribution, to inform dugong management, especially the management of Indigenous hunting.
- \$89 000 for researchers at the University of Queensland to assess the recovery of the East Australian humpback population that was hunted to near extinction in the early 1960s.
- \$116 000 for the South Australian Research and Development Institute to conduct a state-wide survey of Australian sea lion populations, as part of the animals' Recovery Plan.

Since its inception in 2008, the AMMC Grants Scheme has funded 83 marine mammal research projects that have made substantial contributions to marine mammal conservation both nationally and internationally.

ELANOR BELL and RENATA ROBERTSON  
Australian Marine Mammal Centre



2

CARLOS OLIVARRIA



3

JOSHUA SMITH &amp; MICHAEL NOAD

# Sea ice symposium

An international contingent of sea ice scientists converged on Hobart in March for the 4th International Sea Ice Symposium of the International Glaciological Society, hosted by the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC).

The symposium, on the theme *Sea Ice in a Changing Environment*, ran for five days, but the full program stretched over 11 days and included seven workshops and the inaugural Public Open Science Day (see next story). Over 210 delegates, including 173 from 16 overseas countries, attended the meeting, with strong representation from Belgium, Germany, Japan, New Zealand and the USA.

A total of 155 oral presentations, including 10 keynote lectures and over 120 posters, contributed to the 14 symposium topics. The latter were strongly multi-disciplinary and covered a wide range of highly topical issues. These included large-scale change and variability in both polar regions; advances in sea ice analysis using remote sensing, modelling and palaeo records; advances in instrumentation and observation methods; sea ice and ecosystems modelling; and interactions between sea ice and ice sheets, ice shelves, icebergs, the ocean and atmosphere and the biosphere.

Scientific highlights showcased during the symposium included new findings on the 2013 Antarctic sea ice extent maximum and the strong regionalisation of Antarctic sea ice processes, Arctic sea ice decrease, linkages between Antarctic sea ice and ice shelf health, bipolar control mechanisms of algal assemblages, and advances in numerical modelling, remote sensing, instrumentation and methods. The affiliated workshops allowed specialised task and working groups to present and discuss new developments and future directions with their participants.

A strong field of student and young scientist contributions were judged for best poster and oral presentations by a panel led by Professor Emeritus Willy Weeks. Professor Weeks, who is acknowledged as the leading living sea ice scientist, also entertained delegates with a very personal account of sea ice research over the last 50 years (the 'good old days').

In tune with the topic of this symposium, the International Glaciological Society will publish a thematic issue of the *Annals of Glaciology* (Volume 69), including about 50 peer-reviewed manuscripts received from symposium participants and non-participants.

Feedback from symposium participants on the quality and relevance of presentations and the symposium set up has been very positive. Delegates also enjoyed their welcome by the Tasmanian Governor, the Honourable Peter Underwood, one evening at Government House, and the time allocated to enjoy Tasmania's unique outdoor and cultural scene during Wednesday afternoon excursions.

The symposium would not have been possible without the generous support and sponsorship offered by a number of organizations, both local and world-wide. These included the ACE CRC, the World Climate Research Programme's Climate and Cryosphere (Clic) project (Norway), the Office of Naval Research – Global (USA), the Tasmanian Government Department of Economic Development, Tourism and the Arts, the International Association for Cryospheric Sciences, Institute for Marine and Antarctic Studies (IMAS – at the University of Tasmania), the University of Manitoba (Canada), Business



Events Tasmania, and the National Snow and Ice Data Center (USA). This sponsorship included support for young scientists to attend the conference. The Local Organising Committee is grateful to the sponsors and other supporters for enabling this world-class event to be hosted by the ACE CRC in Hobart.

Last but not least, the organising committee is grateful for the help and enthusiasm of many volunteers from the ACE CRC, IMAS and the Australian Antarctic Division. Without the extraordinary help of these people, the symposium and associated events could not have taken place.

PETRA HEIL and ROB MASSOM

*On behalf of the symposium Local Organizing Committee.*





# Public Open Science Day

The new waterfront building of the University of Tasmania, home to the Institute for Marine and Antarctic Studies (IMAS) and the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC), opened its doors to its first major public event on Sunday 9th March 2014

School students and the general public were invited to attend the Public Open Science Day on the theme of sea ice and the polar system. The event was organised by the Local Organising Committee of the International Symposium on Sea Ice in a Changing Environment and the ACE CRC (see previous story). The enthusiastic public response engendered a great deal of energy in those fortunate enough to participate in showcasing the unique contribution of Hobart's highly-diverse research community to Antarctic and Southern Ocean science.

Three keynote speakers provided the audience with an introduction to the wonders and challenges of sea ice physics and ecosystems and connections between Tasmanian/Australian weather patterns and the Antarctic and Southern Ocean. The speakers, Professor Andy Mahoney (USA), Professor Hauke Flores (Germany) and Tasmania's own Dr Mike Pook, captivated the audience with entertaining and informative talks, and many questions were asked of all three speakers after both sessions. One speaker even used icy poles to help demonstrate brine flow through sea ice. Such was the success of these lectures that the IMAS lecture theatre was filled to capacity in both sessions.

Other popular activities included five science stations adjacent to the lecture theatre, giving visitors first-hand experience of Antarctic ice, viscosity (an analogue to gravity drainage of the ice sheet), and ocean waves (simulated in a tank). Emerging technologies were also demonstrated, much to the delight of the many budding 'tech heads' present. The science stations were ably manned by students and young scientists, who provided background information, explained the science and answered questions.

A selection of superb photography provided a display of the polar landscape, wildlife, micro-organisms and work environment. In a side lecture, the crowd was treated to a demonstration of the power of satellite remote sensing; in this case in support of sea ice science and ship operations south of Tasmania. The old favourite 'dress up like an Antarctic expeditioner' (kits courtesy of the Australian Antarctic Division) entertained young and old alike. Another great success was a demonstration of the Antarctic food web. Finally, school-aged attendants participated in a prize draw, with the winners invited to a special session at the sea-ice symposium.

With an estimated 2000–3000 visitors, lots of smiley faces and a wonderful bunch of contributors and helpers, this Public Open Science Day was a spectacular success, and a wonderful lead-in to the international sea ice conference. Visitor feedback was overwhelmingly positive and enthusiastic, with many expressing an interest in more such events. Taking this request onboard, the organisers are now looking at contributing to National Science Week in August 2014.

PETRA HEIL and ROB MASSOM

*On behalf of all involved in the Open Science Day event*

1. IMAS PhD student Mana Inoue shows off an Antarctic ice core during the Public Open Science Day at the ACE CRC.
2. ACE CRC research scientist Dr Jessica Melbourne-Thomas with some enthusiastic children dressed up like expeditioners.
3. Children get tangled in the food web game run by Australian Antarctic Division krill scientist Rob King during the Public Open Science Day.



# A summer of many challenges

Australia's 2013–14 Antarctic summer season marked the 100th anniversary of the summer in which Douglas Mawson and the six remaining members of the 1911–14 Australasian Antarctic Expedition (AAE) finally returned to Australia.



DAVE WOOD

1

The AAE party had spent an unplanned additional year at Cape Denison after Mawson, the only survivor of the disastrous Far Eastern Party, had arrived back only hours after his ship had departed for the winter.

In *The Home of the Blizzard*, Mawson records the menu of the Midwinter dinner in 1913 making an allusion to Shakespeare's *Richard III* in referring to that last winter at Cape Denison as 'the winter of our discontent'. For the Australian Antarctic Division, the summer of 2013 has been one not so much of 'our discontent', as of our having to respond to many challenges. Most of these challenges were a consequence of an extent and thickness of sea ice around eastern Antarctica which have rarely been experienced in the 100 years since Mawson returned from Cape Denison.

Before the season commenced, it looked as if our biggest challenge was to deliver the Aurora Basin North ice core drilling project (see story on page 2), which aimed to drill a 300 m-long ice core at a remote location 550 km inland from Casey station. Our plan involved three field team members being deployed by overland traverse, who would then establish the camp and prepare a landing strip for a ski-equipped Basler BT-67 aircraft. This aircraft would bring the rest of the

team and equipment from Casey and then, at the end of the project, transfer people, equipment and the all-important ice cores back to Casey, from where they would return to Australia by ship or plane. The traverse leg of the mission was made possible by our good friends at the French Antarctic Program, who conveyed our three people, in early December, over a distance of 1300 km from Dumont d'Urville Station.

In the end, the Aurora Basin North project was completed on time and without any significant hitches, achieving all its scientific goals — a superb achievement for all involved. So, contrary to our expectations, it was not this project where we faced our major challenges over the summer, but in the delivery of our shipping program.

We had originally planned that our shipping schedule for the *Aurora Australis* would be more limited than normal — only 125 days at sea — due to the deferral until 2014–15 of a major marine science voyage because of cost pressures. As things turned out, the unexpectedly difficult sea ice conditions required us to spend 193 days at sea. This included 170 days on the *Aurora Australis* and a further 22 days on *L'Astrolabe*, the flagship vessel of the French Antarctic Program, which they kindly allowed us to sub-charter.

Our likely problems with sea ice became apparent early in the summer, when Voyage 1 — the resupply voyage to Davis — was delayed on its way both to and from Davis, putting us 21 days behind schedule. This required us to combine Voyage 2 (to Macquarie Island) and Voyage 3 (to Casey) in order to recover the time lost. This new Voyage 2/3 arrived at Casey only five days late but — as part of a chain of events which received worldwide media coverage — was then redirected towards Commonwealth Bay by the Australian Rescue Coordination Centre to assist in the rescue of the *Akademik Shokalskiy*. This vessel was undertaking a private voyage to Cape Denison to commemorate the 100th anniversary of the conclusion of Mawson's 'winter of discontent', and had become beset by sea ice. With the cooperation of *L'Astrolabe* and the Chinese flagship Antarctic vessel, the *Xue Long*, the passengers were successfully evacuated from the distressed vessel and taken by the *Aurora Australis* first to Casey, to complete the resupply, and then back to Hobart. By this stage, we had also experienced a serious accident involving one of our helicopters on its way back to Davis from visiting a penguin colony near the Amery Ice Shelf. The pilot and two passengers were all injured, but we were able



JESSICA FITZPATRICK



2



3

BARBARA WIENCKE

1. On the unscheduled Voyage 6, cargo was delivered to Mawson station using four AS350 B3 helicopters. The helicopter pictured here is taking a sling load of fuel in an Intermediate Bulk Container to the station.
2. *MV Akademik Shokalskiy* passengers walk across sea ice from the Chinese helicopter to the *Aurora Australis*. The rescue was a good example of international collaboration in the Antarctic, but it created further challenges for Australia's science and operational activities.
3. Heavy sea ice conditions on Voyage 1 resulted in a three-week delay to the ship returning for its second voyage and threw the schedule into disarray.

to use our aviation network (the Basler BT-67, a Twin Otter, and our A319 Airbus which operates to Wilkins runway) to return them quickly to Hobart for emergency medical treatment, from which all are recovering well. The Australian Antarctic Division responded successfully to this emergency through the coordinated efforts of almost 100 people, ranging from medical and operational staff on the ice, to a large number of head office staff, plus excellent forecasting support from the Bureau of Meteorology and advice from other external parties.

Voyage 4 to Mawson — also featuring visits at Casey, to collect the Aurora Basin North ice core samples, and Davis — finally departed on 29 January, 12 days later than originally scheduled. As the *Aurora Australis* approached

Mawson, it became clear that the ice was too thick for the ship to penetrate and a decision was made for the vessel to return to Hobart and to equip it with long range helicopters and other equipment required to undertake a station resupply by air. An unscheduled Voyage 6 departed for Mawson on 9 March, while *L'Astrolabe* was used to undertake the scheduled Voyage 5 to Macquarie Island.

The four helicopters deployed on Voyage 6 successfully delivered (in 1000 litre tanks) 50 000 litres of fuel — the bare minimum required to keep Mawson functional through to next summer. It also delivered 70 tonnes of priority cargo by sling load, and a very relieved group of 2014 Mawson wintering expeditioners who had been unexpectedly forced to return

to Hobart on Voyage 4. This complex operation was completed more quickly than had been planned and, as a result, we were delighted to welcome back the *Aurora Australis* and, most importantly, the extremely patient 2013 Mawson wintering expeditioners, to Hobart on Easter Saturday (19 April). The ship's return brought an extraordinarily complex and difficult season to a resoundingly successful conclusion. We are now busy preparing for whatever challenges the 2014–15 season is going to throw at us!

ROB WOODING

*General Manager, Support Centre,  
Australian Antarctic Division*

# Close of the Mawson Centenary

February 26, 2014, marked the close of an important chapter in Australia's Antarctic history – 100 years since Australian geologist, Dr Douglas Mawson, returned from his two year Australasian Antarctic Expedition (AAE).



The Australian Antarctic Division celebrated the occasion with the opening of a photographic exhibition of 'Mawson's Men' at the Tasmanian Museum and Art Gallery. The exhibition provided a glimpse into the day-to-day life and work of the 32 men of the AAE. The following is an edited version of a speech by Australian Antarctic Division Strategies Branch Manager, Jason Mundy, to guests attending the exhibition.

It was a bitter-sweet homecoming for Mawson, having personally witnessed the death of two of his friends and colleagues, Belgrave Ninnis and Xavier Mertz, during a sledging journey from Cape Denison to map distant coastline. But he and the crew of the *Aurora* received a hero's welcome on their return to Adelaide on 26 February 1914. In the words of Captain John King Davis:

*As the Aurora drew near her berth we saw that the shore was white with people. The temperature was high in the eighties and many of the men stood in their shirt sleeves, while the women wore light skirts and blouses, with big wide hats, and carried gaily-coloured parasols. A heaving line flaked through the air and fell upon the forecandle-head. Then the cheering broke out. As the mooring lines were drawn ashore and secured to the bollards, the cheers rang out louder and louder. In a moment one could hardly*

*hear... I turned to Blair upon the forecandle, having to use a megaphone in order to be heard above the noise, 'Vast heaving! And make fast!' We were home.*

Despite the ill-fated events of the AAE, scientifically the expedition achieved so much.

In the cause of science the men of the AAE, based at Macquarie Island, Cape Denison and the Shackleton Ice Shelf, made breakthroughs in Antarctic geology, biology, meteorology, magnetism and oceanography. The expedition sent sledging parties across more than 4000 km of unknown country and their ship sailed 3000 km of unmapped coastline.

The results of their scientific work filled volumes – daily observations of temperature, barometric pressure, humidity, snow fall, wind speed and direction, daily magnetic and tide observations; hard-won against the cold and wind. And they described the geology and plant and animal life of Cape Denison.

The AAE laid the foundation for Australia's modern Antarctic program and by claiming what was then known as the 'Australian Quadrant' of Antarctica, Mawson established the foundations for the future Australian Antarctic Territory.

The 2011–14 centenary inspired a host of community events across the country and drew focus to Australia's historical and modern Antarctic interests.

The centenary celebrations began in Hobart in spectacular fashion, with a re-enactment, on 2 December 2011, of Mawson's departure for Antarctica. The Governor General, Ms Quentin Bryce, was in attendance, as a flotilla of cruise ships, yachts and small boats accompanied our modern-day icebreaker, *Aurora Australis*, down the Derwent River; just as Mawson had done 100 years previously, aboard the *Aurora*.

On 16 January 2012 the Australian Antarctic Division honoured the achievements of the AAE with a commemorative voyage to Commonwealth Bay, led by Director Dr Tony Fleming. In a small ceremony outside Mawson's Huts, modern day expeditioners raised the Australian flag and installed a time capsule, to be opened 100 years from now. The event was held four days after Mawson and some of his companions spent their first night ashore a century earlier, after arriving at the continent on 8 January 1912.

Many other special events and activities were held over the centenary period. These included a commemorative dinner hosted by the Governor General as patron of the Mawson's Huts Foundation; the opening of the Mawson's Men photographic exhibition at Parliament House; and the construction of a replica of Mawson's Huts, which now sits near the Hobart waterfront.



2



GLENN JACOBSON

3



DEAN LEWINS

The Australian Antarctic Division and the Mawson's Huts Foundation have also continued work to preserve the Mawson's Huts historic site in Antarctica, with a new management plan for the site finalised in 2013.

Perhaps most significantly, the centenary has inspired a vibrant discourse on the nature of Mawson's achievements and Australia's interests in Antarctica, including the production of a large number of books, diaries, exhibitions, seminars, musical events, stamps and coins.

Clearly these events reflect a continuing recognition by Australians of the role of Mawson and his men and the significance of the AAE.



4

KRISTIN RAW

Australia's place in the modern world, and particularly our place in Antarctica, has been shaped by the tenacity and endurance of great Australians such as Mawson.

*Strategies Branch, Australian Antarctic Division*

1. This Australia Post stamp issue, released in February 2014, is the last in a four-year series commemorating the Australasian Antarctic Expedition. It was one of many such mementos inspired by the AAE. *This material has been reproduced with the permission of the Australian Postal Corporation.*
2. A re-enactment of the departure of the *Aurora* in 1911, as the modern-day icebreaker *Aurora Australis* heads for Commonwealth Bay on 2 December 2011, escorted down the Derwent River by a flotilla of yachts, ships and boats. Here the Governor General, onboard launch *Egeria*, takes the salute from *Aurora Australis*.
3. Modern-day expeditioners celebrated the start of the centenary with a ceremony at Mawson's Huts on 16 January 2012.
4. Part of the Mawson's Men exhibition at the Tasmanian Museum and Art Gallery Bond Store, February 2014.

# Beyond Whoop Whoop

It's April 2014. The Boeing 777 flies over Malaysia then banks, proceeding along the Malacca Strait. As the plane turns again, I can't help thinking of the missing Malaysian Airlines plane, MH370, the one presumably lost thousands of kilometres further south in the Indian Ocean. Press reports described the part of the Indian Ocean where it might be as one of the remotest places on earth.

If the Indian Ocean west of Perth is remote, then the Australian Antarctic station at Mawson, thousands of kilometres further south, is beyond *Whoop Whoop*; another world, where normality is turned on its head. Antarctica, the driest continent on earth, holds 70% of the earth's fresh water. Its bright light and white sheets of ice are a photographer's dream, yet for six months of the year it is continually dark; a continent full of danger and contradictions. It is several months since my return from Antarctica, not long enough to properly comprehend my voyage, but I am already aware that it is a significant point in my life as an artist.

Friends ask 'What was the most difficult thing about Antarctica?' and I reply, 'the decision to go'. There is also a difficulty in returning to normal life after a journey that had so many exciting adventures that heightened one's senses. My *Guardian* blogs record my visits to the nunataks at Rumdoodle, to Auster Rookery and the Adélie penguins at Béchervaise Island, viewing icebergs from Mount Henderson, and staring down beautiful blue crevasses.

My incredible journey began in Hobart in October 2013, in a collegiate atmosphere with 90 others that took me across the Southern Ocean on the icebreaker *Aurora Australis*. The ocean voyage had adventure and excitement from the beginning, when we attempted to outrun a storm crossing the Great Australian Bight, only to turn into some wild weather further south that sent the ship rocking and rolling, with sea-spray smattering the windows of the Bridge and sending many scurrying to their bunks. This sea voyage, estimated to be around 11 days, turned into a three-week epic, with much of it spent icebreaking. The effort delivered a piercing audio below deck, in my 'studio', as the ice scratched at the steel hull, and on more than one occasion I stopped painting thinking that the ship had been ripped open.

On arrival in Antarctica a small group of us were helicoptered off the *Aurora Australis*, over Iceberg Alley and onto the ski-way at Davis, where a DC3 flew us across the Amery Ice Shelf to Mawson. After three weeks on-board, I had become used to company in this isolating

landscape. How could you not be sociable in the shared cabins and the close quarters of the ship, with life revolving around the wonderful galley; although after several weeks it felt like being locked in a cafeteria!

As my journey progressed, the number of people around me diminished until, at the end, I was the only one left on a plane that flew back over Bass Strait to Melbourne. It seems now like a nice metaphor that explains how, despite the practical proximity of others, the journey to the remotest part of this earth is a journey from which, by necessity, one returns alone, with your own thoughts and memories. After all, we all had come from diverse backgrounds and professions, with different goals and missions to complete in this hostile environment, where one has to confront oneself both physically and mentally. It is almost like a physical embodiment of panning back from oneself, exemplified when the DC3 banked over the *Aurora Australis* to reveal that my entire world of three weeks — that enormous and imposing ship — was nothing more than a tiny red speck on a vast sea of white.



1. Australian Antarctic Arts Fellow John Kelly began work as soon as his journey began, onboard the *Aurora Australis*.

2. John sketches on the sea ice at Mawson, with Mount Henderson in the background.

3. A small selection of John's work. He produced 55 paintings and wrote five essays for the *Guardian* newspaper during his nine week visit to Antarctica.

4. John painting the field huts on Béchervaise Island near Mawson.





I have no problems admitting I found my experience confronting and challenging; 55 paintings in nine weeks and five essays published whilst working in such a difficult environment broke me down day by day. Physically and mentally the environment took its toll. By the time we flew back to Davis from Mawson, after several weeks of work, I was in need of a rest. However that was to prove impossible.

The first evening I was billeted in the communications building and was within earshot when the communications officer uttered words that felt like fingernails drawing down a blackboard; 'whiteout, helicopter down, injuries!' The helicopter had gone down in a crevasse field on what was termed The Loose Tooth, an appendage of the continent waiting to be an iceberg. It was the same helicopter and pilot who had flown me off the ship a few weeks earlier and the prognosis was not good for our colleagues. The weather had closed in and immediate rescue was impossible. We were told they could be stuck there for a week or more.

The stress and uncertainty that accompanied the accident made working impossible. Over the next few days the anxiety and fear for our colleagues was palpable and those endless days stretched one's mental resources as we waited for the weather to break. It was excruciating. I could only imagine how it felt for those trapped out on the ice.

We were informed that with the loss of the helicopter the normal flying program would



JOHN KELLY

be cancelled and that many of the scientific projects would also be cut short. This meant a small group of us would be on the first and last available DC3 flight back to Casey, after the injured had been retrieved and evacuated. Fortunately, after a couple of days, the weather brightened long enough for the rescue to succeed. A few days later a Twin Otter flew us from the sea ice up to Whoop Whoop, another ski-way, to await the return of the DC3, which duly arrived to fly us out.

By the time the five-hour flight to Casey ended I was exhausted. Because of luggage restrictions I had left a significant amount of my art materials back at Davis, so even if I had the energy to work, I simply did not have the material to keep painting. Instead, I flew back to Hobart with a small group of others on the A319 to spend Christmas with my family. When the crew offered me a lift to Melbourne, I gratefully accepted and had the rare experience of being the only passenger on a commercial airline.

Returning alone, after a visit to the most isolated place on earth, felt like an apt end to my journey.

Whilst in Antarctica and after the helicopter crash, I felt that our presence there might be an extravagance, a far too hostile environment for scientists and others to risk their lives to collect esoteric data. However, a few weeks after my return, the press announced that evidence of gravitational waves from the Big Bang had been observed that confirmed Einstein's theory of relativity. The information had come from a microwave-sensitive telescope in Antarctica that had relied on the dryness and darkness to be able to collect the data, in an environment where time and space behave quite differently to what we are used to. It made me realise just how special this frozen cap is to our ability to understand our world, our universe, and the potential that there might be others. It seems fitting that the evidence for Relativity was collected from this icy world that man had only just begun to explore when the Zurich patent clerk with a wayward haircut put forward his incredible hypothesis.

See more of John Kelly's work at <http://johnkellyartist.com/>

JOHN KELLY

Australian Antarctic Arts Fellow 2013–14



4

# Secrets of the Giant Freezer

1



MARIE DAVIES

An ABC3 television crew visited Antarctica last summer as part of the Australian Antarctic Division's media program. The team filmed footage for their new Australian children's show *Antarctica: Secrets of the Giant Freezer*.

When we first spot the blue ice runway we look at each other in anticipation. This is it. We're minutes away from landing on the most isolated and mysterious continent on the planet. For my cameraman, Josh Zaini, and presenter, Kayne Tremills, it's their first glimpse of this frozen world. For me it's been a six year journey to return to Antarctica, having filmed for six weeks with *Totally Wild* in 2006–07.

The 2007 audience has grown up. It's time for a new, tougher crowd of 8–12 year olds: one that expects even more from the content we make; one that is immersed in social media and new technologies; and one that has a big voice and wants to feel part of the whole process.

Hopefully *Antarctica: Secrets of the Giant Freezer* will answer these challenges. It's essentially a half hour special where Kayne Tremills takes an intrepid journey down south to uncover the most remarkable, jaw-dropping secrets that are ready for the ice-picking.

As well as looking at Antarctica's amazing wildlife, what it's like to live and work there, and its rich explorer history, we wanted to unearth some lesser known secrets. For example, did you know you weigh more in Antarctica than you do in Cairns? Did you know Antarctica is home to the largest flea in the world? How about the fact that a Spanish galleon sank off the coast of the icy continent, weighed down with five million dollars in gold — a treasure that has never been found? We hoped to uncover all these secrets, and more, culminating in a world first — something that no Antarctic explorer has ever done before (no spoilers here; you'll have to watch the show to find out).

Highlights included sleeping out in a home dug ice cave, visiting the half buried Wilkes station, taking photos at the Antarctic Circle sign, working out whether 'goop' would freeze if left out overnight (it does), checking out the southern-most veggie patch in the world, filming

penguins at Shirley island (I dare anyone not to laugh at these amazingly comic birds), chatting with the scientists, *almost* being attacked by a skua (seriously, these guys have no fear!), plus jumping into the water looking for buried treasure (arrrrrr me hearties). Not surprisingly, this last challenge wasn't on the original activities list. Due to unforeseen circumstances we were unable to spend a day filming on a small boat, so we improvised. I don't think Kayne has quite forgiven me (brrrrrr).

Of course, none of the filming would have been possible without some key players, including Media Program coordinator Patti Lucas, Casey Station Leader Anthony Hull, and all the scientists and expeditioners who were at Casey station that week. I'll never forget when we asked for volunteers to dress up in penguin onesies and ski down a slope — more than seven turned up! We really appreciated the amazing support from everyone.





MARIE DAVIES

On top of filming traditional television, ABC3 also has a huge online presence (over 120 000 Club 3 members in fact). Naturally, we wanted to get these guys involved too. Not only did we put out the question 'What do you want us to find out about Antarctica?' we also ran a competition.

In light of the fact it's 103 years since Mawson's infamous trek in Antarctica, we wanted to take 103 of our fans with us on our filming trip. Not literally of course! We asked the 'threeps' to upload photographs of themselves, with or without their friends or sports team, and then to tell us why they thought they should go with Kayne to Antarctica. We picked 103 faces and then I spent my spare time down on the ice taking photographs of these 103 faces. The 103 faces gallery will go online during the lead up to promoting the broadcast of the program. We'll also upload a smorgasbord of bloopers, behind the scenes and extra content that we shot down south.



MARIE DAVIES

It wasn't possible to uncover all of Antarctica's secrets in just one week (looks like I'll just have to go back down). But hopefully ABC3's half hour program and online content will inspire and inform the youth of Australia about this super special continent; enough to want to protect it now and for future generations.

*Antarctica: Secrets of the Giant Freezer* will air in June 2014 on ABC3.

MARIE DAVIES  
Series Producer ABC3



ADD

1. ABC3 presenter Kayne Tremills and cameraman Josh Zaini film a segment for the new Australian children's television show *Antarctica: Secrets of the Giant Freezer*.
2. Casey station expeditioners in their penguin onesies will feature in the ABC3 children's show.
3. ABC3 presenter Kayne Tremills uncovers another Antarctic secret.
4. ABC3 series producer Marie Davies flanked by her cameraman and presenter.

# Managing activities in the Larsemann Hills

The Larsemann Hills are an East Antarctic logistical hub and the only Antarctic Specially Managed Area (ASMA) in which multiple countries have continuously occupied stations. In the margins of a recent meeting of the Council of Managers of National Antarctic Programs, Australia worked with other countries active in the area to continue discussions around managing and protecting the region.



SANDRA POTTER



STUART SHAW

The Larsemann Hills ASMA is an ice-free area of 40 km<sup>2</sup>, some 120 km west of Davis. The area was designated an ASMA in 2007 following a joint nomination by Australia, China, India, Romania and the Russian Federation. The impetus for seeking designation was quite simple; to facilitate the heightened protection of the local environment by promoting coordination and cooperation in the planning and conduct of science. At the time of the nomination the area was already home to an Australian summer facility (Law Base, now Law-Racovita-Negoita), and the year-round stations of China and Russia (Zhongshan and Progress) which were built before the Protocol on Environmental Protection to the Antarctic Treaty was negotiated.

The Larsemanns of the 21st century are an East Antarctic hub akin to King George Island in the Antarctic Peninsula and the McMurdo region in the Ross Sea. Zhongshan has recently been rebuilt and extended and is the staging post for China's activities at Kunlun, 1200 km inland, and the newly established Taishan summer station. Progress has similarly undergone significant redevelopment and has replaced Mirny station as the logistical centre for Russian Antarctic Expeditions; Russia's ski-way and traverse capability link the region to various intra and intercontinental destinations. There are also some 15 km of roads, and a new Indian station, Bharati, replacing a field hut positioned in 2007. Bharati is on a small peninsula between Thala Fjord and Quilty Bay and has been continuously occupied since 2012.

As well as being important in logistical terms, the Larsemann Hills are a site of high conservation value; a particularly notable feature being the 150-plus lakes, ranging in size from shallow ponds to large ice-deepened basins. It is thought that some of these lakes and their resident micro-fauna have been little disturbed for 130 000 years. In addition to its scientific significance, the area has considerable aesthetic and wilderness values arising from its distinctive combination of rugged hills, lakes and fjords framed by the plateau, a glacier and near shore islands and icebergs.

At the time of writing there are more than 70 Antarctic Specially Protected Areas (ASPAs) and seven ASMAs in Antarctica. The Larsemann





Hills ASMA is the only one in which multiple countries have continuously-occupied stations; this presence increasing the importance of robust and regular discussions on matters of shared interest. While the management arrangements are proving to be an Antarctic success story, there remain many challenges ahead with four on site languages, four cultures and four countries' operational needs and policy interests to accommodate.

Among the issues recently discussed by the ASMA Management Group were:

- The adequacy of the ASMA management plan. Following a workshop hosted by the Arctic and Antarctic Research Institute in 2013 a revised plan was submitted to the Antarctic Treaty Consultative Meeting held in April 2014.
- Plateau access difficulties. China and Russia are jointly working on improving the road from Broknes (the eastern-most peninsula) to the plateau.
- Cargo operations. In some years it is not possible to transfer cargo from resupply vessels direct to Broknes, necessitating the identification of alternative landing sites.
- Aviation safety. Multiple countries' fixed and rotary wing aircraft frequent or are based in the area each summer.
- Coordination of lake research and monitoring. Beyond their scientific and intrinsic values, some of the area's lakes are used for station water supply.
- Regional biosecurity arrangements. The Larsemann Hills are a first point of entry into Antarctica for China, India and Russia. Experience elsewhere shows that transport hubs can function as stepping-stones for invasions by non-native species. The measures agreed represent the first such arrangement for Antarctica.
- Enhancing the protection of the ASMA's unique geology. Management Group member countries have jointly nominated Stornes, the Larsemann's largest and most geologically significant peninsula, as an ASPA (see box story).

1. The ice free areas of the Larsemann Hills provide logistical access to countries' inland stations, such as Zhongshan (pictured, with Progress visible in the background) which is a staging post for China's Kunlun station. The broader region has aesthetic and wilderness values arising from its distinctive combination of rugged hills, lakes and fjords, framed by the plateau, a glacier and nearshore islands and icebergs.
2. Russia's Progress station in the Larsemann Hills.
3. The new Indian station, Bharati, under construction in 2012.
4. The Larsemann Hills Antarctic Specially Managed Area No 6 is home to three year-round stations (Zhongshan, Progress and Bharati), an Australian summer facility/base (Law-Racovita-Negoita), and unusual mineral assemblages rich in boron. An Antarctic Specially Protected Area was recently announced at Stornes, to protect these unique 'hard rock' features.

- Local waste management. There exists a risk that any poorly stored waste materials could become significant sources of pollution both in the immediate area and many kilometres distant.
- Oversight of activities at Amanda Bay – an ASPA 30 km from the Larsemann Hills. The ASPA was designated to enhance the protection of a colony of several thousand pairs of emperor penguins breeding on the area's fast ice. Its most frequent visitors are personnel from ASMA Management Group member countries.

SANDRA POTTER

Strategies Branch, Australian Antarctic Division

## Special protection for Stornes 'hard rock'

The first Antarctic Specially Protected Area nomination of a crystalline or 'hard rock' occurrence, on Stornes, has been made by Australia, China, India and the Russian Federation. Stornes is the largest peninsula in the Larsemann Hills and at the 2014 Antarctic Treaty Consultative Meeting in Brazil it was assigned number 174 on the ASPA master list.

Located within the Larsemann Hills Antarctic Specially Managed Area, Stornes is the first ASPA that has been designated primarily for its outstanding geological features, which are collectively known as hard rock occurrences. Hard rock is a term used by geologists to signify crystalline rocks (igneous or metamorphic) as opposed to 'soft-rock' which refers to sedimentary or unconsolidated material. (Marine Plain ASPA No. 143 near Davis is a soft rock occurrence.) Stornes contains assemblages of borosilicate and phosphate which are considered significant both in their variety and origin (see *Australian Antarctic Magazine* 13: 18–19, 2007).

The ASPA is 21 km<sup>2</sup> in area and approximately 1.5 km to the south-west of Bharati (India). Entry, as with all ASPAs, now requires a permit issued by a national authority.

The Australian Antarctic Division acknowledges the expert contributions of Dr Chris Carson of Geoscience Australia and Professor Ed Grew of the University of Maine to the development of the Stornes management plan. Copies of the management plan are available from the Antarctic Treaty Secretariat's website and the Australian Antarctic Division.

REBECCA MALCOLM

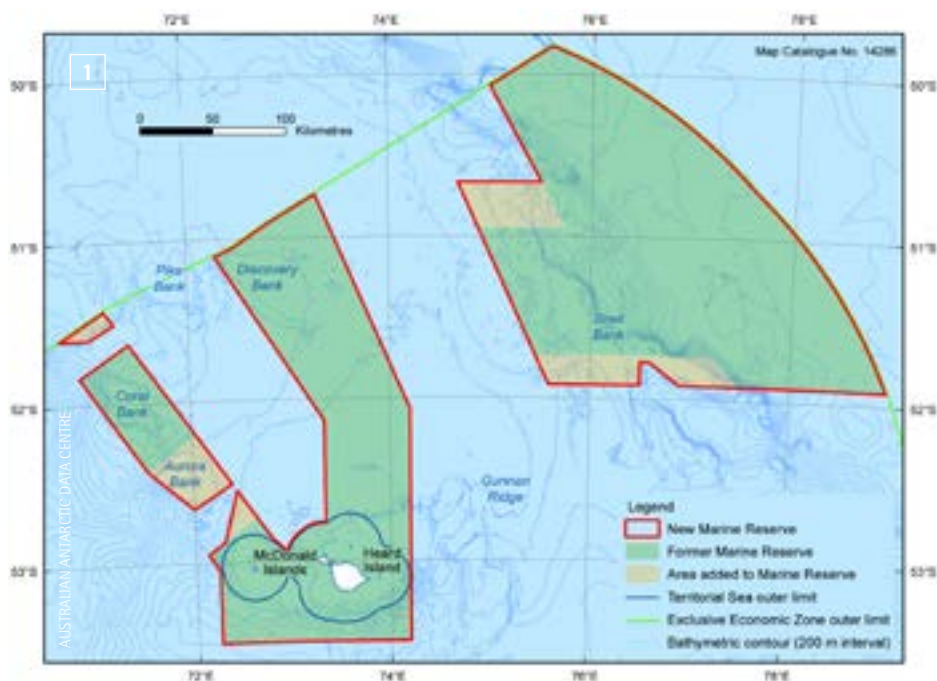
Strategies Branch, Australian Antarctic Division



AADC

# Expansion of the Heard Island and McDonald Islands Marine Reserve

The boundaries of the subantarctic Heard Island and McDonald Islands Marine Reserve have been expanded.



The scientific assessment recommended that 6200 square kilometres of ocean should be added to the Reserve on the basis of its high conservation values. These values include outstanding and representative ecosystems, distinct benthic habitats and species, and foraging grounds for seabirds and mammals. The Reserve is now some 71 000 square kilometres in area.

The Reserve is located 4100 km south-west of Perth, Western Australia, in the southern Indian Ocean. It encompasses the World Heritage listed Heard Island and McDonald Islands, which were inscribed on the World Heritage List in December 1997 on the basis of their outstanding universal natural values.

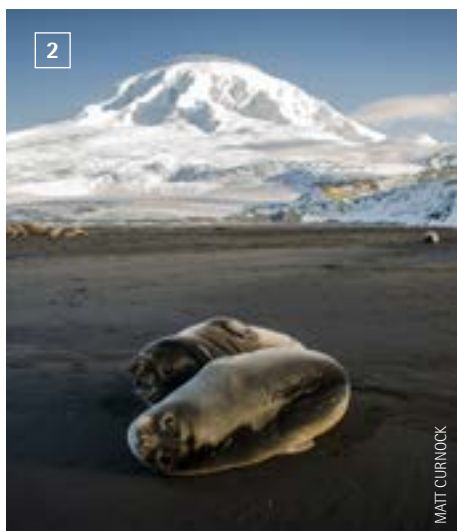
Heard Island and the McDonald Islands possess the Commonwealth's only active volcanos. Heard Island's Mawson Peak — standing 2745 m above sea level — is the highest point in the Commonwealth outside of the Australian Antarctic Territory.

The Australian Government's decision to protect this 6200 square kilometres portion of high conservation value ocean within an IUCN 1a Strict Nature Reserve reflects an ongoing commitment to the sustainable management of Australia's ocean resources.

*\*IUCN Category 1a Strict Nature Reserves are designated to protect habitats, ecosystems and native species in an as undisturbed state as possible. Public access is primarily limited to scientific research and environmental monitoring. It is the highest level of protection afforded under the IUCN principles.*

JAMES FLEMING

Senior Policy Officer, Australian Antarctic Division



The Federal Minister for the Environment, Mr Greg Hunt MP, publicly announced the expansion following the implementation of the *Environment Protection and Biodiversity Conservation Amendment (Heard Island and McDonald Islands) Proclamation* 2014 on 28 March.

The Australian Government's decision to expand the Commonwealth's largest IUCN 1a Strict Nature Reserve\* follows a comprehensive scientific assessment of the region's conservation values and ongoing consultation with key stakeholders (including fishing operators, conservation organisations and Australian Government agencies).

An extensive program of benthic (sea floor) sampling was undertaken to facilitate the scientific assessment. It located a range of distinct benthic habitats and a variety of vulnerable benthic species (including corals, sponges and bryozoans) of conservation significance.

1. This map shows the location of areas added (beige) to the existing Heard Island and McDonald Islands Marine Reserve (green) in March 2014.

2. Heard Island's active volcano, Big Ben, sits within the Marine Reserve.



## Sea Ice Position Analysis

The Antarctic Climate and Ecosystems Cooperative Research Centre released its latest *Position Analysis: Antarctic Sea Ice and Climate Change 2014*, on 11 March. The 44-page publication was produced by Dr Jan Lieser and other sea ice scientists at the ACE CRC, the Australian Antarctic Division and the Institute for Marine and Antarctic Studies. The analysis aims to inform Australian government and the community about the current knowledge of sea ice in Antarctica and to identify issues for consideration in policy development.

CREDIT: JAN LIESER/AERIAL IMAGING GROUP



The document discusses how Antarctic sea ice cover is changing. In the west Antarctic Peninsula region, sea ice extent has dramatically reduced, and the length of the sea ice 'season' has also shortened. In the Ross Sea region of the Antarctic, however, the maximum annual extent of sea ice cover has increased and its season extended. Overall, the maximum annual extent of Antarctic sea ice has increased by around 1.5% per decade since 1979 (or by around 285 000 square kilometres). This compares to a loss of 1.8 million square kilometres of sea ice maximum annual extent in the Arctic.

Download a copy of the Position Analysis at <http://www.acecrc.org.au/access/cms/news/?id=164&full=true>

## New Antarctic Icebreaker

The Federal Government is proceeding with the procurement of a new Antarctic icebreaker, to be crewed and based in Hobart.

The new icebreaker will be able to conduct deep-sea Southern Ocean research and sea-ice experiments, as well as deliver critical fuel and cargo to Australian stations.

During a visit to Hobart in May to announce the procurement, Minister for the Environment, Greg Hunt, said modern, sophisticated research and transport systems would enable Australia to continue leading a world-class Antarctic program and to maintain its position as a leading Antarctic nation.

A key criteria for the new vessel is an icebreaking capability of 1.65 m of ice, while maintaining a speed of three knots. This is a significant capability enhancement over Australia's current icebreaker, *Aurora Australis*, which is rated to 1.23 m icebreaking capacity, and which has struggled to break through thick sea ice in recent seasons.

The new ship will also have a cargo capacity of at least 1200 tonnes, an increase of around 50% on the current ship.

The new icebreaker is expected to be ready for operation in late 2019.



Federal Environment Minister, Greg Hunt (centre), tells media about the new Australian icebreaker.

## Australian Chair for Antarctic environmental committee

Australian Antarctic Division Senior Environmental Policy Adviser, Ewan McIvor, was elected Chair of the Committee for Environmental Protection (CEP) at the Antarctic Treaty Consultative Meeting (ATCM) in Brazil in May.

The Committee advises the ATCM on all environmental issues in Antarctica, with a current focus on preventing the introduction of non-native species, developing the Antarctic protected areas system, addressing the environmental implications of climate change, and managing how tourism interacts with the environment. There are 35 member nations on the CEP, as well as a number of non-governmental organisations with environmental, scientific and technical expertise on Antarctic matters.

'The CEP operates on consensus, so my role as Chair will be to facilitate the free-flow and effective exchange of views, and to identify where there is general agreement on how to advance the Members' shared environmental objectives,' Mr McIvor said.

Mr McIvor has worked in a range of environmental management and policy roles with the Australian Antarctic Division for more than 14 years. He has been a member of the Australian delegation to the ATCM for a decade and has been Australia's representative to the CEP since 2007.



Ewan McIvor is the new Chair of the CEP.

## Antarctic Environments Portal

A new website that bridges the gap between Antarctic science and policy was demonstrated at the Antarctic Treaty Consultative Meeting in May.

The Antarctic Environments Portal presents peer-reviewed science to policy-makers on environmental issues, including the introduction

of non-native species to Antarctica, protected areas, tourism, climate change and environmental clean-up.

Information in the Portal supports the Committee for Environmental Protection (CEP), which provides advice and recommendations to the Antarctic Treaty Consultative Parties on environmental protection. The website includes summaries of the current knowledge of the CEP on its priority issues and management of those issues.



The new Antarctic Environments Portal will bridge the gap between Antarctic science and policy.

The Portal also enables Antarctic scientists to provide independent, scientific advice to the Antarctic Treaty System. This includes bringing emerging issues to the attention of policy makers.

The portal is being developed by Antarctica New Zealand and Landcare Research New Zealand, with input from a number of collaborators including the Australian Antarctic Division. The full version of the portal will be launched at the next Antarctic Treaty meeting, but a preview site is available at [www.environments.aq](http://www.environments.aq).

## New CEO for CRC

Former Australian Antarctic Division Program Leader Dr Tony Worby will lead the Antarctic Climate and Ecosystems Cooperative Research Centre from July 2014. Dr Worby takes over from Dr Tony Press, who is currently responsible for developing the government's 20 year Australian Antarctic Strategic Plan.

Dr Worby's most recent role has been as Deputy Chief (Marine) at CSIRO's Division of Marine and Atmospheric Research. He is an internationally renowned Antarctic scientist and a Fulbright Fellow, with a passion for Antarctic affairs.

## Antarctic Strategic Plan update

Australia's ongoing interests in Antarctica and the Southern Ocean are in the spotlight this year with the commissioning by the Federal Government of a 20 Year Australian Antarctic Strategic Plan. The Plan is being developed by Dr Tony Press, current CEO of the Antarctic Climate and Ecosystems Cooperative Research Centre. The terms of reference call for a comprehensive review of Australia's Antarctic engagement. Dr Press has been consulting with stakeholders across the government and non-government sectors in Tasmania, across Australia, and even across the globe, to seek views on the future direction for Australia's Antarctic program. It is the first time in nearly two decades that Australia has reviewed its Antarctic activities. Some 30 submissions have been received from experts, stakeholders and the general public, and the interest in the future of Australia's Antarctic program has been significant.

'This is a great opportunity to have a good hard look at where we've been, where we are, and where we are going,' Dr Press said.

'I look forward to delivering a plan that will lead Australia's Antarctic program well into the 21st Century.'

The 20 year Australian Antarctic Strategic Plan is due to be delivered to Government on 1 July 2014. For further information visit: <http://20yearplan.antarctica.gov.au/home>



Dr Tony Press (far right) receiving an 'on ice' briefing at Casey in February 2014.

## Australia-Japan meeting to build Antarctic science collaboration

Japanese scientists visited Hobart in February on their Antarctic research vessel *Umitaka Maru*, after completing their annual Japanese Antarctic Research Expedition (JARE) to the Southern Ocean.

The 30 Japanese scientists from the Tokyo University of Marine Science and Technology, the National Institute of Polar Research, and other academic and government organisations, met with Australian Antarctic scientists to build on a long-standing scientific collaboration.

The Japanese team's research contributes to a number of Australian scientific programs in the Indian Ocean sector of the Southern Ocean, led by the Australian Antarctic Division and the Antarctic Climate and Ecosystems Cooperative Research Centre.



Japanese scientists from the *Umitaka Maru* met with Australian scientists in Hobart.



## Oceanography award

Physical oceanographer Dr Steve Rintoul received the Society for Underwater Technology's 2013 Oceanography Award in December, in recognition of his contribution to the field of oceanography.

Dr Rintoul works for the CSIRO in Hobart, Tasmania, and is leader of the Antarctic Climate and Ecosystems Cooperative Research Centre Oceans Program.

Since he began working at CSIRO 22 years ago, Dr Rintoul's research has laid the foundation for the growing recognition of the importance of the Southern Ocean in the climate system. His work has provided new understanding of the structure, dynamics and variability of the Antarctic Circumpolar Current, the largest ocean current on Earth. He has also shown how the Southern Ocean circulation links the shallow and deep layers of the ocean to form a global network of ocean currents that strongly influence climate patterns. His research has provided new insights into the nature, causes and consequences of Southern Ocean change, and his leadership has been critical to advancing coordinated international investigation of the Southern Ocean and to promoting long term Southern Ocean observing systems.





## FREEZE FRAME

MARTY BENAVENTE works as a Senior Field Training Officer and Watercraft Operator for the Australian Antarctic Division. He has spent 10 seasons working in the Antarctic and the subantarctic, including at Casey, Davis, Macquarie Island, numerous resupply voyages, and a summer exchange with the British Antarctic Survey.



*I'm drawn to photographing the moments where you look up from whatever job you're doing and the view or situation you find yourself in just stops you in your tracks. I hope to capture the essence of what I experienced in that instant. This photo was taken during a field training trip on Macquarie Island with hunting dog Flax (pictured) and his handler. It was a cold, snowy morning towards the end of May, with some great light breaking through the cloud cover. As we ascended Gadgets Gully, Flax moved to this spot and dutifully sat there while I took his photo. It's a good indication of the tough conditions the dogs worked in and how comfortable they were with the terrain.*



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