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

Australia's four Antarctic goals are:

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

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

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Australian Antarctic Division

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SHANE MITCHELL

ABOUT THE COVER

Senior Meteorology Observer Jenny Feast took this photo at the end of a clear, still October day, after exploring Breid Basin and Long and Tryne fjords, near Davis. Jenny works as a weather observer for the Bureau of Meteorology in Western Australia and this is her first trip to Antarctica. The photo was taken on a Canon 5D Mark II with a Canon EF 24-105 lens at 35mm, ISO 100, f/4.0 , shutter 1/60sec.

1

BEN KING

NEW DIRECTOR LOOKS FORWARD TO ANTARCTIC FUTURE

2

RICHARD BENNETT

1. Dr Tony Fleming in front of Mt Erebus on Ross Island, during his trip to Antarctica earlier this year.

2. New Australian Antarctic Division Director, Dr Tony Fleming.

Just as heroic era explorer and scientist Douglas Mawson looked to the future of Australia in Antarctica 100 years ago, so too is new Australian Antarctic Division Director Dr Tony Fleming.

His arrival at the Antarctic Division coincides with the centenary of Mawson's Australasian Antarctic Expedition – a time of personal reflection for Dr Fleming, whose family tree includes three figures in Antarctic history.

Dr Fleming credits his mother – the daughter of eminent Antarctic scientist Dr Raymond Priestley (and niece of Charles 'Silas' Wright and Thomas Griffith Taylor; all of whom were part of Scott's Terra Nova Expedition) – as a major influence on his interest in the science of the natural world.

'My mother made sure I understood the Antarctic stories. Grandad was a scientist and Scott's expedition was about science as well as exploration. So I learnt about the history of science and human habitation in Antarctica,' Dr Fleming says.

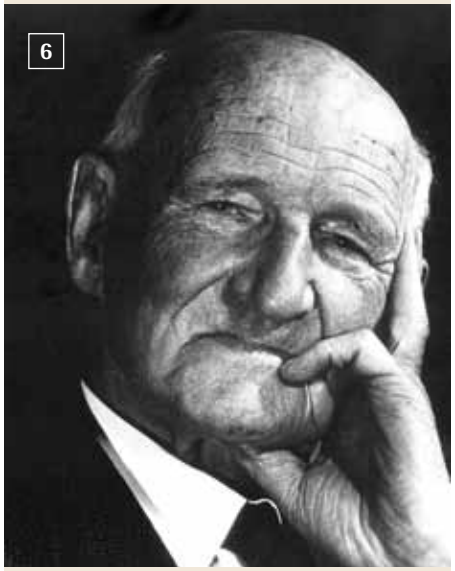
'I also learnt the value of looking to the future, rather than just memorialising the past, and the importance of scientific inquiry and keeping an open mind.'

Subsequently, Dr Fleming's 34-year career has seen him tackle issues ranging from land conservation, environmental policy and legislation, urban planning, national park management, and the provision of essential services to small communities.

While his work has primarily focused on the big picture, he knows the value of 'bread and butter' activities essential to the delivery of strategic end products. And he's driven by a passion for protecting the environment, and human interaction with the environment.

During his first year at the University of New England in Armidale (NSW), where he studied botany and plant ecology, Dr Fleming was

3. Adélie penguins nest in the remains of the Northern Party's hut on Cape Adare.



4. Dr Raymond Priestley's section of Shackleton's Cape Royds hut.
5. Dr Fleming produced a book of his photos taken during his trip to the Ross Sea, which reflects his love of the natural world. Among the photos was this image of Weddell seals, an Antarctic minke whale (in the middle distance) and Mount Erebus.
6. Portrait of Tony Fleming's grandfather, Sir Raymond Priestley.

drawn to conservation activities that took him into the bush on most weekends. Here he became interested in the patterns and processes of ecological communities. He also indulged his enthusiasm for white-water kayaking and nature photography.

'In my first year of uni I aimed to just get passes in my subjects, so that I could get into the bush as much as possible. That's where my future crystallised for me,' Dr Fleming says.

After completing a PhD in biology, he was offered a position in Environment Minister, Senator Graham Richardson's office. Over the next six years he worked at Parliament House, directly contributing to Federal Government decisions on the environment. He was also involved in initiatives that influenced government environmental policy, including the National Reserve System and State of the Environment reporting. Later, he coordinated the Department of the Environment's input into legislative reforms that led to the *Environment Protection and Biodiversity Conservation Act* (EPBC Act, 1999).

In 1998 Dr Fleming joined the NSW National Parks and Wildlife Service, initially as Director of the southern region, but later as Head of the organisation. Here he oversaw the growth and management of the NSW National Park system, cultural heritage protection, wildlife conservation and marine park management, among other things.

'Administering a national park is not just about setting policy, but ensuring that on a day-to-day basis the organisation runs effectively and that it can deliver the services it needs to individual parks and their communities,' Dr Fleming says.

'For example, the Government had responsibility for municipal services in Perisher ski village, so I got some experience in managing core infrastructure in an alpine community. While Perisher is a very different community to that in Antarctica, some of the issues are similar.'

One experience Dr Fleming will no doubt draw upon as he takes the Antarctic Division's reins is his former chairmanship of the Lord Howe Island Board of Management. This tiny island in the Pacific Ocean is inscribed on the World Heritage list for the global significance of its natural beauty and heritage.

'Lord Howe is a fascinating example of an active and vibrant community in one of the most incredible natural places,' Dr Fleming says.

'The Board had to focus on big policy pictures, but also the delivery of essential services. So we'd spend some time talking about World Heritage values and then we'd switch the conversation to power generation or sewage treatment.

'I learnt how a small community operates and observed the strength of a community in defending the interests of the island and each other.'

His most recent experience as National Operations Manager with the Australian Wildlife Conservancy, may also guide his approach to Antarctic duties. The not-for-profit organisation manages over 2.5 million hectares of Australian landscapes for the conservation of threatened wildlife and ecosystems, using a conservation model that Dr Fleming says 'allows science to drive management decisions'.

After only four weeks in the Director's seat at the time of our conversation, Dr Fleming says it's too early for him to be able to talk about the strategic direction of a very complex operation, but he does have some general observations.

'It's clear the Antarctic Division has an important role to play in developing the underpinning science for a number of key government policy areas, including climate-related science and marine research, particularly the sustainable use of resources in the Southern Ocean,' he says.

'The Antarctic Division also has a leadership role in the scientific community, and our new science strategic plan will set the direction for research done by us and others.

'But our bread and butter activities are also critical. High profile activities can only happen if we do a lot of other things really well. Working in Antarctica and the Southern Ocean is a complex logistical exercise and the Division spends a lot of time and resources managing all of that – the stations, transport and communications. So we need to make sure we're doing that effectively and that we're on a path to be able to continue to deliver those services in 20 years time. Achieving a balance between investment in operations and investment in science will be a challenge for me and the Executive.'

Dr Fleming also sees his role as a supportive one.

'Being the Director is, in part, about making sure people are supported to work to the best of their abilities, and that they're given the space to do that. There's enormous talent in the Division and many people who know much more about a topic than I will ever know. So I see my role as supporting and encouraging staff, while articulating a strategic focus in line with government priorities.'

Dr Fleming hopes to visit Australia's four stations over summer to talk to staff. He's already had some experience of Antarctica after a private trip to the Ross Sea earlier this year to mark the centenary of Scott's Terra Nova Expedition (1910–1913). Dr Fleming traced the footsteps of his grandfather, Raymond Priestley, visiting Cape Adare, Cape Royds and Cape Evans. He also went to Inexpressible Island where his grandfather and the other five members of Scott's Northern Party spent an unplanned winter in an ice cave, when the *Terra Nova* was unable to break through the pack ice to collect them. In what has become one of the most extraordinary stories of Antarctic survival, the Northern Party not only had to endure the winter but then had to man-haul sledges 250 miles back to Cape Evans.

When the Northern Party eventually learnt of Scott's fate, Dr Priestley and his friend Frank Debenham discussed an appropriate legacy for the lost explorers.

'Frank and my grandfather thought the legacy should be something to do with science and looking forward, so they created the idea of a polar research institute, which became the Scott Polar Research Institute, with Frank as its first Director,' Dr Fleming says.

This philosophy of looking forward and thinking to the future of Australia's involvement in Antarctica will form the keystone of Dr Fleming's approach to the Director's job.

'The key lesson I took from my grandfather is to look forward. What's the next 20 or 50 years in Antarctica going to be about?' he says.

'It's a different geopolitical environment now than it was in grandad's day and there are new nations that are interested in Antarctica and in cooperating with Australia in Antarctica.

'While the centenary provides an opportunity for Australia to focus on the achievements of early explorers, especially Mawson and his team, it's important to look to the future of Australia's involvement in Antarctica, as Mawson did, and I hope we can maintain and further develop our role as a leader in Antarctica.'

WENDY PYPER
Corporate Communications, Australian Antarctic Division

A centenary of science

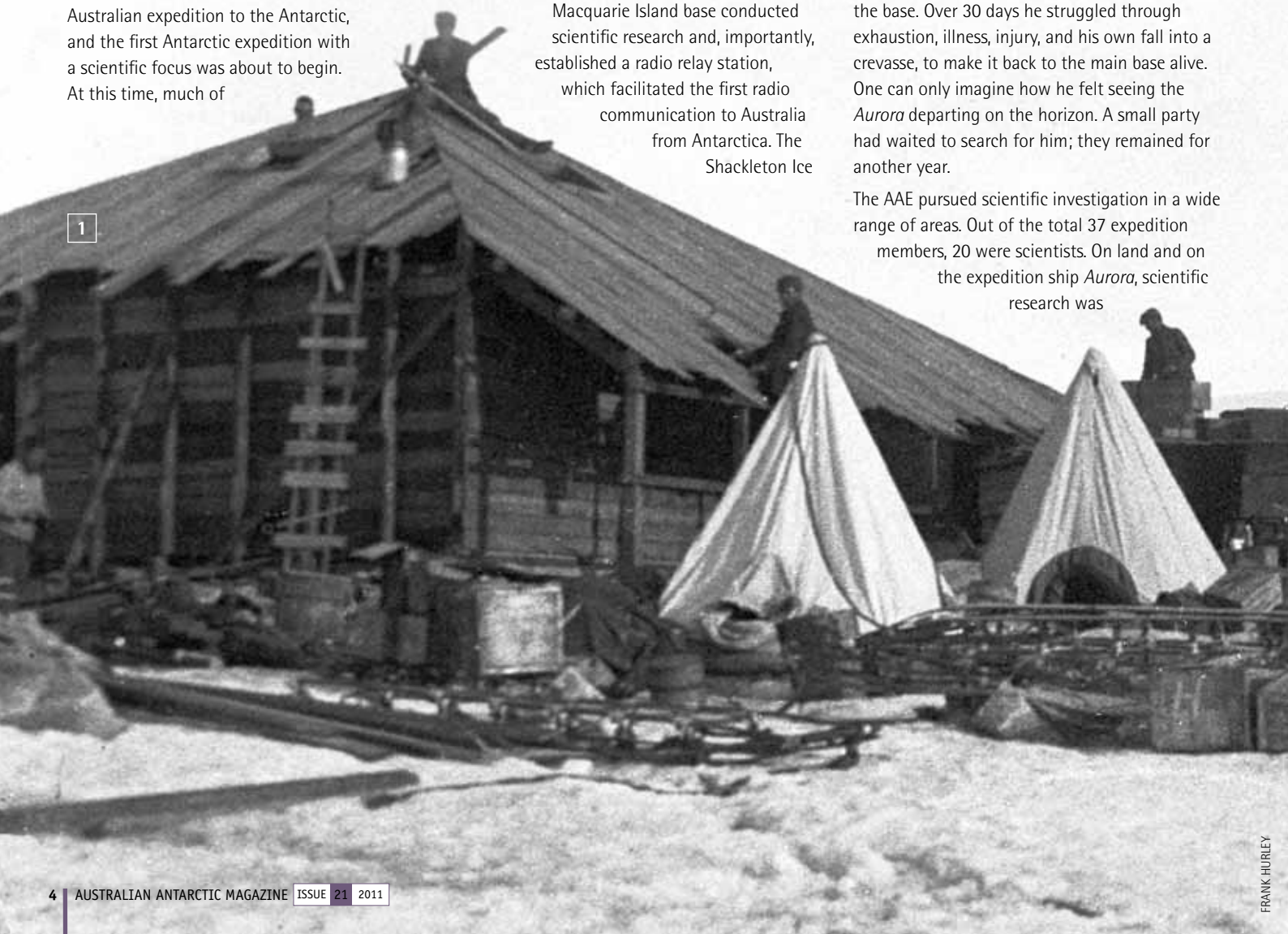
As Australia prepares to celebrate the centenary of the Australasian Antarctic Expedition (AAE), led by Douglas Mawson, centenary project team member Kristin Yates reflects on what the AAE (and the subsequent British, Australian and New Zealand Antarctic Research Expedition) discovered and achieved and their relevance to our modern Antarctic program. A special issue of the *Australian Antarctic Magazine*, focusing on the centenary, will be published in May 2012.

One hundred years ago Douglas Mawson's plans for the Australasian Antarctic Expedition (AAE) were about to come to fruition. The first Australian expedition to the Antarctic, and the first Antarctic expedition with a scientific focus was about to begin. At this time, much of Antarctica still lay as a great unknown. With incredible foresight, Douglas Mawson recognised the importance of Antarctica, writing in *The Home of the Blizzard*, 'As sure as there is here a vast mass of land with potentialities, strictly limited at present, so surely will it be cemented some day within the universal plinth of things'. He correctly predicted that Antarctica would become a region of national and global importance, noting that 'Bound up with the mystery of this seventh continent are volumes of data of vital importance to science, and economic problems which may become of moment in the near future'. Today it is widely accepted that Antarctica provides significant climate change knowledge that is key to the future of our planet. The Antarctic, climate change, and the long-term economic outlook for Australia are intrinsically linked.

The Mawson-led 1911–1914 AAE established three bases: Macquarie Island, the Shackleton Ice Shelf and Commonwealth Bay. The Macquarie Island base conducted scientific research and, importantly, established a radio relay station, which facilitated the first radio communication to Australia from Antarctica. The Shackleton Ice Shelf and Commonwealth Bay parties also undertook scientific research and explored extensively along the coast near these bases. The buildings at Commonwealth Bay (now known as Mawson's Huts) were completed within a month of their arrival, and by winter, preparations were well underway for the several land expeditions of the following summer.

Mawson led the ill-fated Far Eastern sledging expedition, which included Belgrave Ninnis and Xavier Mertz. This expedition was to become a terrible tragedy, but also an extraordinary epic of lone survival. Five hundred kilometres from the base, Ninnis, his sled, and a dog team fell into a large crevasse and disappeared. With seriously depleted provisions, Mawson and Mertz continued on, progressively killing and eating their dogs to supplement their food supply. After 25 days the combined effects of hard physical exertion, starvation, grief, and possible vitamin A poisoning from eating dog livers, Mertz died. Mawson was left alone, over 160 km from the base. Over 30 days he struggled through exhaustion, illness, injury, and his own fall into a crevasse, to make it back to the main base alive. One can only imagine how he felt seeing the *Aurora* departing on the horizon. A small party had waited to search for him; they remained for another year.

The AAE pursued scientific investigation in a wide range of areas. Out of the total 37 expedition members, 20 were scientists. On land and on the expedition ship *Aurora*, scientific research was



1

FRANK HURLEY

1. AAE expeditioners construct the main hut at Commonwealth Bay.
2. Establishing the Western Base Party on the Shackleton Ice Shelf, 1912. A flying fox was used to transfer stores from the *Aurora*.
3. Examples of crustaceans caught in dredging operations during the AAE. Specimens and data collected during the AAE are still used by scientists today.

conducted in geology, geography, cartography, geomagnetism, astronomy, meteorology, glaciology, oceanography, zoology, biology and botany. Data collected during this expedition is still used by scientists today for reference and comparison. For example, data collected by the expedition on Macquarie Island is being used today to help determine sea and land level change. The observations made by the AAE party are being compared, showing that not only is sea level rising, but Macquarie Island is subsiding, most probably still in response to an earthquake in 1924, exacerbating the local influence of sea level rise. The expedition also collected a range of organisms, many of which are now being compared with organisms collected today – providing important data for monitoring environmental change.

The 1929-1931 British, Australian and New Zealand Antarctic Research Expedition (BANZARE), also led by Mawson, discovered and traversed further coastline. The AAE and BANZARE together defined the limits to what is now the Australian Antarctic Territory – a claim covering 42 percent of the Antarctic continent. The Australian Antarctic Territory became permanently occupied in 1954, when Mawson station was established. Mawson is now the oldest continuously occupied station south of the Antarctic Circle. Today, expeditioners there, and at the other stations and locations visited by the Australian Antarctic program, continue the important work begun by the AAE.

As Antarctica grows in national and global importance, the Australian Antarctic Division conducts research in the Southern Ocean, the Antarctic and subantarctic, addressing critical issues such as climate change, the human footprint on Antarctica and the increasing demands for food, energy and security caused by human population growth.

As we observe how rapidly and profoundly our planet is changing, the need to better understand how Antarctica and the Southern Ocean influence the functioning and resilience of the earth system, and how they will respond to future changes, has become urgent. For Australians, added impetus is provided by the fact that what happens to the frozen continent and the Southern Ocean will have profound impacts on Australia. The decadal strategic plan for Australia's Antarctic Science Program is designed to tackle these challenges. The plan focuses efforts within four thematic areas: climate processes and change; terrestrial and nearshore ecosystems – environmental change and conservation; Southern Ocean ecosystems – environmental change and conservation; and frontier science.

Some of this research will be conducted this summer during an Australian Antarctic Division voyage to Commonwealth Bay on the *Aurora Australis*. The vessel departed Hobart 100 years to the day after the AAE (2 December). The vessel was one of a flotilla marking the centenary of the AAE's departure on that date, and the event is just one of many celebrations planned around Australia for the AAE centenary period. The Australian Antarctic Division is maintaining a website where event organisers can list their centenary events. Visit http://centenary.antarctica.gov.au to find out what is being planned and how you can get involved.

KRISTIN YATES
Australian Antarctic Division

1

SPINNING AN ICY YARN IN ANTARCTICA

MARION WHEATLAND

Marion Wheatland has spun her way into Antarctic history in an effort to help conserve history.

For six hours the adventurous Canadian-Australian spun wool on the doorstep of Mawson's Huts at Commonwealth Bay in January this year. She used the yarn to knit a replica of the balaclava worn by Sir Douglas Mawson, which was auctioned at the Mawson's Huts Foundation Centenary Dinner on the eve of the 100th anniversary of the departure of the Australasian Antarctic Expedition. The money raised will go to the Mawson's Huts Foundation to continue the work of protecting and conserving the historic huts.

Visiting Antarctica had always been a dream of Marion's and when her father left her an unexpected financial gift in his Will, she had the means to pursue her dream.

'Feeling that I wanted to do something for Australia and its history and with the ice continually calling to me, I was inspired to take my mum's blue kuletuk (Eskimo parka), and my dad's encouragement to the extreme South. Add in my brother's "I DARE YOU to take your spinning wheel", and I made the booking,' Marion said.

In preparation for her journey Marion practiced spinning different fibres in a variety of chilly locations – the snow at Mt Hotham, a -18°C portable freezer, and Melbourne's -10°C Chill On ice bar.

'Spinning at the Chill On ice bar was enough to give a reasonable test of the behaviour of a variety of other fibres – alpaca, llama, wallaby, possum, poodle and nylon,' she said.

Marion was also able to test which spinning wheel would be up to the job. In the end she decided on a Majacraft double treadle Little Gem, which folds up into a carry bag.

Marion sailed from Dunedin, New Zealand, with Orion Expeditions and arrived at Commonwealth Bay four days later. Her blog picks up the story:

'When I arrived on shore I gathered all my equipment (backpack, spinning wheel, spinning bag, blue fibre, boots, extra clothes, deck chair and camera) and stepped carefully over the ice, around the penguins, away from the seals, and straight into a sink hole…thankfully not too far down. Picking myself up off the penguin poop I carried everything up to the Hut, where I paused. I was really here. This is it. This is 1911. Breathe in the air Marion. You are here!

'Drying my tears, I set up my wheel. I chose a great spot, just in line with the whole vista of the Hut … amid the ice, gently falling snow, and under the watchful eyes of several curious Adélie penguins.

'When I reached the ice at about 2:30 pm, the sun was high in the sky. By the time I had completed the fibre I had set myself to do, the sun had not really moved, but the clock said 9pm! God's blessing of no wind and zero degrees had given me six hours to spin. My tired legs and stiff fingers still worked well enough by the end to put me in the last Zodiac back to the ship. I had achieved what I set out to do!

'I had no trouble with the Majacraft Little Gem, and I did not expect there to be. I was still pleasantly surprised by the smooth motion of the treadle-ing and the efficiency of needing no threading hook.'

Marion also had time for a quick look around the Main Hut. She returned from the voyage with skeins of blue yarn to knit her balaclava, and some incredible memories.

'Breathing in the chill air of Antarctica, you can feel the liquid cold fill your lungs. It is crisp and clear, and to be relished at every moment,' she said.

'Sharing the same air as the explorers of the last century, you know that you also share their history of unimaginable hardship and triumphant survival. For a while, I became part of that. We are all influenced by the past; with such an influence and inspiration, ordinary people can achieve extraordinary things.'

For more information about Marion's voyage and spinning activities visit http://spinningyarninantarctica.com/. For more information about the Mawson's Huts Foundation see http://www.mawsons-huts.org.au/cms/.

WENDY PYPER

Corporate Communications, Australian Antarctic Division

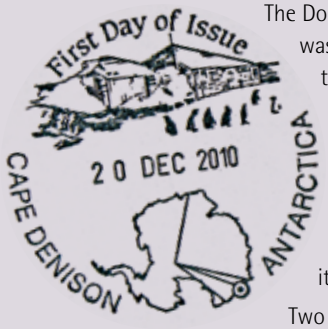
1. Marion spent six hours in relatively balmy conditions (0°C and no wind), spinning her blue wool fibre outside the Main Hut at Commonwealth Bay.
2. Marion knitted a practice balaclava to ensure she had the pattern right, before knitting the replica in the blue wool (also pictured) spun at Mawson's Huts.
3. Douglas Mawson in 1931, wearing the balaclava Marion was inspired to replicate.

Dr David Tingay, the first Cape Denison Post Agent, franking letters.

Cape Denison Post Office established

Almost 100 years after Sir Douglas Mawson tried, unsuccessfully, to establish a Post Office at Cape Denison, his wish has been fulfilled. On 20 December 2010 the first letters emblazoned with a Cape Denison postmarker were stamped at Mawson's Huts in Commonwealth Bay. The new Post Office is the seventh Post Office in the Australian Antarctic Territory (AAT).

Mawson's request to the Australian Postmaster General in 1911 to provide special postage stamps for use during the Australasian Antarctic Expedition was declined, despite him designing a special stamp for the purpose. The first Post Office in the AAT wasn't established until 1947 at Heard Island. A second opened at Macquarie Island the following year. On the Antarctic continent the third Post Office was established at Mawson station in 1954, followed by Davis station in 1957. The fifth Post Office opened in 1959 at Wilkes, following the handover of the station from the USA to Australia. The sixth was opened at Casey station in 1969.



The Doctor for the Mawson's Huts Foundation team, David Tingay, was appointed the first Post Agent for Cape Denison. He said the team was kept busy franking more than 1500 postal items.

'We received 550 regular mail requests, 500 from stamp collectors and about 500 souvenir postal items. There was a huge interest from the people off the tourist ships over summer. We "Antarcticised" the post box, cutting a hole in the top and setting it up outside on the ice. We also had to weigh it down with rocks to stop it from blowing away,' Dr Tingay said.

Two pictorial postmarkers featuring the huts, a map of the AAT and a group of Adélie penguins, were designed for the Cape Denison Post Office. One was the First Day of Issue postmarkers, which was only used on the inaugural day, and the other an 'everyday' postmarker which will be used on future expeditions.

NISHA HARRIS

Corporate Communications, Australian Antarctic Division

Oceans need big animals

After 24 years of marine research with the Australian Antarctic Division, Dr Steve Nicol has developed a new concept of how ocean ecosystems may work. The following is an edited version of an article that first appeared in *New Scientist* magazine in July this year.

Picture an ocean that is teeming with life. The sky is darkened by massive flocks of birds, giant whales cloud the air with the vapour from their blows and from horizon to horizon schools of fish break the surface to escape myriad predators hunting them from every angle. This is not some imaginary scene or a description of a distant ocean paradise; it is culled from descriptions of the marine environment before the large-scale hunting and fishing of marine animals – particularly the large ones. Based on historical accounts, today's oceans are a shadow of their former state and have lost their ability to support such an abundance of life. Although there have been changes in the physics and chemistry of the ocean over the last century, these alone are unable to explain why the removal of the largest marine animals should be accompanied by a drop in overall marine productivity. A number of recent studies, however, suggest that larger and more abundant animals may play a critical role in maintaining and enhancing marine productivity.

To begin to understand the role of animals in marine productivity we need to understand the role of primary producers – the single-celled plant communities, or phytoplankton, that grow in the surface waters. It is in this well-lit surface layer or 'euphotic zone' that most production (the conversion of light into organic matter) occurs through photosynthesis. Nutrients – often in the form of particulate matter – also enter this zone from rivers and erosion, from the atmosphere (either as dissolved gasses or dust from land), from the sediments on the sea floor, and through upwelling of nutrients from deep water. These nutrients, such as carbon, nitrogen and iron, also help fuel phytoplankton growth.

In summer the warm euphotic zone is separated from the cooler, denser water below by a boundary layer known as the 'thermocline'. Gravity constantly pushes both the phytoplankton and particulate matter downwards, and once they sink below the thermocline they are usually lost to the surface ecosystem. The process of removing nutrients from the surface to the deeper ocean is known as the 'biological pump'. The balance between the nutrient inputs and losses and the efficiency of nutrient recycling in the euphotic zone determines the productivity of the oceans. So what role do animals play in this process?

Until recently, the primary role of animals was considered to be as consumers of carbon and other nutrients, which are converted to fast-sinking faecal material. This process speeds up the sequestration of carbon in deep water and is thought to be responsible for removing a significant proportion of the carbon fixed by plants in the surface layer. But new research is showing that animals are more than just carbon transformers.

HARVEY MARCHANT

Components of the phytoplankton, such as this diatom, *Corethron*, found in the Southern Ocean, convert sunlight into organic matter through photosynthesis, in the surface layer of the ocean. Phytoplankton also use nutrients in the water to fuel growth. Gravity forces these cells into the deeper ocean, removing nutrients from the surface, but animals can play a role in bringing these nutrients back to the surface.

Nutrients on the up and down

Nutrients that fall into deeper water are assumed to be lost, but many animals inhabit water far deeper than the euphotic zone. This means they can access deep supplies of particulate matter (and other animals) and bring it back to the surface to re-mineralize the surface layer. For example, vast numbers of marine animals ranging in size from microscopic copepods to large fish undergo diurnal (daily) vertical migrations, usually remaining deeper in the water during the day and visiting the surface at night. This large concerted movement of animals happens every day and can involve vertical movements of thousands of metres.

Another example is sperm whales, which feed on squid and fish at great depths, ingesting nutrients that once were captured at the surface by phytoplankton. When the whales return to the surface to breathe and defecate they release nutrients back into the surface layer. Modelling studies suggest that this recycling of deep material might be significant for scarce but essential elements such as iron. On a smaller scale, humpback whales in the Gulf of Maine have been shown to scavenge nutrients below the euphotic zone and release more nitrogen at the surface via defecation than flows in from rivers.

ANTHONY HULL

BEN WALLICE

STEVE NICOL

Dense aggregations of large animals, such as these crabeater seals in the Southern Ocean, could have a significant effect on ocean mixing by generating turbulence.

For almost a century, krill have been known to undertake regular migrations within the top 200 m of water. Recently, however, scientists have discovered that krill can exploit food supplies through the entire water column. Underwater footage has shown krill near the seafloor at 3500 m, apparently feeding on sedimentary material originating from the surface. Increasingly, footage is appearing of krill at depths previously thought well below their acknowledged habitat of less than 200 m. This makes them a potentially important biological route for bringing nutrients from the sediments back into the surface layer. Of course the process may also work in reverse, with animals feeding at the surface and defecating at depth.

Humpback whales have been shown to scavenge nutrients from below the sunlit surface waters and release large quantities of nitrogen at the surface, when they defecate.

Turbulence

Animals also contribute to the mixing of water and nutrients across the thermocline by generating turbulence. The first way they can do this is by 'induced drift' – where some of the water is dragged along with their bodies as they move. Calculations suggest this process could induce turbulent dissipation similar in magnitude to that produced by winds and tides. Swimming animals also generate wake turbulence as they move through the water. While small animals may have little effect, dense aggregations of larger animals would have a significant local effect on mixing. These calculations are based on estimates of the current density and abundance of swimming animals in the sea. Historical abundances of larger animals was considerably higher than today, so the effect would almost certainly have been far greater.

Recycling

Finally, animals can play a role in ocean productivity through recycling. Recently, we investigated whether whales could fertilize the surface layer of the Southern Ocean by recycling the iron found in their prey (*Australian Antarctic Magazine* 19: 4-5, 2010).

The Southern Ocean is one of the areas where phytoplankton growth is limited because of the lack of iron in the surface waters (Antarctica is a poor source of wind-borne dust containing iron). Thus, any mechanism that maintains this element in the surface layer and allows it to be recycled would help to maintain productivity.

The basic concept is that large whales consume large quantities of krill, but because they produce blubber rather than iron-rich muscle, they have little need for the iron in their diet. Consequently, this essential element passes straight through the digestive tract and exits the body in a plume of faecal material which acts like liquid manure. Whales could only play a role in recycling iron if, in fact, there is a large amount of iron in their faeces. Recent measurements of the iron content of the faeces of baleen whales indicated that it contains at least 10 million times more iron than the background level in seawater.

Not surprisingly, the flesh of whales and krill also contain similarly high concentrations


STEVE NICOL

Krill contain about 24% of the iron in the top 200 m of water within their habitat. Whales that eat krill release this iron back into the water when they defecate.

of iron and at current population levels krill appear to contain about 24% of the iron in the top 200 m of the water within their habitat. This iron is incorporated into their tissues and because krill are strong swimmers, they are able to keep this iron suspended in the upper layer of the ocean, in contrast to smaller organisms or inorganic particles which tend to sink. Because krill live for five to seven years, they can also keep that iron in the surface layer for many years, thereby acting as a buoyant reservoir of iron.

Although individual whales contain large amounts of iron, their relative scarcity means that their main role seems to be in converting the reservoir of iron present in the bodies of krill into liquid manure. This fertilizing role is likely to work on a small scale today, but in the pre-exploitation era when there were millions of great whales in the waters around Antarctica in summer, their affect on iron recycling was likely far greater. Interestingly, there are suggestions that when there were more whales, there was also more krill and that phytoplankton productivity would have had to be higher to support all these animals.

A recent study has actually suggested that phytoplankton abundance has declined in eight of 10 oceanic regions over the past century and this decline is especially evident in areas with especially high harvests of whale and seal


J. BROKOWSKI

A whale leaves a plume of iron-rich faecal material, in its wake. The iron and other nutrients in the faeces are now available to phytoplankton.

populations over the past century. If the effect of large animals on the ocean's nutrient cycles is as great as recent studies suggest, this could be a clue to why the productivity declines when you remove the largest animals from an ecosystem.

If whales and krill do (or did) play a major role in recycling iron in the upper ocean, this explains how an ecosystem with more animals in it can also be more productive. Although the Southern Ocean example focuses on krill and whales, there are a host of other animals and other ecosystems, and similar mechanisms may be operating on different scales and with different groups of predators and prey. It is unlikely that the role of animals as buoyant nutrient reservoirs is restricted to the Southern Ocean, or exclusively to the iron cycle.

Engineering ocean productivity

So where does all this leave us? Until very recently, our concept of how the upper ocean works was driven largely by studies of the physics and chemistry. Even the models used to describe how phytoplankton production is sustained were driven by relatively simple concepts relying on mechanistic relationships between the algae, water chemistry and physics, and the light environment. Animals were rarely viewed as a player in the process, other than in a negative sense.

It is now apparent that animals, particularly larger animals, may play a very important role in sustaining production in the ocean. This would not surprise terrestrial ecologists who deal with ecological communities where the larger animals can play a major role in maintaining the ecosystem on which they depend. This process has been referred to as ecosystem engineering. The open ocean is somewhat different from other ecosystems, partly because of the dominating force of gravity but also because both the primary producers and the herbivores are generally smaller than on land, thus limiting their ability to affect their physical environment. It is easy to see how an elephant can affect is habitat, but less easy to comprehend the effect of krill on theirs. But this does not mean that such effects do not happen; they just may be more subtle and difficult to measure. It has even been suggested that ecosystem engineering may actually be more important in the pelagic system than it is in terrestrial habitats because of the cumulative effect of a vast array of organisms acting at a number of scales simultaneously.

Modern attempts to understand the roles of larger animals in marine ecosystems are also hampered because of the depleted nature of most large marine animal populations. Given the current low number of whales in the ocean, it is understandable that their ecological role can be viewed as insignificant. In an era when there were orders of magnitude more whales, seals and seabirds, and a concentration of these

DANA BERGSTROM

Large terrestrial animals are known to 'engineer' the ecosystems they depend on and the same may be true in the open ocean.

animals in restricted feeding areas, it becomes easier to accept that they may well have an ecological role that extends beyond that of mere consumers. What is becoming apparent is that large numbers of herbivores and smaller carnivores in pelagic ecosystems, can also play a role in ecosystem engineering, despite their relatively smaller size, than the depleted vertebrates. The mixing effects of animal movements and their role in nutrient recycling would act synergistically.

The concepts laid out here are merely the beginning of a new way of viewing the role of animals in pelagic marine systems. Quantification of these effects is the next step and the modelling of the combined effects of turbulence, nutrient recycling in the surface layer and the effects of nutrient scavenging from deep water is already under way. Such models can be used to confirm whether the sum of these effects can have a cumulative positive outcome on marine productivity. If these ideas hold water then it will be necessary to revisit long-cherished concepts in marine ecology that suggest that removal of higher order predators would have a beneficial effect on ecosystem productivity. Instead, intact ecosystems could be viewed as finely tuned production systems with intricate feedback loops that serve to maintain that productivity.

We would have to be much more careful about choosing the organisms we exploit within these systems, given that the effects of exploitation are unlikely to be simple.

STEVE NICOL

Former Program Leader, Southern Ocean Ecosystems

Steve recently retired from the Australian Antarctic Division. Read more about his career on page 26.

2

Journal focuses on Antarctic sea ice research

The results from Australia's major Antarctic sea ice research program conducted during the International Polar Year (2007–2009), were published in a special issue of *Deep-Sea Research Part II: Topical Studies in Oceanography* in May.

TONY WORBY

SANDRA ZICUS

1. Scientists deploy a Remotely Operated Vehicle to observe and film krill under the sea ice.
2. A range of measurements were made at ice stations established on ice floes, to understand the ice and snow properties of the floe and to measure ice thickness and structure. Oceanographic measurements of temperature, salinity and currents under the ice were also taken, and under-ice communities of krill and sea ice algae were examined using a Remotely Operated Vehicle.

Scientific authors from the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) were represented on 13 of the 20 peer-reviewed papers, which detailed the results of the Sea Ice Physics and Ecosystem eXperiment (SIPEX).

This voyage was conducted in the sea ice off East Antarctica (115-130°E) during spring (September–October, 2007) and involved more than 50 scientists from 13 countries working on a suite of projects to characterise the physical, biological and biogeochemical characteristics of the pack-ice zone, and their interactions (*Australian Antarctic Magazine* 14, 2008). A similar sea ice voyage run by the United States Antarctic Program took place in the Bellingshausen Sea, on the other side of Antarctica, at approximately the same time (the results of which are also reported in the journal). Both voyages employed a range of measurement techniques for in situ (in the ice) and underway (ship-based) observations. They also focused on a calibration and validation program for NASA's Ice Cloud and land Elevation Satellite (ICESat), which rescheduled its Geoscience Laser Altimeter System operations to coincide with the timing of the voyages.

The focus of SIPEX was to investigate the relationships between the physical sea ice environment and the sea ice biology, in particular the presence of algae and krill under the ice. A range of novel instruments and techniques were used including, for the first time, radar and laser altimetry from a helicopter, to measure the snow thickness and 'freeboard height' (elevation) above sea level. In addition, an instrumented Remotely Operated Vehicle was used for under-ice observations; a custom-built trawl was deployed for catching krill under the ice; and trace-metal clean sampling equipment was developed to determine the concentration and distribution of iron in sea ice. An overarching goal of the project was to understand the links between sea ice physical, chemical and biological parameters and their importance for sea-ice zone productivity in the Australian Antarctic Territory off East Antarctica.

The ice conditions encountered during the voyage were particularly difficult at times, not only for navigation but for conducting

3. The helicopter-borne laser scanner produces an across-track scanning pattern of the ice surface, to determine surface roughness and elevation. This can be converted into total thickness, if certain physical properties of the ice are known, such as ice density and snow cover thickness and density – measured at the ice stations. The INS (inertial navigation system) provided precise information on the helicopter's location and attitude during operation.

scientific work on the ice. We had difficulty finding ice floes that were suitable to work on, and helicopter reconnaissance flights were needed to navigate through the heaviest ice, which in some areas was up to 10 m thick – some of the thickest reported in the East Antarctic region. The weather conditions were unfavourable at times, with three blizzards during the voyage. The third of these resulted in four consecutive days of white-out conditions that prevented flying operations just when they were needed most for the ICESat satellite validation program, thus preventing coincident airborne and satellite altimetry measurements. However, airborne data collected during SIPEX enabled aircraft measurements to be validated over drilled thickness lines on the ice. It also improved our knowledge of the issues surrounding long-base line GPS positioning that complicate the data analysis.

As well as underway sampling and helicopter-based observations, we established 15 'ice stations' on ice floes to collect data to characterize the sea ice environment. Some of the ice station measurements were completed within one day, others were completed over two days to collect measurements over a full diurnal cycle, and some were completed in just a couple of hours, with the main aim to collect ice cores with high ice-algal biomass for the various biology groups onboard.

Sea ice communities can serve as an important food source for Antarctic krill (*Euphausia superba*), and the distribution of krill is closely linked to sea ice extent in many regions of the Southern Ocean. One research paper in the journal reports major differences in growth, diet and condition of larval and post-larval krill sampled from open water and the under-ice environments. This indicates that different over-wintering strategies are used by different life-cycle stages, and highlights the role of sea ice biota as a food source for krill larvae off East Antarctica. These findings were supported by under-ice observations with the Remotely Operated Vehicle, showing juvenile krill feeding at the sub-surface of the sea ice and in cracks in areas of rafted ice at many of the ice stations. Altogether, the multi-disciplinary sampling program highlighted the structuring role of sea ice in East Antarctic marine ecosystem function and biogeochemical cycling.

It is clear from recent studies that the distribution of sea ice around Antarctica has changed in recent decades. While a net increase in extent of 1.2% per decade has been reported between 1979 and 2008, far greater regional changes have occurred. In the Bellingshausen Sea some regions now experience an annual sea ice season that is three months shorter than in 1979, whereas parts of the Ross Sea have an annual sea ice season that is two months longer. Critical to understanding behavior in sea ice thickness, and the potential impacts of this on both the physical and biological Southern Ocean environment, are field studies that measure and monitor critical sea ice processes and provide the necessary ground validation data for hemispheric to global-scale satellite monitoring.

This research is published in Deep-Sea Research Part II, Vol 58, Issues 9-10, May 2011. (DOI: 10.1016/j.dsr2.2011.01.001)

TONY WORBY[1] and KLAUS MEINERS[2]

[1]SIPEX Voyage Leader, [1,2]ACE CRC

MODEL SIMULATIONS INVESTIGATE TOTTEN THINNING

Enhanced oceanic heat flux and changing ocean dynamics are believed to be the key factors in making the Totten Glacier one of the fastest thinning glaciers in East Antarctica.

To investigate this, a model of the ocean circulation beneath and around the Totten Glacier is currently being developed by scientists at the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) and the Australian Antarctic Division.

The Totten Glacier is located approximately 400 km east of Casey station, on the eastern side of Law Dome, and discharges up to 70 Gt/year of fresh glacial meltwater into the ocean. This is equivalent to 100 times the volume of Sydney Harbour every year. It has a maximum thickness of over 2.5 km at its grounding line – the region at which the glacier departs the continental ice sheet and begins to float – and is nearly 200 m thick at the calving front, 150 km to the north. Recent measurements show that the Totten Glacier is thinning at up to 1.9 m per year, a three-fold increase over the past 10 years. The direct cause of this alarming statistic isn't yet known, but is believed to be ocean driven.

The leading hypothesis is that relatively warm water derived from Circumpolar Deep Water (CDW), is mixed and modified and flows southwards onto the continental shelf, enhancing the melting of the glacier.

Once on the continental shelf, and with the appropriate bathymetric pathways to reach the glacier, the modified CDW, which is denser than the surrounding shelf water masses, is able to sink to the grounding line of the glacier and cause increased melting and rapid glacier acceleration. This is also suspected to be the key cause of the increased melting of other ice shelves showing rapid thinning, such as the Pine Island Glacier in the Amundsen Sea region of West Antarctica.

Since the ice shelf acts to slow glacier flow, ice shelf thinning by increased melting could lead to rapid acceleration of the Totten Glacier, similar to what was observed in the wake of the disintegration of the Larsen A and B ice shelves on the Antarctic Peninsula (*Australian Antarctic Magazine* 14: 22-23, 2008). Observations suggest a transport of modified CDW onto the continental shelf region near the Totten Glacier, but are too sparse to be definitive. Modelling is an obvious way to address the difficulty in obtaining high-resolution observations of the ocean near the Totten Glacier.

At the ACE CRC we are developing a numerical model to examine the thermodynamic interaction between floating ice shelves and the ocean on Antarctica's coastal margins (see *Australian Antarctic Magazine* 19: 6, 2010 for more details).

The output from the ice shelf-ocean model includes the time-evolution of ocean currents, and salinity and temperature of the water. From this, the melt rates of the ice shelves and the dynamics of massive water bodies can be determined.

The circulation and water temperature in the open ocean and under the Totten and Dalton ice shelves is illustrated in Figure 1. This shows the depth averaged ocean currents for March 2006, coloured for ocean temperature. Warm modified CDW can be seen to flow onto the shelf break and towards the eastern side of the front of the ice shelf. The fresh meltwater then flows out of western side and continues westwards around Law Dome.

The melt rate of the Totten Glacier ice shelf is calculated within the model. Figure 2 shows the melt rate (in metres per year) under the Totten ice shelf, with depth-averaged currents overlaid. Melt rates of more than 50 m per year are observed occurring at the deepest part of the ice shelf.

The calving front of the Totten Glacier ice shelf is nearly 200 m thick and located 150 km to the north of its 'grounding line' – the point at which it flows over the Antarctic continent into the ocean.

T. VAN OMMEN

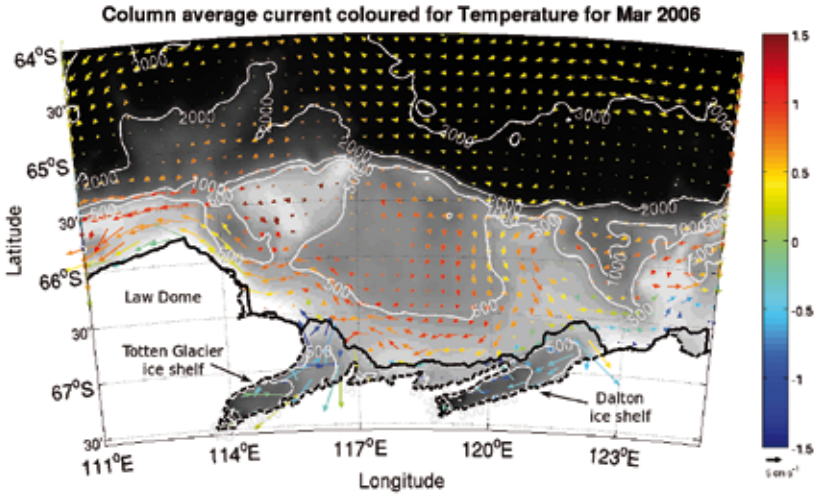
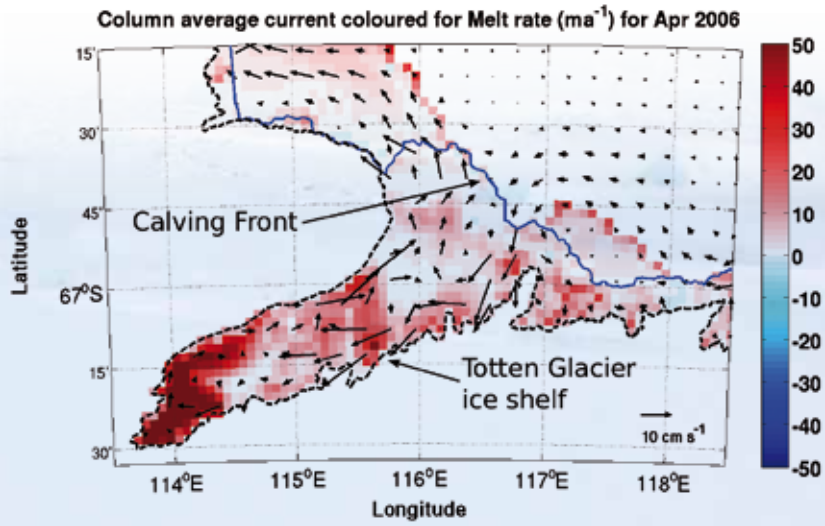


Figure 1. (top) Depth averaged water currents are shown as arrows, coloured for temperature, as they flow towards and under the Totten ice shelf and Dalton iceberg tongue. We see modified CDW (at about 1°C) flow onto the shelf break (at approximately 120°E, 65.5°S) and gain access to the ice shelf mouth.

Figure 2. (bottom) Melt rate (in metres per year) underneath the Totten Glacier ice shelf is shown for April 2006. Depth averaged ocean currents are shown by black arrows. The very back of the ice shelf is clearly visible as displaying the largest melt rates, at over 50 metres per year.



These simulations can assist the planning of future scientific expeditions. Interpreting the output gives a clear picture of the ideal positions for mooring oceanographic instruments such as CTD (conductivity, temperature, depth) buoys, as well as for taking glaciology measurements (for example, bore hole or GPS receiver locations). The model can also be extended to run into the future, and by driving it with various climate scenarios, we can assess the sensitivity and response of East Antarctica's ice shelves to the effects of climate change.

Ultimately, these results will aid in the planning of future observation programs in this region. They will also provide information to the Intergovernmental Panel on Climate Change, about the contribution of the region to global sea level rise.

Supplementary material, including references and 3D animations of CDW flow onto the continental shelf are available at: http://staff.acecrc.org.au/~dgwyther/supp/supp.html

DAVID GWYTHER, BEN GALTON-FENZI and GUY WILLIAMS
ACE CRC and *Australian Antarctic Division*

More information

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Australian Antarctic Science Season 2011–12

This year all Australian Antarctic Science projects are being finalised under our old science strategy, before new projects, approved under the new Australian Antarctic Strategic Plan, begin in mid-2012.

Most projects reviewed in this magazine last year (*Australian Antarctic Magazine* 19: 16-20, 2010) will be continuing, and a snapshot of some of these follows. For the full list of 2011–12 science projects and project descriptions see http://its-db.aad.gov.au/proms/public/projects/projects.cfm?season=1112

Moss bed monitoring. After a successful 2010–11 season photographing moss beds at three sites in the Casey region, the 'OktoKopter' unmanned aerial vehicle (*Australian Antarctic Magazine* 19: 1–3, 2010) will return to Antarctica to photograph moss beds in Antarctic Specially Protected Area 136 on the Clark Peninsula. The OktoKopter carries a high resolution digital camera, a six-band multispectral camera (this detects light reflectance in six wavelength regions, which identifies moss species and health), and a thermal camera to map moss temperature. The data is helping to build a picture of moss health and distribution. To improve the quality and type of data collected on Antarctic mosses, scientists have acquired a new hyperspectral camera (which detects hundreds of spectral bands). This season the camera will be mounted on a tripod to photograph 10 m^2 moss plots. In 2012–13 it will be mounted into a new plane-based unmanned aerial vehicle, after Tasmania-based trials during 2012.

Seabird monitoring and research. A long-term monitoring program of Adélie penguins is conducted on Béchervaise Island near Mawson station each summer to provide information required by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) for the sustainable management of the krill fishery. Work this season will also include monitoring the breeding success of snow petrels.

Research to understand the summer and winter foraging patterns of seabirds across East Antarctica will continue with satellite, GPS and geo-locator tags being attached to penguin and petrel species at Mawson, Davis and Casey stations. Tracking work at Davis will include attaching miniaturised cameras and accelerometers to Adélie penguins to obtain a view of the prey field and determine when they are foraging. The work is part of a joint research project with Japanese researchers through a Japanese Research Fellowship.

Developing water quality guidelines for Antarctica and in-house culturing facilities for marine invertebrates. This project looks at the effects of common contaminants, including fuels and metals, and their interactions with environmental variables, such as salinity and temperature, on a range of Antarctic organisms. From this research, risk assessment techniques and environmental guidelines for the protection and remediation of contaminated sites will be developed.

During this year's short field season at Casey, scientists will collect a range of nearshore marine invertebrates to bring back to the newly built Marine Research Facility at the Antarctic Division's headquarters in Kingston (Tasmania). Over the coming years scientists will optimize methods for the successful culturing of invertebrates in this facility. This will enable year-round experimentation with Antarctic and subantarctic organisms and reduce reliance on on-site research in Antarctica.

1. The OktoKopter in Antarctica.
2. Adélie penguins are the subject of a long-term monitoring program on Béchervaise Island.
3. All albatross species, including the black-browed albatross are endangered, but Recovery Plans are in place to monitor populations and reduce threats to their survival.
4. The Antarctic Division's green Rayleigh LIDAR working in combination with the magenta beam of the German iron LIDAR.
5. One of many rich sea floor communities discovered during the Collaborative East Antarctic Marine Census.

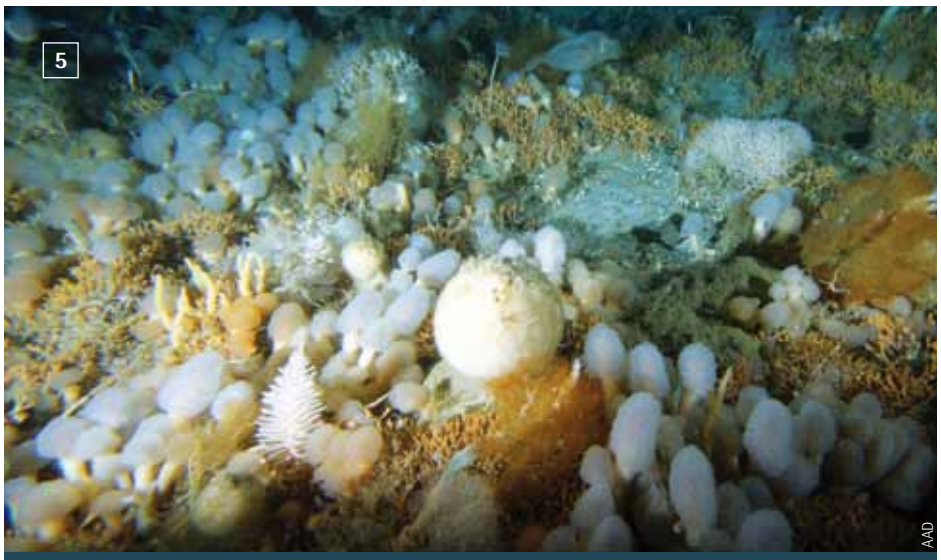
Ongoing projects on Macquarie Island include developing low risk, low cost, on-site remediation techniques to clean up fuel spills; investigating the status and trends of recovering fur seal populations; monitoring albatross and petrel populations; and looking at how subantarctic organisms and ecosystems respond to change caused by global warming, feral animals and weedy plant species.

A number of **marine science projects** will continue this season including the Antarctic Climate and Ecosystems Cooperative Research Centre study on ocean acidification, caused by increasing amounts of carbon dioxide being absorbed by the ocean. This phenomenon is affecting the ability of some organisms to form shells or structures made of calcium carbonate. Scientists will collect samples of pteropods (marine snails) and foraminifera (single-celled, shell-forming organisms) in waters between Australia and Antarctica, to establish a baseline record of shelled zooplankton distribution in the Southern Ocean. This record will be used for future comparative studies of the impacts of ocean acidification in this region.

Atmospheric studies. At Davis, two 'light detection and ranging' (LIDAR) instruments, in combination with three radars (operating at 2, 33 and 55 MHz), will continue gathering information on ice-aerosol cloud formation in the mesosphere (85 km altitude) near the edge of space. In the Arctic, these ice clouds are occurring more frequently and over a greater area than in the past. These changes are hypothesised to be linked to climate change. To determine whether similar ice cloud changes are occurring over Antarctica, the Australian LIDAR will operate in tandem with an iron LIDAR owned by the Leibniz Institute for Atmospheric Physics, which was located to Davis last summer.

The iron LIDAR has successfully measured the first complete year of temperature between 80 and 96 km above Davis, where mesosphere ice-aerosols exist. A second year of observations will allow investigation of inter-seasonal variations and enable otherwise stealthy atmospheric processes to be revealed – since small changes in temperature have a large effect on the ice-aerosol layer. Previously, only twice daily satellite temperature measurements within a range of 500 km of Davis were available. New adaptive optics on the iron LIDAR may also allow measurement of meteor dust particles, which are thought to be the nucleation site for mesosphere ice-aerosol cloud formation. The findings from the Australian-German collaboration will be incorporated in international climate simulations and atmospheric models.

The Davis LIDARs will also be used to study the optical properties of fine aerosol particles in the 5–30 km altitude range in the troposphere and stratosphere, to better understand their effect on climate, and their effect on processes occurring with ozone depletion and its long term recovery.



Census results published

A special volume of the journal *Polar Science* was published in August, featuring research from the Collaborative East Antarctic Marine Census (CEAMARC) voyages – part of Australia's contribution to the International Polar Year (2007–09). The special volume comprises 18 papers describing the purpose and achievements of CEAMARC to date: the hydrography and sea ice conditions of the survey area and distribution patterns of plankton, krill and fish; food web interactions and feeding strategies based on diet, lipid and stable isotope analysis; and a report on the DNA barcoding of bottom-living fish and communities.

The CEAMARC voyages used three ships from Australia, France and Japan to survey the region between Dumont d'Urville and the Mertz Glacier. The voyages aimed to study all organisms in all habitats. Microbes, zooplankton, krill, mid-water fish and bottom-living fish and invertebrate communities were targeted. Sampling occurred throughout most of the water column and on the sea floor of the continental shelf and slope to 2000 m. Detailed studies of the oceanography, sea ice conditions and sea floor morphology and sediment composition were also conducted, to help explain the distribution of organisms.

More results are expected as the analysis of samples and data continues. For more information see *Polar Science* Volume 5, Issue 2, pages 75-312 (http://www.sciencedirect.com/science/journal/18739652/5/2), and *Australian Antarctic Magazine* 18: 13-18, 2010.

GRAHAM HOSIE, *CEAMARC leader*

Surveying dugong responses to extreme weather events

1 A dugong mother and calf in sea grass beds along the Australian coast.

2 Scientists say dugongs off the urban Queensland coast will struggle to find food, after extensive tracts of their seagrass habitat were degraded or destroyed by severe flooding and Tropical Cyclone Yasi. They expect that dugongs will delay breeding this year and that calf counts will be down for several years.

Scientists expect dugongs off the urban Queensland coast will struggle to find food, after extensive tracts of their seagrass habitat were degraded or destroyed by severe flooding and Tropical Cyclone Yasi in the first two months of 2011. According to Professor Helene Marsh of James Cook University, this lack of food will have many flow-on effects.

'The dugongs will change their diet to include less nutritionally desirable species and their search for food further afield will put them at greater risk of incidental drowning in commercial gill nets and shark nets, as happened after Cyclone Althea in 1972,' she says.

'Dugong mortality will also increase as they lose weight and fat stores, and affected dugongs will delay reproduction, leading to a decline in calves in two years time.'

In light of these expected impacts Professor Marsh and her colleagues have received funding, through the Australian Marine Mammal Centre, to conduct an aerial survey of the affected region. The survey will be the seventh in a series conducted since the mid-1980s.

'The survey will allow us to estimate the distribution and relative abundance of dugongs in the survey area and make statistical comparisons of the estimates of dugong density with those obtained from past surveys in the same region,' Professor Marsh says.

'The results will assist with dugong management along the urban coast of Queensland and help us understand the response of dugongs to large-scale extreme weather events.'

The survey will cover more than 37 000 km^2 between the Queensland-New South Wales border and Cooktown, and use two six-seater aircraft flying 137 m above sea level. Teams of two observers on each side of each aircraft will record their sightings independently. The survey design will also account for dugongs observed outside their usual habitat as a result of the extreme weather events.

WENDY PYPER

Corporate Communications, Australian Antarctic Division

MARINE MAMMAL RESEARCH

More than $417 000 in funding for non-lethal marine mammal research was announced by the Australian Government in June. A $175 000 Indo-Pacific Cetacean Research and Conservation Fund (IPCF) will support three three-year projects in Papua New Guinea, Palau and Thailand, while a $147 000 Bill Dawbin Post-doctoral Fellowship was awarded to Dr Isabel Beasley of James Cook University to study Australian snubfin dolphins and Indo-Pacific humpback dolphins in northern Australia. More than $95 000 will also assist an aerial survey of dugongs off the Queensland coast, after widespread habitat loss from the 2011 floods and Cyclone Yasi. All the projects will be administered through the Australian Marine Mammal Centre based at the Australian Antarctic Division. The international work of the centre recognises the large-scale movements of many marine mammal species and accommodates Australia's national and international obligations. The following pages provide an overview of some of the projects. For more information visit www.marinemammals.gov.au

CONSERVING THAILAND'S CETACEANS

The first detailed study of cetaceans in Trat Province, along the eastern coast of the Gulf of Thailand, will provide critical information on their abundance, distribution, and management and conservation needs.

Project leader, Associate Professor Ellen Hines of the San Francisco State University in the United States, says Southeast Asia is a priority region for studies on cetacean conservation and artisanal (small-scale) fisheries, due to the lack of data on cetacean populations and high by-catch rates in the fisheries.

Among the species of interest are the Irrawaddy dolphin (*Orcaella brevirostris*), the Indo-Pacific humpback dolphin (*Sousa chinensis*) and the finless porpoise (*Neophocaena phocaenoides*).

'Our project will be the first in this area to gather data on these vulnerable and near-threatened species, which will be crucial for their management,' Professor Hines says.

'The eastern Gulf coast, particularly Chang Island in Trat province, has few protected areas and is becoming increasingly popular with tourists and gradually overfished.'

Professor Hines and her team will work closely with federal, provincial and local government departments, scientists, fishermen, villagers and students, to collect and disseminate information that will contribute to local management plans and the International Union for the Conservation of Nature's (IUCN) Conservation Action Plan for the World's Cetaceans. The collaboration will build on the team's already strong links with the community, established during eight years of research in the region.

The study will involve boat-based surveys, photo identification, spatial habitat modelling, beach surveys, and interviews with villagers about their cultural and traditional knowledge and conservation values.

'We will use boat-based surveys to investigate the spatial distribution and abundance of coastal cetaceans, to study patterns of habitat use and how this influences their potential interactions with fisheries, and to study cetacean behaviour, group dynamics and movement patterns,' Professor Hines says.

The photo-identification work will identify individual animals through fin markings, enabling the team to estimate home ranges and movement in and out of areas. Geographic Information Systems and statistical modelling will be used to study the relationship between where cetaceans are observed and environmental variables such as salinity, water temperature, depth, and the presence of nets and fishing vessels. Beach surveys will look for cetacean remains that can provide tissue samples for genetic and physical analysis.

Interviews with community members will determine the numbers of fishermen involved in different fishing practices and their catch species. The interviews will also address the history and possible cultural relationship between cetaceans and coastal villagers, stranding locations and numbers, patterns of movement and sightings, and threatening fishing practices.

'Conservation must address the needs and values of local human populations. Studying various dimensions of the human socioeconomic system, and how that influences human use of the environment can shed light on options for cetacean conservation and management,' Professor Hines says.

In addition to formal conservation measures, the research results will be used to produce educational materials for school and village outreach programs that address basic cetacean ecology and marine conservation issues.

WENDY PYPER

Corporate Communications, Australian Antarctic Division

1. A local fishing village in the eastern Gulf of Thailand
2. A herd of Irrawaddy dolphins in the eastern Gulf of Thailand.
3. Professor Hines' research team will use this local vessel to undertake the work.

DOLPHINS UNDER THREAT

1. Dr Isabel Beasley conducts a small meeting at Veribari village in the Kikori Delta, to introduce the upcoming dolphin project and describe the dolphin species that occur in the delta.
2. An Irrawaddy dolphin (*Orcaella brevirostris*).
3. In 2005 the Australian snubfin dolphin (*Orcaella heinsohni*) was differentiated from the Irrawaddy by its skull shape, external appearance and genetics. This snubfin dolphin is using a water spitting technique to herd fish.

The Kikori River Delta of Papua New Guinea is thought to be home to a number of threatened cetacean species, including the Indo-Pacific humpback dolphin (*Sousa chinensis*) and Irrawaddy dolphin (*Orcaella brevirostris*).

Only one small study has previously been conducted on marine mammals in the delta, so virtually no information is available about these, or other species, in the region.

Dr Isabel Beasley of James Cook University says it's important to establish the status of inshore dolphins in the Kikori River Delta for conservation and management purposes.

'We still don't know which species of *Orcaella* occurs in Papua New Guinea,' she says.

'Although Irrawaddy dolphins have been recorded in the delta, they could actually be the newly described Australian snubfin dolphin'.

Dr Beasley was instrumental in the discovery of the Australian snubfin (*Orcaella heinsohni*) in 2005. On the IUCN Red List, the Australian snubfin is listed as 'Near Threatened', and the Irrawaddy as 'Vulnerable', as a result of both species' limited range, low densities in surveyed areas, and continuing vulnerability to human impacts such as overfishing, habitat loss and bycatch.

Snubfin dolphins are particularly vulnerable to local extinction because they are currently considered endemic to northern Australian waters. They occur in small, genetically isolated sub-populations and inhabit coastal/estuarine waters that are subject to wide-spread habitat degradation and development.

'More extensive surveys are needed in northern Australia and Papua New Guinea to support a reassessment of the Australian snubfin dolphin under international and national legislation,' Dr Beasley says.

Through the Indo-Pacific Cetacean Research and Conservation Fund (IPCF), Dr Beasley, in collaboration with Dr Eric Verheij and Mr Olo Gebia of the World Wildlife Fund Western Melanesia Program, will collect baseline information on the diversity, distribution and abundance of dolphins and other marine mammals in the Kikori River Delta, while increasing the local research capacity of communities, and local and national governments.

Dr Beasley says the research and subsequent management plan will identify key species and their habitat and improve understanding of the threats to marine mammals in the delta. A better knowledge of critical habitats will help to mitigate the effect of coastal development on marine mammal populations.

The work will also contribute significant information towards a nomination to the Australian Government to have the Australian snubfin dolphin listed as 'Threatened Fauna' under the *Environmental Protection and Biodiversity Conservation Act* (EPBC Act).

Bridging the gulf for dolphin conservation

In a related project funded by the Bill-Dawbin Post-doctoral Fellowship, Dr Beasley will spend the next three years studying the Australian snubfin dolphin and Indo-Pacific humpback dolphin in the Gulf of Carpentaria in northern Australia. Both dolphin species occur in small, localised populations in northern Australia but their status in the Gulf remains unknown. While anecdotal evidence suggests that some parts of the Gulf may be important for these species, a recent survey around the Sir Edward Pellew Island Group in the southwestern Gulf sighted only a few individuals.

'The Australian snubfin dolphin is currently recognised as Australia's only endemic cetacean and it is likely that Australian populations of the humpback dolphin will also be recognised as separate from the Indo-Pacific species,' Dr Beasley says.

'While we suspect these dolphins are endangered or vulnerable, we do not have enough information on their distribution and abundance to list them as such under Australian Commonwealth or state legislation, to ensure effective management of populations and their habitat.'

To help fill this knowledge gap Dr Beasley will collate information on the biology and occurrence of both species in the Gulf of Carpentaria. This information will feed into models to identify potentially important coastal dolphin habitat in the Gulf. Dr Beasley will then select areas in which to conduct boat-based surveys for the dolphins, in collaboration with Indigenous Sea Ranger groups and Traditional Owners.

'Effective management of Australian snubfin and humpback dolphin populations, and associated species and habitat, needs to be a high priority for Australia, to ensure the long-term viability of these species. This project will provide important data to assist this process,' Dr Beasley says.

WENDY PYPER

Corporate Communications, Australian Antarctic Division

OLIVE ANDREWS, *WHALES ALIVE*

Surveying cetaceans in Palau

The tiny Micronesian island of Palau, in the North West Pacific Ocean, will conduct its first dedicated investigation into the status of cetaceans in the region, after the Government of Palau declared a new national marine mammal sanctuary in Palau's exclusive economic zone in October 2010.

OLIVE ANDREWS, *WHALES ALIVE*

1. The newly declared Paulau Whale Sanctuary may be home to more than 15 species of cetaceans, including the endangered sperm whale.
2. Bottlenose dolphins are one cetacean species known to occur in Palau.

While little is known about the abundance and distribution of cetaceans in the country, anecdotal information from a pilot study conducted by Whales Alive in 2010, suggests that at least 15 species may occur here, including Bryde's whales, endangered species such as sperm whales, and deep-diving beaked whales whose distribution is relatively unknown.

The Palau Marine Mammal Research Project aims to address this knowledge gap by developing a cetacean species list and defining areas of important habitat for cetaceans in Palau waters using visual and acoustic survey methods. Species and habitat information generated from this survey will be used to inform the management and conservation goals of the Palau Whale Sanctuary, and the growth and sustainability of whale and dolphin watching tourism in Palau. Such scientific information is needed before management strategies such as zoning, tourism licensing, and potential fishing restrictions, can be developed to better protect and manage cetaceans within the Palau Whale Sanctuary, particularly species of conservation concern such as sperm whales.

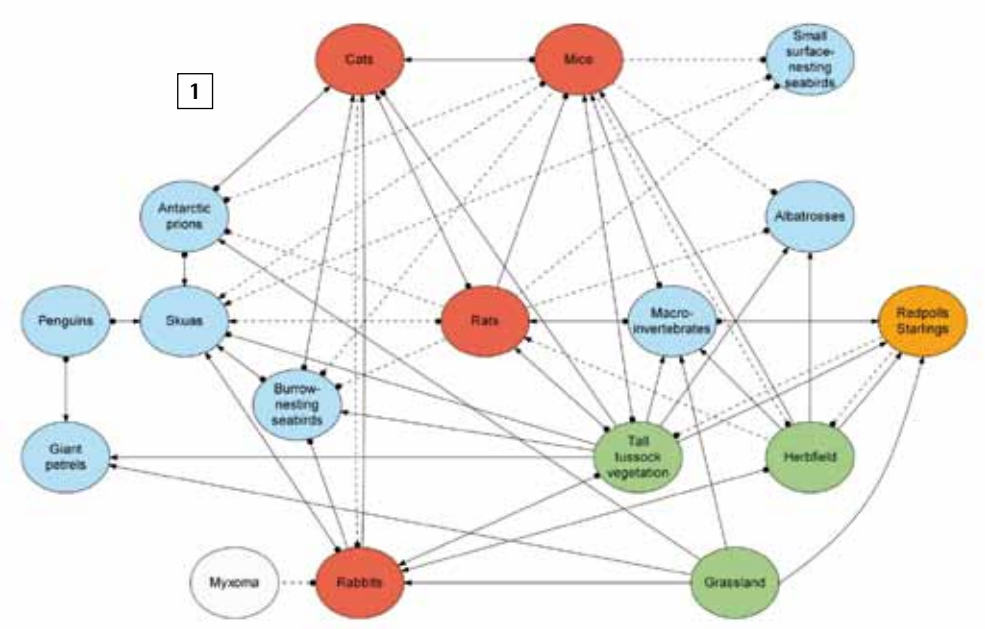
The project will include a training workshop for survey volunteers and collaborators, such as government personnel, tourism operators, non-governmental organisations, students, and private boat owners, to build local capacity and expertise in marine mammal research. The workshop will cover research and data collection techniques, biology and behaviour of common species of marine mammals, and vessel operations in relation to marine mammals.

The research team will also work with local partners to conduct a public education program over six weeks, involving weekly public presentations, school visits and floating classroom sessions for senior science students, who will be offered an opportunity to work first hand with the survey team.

The collaborative project involves Whales Alive, the Palau Government, and local non-governmental organisation Sustainable Decisions, with support from the Indo-Pacific Cetacean Research and Conservation Fund.

OLIVE ANDREWS
Whales Alive

Subantarctic islands in the spotlight



1. This diagram shows the network of interactions between plants and animals on Macquarie Island (prior to the eradication of cats). Red circles indicate introduced pest species, blue circles are native species, the orange circle is the self-introduced alien redpolls and starlings, and the green circles are vegetation. Dashed lines indicate interactions that are not well understood. Lines ending in an arrow indicate a positive influence and those ending in a dot show a negative influence. For example, herbfield has a positive influence on rabbits (as food), while rabbits have a negative influence on herbfield (because of their grazing). These interactions were used to model different eradication scenarios reported in Raymond et al, *Journal of Applied Ecology*, 2010 (doi: 10.1111/j.1365-2664.2010.01916.x).
2. Rabbits on Macquarie Island have a negative influence on herbfield and tall tussock vegetation (as the tussocks in this picture show), with consequences for the wider Macquarie Island ecosystem.
3. The Subantarctic islands were the focus of talks at The Third International Forum on the Sub-Antarctic held in Hobart in August.

Subantarctic researchers from around the world met in Hobart in August for a two-day forum on the future of the subantarctic region, its global significance and value.

Among the speakers at *The Third International Forum on the Sub-Antarctic* were Australian Antarctic Division terrestrial ecologist Dr Dana Bergstrom and modeller Dr Ben Raymond. The pair has recently published qualitative* modelling research in the *Journal of Applied Ecology*, examining the range of possible outcomes from the current Macquarie Island Pest Eradication Project.

Speaking at the forum, Dr Raymond said the project aims to eradicate rabbits, rats and mice from the island, and that the modelling supports the anticipated positive outcomes from the project, including the recovery of tall tussock vegetation and burrow- and surface-nesting birds.

However, the modelling also highlights some of the risks of the project, including the potential failure to eradicate mice and an increase in the populations of non-native redpolls and starlings, which mostly likely flew to the island from New Zealand and Australia in the early 1900s.

For example, in nearly half of Dr Raymond's modelling scenarios targeting rabbits, rats and mice simultaneously, mice were not eradicated due to complex interactions with the other pest species. On Macquarie Island the presence of rats currently suppresses the mouse population, and the eradication of rats would remove this pressure.

'The effect is exacerbated by the difficulty in targeting all individuals of the mouse population. In other island eradications, failure to eradicate mice has been more common than failure to eradicate rats,' Dr Raymond said.

The research shows, however, that qualitative modelling can be used to identify gaps in ecosystem knowledge, which can then be addressed, and can provide quite robust conclusions about some management actions, without requiring detailed knowledge of the system.

'Refinements to this model could be made as new data is collected and as the eradication project unfolds,' Dr Raymond said.

Other speakers at the forum canvassed the subjects of the subantarctic as a unique source of knowledge, as a climate change sentinel, a source of human enrichment, and as an economic and environmental asset. Alien species management and the impact of and responses to extreme events were also discussed. The following stories provide a snapshot of the forum presentations.

For more information about the forum visit http://www.sub-antarctic.org

WENDY PYPER

Corporate Communications, Australian Antarctic Division

* In this context, qualitative modelling focuses on the structure of the ecosystem and general interactions between organisms. It is different from quantitative modelling which uses detailed mathematical descriptions of specific components in the ecosystem.

GETTING AROUND – PLANT DISPERSAL IN THE SUBANTARCTIC

1. Plants have many ways to disperse their seeds. This example on Kerguellen Island shows the bright red fruits of *Acaena magellanica*, known as buzzies. Each buzzie is made up of hundreds of individual fruits, each with four spines topped by arrow-tip-like barbs. *Acaena magellanica* is found on all subantarctic islands as well as in southern South America.
2. Birds are excellent dispersal agents for alien species on subantarctic islands as they move between water, land and air. This sheathbill on subantarctic Prince Edward Island is covered in *Uncinia* (hook-sedge) seeds.
3. Birds can be carried to distant islands on the wind, arriving with viable seeds in their guts or stuck to their feathers.

The subantarctic islands are unique in that some are truly oceanic in origin and have never been in contact with continental landmasses. So how did the lush vegetation that is such a feature of these green oases in the Southern Ocean get there?

Australian Antarctic Division terrestrial ecologist, Dr Dana Bergstrom, told delegates at *The Third International Forum on the Sub-Antarctic* that there were three main ways plants could be dispersed from the southern hemisphere continents to the subantarctic: water, wind and animals (birds, seals and humans). Some plants have developed adaptations that favour different dispersal methods.

On Macquarie Island, for example, there are species of *Epilobium* (tiny herbs), bryophytes (mosses and liverworts) and lichens, which are well adapted for dispersal by wind. These adaptations include fine, dust-like seeds or spores, which can survive extreme conditions.

'Seeds or spores that disperse in the jet stream are exposed to very dry, cold conditions and high UV, while those that disperse in low passage storms have to survive wet and freezing conditions,' Dr Bergstrom said.

Studies have shown that subantarctic islands share more species in common if they are connected by winds, than if they are not, even if they're physically close.

With water dispersal, seeds or plant parts would need to survive in saline water for days to years. Similarly, if seeds are attached to animal fur or feathers, they may need to tolerate immersion in sea water.

Birds are excellent dispersal agents because they move between water, air and land and can carry plant material in their guts, beaks or stuck to their feathers.

'A bird carrying plant material in its beak could be picked up by a strong wind and deposited elsewhere in a few days. In fact a courier pigeon released in Australia did get caught in a storm and was dropped on Macquarie Island three days later,' Dr Bergstrom said.

Birds also regurgitate seeds, which can remain viable in their guts for weeks.

Humans have become a significant dispersal mechanism more recently in the subantarctic islands' history. During the International Polar Year in 2007-09, Dr Bergstrom coordinated an international project, *Aliens in Antarctica*, which found that clothing and equipment carried by expeditioners (such as field biologists) were a significant source of 'propagules' (seeds, spores and eggs). This work led to stricter quarantine protocols to prevent alien introductions. It also led to the development of 'decision trees' for environmental management.

'If a plant is native then our action is to conserve and protect it. If a plant is introduced, we should control or eradicate it. But what if there's doubt? What is the impact of the wrong decision?' Dr Bergstrom said.

'If the plant is introduced and we leave it there, we've permanently altered the natural evolution of the island's ecosystem and possibly degraded its heritage values.

'The subantarctic is giving us these sorts of arguments about the complexity of the interactions between humans and some of the most pristine islands on the planet.'

Dr Bergstrom said the subantarctic is offering us a unique opportunity to build our knowledge – teasing out such issues in the subantarctic, may help us address more complex problems in continental ecosystems.

WENDY PYPER
Corporate Communications, Australian Antarctic Division

1. Dr Ceridwen Fraser collects southern bull kelp on Marion Island.

2. The blue area on the map below shows the current estimated extent of winter sea ice at the Last Glacial Maximum (LGM), while the red dotted line shows the equivalent of the Antarctic Polar Front at the LGM. This red line is where Dr Fraser and her colleagues think sea ice actually extended during the LGM. The pie charts show the distributions and proportions of the genetic variants (haplotypes) of southern bull-kelp found around the Southern Ocean. Only one haplotype (red circles) was observed on the subantarctic islands that fall within the proposed new sea ice extent, and in the part of southern Chile that was covered by glacial ice during the last ice age. This haplotype most likely originated from the New Zealand subantarctic, after bull kelp from the region hitched a ride on the Antarctic Circumpolar Current.

Subantarctic bull kelp suggests ice age was icier

Genetic patterns in subantarctic southern bull kelp (*Durvillaea antarctica*) suggest that Antarctic sea ice extent during the last ice age may have been much greater than currently estimated.

Dr Ceridwen Fraser, formerly of the Allan Wilson Centre at the University of Otago, New Zealand, said the genetic analysis of bull kelp from many subantarctic islands, including South Georgia, Crozet, Kerguelen, Gough, Marion and Macquarie islands, showed the kelp had very little genetic diversity. This suggests it has only recently colonised the islands from a common origin.

In contrast, bull kelp collected from the New Zealand subantarctic region (Auckland, Campbell, Antipodes and Snares islands), and along the coasts of mainland New Zealand and central Chile, was comparatively genetically diverse.

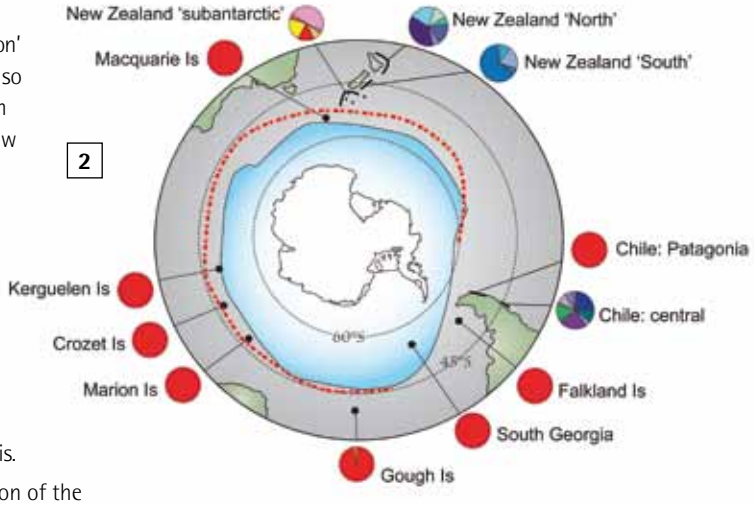
Speaking at the *Third International Forum on the Sub-Antarctic*, Dr Fraser said that bull kelp was a species that could not survive ice scouring caused by glaciers or sea ice.

This means that during the last ice age, which peaked about 20 000 years ago, the coastal-growing kelp could not have survived in coastal areas affected by sea ice. But when the ice age ended and sea ice and glaciers began to retreat, new habitat would have opened up to early colonising species.

'In the northern hemisphere there are many examples of early colonising species that were able to rapidly multiply in newly ice-free areas,' Dr Fraser said.

'This led to a distinct loss of genetic diversity in the recolonised regions, as the early colonisers quickly expanded into the new habitat.'

Dr Fraser's genetic analysis of the bull kelp suggests that such a 'post-glacial recolonisation' of the subantarctic has also occurred, most likely from glacial refugia around New Zealand's subantarctic islands, via the Antarctic Circumpolar Current. Similar genetic patterns have also been observed in some of the small crustaceans living in the holdfasts of the kelp, supporting this hypothesis.



'Post-glacial recolonisation of the subantarctic by bull kelp is a logical hypothesis from this research,' Dr Fraser said.

'But the problem is that current estimates of where sea ice extended during the last glacial maximum don't cover many of the islands where we found evidence of recolonisation.'

Dr Fraser and her colleagues examined the data used to compile estimates of sea ice extent and a recent paper which re-analysed this data and made new estimates of ice cover. This data consisted of sediment cores containing fossil diatoms (microscopic algae), some species of which are common in sea ice.

'We found there was uncertainty about sea ice extent, due to a lack of sediment core data, in a large area that includes several of the subantarctic islands where we found evidence of recent recolonisation,' she said.

'Based on our kelp evidence, we think sea ice may have extended as far as Marion and Crozet islands and even past Macquarie Island, in roughly the 50° latitude zone.'

Further support for the recolonisation hypothesis comes from observations of bull kelp off South America.

'You see a lot of genetic diversity along the Chilean coast but in the fiordland of the south there's only a single genotype across more than 1000 km. This area corresponds to the region thought to be covered by the Patagonian ice sheet during the Last Glacial Maximum, so we think it's a clear example of post-glacial recolonisation.'

Dr Fraser has conducted genetic analyses on other subantarctic ice-affected and ice-resilient seaweed species, to see if this hypothesis is supported by more biological data. Further studies using other scientific approaches are also needed to resolve the issue.

If the estimates of sea ice extent are found to be wrong, current climate models may need to be adjusted to more accurately predict what will happen in the future.

This research, conducted by Dr Fraser, Prof Jon Waters, Prof Hamish Spencer and Dr Raisa Nikula, was published in the Proceedings of the National Academy of Science, USA *106: 3249-3253 in 2009, and* Marine Ecology Progress Series *405: 221–230 in 2010.*

WENDY PYPER

Corporate Communications, Australian Antarctic Division

Preventing a marine invasion in the subantarctic

As the climate warms and visitors to the Antarctic and subantarctic increase, the threat of an invasion by marine species, carried to the region on resupply vessels and tourist ships is increasing.

Speaking at The *Third International Forum on the Sub-Antarctic*, Dr Jennifer Lee, a post-doctoral fellow at the Centre for Invasion Biology, Stellenbosch University, South Africa, said preventative action was essential.

'It's difficult, expensive and sometimes impossible to eradicate species in a terrestrial habitat and there's never been a successful eradication in a marine habitat,' she said. 'There is no cure; prevention really is the only way.'

Dr Lee and her colleagues, in association with the South African National Antarctic program, investigated the risks of transporting alien species into the subantarctic by the two most likely means – on ships' hulls and in sea chests.

The team examined the development of hull-fouling communities on the South African resupply vessel *S.A. Agulhas* by surveying the ship's hull before and after every voyage over two years, using a remotely operated vehicle fitted with a moveable camera and lights. The team divided the hull into 10 two metre-wide transects, four metres apart, and took continuous video footage over these transects.

They observed a range of organisms taking up residence, including various types of algae, small crustaceans, sea squirts and mussels.

'The most profound impact on fouling of the hull occurred after the vessel travelled through sea ice. It went from having about 11% fouling cover to zero. So the risk of transporting species into the Antarctic was very low,' Dr Lee said.

'But the sea ice removed the anti-fouling coating from the ship's hull, which enabled a more rapid accumulation of organisms when the vessel was in port. Then, when the vessel travelled through the open ocean, almost intact communities were transported from Cape Town to the subantarctic islands.'

The team was also shocked to discover the favourable living conditions provided by sea chests. These covered recesses into ships' hulls, where water is taken onboard for engine cooling, have a constant flow of water through them and are protected from heavy seas and ice scour.

'The sea chest of the *Agulhas* was full of a globally invasive bivalve species, the Mediterranean mussel (*Mytilus galloprovincialis*), many samples of which were over two years old. This means they had survived transport to Gough and Marion islands and to colder waters in Antarctica,' Dr Lee said.

A review of the scientific literature indicated that most of the organisms present on the *Agulhas*' hull or in its sea chest were physiologically capable of surviving in the subantarctic environment, and some in even colder water.

However Dr Lee said more information on the temperature tolerance of a wider range of fouling species was required before a full risk assessment could be made.

More information is also needed on how vessel type and size affects hull fouling.

'Most research has been done on medium-sized research ships but small yachts and larger tourist ships could be affected differently,' she said.

'And we don't know how the species composition of the home port affects the fouling community composition. Most work on this has been done in Australia or South Africa, but many vessels leave from Ushuaia in South America.'

Dr Lee said new technologies promised to provide cost-effective strategies for dealing with hull fouling, such as the Hull Identification System for Marine Autonomous Robots. The 'HISMAR' attaches magnetically to ships' hulls and removes light to medium fouling using high pressure water jets. This water is filtered of biological and chemical contaminants before release.

'This sort of technology may be less expensive and time consuming than frequent dry docking or using divers to clean the hull,' Dr Lee said.

'By adopting a more precautionary approach to hull fouling we can reduce the threat of a subantarctic marine invasion while further research is conducted to better define the risks.'

WENDY PYPER

Corporate Communications, Australian Antarctic Division

More information

J. E. Lee and S. L. Chown. Temporal development of hull-fouling assemblages associated with an Antarctic supply vessel. *Marine Ecology Progress Series* 386: 97-105, 2009.

The South African Antarctic resupply vessel *S.A. Agulhas*.

JENNIFER LEE

JENNIFER LEE

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JENNIFER LEE

Fouling communities observed on the hull of the *S.A. Agulhas*, from left: biofilms and fine algae, assorted macroalgae including Enteromorpha intestinalis, cape rock crab *Plagusia chabrus*, macro fauna including *Ciona intestinalis*.

Career in krill offers scientific thrills

Antarctic Medal winner and science program leader, Dr Steve Nicol, joined the Australian Antarctic Division 24 years ago and began shaking up the biology program almost immediately. On the eve of his retirement he reflects on a career that has helped the Division become a leader in Antarctic krill research, conservation and management.

1

STEVE NICHOL

He doesn't like going to sea or sitting through lengthy meetings, but Australian Antarctic Division ecologist, Dr Steve Nicol, has made a successful career out of doing just that.

Since he joined the Division in 1987, fresh from a PhD at Dalhousie University, Canada, and a year-long post-doctoral position in Cape Town, he's clocked up nine sea voyages, more than 470 days at sea, and even longer sitting in meetings of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR).

With his characteristically dry humour Steve says this career mis-match may be attributable to 'a few mistakes' he's made since he filled a vacancy created by the departure of eminent krill biologist, Dr Tom Ikeda, in 1986.

'I was young and had no Antarctic experience when I took over from Tom, and the Division's Chief Scientist, Pat Quilty, stuck his neck out to have me appointed in what was a strongly and internationally contested position,' Steve says.

'I needed to get some solid papers on krill and develop some credibility in the Antarctic community. So I focussed on things no-one else could do because they didn't have access to live krill like we had.'

Steve began his career working on North Atlantic krill off the east coast of Canada, in an area where they swarmed at the surface, staining the water red. He came away from this study with three main impressions about krill: they were really important animals in the marine ecosystem, they were actively behaving animals, and they weren't that good to eat.

When the Antarctic Division job came up, Steve jumped at the chance to study krill at sea and in the Division's unique, yet at that time still rudimentary, aquarium – essentially a cold room with some buckets. Then he started questioning the way things were done; his first 'mistake' and one he continued to make throughout his career.

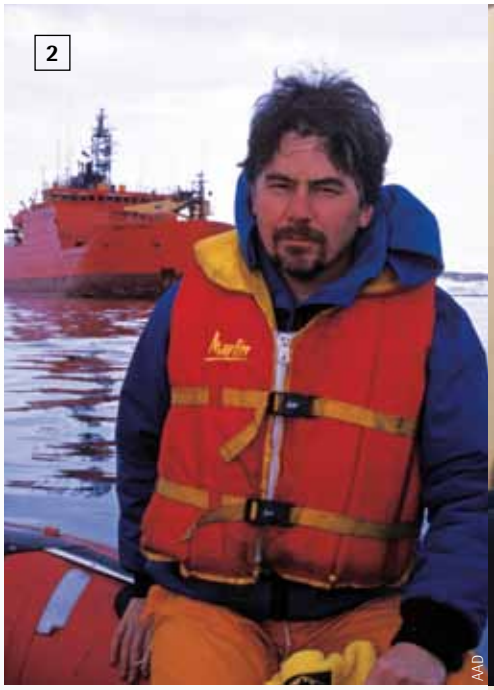
' I discovered that when you ask a lot of questions you tend to get put on committees, given lots of paperwork and finally, if that doesn't shut you up, you are given positions of responsibility,' he says.

These responsibilities saw Steve acting as the Program Leader for Biological Sciences in the early 1990s and culminated in his appointment as Leader of the Antarctic Marine Living Resources program (later re-named Southern Ocean Ecosystems) in 1999. From here he oversaw a science program that serviced Australia's interests in CCAMLR, the international body responsible for the conservation and sustainable use of marine resources, such as krill, in the Southern Ocean.

Steve's involvement in CCAMLR has been both a blessing and a curse. While he dislikes attending meetings generally, he recognises the critical importance of CCAMLR.

'CCAMLR is a strange mix of politics, diplomacy and science. It took me years to figure out how it worked, and how to work within its constraints. It is a challenging environment, but it is the only decision-making conservation body for the Southern Ocean, so making sure CCAMLR is effective is essential.'

CCAMLR has been a significant force in the direction of Steve's work and has in fact



1. Steve at the Antarctic Peninsula during the Elysium Expedition in 2010.
2. Steve during the Baseline Research on Krill, Oceanography and the Environment (BROKE) voyage in 1996.
3. Steve, wearing a distinctive krill tie, has attended CCAMLR meetings every year during his 24-year career with the Australian Antarctic Division.
4. Steve's award-winning photograph of a jade iceberg.

precipitated the research that became the highlight of his scientific career.

'When I was interviewed for the job at the Antarctic Division I produced a paper on what I thought the focus of krill research should be. I said we didn't need to do any more big surveys,' he says.

Ironically, Steve's legacy is likely to be the results of two big surveys that he initiated and led in 1996 and 2006, which provided data for CCAMLR to set sustainable catch limits for the krill fishery off the Australian Antarctic Territory.

These voyages ('BROKE' and 'BROKE-West') utilised the skill set available through the emerging Antarctic Cooperative Research Centre (now the Antarctic Climate and Ecosystems Cooperative Research Centre) and brought together oceanographic and ecological research, at a very large scale, to produce integrated results. The results appeared in two special issues of *Deep Sea Research Part II* and *Nature*.

'We showed that you could pull together a large, interdisciplinary group of scientists on a single ship, with an applied focus, and produce first-class science as well as management outcomes,' Steve says.

However, the intensity and duration of the work involved – with both voyages requiring years of planning and writing up and months of discussions in CCAMLR – can only be sustained for so long.

'One of my reasons for retiring is that I don't think I can commit another decade to this type of research and that is what it takes to do one of these voyages properly,' Steve says.

'If you can't see it through, it's not worth setting off on; besides the last one (BROKE-West) was so successful I want to quit while I'm ahead.'

As well as krill and integrated resource management, Steve has interests in photography and communicating science through popular science writing and the work of artists and musicians. His iceberg photographs have won awards and have appeared at exhibitions, in magazines and on stamps. In 2010 he was invited to join the Elysium Epic voyage as principal scientist, to commemorate the 100th anniversary of Shackleton's 1914 trans-Antarctic expedition. The team of explorers, photographers, film makers and scientists are producing a documentary feature and book from the detailed scientific and photographic survey of Antarctica conducted during the three-week voyage (http://www.elysiumepic.ogsociety.org/index.php).

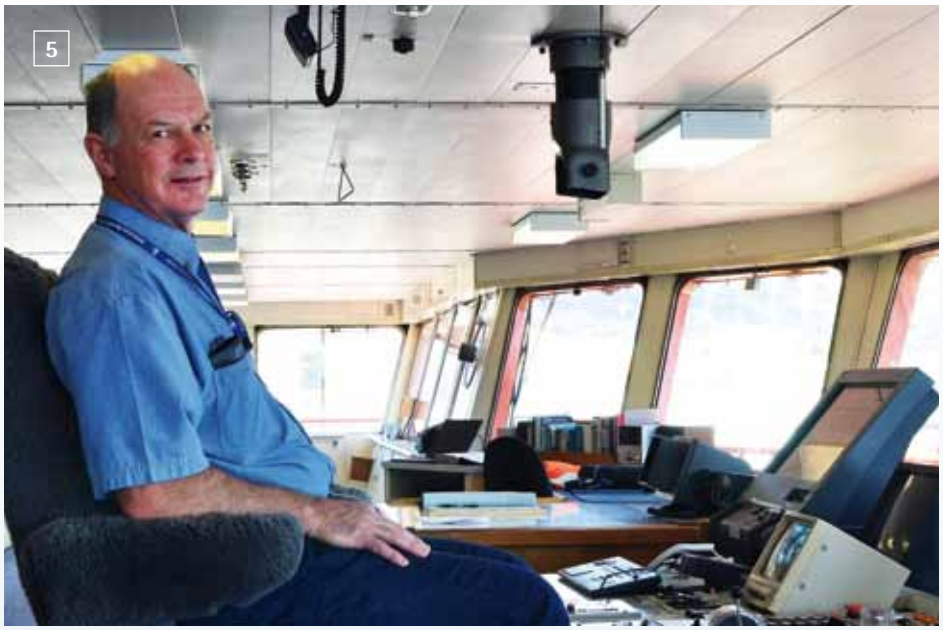
Steve has also been involved in projects on Antarctic literature and has helped organise a number of conferences on the arts and humanities in Antarctica. He is a champion of the Australian Antarctic Arts Fellowship scheme.

'Arts Fellows allow us to tap into a far bigger audience than our science, and we're only just realising this,' he says.

Steve's departure from the Antarctic Division was fittingly preceded by the award of an Antarctic Medal. In his understated way, Steve says it is nice that some of his colleagues 'thought I had done some things that were worthy of nomination'. He was also pleased to see his friend Captain Murray Doyle recognised; highlighting the critical role the ship's crew play in the success of the Australian Antarctic program.

Antarctic Medal awards

4. Dr Steve Nicol built a prestigious career upon krill.
5. Captain Murray Doyle at the controls of the *Aurora Australis*.



In the future Steve hopes that the krill aquarium, which is now a state-of-the-art facility run by Rob King, will continue its trajectory towards being the international centre for research on living krill under the scientific guidance of Dr So Kawaguchi. During Steve's tenure, the aquarium expanded to allow a range of experiments into the growth, moulting and physiology of krill.

'We can study almost anything in the aquarium now, except distribution and abundance. When an issue hits the headlines, like ocean acidification, we can turn on an experiment the next day to look at it,' Steve says.

But now Steve is happy to focus on the next leg of his life journey, a cycling tour around Scandinavia. Later, he hopes to focus on his creative writing interests.

'I'm convinced that the great Antarctic comic novel is yet to be written. Most Antarctic literature is very serious or seriously bad. After working for the Antarctic Division for 24 years I am not lacking in comic material, I'll just have to work on my writing skills!'

WENDY PYPER

Corporate Communications, Australian Antarctic Division

Leading Antarctic marine biologist, Dr Steve Nicol, and a Master of Australia's Antarctic research and resupply vessel, Captain Murray Doyle, have been awarded the 2011 Antarctic Medal.

The awards were announced on 21 June 2011 by the Governor General, Her Excellency, Ms Quentin Bryce AC.

Environment Minister Tony Burke congratulated Dr Nicol and Captain Doyle for their outstanding contributions to Australia's Antarctic program.

'Dr Nicol is the world's foremost Antarctic krill scientist, who has worked in the field for 33 years, transforming the world's understanding of the biology, conservation and management of krill and their role as a food source for other Southern Ocean animals,' Mr Burke said.

Dr Nicol has been a member of Australia's scientific delegation to the international Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the body responsible for the conservation of the marine ecosystems of the Southern Ocean where his research helped set precautionary catch limits for the krill fishery off most of the Australian Antarctic Territory.

Dr Nicol has also spent long periods in the Southern Ocean, leading and participating in nine marine science voyages between 1987 and 2006. His scientific research has appeared in over 100 peer-reviewed publications, including the prestigious journal *Nature*.

Captain Murray Doyle has been Master of the RSV *Aurora Australis* for 16 years, supporting the scientific and logistical operations of Australia in the Antarctic and subantarctic regions.

'During his time as Master, Captain Doyle has developed an exceptional level of experience and skill to safely guide the vessel, crew and expeditioners through the stormy Southern Ocean and challenging ice conditions of the Antarctic,' Mr Burke said.

'The ongoing success of Australia's activities in Antarctica is testament to Captain Doyle's efforts.'

Captain Doyle has also been a Master of the MV *Oceanic Viking* for two years, playing a pivotal role in protecting the Southern Ocean from Illegal, Unregulated and Unreported fishing.

The Australian Antarctic Medal was established in 1987 and is an award in the Meritorious Service Awards category of the Australian Honours System.

It replaced the (British) Imperial Polar Medal and its variations which date back to 1857 for service in the Arctic and Antarctic regions.

NISHA HARRIS

Corporate Communications, Australian Antarctic Division

Icy resting place for Australian Antarctic pioneer

The man known as 'Mr Antarctica' has been laid to rest on a rocky outcrop near Mawson station in Antarctica.

Dr Phillip Law's ashes and those of his late wife, Nellie Law, were interred at a ceremony at West Arm overlooking Horseshoe Harbour on Sunday 19 June 2011.

Dr Law died in Melbourne in 2010, aged 98, and Nel Law died in 1990, aged 75. Their ashes were transported to Mawson station on the icebreaker *Aurora Australis* in February.

Former Australian Antarctic Division Director, Lyn Maddock, said Dr Law's final wish was to be interred with his wife at Mawson, alongside the graves of three other expeditioners who lost their lives on the icy continent.

'Dr Law was particularly fond of Mawson as it was the first Australian station he founded in 1954,' Ms Maddock said.

Mawson Station Leader, Mark Williams, and 19 other wintering expeditioners attended the interment ceremony.

'As Mawson expeditioners we have a special bond with Phil Law,' Mark said.

'His indomitable will, humorous disposition and adventurous spirit set high standards for those of us who follow him.'

Dr Law founded Australia's three continental stations and explored extensive tracts of the Australian Antarctic Territory. He was appointed as the first Director of the Antarctic Division in 1949; a position he held for 17 years. He also established Australia's National Antarctic Research Expeditions (ANARE) – the forerunner to today's Australian Antarctic program – with an emphasis on scientific research in the region. In his 19 years as an Antarctic explorer Dr Law personally led 23 voyages to the Antarctic and subantarctic.

Nel Law was the first Australian woman to set foot on the Antarctic continent when she visited Mawson station in 1961. She was a talented artist and produced a magnificent series of oil and water colour paintings of her first Antarctic voyage. She founded the Antarctic Wives Association of Australia in 1965, later to become the Antarctic Family and Friends Association, and was the group's first President and later Patron.

Read more about Dr Phil Law in *Australian Antarctic Magazine* 18: 22-24, 2010.

NISHA HARRIS

Corporate Communications, Australian Antarctic Division

CHRIS WILSON

Station Leader Mark Williams (in red at centre) conducts the interment ceremony flanked by Mawson expeditioners carrying the ashes of Phil and Nel Law, and the remaining 2011 wintering expedition team.

Dr Martin Riddle (left) receives the inaugural Phillip Law Medal from the ANARE club's Ray McMahon.

Environmental scientist receives inaugural Phillip Law medal

The inaugural Phillip Law Medal has been awarded to Australian Antarctic Division scientist Dr Martin Riddle.

The award, convened by the Australian National Antarctic Research Expeditions (ANARE) Club, recognises an individual who has made an outstanding contribution to Antarctic affairs and the Antarctic community.

Since he joined the Antarctic Division in 1994, Dr Riddle has led a research program focussing on protecting the Antarctic environment and cleaning up the impact of human activities (such as fuel spills) at Australia's Antarctic stations.

'Dr Riddle has directly contributed to major advances in environmental understanding and management through guidelines and measures adopted throughout the Antarctic Treaty system,' said the President of the ANARE Club, Ingrid McGaughey.

'His infectious enthusiasm for the polar region has also been passed on to many students, scientists, media and the wider community.

'He is a highly respected and influential member of the Australian Antarctic program and a very worthy recipient of the inaugural Phillip Law medal.'

In accepting the medal, Dr Riddle expressed gratitude for the opportunity, support and confidence provided by the Australian Antarctic Division, saying it has been a privilege to lead the human impacts research program.

'As I reflect on my time with Australia's Antarctic program I have been continually reminded that not only is Antarctica important to Australia, due to its proximity and its influence over our climate, but it is also important to Australians.

'In the same way that Australians value our beaches, outback and reefs, they also value the Antarctic and have very high expectations for our environmental stewardship of the region. As custodians of the region we carry a great responsibility to meet these expectations.'

The Phillip Law Medal is designed to be a prestigious and ongoing tribute to the Australian Antarctic pioneer. It recognises the important work being done by individuals in Antarctica across a range of areas including science, technology, leadership, administration and environmental management.

NISHA HARRIS

Corporate Communications, Australian Antarctic Division

Biscoe Hut:
Preserving Australia's Antarctic heritage


1

BOB JONES


2

AAD

A project to restore and preserve one of the earliest relics of ANARE (Australian National Antarctic Research Expeditions) history is underway at Mawson station. Biscoe Hut was one of the first buildings erected at Mawson when the station was established in 1954. Its eight metre square space contained the original living and sleeping quarters, mess and kitchen.

The hut was one of three prefabricated by the Norwegian Polar Institute for the 1949–52 Norwegian-Swedish-British Antarctic Expedition to Queen Maud Land, but it was left behind in Cape Town (South Africa) due to lack of cargo space. ANARE Director Phil Law had seen its sister huts in use at Maudheim station in Antarctica on a visit in 1949, and persuaded the Australian Government to purchase the kit in 1952 for use on the first ANARE expedition to Antarctica.

Biscoe was designed for Antarctic conditions and represented the most modern design and technology available in its day. Its pre-cut, modular pieces were easily transported, it was able to be erected on snow or ice due to the design of the sub-floor framing, and it could withstand burial by years of blizzard.

When the hut arrived at Mawson on February 13, 1954, the summer season was waning and temperatures were rapidly dropping. As the main accommodation for 10 wintering expeditioners, Biscoe's erection was a priority. But it took almost a month to first construct level foundations on Mawson's rough, rocky terrain, and then piece together the building, with the instructions, untranslated, in the original Swedish.

Biscoe originally had five bunks down each side, an Aga stove and sink at the western end, a table in the centre and a porch on the eastern end which contained a toilet and meteorological equipment. When new living quarters were built in 1961 the hut was put to a variety of uses including hydroponics, beer brewing, sled repair and a carpenter's workshop.

Heritage conservator Mike Staples completed a heritage assessment of the hut in 1996, before a fire in 2003 damaged its western end. Since 2006–07 Mike has been managing a restoration project each summer season, with assistance from Ben Burdett, Tom Clarke and Marty Passingham.

He describes progress so far and some of the challenges of working on this building rich in history.

'In the first season we cleaned out all the mess and burnt material, and did structural repairs to make sure the hut wasn't going to fall down or blow away. In the second year I did some joiner work on the windows and skylights. In the third year we worked on refitting insulation. When we went back this year (2010–11) we completed the insulation and started refitting the original floor and putting new linings on the inside.'

When it came to replicating the internal lining of the hut, Mike had to put himself in the mindset of the original expeditioners.

'Because it was a prefabricated building they trial erected it in Melbourne before they left, and fitted and numbered all the internal lining panels. When they erected the building at Mawson the frame went up slightly differently, so the lining that had been pre-fitted and marked no longer fitted well, and they had to modify the panels to make them fit. They were in a hurry and they did a pretty rough job of it.

ROBYN NUNDY

1. The weathered and colourful hut exterior in 1997.
2. The Aga stove was a key feature of the newly erected hut (ca. 1955).
3. Heritage carpenter, Mike Staples, working on Biscoe Hut in 2009.

'The new panels that we've fitted reflect the changes that the original expeditioners made; in other words they don't fit very well. It tells a story about what was going on.

'Where we didn't have something to copy, we tried to use the logic we think those guys would have used when they cut the pieces. Quite often I would have an original panel and some photographs and I'd look at it and say, with this evidence and with that evidence I can shape the pieces like this.'

Mike says it's a challenge to preserve the story of the hut's 55 years of life.

'The building has had a number of uses, so there are quite a few penetrations through the panels. We didn't drill many holes through the new linings, but we marked the location of them, so if you look closely you can find where things were.

'For example, there's the original location of the sink. In the early days it had a pipe that went out the wall into a drum on a sled – there were very few moving parts! The other major things were the flue holes in the roof, because when it was a mess hut it had a very big Aga cooking stove which was a key feature of the building. So we marked things like that with little scribe lines. It's a reminder of the early layout of the building and previous uses.'

The final stage of restoration of the hut involves finishing touches such as flooring, electrical work and painting, as well as fitting the building out to make sure it is used into the future.

'If we want to preserve the building into the future it's got to have a function. It's been proven time and again in managing historic buildings, if you don't have regular visitation or occupation they can deteriorate. In the future we would like to see a use where people are in and out of the hut fairly regularly.

'To that end we wanted to make it a pleasant place to be, so it's very well insulated now and the colours that were selected for refinishing the interior relate to earlier colours, but they were modified somewhat. It has been painted a collection of crazy colours over the years.

'It's currently proposed to use the hut as a hobby workshop, but it could be used for a number of things. It's a really nice space because it's bright and open, and it's got the same communications facilities as the rest of the station, so it could be used as an office.

'I often wonder what the early expeditioners would think of the hut now, what with the phone and internet. I think they'd be amazed to see what we're doing now.'

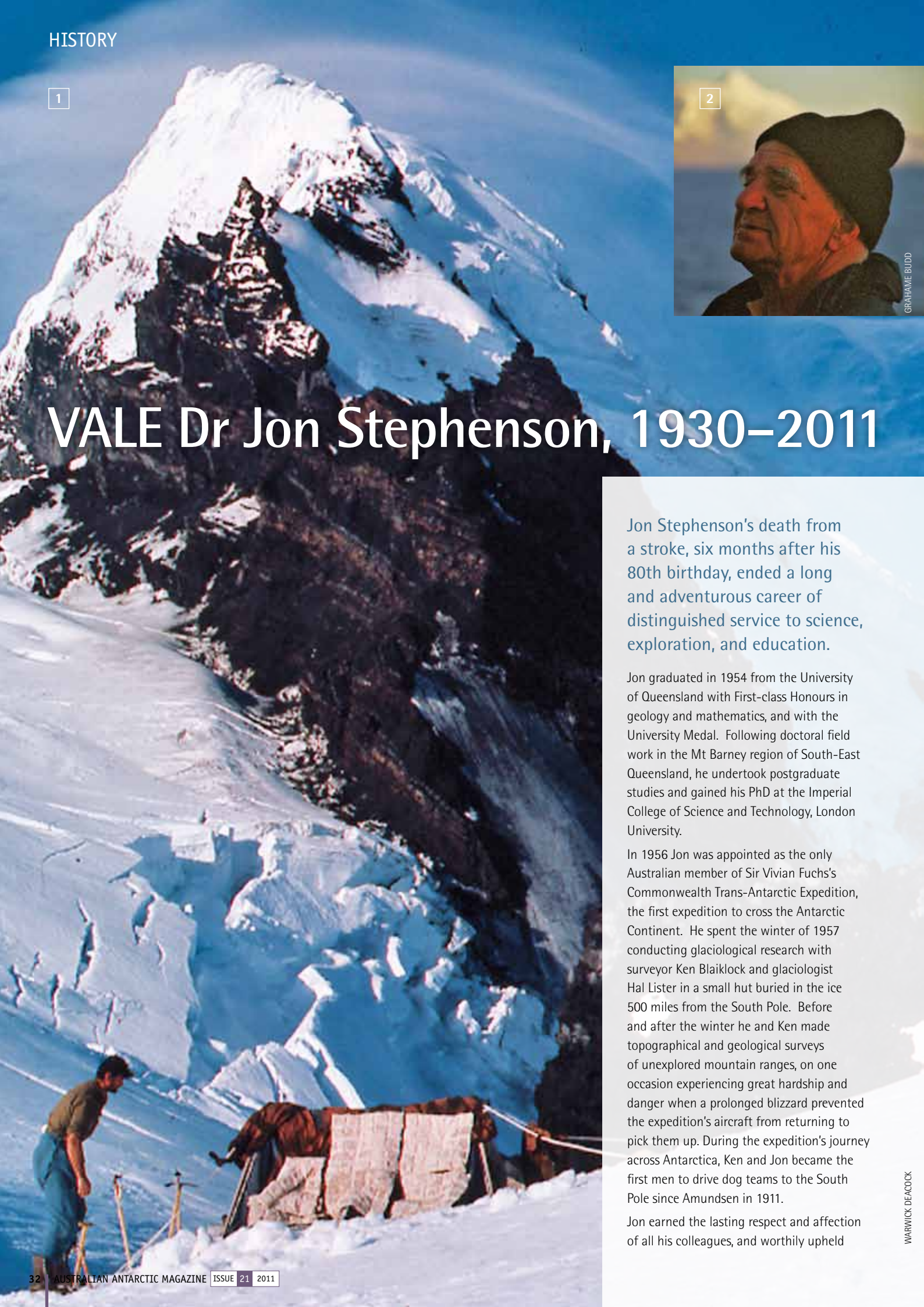
The restoration of Biscoe Hut has been Mike's main focus since 2006. After spending many summer seasons working at Mawson and winter seasons planning and researching at home in Tasmania, he expresses quiet satisfaction with the work that's been completed so far.

'It is a very special building. As a heritage project it's a really nice one, because it's a building which was kind of worn but it's not been abused or changed radically. It's quite a tidy thing to work on. Often when you get buildings that are very old and kind of kicked around, they can be so damaged they don't actually give you a good impression of what they were. When we're finished, Biscoe is probably going to look better than it ever did. I'm really pleased with the way the restoration has unfolded.'

JILL BROWN

Corporate Communications, Australian Antarctic Division

1



2

GRAHAME BUDD

VALE Dr Jon Stephenson, 1930–2011

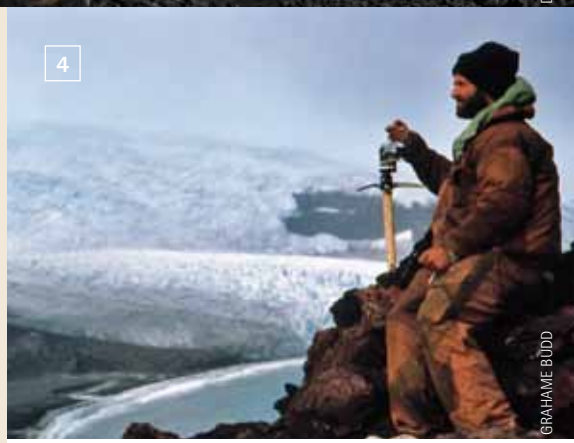
Jon Stephenson's death from a stroke, six months after his 80th birthday, ended a long and adventurous career of distinguished service to science, exploration, and education.

Jon graduated in 1954 from the University of Queensland with First-class Honours in geology and mathematics, and with the University Medal. Following doctoral field work in the Mt Barney region of South-East Queensland, he undertook postgraduate studies and gained his PhD at the Imperial College of Science and Technology, London University.

In 1956 Jon was appointed as the only Australian member of Sir Vivian Fuchs's Commonwealth Trans-Antarctic Expedition, the first expedition to cross the Antarctic Continent. He spent the winter of 1957 conducting glaciological research with surveyor Ken Blaiklock and glaciologist Hal Lister in a small hut buried in the ice 500 miles from the South Pole. Before and after the winter he and Ken made topographical and geological surveys of unexplored mountain ranges, on one occasion experiencing great hardship and danger when a prolonged blizzard prevented the expedition's aircraft from returning to pick them up. During the expedition's journey across Antarctica, Ken and Jon became the first men to drive dog teams to the South Pole since Amundsen in 1911.

Jon earned the lasting respect and affection of all his colleagues, and worthily upheld

WARWICK DEACOCK



1. The Mountain Party's camp at 4000 feet, during their climb to the summit plateau of Big Ben on Heard Island in February 1963. Peak 7600 dominates the background. The party subsequently endured five days of blizzard on the plateau and were forced back to sea level under life-threatening conditions. Read the account of this formidable journey in *ANARE Reports* No. 74 (1964).
2. Jon Stephenson at Heard Island in 2002.
3. Stephenson Glacier and Stephenson Lagoon on Heard Island, named after Jon Stephenson, in recognition of his contribution to the understanding of the island's geology.
4. Jon Stephenson takes compass-controlled panoramas of retreating glaciers at Saddle Point, Heard Island, in February 1963.

Australia's international reputation in Antarctic exploration and science. The Stephenson Bastion at 81°S in the Shackleton Mountains has been named for him. His fine book about the expedition, published in 2009 under the apt title *Crevasse Roulette* (Rosenberg, Sydney), is recognised as a significant contribution to Antarctic literature and history.

From 1958 to 1960 Jon worked as an 'Expert in Mineralogy' with UNESCO at the University of Punjab in Lahore, West Pakistan. He lectured in geology, and undertook field research with students in the Himalayan foothills. When this appointment ended he organised and led a small private expedition to an unexplored region of the Eastern Karakoram. The expedition was plagued by illness, bad weather, and an accident that forced one member to withdraw. Despite these setbacks, Jon completed a topographical and geological survey, and reached a height of 7000 m during a gallant solo attempt to make the first ascent of K12 (7428 m).

In 1963, with two fellow members of the Australian National Antarctic Research Expeditions (Warwick Deacock and myself), Jon undertook an ambitious investigation of the glaciology, geology and vulcanology of the unexplored summit region of Big Ben (2745 m), the heavily glaciated active volcano that forms the bulk of Heard Island. After eight days of relaying heavy loads up the mountain the party camped on the summit plateau (2285 m) with the necessary equipment and supplies for a fortnight's work – but a prolonged blizzard then began, and seven days later the loss of a food depot and other misadventures forced them back to their starting point at Long Beach, fortunate to have escaped with their lives.

On their subsequent overland circuit of the island they discovered, and comprehensively documented, massive glacier retreat – some of the earliest evidence of climate change in the South Indian Ocean. Throughout the journey Jon collected rocks for later studies of their age, petrology, and palaeomagnetism, and as the first geologist to traverse those parts of the island he substantially extended what was then known of the island's geology. In recognition of his contribution, two prominent landmarks on Heard Island – Stephenson Glacier and the Stephenson Lagoon – were named for him.

In 1961 Jon established the Department of Earth Sciences at James Cook University in Townsville, and over the next 35 years he built it up to be the thriving department it is today. From 1979 to 1982 he was Dean of the Faculty of Science. His infectious enthusiasm for his subject, whether in formal lectures and seminars or in field work, made him an inspiring teacher. He organised and led many research expeditions in North Queensland and the South-West Pacific, which yielded much new knowledge, especially about volcanic rocks and the origin and evolution of landforms. The expeditions included an investigation of active volcanoes on Ambrym Island in the New Hebrides, as well as extensive pioneering research in North Queensland on old volcanoes, long lava flows, the Undara lava tubes, and the Toomba lava flow. Jon published numerous research papers and monographs on his findings, and co-edited an important reference book on the geology of North-East Australia. A brilliant photographer, he recently created superb large-format photographic narratives of the Trans-Antarctic Expedition and his Karakoram Expedition, which have been exhibited in many galleries and libraries.

After retiring from his Associate Professorship in 1995 Jon held honorary research positions at James Cook University and the Museum of Tropical Queensland. He continued to broaden his experience in extensive travels, often as a trek leader in the Himalaya and as a lecturer on Antarctic cruises. It was on one of these cruises that Jon made detailed observations of the recent volcanic transformation of McDonald Islands (near Heard Island), which he subsequently reported in the journal *Antarctic Science*.

Jon will be sorely missed by all who knew him. He was a staunch, generous, and stimulating friend, and the perfect expedition companion – tough, dependable, considerate, and great company. One of the most intellectually adventurous persons I've known, Jon had an insatiable appetite for science, history, literature and music. His contributions have been recognised by the naming for him of three prominent topographic features in the Antarctic, by the award of the Queen's Polar Medal, and by the Australian Geographic Society's 'Lifetime of Adventure' award. Our deepest sympathy is extended to his wife Jenepher, their three daughters, and their seven grandchildren.

GRAHAME BUDD
Former ANARE expeditioner 1954–1971

1

Engineering award for Davis station

ANDREW STANLEY

A new super-insulated building at Australia's Davis station has won an Engineers Australia Award for Excellence.

1. Project Engineer Mark Pekin in front of the new Living Quarters.
2. The panels being lifted onto the steel frame of the building

2

MARK PEKIN

The Davis station living quarters, designed by the Australian Antarctic Division and Hyder Consulting, is a steel framed building clad in thermally efficient fibre-composite panels, made from extruded polystyrene foam, laminated timber and a fibreglass 'skin'.

The building can accommodate up to 120 expeditioners and contains a new kitchen, dining room and common areas such as lounges, cinema and a library.

Traditionally, the Antarctic Division has used commercially available cool room style sandwich panels to insulate its buildings from the Antarctic weather. The new 205 mm-thick fibre-composite panels have a greatly improved thermal efficiency, and are flexible and strong. The panels were fabricated at the Antarctic Division's headquarters in Kingston before being shipped south.

The building's main structural steel frame and its foundations were tailored to maximise the inherent strength in the panels. A unique panel fixing method was developed that utilised stainless steel coach screws to fix the fibre-composite panels to the steel frame from the inside only. Laminated timber beams were incorporated into the panels at specific locations to enable them to be fixed to the steel frame without using a bolt to penetrate the panels' outer skin. This eliminates the ingress of cold from outside, and therefore the need for additional thermal flashing.

A potential draw-back of the fibre-composite panels was the build-up of electrostatic charge, due to the action of wind over fibreglass in the dry Antarctic atmosphere. To prevent this, a carbon cloth layer was incorporated into the outer skin of the panel to conduct charge to earth via a drain wire. The carbon cloth layer also provides additional strength and therefore better protection from the impact of any flying debris in extreme winds.

The extreme Antarctic weather conditions dictated every aspect of the building project, including the internal layout of the building, which aimed to improve functionality and minimise the impact on scientists' optical experiments. For example, the southern and eastern ends of the building, which are exposed to the more extreme weather conditions, house the ablutions area, building plant rooms, and kitchen cool room and pantry. As these facilities do not need windows there is no light spill that could affect optical experiments in the neighbouring building. The lounge and dining facilities along the north and west areas of the building provide outlooks over Prydz Bay and towards the Sorsdall glacier. These rooms take advantage of the northerly sun to greatly enhance natural lighting within the building.

The building also has super-insulated windows with two panes of glass, heat mirrors and three krypton gas-filled voids, providing more insulation in each window than a typical pink-batt. These windows enhance the thermal efficiency of the building. As a result, very large windows could be installed in the lounge area, providing excellent natural lighting, while sweeping views of the landscape enhance expeditioners' association with the 'outside'.

Davis Station Leader, Graham Cook, said expeditioners were enjoying their new building.

'The open plan, large windows, modern furniture and sensational 180° views from both the lounge and the mess in the new building have made it a place where expeditioners want to meet, mix , relax and enjoy their surroundings', he said.

MARK PEKIN

Davis LQ project engineer, Australian Antarctic Division

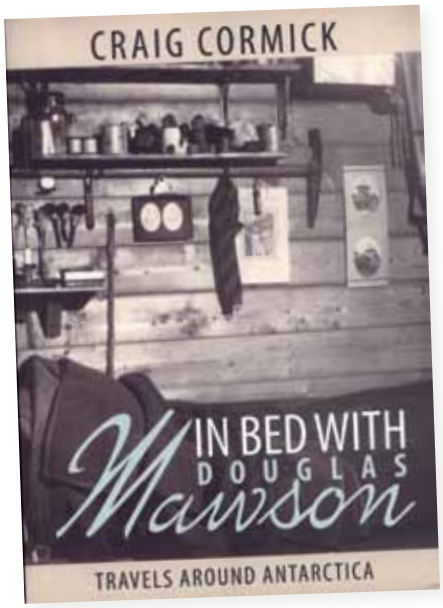
The Engineers Australia Award for Excellence was judged on four criteria:

- sound engineering practice/principles;
- originality/ingenuity;
- adherence to budget and program;
- extent to which the work has provided a safe and healthy working environment.

The Engineers Australia judges said the building design: 'offered a largely pre-fabricated solution which was transportable, strong, spatially efficient and offered outstanding thermal properties. A unique panel fixing system enabled the panels to be fixed to the steel framework from the inside only. This system improves panel durability and thermal efficiency, provides easy access for maintenance and eliminates the need for external scaffolding during construction. The building method provided for faster construction times and a subsequent decrease in overall construction costs.'

The building is now in the running for the National Engineers Australia Awards.

IN BRIEF

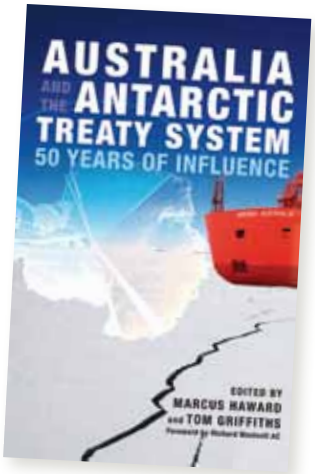


In Bed With Douglas Mawson

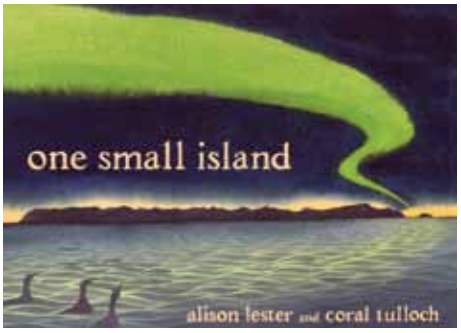
Former Australian Antarctic Arts Fellow, Craig Cormick, has published a book largely written during his seven week journey to Antarctica in 2008. *In Bed With Douglas Mawson* compares a modern voyage to Antarctica with Douglas Mawson's voyage of 100 years ago, and looks at the past, present and the future of Australian involvement in Antarctica. In the book, Craig visits Australia's three Antarctic stations with the ghost of Douglas Mawson at his side, and muses about, and with, the great explorer and geologist, as he experiences the Southern Ocean and the continent for the first time. The book is available from New Holland Publishers Australia for $29.95 www.newholland.com.au/product.php?isbn=9781742570082.

Australia and the Antarctic Treaty System – 50 years of influence

Australia and the Antarctic Treaty System – 50 years of influence, celebrates the 50th anniversary of the Antarctic Treaty. It brings together a high-calibre team of writers and draws on political interviews, historical investigation, legal analysis and scientific research, to reveal the perspectives of both academics and practitioners expert in the history and future of Antarctica. Its 16 chapters cover the history of Australia's involvement in the Antarctic Treaty and thematic issues including Antarctic science, resources, environment, diplomacy and culture.



Edited by Marcus Haward and Tom Griffiths, the book is described by Richard Woolcott AC as 'a major work – a well-researched, wide-ranging and valuable account of the nation's role on the continent and in the development of the highly successful Antarctic Treaty'. The book is available from University of New South Wales Press for $59.95 www.unswpress.com.au/isbn/9781742232232.htm



One Small Island

Former Australian Antarctic Arts Fellows, Alison Lester and Coral Tulloch, have produced a beautifully designed and illustrated non-fiction picture book about Macquarie Island. *One Small Island* tells the story of the natural and human history of the island through Alison's stunning landscape paintings and Coral's detailed artwork and calligraphy. The book begins with the geological birth of the island, and goes on to describe the discovery and destruction of seal and penguin colonies, the introduction of alien species such as rats, cats and rabbits and efforts to remove them, and the establishment of a scientific station. The book draws on historical journals, maps, scientific notebooks and photographs of Macquarie Island. It is available from Penguin Australia for $29.95 www.penguin.com.au/products/9780670072361/one-small-island

Mawson's Last Survivor: The Story of Dr Alf Howard AM

Alf Howard (1906–2010) sailed with legends of the heroic era of Antarctic exploration and became a legend in his own lifetime. He was the last surviving member of Sir Douglas Mawson's 1929–1931 British, Australian and New Zealand Antarctic Research Expedition (BANZARE) and the last survivor to have served aboard the coal-fired, three-masted wooden ship *Discovery*, built for Captain Robert Falcon Scott's 1901–1904 Antarctic odyssey.

Alf's adventurous life and work is documented in a new book by his biographer, Dr Anna Bemrose. *Mawson's Last Survivor: The Story of Dr Alf Howard AM* details Alf's work as a young chemist and hydrologist during BANZARE (illustrated with Frank Hurley's photographs), and his distinguished career with the CSIRO. It also reveals Alf's thirst for knowledge and adventure, and his spirit of generosity – he held degrees in physics and linguistics and a PhD in psychology and for more than 20 years, until the age of 97, he designed computer programs and provided statistical advice to postgraduate students and staff at the University of Queensland. In the 1990s, Alf returned to Antarctica four times.

The book is a fascinating account of a humble Antarctic pioneer with a wry sense of humour. It is available from Boolarong Press for $32.95. http://www.boolarongpress.com.au/content/bookstore/

RAY MORRIS

FREEZE FRAME

KERRY STEINBERNER first visited Davis as a volunteer biologist in 1997–98 after completing an Honours degree in Antarctic Studies. She has since wintered at Mawson and Macquarie Island and visited Casey and Heard Island in various roles with the Bureau of Meteorology and the Australian Antarctic Division. This year she wintered at Davis as a meteorological observer. She used her grandfather's old Canon camera on her first Antarctic trip and has had plenty of inspiration to practice since.

This ice sculpture was taken at Crooked Lake, near Davis. The ice blocks were originally rafted ice in the freshwater lake, which were so large, sharp and dense that they were difficult to drive through in June. By September, when I took this photo, they had been eroded into small sparse sculptures by the wind. To get the sun angle right I had to lie on my back and take this upside down over my head.

ANTARCTICA
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Australian Government
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