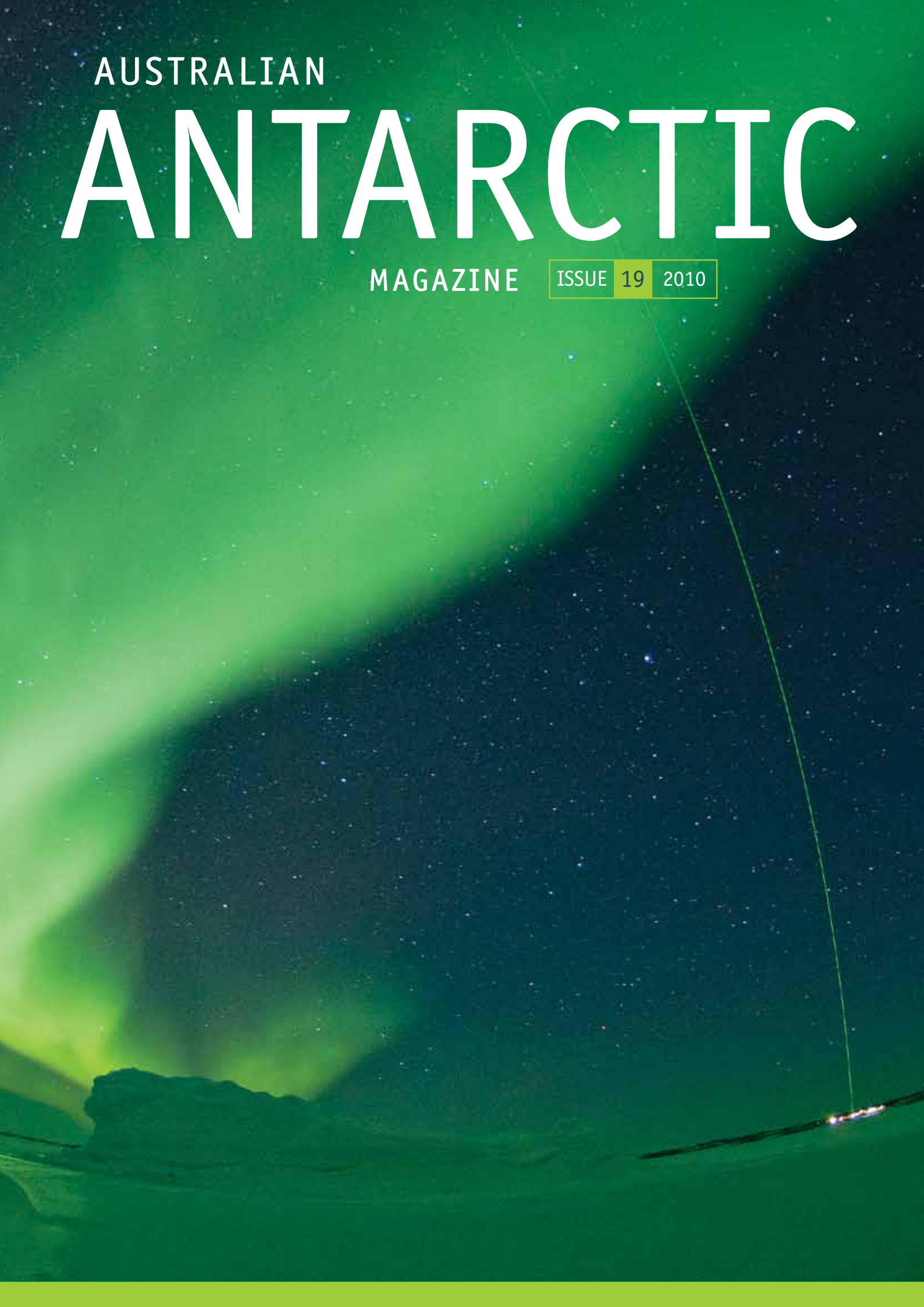


AUSTRALIAN ANTARCTIC MAGAZINE

ISSUE 19 2010

AUSTRALIAN
ANTARCTIC
MAGAZINE

ISSUE 19 2010

The Australian Antarctic Division, a division of the Departmentof 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.

The Editor
Australian Antarctic Magazine
Australian Antarctic Division
203 Channel Highway
Kingston, 7050
Tasmania, Australia

Australian Antarctic Division
Telephone: (03) 6232 3209
(International 61 3 6232 3209)
Email: magazine@aad.gov.au
Facsimile: (03) 6232 3288
(International 61 3 6232 3288)

Editor: Wendy Pyper
Production: Sally Chambers, Jonothan Davis, Jessica Fitzpatrick, Glenn Jacobson, Mat Oakes.

Graphic Design: Clemenger Tasmania

ISSN 1445-1735 (print version)

Australian Antarctic Magazine is printed on Monza satin recycled paper; a 50% post-consumer waste and 50% FSC-certified fibre stock.

Australian Antarctic Magazine can be viewed online: www.antarctica.gov.au/magazine

Australian Government
Department of Sustainability, Environment, Water, Population and Communities
Australian Antarctic Division

CONTENTS

BEN O'LEARY

ABOUT THE COVER

Weather observer Nick Roden took this photograph of the aurora australis, intersected by the LIDAR laser beam at Davis station, on a cold July night this year. The aurora australis results from the interaction of the solar wind with the Earth's magnetic field. 'Excited' oxygen atoms hit by charged particles from the sun emit river-like ribbons of neon-green light as they return to their lowest energy state. Nick says it took only 30 seconds to take the photograph but planning for it and waiting for the right conditions took many months. Another of Nick's aurora photos features in this issue's Freeze Frame section on page 37.

ARKO LUCIEER

AERIAL 'OKTOKOPTER' TO MAP ANTARCTIC MOSS

ARKO LUCIEER

Top: This small depression in a Casey moss bed highlights the effect of micro-topography and water availability on moss health. The moss above the depression is drying out and turning light brown.

Above: The first UAV, comprising a remote-controlled helicopter with a camera, at Robinson Ridge in 2010.

Polar regions are experiencing rapid and severe climatic shifts with major changes in temperature, wind speed and UV-B radiation already observed in Antarctica. As climatic records only extend back 50 years, we urgently need new proxies to determine if coastal climate has changed over the past century.

In a manner similar to trees, old-growth mosses preserve a climate record along their shoots. The Windmill Islands region near Casey has the most extensive and well-developed moss beds in Eastern Antarctica. Our ability to accurately date these mosses and map their extent in sufficient spatial detail means that, for the first time, mosses can be used as sentinels to provide crucial information on how the Antarctic coastal climate has changed over past centuries and how biota has responded to these changes.

In the first year of our project, 'Spatial analysis of changing terrestrial ecosystems in the Windmill Islands and the sub-Antarctic', and the first field season at Casey in 2010, we found that the spatial scale of the moss beds (tens of square metres) makes satellite imagery unsuitable for mapping their extent in sufficient detail. However, recent developments in the use of unmanned aerial vehicles (UAVs) for remote-sensing applications provide exciting new opportunities for ultra-high resolution mapping and monitoring of the environment.

In 2009, we developed a new UAV consisting

1

WENDY PYPER

of an electric remote-controlled helicopter capable of carrying three different cameras for cost-effective, efficient, and ultra-high resolution (less than 5 cm pixel size) mapping of terrestrial vegetation in the Windmill Islands. We managed to collect spatial data for four different moss sites: Antarctic Specially Protected Area (ASPA) 135, the Red Shed, Robinson Ridge, and ASPA136. During our UAV tests at Casey in 2010 we also demonstrated that the UAV is ideal for capturing photographs of the station buildings and environment – providing a quick and easy way to collect spatial information for management purposes.

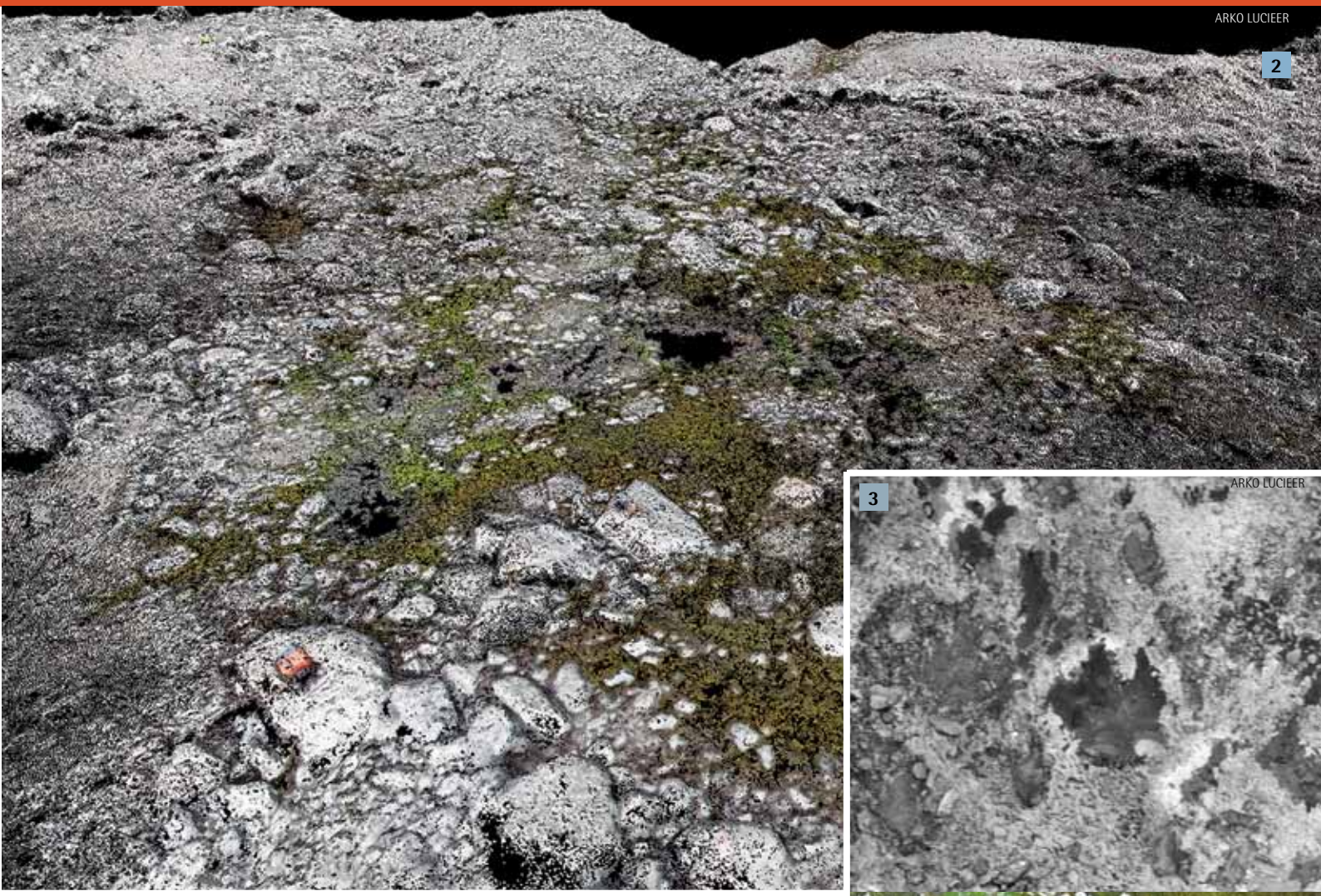
The location of moss communities is largely driven by water availability and is restricted to moist environments that receive water during the summer snow melt. Topographic factors such as micro-topography (e.g. boulders and rocks), water drainage, upstream catchment, slope and solar irradiance play a key role in moss occurrence and health. We collected data on the moss bed topography using accurate GPS receivers to capture some of these important environmental factors. From these GPS transects we managed to create digital elevation models (DEMs), but we found that the subtle variation in the terrain (micro-topography) was insufficiently captured in the GPS data. Accurate and detailed information on the micro-topography is of crucial importance for moss bed mapping and monitoring as it drives water availability and local temperature. To address this issue we adopted an exciting new technique developed in the field of computer vision. With this technique we can extract very detailed '3-D point clouds' of the terrain by overlapping UAV photographs, allowing us to capture the micro-topography in an extremely detailed spatial dataset (image 2).

More recently we purchased and developed a new UAV called the 'OktoKopter'. This multi-rotor helicopter is a much more stable platform than the UAV we developed in 2009. The OktoKopter allows us to take sharper photos with a full-size digital SLR camera and a stabilised camera platform. The Oktokopter also has an autopilot that allows autonomous navigation to GPS waypoints, enabling more efficient coverage of the moss beds. In 2011 we plan to use the OktoKopter to map the Casey moss beds in greater detail than before. The OktoKopter will carry three new sensors: a high-resolution digital camera (DSLR), a six-band multispectral camera (allowing us to detect moss species and their health), and a thermal camera for mapping the moss temperature. This exciting new equipment and the science behind it will provide us with state-of-the-art datasets that will teach us more about these special Antarctic sentinels.

ARKO LUCIEER[1], SHARON ROBINSON[2] and DANA BERGSTROM[3]

1. University of Tasmania, 2. University of Wollongong, 3. Australian Antarctic Division

1. *The more stable eight-rotor OktoKopter, mounted with a six-band multispectral camera, which will be used to map Casey moss beds in the 2011 Antarctic summer.*
2. *A 3-D point cloud with 1 cm point spacing that captures the micro-topography of the moss beds. This point cloud is derived from overlapping UAV photography.*
3. *Two detailed UAV photographs of a 6 m x 4 m area showing a visible photograph (bottom) and a near-infrared (NIR) photograph (top). The NIR photograph shows healthy moss as bright pixels.*
4. *UAV photograph and location of moss quadrats draped over the DEM.*

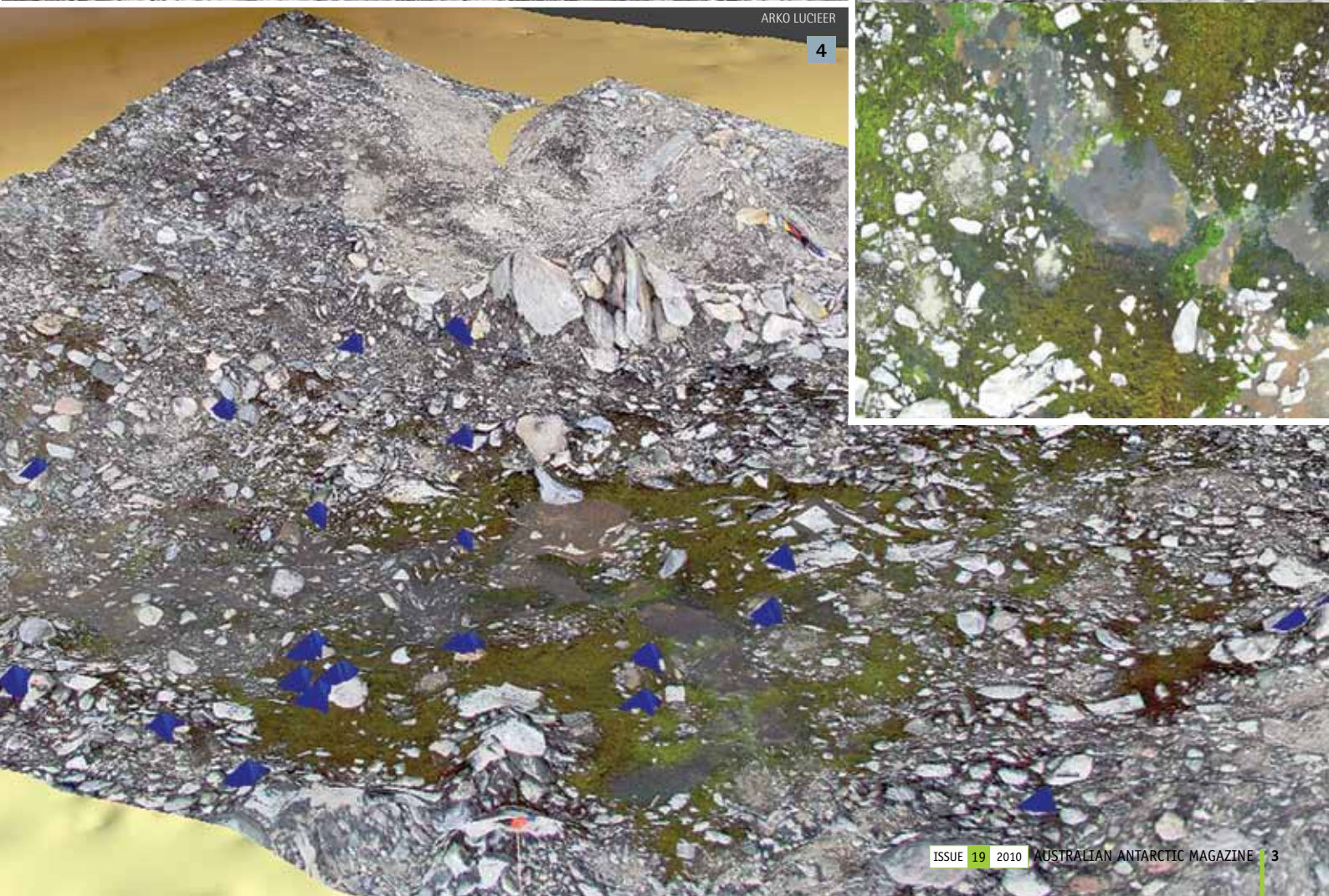


ARKO LUCIEER

2

ARKO LUCIEER

3



ARKO LUCIEER

4

Whale poo fertilises oceans

1

DAVE & FIONA HARVEY

Australian Antarctic scientists recently tested their hypothesis that whale poo can act as a fertiliser in the ocean. Their results suggest that the recovery of whale populations to pre-whaling numbers could actually increase the productivity of the ecosystem.

The idea that whale poo could help to fertilise the ocean has been floating around for a while. Basically, large whales in the Southern Ocean consume large quantities of krill, but because they are producing blubber rather than muscle they have no 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 that acts like liquid manure.

A number of studies have shown that the growth of microscopic algae in the Southern Ocean is limited by the iron concentration in the water. Iron enters the ocean either through wind-blown dust from the Antarctic continent or through the upwelling of water from the ocean depths. The deep water is richer in nutrients because particulate matter, including dead algae and detritus, sinks out of the sunlit layer to the ocean's interior, where microbial processes break it down into its constituent chemicals. Any process that keeps the nutrients in circulation in the surface layer, rather than sinking, should ensure that algal growth is sustained. This is where the notion of whales as fertilisers of the ocean comes in.

Whales could only play a role in recycling iron if there was a large amount of iron in their faeces. However, the difficulty of measuring the iron content of whale poo has held back research for a number of years. Luckily, in the Hobart area there is a critical mass of Southern Ocean scientists with a unique range of skills who were undaunted by the difficulties involved in testing this theory. As part of the non-lethal whale research program being conducted by the Australian Marine Mammal Centre at the Australian Antarctic

2

MIKE DOUBLE

Division, we had been using advanced molecular techniques to examine whale poo collected from around the world in a bid to understand their diet. So we had a collection of poo samples and we knew what the whales had been eating. Scientists at the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) had also been studying the role of iron in the Southern Ocean, so we also had specialised chemists and the sophisticated equipment required to measure the minute quantities of iron in seawater. Add some marine ecologists to this mix of expertise and we had the potential to address the question of whether whales could be involved in their own version of ocean fertilisation.

After analysing 28 samples from four different species of whale, we were surprised to discover that baleen whale poo contains 10 million times more iron than an equivalent weight of seawater. From our molecular studies we knew exactly what the whales had been eating and we were able to confirm that the krill in their diet was the source of the iron we were measuring. Finally, we wanted to see how much iron whales had stored in their bodies, so we measured the concentration in muscle samples from stranded blue and fin whales, and again we got very high values.

The high concentrations of iron that we measured in the flesh of whales and krill in the Southern Ocean suggested that the role of larger animals in the cycling of nutrients had been overlooked in the past; so we did a few simple calculations. We had recent estimates of how much krill there are in the Southern Ocean; we knew the background concentration of iron in the seawater; and we could estimate the area in which krill were most abundant. So we were able to compare the total amount of iron in krill to the total amount of iron in the seawater where they live. We found that in 19 million square kilometres of the Southern Ocean krill appear to contain 24% of the iron. This iron is incorporated into their tissues and because krill are strong swimmers they can keep this significant quantity of iron suspended in the upper layer of the ocean, unlike smaller organisms or inorganic particles, which tend to sink.

Although individual whales contain large amounts of iron, their relative scarcity means that their main role seems to be in converting the iron reservoir in the bodies of krill into liquid manure. This fertilising role is likely to work on a small scale today, but in the pre-whaling era when there were millions of great whales in the waters around Antarctica in summer, their effect on iron recycling was likely to be far greater. Interestingly, there are suggestions that when there were more whales, there was also more krill and that algal productivity would have had to be higher to support all these animals. If whales and krill are vital for recycling iron in the ocean, then this explains how an ecosystem with more animals in it can also be a more productive ecosystem. Could it be that allowing whales to recover to their former numbers would actually enhance fisheries production, rather than detract from it?

This research was conducted by Simon Jarman, Klaus Meiners and Steve Nicol from the Australian Antarctic Division and Andrew Bowie, Delphine Lannuzel and Pier van der Merwe from the ACE CRC.

STEVE NICOL
Program Leader, Southern Ocean Ecosystems


J. BROKOWSKI

3


SARAH ROBINSON

4

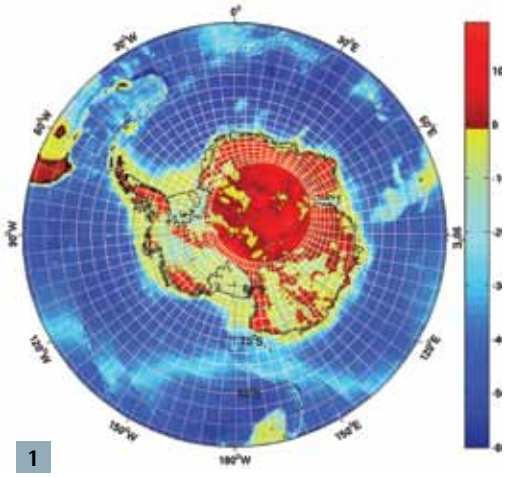
1. *Whales such as this humpback could play a role in fertilising the oceans and enhancing ecosystem productivity.*
2. *A scientist takes a whale poo sample for molecular analysis.*
3. *A whale leaves a plume of faecal material in its wake.*
4. *Australian Antarctic Division whale researcher Dr Nick Gales collects a sample of whale poo.*

MODELLING INTERACTIONS BETWEEN ANTARCTICA AND THE SOUTHERN OCEAN

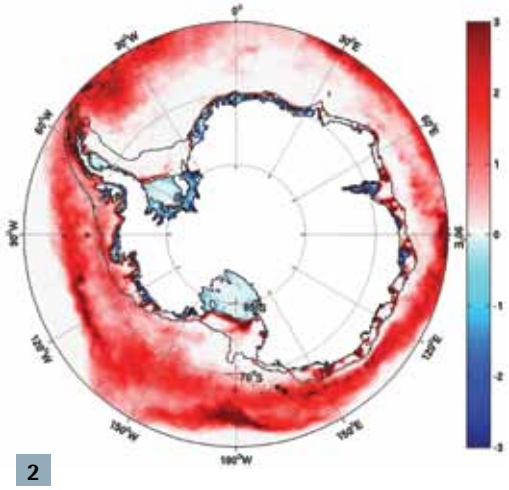
Ice sheets have a complicated relationship with oceans. The margins of Antarctica are shrinking due to warmer climate, causing sea levels to rise and the oceans to freshen. The increased loss of ice from Antarctica is mostly due to the rapid thinning and retreat of glaciers, driven by the enhanced melting of ice shelves that fringe the continent. These massive floating ice shelves are continually eroded by melting that occurs at their base and the calving of icebergs from their front. The enhanced supply of cool and fresh glacial meltwater into the Southern Ocean is the most likely cause of the observed changes seen in the dense (cold and salty) water that feeds the global overturning circulation. However, we do not yet fully understand the processes that link ocean warming to ice-shelf melting and the retreat of glaciers and dense water formation.

Research at the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) will improve our understanding of the interaction between the Southern Ocean and the Antarctic ice sheet using state-of-the-art modelling. The model solves mathematical equations that describe the physics of the ocean and its interaction with ice shelves (see graphics). This model is based on the Regional Ocean Modelling System, which is widely regarded as the best model for coastal oceanographic process studies. The model is able to simulate interactions between ocean flows and topography such as the buoyant plumes of glacial meltwater that can rise under ice shelves and the dense water that flows from the continental shelves to the deep ocean. Realistic simulations rely on comprehensive descriptions of the various physical components (the sea floor, ice sheet, ocean and atmosphere) and the way that these interact with each other. These inputs, collectively known as 'boundary conditions' are in part derived from a suite of observations. However, many inputs are often poorly understood, such as the shape of the ocean cavity beneath ice shelves.

Oceanographic observations like those collected by the AMISOR project (see page 26) are extremely valuable for defining boundary conditions and testing the level of realism that the model can produce. Continued collection of such data is important to further improve the models. Conversely, the development of realistic simulations can help to extend our interpretation of the few observations we do have, to times and places where there are currently none. In addition, the planning of future field campaigns can be guided by results from these types of realistic simulations. Future research needs strong interdisciplinary collaboration between modellers and observers to rapidly progress our understanding of the role of the cryosphere in the global climate system. Realistic simulations can be a valuable research tool for all sciences interested in the Southern Ocean and coastal oceanic environment around Antarctica.



1



2

3

ANDREW MEIJERS

If you wish to learn more about the modelling outlined here please contact Ben at Ben.Galton-Fenzi@utas.edu.au

BEN GALTON-FENZI
ACE CRC

1. *Southern Ocean bathymetry and Antarctic bedrock topography overlain with the model horizontal grid, showing every 20 cells (white lines). The model domain extends from 50°S to the Antarctic continent. The grid was developed to allow for simulations that can examine the retreat of the Antarctic ice sheet under future climate change scenarios.*
2. *Mid-winter snapshot of the surface ice growth rate (metres per year), where red is ice growth and blue is melt. The continental shelf break is indicated by the 1000 m bathymetry contour (thin black line). The ice shelves are mostly melting and strong sea ice growth can be seen from polynyas on the continental shelf and at the advancing ice front in the open ocean.*
3. *This jade iceberg was once part of the Antarctic ice sheet.*

ICECAP returns to Casey

The ICECAP project ('Investigating the Cryospheric Evolution of the Central Antarctic Plate') returned to Casey in December 2009 for the second of three field seasons. The suite of instruments on the Basler aircraft enables us to explore the bedrock topography and geology, conditions at the bottom of the ice sheet and layer structures within the ice.

The first season, which had mapped the Aurora Subglacial Basin and Totten Glacier on a broad scale, revealed that much of this region of the ice sheet sits on bedrock far below sea level (*Australian Antarctic Magazine* 17: 24, 2009). Taken together with observations that the lower reaches of the Totten Glacier is losing ice, this suggests the ice sheet in this region is potentially more sensitive to higher ocean temperatures than previously expected. Accordingly, the 2009–10 season focussed on surveys over the trunk of the Totten Glacier, with additional flights over the Denman Glacier and several long-range flights east of Casey, to extend the broad-scale exploration of the first season.

A short stay at Casey, between campaigns at McMurdo and Dumont d'Urville stations, achieved nine flights in 14 days, covering 17 000 km. The total for the season was 38 flights and 62 000 km surveyed.

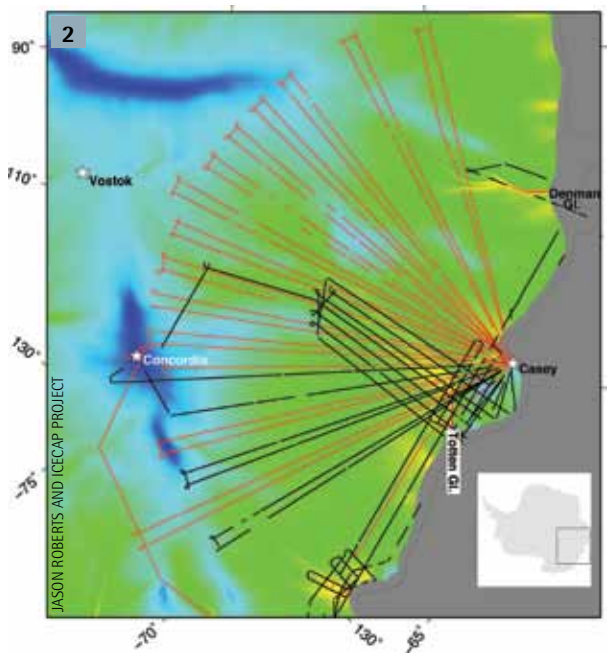
The 2009–10 field season also marked ICECAP's participation in NASA's Operation ICE Bridge (www.nasa.gov/mission_pages/icebridge/index.html); adding a scanning, photon-counting LIDAR (light detection and ranging instrument) to the existing instrument package. ICE Bridge work involved flying along tracks previously surveyed by NASA's ICESat altimeter satellite, to continue monitoring changes in the ice sheet elevation until ICESat-II is launched.

The Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) has funded 20 flights out of Casey for the 2010–11 field season, totaling about 40 000 km of data, during December and January, with a short interval of operations at Dumont d'Urville. ICECAP flies at night to minimize solar magnetic noise on its magnetometer instruments, which increases the hectic pace of station life. Such major aerial surveys rely on the participation of many people, especially for air-ground support, communications, and weather forecasting. As such, ICECAP involves scientists from the ACE CRC, the Australian Antarctic Division, Laboratoire d'Études en Géophysique et Océanographie Spatiales (LEGOS), the universities of Edinburgh, Exeter and Texas at Austin, with logistics support from the Australian Antarctic Division, United States Antarctic Program and Institut Paul Émile Victor.

ROLAND WARNER and JASON ROBERTS
ACE CRC and Australian Antarctic Division

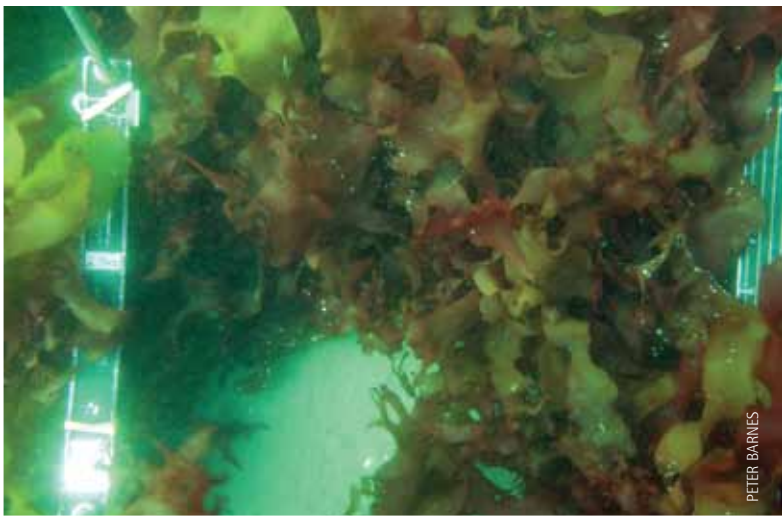
More information

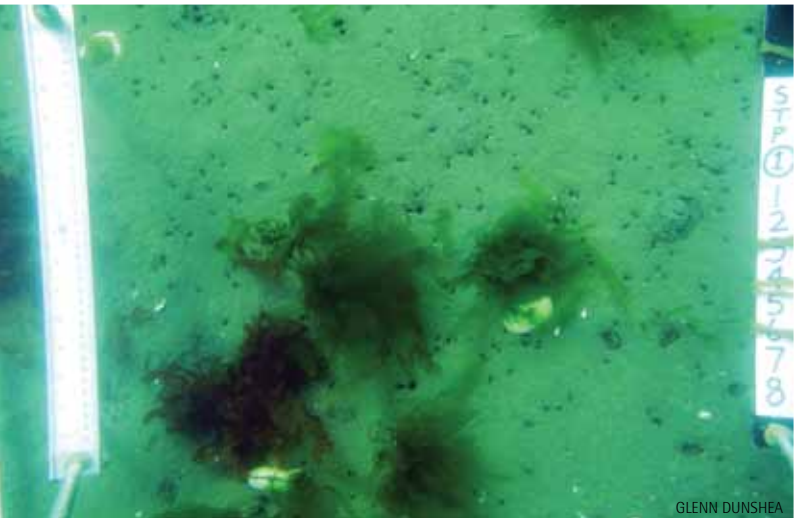
D. Fox (2010). *Could East Antarctica Be Headed for Big Melt?* Science 328(5986), pp 1630-1631, doi: 10.1126/science.328.5986.1630

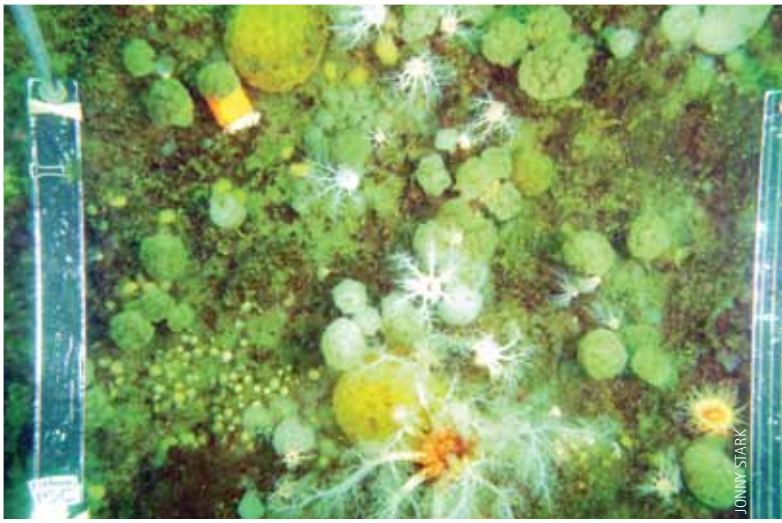


1. *The ICECAP team and Basler aircraft at Casey (L-R): Dean Emberley (pilot, Ken Borek Air), Jamin Greenbaum (Texas), Jorge Alvarez (Texas), Andrew Wright (Edinburgh), Duncan Young (Texas), Young Gim (NASA Jet Propulsion Laboratory), Dave Meyer (engineer, KBA), Noel Paten (Australian Antarctic Division), Ray Cameron (pilot, KBA). (Not pictured – Glenn Hyland of the Antarctic Division). The red antennas of the ice-penetrating radar can be seen on one of the wings.*
2. *The flight tracks of the first (red) and second (black) ICECAP seasons in the Casey region, surveying the Aurora Subglacial Basin south of Casey and the Denman and Totten glaciers, superimposed on computer modelling of ice sheet flow; from very low flows in blue to major glacial flows in yellow and red.*
3. *Jamin Greenbaum from the University of Texas makes pre-flight checks of the ICECAP instruments aboard the Basler aircraft.*


GLENN JOHNSTONE


PETER BARNES


GLENN DUNSHEA


JONNY STARK

Seabed surveys for sewage solutions

The environmental impact of sewage discharged from Davis station into the surrounding bay was the focus of an intensive scientific diving program in Antarctica last summer (2009–10). The secondary wastewater treatment system at Davis failed several years ago and sewage has since been macerated and discharged to the ocean. While this practice meets the minimum requirements of the Protocol on Environmental Protection to the Antarctic Treaty, understanding the impact of the sewage outfall on the environment will inform future management of the site and the potential installation of a new treatment plant.

As reported in a previous issue of this magazine (17: 20-21, 2009), the three main research questions for our team (six divers and 11 associated support and research personnel) were:

- How well does the sewage disperse in the vicinity of the outfall and are there better alternative locations for the outfall?
- What are the nature and extent of the impact of the present sewage outfall?
- How toxic is the sewage effluent to local species?

To answer these questions we aimed to survey and characterise the habitats, chemistry and biological communities at sites near the sewage outfall and compare these to 'control', or reference sites, far away from the possible influence of the sewage. A rapid survey technique was developed especially for this purpose, to enable comprehensive sampling at as many sites as possible in a five-week window of opportunity for diving. A site was defined as an area of approximately 50 m radius around the work boat at anchor, as this was the area that divers could easily and safely work. In each site a number of different tasks were performed:

- Habitat surveys were conducted to determine the types of physical and biological habitats and their variation from site to site. To do these, four 25 m tape measures were laid on the seabed. Along these the divers recorded the proportion of different substrata types (rock, sand, mud), and types of biological cover (seaweed and invertebrates such as sponges). This information is very important when comparing many different sites, as the types of habitat can have a very strong influence on the types of biological communities present.
- Photoquadrat surveys were performed to collect detailed information on the seabed biological communities. A special frame with a camera mounted on it was used to take

Above: Some examples of the range of habitats encountered in photoquadrats taken by divers (clockwise from top left): A muddy site with many sea pens and several giant isopods visible on the surface, and many bivalve siphons visible at the sediment interface; a sandy site dominated by macroalgae; a site dominated by invertebrates – sea cucumbers, anemones and ascidians; a sandy site with some green macroalgae and many bivalve siphons evident.

a photograph of an area of the seabed of a fixed size. These photos were taken in plots along each of the habitat survey tapes. There were two plots on each tape, 5 m long x 2 m wide, and 8–10 photos were taken in each plot for analysis back in Australia.

- Sediment cores were collected by divers for a range of purposes. Large cores (10 cm diameter x 10 cm deep) were collected to examine the biological communities living within the sediment. Typically, hundreds of small invertebrates (worms, crustaceans, snails and bivalves) were observed in each core. The types of species present and their abundance will provide a measure of ecosystem health as certain types of communities can be characteristic of polluted or disturbed sites. The divers also took smaller cores (5 cm diameter x 10 cm deep) for analysis of physical (grain size) and chemical characteristics. A range of chemical analyses are now being conducted on these cores, including for metals, sewage biomarkers, chemicals, detergents and oils. Smaller cores (taken using 60 ml syringes with the ends cut off) were also extracted for analysis of microbial and micro-invertebrate communities. Microbial communities in particular can provide an excellent indication of the presence of sewage contamination. Replicates of all three core types were taken in two plots, approximately two metres in diameter and at least 10 m apart.
- Invertebrates and fish were collected for several different studies.

The rapid survey technique was designed so that these tasks could be completed at a site in just two dives (with two pairs of divers), but this was dependant on water depth, as dive times are shorter in deeper water.

For much of the season we had to navigate underwater in very poor visibility, due to the plankton bloom that occurs over summer, reducing water clarity to only a few metres of green soup. Later in the season the visibility improved and we encountered some amazing wildlife, particularly in the mouth of Long Fjord where we found very diverse communities of invertebrates. Here there were extensive reefs of serpulid polychaetes (tubeworms), which in turn provided habitat for an amazing array of invertebrates living in and on them, including colourful sponges, ascidians, molluscs and echinoderms. These areas could be biodiversity hotspots and certainly warrant future investigation. Much of the Davis coastline was dominated by macroalgae – red, green and brown seaweeds occupying extensive areas of seabed and contributing to local primary productivity.

JONNY STARK

Davis can be a very unforgiving place to dive from a boat. There is very little shelter from winds as the coastline is low lying and open. We had many days of marginal weather, where the winds were not too strong to prevent us from operating on the water but strong enough to make it very cold and unpleasant. However our work boat, *Pagodroma*, had a nice little cabin, and once we got the heater working we could all crowd in and warm up between dives and munch on frozen sandwiches.

The strong winds caused the boat to swing widely on its anchor, making it difficult for both the divers underwater and the tenders on the surface manning the umbilicals. Unfortunately we were not blessed by the weather of the so-called Riviera of the South, with many more windy days than calm ones. Given the demanding and difficult nature of the field work, it was important to have a team of people we could rotate in and out of the boat over the course of a week, giving divers and tenders a chance to get out of the weather for a day and spend some time in the laboratory, processing the many samples we were collecting.

Early results from the analysis of our samples, surveys and photoquadrats indicate that the discharge from the outfall is being carried south along the Davis shoreline towards Marchant's Landing. However, we will not know the extent or potential impact of the sewage until all the analyses are complete.

In all we surveyed 30 sites, conducted approximately 2.8 km of habitat surveys, took about 2000 photoquadrats, collected more than 400 sediment cores and did 176 dives. Not bad for four and a half weeks!

JONNY STARK

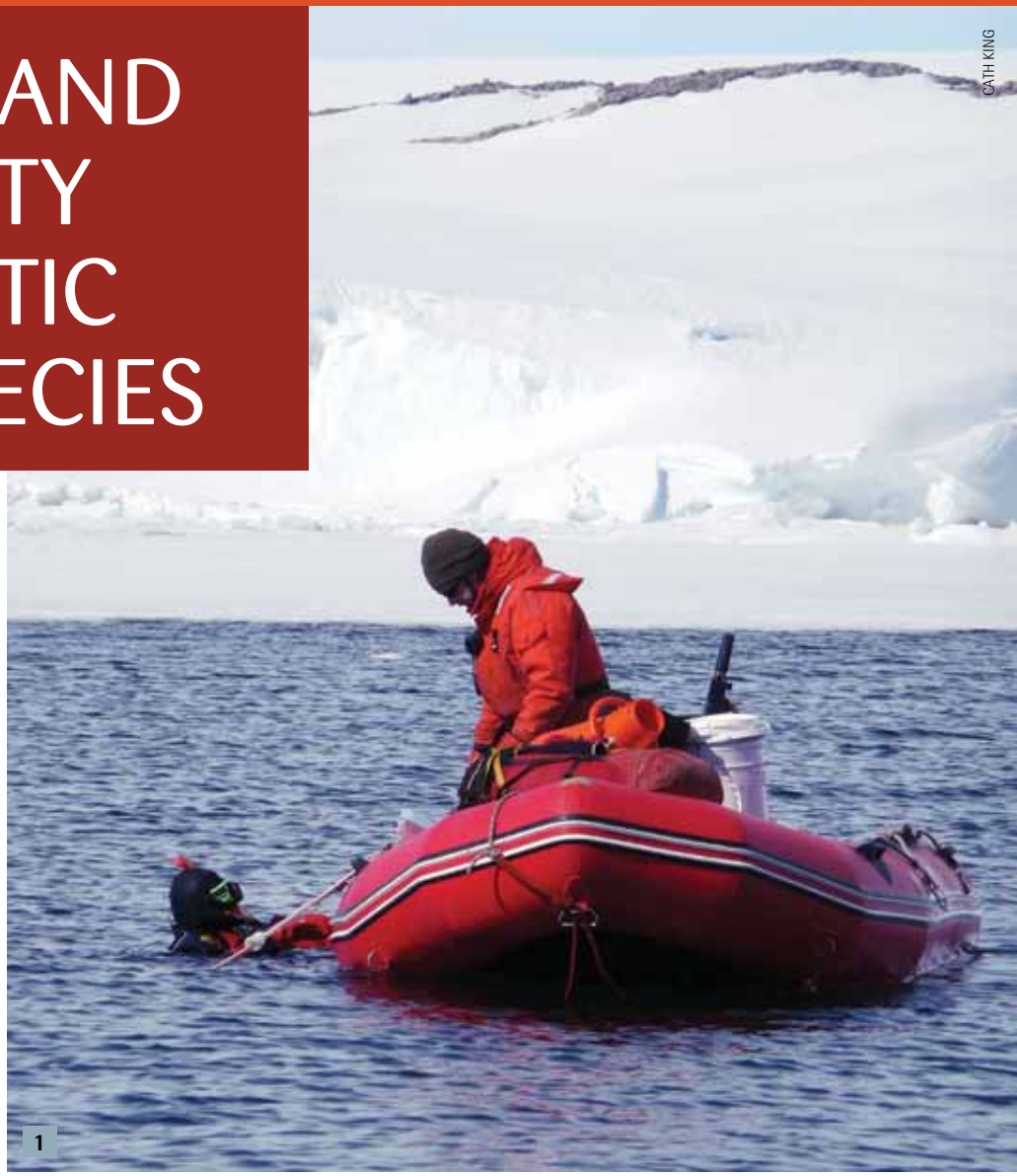
Benthic ecologist, Australian Antarctic Division

Above: Diver Glenn Johnstone ascending with a bag of samples.

Below: A portion of a polychaete reef in Long Fjord, with a range of other invertebrates living in and on it, including sponges, nudibranchs, starfish and worms.

CHRIS GILLIES

DISPERSAL AND BIODIVERSITY OF ANTARCTIC MARINE SPECIES


CATH KING

1

Understanding the dispersal of marine species is an important component of managing Antarctica's living marine resources. For example, the Commission for the Conservation of Antarctic Marine Living Resources and the Antarctic Treaty's Committee for Environmental Protection are considering the feasibility of Marine Protected Areas (MPAs) in Antarctica and the Southern Ocean. MPAs break up ecosystems into representative areas that can be managed for different activities, including fishing or conservation. But to do this effectively, we need to understand how species move within and disperse across such boundaries.

One of the challenges for scientists is determining how far, and where, organisms disperse. For large animals such as seals or birds, we can use satellite tracking to monitor an individual's movement. However, for animals such as marine invertebrates – many of which are small or have microscopic larval phases – we simply can't track them this way. Instead we can use their DNA as a unique type of tag, to understand dispersal.

Through the Australian Antarctic Division and the University of Tasmania's Institute for Marine and Antarctic Studies (IMAS), my team of postgraduate students and I are using modern genetic methods to study the connectedness of marine invertebrate populations in Antarctica. We are beginning to show that many Antarctic species don't disperse as far as we originally thought and that the spatial scale over which populations exist is actually quite small.

For many years scientists have assumed that populations of marine invertebrates around Antarctica would be highly connected due to the circum-Antarctic current that flows in a clockwise direction around the continent. This is akin to Nemo travelling from the Great Barrier Reef to Sydney on the East Australian Current. In fact my team is showing that even for species that have a circum-Antarctic distribution dispersal is quite limited. When we compare DNA sequences in animals such as pycnogonids (sea spiders), sea urchins, amphipods and deep sea corals from areas including the Weddell Sea, Ross Sea, Antarctic Peninsula, Dumont d'Urville Sea and the Davis Sea, we find that the populations from different regions are only distantly related. From this we can infer that there is very limited dispersal, at least across large spatial scales, around Antarctica.

If the larvae of marine invertebrates aren't travelling on the circum-polar current and dispersing all around Antarctica, how far do they go? Another aspect of our research is understanding dispersal on much smaller scales – for example, between bays and headlands around Casey or Davis stations. We have developed microsatellite DNA markers (highly variable regions of DNA that enable us to look at differences between individuals rather than just populations) for three species – the amphipod *Orchomanella franklini* and the sea urchins *Sterechinus neumayeri* and *Abatus ingens*.

During the summers of 2008–09 and 2009–10 we collected samples of these three species from Casey and Davis stations for genetic analysis. Importantly these three species have quite different larval types; *O. franklini* and *A. ingens* are both 'brooders'. This means their larvae develop internally and they are not released until they are fully developed, so we expect they would settle quickly and not disperse far from their parents. In fact our genetic data so far is showing that the amphipods don't disperse much more than a few tens of metres. In contrast, *S. neumeyeri* is a 'broadcast spawner', which releases gametes into the water column where fertilisation and subsequent development takes place. For this species we expect that larvae may be carried some distance before they metamorphose and settle, and so dispersal could be relatively high. By comparing the genetic structure of species which brood and broadcast

spawn, we will be able to develop a better understanding of dispersal processes across a wide range of life-history types, which will help inform management and marine protected area design in Antarctica.

Genetic data is also incredibly important for understanding biodiversity. As a result of recent discovery voyages associated with the Census of Antarctic Marine Life project, we have been able to access samples of marine invertebrates from around Antarctica. Using genetic data from these samples we've shown that within many animal groups there are many unknown and unidentified species. PhD student Helena Baird has found at least seven new species of *Eusirus* amphipods within what was initially considered only two species. PhD student Narissa Bax has also found evidence of cryptic species (physically alike but genetically different) in the stylasterid coral *Errina fissurata* in the Ross Sea and we are certain there are many more species yet to be discovered.

Genetic diversity is important for the survival of populations – the more genetic variation that exists in Antarctic communities, the greater the likelihood that they will be able to adapt to environmental change. Our genetic research is beginning to help us understand that Antarctic marine communities are actually very diverse, and this genetic variability will be important in terms of how resilient they are to climate change.

KAREN MILLER

Australian Antarctic Division and Institute for Marine and Antarctic Studies

More information

C. Arango, A. Soler Membrives, and K. Miller (2010). Genetic differentiation in the Circum-Antarctic sea spider *Nymphon australe* (Pycnogonida; Nymphonidae). *Deep Sea Research II*, doi:10.1016/j.dsr2.2010.05.019


KAREN MILLER


HELENA BAIRD

AAD

JAKE VAN OOSTEROM

1. *Snorkelling for sea urchins at Casey.*
2. *Collecting marine invertebrates with a dip-net near Casey station.*
3. *The orange stylasterid coral of the* Errina *genus in Antarctica.*
4. *Genetic analysis of this* Eursirid *amphipod has revealed many cryptic species within the genus.*
5. *PhD student Narissa Bax's genetic research is identifying cryptic species of stylasterid corals in Antarctica.*

More than $700 000 in funding for non-lethal whale research was announced by the Australian Government in June. A $267 000 Indo-Pacific Cetacean Research and Conservation Fund (IPCF) will support four three-year projects in Papua New Guinea, Pakistan, Fiji and Bangladesh while a $440 000 Bill Dawbin Postdoctoral Fellowship was awarded to Dr Amanda Hodgson of Murdoch University for applied cetacean research. The work 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

Humpback Whales in Fiji. Photo Saras Sharma

SURVEYING PAKISTAN'S WHALES AND DOLPHINS

Surveys of whale and dolphin populations off the Balochistan coast of Pakistan will contribute to understanding and conserving marine mammals in the North Arabian Sea.

The project, headed by the World Wildlife Fund (WWF) in Pakistan and funded through the Indo-Pacific cetacean research initiative, will determine cetacean abundance, diversity, and seasonal habitat use along a 700 km coastal stretch.

The survey area lies within a WWF 'Global 200 eco-region' – a high priority conservation area – and within the Indian Ocean Whale Sanctuary. Despite this, there are currently no marine protected areas in Pakistan.

'The study will help to identify the important areas needing protection and management. The priority hotspots can then be assessed for possible declaration of Marine Protected Areas,' Deputy Director General of the WWF in Pakistan, Dr Ejaz Ahmad, said.

Throughout the duration of the project there will be an emphasis on awareness and capacity-building of local government staff, students and coastal communities in marine mammal conservation. Some of the preliminary survey work will be done in consultation with fishing communities, who will help researchers identify cetacean hotspots.

'A public awareness and education program within the project will help raise awareness about cetaceans and change the attitudes and behaviour of the general public,' Dr Ahmad said.

'Capacity-building of stakeholders that include government officials, fisher-folk and students will help and motivate them to understand cetacean conservation and participate in conservation efforts.'

Information gleaned from the surveys will help manage habitat destruction as a result of development activities on the Balochistan coast, and evaluate the impacts of these actions on marine life, particularly cetaceans.

Dr Ahmad said the project will contribute to a trans-boundary conservation program for cetaceans, involving non-government organisations of nearby countries, including the Green Front of Iran and the Oman Whale and Dolphin Research Group.

'We also hope that this work will contribute to the establishment of a sustainable ecotourism industry in the region focussed on dolphin and whale watching, which will benefit local communities,' he said.

JILL BROWN

Corporate Communications, Australian Antarctic Division

What is the IPCF?

The Indo-Pacific Cetacean Research and Conservation Fund aims to promote positive conservation outcomes for cetaceans in the Pacific and Indian Ocean regions by:

- building a stronger scientific base for cetacean policy and conservation in the Indo-Pacific region, particularly within developing countries;
- deepening the pool of academic expertise about cetaceans within developing countries in the Indo-Pacific region;
- contributing to cetacean research efforts for the global public good;
- developing partner country capacity to solve local cetacean research, conservation and management issues; and
- fostering linkages that encourage solutions to cetacean research and conservation challenges.

For more information contact ammccoordinator@aad.gov.au

Researchers in Pakistan will determine cetacean abundance, diversity, and seasonal habitat in a WWF Global 200 eco-region.

R & E MANSUR/BCDP/WCS

Fiji focuses on endangered humpback whales

Researchers will map the movements of endangered Oceania humpback whales (*Megaptera novaeangliae*) in Fijian waters to build a complete picture of the species' slow recovery from whaling.

The Oceania sub-population of humpback whales was classified as endangered in 2008, based on the small number of individuals present on tropical breeding grounds in comparison to pre-whaling abundance estimates, including comparisons between historical and land-based counts conducted in Fiji. These included surveys by Dr Bill Dawbin in the 1950s (who recorded 1648 humpbacks in three years), and surveys in 2002, 2003 and 2008.

Ms Saras Sharma from the Fiji Ministry of Fisheries said that establishing a consistent and long-term dataset on movement patterns is an important step in understanding the recovery, trend and status of this species within Fiji's national waters. This work builds on preliminary work on humpback migration and Fiji's first national cetacean survey in 2009.

'This project is different because it's on a broader and more intense scale and involves a lot of organisations and people. The Indo-Pacific Research funding has greatly assisted the project through training and capacity-building, equipment and logistics,' Ms Sharma said.

'We have been fortunate to engage various government and non-government organisations in the project, and have created a significant level of cetacean conservation awareness and effort throughout Fiji.'

The project will build the capacity of national government staff and researchers for cetacean conservation, and aims to be relatively low-cost and easy to replicate to ensure sustainability over the longer term.

Fiji declared its exclusive economic zone a whale sanctuary in 2003, providing protection to resident and migratory cetaceans. The information gathered through this survey will contribute to the formulation of practical actions to manage the sanctuary.

JILL BROWN

Corporate Communications, Australian Antarctic Division

Below: This Fijian double-hulled canoe is used for survey work and the recording of whale song. Long-term datasets on the movement of the endangered Oceania sub-population of humpback whales will allow Fijian scientists to monitor its recovery.

SARAS SHARMA

CAPACITY-BUILDING IN PAPUA NEW GUINEA

CRIBB/WDCS

Above: Spinner dolphins in waters near Madang, Papua New Guinea.

Field surveys around the islands, atolls and coral reefs of Papua New Guinea will provide some of the first baseline information about cetaceans in the region, while building the country's capacity for cetacean research and conservation.

Dr Cara Miller of the Whale and Dolphin Conservation Society International said the project would develop in-country capacity in terms of conducting research, developing appropriate management strategies and providing background information on cetaceans and their habitats.

'Activities will include information and awareness sessions, discussion and planning, and conducting whale and dolphin surveys in surrounding waters,' she said.

The project takes a three-pronged approach to cetacean conservation and management: the development of practical field research skills for a core group of in-country participants; the progression of a national management plan for cetaceans; and the roll-out of other education and awareness initiatives.

'My hope is that this project actively assists our in-country participants to effectively implement national and regional cetacean conservation initiatives and plans,' Dr Miller said.

'It will improve their capacity to design and undertake cetacean surveys and prepare them to engage in issues that have relevance and linkages to cetaceans and their habitats within the country's exclusive economic zone.'

The surveys will be the first to be conducted in Manus province, Papua New Guinea's smallest province, which has a vast sea area rich with marine life and coral reefs. The Papua New Guinea government is particularly interested in surveying this area as it works towards establishing a comprehensive picture of national biodiversity.

JILL BROWN

Corporate Communications, Australian Antarctic Division


R & E MANSUR/BCDP/WCS

DOLPHIN HOTSPOT A CONSERVATION PRIORITY

R & E MANSUR/BCDP/WCS

A project led by the Wildlife Conservation Society will improve understanding of the ecology and fisheries interactions of Indo-Pacific humpback dolphins (*Sousa chinensis*) and Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in the eastern Indian Ocean – a hotspot of cetacean diversity.

Using photo-identification survey methods in coastal waters of the Bay of Bengal, researchers aim to discover the nature and magnitude of conservation threats from fisheries interactions and global climate change, to the two species.

'The only previous information on humpback dolphins in Bangladesh was obtained opportunistically during photo-identification work on Indo-Pacific bottlenose dolphins,' Mr Brian Smith of the Wildlife Conservation Society said.

'Funds from the Indo-Pacific Cetacean Research and Conservation Fund will allow us to conduct dedicated fieldwork on humpback dolphins and fully analyse existing data on bottlenose dolphins. We can then apply this information to conservation management.'

Information on dolphin abundance, survival rates, habitat characteristics, ranging patterns, scars and mutilations from fishing gear entanglement, and the density and distribution of fishing gears will be used to develop an effective management plan for both species in the context of local human needs.

Mr Smith said there is wide-ranging support for dolphin conservation from both government, which is developing plans for a protected area network, and local fishing communities, who regard dolphins and other cetaceans as symbols of good luck and companionship. However, both the government and the local fishing communities lack the technical resources to design a science-based protected area network.

'This project will have a substantial positive impact on cetacean conservation in Bangladesh by providing a thorough base of knowledge on the status of two species that are vulnerable to human impact and by strengthening the capacity of local scientists and resource managers to address the conservation needs of marine species,' Mr Smith said.

'The latter benefit will be achieved through a strong emphasis on training and long-term mentoring, and the participatory approach we take while conducting all research activities.'

The capacity-building aspect of the project will also benefit other cetacean species that occur in Bangladesh in sufficient numbers for early management interventions to be effective in protecting them. The estuarine and marine waters of Bangladesh are contained within the International Whaling Commission's Indian Ocean Sanctuary and serve as a vital safety net for cetaceans that are generally less abundant, and at greater risk, in other parts of Asia. These species include the Ganges River dolphins (*Platanista gangetica*), Irrawaddy dolphins (*Orcaella brevirostris*), and finless porpoise (*Neophocaena pfhocaenoides*).

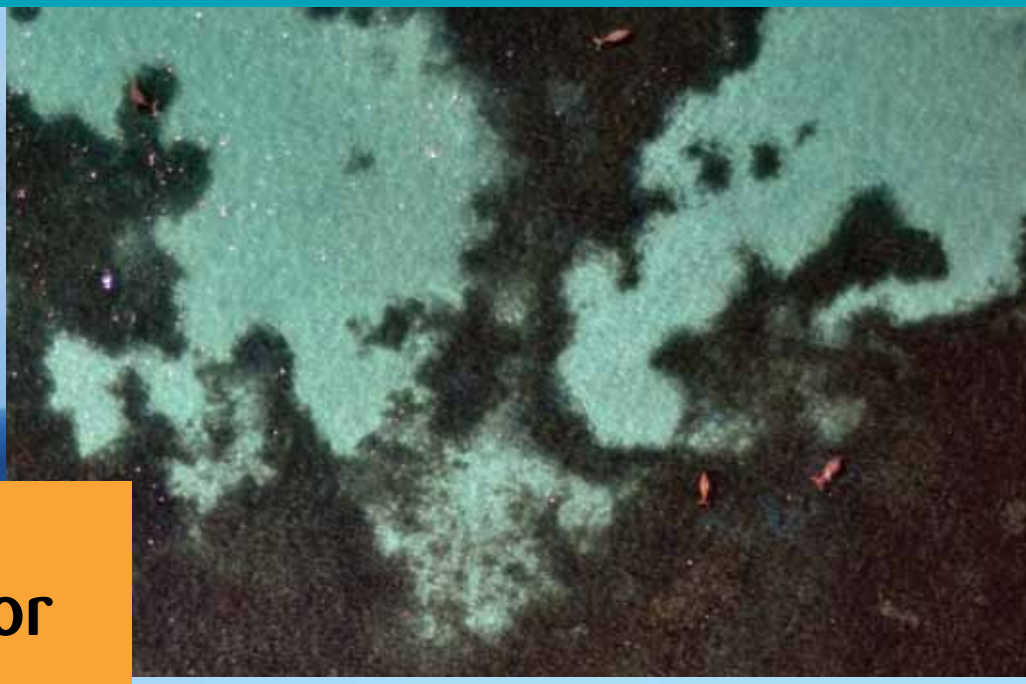
JILL BROWN
Corporate Communications, Australian Antarctic Division

Above: Indo-Pacific humpback dolphins and Indo-Pacific bottlenose dolphins (insert) are a focus of research in Bangladesh.

Below: Fishing activities pose a threat to cetacean conservation in many parts of the world.


R & E MANSUR/BCDP/WCS


INSITU PACIFIC



Unmanned aircraft count for conservation

Unmanned aircraft have captured high-quality images of dugongs in Australia's first trial to see whether the military-style drones can help scientists manage and conserve marine mammals.


NEIL SMITH

Murdoch University's Dr Amanda Hodgson – recipient of the Bill Dawbin post-doctoral fellowship for applied cetacean research – enlisted the help of Insitu Pacific and its ScanEagle Unmanned Aerial Vehicle (UAV) to investigate whether UAVs are a cost-effective and capable alternative to fixed-wing, manned aircraft for counting and surveying marine mammals.

'The conservation and management of many marine mammal species is largely dependent on monitoring habitat use and population status by conducting aerial surveys from manned aircraft,' Dr Hodgson said.

'We've shown that a stills camera mounted on normal planes can provide dugong sighting data equivalent to human observers and after this first direct trail of UAV technology it looks like the photos from the UAV are just as good.'

The ScanEagle is a low-cost, long-endurance system designed specifically for surveillance and flexible, rapid deployment on land and at sea. It can operate up to an altitude of 20 000 feet for up to 28 hours at a time.

UAVs like the ScanEagle eliminate the risks posed to human observers by flying low over large areas of ocean in small planes, and the ability to review photos (rather than relying on observer counts alone) should enable more accurate detection, location and identification of species.

'During this first trial we've focused on dugongs and collected images of them with various camera adjustments, while flying the UAV at various heights, air speeds and in different environmental conditions to assess the best way to use this technology to survey dugongs,' Dr Hodgson said.

Dr Hodgson will work with Insitu Pacific over the next three years to fine-tune its UAV camera systems with the objective of improving surveys of dugongs and humpback whales. These animals have been routinely surveyed for a number of decades in many sites around Australia and the datasets produced have formed the basis for conservation management.

Once the camera system is fully developed, Dr Hodgson will directly compare the results from traditional manned and UAV surveys of dugongs and humpback whales to test the efficacy of the UAV surveys.

'Eventually we hope UAVs will allow us to survey large and remote areas where manned surveys are logistically challenging,' she said.

'Large areas of Australia's coastline have never been surveyed for dugongs or humpback whales and UAVs capable of flying long distances may allow us to access these remote areas.'

Adapted from an article published by Murdoch University www.murdoch.edu.au

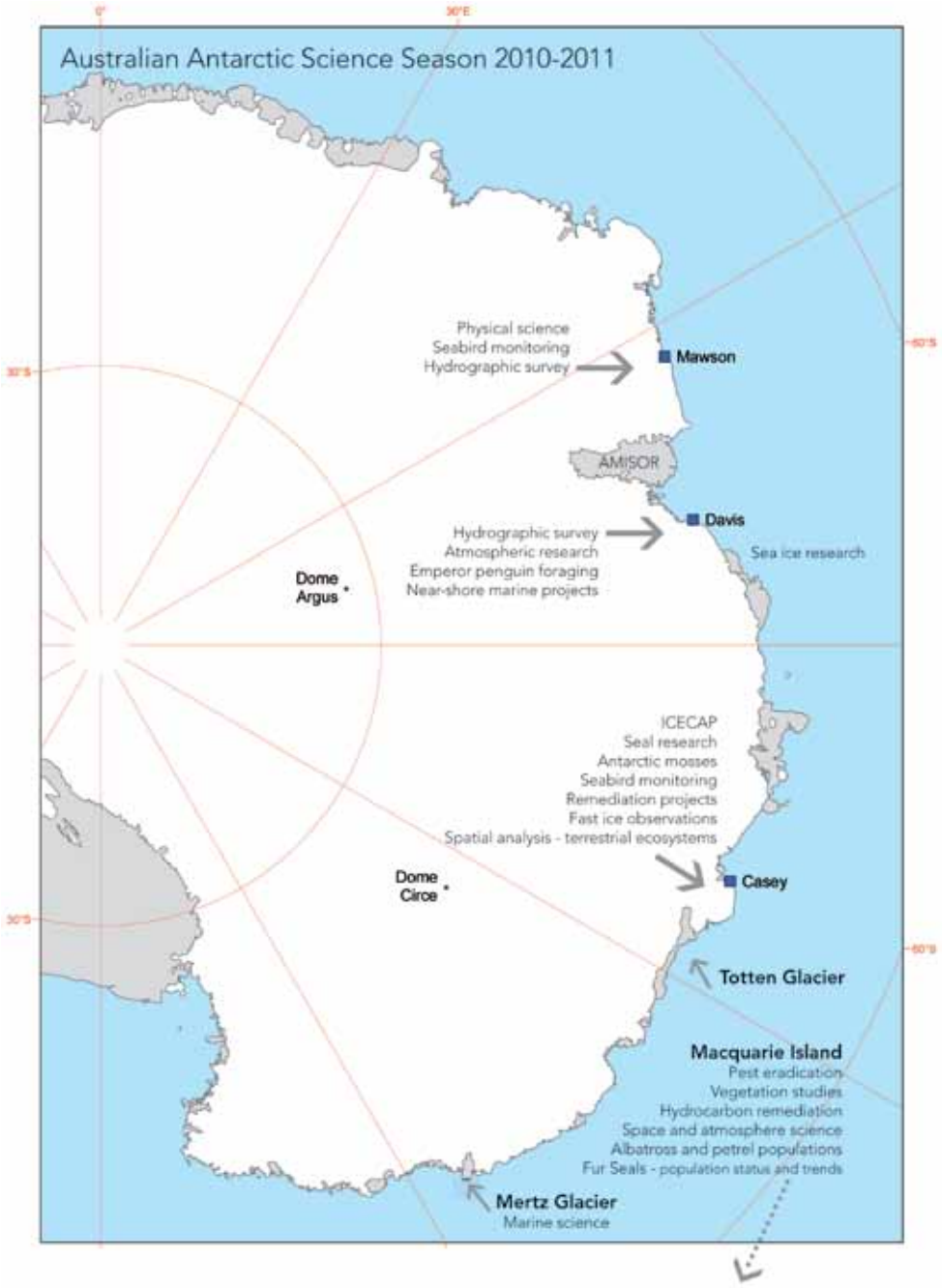
Dr Hodgson's UAV research has previously featured in Australian Antarctic Magazine *13: 25, 2007.*

Top left: The ScanEagle in flight.

Above: Amanda and the five Insitu Pacific UAV operators in Shark Bay (L-R): Pete Cassimatis, Amanda Hodgson, Marty Evans, Carl Brown, Neil Smith and Rich Clifford.

Top right: An image from the ScanEagle UAV showing four dugongs in Shark Bay.

AUSTRALIAN ANTARCTIC SCIENCE SEASON 2010–11



Major science projects this season include continued research at Davis on the impact of climate change and pollution on marine invertebrates; satellite tagging of fledgling emperor penguins; and Arctic-Antarctic comparisons of atmospheric phenomena. At Casey the ICECAP project enters its third and final season, while at the Totten Glacier scientists will measure the contribution of the glacier's drainage basin to sea-level rise and provide validation measurements for the CryoSat-2 satellite mission. At Mawson and Davis a hydrographic survey will map the sea floor to identify changes caused by local human activities and future climate-related impact (such as greater iceberg scouring). A major marine science voyage to the Mertz Glacier region will begin studying the impact of an iceberg calving event from the glacier tongue in February 2010. For the full list of 2010–11 science projects and project descriptions see http://its-db.aad.gov.au/proms/public/projects/projects.cfm?season=1011

MAWSON

Hydrographic survey: A multibeam swathe mapper (a type of depth sounder) is being used to create a detailed three-dimensional picture of the sea floor at Mawson and Davis. The swathe mapper sends out a beam of sound on either side of the boat and the returning echo provides depth information in a broad path or swathe. This depth data allows scientists to visualise sea floor features, including iceberg scouring. Regular disturbance of the sea floor by icebergs is expected to favour some marine species and disadvantage others, creating distinctive biological communities. The technology will help scientists document the scale of impact caused by humans and the potential impact of future climate change driven by key processes such as changes in sea ice. This information will contribute to environmental management to protect Antarctic coastal ecosystems.

Seabird monitoring: A long-term monitoring program of Adélie penguins is conducted on Béchervaise Island 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 (see *Australian Antarctic Magazine* 17: 6-8, 2009). This season will also include detailed nest censuses of snow petrels at Béchervaise Island and broad-scale surveys of snow petrel and Adélie penguin abundance and breeding success in the Mawson region. To determine where the birds forage during the winter months, small archival geo-locator tags will be attached to both species which will be retrieved in the following field season to download location data.

WENDY PYPER

A snow petrel nest census will be conducted at Béchervaise Island this summer.

Physical sciences: A number of instruments based at Mawson measure space and atmospheric phenomena. They generally operate remotely and automatically send data to servers in Australia. They include cosmic ray telescopes to measure particle radiation from the sun and outside the solar system, an induction magnetometer to measure ultra low frequency space plasma waves, a geomagnetic observatory to measure changes in the earth's magnetic field and a riometer to measure changes in the ionosphere (above 90 km). The data feed into climate research and models and space weather forecasts.

BOB SHEEHY

These ground-level cosmic ray telescopes detect radiation arriving from space. Other telescopes are located 11 m underground, below the laboratory, to capture more penetrating radiation.

DAVIS

The Amery Ice Shelf Ocean Research (AMISOR) project is part of a broad umbrella study of the entire Lambert Glacier Basin–Amery Ice Shelf system, to understand both the climatic history of the region and its probable response to global warming. See the related story on page 26 for details.

Near-shore marine projects: A number of near-shore marine projects are continuing at Davis this season, using marine invertebrates such as sea urchins, crustaceans and molluscs to study the impact of environmental change and pollution on Antarctic marine ecosystems.

- **Developing sediment and water quality guidelines for Antarctica:** This project looks at the effects of common contaminants such as petroleum hydrocarbons and metals and their interactions with environmental variables, including temperature and salinity, on a range of Antarctic organisms from micro-algae to macro-invertebrates. Last season toxicity tests were conducted (in a new field aquarium) to study the potentially synergistic effects of copper, cadmium, lead, zinc and nickel, and changes in temperature and salinity. This season the work will expand to include new test species. From this research, risk assessment techniques and environmental guidelines for the protection and remediation of sites will be developed.

WENDY PYPER

The new field aquarium at Davis, used to hold and acclimatize invertebrates for experiments.

- **Ocean acidification impacts on marine benthos:** Last season, experiments examining the impact of ocean warming and ocean acidification on juvenile sea urchins (*Abatus nimrodi*) were conducted by scientists from the University of Sydney, University of Tasmania and the Australian Antarctic Division. This season scientists will look at the impact of ocean warming and acidification on the early life history stage of other invertebrates. By examining the impact on planktonic and benthic life stages of ecologically important calcifying organisms (organisms that form shells or structures of calcium carbonate) and non-calcifying organisms, predictions can be made on the potential vulnerability of marine biota to climate change and the potential 'winners' and 'losers' of climate change.

- **Assessing oil toxicity to benthic invertebrates:** This Southern Cross University-led project is assessing the ecological risks of oil contaminants associated with fuel use in Antarctic waters, by studying the behaviour, bioavailability and toxicity of commonly used fuels including SAB (Special Antarctic Blend) to the sensitive early-life stage of Antarctic marine invertebrates. The project will provide a scientific basis for better managing fuel carriage and transfer in the Antarctic and for developing spill contingency plans.
- **Resilience of marine invertebrates to climate change:** This project looks at how the distribution of marine invertebrates is maintained through processes such as larval dispersal or isolation, and how these processes may be affected by environmental change. This season scientists will continue experiments to understand how changes in ocean temperature and salinity might affect the dispersal potential of invertebrate larvae, in terms of their developmental time and behavioural changes. Scientists will also sample larvae for genetic analysis to identify the origin of larvae in the water column and determine how far they have dispersed from their parent populations. See the story on page 10 for details.


KAREN MILLER

Scientists sample the sea floor for marine invertebrates at Davis.

Emperor penguins: Last season, scientists trialled some new satellite trackers on emperor penguin fledglings at Amanda Bay, to follow the development of diving capability over about four months. This year similar tags will be deployed on fledglings and some adults to see whether there is any overlap between the foraging areas of juveniles and adults in summer. For more information see *Australian Antarctic Magazine* 15: 11, 2008.

Lidar studies: This season the 'light detection and ranging' (lidar) instrument, in combination with radar, will continue gathering information on ice-aerosol cloud formation in the mesosphere (85 km altitude). In the Arctic these ice clouds are occurring more frequently and over a greater area than in the past. To determine whether similar ice cloud changes are occurring over Antarctica, the Davis lidar will be complemented by an iron lidar owned by the Leibniz Institute for Atmospheric Physics, which will be re-located to Davis for about 18 months. The iron lidar can measure temperature between 80–92 km altitude, where mesosphere ice-aerosols exist. 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 Davis lidar will also be used to study the optical properties of fine particles in the 5–30 km altitude range. Some of these particles may be associated with smoke from fires in Southern Hemisphere continents, particularly Africa and South America. The sources of any aerosol layers measured will be identified using two different models of atmospheric transport. The work will provide insights into the evolution of smoke particles over Antarctica, which may help improve calculations of solar heating. The data will also be made available for validating the upcoming Glory satellite mission (see http://glory.gsfc.nasa.gov/misison_details.html).


JOHN FRENCH

The lidar and radar can detect these noctilucent ('night shining') clouds which form at about 85 km altitude at temperatures below -120°C.

CASEY

Seabird monitoring: Automated cameras will be set up to monitor Adélie penguin nesting sites at breeding locations near Casey and Davis stations to extend our understanding of Adélie penguin population dynamics over broader environmental conditions. Satellite trackers will be attached to fledgling Adélie penguins and geo-locator tags will be fitted to adult snow petrels to learn about their winter migratory routes and foraging locations. Other sites near Casey and Davis will be assessed for the set up of automated cameras for monitoring other seabird species, and for their suitability for tracking studies. Broad-scale surveys of penguin breeding sites will be conducted along the coastline around both stations.

Moss bed monitoring: A remote-controlled 'OktoKopter' – an eight-rotor helicopter – will be used to map the extent of moss beds at Casey and Windmill Islands. See the story on page 1 for details.

Remediation projects: These include ongoing research into the cost-effective clean-up of petroleum spills in the Antarctic and other cold regions, and development and application of technologies to clean up heavy metal contaminants from abandoned waste disposal sites.

ICECAP: December sees the return of the ICECAP project ('Investigating the Cryospheric Evolution of the Central Antarctic Plate') to Casey. See the story on page 7 for details.

Totten Glacier and CryoSat-2: Significant changes in the surface elevation of the Totten Glacier in East Antarctica have highlighted the region's importance for understanding ice, ocean and atmosphere interactions. The ongoing measurement of the changes in ice surface over Antarctica is made possible by the recently launched European Space Agency (ESA) CryoSat-2 satellite mission, which aims to systematically measure changes across the ice sheet, extending to ice shelves and sea ice. Quantifying these changes will provide insights into the contribution of specific regions of Antarctica to global sea-level rise. This project will contribute to the calibration and validation of the CryoSat-2 mission (confirming satellite measurements match ground and airborne measurements) over the Totten Glacier and surrounding region behind Casey station.

GPS devices and meteorological sensors will be deployed at six sites to measure ice elevation and movement. The sensors will also measure the water content of the atmosphere, which can be directly compared to values used for the CryoSat-2 satellite data. These six sites will also provide reference points for an airborne survey by the Alfred Wegener Institute

The CryoSat-2 satellite.

(AWI). The AWI aircraft will be equipped with a laser altimeter and an airborne replica of the radar device used on the CryoSat-2 spacecraft. These data, combined with in-situ surveys of the ice sheet, will assist calibration of the ESA mission, ensuring accurate estimates of how Antarctica is responding to climate change.

MACQUARIE ISLAND

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; investigating why an endemic cushion plant appears to suffering from rapid die-back; and looking at how subantarctic organisms and ecosystems respond to change caused by global warming, feral animals and weedy plant species.

MARINE SCIENCE

Mertz Glacier: This season sees a major marine science voyage to the Mertz Glacier region, after a large iceberg collided with the Mertz Glacier tongue in February, snapping off about 80% of the tongue. The resulting 78 km-long iceberg changed the geography of the region, which is expected to affect ocean circulation in the Mertz polynya (an area of open water). A number of research projects will be conducted by the Antarctic Division, CSIRO, the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC), and others, to study the impact on the local environment. Opportunistic projects will also be conducted, continuing long-term marine and ice-edge research.

- **Ocean acidification** caused by increasing amounts of carbon dioxide being absorbed by the ocean will affect the ability of some organisms to form shells or structures made of calcium carbonate. This ACE CRC project will collect samples of pteropods (marine snails) and foraminifera (a component of the zooplankton) from the Mertz region as part of a larger study investigating the shell strength and structure of these organisms in Southern Ocean waters. Samples collected today will be used to identify changes in organisms collected in the future. See *Australian Antarctic Magazine* 18: 4-5, 2010 for details.
- **Marine microbes –** A number of projects will sample marine microbes (algae, bacteria and protozoa) from the Mertz region as part of broader-scale studies. An Australian Antarctic Division project will test the hypothesis that krill control the ice-edge phytoplankton bloom by grazing on phytoplankton and exporting their accumulated iron to depth as faecal pellets, limiting further growth. To do this, ratios of iron-containing proteins (ferredoxin and flavodoxin) will be measured in the microbial community as proxies for iron limitation. Microscopy and pigment analysis will also be used to identify community composition and individuals within the community. Characteristics of 'keystone' species that play important functional roles in the community will be examined, including carbon content, cell volume and chlorophyll composition. This work will contribute to food web and carbon flux models.

  DNA sequence analysis of the microbial community will also be undertaken by University of NSW scientists involved in the Australian Southern Ocean Genome-Based Microbial Observatory. The work will identify cryptic species (species that are difficult to separate based on physical features) and very small organisms that can't be visualised by microscopy. It will also contribute to the molecular characterisation of the keystone species within communities.

  Finally, a type of microalgae known as 'Parmales' will be collected. Parmales are components of 'marine snow' and part of the diet of grazers such as krill and protozoa. This Australian National University project aims to separate and concentrate Parmales from the marine microbial community using a flow cytometer. This instrument allows individual cells in a sample to be identified and removed for further study. Once concentrated, microscopy, pigment analysis and DNA sequencing will be used to begin classifying them and understanding their ecological role.
- **Physical oceanography –** The Mertz Glacier region plays an important role in the global ocean overturning circulation – a pattern of ocean currents that strongly influences climate. Polynyas in the region (areas of open water or low sea ice concentration) produce about 25% of the Antarctic Bottom Water (cold, salty water), which drives the overturning circulation, carrying oxygen and nutrients to the ocean depths in all ocean basins. This project will measure the export of Antarctic Bottom Water from the Mertz region and broader Adélie Land coast, as well as temperature, salinity and oxygen. These measurements will be compared to earlier observations to detect how the Southern Ocean limb of the overturning circulation is responding to the geographic changes caused by the glacier tongue calving, and longer-term climate change.

This pteropod, Clio pyramidata antarctica, *is one species that may be affected by ocean acidification.*

JOHN BOWMAN

This sea-ice bacteria, Psychroflexus torquis, *growing on an agar plate, forms proteorhodopsins and only grows at low temperatures, between -10°C and 10°C.*

- Proteorhodopsins are special proteins that enable bacteria to use light to generate energy. Scientists hypothesise that the formation of proteorhodopsin has evolved to cope with the extreme lack of nutrients in some environments. This University of Tasmania-led project aims to determine the significance of proteoprhodopsins in the productivity of Southern Ocean microbial communities, including which microbes use it, and which environmental factors – light, nutrients, temperature – may drive its formation and activity.

Sea ice research will be conducted by an international team from Australia, Canada and France. An airborne sea ice thickness survey, from the ice edge to the continent, will be undertaken using a helicopter (from the ship) equipped with a range of instruments to measure snow and ice characteristics. The data will be used for satellite calibration and validation and will continue a record of airborne sea ice measurements in the East Antarctic.

A second project will test a safety feature of the Explorer Autonomous Underwater Vehicle (AUV) for its planned missions under the Antarctic sea ice (www.mun.ca/creait/MERLIN/auv.php). The safety feature – the 'beacon system' –provides an acoustic 'heartbeat' during normal operation, warns of a major fault and uses a range-meter for emergency location. During under-ice operations the AUV will carry an upward-looking sonar to map the underside of sea ice; a hyper-spectral radiometer for measuring light passing through the ice and snow cover (under-ice irradiance); and a fish echo sounder to detect the presence of fish.

MEMORIAL UNIVERSITY OF NEWFOUNDLAND

The Memorial University of Newfoundland's Explorer Autonomous Underwater Vehicle.

GARY BOLITHO

Snow petrel –

NEW 10-YEAR SCIENCE STRATEGIC PLAN

A new Australian Antarctic science strategic plan 2011–12 to 2020–21 was approved by the former Minister for Environment Protection, Heritage and the Arts in July 2010.

The plan will guide the Australian Antarctic Science Program over the next 10 years to focus efforts within four thematic areas:

- Theme 1 – Climate processes and change
- Theme 2 – Terrestrial and nearshore ecosystems: environmental change and conservation
- Theme 3 – Southern Ocean ecosystems: environmental change and conservation
- Theme 4 – Frontier Science

Themes 1, 2 and 3 address the priority science needs articulated by government policy and resource management agencies. The research in these themes will be designed to link monitoring, observational and experimental science with the required process studies, synthesis and integrative modelling. It will also provide scientific input to policy-makers and conservation and resource managers. There will be increased emphasis on delivering project and program outputs and products to the end-user community. The Frontier Science theme will encourage and support research that falls outside the priorities of other thematic areas, but within Australia's national science priorities.

During October scientists working within the Australian Antarctic program met to develop an implementation plan for the strategic plan. Expressions of Interest for projects that address the research priorities identified during the workshops will be assessed against these priorities.

For more information see www.antarctica.gov.au/science

ANTARCTIC OPERATIONS

TODOR IOLOVSKI

The 2009–10 Antarctic/subantarctic operational season stretched into the current season, with a number of station infrastructure projects continuing throughout winter and a number of short winter traverses.

On Macquarie Island a new powerhouse was constructed to provide a more reliable energy supply for radionuclide detection equipment run by the Australian Radiation Protection and Nuclear Safety Agency. ARPANSA carries out Australia's radionuclide monitoring obligations under the Comprehensive Nuclear Test Ban Treaty. Its seven radionuclide monitoring stations, located within Australia and its territories, can detect the time, location and nature of a possible nuclear event.

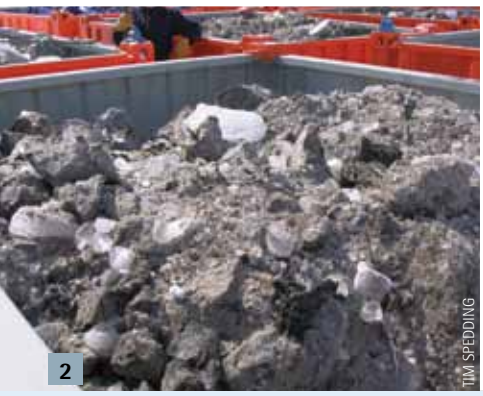
The Tasmanian Government's rabbit and rodent eradication project on Macquarie Island also began in June. The Antarctic Division is providing logistic support to the eradication program and more details are available at www.parks.tas.gov.au/index.aspx?base=12997

Building work continued on the living quarters at Davis during winter (see *Australian Antarctic Magazine* 17: 26, 2009) and works are scheduled to be substantially completed by the end of summer, with the first occupants moving in at the start of winter 2011. At Casey, work continued on the 'west wing accommodation' – an extension to the living quarters known as the 'Red Shed' – and will be completed in February 2011. The extension will add 36 new single-occupancy rooms, which replace the 24 beds that are currently housed in 25 year old shipping containers. The extension consists of 14 x 40 foot-long shipping containers, on two levels, clad with insulation panels in the same colour as the Red Shed. The new building will more comfortably accommodate the influx of short-term visitors, arriving at Casey via the Airlink, over summer.

A number of short traverses were conducted over winter to support a variety of projects and to build and develop experience in such undertakings. The Davis crew attempted a traverse to the Larsemann Hills and Amanda Bay just after mid-winter, but were thwarted by abnormally low temperatures (around -40°C) and a range of associated mechanical and equipment issues. Despite this the team added greatly to the Australian Antarctic program's experience base for winter traverse operations. A successful sea-ice traverse was mounted at Mawson to investigate the emperor penguin colonies at Taylor Glacier and Fold Island. Similarly at Casey, another short traverse was mounted to undertake maintenance work to the automatic weather station on Law Dome summit.

The 2010–11 summer season will again see approximately 500 people deployed south with the Australian Antarctic program, with departures from October 2010 until April 2011. The first expeditioner contingent departed in October on the Airbus A319–Hercules C130 (United States) link from Hobart to McMurdo and Casey, while the French ship *L'Astrolabe* took expeditioners to Macquarie Island and the *Aurora Australis* transported people and cargo to Davis (for transfer to Mawson by air). The two twin turboprop C-212 aircraft also made the long,

Above: The west wing accommodation at Casey will add 36 new single occupancy rooms.



11.5 hour transit from Hobart to Dumont d'Urville and then on to Casey, where they are supporting projects across all three continental stations.

An American and a German Basler will each visit Casey during the summer to undertake geophysics surveys over the icecap, while two Squirrel helicopters will operate from Davis station and then support the Macquarie Island resupply. The Antarctic Division is also supporting the US, French, Italian and other national programs with aviation support, and receiving reciprocal assistance in the form of shipping, aviation and project support.

At Commonwealth Bay, the Mawson's Huts Foundation, in conjunction with the Antarctic Division, will again undertake important conservation work on the historic huts built by Sir Douglas Mawson and his team almost 100 years ago.

Finally, the last of the waste from the old Thala Valley tip at Casey – about 540 tonnes stockpiled on geotextile fabric at the site – will be containerised for removal. The waste consists of soil containing heavy metals and hydrocarbons (mostly fuel and lubricants) that was left over from a large-scale clean-up in 2003–04, when containers ran short. The tip was used in an era before complete waste removal was practised by Australia (1964–1980). The Protocol on Environmental Protection to the Antarctic Treaty established an international obligation for waste disposal sites to be cleaned up by the generators of the waste. Once the waste stockpile has been removed, long-term chemical and biological monitoring of nearby Brown Bay will assess the effectiveness of the clean-up effort and the recovery of the ecosystem.

ROBB CLIFTON[1] and WENDY PYPER[2]

1. Operations Support and Coordination Manager,
2. Corporate Communications, Australian Antarctic Division

1. *Building the new ARPANSA powerhouse on Macquarie Island.*
2. *Some of the waste from the Thala Valley tip site.*
3. *Inside the new living quarters at Davis.*
4. *Loading bait for the Macquarie Island rodent eradication program.*


CAMILLA STARK

Right: Stratospheric clouds, seen here illuminated by the sun during twilight, only occur at high polar latitudes in winter, at temperatures less than -80°C. They promote chemical changes in the atmosphere that destroy ozone.

INTERNATIONAL POLAR YEAR CONFERENCE

From June 8–12 this year about 2300 scientists, policy-makers, teachers and students attended some 1800 presentations during the International Polar Year-Oslo Science Conference (IPY-OSC) in Oslo, Norway. The conference was the first opportunity for participants in the IPY (2007–09) – an internationally coordinated scientific campaign in the Arctic and Antarctic – to reunite and to celebrate and publish early results. Here's what two of our Antarctic scientists had to say about the meeting.

Dr Tas van Ommen – ice core and climate scientist


MARK CURRAN

Participating in the five days of the IPY-OSC, with some 2300 others, was both impressive and invigorating. It was also a challenging exercise to select from the 1800 presentations in, at times, 17 parallel sessions.

The science reported included some real highlights of the IPY generally and updates on the latest developments. From an Australian perspective it was fascinating to see the view beneath the ice sheet that is emerging from the IPY AGAP project ('Antarctica's Gamburtsev Province' – *Australian Antarctic Magazine* 15: 16, 2008). Australia made a significant contribution to the operation of AGAP and is involved in the closely related IPY ICECAP project ('Investigating the Cryospheric Evolution of the Central Antarctic Plate' – see page 7). Together, these results are reshaping our view of what lies beneath East Antarctica. From AGAP, we see a much more detailed view of the Gamburtsev Mountains. It shows rugged peaks and deep valleys that somewhat resemble a modern-day alpine landscape that has been preserved beneath the ice for millions of years.

Another IPY project of special interest to the Australian program is the IPICS initiative ('Ice Core Partnerships in Ice Core Sciences'). Australia is a leading participant in IPICS and we presented new results from the Law Dome ice core at the meeting. These results show how Antarctic climate records at the end of the last ice age can be synchronised with those from Greenland to reveal a see-saw behaviour: at times when Greenland is cold, Antarctica warms more strongly, and when Greenland has rapid warming, Antarctica cools. The ice age finishes with the poles taking turns to warm.

Also from the realm of ice core science, a paper presented by British Antarctic Survey researchers re-examined temperature estimates of previous warm interglacial periods (ca. 120 000 and 330 000 years ago). Current thinking indicates that central Antarctica was a few degrees warmer than it is now, but the revision would increase that estimate to as high as six degrees warmer.

Of course a final highlight of any meeting this size is the unparalleled opportunity to discuss present and future science plans and the meeting itself has no doubt stimulated the post-IPY polar research agenda.

Dr Andrew Klekociuk – atmospheric scientist


GLENN JACOBSON

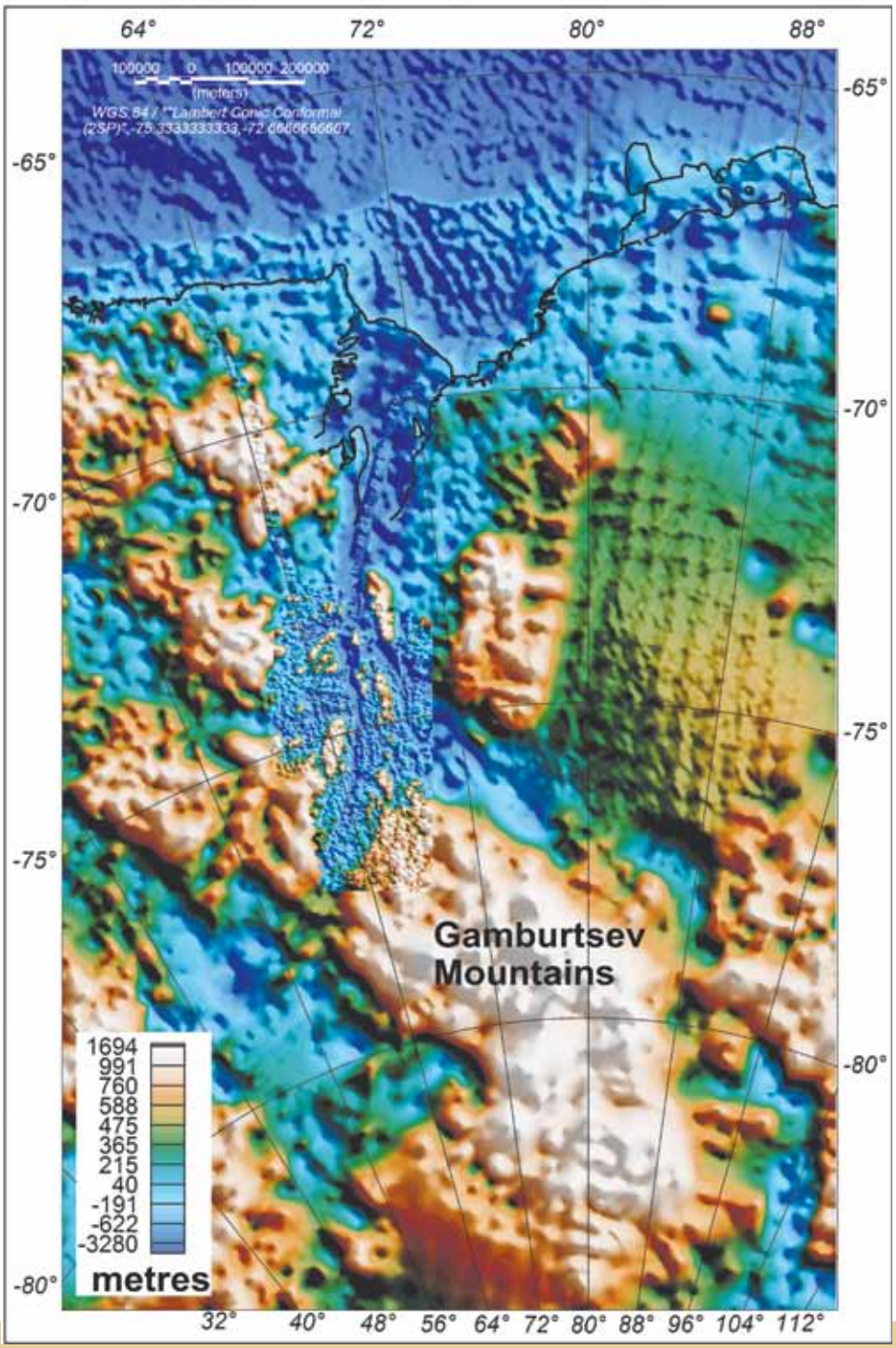
I was involved in a specific IPY study related to ozone depletion above Antarctica (*Australian Antarctic Magazine* 12: 12-13, 2007), and through this became involved in convening a special session at the IPY conference on climate processes in the polar lower atmosphere (http://ipy-osc.no/session/t2-2) . From this and earlier work I had developed an awareness of the roles played by the Arctic and Antarctic in climate forcing and reacting to various important climate processes. But what surprised me at the conference was hearing how far-reaching and significant these roles really are.

For me, the most significant revelation at the meeting was just how uncertain we are about the future of summer sea ice in the Arctic. Modelling suggests rapid change due to feedbacks from circulation changes in the oceans and atmosphere, but the predictions appear to be underestimating the rate and magnitude of change. The disappearance of the summer sea ice is having a far-reaching impact on ecosystem processes, as well as human society at high latitudes. This change is also significantly influencing Arctic atmospheric temperatures and circulation, which are positively reinforcing sea ice decline. The Arctic issues are teaching us

new lessons about the feedbacks between the atmosphere and cryosphere, which are now being applied to the Antarctic.

An interesting new insight came from Lorenzo Polvani (Columbia University, USA). He reported that new climate model results suggest that a significant amount of change in the summer atmospheric circulation in the Southern Hemisphere has likely been forced by the springtime Antarctic ozone hole. This work is part of a growing body of evidence showing the importance of the Antarctic stratosphere (about 15–55 km above Earth) in influencing trends and variability across southern mid- and high-latitudes over the past 30 years. We also heard further about trends and variability in surface temperatures and sea ice in West Antarctica. The general pattern of change is not fully consistent with dominant forcing from stratospheric ozone changes, but the modelling work that has led to this view has yet to benefit from recent developments in coupling the dynamical and chemical components of the atmosphere.

Overall, the meeting reinforced to me just how important, vibrant and dynamic polar research currently is. It will be fascinating to watch the results from the IPY emerge over the next few years as scientists and policy-makers explore the wealth of information that has been gleaned.



The AGAP and ICECAP projects are revealing what lies beneath the East Antarctic ice sheet. AGAP expands upon the results of an earlier airborne geophysical survey of the Gamburtsev Mountains in 2002–03 during which gravity, magnetic and ice-penetrating radar data enabled scientists to map the shape and distribution of the subglacial mountains and bedrock geology (pictured). The legend shows metres above (and below) sea level. Image courtesy of Mark McLean and Chris Wilson, School of Earth Sciences, University of Melbourne.

Sophistication in information-gathering

The umbrella provided by IPY has fostered a unique collaborative environment in which polar processes have been freshly examined from many angles in an effort to capture salient information on environmental change. IPY research has been timely in two respects. Firstly, data gathering has significantly benefitted from recently established infrastructure, such as the train of satellites in NASA's Earth Observing System, the worldwide array of Argo ocean sensors and improved networks of automatic weather stations. Secondly, state-of-the-art climate models have recently reached a sufficient level of maturity to benefit from the new observations for model validation and process studies.

An example of the current level of sophistication in marrying modelling and observations is demonstrated in the 'POLARCAT' program (www.polarcat.no) which produced new measurements of trace gases in the Arctic. POLARCAT involved several airborne and ground-based campaigns to characterise the components and transport of Arctic pollution. The level of sophistication in small-scale weather forecasting now allows aircraft to repeatedly 'sniff' the same small parcels of air over several days as they meander around the Arctic region. This type of work is important in helping to quantify the dispersal of pollutants such as black carbon and sulphate aerosols, which are having a measured impact on the coupling of solar energy to the Arctic surface.

ANDREW KLEKOCIUK

(R-L): Kim Finney (Manager, AADC), Colin Summerhayes (ex-Executive Director of SCAR) and Prince Albert of Monaco at the IPY conference in Oslo.

Polar data in the PICture

Data are the fundamental currency of science. Public access to polar data helps us understand and predict future climate scenarios and ensure wise management of resources, improved decision support, and effective international cooperation on resource and geopolitical issues.

In the spirit of this philosophy, key Arctic and Antarctic nations collaborated during the International Polar Year (IPY) to pursue the concept of a polar data commons – where the data is available to anyone, without restriction. As data streams in from IPY activities, a group has been working to form a virtual data coalition that is the Polar Information Commons (PIC).

The PIC (www.polarcommons.org) aims to place data in the public domain and is affiliated with the Creative Commons and Science Commons initiatives. Data belonging to the PIC are branded with a badge (a graphical icon) and linked to a set of behavioural guidelines on appropriate and ethical data use, and a Creative Commons data access waiver or license.

The badge can be found by search engines such as Google. However, all PIC-badged data should eventually find its way into NASA's Global Change Master Directory (http://gcmd.nasa.gov/index.html), a sophisticated metadata search engine responsible for hosting all Antarctic metadata (metadata is information about data, such as where and when the data was collected).

The PIC will also consist of a group of networked polar data repositories that will archive data. These actively managed repositories will also be responsible for publishing these data for re-use by the polar community and for merging PIC data with new and existing polar data products.

The Australian Antarctic Division, in collaboration with the Tasmanian Partnership for Advanced Computing, the Australian Research Collaboration Service and the Australian National Data Service, has established a PIC Cloud Repository Service (http://piccloud.arcs.org.au/piccloud/). This internet-based storage facility links to a metadata and data publishing system, and catches data generated by scientists who do not have anywhere to store their data. Eventually, data centres will be notified of datasets going into the Cloud and they will be able to harvest data of interest. It is hoped only a few 'orphan' datasets – without a data centre home – will reside in the Cloud.

The PIC initiative was launched on 8 June 2010 during the International Polar Year conference in Oslo. The Australian Antarctic Division's Data Centre Manager, Kim Finney, and Metadata Officer, Dave Connell, demonstrated the PIC Cloud and other Antarctic Division data publishing applications to Prince Albert of Monaco – a well-known polar enthusiast – and many of the researchers gathered at the IPY conference. Of particular interest was the Australian Antarctic Data Centre's (AADC) Data Navigator tool (http://data.aad.gov.au/aadc/navigator/login/navigator_welcome.cfm), a new application developed for the purpose of downloading, discovering and mapping data. For more information about this tool see www.antarctica.gov.au/science/cool-science/2010/accessing-data-with-data-navigator

KIM FINNEY and DAVE CONNELL
Australian Antarctic Data Centre

Grand finale to decade-long census

The grand finale of the decade-long Census of Marine Life (CoML) was celebrated in London in October.

The CoML program aimed to assess and explain the diversity, distribution and abundance of life in the oceans. One of the 14 CoML projects was the Australian-led Census of Antarctic Marine Life (CAML), which undertook the largest ever survey of the Southern Ocean, coordinating more than 19 voyages and involving more than 300 scientists from 30 countries.

The grand finale – a four-day symposium at the Royal Society and Natural History Museum in London – celebrated the major achievements of CAML. These included:

- the inventory of 16 500 marine taxa, with hundreds new to science;
- DNA barcoding of 2500 species;
- DNA comparison of hundreds of species which appear to inhabit both the Antarctic and Arctic waters;
- more than 1000 scientific and general publications;
- online illustrated field guides and pages in the Encyclopaedia of Life; and
- bioregionalisation data for conservation of Vulnerable Marine Ecosystems.

A special issue of *Deep Sea Research Part II*, featuring papers from a 2009 CAML symposium, is out now. A special volume of the journal *Polar Science* will be published in mid-2011 and will feature papers from a major CAML voyage.

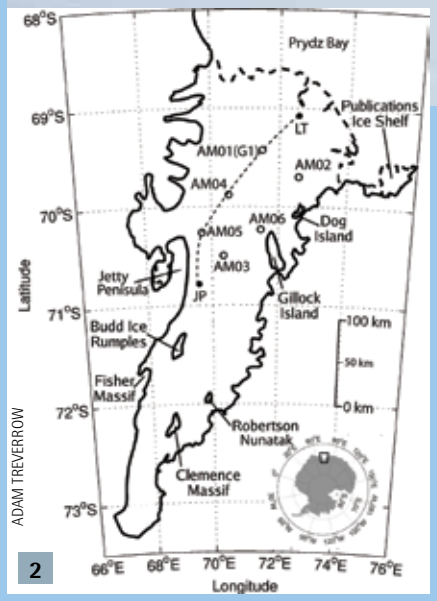
Data collected during CAML will continue to be deposited in the Scientific Committee on Antarctic Research - Marine Biodiversity Information Network data portal, well beyond the conclusion of the official CAML program. This database will be linked to the new Antarctic Biodiversity Information Facility (ANTABIF); www.biodiversity.aq

View a video about CAML at www.antarctica.gov.au/media/video

AMISOR: Understanding the ocean beneath the ice

The Amery Ice Shelf Ocean Research (AMISOR) project has been running since the 1999–2000 Antarctic summer. A central pillar of the program has been the use of a hot water drill system to create boreholes through the ice shelf to access the underlying ocean. Whilst the 2009–10 season was the last for borehole drilling, instruments moored at each borehole site will provide information on ice shelf-ocean interactions for many years to come.

1 ADAM TREVERROW



2 ADAM TREVERROW

The Amery Ice Shelf, located between Davis and Mawson stations, is the largest ice shelf in East Antarctica and third largest in Antarctica. It has an estimated floating ice area of 60 000 km² and a catchment region that drains approximately 16% of the East Antarctic grounded ice sheet area. The Amery Ice Shelf has been a key site of Australian glaciological research since the 1960s. As a part of this research effort the AMISOR project aims to quantify ice shelf–ocean interactions and their impact upon the discharge of grounded ice, modification of water masses and the conditions leading to the formation of marine ice (a layer of ice up to several hundred metres thick, formed on the base of the ice shelf by the refreezing of sea water). Scientists suspect that bands of marine ice that form on the base of the shelf may influence its stability and dynamics.

A major component of the AMISOR program has been hot water drilling at various locations on the Amery Ice Shelf to access the underlying ocean for sampling (*Australian Antarctic Magazine* 12: 32-33, 2007). Since commencing with a trial season in 1999, seven boreholes have been drilled. The hot water drill has interchangeable drilling and ice coring attachments which has enabled 14 ice cores to be recovered from targeted depths within the ice shelf. Once the borehole extends through the entire shelf thickness a range of instruments are used to take snapshot measurements of the ocean properties beneath the ice. For longer term monitoring of the ice and ocean a mooring of instruments extending from the surface to just above the sea floor is left in place at each borehole. During the summer field season, instrument moorings at previous drill sites are visited to download oceanographic and glaciological data. Despite the end of drilling on the Amery Ice Shelf for the time being, these annual visits provide data that are vital to ensuring our insight into the seasonally variable conditions of the ice shelf continues into the coming years.

The 2009–10 field season had a great start with the twin turboprop aircraft (C-212) ready and waiting at the Davis sea ice ski-way for the 15 tonnes of field gear and six-person drill team that arrived from Hobart in November. One week and 18 return flights later the entire drill system and team were in place at the fifth AMISOR borehole site, creatively named AM05. This site was located 20 km from Jetty Peninsula and the Beaver Lake region near a band of marine ice frozen onto the base of the Amery Ice Shelf. Two previous boreholes have been located along an ice flowline on this band of marine ice.

3 SHAVAWN DONOGHUE

The addition of a further instrument mooring in this region will assist our understanding of ice shelf–ocean interactions and their influence on marine ice layer formation.

The 2009–10 drill season saw a mix of old and new AMISOR personnel. Shavawn Donoghue, Al Elcheikh and Adam Treverrow were joined by Kelly Brunt, Steve Cann, Adam Christensen, Jeff Cumpston and Jeremy Ridgen, who all made their AMISOR debut. The team was able to finish drilling and mooring operations at AM05 with plenty of time to spare for a second borehole. AM06 was drilled a short 63 km to the east of AM05 and right next door to Gillock Island and its occasional mists. In contrast to AM05, where marine ice forms on the base of the shelf, AM06 is located in a region where modelling indicates in-flowing water from the open ocean produces strong melting at the ice shelf base.

The move to the second drill site occurred on 23 December with a great effort from all pilots and engineers of Helicopter Resources and several welcome pairs of helping hands from Davis. The following days were spent rebuilding the drill system and camp in time for a Christmas roast. Drilling restarted on 29 December, making it the quickest ever set-up of the AMISOR drill system. The good run continued with the AM06 borehole and mooring also completed in record time, enabling three of the team to return to Hobart in January. The remainder of the team stayed at Davis until February to coordinate retrieval of all drill and camp equipment from the ice shelf and packing for return to Hobart.

The AMISOR community thanks all those involved for making each drilling season run smoothly these past 11 years.

ADAM TREVERROW and SHAVAWN DONOGHUE

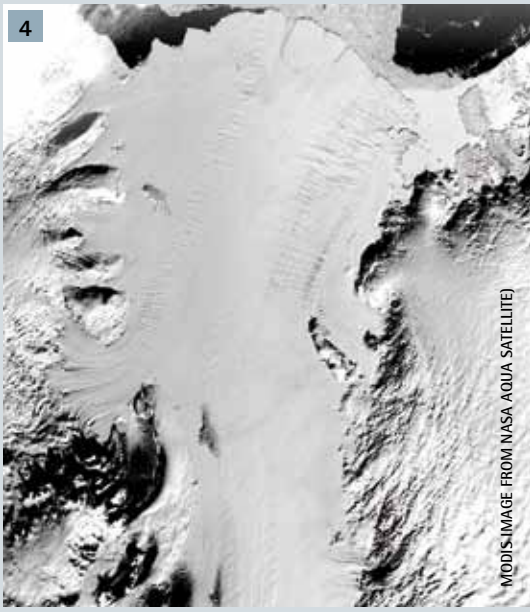
Antarctic Climate and Ecosystems Cooperative Research Centre

ICE SHELVES AND GLOBAL CLIMATE

Antarctic ice shelves, such as the Ross, Filchner–Ronne and Amery, are important components of the global climate system as they form an interface between the grounded Antarctic ice sheet and the surrounding ocean. Whilst the melting of floating ice shelves has only a minor influence on sea level, they provide a buttressing effect that retards coastal discharge of ice from the interior of the continent. Following the break-up of the Larsen B ice shelf on the Antarctic Peninsula during 2002, satellite measurements indicated accelerated ice discharge from glaciers flowing into the collapsed region of the ice shelf and an increased rate of sea level rise.

Large ice shelves are strongly affected by complex interactions with the oceans and contribute to the formation of water masses important to global ocean circulation. These interactions link ice shelves and the global climate system via ocean circulation. This linkage means changes in global climate can influence the mass balance (total gain or loss of ice) of the Antarctic ice sheet and vice versa. Modelling (see related story on page 6), has indicated that global warming can strongly influence ice shelf mass loss and dense water (cold and salty) formation through melting at the base of ice shelves. In addition to basal melting, complex ice shelf–ocean interactions beneath the Amery Ice Shelf produce significant refreezing at the base of the ice shelf resulting in the formation of a layer of marine ice, up to several hundred metres thick in places. The spectacular jade coloured icebergs encountered in Prydz Bay and along the Fram Bank are marine ice from the base of the Amery Ice Shelf.

4



MODIS IMAGE FROM NASA AQUA SATELLITE)

1. *The AM06 camp with Gillock Island in the distance.*
2. *Location of the six AMISOR borehole sites on the Amery Ice Shelf.*
3. *The AMISOR drill team on a sunny Christmas Day (L-R): Kelly Brunt, Alan Elcheikh, Shavawn Donoghue, Jeremy Ridgen, Adam Treverrow, Steve Cann.*
4. *A satellite image of the Amery Ice Shelf. The 'Loose Tooth' is visible at the end of the ice shelf (top, centre), where it meets the ocean at Prydz Bay.*
5. *Inside the hot water drill tent. (L-R): Shavawn Donoghue, Al Elcheikh and Kelly Brunt.*
6. *The first day in the field for the season – with some of the drill and camp equipment on the Amery Ice Shelf.*

5

ADAM TREVERROW

6

ADAM TREVERROW

Saving seabirds

Seabird protection received a boost this year through initiatives agreed at three major Antarctic meetings.


SUSAN DOUST

The fifth meeting of the Advisory Committee for the Agreement on the Conservation of Albatrosses and Petrels (ACAP), held in Mar Del Plata, Argentina, in April, progressed a range of seabird conservation initiatives.

Among the key outputs of the meeting were revised 'best-practice' advice and fact sheets about ways to reduce seabird bycatch in trawl and longline (pelagic and demersal) fisheries. Pelagic longline fisheries generally, and especially those targeting tuna, have a very high risk of interactions with ACAP-listed species. A review of recent scientific literature and research results again confirmed that reducing the time baited hooks are near the surface and thus available to birds is critical for effective bycatch mitigation in these fisheries. To achieve this, best-practice advice currently advocates an appropriate line weighting regime, used in combination with other mitigation measures that further reduce accessibility of baited hooks, such as night setting, bird scaring lines and the avoidance of peak areas and periods of seabird foraging activity.

Other outputs from the meeting included updated analyses of global albatross and petrel population trends and a financial commitment to further work to reduce bycatch in tuna and other high seas fisheries managed by Regional Fisheries Management Organisations. While the data for several species and populations are dated or otherwise limited, of the 29 species listed under ACAP, 10 species continue to decline (Amsterdam albatross is the world's rarest species, with just 30 pairs breeding annually), six species show recent increases, seven species are stable and the trend for six species is unknown.

The Australian delegation to ACAP comprised Graham Robertson and Ian Hay from the Australian Antarctic Division and Rosemary Gales from the Tasmanian Department of Primary Industry, Parks, Water and Environment. Australian contributions to the meeting were very well received and included seven papers and data on several research projects into new or improved ways to reduce bycatch of seabirds in longline fisheries, a proposal to significantly change what and how ACAP Parties report on their conservation efforts, and recent monitoring and research on Australian breeding populations.

An outcome of this year's Antarctic Treaty Consultative Meeting (ATCM) of interest to ACAP was the meeting's approval of revised management plans for four of the Antarctic Specially Protected Areas (ASPAs) in the Australian Antarctic Territory. These were: ASPA 101, an emperor penguin colony at Taylor Glacier, and ASPA 102, a southern giant petrel breeding area at Rookery Islands (both west of Mawson); ASPA 103 - the Ardery-Odbert Islands, which provide petrel breeding sites near Casey; and ASPA 164 – Scullin Monolith, the greatest concentration of breeding seabird colonies in eastern Antarctica, east of Mawson.

In addition, biosecurity was discussed at both the ACAP meeting and the meeting of the Committee for Environmental Protection, which met in parallel with the ATCM. Much of the impetus for bringing in quarantine protection for Antarctica arises from Australia's work on introduced species, including the risks of introducing poultry disease to Antarctic birds. Biosecurity risks to Antarctica are seen as increasing as a result of climate change, which is expected to improve the survival chances of organisms introduced from lower latitudes. Preventing introductions of alien species and disease is also a critical step in conserving breeding habitat and ACAP reviewed and adopted a detailed set of biosecurity guidelines for breeding sites of ACAP-listed species.

The ACAP work and the special protection afforded to seabird sites in Antarctica are positive steps in improving the survival of albatrosses and petrels across the Southern Ocean and beyond, where the simple term 'bycatch' hides the deaths by drowning of tens, if not hundreds, of thousands of birds annually.

For more information on the 'AC5' meeting outcomes visit the ACAP website: www.acap.aq

IAN HAY
Senior Policy Officer, Australian Antarctic Division


ERIC WOEHLER

Above: A Southern giant petrel.
Left: Ardery (left) and Odbert islands (ASPA 103) are important petrel breeding sites in Antarctica.

ANTARCTIC TREATY PARTIES TACKLE EMERGING CHALLENGES

The 33rd Antarctic Treaty Consultative Meeting (ATCM) and 13th meeting of the Committee for Environmental Protection (CEP) were held in Punta del Este, Uruguay, in May 2010.

STEPHEN POWELL

Above: Tourists at a gentoo penguin rookery on Cuverville Island.

The meetings considered a range of proposals, including recommendations arising from two recent Antarctic Treaty Meetings of Experts (ATME): one on climate change and implications for Antarctic management and governance; the other on management of ship-borne tourism. Meetings of Experts provide the Antarctic Treaty Parties with a forum for detailed discussion of specific issues, drawing on specialist expertise.

Climate change

- The ATME was informed by the first international, detailed synthesis of scientific understanding of the Antarctic climate system, presented in the *Antarctic Climate Change and Environment* report prepared by the Scientific Committee on Antarctic Research.
- Australia presented an initial assessment of the implications of climate change for existing and future infrastructure, logistics and environmental values. The ATCM endorsed the recommendation that other Parties should conduct and report on similar assessments.
- Future ATCMs will focus on the implications of climate change for management of the Antarctic, and almost 30 other recommendations arising from the ATME. These include addressing risks associated with the introduction of non-native species, which are predicted to increase in a warming world. This issue is being tackled through work initiated by Australia, France and New Zealand to develop a package of practical preventive measures.

Tourism and shipping

- The ATME built on the Parties' previous efforts to ensure Antarctic shipping, in particular tourism shipping, is as safe as possible. Cooperation with the International Maritime Organisation (IMO), which regulates shipping activity worldwide, has been a particular focus. In response to an ATME proposal by Australia, the Parties agreed to cooperate on Antarctic issues under consideration in the IMO, to help ensure Antarctic interests are properly considered.
- The ATCM agreed on the importance of conducting inspections of passenger vessels bound for the Antarctic Treaty area, and the exchange of information on vessel locations and search-and-rescue assets.
- Australia provided an assessment of the environmental aspects of ship-borne tourism. The CEP encouraged use of this approach as a guide to assessing the environmental risks of all Antarctic shipping. Further work to assess the range of ways that tourism interacts with the Antarctic environment is being undertaken through a study proposed by Australia, New Zealand and France.

PHILLIP TRACEY and EWAN McIVOR
Senior Policy Officers, Australian Antarctic Division

Countdown to 2012: Australia to host the 35th ATCM in Hobart

Australia will host the 35th Antarctic Treaty Consultative Meeting in Hobart, Tasmania, in 2012.

Australia has been active in Antarctica for more than 100 years and negotiated the Antarctic Treaty with 11 other original signatories in 1959. Since then Australia has hosted two meetings of the Treaty Parties – the first in 1961, and the 12th in 1983.

For the first time the meeting will be held in Hobart, the home of the Australian Antarctic Division and two international Secretariats; the Convention on the Conservation of Antarctic Marine Living Resources and the Agreement on the Conservation of Albatrosses and Petrels.

Hobart is Australia's main gateway for Antarctic departures and arrivals, and a hub of Antarctic and Southern Ocean research, and will be the perfect place to showcase Australia's commitment to the Antarctic Treaty and its goals of peace, science and environmental protection.

Tasmania's historic and natural attractions will also be on offer to delegates from the 48 Antarctic Treaty Parties over the meeting period.

The meeting will be jointly organised by the Australian Antarctic Division and the Department of Foreign Affairs and Trade.

WENDY PYPER

THE SOUNDS OF ANTARCTICA

JAMES SMITH

Sound artist and RMIT University academic Dr Philip Samartzis travelled to Antarctica as an Australian Antarctic Arts Fellow in 2009–10 to record sounds that describe the impact of extreme climate and weather events on the human condition.

As a sound artist, the compositions I produce often comprise field recordings of natural and constructed environments, which are arranged and mixed to reflect the acoustic and spatial complexities of everyday situations. I draw on a range of practices ranging from acoustic ecology and bioacoustics to musique concrète and sound art, to arrive at compositions that highlight the pervasive nature of sound and the myriad ways it informs and influences our daily experiences. I design my compositions for multi-channel surround sound systems that afford immersive and tactile listening experiences, to demonstrate the transformational qualities inherent in sounds familiar and strange.

During my arts fellowship I spent one month on the *Aurora Australis* enduring a topsy-turvy voyage across the Southern Ocean whilst we travelled to Davis station, and later to the formidable Macquarie Island. At Davis I spent six weeks making sound recordings in and around the station and further afield at some of the outlying huts in the desolate yet beautiful Vestfold and Larsemann Hills.

The aim of my project is to represent the complexities of our incursion into Antarctica by bringing together all the elements that inform and shape human experience on the continent. To achieve this I focused on everyday events around station, including the sounds of general infrastructure and transport, along with the various technologies used to facilitate research, construction and maintenance projects. I also surreptitiously employed an assortment of microphones hidden in various nooks and crannies to capture the general hubbub of station life.

To contextualize the sounds of human enterprise I undertook a rigorous study of the natural environment, making various recordings of the freezing wind howling off the Antarctic Plateau, whilst icebergs, brash ice and frozen lakes provided an endless source of amazing sound. I was particularly enamored with the assorted grunts, snorts and wheezing emanating from the wallows of southern elephant seals surrounding Davis. These recordings later proved to be a hit with children and adults from all walks of life.

Whilst life on the frozen continent did have its challenges, they seemed quite trivial once I arrived at Macquarie Island. Nothing quite prepares you for the relentless wind or the stinging sand granules battering the isthmus where the station is located. As accommodation was in short supply I made daily trips between ship and shore, during which time the boating team had to navigate some pretty wild seas before crash landing on the beach. Once safely on land it was a matter of trying to stay upright whilst locating sounds that could be heard over the roar of the ocean and wind. Although my 10 days on Macquarie Island were some of the most arduous days that I care to remember, listening to my recordings I count myself fortunate to have experienced a place so remote and hostile, yet endearing in so many ways.

PHILIP SAMARTZIS

Since returning to Australia in April 2010 I have presented my fieldwork in festivals in Hanover, Germany, Buenos Aires, Argentina, and at the Heide Museum of Modern Art. In October I travelled to Cape Town to present a sound installation at the IZIKO South African National Gallery. I also conducted workshops for the visually impaired that provided them with a detailed aural experience of Antarctica.

I thank everyone at the Australian Antarctic Division, Davis, Macquarie Island and aboard the *Aurora Australis*, along with fellow artists and researchers, for the generous support and interest that was provided to me during the fellowship. I certainly could not have achieved all that I did without them and for that I will be forever grateful.

PHILIP SAMARTZIS
School of Art, RMIT University

To find out more about Philip's work visit www.microphonics.org

Main: Philip takes sound recordings on the sea shore at Davis.

Inset: A self-portrait of Philip making sound recordings in Antarctica, which was used in an exhibition called Sur Polar II *in Buenos Aires, 2010.*

THE ANTARCTIC DANCE

Tina Evans is an emerging director, choreographer and performer working across dance, physical theatre, music video and film. She travelled to Davis and Mawson on an Australian Antarctic Arts Fellowship in 2009–10 to collect photographs, sounds and experiences for a live performance at the Melbourne Fringe Festival in 2011.

During my fellowship I aimed to see, experience and capture as much of the Antarctic ice as possible by taking photographs, recording sounds of ice, filming the ice and physically responding to it – recording choreographic and sensory stimulation of ice movement, patterns, texture, structures and illuminated colour.

From this experience I will choreograph and direct a live performance about the Antarctic ice – its diversity, movement, cycles and signs of climate change. My work will explore the creation and circulation of ice, the seasonal cycles of ice, the textures, patterns and movement encrypted in the ice, and it will look at ice from a large scale right down to the actions of ice molecules. The work will merge dance, sound, set, costume, photography and film and will be presented in a large outdoor space at Federation Square in Melbourne as part of the 2011 Melbourne Fringe Festival.

My challenge during the fellowship was to see and experience as much as possible in limited time. I had a whirlwind adventure during two nights at Davis. It began with cruising on a zodiac boat around the icebergs off the coast of Davis, which was staggeringly spectacular. Almost as soon as we stepped off the zodiac boats a few of us were ushered into a helicopter to fly over the ice and land at Platcha Hut. The ice and lakes were shimmering and it seemed like we'd landed in paradise. I was struck by the silence as we hiked up the ice plateau. To experience as much of Antarctica as possible I slept outside in a bivvy (and was cosier than expected!). Then it was time to fly back to the ship and sail on to Mawson, where more highlights awaited.

I was lucky to tag along with others who were undertaking field training at Mawson. After driving across the ice in a Hägglund we stopped and walked to a Russian plane crash site. Little did I know that I was about to be roped up and lowered down into a large ice crevasse. The experience of the ice from within was surreal. I kept yelling 'I don't ever want to come out!' The crevasse was a dazzling array of ice textures, patterns and pockets. More enchantment followed as we made our way to the hut at Rumdoodle, which is surrounded by frozen lakes and ice that extends forever. But I was soon back on the ship and as we pulled away from Mawson station it really hurt. I didn't want to be leaving this extraordinary continent so soon.

Since returning I have refined the material I collected and am further developing ideas for the work. I have drawn a creative team together for the project including sound artist Philip Samartzis (see story on page 30) as well as set, lighting and costume designers. I have been further delving into Antarctic ice and climate research and I'm also in the process of securing funds for the project from sponsors and government.

The creation and facilitation of the work will take place through 2011 and will be presented from October 4–8 at Federation Square in Melbourne. In addition to the performances, I will conduct workshops exploring the Antarctic ice with school children. The performance work will be filmed and further developed into a short film that will be distributed to media outlets, festivals and online.

TINA EVANS

http://tinaevansperformance.com

Below left: Tina is lowered down at a crevasse during field training near Mawson.

Below right: Tina, pictured here at Mawson station, has a Bachelor of Arts (Dance) from the Western Australian Academy of Performing Arts. She is now working on turning her Antarctic experience at Mawson and Davis into a live dance performance for the Melbourne Fringe Festival in 2011.

NICK

JOHN KITCHENER

SCIENTISTS IN SCHOOLS – ANTARCTICA MEETS DARWIN

The Scientists in Schools program initiates partnerships between individual scientists from any workplace and interested school teachers. It provides support, ideas, and some travel funds for the two to meet and interact at either workplace. The detail is left to those directly involved, which makes it an attractive and flexible relationship. In my case the invitation came at a serendipitous time at the end of 2009 when I was already contemplating a family camping holiday to northern Australia.

I have a passion for sharing my Antarctic experiences with those who do not have ready access to such exciting and significant activities, so I decided to visit my partner school for a few days, and to call in to several schools along the way, in Alice Springs and Katherine. My offers were readily accepted, so I gave a presentation to each one, tailoring it to the audience; from indigenous primary school children through to senior high school and School of the Air.

At my partner school – Girraween Primary School on the eastern outskirts of Darwin – teachers Kay Chaffey and Robyn Tidswell combined their Year 5/6 classes for my visit. So I was interacting with more than 40 students who were incredibly eager to listen to me and absorb my tales of what it's like to work in Antarctica. Prior to my visit they studied a unit on Antarctica and had each selected a topic to research and present on the classroom wall. It was wonderful to see a whole wall covered in their art work and projects as I walked into their classroom. This meant that they already had significant knowledge of the scientific concepts I was talking to them about and I could tell how much they enjoyed the fact that I was embellishing an area familiar to them, and making it real for them.

I had already learned from previous school visits and from open day activities in my work place that hands-on activities, preferably involving cold weather clothing, is a must – even if the outdoor temperature is over 30 degrees! As predicted, this worked a treat, with everyone vying to try on a fluorescent freezer suit, rather glary striped thermal underwear, snow goggles, hat and gloves.

Another more tactile experience involved 'glacier goo'. I decided to introduce my students to the concept of ice sheet dynamics by taking an exercise from the website https://cms.cresis.ku.edu/education/k-12/ice-ice-baby-lessons We made wonderful oozing 'ice' from PVA glue and borax. Not only did the children adore making something themselves in small groups, but they got to play with this goo, dolloping it on a map

JENNY EDDY

JENNY EDDY

of Antarctica, watching it ooze beautifully, and measuring its flow rate.

I had three 3-hour sessions with this large number of students and was totally exhausted and exhilarated from the experience. I was surprised by their undivided attention; however, I think this was partly the expertise of the teachers who kept things moving along at a good pace, and changed tack when necessary to keep them all motivated.

These partnerships are a win-win situation and an incredibly positive exercise in which to be involved. I feel I've contributed to helping young children not to be scared of science at the same time as helping them and their community understand what Australia is doing in Antarctica and how important it is.

For more information about the Scientists in Schools program visit www.scientistsinschools.edu.au

BARBARA FRANKEL

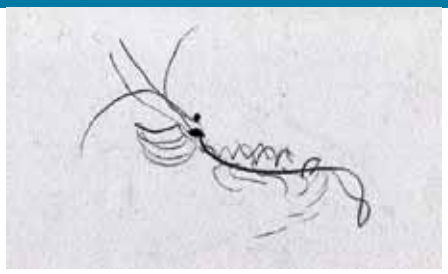
Ice core analyst, Australian Antarctic Division

Above: Barbara dressed in her freezer suit demonstrating how to make 'glacier goo'.

Left: Barbara with her partnership teacher, Kay Chaffey of Girraween Primary School, at the Scientists in Schools information session in Darwin, June 2010.

Below: Barbara beneath a sign welcoming her to Girraween Primary School in the Northern Territory.

JENNY EDDY



ANTARCTIC VISIONS

Antarctica has been the subject of many an academic conference, but few of them focus solely on the role that the arts, humanities and social sciences play in the study of the continent. This was the aim of an international conference *Antarctic Visions: Cultural Perspectives on the Southern Continent*, held in Hobart in June, which followed its predecessor, *Imagining Antarctica*, held at the University of Canterbury in 2008.

Antarctic Visions attracted around 65 delegates from across Australia, New Zealand, the US and the UK. Participants ranged from artists and photographers to archaeologists and psychologists, and included a handful of intrepid scientists interested in making connections across the so-called two cultures divide.

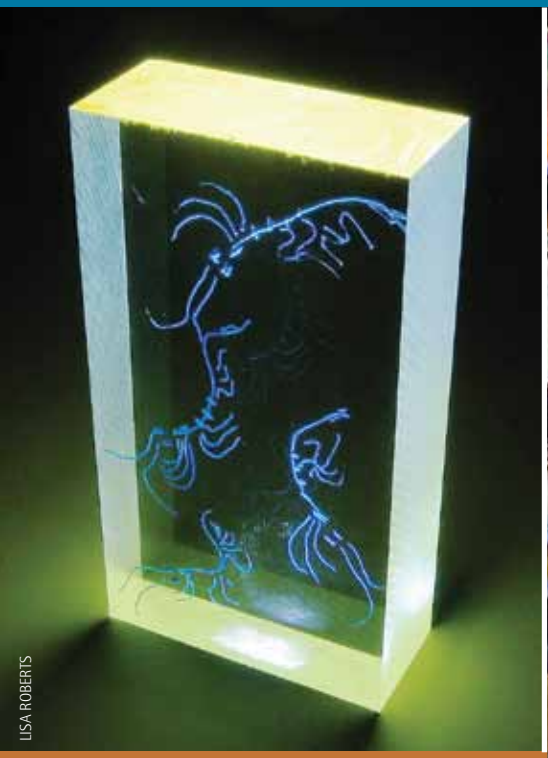
The conference began with an energetic keynote address from Max Jones, the editor of the recent Oxford World's Classics edition of the journals of Robert F. Scott. Subsequent session topics included 'Exploration History and Heritage, Art and Science', and 'Perceptions, Policy, Politics'. Presentations boasted titles as diverse as 'What Mawson knew', 'Hidden depths: poetry for science', 'Penguin metaphorics' and 'Naked Antarctica: just what do different portrayals of the naked body in Antarctica tell us about our relationship with the continent?' Two well-attended public lectures opened the discussion to a wider audience. The final day of the conference focussed on Antarctic exploration history and included a presentation by Jon Stephenson of the Commonwealth Trans-Antarctic Expedition.

The conference highlighted the many opportunities for interdisciplinary exchange in Antarctic studies, particularly between the arts and sciences. An edited collection of essays based on papers given at both conferences is planned with Quintus Publishing, as is a special issue of the new *Polar Journal*. A similar conference, this time incorporating a major theme on music, will be held at the Australian National University in Canberra in June 2011.

ELIZABETH LEANE[1] and STEVE NICOL[2]

1. University of Tasmania, 2. Australian Antarctic Division

Top: One of a series of drawings of krill by conference participant and artist Lisa Roberts after her visit to the Australian Antarctic Division in 2009.



LISA ROBERTS

BRIDGING THE 'TWO CULTURES' DIVIDE

JOSEF GODING

Artist, animator and researcher, Lisa Roberts, reflects on the importance of art-science collaborations in communicating Antarctic science.

There is an urgent need to connect more people to Antarctic science. Many stories I hear from Antarctic scientists relate to global climate change and these stories affect everyone. Many artists I meet express a compulsion to know and interpret the stories. These important stories need to be told often, in many ways, and made accessible to the public.

At the *Antarctic Visions* conference, many artists presented works that connect people to Antarctic science with high dramatic impact: Kirsten Haydon's jewellery, the results of 'Exploring Antarctica through making'; Judit Hersko's performance narrative, 'Unknown explorer' (herself as artist-explorer); and Claire Beynon's films and art works that reflect 'Hidden depths: poetry for science'.

I presented animations and art works I had made as part of a PhD project, 'Antarctic animation: expanding perceptions with gesture and line'. The animations combine scientific data and subjective responses to Antarctica to communicate accurate climate change information. The art works in various media reflect key ideas in the animations.

The animations were made from information contributed by scientists, artists and other Antarctic observers. Key contributors included scientists Steve Nicol and Rupert Summerson, who also spoke at the conference. I had heard Steve's story of first encountering live krill, and Rupert's response to inland Antarctica in the form of improvised music, during the *Imagining Antarctica* conference in 2008. Their responses are combined with data sets in my animation *Energies* and work to connect people to climate change information at a sensory level.

The connections I made with people during *Antarctic Visions* have led to two unexpected ventures. First, to develop a proposal with other artists to communicate data that will be collected from the Antarctic sea ice zone in 2012; and second, to co-author a scientific paper, as an animator, about krill sex!

The second venture arose after I visited the Australian Antarctic Division and watched video footage of a new observation of Antarctic krill mating. Their circling, spiralling, crossing dance inspires me to animate. But what are the krill actually doing? Weeks later I received an invitation from So Kawaguchi, lead Antarctic Division krill scientist, to co-author a paper about the observation. As he explains krill anatomy and theories about krill mating, I make drawings to add to the paper. These may help to reconcile theories with observations. My next challenge is to make a beautiful animation of the mating dance. Moving pictures that appeal to the senses have a chance of connecting more people to science.

LISA ROBERTS

www.lisaroberts.com.au

Insert: Euphausia superba*: Antarctic Krill 01 (2009). Perspex block, engraved and inlaid with acrylic. 45mm x 80mm x 20mm. Up-lit with white LED light.*

Top: Lisa Roberts in her studio in Sydney.

IN BRIEF

Departmental change

After a federal election in August 2010 the Australian Antarctic Division became part of the Department for Sustainability, Environment, Water, Population and Communities, under the portfolio of the Hon Tony Burke, MP. For further details see www.environment.gov.au

Australian Antarctic Expedition centenary

Almost 100 years ago, on 2 December 1911, Mawson's scientific Australasian Antarctic Expedition (AAE) left Hobart bound for Macquarie Island and East Antarctica. Mawson's 1911–14 AAE was the first wholly Australian Antarctic expedition. From 2011 Australia celebrates the centenary of this expedition and 100 years of Australian expeditions in Antarctica. The Australian Antarctic Division has developed a web site which will list events and activities celebrating the occasion. The site also provides links to other AAE and Mawson-related sites. For more information visit http://centenary.antarctica.gov.au

The Mawson's Huts Foundation has initiated a number of fund-raising projects to mark the AAE centenary. These include the production of limited edition gold and silver coins, 100 ml bottles of 100-year-old port, and a full-length documentary on Mawson, the AAE and the conservation project. To increase public awareness of Mawson and his 1911–14 expedition, construction of a full scale replica of the Main Hut is planned for the Hobart waterfront. The Hobart City Council has approved the use of Council land opposite Mawson Place, subject to planning approval. It is envisaged that construction will be completed prior to the centenary celebrations in December 2011 and that the hut will become an important tourist attraction for Hobart. The Foundation has also launched a membership drive to help raise funds for the conservation of the historic huts at Cape Denison. This includes the publication of a regular newsletter titled *The Blizzard*. Further details relating to Foundation activities can be found at www.mawsons-huts.org.au

STATION LEADERS 2011

CASEY

Dave Buller (top right) is a career Army officer with a background in logistics and in particular amphibious operations, including time as a LARC operator. Dave has led teams during a variety of postings that have included time spent on Navy amphibious ships and deployments to East Timor, Bougainville, Solomon Islands and Afghanistan. Dave has recently returned from three years in Ontario as the Australian Army's Liaison Officer to the Canadian Defence Force, where he worked with a number of foreign militaries, multinational organisations and dignitaries. Dave comes to the Antarctic Division on secondment from the Army in Canberra. He enjoys fitness training, mixed martial arts, BMW motorbikes and travelling. He and wife Tarni have two children, Kyl-Shane (8) and Taylor-K (3).

DAVIS

Graham Cook (middle right) returns to Davis after previously working as the Station Leader at Mawson (2005), Davis (2007) and Casey (2009). Graham previously worked as Operations Manager with Federal Hotels' Strahan Village Resort and Manager of Gordon River Cruises on Tasmania's west coast. He has also been responsible for the operation of a number of Aboriginal community stores and Aboriginal enterprise developments in remote regions of Australia. Graham has travelled extensively throughout South East Asia and is a keen mountaineer, skier and bushwalker.

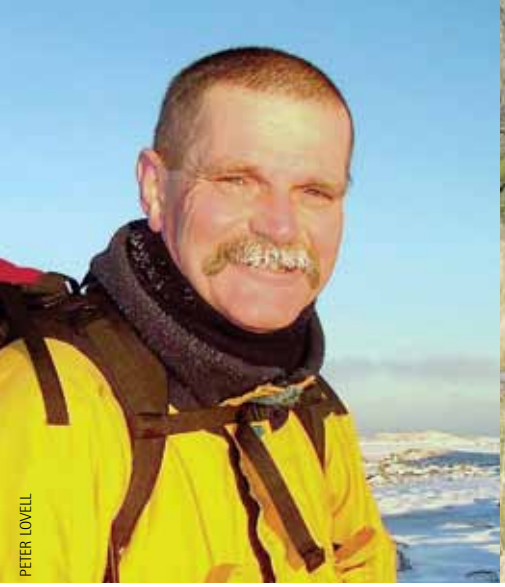
MAWSON

Mark Williams (right) has been a police officer with the Queensland Police for 30 years, and has gained a diverse range of operational and managerial leadership experience with small to large teams. Mark is a keen traveller and has trekked in Peru, China and Portugal, and made various other trips to experience different cultures. He also enjoys skiing and bushwalking and regularly competes in triathlons and marathons. He hopes this will be the first of many trips to Antarctica. He lives in Brisbane with his wife and daughter.


TARNI BULLER


GRAHAM COOK


MARK WILLIAMS



PETER LOVELL

DON FLETCHER, ACT PARKS & CONSERVATION

MACQUARIE ISLAND

Ivor Harris (above) will take over as Station Leader at Macquarie Island from October 2010 until April 2011. Ivor was a Station Leader at Casey (2003) and Mawson (2006) and has worked as a veterinarian, laboratory animal scientist, microbiologist, TAFE teacher and Army officer. Ivor is currently a scientific manager with the Australian Army Malaria Institute in Queensland where he has coordinated major studies, including field research teams in areas such as East Timor and the South Pacific. After recently diving on the wreck of Lapérouse's *Astrolabe* in the Santa Cruz Islands, Ivor is hoping his own voyage on the *L'Astrolabe* will be less eventful.

Trish Macdonald (above) will take over from Ivor in April until mid-2012. Trish has worked as an instructor and guide for Outward Bound in Australia and Canada, and Wilderness Expeditions in Australia and Nepal – where she guided climbing, skiing, white-water rafting and bushwalking trips. She has a background in natural resource management and wildlife research and has worked as a ranger and wildlife ecologist with various national park services for 22 years. She currently works for the Threatened Ecological Communities listing section in Canberra. Trish has experience in feral pest control and research and is looking forward to assisting the rabbit and rodent eradication program on Macquarie Island.

If you'd like to see and hear more about our station leaders you can view short videos of them on the Australian Antarctic Division website at http://www.antarctica.gov.au/media/video

Lessons in an Ice Box

Tasmanian primary school students and teachers can now experience Antarctica through two Ice Boxes available through the Tasmanian Museum and Art Gallery (TMAG). Each Ice Box contains Antarctic objects provided by the Australian Antarctic Division, the Tasmanian Polar Network and others, which reflect the Antarctic environment, the history of Antarctic exploration and its connection with Australia, and the people in Antarctica today.

TMAG's Manager for the Centre for Learning and Discovery, Andy Baird, says the objects include 1950s sledging biscuits, karabiners, ice screws, expeditioner clothing from the heroic to the modern era, emperor penguin chicks, polar medals and a coal sample from the Prince Charles Mountains. The boxes themselves also have a history of use in Antarctica by the Australian Antarctic Division, transporting field equipment for marine voyages and continental expeditions.

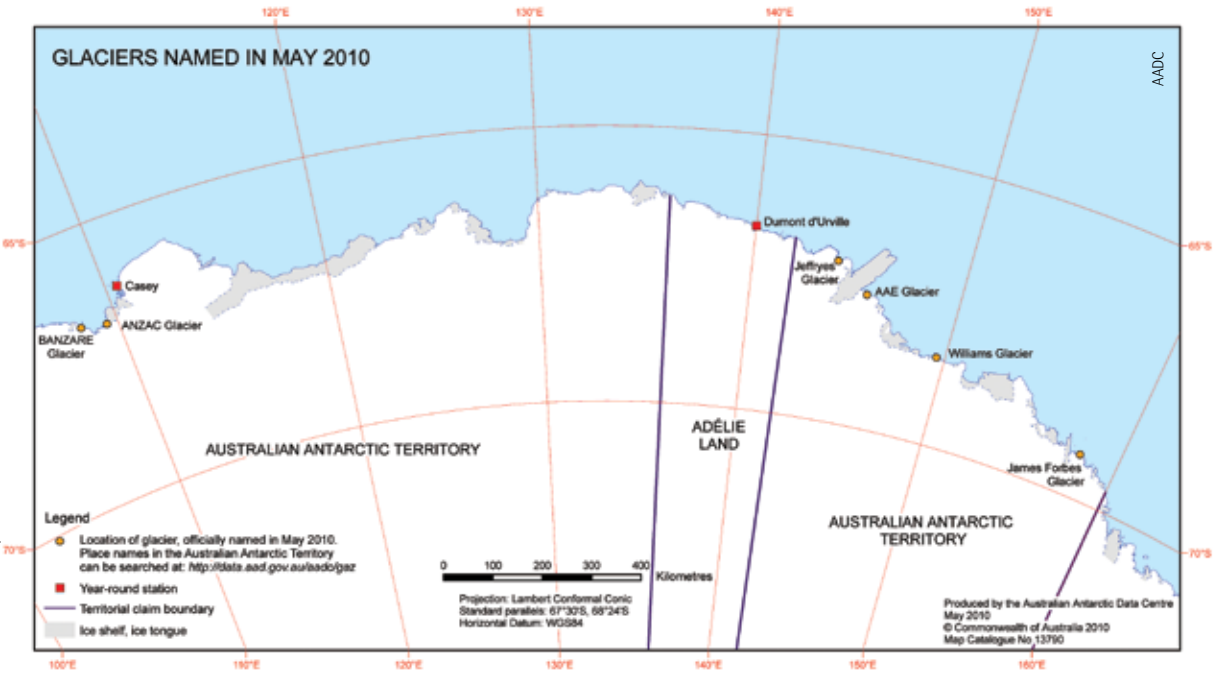
The Ice Box objects come with a teachers' guide that details the provenance and background information for each object, as well as a series of large laminated photographs and a few key reference books, including Mawson's *Home of the Blizzard* and Apsley Cherry-Garrard's *The Worst Journey in the World*.

To borrow an Ice Box contact TMAG at tmag.bookings@tmag.tas.gov.au or (03) 6211 4189.

TMAG

Historic naming of Antarctic glaciers

Six glaciers in the Australian Antarctic Territory have been officially named in honour of historically significant figures and groups who have played an important role in the Antarctic region or Australian history. The new names were recommended by the Australian Antarctic Names and Medal Committee. The glaciers are all situated in the area explored by Sir Douglas Mawson during his Australasian Antarctic Expedition of 1911–14. The names reflect the contributions to Antarctic exploration in the first part of the 20th century, and of some members of the first Australasian Expedition who have not yet been recognised. They are: James Forbes Glacier, Williams Glacier, Jeffryes Glacier, AAE Glacier, ANZAC Glacier and BANZARE Glacier. For details see www.antarctica.gov.au/media/news/2010/australian-antarctic-glaciers-named



FREEZE FRAME

NICK RODEN has spent the past 12 months working as a weather observer at Davis for the Bureau of Meteorology. Prior to his Antarctic deployment Nick was a professional golfer. Seeking a career change, he completed a Bachelor of Science with Honours at the University of Tasmania, focussing on the effect of ocean acidification on Southern Ocean organisms. He plans to continue this research in a PhD when he returns.

BEN O'LEARY

This image is one of 138 separate 30-second exposures from a time-lapse sequence taken on a very cold morning (-35°C) in July. I used a 10.5 mm fisheye lens which distorted the horizon and LIDAR beam. For me, the challenge of photography and cinematography in Antarctica is producing an image or sequence that does this magnificent place justice. Many people can only experience Antarctica through the images and stories that Antarctic expeditioners bring home. I hope that they will be compelled to protect and value this last great wilderness just as much as those fortunate to have experienced it first-hand do.

ANTARCTICA valued, protected and understood

Australian Government
Department of Sustainability, Environment, Water, Population and Communities
Australian Antarctic Division

www.antarctica.gov.au

★7317