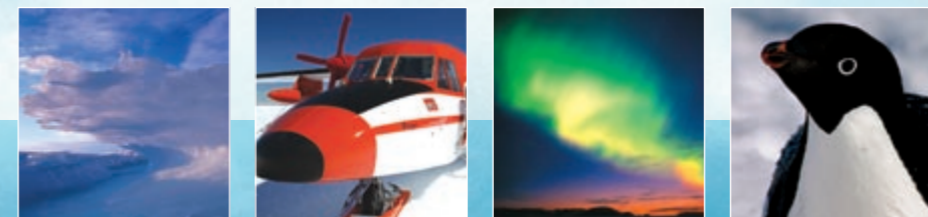




*“Australia’s presence in Antarctica is key to uncovering knowledge crucial to the future of the planet.”*

Tony Press,  
Director AGAD



## AUSTRALIA IN ANTARCTICA 2006



Australian Government  
Antarctic Division

Australian Government Antarctic Division  
[www.aad.gov.au](http://www.aad.gov.au)



Australian Government  
Antarctic Division

## DIRECTOR'S WELCOME

Welcome to *Australia in Antarctica*, the Australian Government Antarctic Division's (AGAD) report of what the Australian Antarctic programme has achieved during the year and where it is heading. As the leader of Australia's Antarctic programme, the Antarctic Division plays an important role in protecting and advancing Australia's Antarctic interests and ensuring Antarctica is 'valued, protected and understood'. Each issue of *Australia in Antarctica* will provide snapshots of this role through short articles, facts and figures.

Australian geologist Douglas Mawson's pioneering steps into the Antarctic in the early 20th Century, kicked off an era of significant scientific discovery. Nearly 100 years on, Australia's presence in Antarctica is still key to uncovering knowledge crucial to the future of the planet. For example, climate research in Antarctica is critical to our understanding of the global climate and climate change and, reflecting this, the Antarctic Division is increasing its focus on climate-related research. Our research helps to inform international bodies, such as the Intergovernmental Panel on Climate Change, and in turn influence the international responses to climate change.

In 2006, Australia hosted the combined meetings of the Scientific Committee on Antarctic Research and the Council of Managers of National Antarctic Programs. The Antarctic Division's involvement in these international organisations ensures Australia will have a say in decisions and provides advice on priority science, environmental management and operational matters affecting the whole of Antarctica.

In 2007 Australia will participate in some 50 scientific projects during the International Polar Year (2007-08). Four of these will be led by the Australian Government Antarctic Division. These IPY projects will leave a legacy of information and collaboration that will support Antarctic research into the future, and will inspire and encourage a new generation of scientists. The year will play an important role in improving world-wide understanding and awareness of Antarctica and its influence on the entire planet.

As we move farther into the 21st Century the Australian Government and the Antarctic Division face many new and imposing challenges that will influence our work in Antarctica. The Antarctic Division is addressing these issues through a strategic Antarctic Futures Project, which will provide a vision of Australia's role in Antarctica to 2020.

I hope you enjoy reading about these and other exciting and challenging issues and activities in the following pages.

*Tony Press*

TONY PRESS  
Director AGAD

AUSTRALIA CLAIMS THE AUSTRALIAN ANTARCTIC TERRITORY (SOME 42% OF ANTARCTICA), AND RUNS THREE PERMANENT STATIONS AT CASEY, DAVIS AND MAWSON AND A SUBANTARCTIC STATION ON MACQUARIE ISLAND (NOT SHOWN).



The Australian Government Antarctic Division (AGAD), a Division of the Department of the Environment and Heritage, leads Australia's Antarctic programme 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 programme, maintaining four permanent Australian research stations – Casey, Davis, Mawson and Macquarie Island – and conducting scientific research programmes 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.

*Australia in Antarctica* provides an annual snapshot of the Australian Government Antarctic Division – who we are, what we do and our main achievements and activities for the year.

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Thumbnails (left to right): Peter Bower, Peter Campbell, Sean Wicks, Christopher R Clarke

BACK COVER PHOTO:

Steve Nicol

## CRUISING IN THE SEA ICE ZONE

The sea ice zone off the Australian Antarctic Territory will be the focus of a multidisciplinary study in August and September 2007. The 'sea ice cruise' will study the physical and biological characteristics of the sea ice environment and the links between them.

Sea ice plays a pivotal role in ocean-atmosphere interactions, global ocean circulation and ecosystem function. In particular, sea ice plays an important role in the life cycle of krill, which in turn are a food source for many species of penguins,

seals and whales. The study will investigate the links between winter ice cover and the breeding success of krill the following spring and summer. As krill are commercially harvested it is important to understand the impact that a changing sea ice cover may have in the future, particularly if there is a decrease similar to that observed in the Arctic over recent years.

The voyage will also validate satellite sensors over the sea ice zone, in particular new radar and laser altimetry products that are being developed to determine sea ice and

snow cover thickness. Currently, there is no accurate method of determining sea ice thickness over large areas, so it is possible that the Antarctic sea ice cover is thinning, but scientists don't know it. The research, to be conducted by the Australian Government Antarctic Division and the Antarctic Climate and Ecosystems Cooperative Research Centre, in collaboration with NASA and the European Space Agency, will help to improve the technology that may one day help resolve this problem.

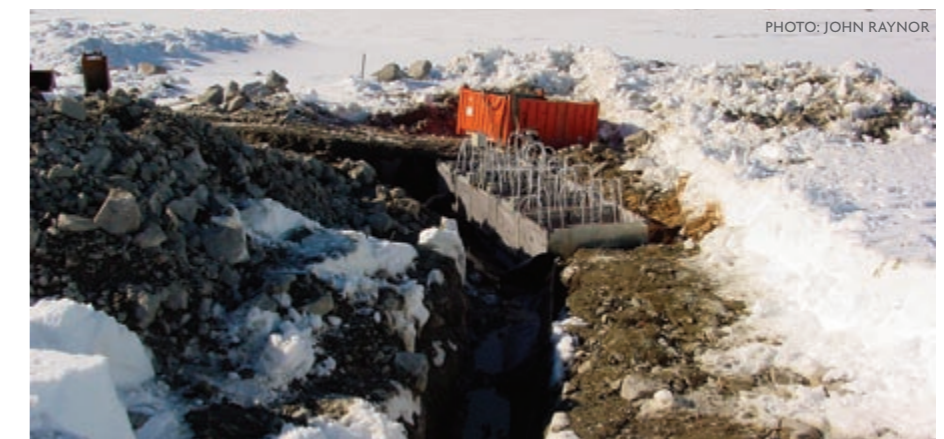
## CLEANING UP ANTARCTICA

The Australian Government Antarctic Division has embarked on an extensive clean-up campaign to remove 30-year-old waste from disused tip sites at Australia's Antarctic stations, and to remediate the effects of fuel spills that have occurred. In 2004 approximately 1000 tonnes of excavated material were returned to Australia for final disposal and a similar amount has been stockpiled at Thala Valley, near Casey station, pending removal.

Research on the sensitivity of marine invertebrates and soil processes to the resulting pollutants is also being undertaken to determine what level of clean-up is required to protect the Antarctic ecosystem. In related research, the addition of fertiliser to contaminated soil has been found to enhance degradation of petroleum pollutants by natural microbial populations.

A new 'permeable reactive barrier' composed of different materials has also been established between an old diesel spill site at Casey and the coast, to intercept a plume of hydrocarbons flowing through the soil in summer. Preliminary results suggest the barrier is working effectively and the technology might be transferable to other locations both in Antarctica and in the Arctic. These experiments will continue in coming summers.

EACH SUMMER MELTING SNOW CARRIES DIESEL FROM A SPILL AT CASEY IN 1999, DOWN TOWARDS THE COAST. A PERMEABLE REACTIVE BARRIER HAS BEEN INSTALLED INTO A TRENCH, 5.5 M WIDE, 2 M LONG AND 1 M DEEP, TO FILTER AND REMOVES CONTAMINANTS FROM THE WATER. PROBES AND SENSORS, WHICH MONITOR CONDITIONS INSIDE THE BARRIER, ARE VISIBLE.



# MEET THE AUSTRALIAN GOVERNMENT ANTARCTIC DIVISION

Since 1981 the Australian Government Antarctic Division headquarters has been based in Kingston, Tasmania, just south of the capital city and international port of Hobart. The Division employs some 300 staff, located at Kingston, the University of Tasmania and Macquarie Wharf in Hobart. Over the peak summer season, from October to March, more than 400 people are deployed to Australia's three permanent Antarctic stations – Casey, Davis and Mawson – and a subantarctic station on Macquarie Island.

Antarctic Division staff work in the areas of policy, science, logistic support, polar medicine and administration. Together, we strive to fulfil the Australian Government's goals in Antarctica. These are to:

- Maintain the Antarctic Treaty System and enhance Australia's influence in it;
- Protect the Antarctic environment;
- Understand the role of Antarctica in the global climate system; and
- Undertake scientific work of practical, economic and national significance.

The Division works to achieve these goals within the framework of the Antarctic Treaty, a highly successful international agreement that, since 1961, has provided the basis for managing the Antarctic as a place for peace and science.

The Antarctic Treaty System is considered to be the best way to advance Australia's policy interests in Antarctica which include: preserving our sovereignty over 42% of the Antarctic continent; protecting the environment; conducting scientific research; and influencing developments in the region.

At the Division, experts in Antarctic, international and environmental policy represent Australia at international forums, including the Antarctic Treaty Consultative Meeting, and meetings of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and the Committee for

Environmental Protection. Staff also provide advice on, and are active in, the conservation of marine living resources (such as fish stocks and krill), combating illegal, unreported and unregulated fishing, the protection of albatrosses, petrels and seals, reducing environmental impacts (such as through waste and fuel use minimisation strategies), tourism management, Antarctic heritage issues, and administering the Australian Antarctic Territory and the Territory of Heard Island and McDonald Islands.

Antarctic Division scientists support these policy goals by providing scientific information that contributes to our knowledge of Antarctica and the Southern Ocean. Research is conducted under four main strategic themes:

- **Ice, ocean, atmosphere and climate** aims to better understand the role of Antarctica and the Southern Ocean and atmosphere in the global climate system.
- **Southern Ocean ecosystems** conducts research that assists in the management and conservation of Antarctic resources through Australia's role in a number of international agreements, organisations and research programmes, including the International Whaling Commission, CCAMLR and the Agreement on the Conservation of Albatrosses and Petrels.
- **Adaptations to environmental change** looks at the response of high latitude ecosystems, communities and species to environmental change.
- **Impact of human activities in Antarctica** investigates how the biodiversity of Antarctica responds to human-induced environmental change, and develops new techniques to remediate environmental impacts, such as those caused by fuel spills or alien species.

Logistic support staff provide the infrastructure, equipment and expertise to transport personnel to and within Antarctica,

and to live and work in Antarctica and the subantarctic. This includes managing the charter of ships and aircraft, supporting marine science voyages and scientific field activities, conducting station resupply, waste removal, and station and field training for expeditioners, and family liaison services. Staff also provide services associated with the design, construction, maintenance and procurement of station buildings and facilities, plant and equipment and communication systems.



PHOTO: JOHN SMITH

## COOL FACT:

The Australian Government Antarctic Division employs three doctors in its Polar Medicine Unit who are responsible for all of the Division's medical requirements. Services include medical screening of personnel, provision of medical supplies to stations, field camps and ships, the recruitment and training of Expedition Medical Officers each year – for deployment to Antarctica and the subantarctic – and 24 hour support of these practitioners. The Polar Medicine Unit is also actively involved in medical research.

## COOL FACT:

The Australian Government Antarctic Division recently changed its name from 'Australian Antarctic Division'. Changes to our website, signage and publications will occur in coming months.

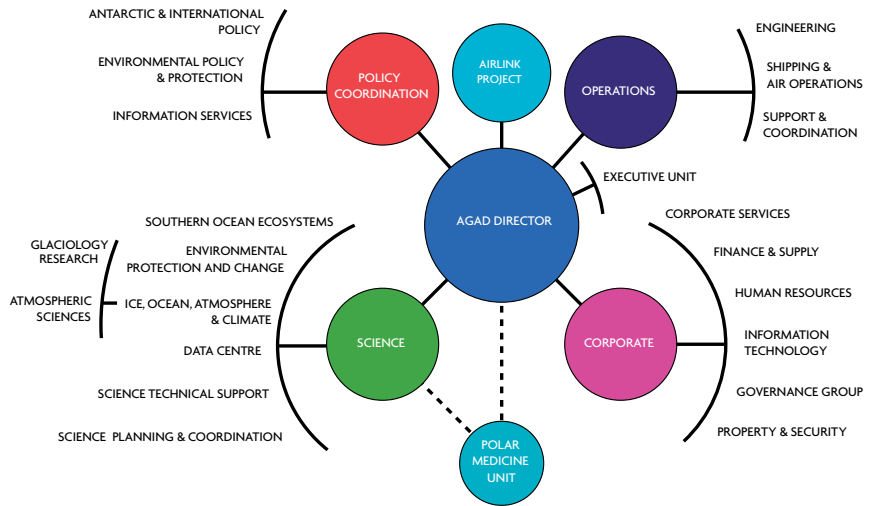
# BUDGETING FOR ANTARCTICA IN 2006-07

The total budget of the Australian Government Antarctic Division in 2006-07 is just over \$102 million. Of this more than \$34 million is allocated to achieving policy outcomes and more than \$67 million to achieving scientific outcomes. From these allocations a range of supporting activities are paid for, some of which are illustrated here.

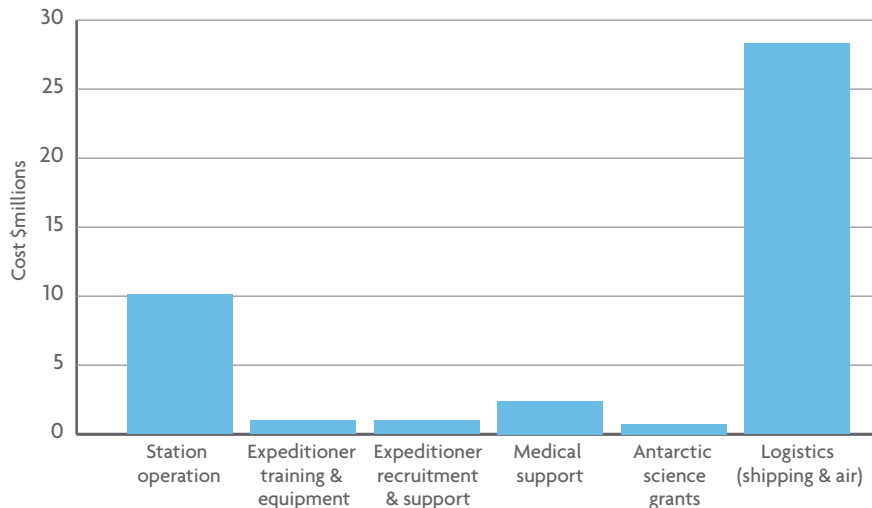
For example, shipping and air transport is the most expensive of the Division's support activities at \$28.3 million, while operating and maintaining Australia's four stations (including feeding expeditioners) costs \$10.1 million. The \$1 million for expeditioner training and equipment covers pre-departure training in a range of trade and professional activities as well as training in Antarctica – such as search and rescue and fire training. It also covers clothing provided for living and working in Antarctica. Another \$1 million is allocated to recruit expeditioners, conduct medical screenings and to provide accommodation, food and other services once they arrive in Hobart. The Polar Medicine Unit receives \$2.4 million to provide medical services and support in Hobart and Antarctica.

Last, but not least, \$750 000 in Antarctic science grants are awarded to about 50 chief investigators from universities and other institutions in Australia, who are undertaking research that will make a significant contribution to Australia's Antarctic research programme. Grants are a maximum of \$60 000 for multi-disciplinary research projects and \$30 000 for a single disciplinary project. The Australian Government Antarctic Division also covers the cost of getting these scientists to Antarctica.

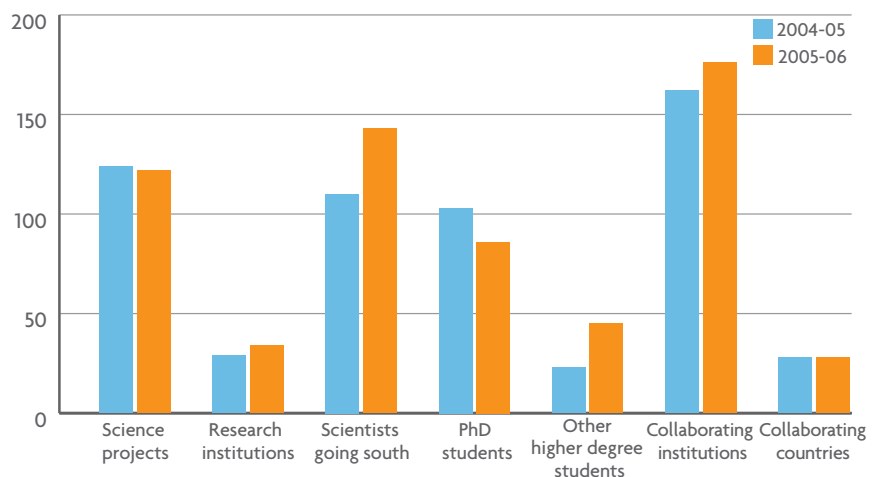
## Australian Government Antarctic Division



## Expenditure on key activities 2006-07



## Australian Antarctic programme statistics



AUSTRALIA'S ANTARCTIC SCIENCE PROGRAMME SUPPORTS MANY SCIENTISTS AND STUDENTS AND COLLABORATES WITH A RANGE OF RESEARCH INSTITUTIONS.

### COOL FACT:

Australia administers the Territory of Heard Island and McDonald Islands. More information [www.heardisland.aq](http://www.heardisland.aq)



CASA 212-400

IMAGE: WADE FAIRLEY

## AUSTRALIA'S ANTARCTIC AIRLINK TAKES FLIGHT

In 2005 the Australian Government Antarctic Division was allocated \$46.3 million by the Australian Government to establish an intercontinental air transport system linking Australia and Antarctica. In combination with the two CASA 212-400 aircraft which were introduced to Antarctica in 2004 to move passengers and cargo between stations and field camps, the Airlink – an Airbus A319 – will enhance our scientific research capabilities by helping to deliver more people to Antarctica in less time, and to more distant parts of the Australian Antarctic Territory.



THE AIRBUS A319

In the 2005-06 austral summer a four kilometre-long runway, situated on blue glacial ice, was graded, and a trial 200 x 40 m snow-capped pavement was successfully constructed at Wilkins Aerodrome, 70 km from Casey. This season the snow-capped runway will be completed. Demonstration flights of a jet aircraft will commence in 2006-07.

**More information:**  
[www.aad.gov.au/airlink](http://www.aad.gov.au/airlink)

### CASA 212-400 flight statistics for 2005-06

Total hours flown – 328  
 Hours flown in support of science – 124  
 Inter-station flight hours – 115  
 Passengers flown between stations – 50  
 Passengers flown between field camps – 70  
 Weight of cargo flown between stations and/or field locations – 47 700 kg



### Airlink facts

- With a range of 6500 nautical miles the A319 can fly from Hobart to Antarctica and return without refuelling.
- The aircraft's internal configuration can be arranged to accommodate different combinations of passengers and cargo.
- The aircraft will carry between 19 and 40 passengers. Each passenger can take 50 kg of stowed luggage and 5 kg of carry on luggage.
- The A319 is 33.84 m long, 11.76 m high and has a wingspan of 34.1 m.

### COOL FACT:

The longest, uninterrupted flight made by the CASA 212-400 aircraft is from Hobart to Casey on its delivery flight – 12.5 hours and approximately 1850 nautical miles (3426 km). The longest routine flight in Antarctica is between Casey and Davis – 5 hours or approximately 750 nautical miles (1389 km).

THE AURORA AUSTRALIS OR SOUTHERN LIGHTS ARE PRODUCED AS A RESULT OF CHARGED PARTICLES FROM THE SUN (SOLAR WIND) COLLIDING WITH GASES IN THE UPPER ATMOSPHERE. THE INTERACTION OF THE SOLAR WIND AND THE EARTH'S MAGNETIC FIELD, THE SAME PROCESS THAT LEADS TO THE AURORA, INFLUENCES THE GLOBAL ELECTRIC CIRCUIT IN THE POLAR REGIONS. SCIENTISTS WILL STUDY THE GLOBAL ELECTRIC CIRCUIT DURING THE INTERNATIONAL POLAR YEAR.

# INTERNATIONAL POLAR YEAR



A new era in our understanding of the polar regions and their impact on the Earth's climate, ecosystems and societies will awaken when the International Polar Year (IPY) gets underway in March 2007.

IPY 2007-2008 will lay the foundation for major scientific advances in the Arctic and Antarctic while leaving a legacy of observing sites, facilities and systems to support ongoing research and monitoring. The IPY is the fourth global polar year – the last was in 1957-58 and set the scene for negotiation of the Antarctic Treaty.

The Australian Government Antarctic Division will lead four of eight scientific projects being hosted by Australia, while Australian scientists will be involved in some 50 other international projects. The Antarctic Division-coordinated projects are:

## Census of Antarctic Marine Life

The five-year Census of Antarctic Marine Life (CAML) will determine species biodiversity, abundance and distribution around Antarctica – on the sea floor, continental slope, in deep waters, under collapsed ice shelves and in upper sunlit

waters. As knowledge of Antarctica's marine biodiversity is patchy, CAML will establish the state of these communities, providing a baseline against which future change can be measured. More information: [www.caml.aq](http://www.caml.aq)

## Taking the Antarctic Arctic Polar Pulse

This project will include development of a snapshot database of health events occurring in the Antarctic during the IPY. Research will include investigations into the impacts of living in the total darkness of winter, the effects of isolated and confined conditions on the human immune system, metabolism, stress and social behaviour, and the viability of using internet-based telemedicine techniques to diagnose and treat disorders over exceptionally long distances.

## Aliens in Antarctica

Aliens in Antarctica will assess the extent to which people unintentionally carry propagules (seeds, spores, eggs) of alien (non-native) species into the Antarctic region during the 2007-08 summer. People travelling to the Antarctic and subantarctic islands, by ship and aircraft, will have their clothing and equipment inspected for propagules.

The project will provide an understanding of the threat that alien propagules pose, enabling appropriate mitigation methods to be established to combat this threat.

## Solar variability linkages to atmospheric processes

This project will investigate whether solar variability affects the Earth's weather and climate. Scientists will measure the global electric circuit – an electric current that flows around the world between the ground and the lower reaches of the ionosphere (about 70 km up) – to determine whether changes in the sun have an effect on the Earth's weather system. Such changes could alter the global electric circuit and the conditions under which clouds develop, potentially providing a link between solar activity and climate. Accurate measurements of the current could also enable scientists to monitor changes in global thunderstorm activity as the world warms.

More information: [www.ipy.org](http://www.ipy.org)



## NEW METHODS TO MONITOR ADÉLIE PENGUINS

Automated cameras will soon be used in remote regions of Antarctica to measure breeding and chick survival in Adélie penguin colonies.

The cameras will 'sleep' through winter and then 'awaken' at the beginning of summer, as their solar panels recharge – just in time to catch the action.

The technology has been built to increase the number of sites at which Adélie penguins can be monitored, as part of an international Ecosystem Monitoring Programme established by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) 15 years ago.

The CCAMLR Ecosystem Monitoring Programme (CEMP) aims to monitor the impact of the krill fishery on the Southern Ocean ecosystem and assist its sustainable management. As Adélie penguins are large consumers of krill, they are useful indicators of the effects of changes in krill abundance – caused by harvesting for human consumption or natural variation.

Thus, as part of the CEMP, Australia began monitoring Adélie penguins at Béchervaise Island, near Mawson, in 1990.

An automated system was developed soon after CEMP began, to measure the time Adélie penguins spend at sea foraging for krill. This system will continue to be used at Béchervaise Island, while the new cameras will be installed at other sites near Mawson and possibly elsewhere.

The beauty of the cameras is that after set up, only a short, single visit is required each year to download photos. This makes it possible to monitor at several sites in a region at minimal logistical cost.

Statistical analyses are now being applied to the data collected over the 15 years of the CEMP. These analyses will tell scientists how many nests or penguins need to be monitored to be sure of detecting changes in the ecosystem in time to take timely management action. Combining this knowledge with the automated technology will allow for more effective monitoring

across the Australian Antarctic Territory, and more broadly around Antarctica.

**More information:**

[www.aad.gov.au/default.asp?casid=2939](http://www.aad.gov.au/default.asp?casid=2939)



PHOTO: CHRISTOPHER R. CLARKE

### COOL FACT:

CCAMLR was established in 1982, mainly in response to concerns that an increase in krill catches in the Southern Ocean could have a serious effect on populations of krill and other marine life. CCAMLR holds annual meetings at its headquarters in Hobart. More information: [www.ccamlr.org](http://www.ccamlr.org).

## AUSTRALIA'S ANTARCTIC FUTURE

The Australian Government Antarctic Division has embarked on a new project to define how Australia will be involved in Antarctica in the future.

The Antarctic Futures Project will define top level objectives for Australia's engagement in Antarctica to 2020 and present an agreed '2020 vision'. This vision will provide context for short, medium and long term decision-making about Australia's approach to the Antarctic. It will also allow for more confident strategic and operational planning within the Australian Antarctic programme

and within the AGAD, optimum use of Government resources, and an improved understanding of how our involvement in Antarctica matches with expectations.

To achieve the vision the project team is consulting with current and potential future participants in the Antarctic programme and federal and state government agencies that have an interest in Australia's place in Antarctica, or that may have a future interest – from a policy, science or operational perspective. The team is also using previous reviews and analyses, such as the Antarctic

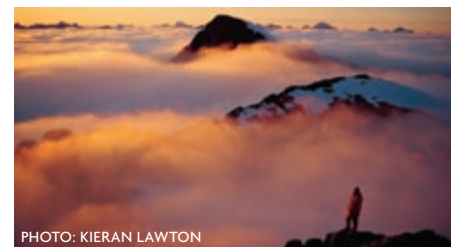


PHOTO: KIERAN LAWTON

Science Advisory Committee's Foresight Report and the 'bold new vision' being developed by AGAD scientists.

The project outcomes will help to protect future options – ensuring that the options for future generations will not be constrained by the decisions we make now.

PHOTO: © DAVE AND  
FIONA HARVEY

THE AUSTRALIAN CENTRE  
FOR APPLIED MARINE  
MAMMAL SCIENCE  
AIMS TO IMPROVE THE  
MANAGEMENT AND  
CONSERVATION OF  
WHALES, DOLPHINS, SEALS  
AND THE DUGONG.

## NEW MARINE MAMMAL RESEARCH CENTRE FOR HOBART

### COOL FACT:

Under the *Environmental Protection and Biodiversity Conservation Act (1999)* all whales, dolphins and porpoises are protected in Australian waters.

A new Australian Centre for Applied Marine Mammal Science is being established at the Australian Government Antarctic Division, to improve the management and conservation of Australia's 40 species of whales and dolphins, 10 species of seals, and the dugong.

The Centre will receive \$2.5 million over four years through the Australian Government's Commonwealth Environment Research Facility (CERF) programme, established in 2004. The centre will also seek direct funding from marine industry groups such as oil and gas.

Minister for the Environment and Heritage, Senator Ian Campbell, said the Centre would provide a high profile, internationally competitive research hub that would build on existing research and address gaps in the knowledge relating to marine mammal management and conservation.

'The Centre will also help improve links between the Australian marine mammal research community, the development of strong industry partnerships, and the integration of research and policy,' he said.

'The Centre's work will be especially important as we continue our efforts to convince pro-whaling nations of the benefits of non-lethal scientific research on whales.'

Research will be conducted under six themes, including the effects of noise on marine mammals, methods to estimate population structure and numbers, human-marine mammal interactions and the development of non-lethal study techniques.

The research will be led by scientist Dr Nick Gales and will inform the development and implementation of public management and policy through an improved ability to forecast, assess, manage, and mitigate threats, and ensure sustainability of marine mammal populations.

'This will result in an improved capacity to conserve and protect marine mammals, while facilitating science-based processes for the management of activities such as whale watching and trawling,' Dr Gales said.

More information about ACAMMS:  
[www.aad.gov.au/acamms](http://www.aad.gov.au/acamms)

More information about CERF:  
[www.deh.gov.au/programs/cerf](http://www.deh.gov.au/programs/cerf)





PHOTO: AFMA

INDUSTRY PARTNERS IN THE PROJECT INCLUDE COMMERCIAL COMPANIES OPERATING IN THE HEARD ISLAND AND McDONALD ISLANDS REGION, SUCH AS PETUNA SEALORD PTY LTD, WHICH OPERATES THIS LONGLINING VESSEL AVRO CHIEFTAIN.

## DEEP SEA CAMERAS ASSIST SEA FLOOR STUDIES

Deep sea cameras operating at depths of up to 2000 metres are being developed to study the impact of 'demersal fishing' – trawling, longlining and trapping – on sea floor communities around Heard Island and the McDonald Islands (HIMI).

An understanding of the effects of demersal fishing gear on these sea floor ('benthic') communities (which include corals, sponges and sea fans) will enable scientists to determine whether special management or mitigation measures are needed to conserve them. Such measures may include avoidance of an area by fishers, fishing gear modification, and practical guidelines to minimise fishing impacts.

The \$3 million project – a collaborative initiative between the Australian Government Antarctic Division, the Fisheries Research and Development Corporation, the Australian Fisheries Management Authority and industry and research partners – will further develop current video and still camera technology, and devices for attaching the cameras and associated equipment (such as lights, lasers and batteries) to trawls, longlines and trawlines.

The aim is to develop a package that can be easily deployed by observers on commercial fishing vessels, during normal operations. Scientists will then monitor the interaction of the fishing gear with different benthic communities and study the number and extent of different habitat types in the HIMI region.

'This will be the first time anyone has looked at the effects of demersal fishing at this depth,' project leader, Andrew Constable, says.

'The results will contribute to the current world-wide debate on whether bottom trawling should continue, and provide some of the first information on the effects of longlining and trapping on benthic habitats.'

The technology arising from the project will later be used to investigate the interactions of demersal fishing gears with benthic habitats on the continental shelf of Antarctica.

SOME OF THE BOTTOM-DWELLING ANIMALS CAUGHT IN RESEARCH TRAWLS AROUND HEARD ISLAND IN 2003 – THE BRITTLE STAR *GORGONCEPHALUS CHILENSIS*, A PREVIOUSLY UNRECORDED SHRIMP *CALAXIOPSIS SP.NOV* AND THE ANTARCTIC PAPILLOSE OCTOPUS *GRANELEDONE ANTARCTICA*.



## ICE CORES ASSIST CLIMATE STUDIES

The Antarctic and Southern Ocean regions drive important atmospheric and ocean circulation processes that influence global weather and climate. Thus, understanding these processes is vital for detecting and predicting climate and environmental changes and their impacts – such as sea level rise, the variability and rate of climate change, and future greenhouse gas levels. Research through the Ice, Ocean, Atmosphere and Climate programme at the Australian Government Antarctic Division and the Antarctic Climate and Ecosystems Cooperative Research Centre is contributing to this understanding in a range of ways.

One way is through the study of Antarctic ice cores. These time capsules of global climate information contain traces of dust,

gases (in air bubbles) and chemicals from natural sources (such as volcanic eruptions) and human activities around the world. Each time it snows this information is laid down in layers of ice – like tree rings – and can be used to detect major environmental changes and variations in the chemistry and circulation of the atmosphere that occurred over months, years or millennia. By analysing these ice core components, scientists can reconstruct past climate and compare it to the present, to see how it has changed.

Recently, for example, a 650 year old ice core was retrieved from Law Dome, inland

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LAYERS OF ICE IN THIS ICE CORE FROM LAW DOME (ABOVE) CONTAIN INFORMATION ABOUT THE CHEMISTRY OF THE ATMOSPHERE, AS FAR BACK AS THE 15TH CENTURY.

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of Casey station. Analysis of this ice core will help climate scientists understand the natural changes in the Antarctic climate system during a period known as the Little Ice Age (1400–1850 AD) and to compare the natural warming at the end of this period with recent warming.

Climate scientists are also gearing up to drill a 1-1.5 million year old ice core which will provide information on climate, temperature and greenhouse gas concentrations over a period of fundamental change in the ice age cycle, some 900 000 years ago. An understanding of what caused the switch from an ice age every 41 000 years to one every 100 000 years, will help scientists better understand the climate system and make realistic predictions of future natural or human-induced change.

## KRILL SURVEY COMPLETE

Ten years after it began, one of the largest marine ecosystem research projects of the Australian Antarctic programme, ended in February 2006.

The Baseline Research on Oceanography, Krill and the Environment-West (BROKE-West) voyage, surveyed 1.5 million km<sup>2</sup> of ocean between 30° and 80° east, in a region designated by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) as Statistical Division 58.4.2 (see map). The survey aimed to describe the marine ecosystem of the region and determine krill distribution and abundance – to help calculate precautionary catch limits for the krill fishery in the region.

BROKE-West followed in the footsteps of BROKE which, in 1996, conducted a similar survey of the adjacent 4.7 million km<sup>2</sup> CCAMLR Division 58.4.1. Together, the two surveys, adjacent to the Australian Antarctic

Territory, stretched around one third of the Antarctic coastline.

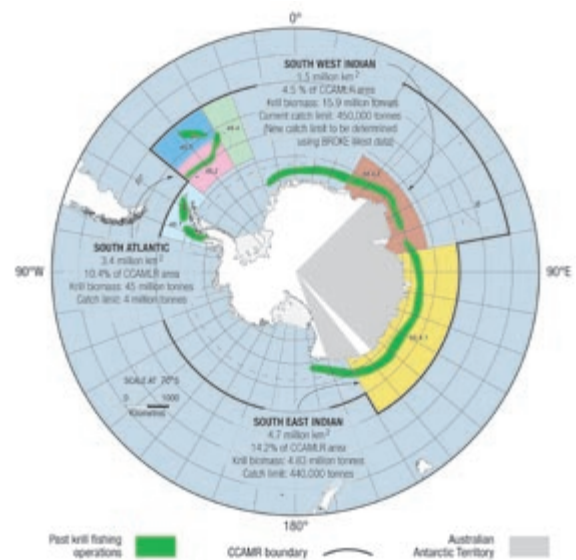
While BROKE and BROKE-West were designed around the need to estimate krill distribution and abundance they also provided an opportunity to conduct large scale oceanographic experiments and to collect a suite of ecological information about this little visited stretch of the Antarctic coastline.

For example, while most sectors of the BROKE-West survey area confirm earlier findings of cooler Antarctic waters and less salinity, the easternmost

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BROKE-WEST ESTABLISHED THAT THERE WERE 15.9 MILLION TONNES OF KRILL IN DIVISION 58.4.2. THE ANNUAL CCAMLR MEETING WILL CONSIDER USING THIS ESTIMATE TO ESTABLISH A NEW CONSERVATION MEASURE ON THE KRILL FISHERY IN THIS AREA.

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line of the survey showed an increase in both temperature and salinity. This may be due to a convergence of ocean fronts and a movement of currents south. Researchers will undertake further analysis over the coming year to determine why this has happened and what it means for ecosystems in the region.