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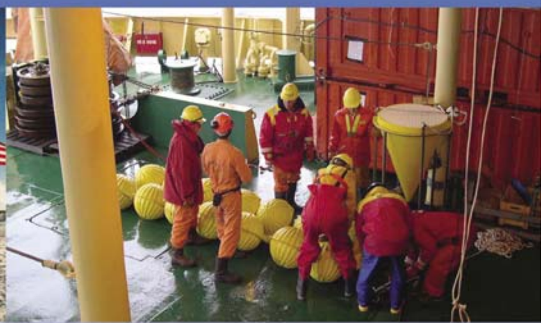
## IN THE SPIRIT OF COOPERATION



# Australian ANTARCTIC MAGAZINE

6 Autumn 2004

# In the spirit of cooperation

Those of us involved with Antarctica and the Southern Ocean know that it's not easy to get to know how the place works. We are dealing with complex physical and biological interactions over great distances and spanning millions of years, in a remote and harsh environment.

Improving our understanding of the part played by this region in global processes demands cooperation – between individuals and small groups working in the field and between nations with a common stake in the future well-being of our planet.

If there is any common theme in the story of human Antarctic endeavour, it has to be cooperation. I write this as I am about to set off to the 27th Antarctic Treaty Consultative Meeting in Cape Town, in May 2004.

The Antarctic Treaty, now in its fifth decade, is one of the most successful and enduring of all international agreements. Signed when the Cold War was at its chilliest, it brought together nations from opposite political poles in the common cause of cooperation in building a better understanding of our world.

Antarctic Treaty nations met for the first time in Canberra in 1961, a recognition of Australia's strong advocacy of international cooperation in the Antarctic. One of the twelve original signatories represented at that meeting was South Africa, whose hosting of the 2004 meeting will be a reminder of its own enduring commitment to Antarctic science through the difficult apartheid years and up to the present.

The unique success of this international agreement depends on the willingness of participating nations to work hard – not just in Treaty forums but also in the field and the laboratory.

This year, 2004, signals an important event in the history of Australia's involvement with Antarctica because it is the jubilee year of our oldest Antarctic station and the oldest of all permanent bases south of the Antarctic Circle.

When Mawson was established in 1954, Phillip Law believed that Australian involvement with the ice continent would prove of immense and lasting value to the nation and the world. How right he was. The success was due in part to our strength in international forums, but it was also because the men of the 1954 party

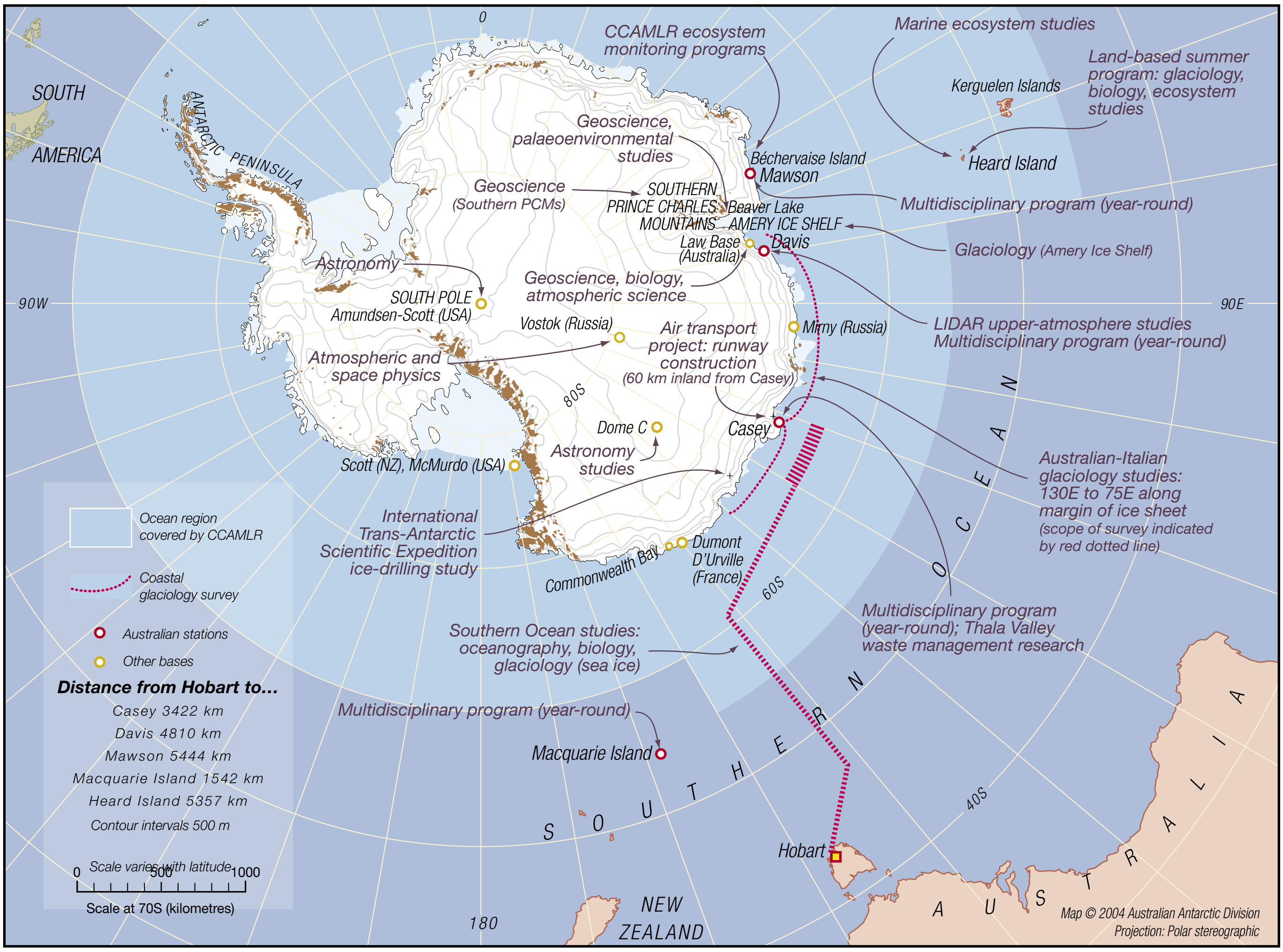
ANDREW JACKSON

*Australian Antarctic Division Director and Chair of the Antarctic Treaty's Committee for Environmental Protection (CEP), Dr Tony Press, addresses delegates to the CEP VI meeting in Madrid in June 2003.*

and those many hundreds of Australians who followed over the years brought a spirit of cooperation and mutual support, combined with sheer hard work, to their southern endeavours.

As we pass this milestone, we can reflect with pride on recent Australian Antarctic endeavours that have continued this great tradition.

We can look on the establishment in 2003 of the Antarctic Climate and Ecosystems Cooperative Research Centre in Hobart. This CRC is




PETER BOYER

*Australian Antarctic field research activities 2003–04* based on collaboration between many institutions and researchers across many disciplines working together in to understand role of the Antarctic in global and regional processes. This venture is part of a much wider Australian imperative to pursue our understanding global climate change.

This year Antarctic research programs such as the International Trans-Antarctic Scientific Expedition ice-drilling study and the Australian-Italian sea ice program have emphasised our commitment to working with other nations in the field as well as in the conference room.

A summer research program on Heard Island produced some valuable evidence of the impact of climate changes over recent decades. Glaciologists found that in the past three years alone, Brown Glacier has retreated 50 metres, and slopes over most of its length have lost from four to eleven metres in thickness.

Our long-standing commitment to monitoring and assessing the ecological systems of the Southern Ocean has been maintained and strengthened by our biological work at sea and on Heard Island. Time-honoured programs of observing the feeding ecology of important land-based predators such as seals, penguins and flying birds have continued to bring significant results, not least of which is valuable data supporting international moves to protect Southern Ocean ecosystems from illegal fishing.

The outstanding work of the albatross field research party on Heard Island, plotting in detail the feeding behaviour of two key species so graphically illustrated in this issue, is a case in point. This research was part of a much wider land-sea effort that looked in detail at the island's major predators and their prey, studies which provide us with a timely reminder of the vital connections between all forms of life.

We can reflect on the strides that have been taken over the past year or so in developing Australia's Antarctic air transport capability. A major step forward was taken in April 2004 with the delivery of the first C212-400 aircraft. The increased mobility and versatility offered by the aircraft will open up new opportunities for Australian Antarctic science, illustrated by the success over the 2003-04 summer of Canadian Twin Otter aircraft, used to transfer people between stations and enabling us to conduct comprehensive science programs in some very remote places.

For the first time, the Australian Antarctic Division was able to resupply its three continental stations – Casey, Davis and Mawson – in a single voyage with the charter of MV *Vasiliy Golovnin*, increasing the availability of Aurora Australis for marine science research.

Australia's work to clean up its old rubbish sites in Antarctica has commenced in earnest with the clean-up of the Thala Valley tip site near Casey Station. This follows years of research into remediation of abandoned tip sites created in the days when we left behind most of what we took to Antarctica with little regard to its eventual effect on the environment.

I look forward to the 2004 Antarctic Treaty Consultative Meeting knowing that we have continued to do our bit in the great Antarctic cause. As we in the Australia's Antarctic program celebrate fifty continuous years in Antarctica, we can look back with pride on a year that has upheld the highest traditions of Antarctic cooperative endeavour.

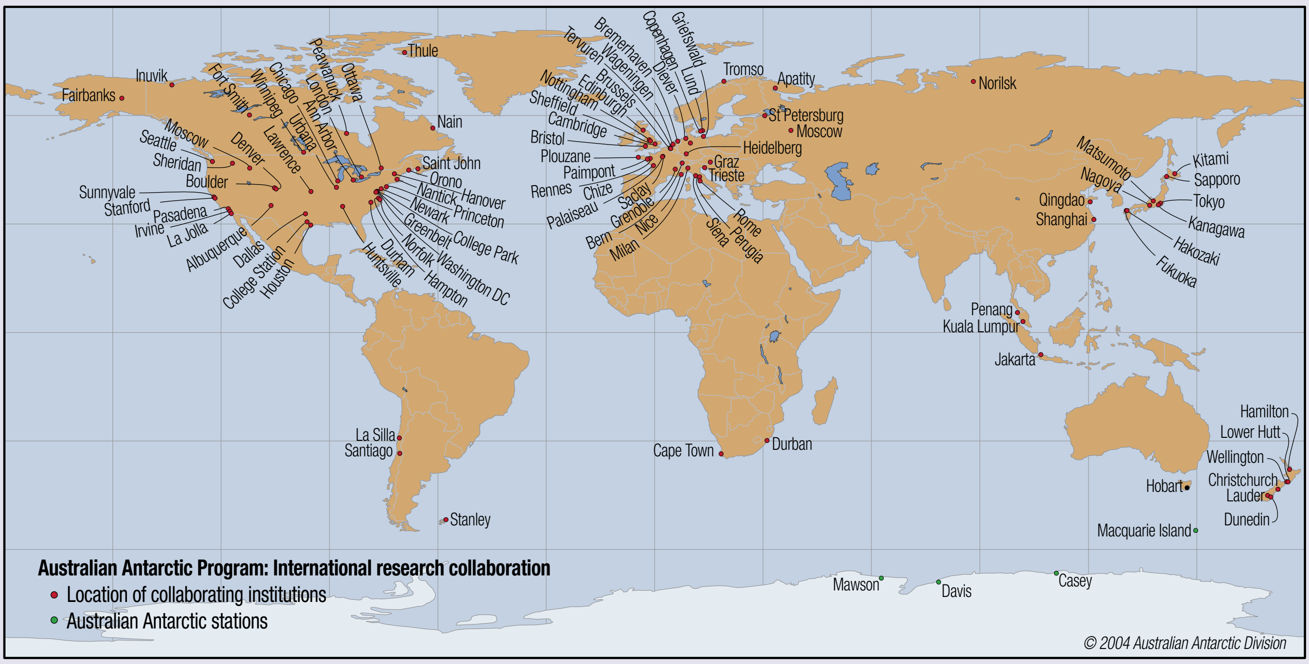
Tony Press

## International scientific collaboration: let's maximise our efforts

Australia values the collaborations we already have in all areas of Australia's Antarctic science program enormously, but we are keen to establish more. The spirit of cooperation within the Antarctic Treaty is a fantastic springboard for collaborative scientific research. The more we can all work together and combine our logistic and scientific support, the better it will be for scientific knowledge of the Antarctic continent and Southern Ocean.

If you are interested in working with us in the Australian science program please contact us. Look at our web site at <http://www.aad.gov.au> and phone, fax or email us with your ideas for joint projects. In May each year we open science applications for the following season, i.e. in May 2004 we will call for applications for the 2005–06 season.

It always takes time to set up new collaborations but the first step is to start talking to us. Australia has just announced its new science strategic plan for the next five years and published it on the AAD website at <http://www.aad.gov.au/default.asp?casid=13950>. So please take a look and think about how we can work together. – *Gwen Fenton, Science Planning & Coordination, AAD*



# Antarctic research: a collaborative model

ROB MASSOM

*On Voyage 1 this season scientists from 20 overseas institutes (and six countries) collaborated on an international sea ice survey.*

Many years ago I was invited to spend a short period working in a biological research laboratory in the USA. I was asked by my host to be sure the laboratory door was locked whenever I was the last one to leave because, he told me, other researchers in the building had less grant money than he and he wasn't about to share any of his equipment with them! From my then viewpoint – a quaintly-funded but exhilarating research laboratory at the University of London – I found his attitude quite dispiriting. I still do today.

A striking feature of Antarctic scientific researchers is their readiness to collaborate, co-operate and share; the fragile and fickle flower that is absent in so much of science is, thankfully, a hallmark of Antarctic science. The former Governor of Tasmania, Sir Guy Green, in the inaugural Phillip Law Lecture in 2002 pointed to some special features of Antarctic science and its practitioners. With respect to the all-too-frequent practice of attacking the scientist rather than his/her theory he notes: 'In strong and refreshing contrast Antarctic science … is still being conducted and debated in accordance with the traditional norms of scientific discourse. Whilst Antarctic scientists are as protective and concerned about the environment and its biota as anyone else and whilst there are vigorously debated differences of opinion between Antarctic scientists about environmental issues, the personal attacks and low-grade debate which characterise environmental discussion elsewhere ... are completely alien to the atmosphere in which Antarctic science is conducted.'

Perhaps it is the underpinning ethos of the Antarctic Treaty that does it, perhaps it is the role that SCAR (the Scientific Committee on Antarctic Research) has played in coordinating large-scale research in Antarctica, or perhaps it is the naturally-forming camaraderie and respect that develops amongst people who work in harsh and dangerous environments. Whatever it is, we have good reason to be thankful because the beneficiary of it is our understanding of the way the Antarctic works, and how it is integral to so much that happens in the rest of the world. Given its size and the small number of researchers who work there, it is truly astonishing just how much we now know about this vast region of the earth. The story that is unfolding is as compelling as the deeds and exploits of those who, a century ago, prepared the way for us today. Like the best fairy tales, this one also starts a long time ago.

Until about 140 million years ago Antarctica was nestled in the arms of South America, Africa, India, and Australia in the super-continent called Gondwanaland. Its climate was cool-temperate; equable enough for plants and animals to thrive. Antarctica would have looked much as western Tasmania does today – the little garden in the Australian Antarctic Division headquarters has been planted with the modern relatives of species we know existed then. Marsupial mammals, spreading southwards from South America, reached Australia via Antarctica – their fossils have been found in the Antarctic Peninsula. Gradually the southern continents started to drift northwards and Antarctica became isolated and exposed to new forces. The widening sea around its shores, and the spin of the Earth on its axis, caused a strong current – the Antarctic Circumpolar Current – to further isolate it from the more northern and temperate influences that nurtured its flora and fauna. And so it cooled. By about 37 million years ago a permanent ice cap had formed, and the waters

ROBB CLIFTON

*In 2002–03 the highly successful geoscience research expedition Prince Charles Mountains Expedition of Germany-Australia (PCMEGA) saw twenty scientists from five Australian, one Russian and six German research institutes undertake a comprehensive study of the formation of these mountains and their preserved record of the Earth's history.*

ROB MASSOM

surrounding it had become even colder. Luxuriant flora and fauna all but disappeared. The waters swirling around the continent, made biologically rich by up-welling nutrients brought aloft from the abyssal depths by currents returning southwards from their long circuit around the globe, sported a complex and ecologically diverse flora and fauna upon which specially adapted species prospered.

A thin soup of microscopic plants and animals sits at the head of a great feeding table that supports a complex web of animals including the largest that have ever existed. The ocean is so productive that it may be imagined as a high interest-bearing bank account, where a dollar deposited in its nutritious waters grows almost instantaneously to two, then four, eight etc. As each new dollar emerges it is snapped up and put to use by a myriad of hungry mouths to drive a burgeoning marine economy. It may be cold but the high-latitude Southern Ocean is mightily productive!

An issue that is starting to engage the minds of oceanographers is that the strength of the currents returning to Antarctica appears to be waning. If this continues to be the case, and the deep nutrients are returned to the sunlight zone in diminishing amounts, the ocean's productivity will start to decline. The factors causing this change in current flow are to do with increased rainfall in the mid-latitudes resulting from global climate change but knowing this does not dispel the concern. We are continuing our observations on this most ominous development.

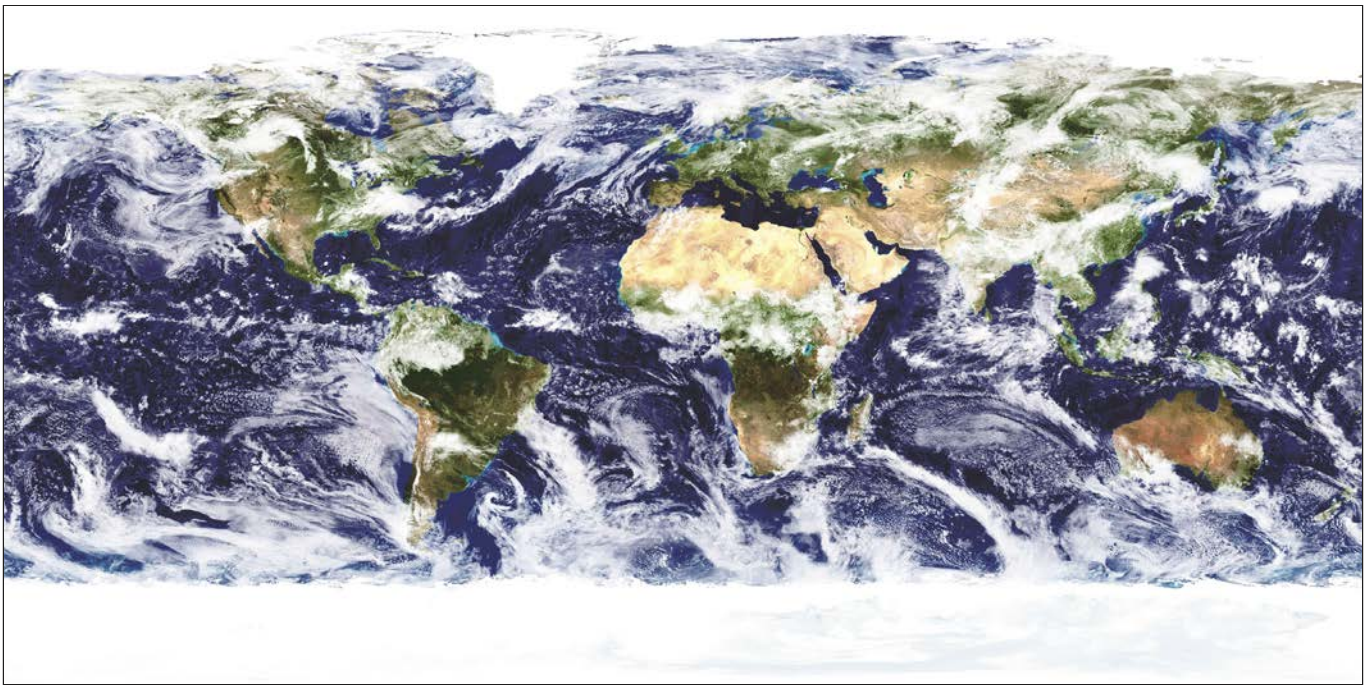
BARRY CHESTER

*Above left: Launching a sediment trap – arrays of these are deployed by many nations around Antarctica to determine what and how much of the biological production in surface waters is transported to the deep ocean. Above: Dr Agus Supangat and Mr Mohammad Lukman presenting an inscribed plaque from Indonesian President Megawati Sukarnoputri to Davis station, on the occasion of the arrival of the first Indonesian scientists on continental Antarctica, February 2002.*

The interrelationships between the cold, the ice, the ocean and the atmosphere above the ocean are as complex as their relationships with the biological world beneath it. The whole system is precisely that – a system in which the many parts are intricately engaged with every other part, as are the cogs and escapements in a watch. In the Antarctic Climate and Ecosystem CRC we are examining the effects of variation in the physical environment on biological productivity and sustainability. Through the development of so-called coupled models we are putting together the bits of the puzzle regarding the way in which ice, water and atmosphere interact with one another and collectively contribute to the climate of the southern hemisphere. In a region of the Earth where there are few researchers able to collect data on the physical environment our observations on Antarctica's role in climate are extremely important.

It is only through working with others that this story is taking shape. Through collaboration and cooperation we are able to bring the best researchers together to tackle what are emerging as some of the greatest challenges facing humankind. When we leave the laboratory at night we are happy to leave the door open, in the hope that we can entice some new collaborators to come in and work with us.

*Michael Stoddart,*
*Chief Scientist, AAD*



NASA GODDARD SPACE FLIGHT CENTER

*Antarctica's central role in global processes can only be understood through the cooperative engagement of many nations and many scientific disciplines.*
*(This image was produced using a collection of satellite-based observations by scientists and visualisers who stitched together months of observations of the land surface, oceans, sea ice and clouds into a seamless, true-colour 'blue marble' mosaic of every square kilometre of our planet. Another example of the power of collaboration.)*

# Studying the big picture: 50 years of international cooperation in Antarctic earth system science

As exemplified in the other articles in this issue of *Australian Antarctic Magazine*, much of present day Antarctic research is conducted within a spirit of collaboration, be it bilateral, multinational or truly international. This article provides a background to some of the larger international initiatives, many of them global rather than regional, that have helped determine the direction and progress of Antarctic science. The list of programs summarised here is by no means exhaustive, but hopefully provides some insight into the relevance and benefits of international cooperation. International cooperation allows researchers to share specialised expertise as well as resources, and to synthesise results to tackle large-scale regional and global issues involving the whole of Antarctica and the Southern Ocean. The total outcomes of these international efforts have always been greater than the sum of the components.

The modern era of intense scientific investigation of Antarctica through international collaboration grew from the highly successful **International Geophysical Year (IGY)** 1957–58. IGY was originally proposed as the 3rd International Polar Year (the first two International Polar Years in 1882–83 and 1932–33 involved predominantly Arctic activities) but developed to become a comprehensive global study of geophysical phenomena and their relationships with solar activity. It aimed to make wide-spread, simultaneous and intensive observations of a range of geophysical phenomena, using the latest instrumentation, rocket and satellite technologies. From the start, Antarctica was identified as an area of great scientific importance. The International Council of Scientific Unions (ICSU), the peak international non-governmental scientific body now called the International Council for Science, approved the concept of the IGY and established the Comite Spécial de l'Année Géophysique Internationale (CSAGI) to plan and coordinate activities. ICSU and UNESCO contributed funding to the central organisation of IGY and the World Meteorological Organisation (WMO) made a substantial contribution to archiving weather data, but individual nations funded their own scientific activities and also contributed to the central organisation. Estimates of the total cost of the IGY range from US$200 million to over US$1000 million if the cost of logistics is included (in 1958 dollars!).

The IGY included studies of meteorology (large scale dynamic and thermodynamic processes), geophysics, the structure of the ionosphere, cosmic rays, solar activity (the sun was more active in 1957-58 than at any time in the previous 400 years), glaciology, oceanography, seismology, and the earth's gravitational field. Globally 67 nations participated in the IGY and 12 nations had Antarctic programs. There were 40 scientific stations operated on the Antarctic continent and a further 20 on subantarctic islands. Most scientific objectives were met or exceeded, and data collected during the IGY fed scientific analyses for many years into the future. The World Data Centre (WDC) system was established for IGY data and the three WDCs (which hold duplicate data sets) continue as important repositories of geophysical data today. The Van Allen Radiation Belts were discovered during the IGY; the first artificial satellite was launched by the USSR (Sputnik-1, October 4 1957); large areas of the Antarctic continent were investigated for the first time; and the base-level of geophysical observations and research opportunities was broadened in many countries.

ANNÉE GÉOPHYSIQUE INTERNATIONALE
1957 1958
INTERNATIONAL GEOPHYSICAL YEAR

Equally important however was the considerable media attention that IGY attracted and the spirit of harmony that it created. The IGY caught public imagination and, despite a background of political tension (such as the Cold War and competing territorial claims in Antarctica) it provided a framework for nations with conflicting interests to work together. The IGY demonstration of international cooperation in Antarctica, with suspension of territorial rivalries, led to the establishment in 1958 of the Scientific Committee on Antarctic Research (SCAR) and signing of the Antarctic Treaty in 1959.

The **Scientific Committee on Antarctic Research (SCAR)** is the committee of ICSU charged with the initiation, promotion and co-ordination of scientific research in Antarctica. SCAR is an international, interdisciplinary, non-governmental organization which can draw on the experience and expertise of an international mix of scientists, and one function of SCAR is to provide expert scientific advice to the Antarctic Treaty System.


ROBERT DINGLE

*Australia's second permanent Antarctic station, Davis, was established in January 1957 in the Vestfold Hills ready for the International Geophysical Year.*

Originally formed from the 12 nations which were active in Antarctica during the IGY, SCAR now has 27 Full Members (those countries with active scientific research programs in Antarctica), six Associate Members (those countries without an independent research program but planning for the future) and seven Union Members (other scientific bodies affiliated with ICSU that have an interest in Antarctic research).

At the working level SCAR is structured into three Standing Scientific Groups (SSGs) for geosciences, life sciences and physical sciences (formerly Working Groups). The SSGs exchange information on disciplinary scientific research being conducted by national Antarctic programs; identify research areas or fields where current research is lacking; and coordinate proposals for future research to achieve maximum scientific and logistic effectiveness. Where a requirement for a new cooperative SCAR initiative is identified, a formal proposal is developed and, if accepted by nationally appointed SCAR delegates meeting in plenary, a Scientific Programme Group (SPG) is appointed for a fixed-term to implement the cooperative program (formerly Groups of Specialists). SCAR Delegates, and the SSGs and other groups, meet every two years. Australia has hosted these biennial meetings on three occasions: SCAR III (Canberra, 1959), SCAR XXII (Canberra, 1972) and SCAR XX (Hobart, 1988). Australia will also bid to host the 2006 meeting (SCAR XXIX) in Hobart.

While the routine SCAR functions of information exchange, provision of scientific advice, etc. are important, it is the internationally cooperative programs developed within SCAR that do the most to advance Antarctic research. Possibly the largest and most successful of these was **BIOMASS (Biological Investigations of Marine Antarctic Systems and Stocks)**. During the Second SCAR Biology Symposium in Cambridge in 1968, it became apparent that little was known of the biology, ecology and population dynamics of Antarctic krill (*Euphausia superba*), one of the most significant organisms in the Antarctic marine ecosystem. Foreseeing a need for substantial expansion of research on the Antarctic marine ecosystem, SCAR (together with the Scientific Committee on Oceanic Research; SCOR) established a Group of Specialists to develop a proposal for international cooperative studies in the area. This became BIOMASS, whose principal objective was to gain a deeper understanding of the structure and dynamic functioning of the Antarctic marine ecosystem and to provide a basis for sustainable future management of the resource. Originally conceived as a ten year research program, BIOMASS was eventually extended over fifteen years and included two major multinational oceanographic campaigns: the **First International BIOMASS Experiment (FIBEX)** in 1980–1981, and the **Second International BIOMASS Experiment (SIBEX)** in 1983–1985. Australia's involvement in BIOMASS (including both FIBEX and SIBEX) was the impetus for establishing a high latitude deep-sea oceanographic capability, initially with a major refit of MV *Nella Dan*, but eventually leading to the considerable marine science capability that exists within the present Australian Antarctic Program. The scientific achievements of BIOMASS were numerous but BIOMASS was also instrumental in establishing the scientific basis that led to the development of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) within the ATS.

Another important cooperative initiative of SCAR was the **Group of Specialists on Global Change and the Antarctic (GLOCHANT)** which was established in 1992. The mission of GLOCHANT was to contribute regional Antarctic science into the global International Geosphere-Biosphere Programme (IGBP) and the World Climate Research Programme (WCRP) (see next paragraph). To coordinate GLOCHANT activities a SCAR Global Change Office was established at the Antarctic CRC in Hobart in 1995. The work of the Group of Specialists wound up in 2002, but three ongoing GLOCHANT initiatives, each with considerable Australian input, continue. These are a project on **Antarctic Sea Ice Processes and Climate (ASPeCt)**, the **International Trans-Antarctic Scientific Expedition (ITASE)** which is concerned with the record of the past 200 years of climate and environmental record that can be recovered from shallow ice cores (see article by van Ommen and Goodwin in this issue, p. 22) and the **Antarctic Ice Margin Evolution (ANTIME)** project which is concerned with the late Quaternary sedimentary record around Antarctica.

While SCAR is an organisation with regional responsibility, there are also other larger global cooperative programs developed in the decades after the IGY that are co-sponsored by ICSU. These include the **World Climate Research Programme (WCRP)** which

STEVEN BROOKES

STEVEN BROOKES

STEVEN BROOKES

*The Second International BIOMASS Experiment (SIBEX) II, 1985. Clockwise from top: The team of Australian marine scientists aboard* Nella Dan*; Sorting krill and zooplankton; Retrieving the CTD.*

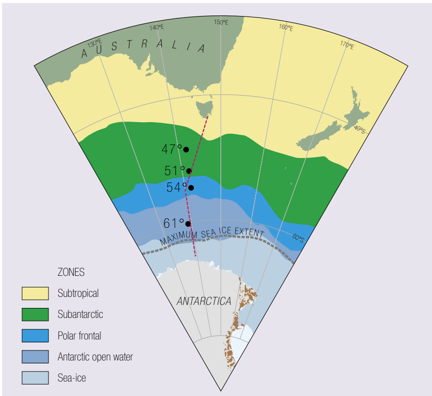
deals with the physical aspects of climate, and the **International Geosphere-Biosphere Programme (IGBP)** which is concerned with the interactive physical, chemical and biological processes that regulate the total Earth System. Two more recent international global environmental change research programs now work in close collaboration with WCRP and IGBP: the **International Human Dimensions Programme on Global Environmental Change (HDP)**, and **DIVERSITAS**, an international program of biodiversity science.

WCRP grew directly from the **Global Atmospheric Research Programme (GARP)**, itself a direct consequence of the success of the IGY. The 1970s GARP was an example of coordinated international activity that culminated in the first detailed study of the entire global atmosphere over a period of a year in 1979 – the **First Global GARP Experiment (FGGE)**. While not including specific major activities in the Antarctic, GARP made full use of the Antarctic observing network established in the IGY, and the results of GARP, in particular the application of a global system of geostationary and polar orbiting satellites, underpins modern meteorology. The **World Climate Research Programme (WCRP)** was established in 1980, under the joint sponsorship of the International Council for Science (ICSU) and the World Meteorological Organization (WMO), and has been subsequently also sponsored by the Intergovernmental Oceanographic Commission (IOC) of UNESCO. The objectives of WCRP are to develop the fundamental scientific understanding of the physical climate system and climate processes needed to determine to what extent climate can be predicted and the extent of human influence on climate. The program encompasses studies of the global atmosphere, oceans, sea and land ice, and the land surface which together constitute the Earth's physical climate system.

The **World Ocean Circulation Experiment (WOCE)** of 1990–2002 was the first component of WCRP in which the Australian Antarctic Program made a major field contribution. The field phase of WOCE lasted from 1990–1998 and aimed to collect a 'snapshot' of detailed observations of the global ocean that would support larger objectives of developing models for predicting climate change and of identifying data sets required to monitor the long-term behaviour of the ocean and detecting changes in ocean circulation. Nearly 30 nations contributed to the WOCE in-situ observations. Within the Australian Antarctic program, seven north-south transects were made across the Southern Ocean choke-point between Hobart and Antarctica, measuring temperature, salinity and other parameters over the full-depth of the ocean. In the Southern Ocean, Australia also contributed to expendable bathy-thermograph (XBT) transects, mooring programs, and drifter deployments. WOCE field observations were supplemented by global satellite observations and the development of global numerical ocean models to assimilate the measurements. WOCE laid the basis for ongoing study of the global ocean including the demonstration of appropriate satellite and in situ observing systems and realistic global ocean models. The analysis of WOCE data continues today.


CHRISTIAN GALLAGHER


IAN ALLISON



S BRAT & C CURRAN

*Top: International Trans-Antarctic Scientific Expedition (ITASE), 2004. Shallow ice core drilling in support of the ITASE program at a site east of Casey. Middle: World Ocean Circulation Experiment (WOCE), Voyage 1 1995–96. Emptying water samples from the CTD (conductivity, temperature and depth) instrument. Bottom: Climate Variability and Predictability (CLIVAR), 2001. The CLIVAR track between Tasmania and the Antarctic coast, showing the major zones of the Southern Ocean and the location of sediment trap arrays.*

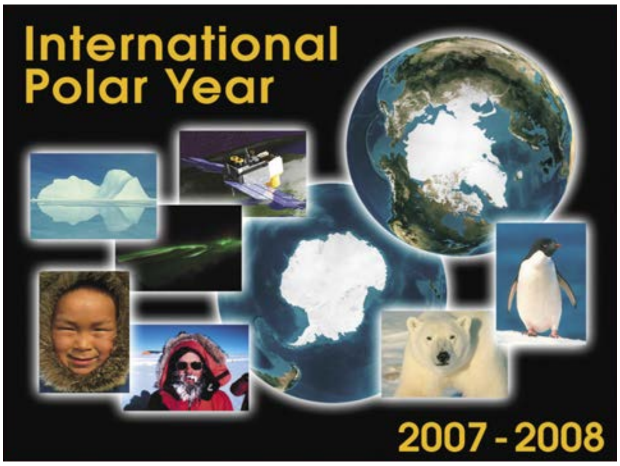
WCRP currently consists of four broad-based multi-disciplinary core projects, with the development of global climate models as an important unifying component. Two of these core-projects are most directly relevant to our Antarctic program. **Climate Variability and Predictability (CLIVAR)** is a follow-on project from WOCE and is the main focus in WCRP for studies of climate variability, extending effective predictions of climate variation and refining the estimates of anthropogenic climate change. CLIVAR is attempting particularly to exploit the 'memory' in the slowly changing oceans. A key scientific question in the strategy for Australia's Antarctic science program for the next five years is 'What are the Southern Ocean processes responsible for climate variability and predictability on seasonal, inter-annual, decadal and longer timescales, and how do these influence sea-level?' Work that will be undertaken to address this is based on sustained observations (hydrographic transects, robotic floats, deep-ocean moorings, satellite observations, etc.) and modelling efforts, and will both contribute to the wider CLIVAR objectives and benefit from international collaboration within CLIVAR.

The **Climate and Cryosphere (CliC)** Project is the most recent core project of WCRP, started in 2000 and with an expected life span of about 15 years. CliC addresses those portions of the Earth's surface where water is in a solid form (including snow cover, sea ice, lake ice and river ice, glaciers, ice caps and ice sheets, and frozen ground including permafrost) as an integral part of the climate system. The principal goal of CliC is to assess and quantify the impacts of climatic variability and change on components of the cryosphere and their consequences for the climate system, and to determine the stability of the global cryosphere. In support of this goal CliC seeks to enhance and coordinate efforts to monitor the cryosphere, to study climate related processes involving the cryosphere, and to model and understand its role in the climate system. Many CliC objectives parallel those of the Australian Antarctic glaciology program. These include determination of the role of the Antarctic ice sheet in future sea level change; the impact of sea ice on the mean state and variability of regional and global climates; the role of both sea ice and hydrological processes involving glacial ice in the overturning thermohaline circulation of the global ocean; and the acquisition of better data on past climate from Antarctic ice core records. Australian participation within CliC will be critical to achieving national objectives, which address problems involving the whole of Antarctica, not just Australia's area of operation. Climate processes in the Southern Ocean are of particular importance both to Australia and globally, and these are addressed by a combined **CLIVAR–CliC Southern Ocean Panel**.

While WCRP addresses physical aspects of climate, the **International Geosphere-Biosphere Programme (IGBP)**, established in 1986, is concerned with the interactive physical, chemical and biological processes that provide a unique environment for life, and the changes that are occurring in this system. IGBP has a focus on global biogeochemistry. Components of IGBP that involve, or have involved, Antarctica include the regional sub-projects **Southern Ocean – Joint Global Ocean Flux Study (SO-JGOFS)**, concerned with the role of the oceans in the global carbon cycle, and **Southern Ocean Global Ocean Ecosystem Dynamics (SO-GLOBEC)**, which aims to understand marine population variability in response to environmental variability. The SO-GLOBEC program focuses on Antarctic krill as the target species but also includes study of krill habitat, prey, predators and competitors, such as salps. IGBP also includes a program on **Past Global Changes (PAGES)**. PAGES supports research aimed at understanding the Earth's past environment in order to make predictions for the future and has as one of its foci the study of paleoclimate and environmental variability in polar regions, with links to ITASE and ANTIME (see above) as well as deep ice coring. The Australian Antarctic Program has links to each of these international initiatives.

The year 2007 will mark the 125th anniversary of the First International Polar Year, the 75th anniversary of the Second Polar Year, and the 50th anniversary of the International Geophysical Year. The IPYs and IGY resulted in significant new insights into global processes, and laid the foundation for decades of invaluable polar research. A groundswell of support has arisen from the broad scientific community for a new international initiative, on these anniversaries, which recognizes the importance of polar science and acts as a springboard for further major advances. Hence, in February 2004, ICSU endorsed an **International Polar Year 2007-2008** (IPY 2007-2008). ICSU will propose to the World Meteorological Organisation that the two organizations should jointly sponsor IPY 2007-2008. IPY 2007-2008 is envisioned as an intense, internationally coordinated campaign of research that will initiate the dawn of a new era in polar science. It will include research in both polar regions and involve strong links to the rest of the globe, be multi- and interdisciplinary in scope and truly international in participation. It will educate and excite the public; help train the next generation of engineers, scientists, and leaders; and include elements from a wide range of scientific disciplines, including social science. An ICSU Planning Group for IPY 2007–2008 has been established and has set the preliminary themes for the project as:

- Understanding change at the poles
- Exploring earth's icy domains, and
- Decoding polar processes.




Suggestions for IPY 2007–2008 have been canvassed from the community, and nearly 350 have been received by the Planning Group. Australian Antarctic scientists have submitted a number of these, including the suggestion that Australia leads and coordinates a ship-survey for a Census of Antarctic Marine Life. Fourteen countries have already established National Committees to work towards implementation of IPY 2007-2008. The work of the Planning Group is continuing over the next few months to develop an initial program structure, to prepare a draft Outline Science Plan, and to determine the processes and structure by which the program will be implemented. Updates on progress with IPY 2007–2008 will be available at <http://www.ipy.org>.

Over the last 50 years, and longer, international cooperation has been a key to the success of large-scale programs of research in the Antarctic and Southern Ocean. Australian scientists have often played a major role in the development and management of these programs, and the Australian Antarctic Program has a long record of participating in and contributing to the international programs. The benefits to both national goals and international science have been considerable. New initiatives such as the International Polar Year 2007–2008 provide a framework for ongoing fruitful cooperation.

*Ian Allison, Glaciology Program Leader, AAD & ACE CRC*

DIANA CALDER

# Cooperation and the Antarctic Treaty

Cooperation is synonymous with the Antarctic Treaty. It may sound glib, and to many whose life revolves around the Treaty the words roll off our tongues like a mantra. But the importance of cooperation within the Antarctic Treaty, and between the nations active in Antarctica, is as important today as it has ever been. It is hard to understate: without cooperation we would not have a Treaty, and without it we would not be able to do many of the things which we take for granted in Antarctica.

The need for cooperation between Antarctic nations emerged as post-war interest in Antarctica developed. Territorial claims had been established by seven nations, other nations were active in the region and some with territorial aspirations of their own. At the same time, significant scientific interest was emerging, particularly in the lead up to the ICSU's International Geophysical Year which was timed for 1957-58 to capitalise, among other things, on Antarctica as a place for measurement of sun spot activity. Scientific programs were planned by many nations throughout Antarctica, and there was a concern that territorial interests could interfere with the planning and conduct of the research. So the nations involved in preparations for the Antarctic components of the IGY agreed that for the duration of the program there would be freedom to conduct activities anywhere in Antarctica, provided they were done consistent with the scientific objectives of the IGY.

As we know, the IGY was enormously successful, in no small part because of the cooperation between nations in ensuring that political differences were set aside for the good of science of international importance. Recognising the enduring importance of being able to conduct research in Antarctica, it was proposed that the principles that had underscored the cooperation that characterised the IGY should be perpetuated by international agreement. The Antarctic Treaty, which was born from the IGY, made cooperation and international harmony central planks, as witnessed by the pre-ambular paragraphs as well as in several articles of the Treaty which cement cooperation as a core principle.

Article II of the Treaty provides for freedom of scientific research and cooperation between nations to make that possible. This commitment is implemented by Article III which provides for exchange of information on research plans, exchange of personnel between national programs and the exchange of results from research. It also encourages cooperative working relationships with the specialised agencies of the United Nations. The essential provisions of Articles VII and VIII of the Treaty provide for the appointment of observers to inspect activities in Antarctica and require cooperation so that observers can undertake their duties unencumbered by jurisdictional concerns. The Treaty goes on to provide for meetings of Parties in a consultative forum to discuss measures to further the Treaty's objectives – these meetings take their decisions on the basis of consensus, which is a great test of the willingness of Parties to accommodate differing view points.

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ANDREW JACKSON

*Top: The First Antarctic Treaty Consultative Meeting, Canberra 1961, is addressed by the Prime Minister of Australia, Sir Robert Gordon Menzies.*
*Bottom: ATCM XXVI, Madrid 2003.*

A cornerstone of the Antarctic Treaty was the agreement embodied within Article IV to accommodate differences of view over sovereignty. Dealing with this issue required careful negotiation at the time of development of the Treaty and a high level of cooperation so that the Treaty could protect the differences of position. Of course, these differences have not gone away and the Treaty continues to protect the positions of Parties with an interest in the sovereignty question. The Parties continue to cooperate so that the regular business of Treaty meetings and the conduct of science can proceed without impediment. It is hard to imagine life in Antarctica had Parties not found harmony on this fundamental issue in 1959, or the consequences if the Parties were to now step off this well established foundation stone of Antarctic cooperation.

It is true that cooperation has not solved every issue confronting the Parties to the Antarctic Treaty, or to some of its related agreements such as CCAMLR. But what it has done is ensure enduring adherence to the Treaty system and commitment to work within it to achieve progress. The cooperative spirit has seen the Treaty embrace new Parties, work closely with other international regimes, broaden the debate to include non-government organisations, and forge links with industry and other interest groups. Commentators frequently observe that as a regime governing a whole continent, the Antarctic Treaty system is unique in its cooperative and peaceful achievement.

The day to day practice of cooperation in Antarctica is manifested in many ways – through science (joint programs), logistics (including shared use of resources), communications (such as advance exchange of expedition details), response in emergencies (mutual assistance for medical evacuations), and so on.

The multilateral cooperation found in the Antarctic Treaty system has also led to bilateral Antarctic cooperative agreements of which there are many. For its part, Australia has a number of bilateral agreements relating to the Antarctic, including with New Zealand and with France. Such agreements exist because of the cooperative environment fostered by the Treaty.

For those of us who work in the policy dimension, cooperation is a basic tool in a decision-making environment that relies on consensus. Progress within the Treaty does not rely on strength of numbers. Consensus is earned through shared aspirations, skilful diplomacy, patient negotiation and timely compromise. That sounds like a pretty fair definition of cooperation. And through this mechanism the Antarctic Treaty has established the framework for diplomatic and practical cooperation that has characterised work in the Antarctic, and will continue to do so.

*Andrew Jackson, Manager, Antarctic and International Policy, AAD*

# Antarctic bioprospecting, benefit sharing and cooperation in Antarctic science

Antarctic ecosystems consist of diverse communities of organisms uniquely adapted to their extreme environment. One of the drivers of Antarctic science is to investigate this rich biodiversity. There is little doubt that knowledge of Antarctic biodiversity benefits humankind, because it allows us to better understand the world we live in and to make informed decisions about the future. It also offers other important benefits to society, not the least of which is the development of new medicines to treat human disease. Many of the unique chemicals produced by living organisms to assist them in their daily battle for survival also have valuable pharmaceutical properties. The process of tapping into the world's natural biological resources for healthcare and other purposes is known as bioprospecting. This process is also sometimes referred to as biodiscovery – at least at the early stage of exploration and initial sample collection.

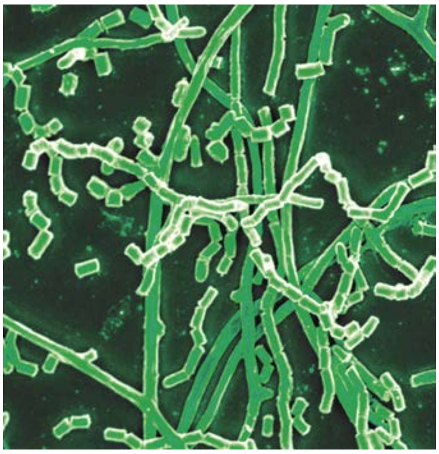
The potential for research on Antarctic organisms to contribute to the public good is well demonstrated by the following extract from a patent claiming an enzyme derived from krill and fish. The patent claims that this enzyme is useful in the treatment of:

> *viral infections such as herpes outbreaks, fungal, bacterial or parasitic infections, including the primary and secondary infections of leprosy, colitis, ulcers, haemorrhoids, corneal scarring, dental plaque, acne, cystic fibrosis, blood clots, wounds, immune disorders including autoimmune disease and cancer.*

Patents such as this are the lifeblood of the biotechnology and pharmaceutical industries. A patent gives its owner, and anyone else who the owner permits, the right to use the invention for the life of the patent (usually 20 years) and to exclude others from using it. The trade-off to society is that the patent owner has to disclose the invention and the best method of performing it. The patent owner gets the benefit of a period of time when they are free from competitors in the market. But once the patent expires others are free to use the invention.

The main argument justifying patents is that they encourage innovation: they provide the necessary incentive for patent holders to invest significant time and money in bringing their inventions to market. If a blockbuster drug results then the patent owner receives a windfall. However, there are many pitfalls on the long and winding road to market. For drugs, the usual figure for time from invention to market is 12-15 years and the estimated cost is $500-800 million, with only one in 5000 products actually making it to market. Hence, we can perhaps take it as read that, if we want new medicines, we have to have patents (although it must be acknowledged that some would, nevertheless, argue to the contrary). These costs of drug discovery do not even take account of the early pre-invention phase. For medicines based on natural products, samples have to be collected, isolated, characterised, and screened for pharmaceutical activity before drug-related patents can be filed. Each of these steps is expensive and risky and requires considerable skill.

Despite these potential pitfalls on the road to product development, the importance of bioprospecting in the process of drug discovery is widely acknowledged and there is general support in industrialised countries for the development of a bioprospecting industry. The Convention on Biological Diversity (CBD) recognises, on the one hand, the enormous public benefit to be had from exploitation of natural resources and, on the other hand, the sovereign rights of countries to control access to their resources and to share in the benefits from their exploitation. The CBD and the associated Bonn Guidelines set up a system for facilitating and regulating bioprospecting by providing guidance to countries on how to deal with the three key issues of access, benefit sharing and technology transfer. The goal is not only to provide appropriate incentives for innovation, but also to acknowledge the sovereign rights of owners of natural resources to control access and share profits and technological developments.



DAVID NICHOLS

*False-colour scanning electron microscope image of* Nocardia spp. *showing the filamentous nature of hyphae breaking into individual cells. These bacteria were isolated from Antarctic soil. The great diversity of Antarctic bacteria is seen as having enormous biotechnology potential.*

What, then, of bioprospecting and patenting in the Antarctic? Some important points need to be made.

1. The underlying philosophy of the Antarctic Treaty System is that the region should be dedicated to cooperative scientific research. This is reflected in Article II of the Treaty, which provides for freedom of scientific research and Article III, which provides for exchange of observations and results.

2. Various forms of commercial activity are well established in the Antarctic and bioprospecting research has been underway in the Antarctic for decades. The patent referred to earlier is but one example out of many that make claims to products derived from Antarctic natural resources.

3. Two of the major concerns associated with exploitation of Antarctic resources, namely overharvesting and environmental impact, are probably not relevant when considering collection for bioprospecting purposes. At the early biodiscovery stage sample sizes are small (as little as a teaspoonful of Antarctic soil). Once a chemical with potential medicinal properties has been isolated it may be necessary to collect larger quantities for proof of concept, but, after that, ideally the chemical should be capable of synthetic manufacture in the laboratory. Significant impacts would only be an issue if synthetic production were not possible and large scale harvesting from the wild was required. Hence, bioprospecting could be seen as an acceptable industry for Antarctica: potential benefit for society, with minimal potential cost to the Antarctic environment.

4. From the economic perspective, the risky and costly business of drug development is further exacerbated if the cost of collection trips to the Antarctic is factored in. However, research expeditions to Antarctica are generally publicly funded. There are a limited number of people undertaking activities in the Antarctic providing good capacity to monitor their activities. The return from bioprospecting could result in increased funding for basic Antarctic research.

5. The normal mechanisms for ensuring benefit sharing from exploitation of biodiversity (the CBD and the associated Bonn Guidelines), which are founded on recognition of sovereign rights over natural resources may be difficult to apply in the Antarctic. At the same time, the Antarctic Treaty System has not established a regime for regulating an emergent Antarctic bioprospecting industry.

6. For this reason, the Treaty parties have begun to consider the issue of what, if any, regulatory requirements should be put in place in relation to Antarctic bioprospecting. There are various precedents that might provide assistance, including the CBD/Bonn Guidelines, the International Treaty on Plant Genetic Resources for Food and Agriculture, and the Law of the Sea in its application to the deep sea bed. However, it must be remembered that it may be many years before any of the profits of Antarctic bioprospecting are realised, if at all.

JOANNE CAVANAGH

*David Nichols and John Grey in Ellis Fjord, Vestfold Hills, collecting sea ice cores to isolate bacteria. Sea ice is a rich source of bacteria with unusual chemicals required to thrive in this harsh environment.*

7. Antarctic bioprospecting does not only raise issues in relation to benefit sharing; it also has important consequences for Antarctic scientific research. The Treaty Parties will need to consider the implications, if any, for the exchange of information and scientific results. It is inevitable that once promising drug precursors are found they will be the subjects of patents. This makes sound commercial sense. Of themselves, these patents may not impinge too greatly on freedom of scientific research, provided that they only claim rights over pharmaceutical applications and do not extend more broadly, making claim to such things as isolated gene sequences and proteins.

However, freedom of scientific research and exchange of observations and results may be further constrained by confidentiality and non-publication obligations required by commercial partners. A certain level of confidentiality is required to ensure that the novelty of any down-stream patent applications is not compromised. But if these obligations are cast too broadly, they may have serious impact on the philosophy of free exchange of scientific observations and results. If necessary, a balance may need to be found between the interests of bioprospectors in protecting their patent rights and of researchers in protecting their freedom to publish their results, to make their materials available and to discuss their ideas with colleagues around the world.

In conclusion, bioprospecting offers great promise as a clean, green Antarctic industry. At the same time it is necessary to maintain the spirit of cooperation that is so much a feature of Antarctic science. As commercial interest in Antarctic bioprospecting develops, we will watch with interest the policy response developed by the Antarctic Treaty.

*Dianne Nicol, Senior Lecturer, Law Faculty, University of Tasmania*

# Will tourism change how we manage Antarctica?

From the beginnings of the Antarctic tourism industry in the 1950s the management of tourism and non-Governmental activities in the Antarctic Treaty area has been based on cooperation between the tourism industry and Antarctic Treaty Parties. Following establishment of an industry body, the International Association of Antarctica Tour Operators (IAATO) in 1991, the relationship with tour operators strengthened – IAATO has been invited to send representatives to Antarctic Treaty Consultative Meetings (ATCM) as invited experts. Since that time the ATCM and IAATO have continued to work together on the management of tourism activities in Antarctica. This collaboration has led to the development of guidelines and operating procedures that aim to minimise the environmental impacts of tourism, as well as promoting the conduct of safe and sustainable tourism activities.

Over the past decade there has been significant growth in the Antarctic tourism industry with increasing diversity in the activities being undertaken, and a rise in the number of tourists and the localities being visited. In 1992–93 there were only 6,704 tourists that landed in Antarctica compared to 13,263 in 2002–03. IAATO estimates that the total number of tourists visiting increased to 17,547 in 2003-04. The range of ship-based activities has expanded similarly, with activities in recent years including marathon runs, camping, kayaking and scuba diving.

The increase in the diversity and size of the tourism industry, together with concerns relating to the practical management of adventure tourism, has resulted in the ATCM reviewing how tourism activities are managed. During recent meetings the Treaty Parties have held detailed discussions on a wide range of issues related to the management of tourism. These issues have included:

- adoption of an accreditation scheme;
- development of coordinated environmental monitoring schemes at tourist sites;
- development of activity and site specific guidelines;
- the requirement for safety regulations and insurance;
- creation of a centralised database on non-government activities;
- self-management of the industry;
- adoption of an on-board observer scheme;
- development of navigational guides for yacht operators;
- development of an Antarctic polar shipping code; and
- production of educational material for tourists.

The XXVI ATCM in 2003 decided to convene a Meeting of Experts to consider some of these issues in more detail prior to the XXVII ATCM. The Parties accepted the offer of the Norwegian Government to host the meeting in Norway from 22–25 March 2004.

ROD LEDINGHAM

The Meeting of Experts considered the following topics relevant to the issue of tourism and non-governmental activities in Antarctica:

- development of an accreditation scheme;
- monitoring, cumulative impact and environmental impact assessment;
- safety and self-sufficiency, including search and rescue and insurance;
- jurisdiction, industry self-regulation, and an analysis of the existing legal framework;
- guidelines;
- adventure (extreme) tourism and government sponsored tourism; and
- coordination amongst national operators.

These discussions will lay the groundwork for decisions to be made at future Treaty meetings.

*Warren Papworth, Policy Section, AAD*


*David Nichols and John Grey in Ellis Fjord, Vestfold Hills, collecting sea ice cores to isolate bacteria. Sea ice is a rich source of bacteria with unusual chemicals required to thrive in this harsh environment.*

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*Warren Papworth, Policy Section, AAD*

# The Antarctic Climate and Ecosystems CRC: a truly collaborative partnership

The Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC), funded by its partners and the Federal Government from 2003 to 2010, is underway. This exciting CRC is the second to focus on Antarctic and Southern Ocean research and will build on the outstanding track record of its predecessor, the Antarctic CRC, that produced over 500 scientific publications, over 50 PhD students and significantly advanced our understanding of the Antarctic region.

The Cooperative Research Centres program was started in 1991 as an initiative to generate more focused, productive research and development from existing research infrastructure, rather than building whole new research agencies. CRCs are partnerships among universities, Commonwealth and State research agencies (such as CSIRO and the Australian Antarctic Division) and policy and industry sectors. The objective of these partnerships is to use the existing research infrastructure to target specific industry and community issues of national significance. Antarctica and its surrounding Southern Ocean is becoming recognised as a major engine room of global climate and oceanographic processes, having major effects on the rates of global warming, sea level rise and the processing of greenhouse gases such as carbon dioxide. Thus, the ACE CRC and its predecessor fit well into the national CRC Programme.

The ACE CRC is a joint venture between the Australian Antarctic Division, CSIRO Marine Research, CSIRO Atmospheric Research, the Commonwealth Bureau of Meteorology and the University of Tasmania as its core partners. Contributing Supporting Partners include the Australian Greenhouse Office, the Tasmanian Department of Economic Development (TDED), the Australian National University (ANU), Silicon Graphics Inc, the National Institute of Water and Atmospheric Research (NIWA, New Zealand), and the Alfred Wegener Institute (AWI, Germany). The ACE CRC research program involves collaborations and research partnerships with individuals and institutions in 13 countries, including Belgium, France, Germany, Italy, Japan, New Zealand, Norway, United Kingdom, China and the United States of America among others – a truly international partnership.

The ACE CRC involves five main research programs focused on Antarctic Marine Ecosystems, Climate Variability & Change, Ocean Control of Carbon Dioxide, Sea Level Rise, and Antarctic and Southern Ocean Policy. The research programs are supplemented with education, communication and extension and commercialisation programs.

Together, these programs will provide unprecedented understanding of just how the Southern Ocean and Antarctic sea ice moderate global oceanographic and climate processes in the face of human generated impacts elsewhere. For example, the Southern Ocean has the potential to be a major sink for excess carbon dioxide generated by industrialised societies, but the rate of carbon dioxide uptake by the ocean depends on the ocean's circulation and the status of the Southern Ocean ecosystem – which in turn will be affected by global warming. The rate of sea level rise also depends on the Southern Ocean circulation and its uptake of heat as well as changes in precipitation in Antarctica, and on the longer time scale the state of the Antarctic ice sheets. Unravelling the complexity of interactions between ocean circulation, carbon dioxide uptake, Antarctic marine ecosystems and global warming will require the synthesis of research across all of the ACE CRC research programs. This will be a challenging task because traditionally the different disciplines have tackled their science at different scales in space and time, and bringing these disciplines together will involve adjustments to those existing methods. Making those adjustments will be a key feature of the ACE CRC.


JOHN SMITH

ace CRC
ANTARCTIC CLIMATE & ECOSYSTEMS
COOPERATIVE RESEARCH CENTRE

Another key element of the ACE CRC is the formal recognition of the importance of relating our scientific outputs to national and international policies about Antarctica, conservation of its ecosystems and the impacts of the global climate changes to which the Southern Ocean is so important. The ACE CRC Policy Program will provide a direct, focused avenue through which to give the predictions from science maximum effect nationally and internationally, allowing Australia to better anticipate the effects of global climate changes and adjust to those changes.

This is an exciting combination of research covering several science and political disciplines. Into this mix we will be sponsoring a host of post-graduate students, who will be the leaders in these fields in a few years. The multi-disciplinary and international nature of the ACE CRC provides an unequalled mix of post-graduate opportunities and it is our aim to support over 50 graduates by 2010. By that time, too, we will have contributed whole new insights to the functioning of the Southern Ocean and Antarctica and just how important they are to our future under a changing global climate.

*Bruce Mapstone, CEO, ACE CRC*

# AME takes aim


*Antarctic petrels roosting on an eroded iceberg*

The Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) has as one of its four themes one which focuses on the relationships between the physical environment of the Southern Ocean and the biological productivity of the region. This Program, the Antarctic Marine Ecosystems (AME) Program, has a broad and ambitious goal:

*To gain an understanding of the links between Southern Ocean sea ice and ocean circulation patterns and the productivity that sustains penguins, great whales and the region's fisheries so that the effects of physical changes can be predicted.*

The predecessor of the ACE CRC, the Antarctic CRC, conducted far-reaching research which enabled Australian scientists to gain a better understanding of how the atmosphere, oceans and ice were involved in the global climate system. This research also provided a much improved understanding of the oceanography of the East Antarctic coastline. In parallel with these efforts of the physical sciences community, ecologists at the AAD were developing food web models and models which are driving the ecosystem approach to the sustainable harvest of the living resource of the Antarctic region. As our knowledge of the physical world developed it became possible to make predictions about the magnitude and direction of projected change on the Antarctic region. It also became apparent that the ecosystem modelling efforts were unable to match the physical models in their ability to predict the effects of change on the living systems of the region. This is partly because of the complexity of ecological systems but it is also because there is a lack of observations that link physical variability and change with associated ecological change. The ACE CRC has as one of its aims the provision of a sound observational basis on which to build realistic scenarios for the future based on an understanding of the natural environment.

Climate predictions indicate that the Antarctic marine environment will change and this change may come rapidly. Major changes could include a reduction in annual sea ice – although this may well have occurred already (see 'Ice core evidence for 20% decline in Antarctic sea ice ...', p. 18) – and changes in the vertical and horizontal circulation of the Southern Ocean. It has been known for some time that there are strong relationships between biological productivity and the annual advance and retreat of the sea ice and that the ocean circulation patterns are critical in enhancing and sustaining productivity of the region. Because the exact mechanisms for these relationships have not been quantified, there is currently no ability to predict the possible effects of these changes if they occurred in isolation, let alone if they occurred together, as would be most likely. Research in the AME Program seeks to better understand the underlying causality of biological variability in the sea ice zone and to improve the ability to predict the effects of long term change.

East Antarctica is a wonderful laboratory for the examination of ecological relationships in the sea ice zone. The extent of winter sea ice varies by a factor of three from east to west which allows an examination of the effects of ice on biological communities. In addition, the circulation patterns vary considerably across the area despite the coastline running at a roughly constant latitude. Because of research carried out as part of the Australian Antarctic program over the last decade, this area is now relatively well studied and there are large-scale datasets which can be examined for ecological relationships. It is hoped that new technology will also be brought to bear on these studies. This will include autonomous underwater vehicles, advanced remote sensing techniques and the results of the ARGO float program.

In parallel with the observational research there will be a new focus on ecosystem modelling. The aim of this effort will be twofold. Firstly, it will involve a critical examination of the hypotheses that have been developed to explain co-variation between physical and biological variables in the sea ice zone. Secondly, the physical climate models will be integrated with the ecological and management models so that the effects of various climate change scenarios on sustainable harvesting levels can be examined.

The ACE CRC has set itself some ambitious goals but perhaps the most difficult of these will be to bring together the physical and biological scientists to address a common theme. There is no doubt that the Antarctic region faces some critical changes over the next several decades but understanding of the effects of these changes can only come through focussed interdisciplinary study.

*Steve Nicol, Program Leader, Antarctic Marine Living Resources Program, AAD & Antarctic Marine Ecosystems, ACE CRC*

# Australia and Japan: two decades of collaboration in Antarctic marine science

Australia has had a long, highly productive association with Japan in Antarctic research, especially in marine science. Australian marine scientists have worked in Japan and have participated in Japanese Antarctic Research Expeditions (JARE) just as Japanese scientists have worked in the Australian Antarctic Division's laboratories as well as participating in ANARE marine science cruises. Recognition of the collaborative ties between the AAD and the Japanese National Institute for Polar Research (NIPR) was marked by the signing of a Memorandum of Understanding by the Directors of the organizations in 2000.

The first krill biologist in the Australian Antarctic Division was Dr Tom Ikeda. In the early 1980s Tom undertook pioneering work to show that krill live for 7 to 11 years, rather than the 3 or 4 years that was the conventional wisdom at the time. This finding had major ramifications for the management of the krill fishery. He also demonstrated that krill shrink when in the absence of food – as possibly happens during the Antarctic winter – which overturned the belief that larger krill were older than smaller specimens. Tom returned to Japan in the mid 1980s where he has held a series of distinguished academic positions.

At present, another Japanese krill biologist, Dr So Kawaguchi, is working for the AAD investigating the physiology of krill. In the late 1990s So undertook a year-long fellowship, funded by the Japanese Science and Technology Agency, in the AAD working on, among other things, parasites living in the gut of krill which cause tissue damage and are thought to impair krill growth.

In the early 1990s, when there was no diving capability in the Australian Antarctic Program, Dr Harvey Marchant joined JARE to travel to the Japanese station of Syowa principally to work on diver-collected marine snow – aggregates of single-celled plants, animals and bacteria. The work he undertook with Japanese colleagues was the first report of the composition of marine snow in Antarctic waters and its potential role as food for krill and other grazers.

Several Japanese scientists have worked in the AAD laboratories and others have participated in marine science cruises on the *Aurora Australis*. Most recently Dr Akira Ishikawa from Mie University undertook a two year fellowship funded though a bilateral program between the Japanese Society for the Promotion of Science and the Australian Academy of Science. He worked with Harvey Marchant and Graham Hosie to investigate the ecological role of the smallest (but the most abundant) size classes of phytoplankton in the Antarctic Ocean. This involved both work on marine science voyages as well as experimental studies in the AAD's laboratories.


*Spot the visitor among members of JARE 35.*

NIPR in Japan has an excellent program for hosting polar researchers from other nations to work there for several months. Three scientists from the AAD have been invited as part of this program. Rod Seppelt spent three months in 1985 there undertaking botanical research, Harvey Marchant worked on marine microorganisms for four months in 1988, and in 1997 and 1999 Graham Hosie spent two and three months respectively working on marine invertebrates. Andrew McMinn from the University of Tasmania has recently returned from a three-month stay.

As well as being a Visiting Researcher in NIPR Graham Hosie has built close ties with scientists at other Japanese institutions especially through collaborative investigations using Continuous Plankton Recorders (CPR). These instruments are towed by ships to collect and preserve plankton samples. The samples provide information on the species composition, and abundance of plankton along the ship's track. The *Aurora Australis* does several voyages every year along different cruise tracks at different times. In contrast, the *Shirase*, the Japanese icebreaker used to resupply Syowa station, travels south from Fremantle and returns to Sydney along the same track and at the same time every year. CPRs on both vessels provide different but complementary information. (See the following two articles.)

The most ambitious collaboration to date took place in the 2001–02 summer when Australia and Japan undertook a four-ship survey of seasonal changes in Antarctic waters south of Australia. Australia's contribution was the spring-time CLIVAR cruise of the *Aurora Australis* on which three scientists from Japan participated. This voyage was followed by cruises of the *Hakuho Maru*, the research vessel of the Ocean Research Institute of the University of Tokyo, the *Tangaroa*, a New Zealand research vessel chartered for use in JARE specially for this activity and the *Shirase*. The main aim of the four-ship survey was to investigate seasonal physical, chemical and biological changes in the sea ice zone. The cruises were planned so that data from each of them could be analysed together to give information on how the water chemistry and biology changed between November and March. Much of the work has been written up and is expected to be published in a special issue of an international journal.

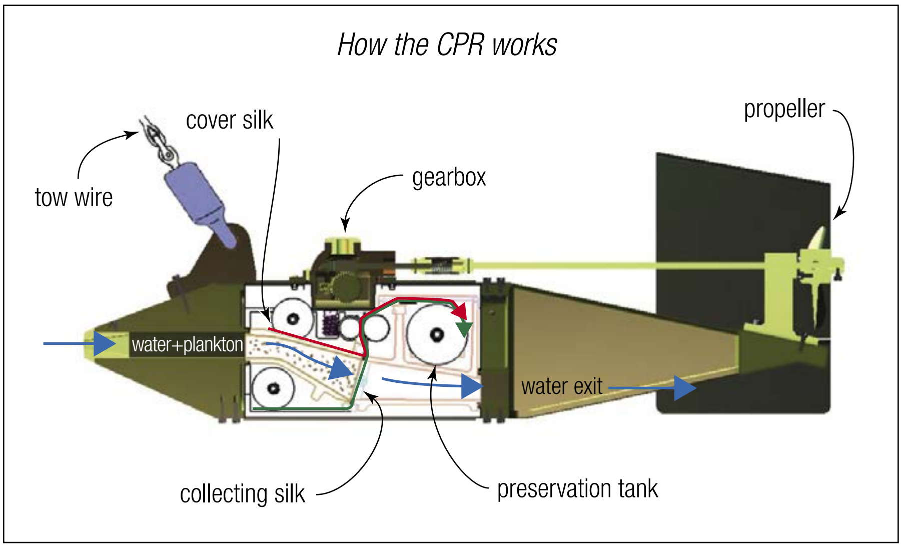
Discussions are presently underway with our Japanese colleagues on mounting major collaborative initiatives as part of the International Polar Year in 2007. One such venture is likely to be a contribution to the Census of Marine Life, an international initiative to assess the diversity, distribution, and abundance of marine life.

In the best spirit of cooperation in the Antarctic Treaty system, our interactions with the Japanese have flourished over the last twenty years with some major activities in science but also a deeper appreciation of each other's cultures by those involved.


*Harvey Marchant, Biology Program Leader, AAD*

# Plankton survey uses old technology to monitor the future

In the mid 1920s, British scientist Sir Alister Hardy developed a radically new method for sampling plankton continuously, rather than taking spot samples using conventional plankton nets. Net sampling can often be inaccurate because of the unique patchy distribution and behaviour of plankton. Sir Alister designed the continuous plankton recorder to help study and to map these patches. He conducted the first trials of his 'Type I CPR' in Antarctic waters during the 1925-1927 voyages of RRS *Discovery* and RRS *William Scoresby*. Initial tows across the southern Atlantic Ocean brought mixed results, but a series of tows across Drake Passage, over nearly 300 nautical miles, produced the first continuous trace of Antarctic plankton patterns.

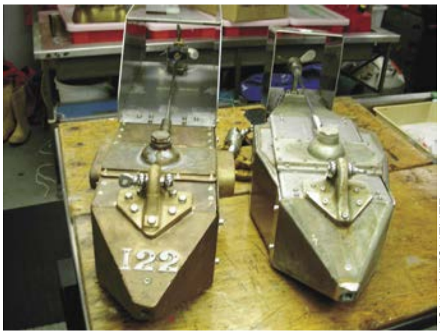



*Above: Cutaway view of the internal mechanisms of the AAD-built CPR. Plankton are filtered by the collecting silk (shown in green) stretched across the tunnel. This is then met by the cover silk (red) before rolling into the preservation tank. Left: Deploying the CPR from RSV* Aurora Australis. *Bottom: Old and new side-by-side. An AAD-built Mk V CPR and a 1960s Mk II CPR (No. 122) pressed back into service.*

JOHN KITCHENER

Hardy later designed the more compact Type II CPR and established the North Sea and North Atlantic CPR survey, which is now the longest running marine biological survey, providing detailed synoptic plankton data for more than 70 years. Over that time the CPR has proven to be the most cost-effective method of repeatedly surveying large ocean areas quickly. The survey has been successful in detecting gradual changes in zooplankton and phytoplankton composition and distribution patterns, and the introduction and spread of non-indigenous species in the North Sea. In the mid-1980s the survey detected a significant regime shift in the plankton that may lead to catastrophic effects on the region's ecosystems and subsequently its fisheries. This shift happened in just one or two years rather than as a linear response to climatic or environmental change over several years.

Sixty-five years after the CPR was first trialled, the instrument returned to Antarctic waters when the Australian Antarctic Division initiated a CPR survey of the Southern Ocean. The purpose was first to map the patterns of biodiversity of plankton through the region, and then to use the sensitivity of plankton to environmental change as early warning indicators of the health of the Southern Ocean. That survey will also serve as reference on the general status of the Southern Ocean for comparison with other monitoring programs. Understanding patterns of variation in biological systems, both natural and those caused by climate change, has been an integral part of Australia's Antarctic research strategic plan. Plankton form the foundation of the Antarctic marine ecosystem and are thus the logical place to start such research.




JOHN KITCHENER

CPR units were obtained from the Sir Alister Hardy Foundation, and trialled on RSV *Aurora Australis* during the ship's maiden voyage to Heard Island in July and August 1990. Trials continued in the sea ice zone during subsequent summer seasons. The units performed well enough but were easily damaged by ice, and during deployment or retrieval. In 1995, the Australian Antarctic Division instrument workshop and drafting team used a computer to designed a new 'Type II Mark V' CPR. The device was constructed from marine grade stainless steel rather than phosphor bronze as used previously. It was more streamlined then previous models, and internal recording cassettes were redesigned for easier loading and unloading of plankton mesh and preservative. The precision provided by computer control of machining meant that all new cassettes were interchangeable between external CPR bodies and had fully-interchangeable parts. But otherwise, the Mk V CPR differs little in overall design and performance from Hardy's original Type II.

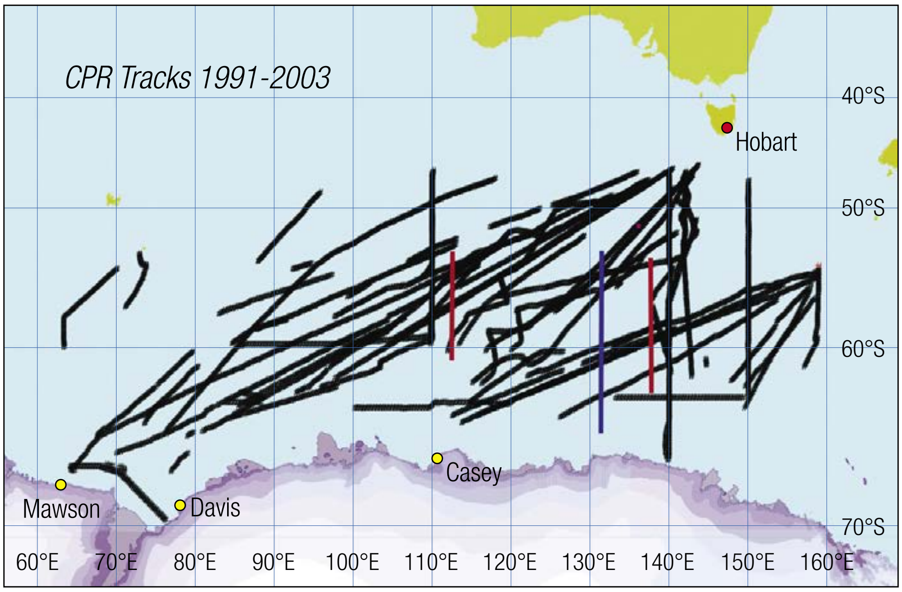
The CPR looks like a Heath Robinson device but actually functions simply. It is a self-contained automatic sampler towed behind the ship at normal ship speed and can operate in nearly all sea conditions. As the CPR is towed along, water and zooplankton enter a small 1.25 x 1.25 cm aperture in the nose cone, which then expands into a wider collecting tunnel, slowing down the water flow. The plankton are then trapped between two bands of 270 µm mesh silk (6m long x 15 cm wide), loaded in a removable cassette. The silk and plankton 'sandwich' is wound on to a take-up spool inside a formalin preserving chamber, all driven by passing water turning an external propeller. Regardless of the speed of the vessel, the sheets of silk are advanced at a fixed rate of 1cm per nautical miles travelled. Each tow represents a 450 nautical mile track of continuous sampling. Back in the laboratory, each set of silks is unrolled and cut into sections representing five nautical mile samples. Plankton are then identified by microscope and counted.

The northern hemisphere survey has always relied on ships of opportunity such as cargo vessels and ferries, but the SO-CPR Survey uses research vessels which gives us access to a suite of oceanographic, meteorological and navigational data recorded continuously onboard. These data can be spliced with the CPR data, giving for each five-nautical-mile plankton sample the position and time of sampling, plus averaged environmental data such as water temperature, salinity, fluorometry (indicating chlorophyll concentration), light levels, and ultra-violet light levels.

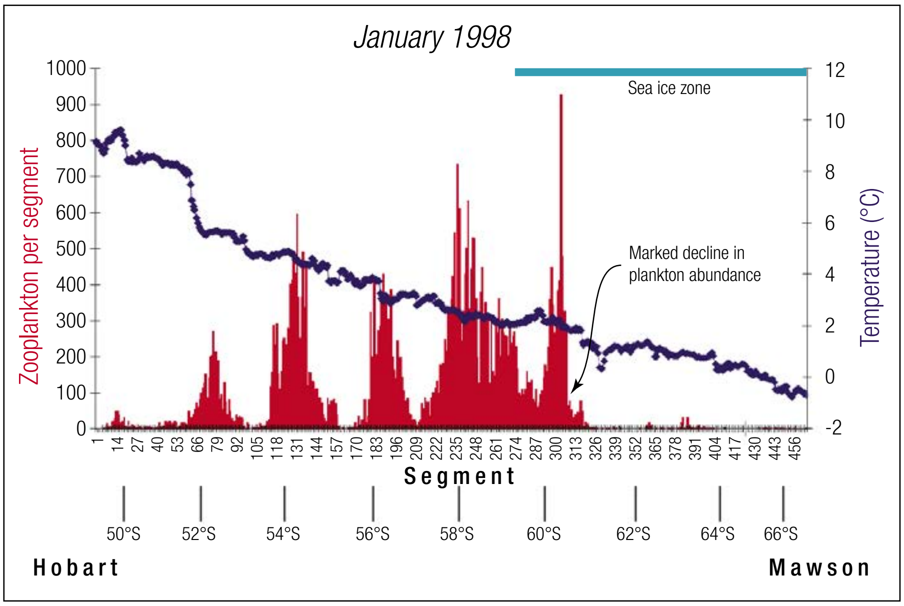
The principal survey area extends from 60°E to 160°E and south of about 46°S to the Antarctic coast – an area of more 14 million square kilometres or just under 30 percent of the Southern Ocean. CPRs are towed on all voyages of *Aurora Australis* when travelling to and from Antarctic stations and on dedicated marine science voyages, from early spring to autumn and occasionally in winter. Sampling has been done in all months except June. This sampling forms the core of the data, both geographically and temporally.

Since 1999, CPRs have also been towed from the Japanese icebreaker *Shirase* during its annual resupply of Syowa station. This takes advantage of the ship's fixed route and time schedule as a temporal reference for measuring long-term annual variability and to help interpret the Australian data. Tows have also been conducted on other Japanese research vessels opportunistically which has allowed hypotheses on spatially and seasonally variation to be tested (see 'Australia and Japan: two decades of collaboration in Antarctic marine science', p. 15).

Sampling was less intensive prior to 1997, during the development of the survey, and the redesigning, trialling and commissioning of the AAD machines. However, to date, the survey has already completed over 200 tows, providing more than 60,000 nautical miles (110,000 km) of records equivalent to 12,000+ samples for over 200 zooplankton species, and all coupled with environmental data. This number of samples would be impossible to collect using conventional net sampling.




*CPR tracks covered from 1991 to the end of the 2002-03 season.* Shirase *fixed tracks are shown in red. The four-ship survey of 140°E longitude in 2001-02 is shown in blue.*




*A typical series of CPR tows during a 2365 nautical miles (4380 km) run from Hobart to Mawson. Total abundance of zooplankton in each of the 460+ samples is shown in red with corresponding sea surface temperature averaged for the segment shown as a blue line. The typical decline in zooplankton south of latitude 60°S is highlighted.*

Typical CPR tows show very high abundance of zooplankton in the surface waters (top 20 m) of the permanent open ocean zone between the sea-ice zone and the Subantarctic Front, located not far south of Australia, Africa and South America. This is an area previously thought to have low plankton abundance, because it is low in nutrients (oligotrophic). By comparison, the surface waters of the sea ice zone have considerably lower species diversity and abundance. The demarcation between these areas of high and low abundances is consistently observed and quite abrupt, just south of 60°S latitude. This indicates the existence of a regular and perhaps new oceanographic event, as it cannot as yet be easily related to other known oceanographic features in the area.

Other north-south differences in abundance and species composition in the CPR tows are also regularly observed in relation to other frontal zones, such as the Polar Fronts and Subantarctic Fronts further north. Even subtle variation in zooplankton patterns have shown greater sensitivity in identifying oceanographic features that would normally only be readily identified through detailed profiling with oceanographic equipment.

The survey so far has identified new community and species distribution patterns, and we now have sufficient data to

*to page 17*

# Australian, Japanese scientists collaborate

The wide geographical coverage of the Continuous Plankton Recorder Survey (CPR) in the Southern Ocean is ideal for mapping biodiversity of plankton through the region. But with the survey extending over much of the year, changes in plankton patterns caused by geographical differences can be confused with those due to time. This complicates one of the objectives of the survey in identifying seasonal and long term changes in zooplankton patterns in response to environmental change.

DR TORU HIRAWAKE, NIPR

Fixed routine transects surveyed regularly would solve this problem, but a demanding Australian Antarctic shipping schedule has made this impossible.

By contrast, the Japanese icebreaker *Shirase* in servicing the Japanese Antarctic program's Syowa station has a fixed time schedule and route down longitude 110°E south from Fremantle each December. *Shirase* also follows the same return leg in February-March from Syowa, past Casey to 150°E, then north to Sydney. Japan's National Institute of Polar Research (NIPR) had established a long-term routine zooplankton monitoring program in 1972 with daily plankton net sampling across the Southern Ocean conducted at more or less the same time (noon) and location each year.

Some cyclic patterns linked with seawater temperature could be identified in the data, but it was clear that the small size of the net and the large distances between sites, 300 nautical miles (555 km), did not provide the required resolution for long-term mapping and monitoring of changes in plankton patterns in relation to the various oceanographic boundaries in the Southern Ocean. However, NIPR agreed that CPR tows from *Shirase* would benefit both national programs, enhancing their existing plankton monitoring program, while providing much needed fixed transects. A schedule of collaboration was agreed between Dr Graham Hosie, AAD, and Prof. Mitsuo Fukuchi, Director of the Centre of Antarctic Environment Monitoring at NIPR. Australian CPR units have been operating on Shirase since the 1999–2000 season.

The collaboration between Australia and Japan also provided the opportunity to occasionally use other Japanese vessels conducting plankton research around Antarctica – *Kaiyo Maru* (National Research Institute of Far Seas Fisheries), *Hakuho Maru* (Ocean Research Institute, Tokyo University), *Umitaka Maru* (Tokyo University of Fisheries) and *Tangaroa* (on charter to NIPR from NIWA, New Zealand). These vessels have supplied a large amount of routine data – nearly a quarter of the data has been supplied by Japanese vessels.

DR TORU HIRAWAKE, NIPR

*Above left: Crew of the* Shirase *ready to deploy the CPR during sea trials in the Sea of Japan. Above: Graham Hosie preparing the CPR for sea trials on* Shirase *in the Sea of Japan, September 1999.*

Use of these ships has also allowed a number of unique experiments to be conducted. The first of these was a set of almost simultaneous tows across the Antarctic Circumpolar Current in November-December 1999, along three widely spaced transects south of Africa (*Kaiyo Maru*), Fremantle (*Shirase*) and Macquarie Island (*Aurora Australis*) to test for similarities in zooplankton patterns across the frontal zones of the Antarctic Circumpolar Current. In theory, because the ACC flows uninterrupted around Antarctica, the species composition of zooplankton should be the same within any part of the current. The three-ship survey found the hypothesis to be true.

The complementary experiment of looking at change within a season along a single transect, conducted in November and March of the 2001–02 summer, involved CPRs towed repeatedly by four ships, *Aurora Australis, Hakuho Maru, Tangaroa* and *Shirase*, along longitude 140°E. A number of plankton assemblages were identified with strong north-south zonation in association with the various oceanographic fronts. While these fronts varied in position through the season, the composition and integrity of the plankton assemblages remained consistent relative to the fronts, and strongly correlated with temperature.

The third experiment produced perhaps the most interesting results so far. Later in the 1999–2000 summer *Kaiyo Maru* closely followed Sir Alister Hardy's April 1927 CPR transect across Drake Passage. We are still looking for Sir Alister's original raw data in order to make a full comparison, but an initial comparison with his published descriptions of the 1927 data suggests a major change in plankton patterns has occurred between 1927 and 2000.

There is no doubt that the collaboration between Australia and Japan has greatly improved the CPR survey with the additional tows. The survey would benefit further with additional fixed transects. Germany is now assisting the survey with tows from their research vessel *Polarstern* south of Cape Town in March–April 2004, and it is hoped that CPR tows will then become routine on all future *Polarstern* voyages. Other nations have expressed interest in joining the survey.

*Graham Hosie, Southern Ocean Continuous Plankton Recorder Survey, Biology Program, AAD*

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*from page 16*

start commenting on patterns of biodiversity in relation to the various oceanographic zones in the region, as well as seasonal and inter-annual patterns. We cannot yet identify longer term patterns or trends, but the northern CPR survey has shown that changes in an ecosystem can occur very abruptly when changes in environmental conditions reach a point that causes a species or group of species to suddenly flourish or decline, altering the ecosystem balance. Both northern and southern surveys have also proven the value of plankton as sensitive indicators of environmental patterns and the CPR as a useful tool for mapping the consequences of change in the marine environment.

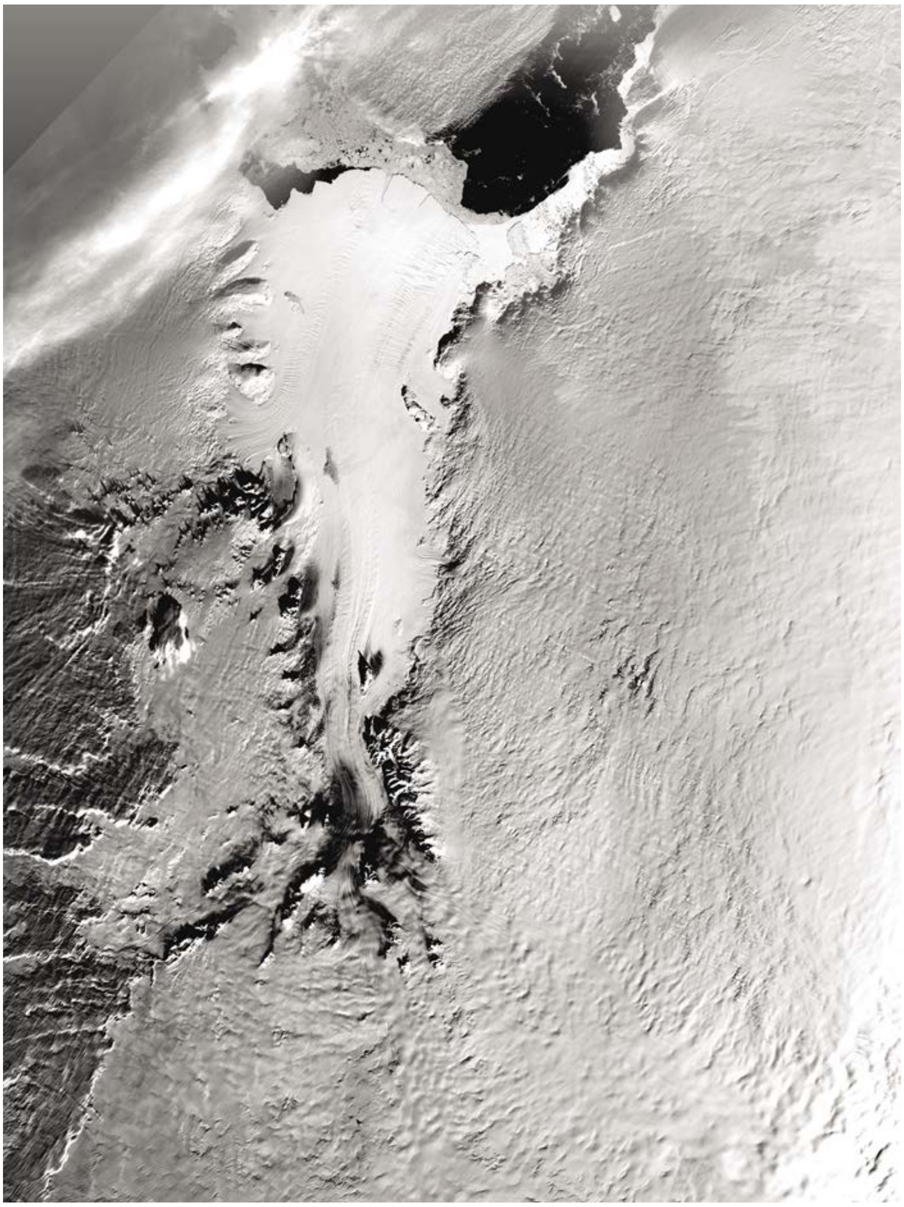
*Graham Hosie, Southern Ocean Continuous Plankton Recorder Survey, Biology Program, AAD*

# AMISOR trilogy: The diesel and the dog

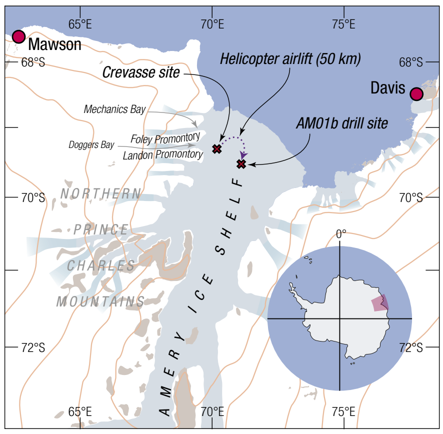
The first step in the transition to regular fixed wing aircraft deep field support was accomplished this season, with the AMISOR hot water drilling project trying to extend its range of operations to the far western reaches of the Amery Ice Shelf. A third borehole was planned to be drilled through ice some 400 m thick, nearly half of which was again expected to be marine (or jade) ice refrozen to the base of the shelf. If successful, production of this borehole would have completed a trio of instrumented holes spaced 50 km apart, in a line coincident with earlier surveys across the northern front of the shelf within 100 km of the calving front. Despite some weather delays, early season deployment allowed two Twin Otter aircraft to fly direct from a sea ice ski-way in front of Davis station, obviating the need for a ship visit to Sansom Island as an intermediate platform for operations.

The drill site this year was to be within viewing distance of Landon and Foley promontories, which flank Doggers Bay to the south and north respectively, where the early 1960s dog sled teams from Mawson dropped from the plateau onto the Amery. Their mechanical counterparts – snow-trac vehicles – were driven onto the ice shelf further north via Mechanics Bay. It was to be our privilege to have this opportunity for another brush with the justifiably proud history of ANARE exploration in the region. A wistful eye could even imagine a puff of vapour to the west as the collective breath of a faithful husky team mushing their way across the surface toward us. It was fated not to be the case.

During our passage south (Voyage 2, *Aurora Australis*) the aircrews at Davis had managed to deposit a cache of some 30 fuel drums at the proposed site, leading us to believe we had a great head start for the season. A further eight tonnes of cargo were delivered, and field personnel positioned who commenced basic camp construction, until a rude shock shook our season to its very foundations. On the final cargo flights for the day, with golden rays of sunlight slanting low across the flat expanse of the shelf, it became apparent that the entire area was riddled with crevasses. The campsite was in fact as near as possible to exact centre in the middle of a 50 m wide snow bridge covering a relic crevasse. Visible only from the air, in favourable lighting conditions, it was clear the site had to be abandoned, and furthermore, it was no longer valid to oper-



MIKE CRAVEN




PETER BOYER

*Top: Satellite image of the entire length of the Amery Ice Shelf, which spans about 550 kilometres from Prydz Bay at the front to the confluence of the three major glaciers feeding into the shelf: the Lambert, Mellor and Fisher Glaciers. (MODIS data from NASA's TERRA satellite on 2 December 2000)*
*Above left: Twin Otter view of AMISOR camp in a crevasse field on the NW Amery. The crevasse field, only evident in late evening with low slanting sun angles, can be seen as subtle markings across the surface. Above right: Map showing the location of the proposed AMISOR camp in the middle of a crevasse field, and the relocated central drill site, AM01B.*

ate fixed wing aircraft in the area as sastrugi formation in the snow-pack dictated landing across the predominant crevasse direction.

As with all things ANARE, a dilemma remains as such only long enough to be photographed. Soon we had the eager Squirrel AS350B helicopter aircrews sling-loading our cargo back to the safety of the north-central shelf site drilled two years previously. To give an indication of relative carrying capacity, what had taken the Twin Otters 13 flights to deliver over a distance of some 350 km, now took the helicopters 26 flights to relocate over 50 km. Mere statistics. As usual the spirit of co-operation and willingness to tackle any task shone through, and we soon found ourselves in a position to salvage what we could from the remnants of the season.

Prior to relocation we had tried an aerial reconnaissance of the area for a safe site to proceed with the original plans. None was found in close enough vicinity to the proposed site to enable us to predict with any confidence that we would be drilling through the much sought after marine ice layer on the underside of the shelf. The western band of marine ice is believed to be a narrow one, extending longitudinally in the direction of the ice flow, and despite circling for two hours over the region, as each crevasse field petered out a new one came into view with entirely new and/or random orientation. It is recognised that several over-snow traverse trips (dog-sled, skidoo, snowtrac) have been conducted through the area in the past without major incident, although not surprisingly occasional slotting of vehicles had occurred.

MIKE CRAVEN

*Christmas Eve fly-by as a Twin Otter returns to Davis carrying the small but precious ice cores recovered by the hot water drill from the borehole.*

Many of the crevasses could be deemed safe, and luck has played its part. But in the era of fixed wing aircraft operations it would be negligent if not folly to ignore their presence and we must choose carefully any future drill sites in this region. Also with a hot water drilling operation relying on the establishment of a sub-surface well to store water for recirculation we could not guarantee that the drill would not strike a cavity at some depth below the surface and drain away the precious water supply. You have to have shovelled the 24 cubic metres of snow required for melting to fully appreciate the impact of this. There was no option but to move.

In brief, we finally managed a borehole alongside our old central site, supplementing previous scientific sampling there with a sediment core from the seabed, and a video record of the entire ice sequence through the shelf, plus footage of the sea floor. We retrieved another year's data from previous mooring sites, established a depot on the shelf at a future proposed drilling site 130 km to the south, where snow accumulation hopefully will not completely bury it, and managed to release several of the team on time for transfer to the ITASE ice core project inland of Casey. Not exactly flushed with success, but grateful once more for the hard working cooperative ethic of the many people we have the good fortune to be associated with in our endeavours.

*Mike Craven, Glaciology Program, AAD & ACE CRC*

## International collaboration brought to the AMISOR project

Initial data results and interpretation from the AMISOR project are now beginning to appear in the international scientific arena with presentations in recent years at Nagaoka, Japan (2000), Bergen, Norway (2002), Cambridge, England (2003), and Milan, Italy (2003). In the meantime we have established excellent networking links with a number of institutions that this season led to the establishment of two collaborative work agreements for the summer. The Polar Research Institute of China sent three expeditioners to conduct ground surveys around the drilling site using GPS (Zhang Xiaohong) and ice radar (Wang Dali) to better understand the dynamics of the ice shelf, and provided an acoustic Doppler current profiler (ADCP) to be added to the scientific instrumentation to collect vital information on the vertical structure of water currents beneath the shelf over annual cycles (Chen Hongxia). Future operations may see

MIKE CRAVEN

*Our happy Chinese colleagues (Dali, Xiaohong, and Hongxia) prepare a delicious meal of special dumplings after completion of their survey work around the HWD site.*

ice core drilling operations conducted alongside the HWD boreholing. This collaborative work further strengthens the ties between Davis and Zhongshan stations, where excellent interaction already exists.

On the basis of the permeable marine ice detected deep in the ice shelf at our previous drill site, NASA-JPL (Pasadena, USA) sent Jaret Matthews with their ice borehole probe to record imagery through downward and sideward looking video camera units. With the JPL probe we were able to follow the transition in the ice from compacted firn near the surface, through continental meteoric ice, into the marine ice layer, and the gradation to brine pockets and honeycomb nature of the ice at great depth. Valuable insight may be gained from this into the still not well understood formation mechanism of such marine ice layers. Extension of this collaboration may see the camera deployed at one or more future borehole sites.

# Climate variability in Eastern Wilkes Land: Australian ITASE ice core drilling, 2003-04

This past season a six person ice-coring team was deployed for two weeks at a remote location in Wilkes Land some 750 km east of Casey. The aim of this project was to recover ice cores to provide records of past climate in this region. This was a cooperative project, between the Environmental Geoscience Group at the University of Newcastle and the AAD Glaciology Program, and called for a complex logistical effort using two Twin Otter aircraft to ferry personnel and equipment the 2.5 hour trip from Casey, via a fuel depot, to the field camp.

At the conclusion of the season, researchers had retrieved a 147 m deep core from the main field site and collected numerous shallow cores and undertaken radar studies to explore the spatial variation within the snow pack.


BARBARA SMITH

BARBARA SMITH

The reason for such a major undertaking lies in the rich record of climate information that ice-cores can provide, extending back far beyond the instrumental record (for example see 'Ice core evidence for 20% decline in Antarctic sea ice extent since the 1950s' on page 22).

Antarctica and high southern latitudes play an important role in global climate, and climate records from this region are a key to better understanding climate change. Unfortunately, historical records of Antarctic climate are short, mostly dating from the International Geophysical Year in 1957, or even later, and the spread of sites is sparse.

The Wilkes Land project is part of the multi-national ITASE Program (International TransAntarctic Scientific Expedition). ITASE was formulated in 1990, with strong Australian input, in response to a need for more records of climate variability across Antarctica. The focus for ITASE is on climate and environmental records of the past 200 years – a period covering the time of increasing human influence on the global atmosphere. Most ITASE climate records are derived from ice cores, although other measurements, such as the temperatures of boreholes and subsurface radar profiles are also used to provide climate information.

The ITASE program currently involves nineteen nations and is sponsored by the International Geosphere-Biosphere Program (IGBP) and Scientific Committee on Antarctic Research (SCAR).

CHRISTIAN GALLAGHER

*Top right: Expeditioners and Twin Otter crew load a skidoo into one of the aircraft through a combination of skidoo power and human force. Two skidoos can be loaded inside the aircraft, however it's a tight fit, so the second skidoo needs to be loaded backwards.*

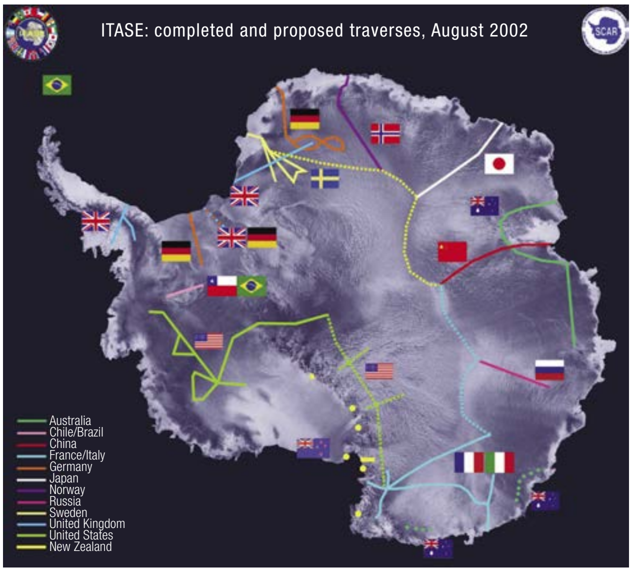
*Above left: Electronics engineer Al Elcheikh at the controls of the electromechanical 'Eclipse' drill used to retrieve a 147 m ice core from site GD17.*

*Above: The ground penetrating radar unit is a small white and yellow box dragged behind the skidoo and sled. The computer running the radar and collecting data is housed in the covered sled. The black canopy prevents light from reflecting on the computer screen, allowing the operator to monitor the radar system.*

So far, internationally more than ten long traverses have been undertaken and numerous ice cores have been recovered from most areas of the continent. Australian contributions have been made in the Lambert Glacier Basin, Wilkes Land, Wilhelm II Land and at Law Dome. Aside from the deep records at Law Dome that stretch back tens of millennia, most records in the Australian Antarctic Territory are short, covering typically a few decades.

The Wilkes Land ITASE work of this past season developed from previous Australian work in the region; ANARE glaciological traverses in the 1980s were precursors to ITASE, producing an array of shallow cores 30–60 m deep from 95°E–135°E longitude giving climate records spanning the mid-to-late twentieth century.

Now, some 20 years after the previous ANARE fieldwork in eastern Wilkes Land, the region has been revisited. The 147 m core retrieved in the 2003–04 season should allow a detailed record of climate changes in the area for the last two to three centuries. This record will be longer than earlier records in the region, but crucially, it will also increase the period during which ice core climate record overlaps meteorological record by 20 years. This is double the previous period of overlap and it allows much better comparisons between the two types of climate information.




The reason for selecting the drilling site GD17, approximately 200 km inland of Porpoise Bay (some two-thirds of the way from Casey to Dumont d'Urville), lies in the interacting influences of ice sheet topography and Southern Ocean atmospheric circulation on the snow accumulation.

The 1980s ice cores from this region show a well-preserved climate signal: a factor that is not universal, depending upon rate of snowfall and re-working of the surface by wind.

Also, the earlier work suggests an intriguing transition eastwards in Wilkes Land, from a regional maritime climate signal that is similar to that recorded at Law Dome, (to the west) to a signal that appears to be related quite strongly to a see-saw in sea level pressure over the Southern Ocean near Macquarie Island and the Ross Sea. This transition may be the result of the influence of persistent high pressure systems south of eastern Australia and their influence on atmospheric circulation over Wilkes Land, producing strong katabatic outflow as cold air sinks down the west side of the ice sheet ridge between Dome C and Dumont d'Urville.

The climate record from this site should provide a valuable comparison with other data from Law Dome, and a useful extension of recent findings, including the ability to track past changes in sea ice and sea level pressure.

The season provided an exciting new insight into the benefits that intra-continental air transport can bring: in this case the ability to retrieve an ice core from such a remote site in just two weeks off-station. It was not without its challenges however, as a late-season window and accompanying poor flying conditions demanded modification to the work-plan. A second long ice core in the region, which was called for in the scientific plan, was not obtained in this season. Nevertheless, the wealth of data from the one long core and several short cores obtained in 2003–04 will undoubtedly provide new and exciting results, and the aerial reconnaissance undertaken this year will benefit a re-visit of the area for that second core!

The ice cores are currently being analysed in the Glaciology Laboratory in Hobart, by scientists from the two organisations.

*Tas van Ommen, Glaciology Program, AAD & ACE CRC, Ian Goodwin, University of Newcastle, and Barbara Smith, Glaciology Program, AAD & ACE CRC*

# International sea ice survey success

The Sea Ice Remote Sensing Validation Experiment on Voyage 1 (2003) was a survey of sea ice and snow cover conditions in the region bounded by 64–65°S and 112–119°E. The purpose of this survey was to obtain data to validate and help improve the algorithms used to derive sea ice geophysical products from a variety of new satellite sensors. This program involved considerable international collaboration with groups from institutions in Belgium, China, Germany, Japan and USA. participating in the voyage. This program was completely successful and one of the more gratifying outcomes that arose from it was the strong integration of the efforts of the teams from different institutions, and the extensive opportunities for future scientific collaboration that have resulted from the work.

There were 27 scientists associated with this project; 20 from overseas institutes. The institutes represented were:


ROB MASSOM

*Voyage 1 scientists undertake a wide range of measurements at a sea ice site accessed from* Aurora Australis

*Australia* – Australian Antarctic Division, Cooperative Research Centre for Antarctic Climate and Ecosystems, University of Tasmania
*Japan* – Kitami University, Chiba University, Hokkaido University
*Belgium* – Université Libre de Bruxelles
*USA* – The University of Kansas, University of Florida, University of Colorado, New York University, National Aeronautics and Space Administration
*China* – Polar Research Institute of China
*Germany* – Alfred Wegener Institute

*Ian Allison, Glaciology Program Leader, AAD & ACE CRC*

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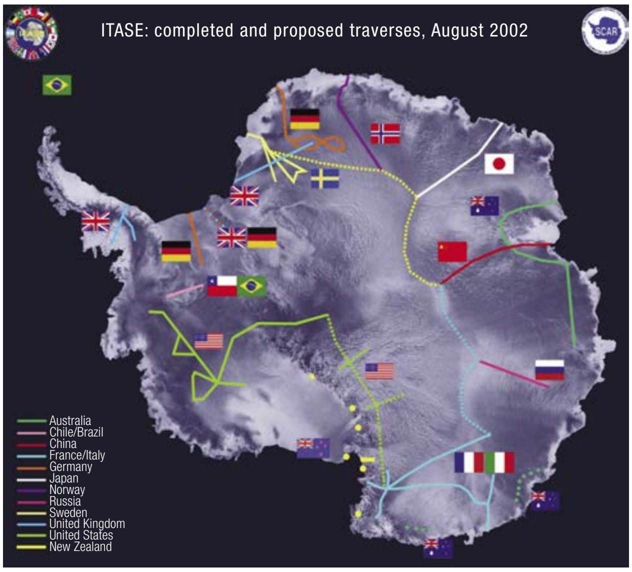


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*Tas van Ommen, Glaciology Program, AAD & ACE CRC, Ian Goodwin, University of Newcastle, and Barbara Smith, Glaciology Program, AAD & ACE CRC*

# International sea ice survey success

The Sea Ice Remote Sensing Validation Experiment on Voyage 1 (2003) was a survey of sea ice and snow cover conditions in the region bounded by 64–65°S and 112–119°E. The purpose of this survey was to obtain data to validate and help improve the algorithms used to derive sea ice geophysical products from a variety of new satellite sensors. This program involved considerable international collaboration with groups from institutions in Belgium, China, Germany, Japan and USA. participating in the voyage. This program was completely successful and one of the more gratifying outcomes that arose from it was the strong integration of the efforts of the teams from different institutions, and the extensive opportunities for future scientific collaboration that have resulted from the work.


ROB MASSOM

*Voyage 1 scientists undertake a wide range of measurements at a sea ice site accessed from* Aurora Australis

There were 27 scientists associated with this project; 20 from overseas institutes. The institutes represented were:

*Australia* – Australian Antarctic Division, Cooperative Research Centre for Antarctic Climate and Ecosystems, University of Tasmania

*Japan* – Kitami University, Chiba University, Hokkaido University

*Belgium* – Université Libre de Bruxelles

*USA* – The University of Kansas, University of Florida, University of Colorado, New York University, National Aeronautics and Space Administration

*China* – Polar Research Institute of China

*Germany* – Alfred Wegener Institute

*Ian Allison, Glaciology Program Leader, AAD & ACE CRC*

# Ice core evidence for 20% decline in Antarctic sea ice extent since the 1950s

Antarctica remains an under-explored region of the planet, despite the fact that some expeditioners take a trip 'south' for granted. It is a difficult place to get to today and was obviously even harder in the past, limiting the amount of reliable scientific data.

One area where this limit is felt is in the sparsity and shortness of climate records, which are needed to interpret recent changes and to test the longer-term applicability of climate models. Key climate parameters from the Antarctic region are the extent of sea ice, and its potential response to climate change.

Antarctic sea ice forms an icy covering on the south seas each year – more than doubling the size of Antarctica and has often been termed the 'frozen skin of the Southern Ocean' (Nicol and Allison, *American Scientist* 85, 426-439, 1997). While it often hinders Antarctic operations, it is a vital component in the global climate system. It plays a major role in climate through its influence on heat exchange between ocean and atmosphere, it assists the formation of Antarctic Bottom Water (through brine rejection) which sinks to the depths of the ocean subsequently driving global ocean circulation, and it provides essential ecosystem support right through the food chain from microbes, phytoplankton, and krill, to penguins, seals, and whales. Sea ice also acts as a sensitive indicator of climate change ... or does it?


MARK CURRAN

MARK CURRAN

The general scientific consensus is that global climate is warming, and this warming should be seen in Antarctica. However, the picture is complicated, and the Antarctic continent cannot be viewed as a single climate regime. Warming is seen in the Peninsula region, and through most of coastal Antarctica, but the interior is generally cooling – most likely as a result of changes in atmospheric circulation.

Most climate models predict that sea ice should respond to ocean and atmospheric warming with a resulting decrease in sea ice extent. Records of whaling ship locations (de la Mare, *Nature* 389, 57 (1997) and penguin population survival tend to suggest Antarctic sea ice may be declining – however satellite records of sea ice extent tell a different story.

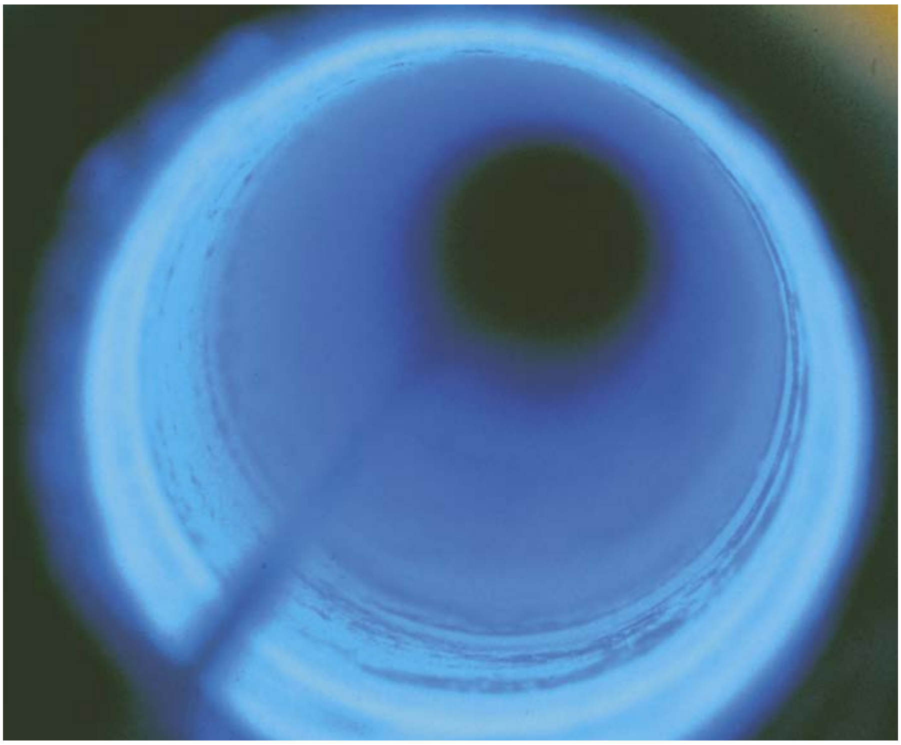
The advent of satellite imagery since the mid-1970s enabled scientists to remotely 'view' Antarctica and measure the extent of sea ice. This data shows little or no change, or possibly even an increase in sea ice extent since the 1970s. So what is happening? Is Antarctic sea ice extent increasing or decreasing? The answer is both! The effect seen depends on the timescale we are considering.

The problem is that there were no reliable records of sea ice extent prior to the mid-1970s, to look at long-term trends.

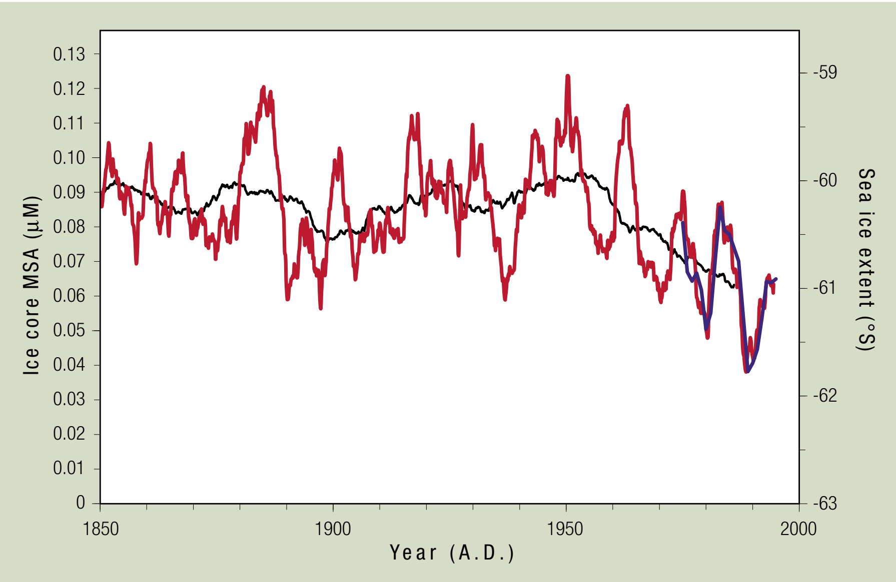
Enter the phytoplankton. These single celled algae live in and around the sea ice and release chemical signals to the atmosphere which gets trapped in snowfall on the continent. This is locked away in the Antarctic ice sheet, waiting for glaciologists to drill ice cores and analyse them to reveal the hidden message from the phytoplankton. This message takes the form of methanesulphonic acid or MSA.

MSA is produced from oxidation in the atmosphere of dimethylsulphide, which is itself produced by certain species of phyto-

*Above left: The supply ship* Polar Bird *in Antarctic sea ice .*
*Left: Preparing ice cores for methanesulphonic acid (or MSA) analysis. Sampling must be done in a freezer at -18°C, and in a laminar flow hood under clean conditions to avoid contamination.*



VIN MORGAN




*Top: Peering into the past ... A view down the borehole at Law Dome, Antarctica. Here scientists recovered an ice core that answers a climate mystery about sea ice extent.*

*Above: Figure 1. Law Dome ice core MSA record (1840-1995) in red and agreement with the overlain satellite sea ice extent record (1973-1995) in blue (80-140°E). The black line is the long term MSA trend (20 year running mean) which is used as a sea ice extent proxy. Sea ice extent did not change much between 1840 and 1950, but shows a 20% decrease since around 1950. This decrease is not steady, but shows high decadal fluctuations. This decadal variability masks detection of a sea ice trend in the shorter satellite record.*

plankton and in the Southern Ocean. The distribution of these species is intimately associated with sea ice. Through analysis of ice cores from Law Dome, we have discovered that the amount of MSA in the core is related to the maximum extent of sea ice in that region. This is because in years where there is more sea ice (greater northerly extent) there is more phytoplankton activity following sea ice decay and more MSA production.

In a recent paper in the journal *Science*, (Curran et al., November 14, 302, 1203, 2003) we have calibrated the ice core MSA record against satellite records of sea ice extent since the mid 1970s (see Figure 1). Annual MSA concentrations significantly correlate with maximum sea ice extent around the whole of Antarctica, with the highest correlation in the region (80-140°E) surrounding Law Dome.

This calibration enables us to use the MSA record from the Law Dome ice core as a tool to investigate past sea ice extent. So what happened to sea ice extent prior to the 1970s and the satellite era?

The MSA record from the top 150 m of the Law Dome ice core gives a 'proxy' for sea ice extent over the period 1840 to 1995. The two main findings presented in the paper are the discovery of these persistent, high-amplitude, decadal fluctuations and the dramatic decrease in sea ice extent over the last ~50 years. The high variability explains why satellite trends are confusing. Detection of long-term change is masked by large fluctuations from decade to decade and it is these decadal fluctuations that have produced apparent short-term increases in the satellite data. The large reduction of the northerly extent of sea ice in the region south of Australia (80-140°E) of 1.5 degrees of latitude equates to a 20% decrease since the 1950s.

While this research indicates the Antarctic sea ice is decreasing, we cannot say how unusual these changes might be over longer timescales from centuries to millennia or more. What we have is a better understanding of the past history of sea ice and this provides another piece in the puzzle of understanding the role of Antarctica in the global climate system. Work is continuing to look deeper in the ice core, further back in time, to provide more knowledge of past sea ice changes and climate variations. This will improve our ability to predict future changes, guide policy and adapt as necessary.

*Mark Curran & Tas van Ommen,*
*Glaciology Program, AAD & ACE CRC*

MARK CURRAN

*Ice core evidence suggests that the sea ice south of Australia has retreated by around 1.5° of latitude (approximately 170 km) over the last 50 years, which represents a decrease of 20%.*

# Australian–Italian glaciological program success

Glaciologists from Italy and Australia have formed a joint project to measure the amount of ice flowing out from the ice sheet in the large sector of East Antarctica between Dumont d'Urville and the Amery Ice Shelf. The project was conceived during discussions between Massimo Frezzotti and Neal Young at a SCAR workshop on ISMASS held in June 2001 in Annapolis, USA. (ISMASS is a SCAR initiative to assess the past, present, and future mass budget of the Antarctic ice sheet and its contribution to sea level change, and to investigate related processes.)

The joint project to measure the mass flux combines expertise, knowledge, and capabilities of the glaciology groups and national expeditions of Italy and Australia to achieve a common goal. The Italians are contributing the field work involving radio echo sounding of ice thickness by an Italian team and aircraft. The Australians are providing support and accommodation at Casey and Davis, and deploying fuel depots, in addition to the science results from satellite remote sensing measurements of ice movement, and associated data.

The initial planning for the project had activities spread over two seasons because of the large area to be covered and the likelihood of weather or scheduling constraints on the availability of the Italian aircraft limiting the amount of work that could be achieved in a single season. Fuel was pre-positioned at Mirny by the Russian Antarctic expedition ship for the long leg between Casey and Davis. Two fuel depots were deployed east of Casey using Australia's chartered Twin Otter aircraft in November 2003 – one inland of Blair Glacier, west of Porpoise Bay, and another closer to Casey inland of the Moscow University Ice Shelf. This second depot was also used to support the glaciology ITASE project, east of Casey, in January 2004. A third depot was deployed on Apfel Glacier near Bunger Hills. Fuel from the Mirny depot was also used to support flights by Australian chartered Twin Otter aircraft during this season.

Field work for the joint project started with the flight by the Italian team in their Twin Otter from Dumont d'Urville to Casey on 1 December, taking up fuel at both depots along their route. The field phase of the project was completed with the return flight from Casey to Dumont d'Urville on 14 December. In total, there were seven flying days, and seven days for crew rest or lost to weather. Seven nights were spent at Casey, and six nights at Davis.

KAREN KRISTENSEN

*Members of the field team (from left: Jim Haffey, Dave Bewett, Achille Zirizzotti, Alessandro Forieri, Andrea Passerini, Professor Ignazi Tabacco) in front of their aircraft at Lanyon Junction near Casey. The Italian aircraft was the third Twin Otter to operate out of Australian bases during the 2003–04 season. It was used to support the Italian National Antarctic Research Program at Zucchelli station at Terra Nova Bay (TNB) and for associated work at the Concordia station at Dome C (DC), as well as the radio echo sounding work in the sector between TNB, DC, and Dumont d'Urville, and the joint Australian-Italian project between Dumont d'Urville and Amery Ice Shelf. The aircraft was fitted with the ice radar developed by the Italian group under Prof Tabacco, GPS navigation equipment, and a digital logging system. The complete field party comprised the four Italians in the science team together with two pilots and an aircraft engineer.*

The field program completed in the 2003–04 season was immensely successful. The field team flew all of the combined pattern of flight lines planned for both field seasons including a pattern of lines over the Amery Ice Shelf. Good ice thickness data was acquired along most of the length of the flight lines, with some gaps that were to be expected because of conditions in the glaciers. The flight plans had been revised in the weeks prior to departure so as to minimise the fuel uptake from Casey and these depots. This exercise maximised the scientific returns for reduced fuel consumption, minimised the impact on the project and released fuel for use in other operations.

The flight pattern was designed to achieve two goals. The first was to gather ice thickness data along a connected set of lines close to the coast for measurement of the ice flux out of the grounded ice sheet. These lines were actually placed some distance in from the coast or grounding zone so that they avoided the more extreme sub-glacial topography at the margin, and to avoid areas of extreme crevassing. The very broken nature of the ice in these areas scatters the radar energy creating a lot of strong clutter in the returned echoes, which then obscures the weaker echoes from the bottom of the ice.

The second goal was to gather ice thickness data on the ice shelves and major outlet glaciers, which are those parts of the ice cover that are expected to exhibit a larger or quicker response to change in atmospheric or oceanic climate. The areas where this was done in order from east to west included Porpoise Bay, Moscow University Ice Shelf, Totten Glacier, Law Dome ice cap, Vanderford Glacier, Shackleton Ice Shelf, Denman Glacier, and West Ice Shelf.

The success of the field work owes much to the excellent support provided by the air crews, and the support and hospitality of the station teams at Casey and Davis, as well as to the dedication of the Italian science field party under the direction of Prof. Tabacco. The data collected includes all that was planned for this season and indeed much more than was hoped for, although there is still plenty remaining that can and needs to be surveyed. Now begins the long task of analysis of the field data and associated phases of velocity measurement and integration of the various data sets. The work provides a very sound basis for planning details of future surveys and investigations.

*Neal Young, Glaciology Program, AAD & ACE CRC & Massimo Frezzotti, ENEA, Rome*

# From South Pole to Dome C: Antarctic astronomy 10 years on

The rear door of the Hercules lifted, a shaft of bright light illuminated the dark interior of the transport plane, and the first bite of the polar air gripped me. I'd arrived at the South Pole at last. It was January 1994, nearly four years on from when a small group of idealists had dared to dream that Australians could do astronomy in Antarctica. With the encouragement of colleagues from the recently formed US Center for Astrophysical Research in Antarctica, we'd put together two experiments to test our speculations about the conditions we'd encounter. There were two questions we hoped to answer that coming winter. Would the infrared sky be 100 times darker than in Australia, and was there 'super-seeing' of the stars?

Jamie Lloyd, who'd just finished his honours year at the University of New South Wales (UNSW), was the advance party, and I was the following infantry division. He'd arrived a week before me, hand-carrying what looked, to anyone else, like a golden dust-bin with him on the plane. It was the IRPS, or Infrared Photometer Spectrometer, the subject of his honours thesis. Ten years previously it had been a state-of-the-art instrument on the Anglo Australian Telescope, used by David Allen to pioneer the fledgling field of infrared astronomy. Now it was about to become Australia's first experiment at the South Pole, and our first step on the road which we hope will lead to the building of the world's largest telescopes on the summits of the Antarctic plateau, able to look back in time to the formation of planets, stars and galaxies.


*The IRPS, or Infrared Photometer Spectrometer, at the South Pole in January 1994, with Michael Burton keeping it company.*

I was bringing with me a second experiment, put together by Rodney Marks, a young graduate student who in the last year had taught himself French, headed off to the Université de Nice on the French Riviera to learn the science of micro-thermal turbulence from its master, Jean Vernin, and returned to UNSW to build his own experiment to measure the turbulence above the South Pole.

The IRPS had been 'winterised' over the previous six months by Jamie, work-

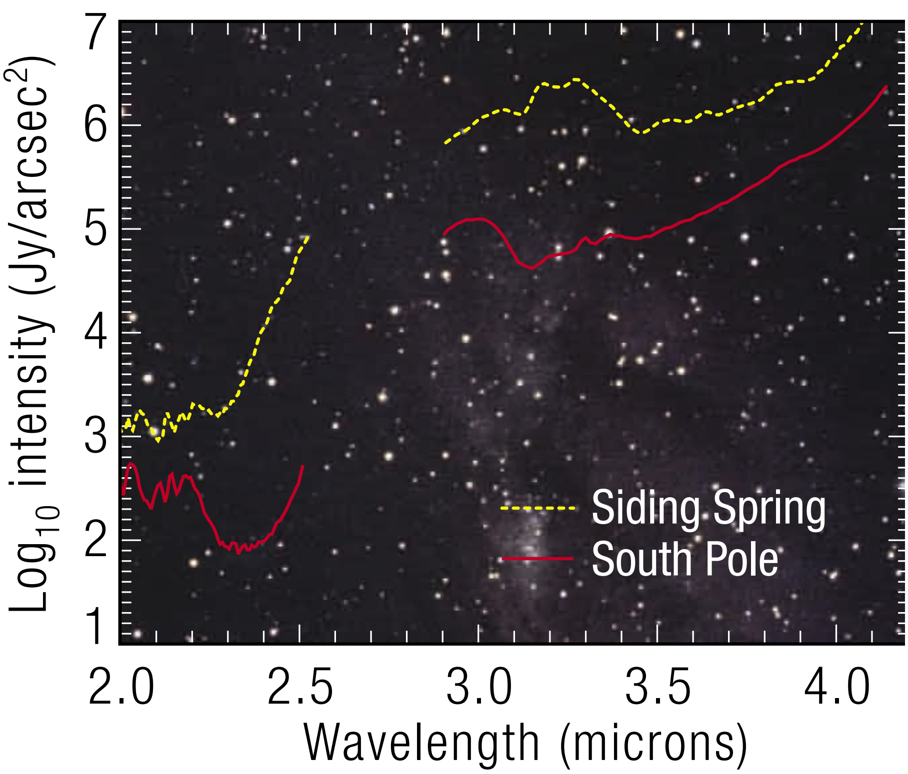
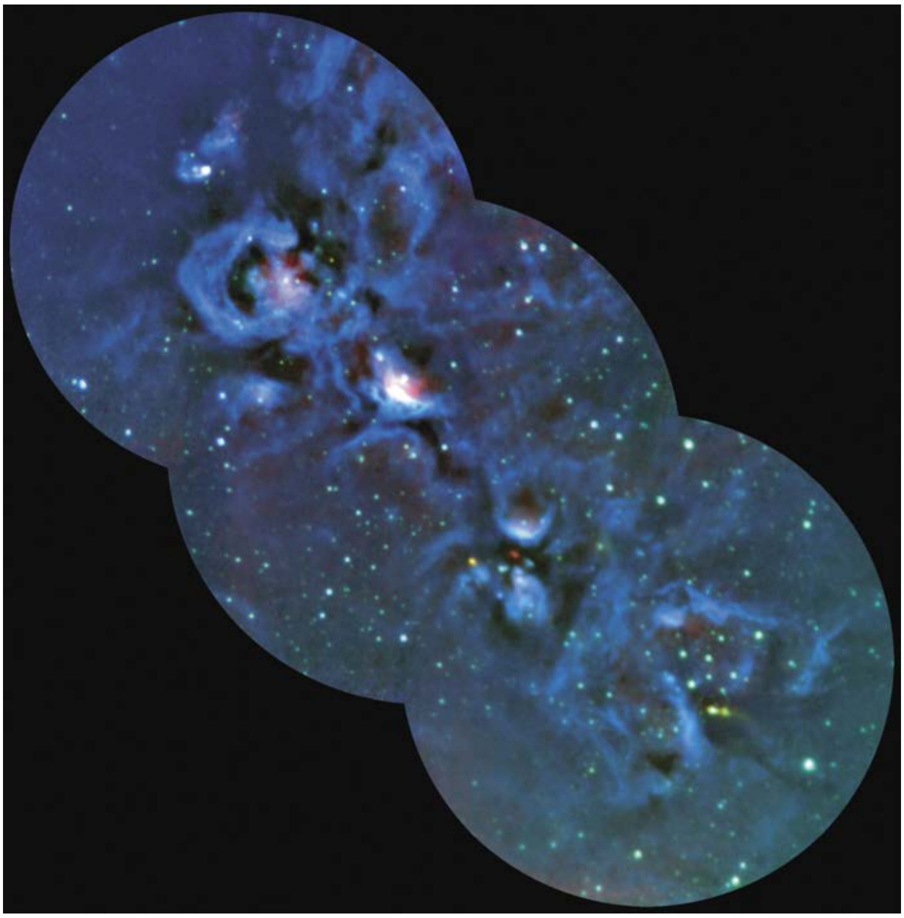



*Figure 1: A comparison of the infrared sky emission between the South Pole, and Siding Spring Observatory, Australia's leading observatory site in NSW. The graph shows the strength of the emission from the sky, between wavelengths of 2 and 4 microns, and the y-axis is logarithmic. This emission is the background noise through which we must peer to observe stars in the infrared. As is apparent, at the South Pole the sky is between ten and 100 times darker than Siding Spring. Going there is like turning the lights out for an optical astronomer trying to observe in the day-time! These data were obtained with the IRPS over the winter periods from 1994-1996. They are published in Ashley et al, 'South Pole observations of the near-infrared sky brightness', 1996,* Publications of the Astronomical Society of the Pacific, *volume 108, pp721-723 and in Phillips et al, 'The near-infrared sky emission at the South Pole in winter', 1999,* The Astrophysical Journal, *volume 527, pp1009-1022.*



MICHAEL BURTON ET AL

*An infrared image of the star forming complex of NGC 6334, situated 5,500 light years away in the Southern Galactic plane, as observed with the 60cm SPIREX telescope at the South Pole in 1998. There are three colours in the image, with the blue colour that dominates coming from a complex organic molecule that has been found to be distributed all over star forming clouds - PAHs or polycyclic aromatic hydrocarbons. These emit at 3.3 microns when fluorescently excited by far-UV radiation from massive young stars. Such stars are distributed like beads along a string in a dense molecular cloud which runs through the heart of this image. Stars are forming in it from its collapse under its self-gravity. They cause the greens and reds in this image, which represents emission from 3.5 and 4.1 microns. The whole image appears in the sky as nearly the size of the full moon. Despite the small size of the telescope, the greatly improved sensitivity in these wavebands in Antarctica has allowed it to take the deepest, wide-field images from 3-4 microns of any telescope. Image from Burton et al, 'High resolution imaging of photodissociation regions in NGC 6334', 2000,* The Astrophysical Journal, *volume 542, pp359-366.*

MICHAEL BURTON

*The AASTO (automated astrophysical site testing observatory), 1 km from the South Pole. This laboratory is about the size of a typical portacabin and can be carried in the back of a Hercules aircraft. The interior is kept at room temperature through waste heat from a thermo-electric generator catalytically oxidising propane fuel. On the roof, and on a nearby tower (out of shot), are placed the experiments which measure the various properties of the atmosphere that affect the conduct of astronomical observations. In this picture we can see a blackbody source, used to calibrate two infrared sky monitors (to left) and a sonic radar, or SODAR, use to measure the levels of turbulence in the boundary layer (to right). For further information see Storey et al, 'An automated astrophysical observatory for Antarctica', 1996,* Pub. Astronomical Society of Australia, *volume 13, pp35-38.*

ing under the supervision of my colleague Michael Ashley, both doing their best to anticipate how it would perform when left outside, at up to minus 75 degrees for six months, while needing to be filled each day with liquid nitrogen (100 degrees colder still), in the winter dark, by winterer John Briggs. Jamie had laboured heroically in the week before I arrived putting the IRPS together, working in a laboratory still under construction, confined to the corner of a desk, with two other telescopes also going up around him. However the IRPS was still in bits when I got there, and we had all of a one hour change-over, for Jamie was to depart on the plane I'd just arrived on!

Jamie tried to brief me on where he'd got up to, while I sat mutely in the galley, trying to take it in while gasping for breath, as all new arrivals to Pole do, unaccustomed to the thin, dry air at a pressure altitude of over 3,000 m. Then Jamie shot off, and I was left with John Briggs to get the IRPS and the micro-thermal experiments together in this alien environment.

Somehow we did it and, a week later, when I saw the Moon pass through the beam of the 5mm diameter 'telescope' that the IRPS effectively was, shining brightly in the infrared 'L-band' of 3.8 microns, it was perhaps the most exciting moment of my professional life as an astronomer.

That winter the IRPS confirmed for us that the infrared sky was indeed as dark as we'd anticipated (see Figure 1, and photograph previous page). However, we also found that the boundary layer generated considerable turbulence that disturbs the smooth wave-front arriving from an astronomical source in its last few metres before it would reach a telescope, creating the appearance of an excessive twinkling of the stars.

The infrared observations led us, four years later in 1998, to our first 'real' astronomical experiment, when we worked with our US colleagues on the 60cm SPIREX telescope, to image star forming regions in our Galaxy in the thermal infrared wavebands, from 2-4 microns. We were able to view extensive clouds of complex organic molecules enshrouding protostars, still embedded within great clouds of dust, the natal cocoons from which they were being born (see infrared image previous page).

The micro-thermal turbulence measurements, on the other hand, caused something of a puzzle to us as we sought to understand the implications they posed. They led to a series of further experiments over the coming years as we fully characterised the turbulence. Yet, while the measurements caused some dismay at first, they may be leading us to a remarkable, if somewhat abstruse, conclusion, now that we have managed to take them from Dome C.

Dome C is one of the summits of the Antarctic plateau, in the middle of the Australian Antarctic Territory, and the site of the French-Italian Concordia Station. Our measurements suggest that it may be the best site in the world for the next generation of optical/infrared telescopes with diameters of up to 100m. The extremely narrow boundary layer in which all the turbulence is generated greatly simplifies the requirements for adaptive optics correction, an essential element in recovering the diffraction limit of a telescope from distortions caused by the atmosphere, thereby allowing the telescope to image sources with a clarity almost equivalent to being in space.

This January marks for us a decade of astronomy on the Antarctic plateau. The early site testing experiments were soon followed by a more sophisticated approach, that of the 'automated astrophysical site testing observatory' or AASTO (see image on previous page), and involving scientists from the ANU. Driven by the enthusiasm and vision of John Storey, leader of the UNSW group, a series of increasingly sophisticated experiments were built for the AASTO: sky monitors to measure the sky at optical, infrared and sub-millimetre wavebands, and instruments to characterise the turbulence profiles at all heights through the atmosphere.

Working with the AASTO has been an eventful experience, for the trials of winterising and automating experiments are not trivial ones! The greatest challenges have been caused not by the experiments, but by the need to provide reliable power to run them in a warm but autonomous environment. Perhaps reminiscent of the challenge faced by Mawson's men in 1911 trying to get their 'air tractor' working to haul their equipment, the problem of reliable power generation almost proved our nemesis.

Perseverance paid off, and the AASTO produced a string of results. The site testing program at the South Pole is now virtually over; we expect measurements there to finish after this coming winter. Our work at the Pole is not over, however. One of the experiments is already being adapted to a new use, the search for exoplanets, orbiting around other stars! That story will have to wait for another day.

We have now reached the next stage of the journey to an Antarctic observatory, Dome C. With the rapid development of Concordia station by the French and Italians, a new frontier is opening here for Antarctic science. Extreme cold, dryness, absence of katabatic winds, and high elevation hold the promise of providing the best Earth-based site for observing the distant Cosmos.

Jon Lawrence, a postdoctoral fellow in our group, redesigned the AASTO into the AASTINO (automated astrophysical site testing international observatory), complete with a new, improved power generator, a Whispergen engine (see image above). Originally designed for ocean yachting but now transformed for Antarctica, and working on the principle of a Stirling thermodynamic engine, it has proved far more reliable than the propane-fuelled thermoelectric generator used on the AASTO. This last winter the AASTINO operated, completely autonomously, for over 100 'days' at Dome C. While we communicated with it via Iridium telephone, it was sited over 1,000 km away from the nearest human being. See for yourself the amazing results from the webcam at <http://www.phys.unsw.edu.au/southpolediaries/> – hardly a day of cloud was seen during the entire period!

The first scientists will be wintering at Concordia Station in two seasons' time. The initial results from the first full season of winter measurements there exceeded expectations, and interest in the site as the possible location for an 'extremely large telescope' (ELT) is growing rapidly, especially in Europe. A few parameters for the site still need to be ascertained before such a decision would be made, in particular the characteristics of high-altitude turbulence. We are building an instrument, a 'multi-aperture scintillation sensor', or MASS, in conjunction with NASA's Jet Propulsion Laboratory, in order to make the necessary measurements this coming winter. If the results turn out as we anticipate, there may be only one logical place to build the ELT – a prospect that has one salivating!

Visit the South Pole Diaries website at <http://www.phys.unsw.edu.au/southpolediaries/> for further information, including our daily diaries from 1994, picture galleries and web cameras of the South Pole and Dome C, and a full bibliography of Antarctic astronomy publications.


GIANPIERO VENTURI

*The AASTINO (automated astrophysical site testing international observatory) at Dome C, with one of the two towers of Concordia station to the rear. Standing on top of the AASTINO with the UNSW flag are Jon Lawrence, John Storey and Tony Travouillon (left to right), who assembled the laboratory in January 2003. Exhaust pipes from the Whispergen Stirling cycle power generator can also be seen on top of the AASTINO (to left) and the SODAR instrument to right (having been moved from the South Pole). About to be installed, in the centre, was a sub-millimetre sky monitor. For further information see the webpage link.*

*Michael Burton, School of Physics, University of New South Wales*

# Radiation blasts Space Ship Earth

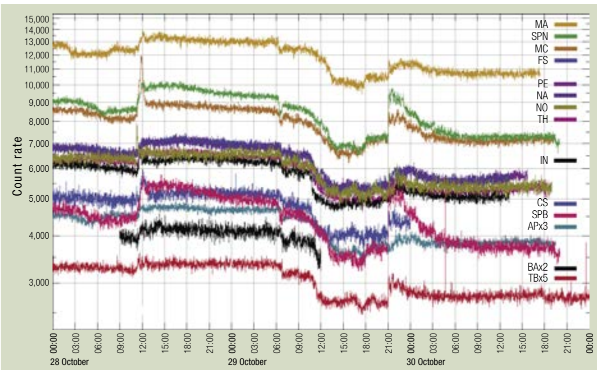
In September 2002 a team of three departed from Cape Town on board the *Kapitan Klebnikov* bound for Mawson. Their task was to install the new components of a neutron monitor, a device that measures the ground effects of the dynamic radiation environment surrounding the earth. This instrument is part of the international Space Ship Earth collaborative network ('Space Ship Earth: monitoring space weather', *Australian Antarctic Magazine,* 1:31)). The neutron monitor sites that make up the network are carefully chosen to view specific directions in space as shown in the graph opposite. Nine installations view in narrow bands around the equator whilst two others view the far north and south giving complete 3-D coverage. The data are recorded with one minute accuracy and transmitted in real time back to the central coordination agency, the Bartol Research Institute of the University of Delaware, from which they are forwarded to industry and governments. The Australian Antarctic Division and the Institute of Terrestrial Magnetism, Ionosphere and Radiowave Propagation in Moscow make up the rest of the consortium. The value of these measurements is that they give an immediate picture of the high-energy radiation environment in space near the Earth that affect spacecraft operation and that is responsible for the increased radiation dosage received in aircraft, particularly those travelling at high altitude and high magnetic latitudes.

During the 2002 winter the cosmic ray laboratory at Mawson had been extended from its 'L' shape to a rectangle to house the new monitor. The existing monitor at Mawson was to be upgraded with new electronics and two identical modules added in the building extension to triple the total size and thus almost double the statistical accuracy of the data. The installation of the new modules involved manually placing 20 tonnes of lead rings in rows into which the detection counters were fitted and enclosing the module in a thick plastic housing. This was achieved in under a week due to the assistance of the station staff. Within a short time the new system was fully operational with data flowing back to Kingston and on to Bartol.

MARC DULDIG

KYM NEWBERY

*Above left: Upgrading the neutron monitor in the newly extended Cosmic Ray Laboratory at Mawson. Above: An aurora illuminates the cosmic ray laboratory at Mawson station.*

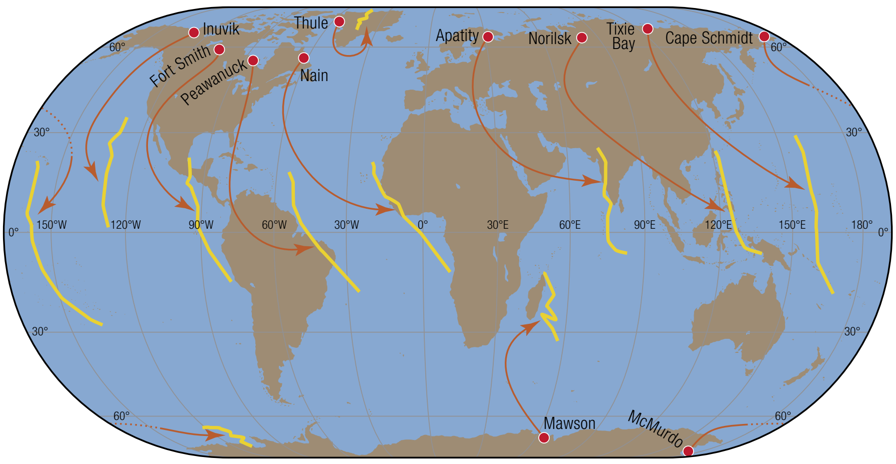



*Left: Space Ship Earth data showing Ground Level Enhancements from 28 to 31 October 2003. The top trace is the data from Mawson station. Below right: The location (red circles) and corresponding viewing directions (yellow lines) of the Space Ship Earth network of neutron monitors.*

The unexpected recent solar activity at the end of October and November resulted in rare radiation blasts hitting the Earth with such energy that they produced increased background radiation at sea level (see the following story). These occurrences are known as Ground Level Enhancements (GLEs) and only 67 have been recorded since reliable records began in the late 1940s. A total of three such events were recorded around 12 Universal Time (UT) on 28th of October, 21 UT on 29th of October and 18 UT on 2nd of November. The Space Ship Earth data from the first two GLEs are shown in the figure. Although sequences of GLEs are not unknown the occurrence of a sequence and such an active solar region well into the declining part of the 11 year solar activity cycle is extremely rare. Looking at the figure it is clear that the radiation environment was anything but steady (it usually is almost flat at this stage of the solar cycle) and the large but not smooth drop before the second GLE is due to the material blasted off the sun during the first GLE hitting the earth a day later and causing a large geomagnetic storm.

Perhaps even more exciting is the fortuitous recording of flight radiation dose data by Qantas pilot Ian Getley during the second GLE. As well as being a pilot, Ian is undertaking postgraduate studies on radiation dosage in aircraft and was the pilot on a Qantas Boeing 747 flight between Los Angeles and New York at the time of the event. His equipment recorded a greater than 30% increase in the dose rate at the time of the GLE. This is possibly the first time that flight data at high altitude and reasonably high magnetic latitude have been recorded and will prove invaluable in refining both the atmospheric response to such radiation and in assessing the radiation dose hazard in such events. Following European Union legislation requiring airlines to keep track of radiation exposure by aircraft crew a few years ago and similar legislation in other countries it is timely that we learn more about these rare but important events.

MARC DULDIG, SPACE AND ATMOSPHERIC SCIENCES PROGRAM LEADER, AAD



# Our explosive star puts on a fine show

Flares are intense magnetic explosions on the sun – the biggest bang in our solar system. A recent solar flare was the third largest ever recorded. On 28 October 2003 it launched a stream of high energy protons toward the Earth at close to the speed of light, taking about 15 minutes to reach Earth and be recorded by neutron monitors installed and operated by the Australian Antarctic Division at Mawson and Kingston.

The flare came from solar active region (SAR) 10486, which had grown to one of the largest sunspots (upper left) seen by the Solar and Heliospheric Observatory (SOHO), a cooperative project between the US National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA). SAR 10486's spectacular show projected a series of powerful flares and associated plasma eruptions into space called coronal mass ejections (CME), one of which can be seen as a bright flash in (upper right). It was associated with a CME (lower left), which sent a large plasma cloud directly towards Earth. The expanding CME cloud and the effect of the high energy protons on the SOHO imager (multiple white spots) can be seen in the lower right image. The fast-moving cloud reached Earth's magnetosphere a mere 19 hours later, almost a record speed for a CME – greater than 2000 km per second.

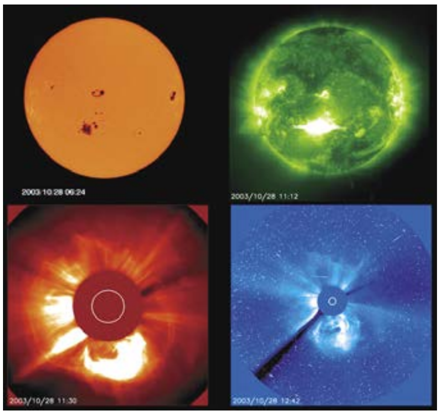
As a result of this solar storm, an impressive sudden magnetic impulse was detected on all our station magnetometers that also recorded the subsequent intense geomagnetic storms. High energy protons caused a series of Polar Cap Absorption (PCA) events as detected on our station riometers. These space weather events were reported to impact upon space and ground based technologies: two spacecraft were significantly damaged by the high energy particle bombardment; a disturbed ionosphere impacted on HF communications; and some 20,000 homes lost power in Malmoe, in southern Sweden as a consequence of induced currents tripping circuit breakers in the power grid.

The auroral oval expanded considerably and moved away from our Antarctic stations, over Macquarie Island and Tasmania (as observed by the TIGER radar on Bruny Island) and then equatorward. Auroras were seen as far north as Perth and Wollongong. But persistent cloud cover over Hobart and Kingston meant that only the occasional glimpse could be seen through gaps in the cloud – and only then by a keen auroral observer like the AAD's John Innis, who reported his observations to IPS Radio and Space Services:

*The auroras we have seen through the gaps looked quite active at times. The best I have seen (most colourful and active) was a short (10 minute) glimpse we had on Friday night (31 October), about 10:45 pm local summer time … To the south a large window in the clouds opened, and we had a bright white-green glow topped with red, but otherwise unstructured, and a series of fast growing, narrow, and short lived rays. The glow extended to perhaps 30 degrees about the south horizon, with the tops of the rays extending to around 60 degrees. The lower border of the glow was not determinable due to cloud. The rays grew and decayed in around 10 seconds, at times less, and were less than about 1 degree in apparent width.*

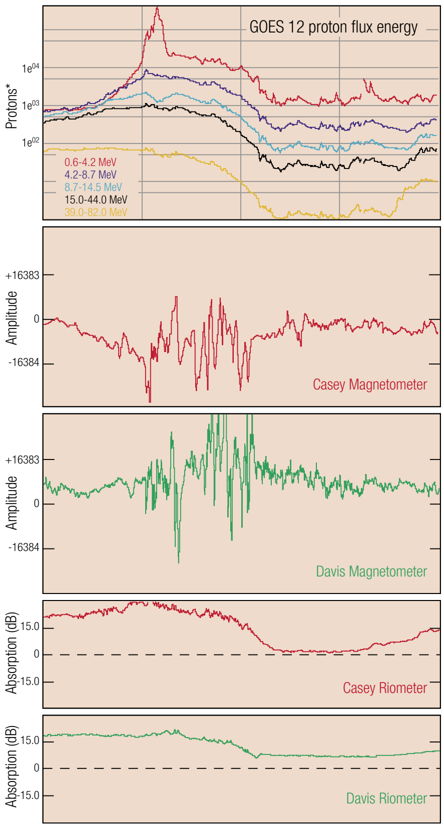
The association of solar activity and tropospheric climate in the pre-industrial era suggests that about a third of global warming observed through the twentieth century results from increased solar activity. Our routine geophysical observations in Antarctica form a climatological baseline extending back to 1958 at Mawson and Casey, and for two decades at Davis and Macquarie Island. Because the upper atmosphere changes rapidly from one location to another, each of the four sites makes a unique contribution to the climate archive. There is accumulating evidence linking climate to solar variability. Further research is needed to address the questions 'how do we forecast space weather events?' and 'how do solar events affect climate?'

RAY MORRIS AND DANIEL BOMBARDIERI,
SPACE AND ATMOSPHERIC SCIENCES PROGRAM,
AUSTRALIAN ANTARCTIC DIVISION



SOHO/EIT AND LASCO INSTRUMENTS

RAY MORRIS




JUDY WHELAN & MIKE HYDE

*From top to bottom: 1. A montage of solar images, courtesy of SOHO/EIT and LASCO instruments. 2. An aurora over Kingston resulting from a similar X-ray flare and CME event during November 2001.*
*3. Stacked plots of GOES-12 satellite proton flux energy bands resulting from the X-ray flare and CME of 29 October 2003 (topmost panel). The resulting magnetic storm and polar cap absorption events recorded at Casey and Davis for the CME of 28 October 2003 are shown in the lower four panels. Refer to the GOES-12 data posted at <http://spidr.ngdc.noaa.gov/spidr/>.*

# Records set by 2003 ozone hole

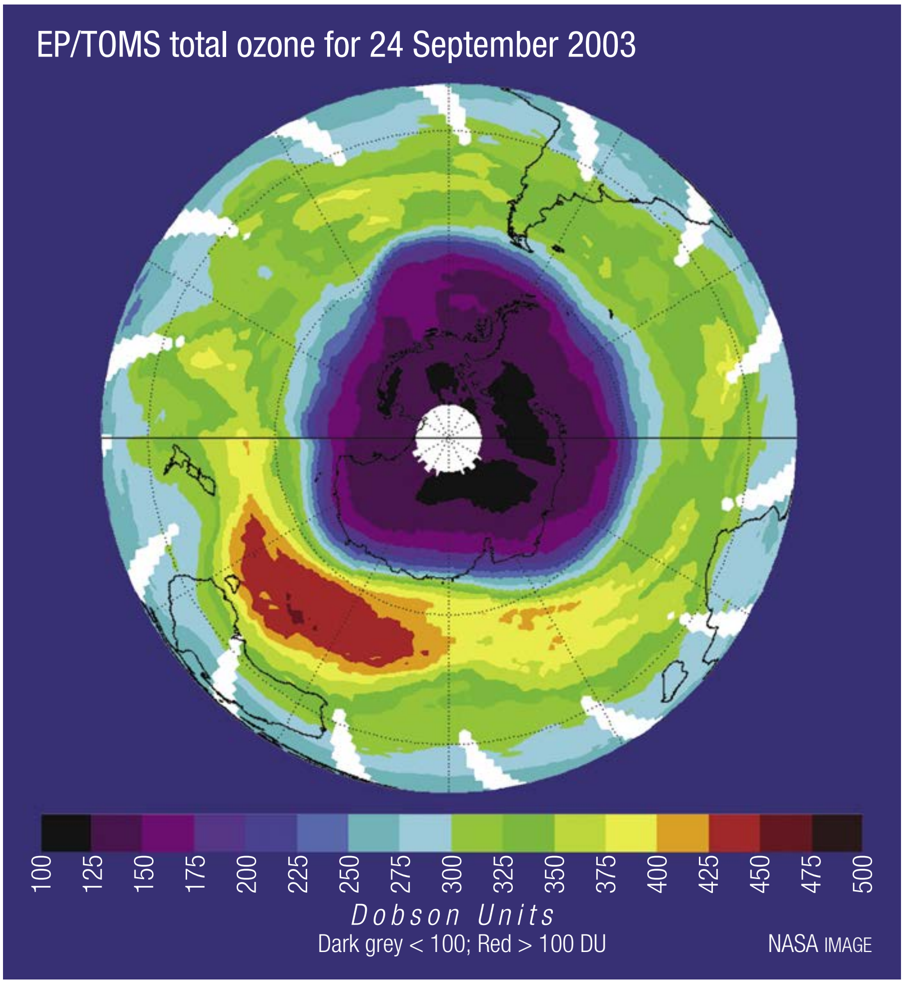
As anticipated in July ('Stop Press: Large ozone hole predicted', *Australian Antarctic Magazine* 5:25), a large hole formed in the ozone layer over Antarctica during the spring of 2003. At its maximum extent on 24 September, the hole equalled in size the record set on 10 September 2000. This situation strongly contrasted with the behaviour seen in 2002, when the ozone hole was the smallest in over a decade ('Unusual behaviour of the Antarctic ozone hole', *Australian Antarctic Magazine,* 5:24).

At Davis, atmospheric measurements by the AAD and Bureau of Meteorology using balloons and lidar followed the evolution of the ozone hole as part of a study into the microphysics of stratospheric ozone. These measurements also contributed to the first year of an international program which is investigating polar ozone loss.

Because of below average temperatures in the polar stratosphere over the 2003 winter, and the relative stability of the polar vortex, the ozone hole grew rapidly during August, attaining a size and depth not previously witnessed for that time of year. Significantly, the region over Antarctica where more than 50% of the total column ozone was destroyed reached an area about 20% higher than the previous record set in 2000. The growth phase peaked in early September, and the areal extent of the hole remained near record levels for much of the month. During October and November, the hole decayed relatively quickly, following a trend similar to that observed in 2000. Interestingly, the 'filling-in' of the hole was more rapid than the decay of the polar vortex, and is probably related to influences on stratospheric circulation from the tropics.

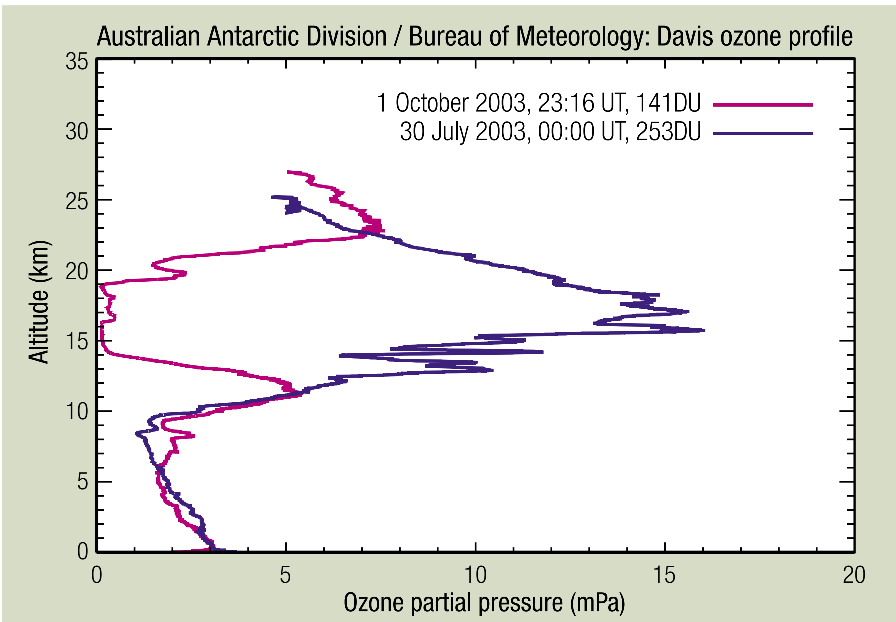
Despite the large extent of the ozone hole in 2003, solar ultraviolet (UV) levels near the surface were not unduly elevated. The only populated region to lie under the hole was the southern tip of South America, and this region was exposed on four occasions in September and early October. During these times, low solar elevation angles combined with cloud cover restricted UV exposure to levels comparable with mid-latitude summer sites.

What will happen in 2004? The winds in the equatorial stratosphere should reverse in direction to flow eastward during the year, and this may enhance the size of the ozone hole by restricting the poleward flow of



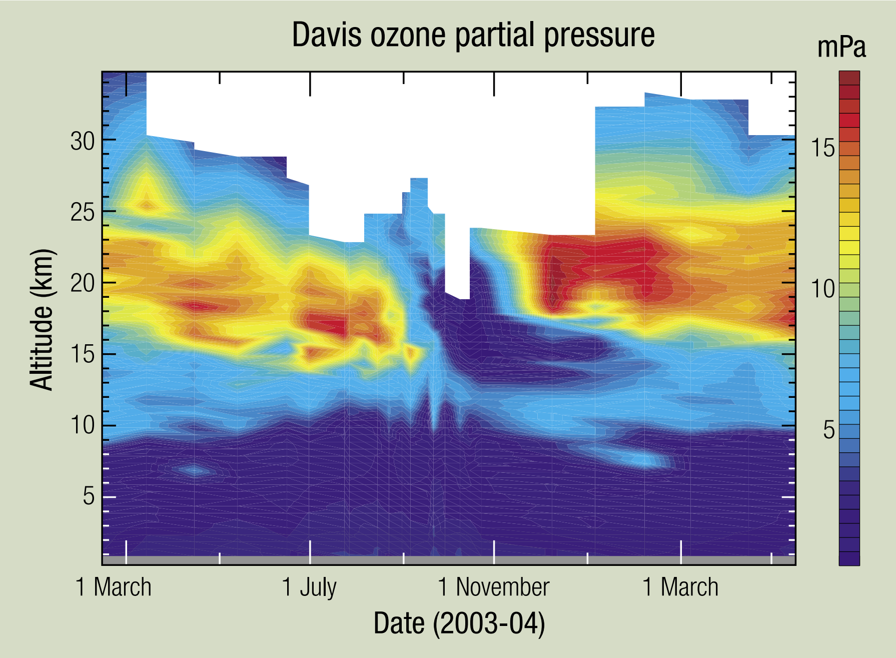

NASA GODDARD SPACEFLIGHT CENTER

*Southern Hemisphere total ozone concentration for 24 September 2003, when the ozone hole over Antarctica reached its maximum size, as measured by NASA's Earth Probe satellite. Smaller Dobson Unit values represent lower ozone concentrations. Note the region of high ozone levels between Australia and Antarctica. This was associated with a persistent region of low pressure over the Southern Ocean.*




ANDREW KLEKOCIUK

*Vertical profiles of ozone obtained using balloons at Davis before (30 July) and during (1 October) the passage of the ozone hole over the station. The measurements on 1 October show that almost all of the ozone between altitudes of 14km and 19km was destroyed.*




*Left: Time evolution of ozone levels above Davis during 2003 and 2004 from balloon measurements. The ozone layer (represented by red colours near 20km) gradually descended in altitude during autumn and winter of 2003 as the atmosphere cooled. The layer was almost completely absent between late August and the end of October as a result of the ozone hole. Low ozone values near 15km persisted until the end of the year.*
*Below: A Type II Polar Stratospheric Cloud observed at Mawson on 08 July 2003. Stratospheric clouds play a central role in the destruction of ozone over Antarctica. This cloud formed down-wind of the mountains around Mawson.*


ozone from the tropics. A similar situation occurred in 2002, however other meteorological factors disturbed the Antarctic atmosphere and created an abnormally small hole. We'll have to wait and see, as there are still many subtleties in global atmospheric dynamics that remain to be understood.

*ANDREW KLEKOCIUK, SPACE AND ATMOSPHERIC SCIENCES PROGRAM, AAD*

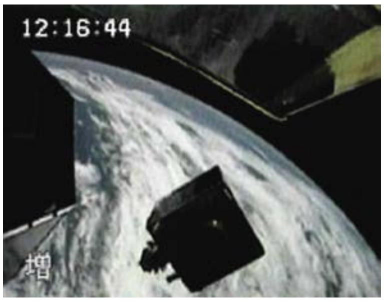
## Antarctica Online

AAD ozone hole press release: <http://www.aad.gov.au/default.asp?casid=11817>
World Meteorological Organization 2003 ozone bulletins and press release: <http://www.wmo.ch/web/arep/ozone.html>

# Australia's first micro-satellite to elevate our Antarctic magnetometer science

Scientists are set to conduct high resolution ground-space measurements of Earth's magnetic field above Antarctica using a magnetometer on board the Australian polar orbiting micro-satellite, FedSat, and magnetometers in Antarctica. This represents a significant enhancement of the role of the Antarctic ground-magnetometer array from the summer of 2002–03.

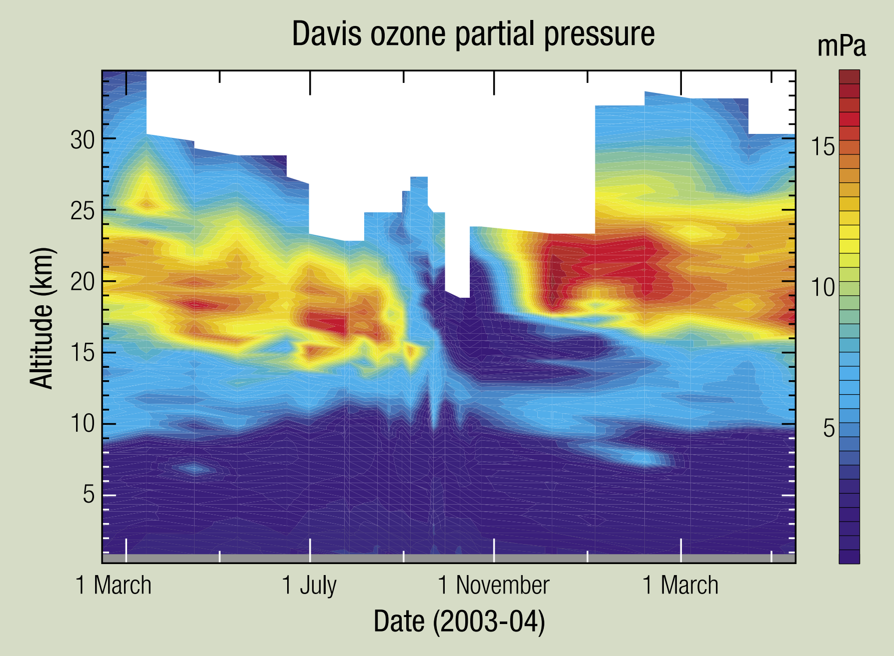
On 14 December 2002, the 58 kg FedSat, Australia's first scientific micro satellite, was launched from the NASDA/JAXA Tanegashima Space Centre in southern Japan and placed in an 800 km altitude Sun-synchronous polar orbit with a 100 minute period. The primary scientific payload on FedSat is Newmag, a fluxgate magnetometer experiment built by the University of Newcastle as its contribution to the Australian Cooperative Research Centre for Satellite Systems. Fedsat and Newmag will enable the first Australian based ground-satellite investigation of magnetic pulsations and current systems over Antarctica.


*Lift-off! Launch of Australia's scientific polar orbiting micro-satellite FedSat. Above: Fedinject*

For the past several years two Narod fluxgate magnetometers have been deployed at sites about 110 km inland from Australia's Davis and China's Zhongshan stations to form a square array of magnetometers. Permanent induction magnetometers have been operating at Davis since 1981 and at Zhongshan since 1992 under the auspices of an international collaboration between the University of Newcastle, the Polar Research Institute of China, and the Australian Antarctic Division. The summer deployments have been made by helicopter.

The Narod magnetometer systems, also developed by the University of Newcastle space physics group, are housed in boxes, sealed against drift snow, and connected to the magnetometer head via a 60 m cable. Power is supplied by battery coupled to a solar panel secured on the snow to prevent




ANDREW KLEKOCIUK

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GREG HEMSWORTH

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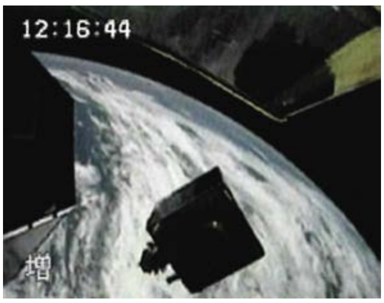
BRIAN FRASER




PROVIDED BY BRIAN FRASER

*Lift-off! Launch of Australia's scientific polar orbiting micro-satellite FedSat. Above: Fedinject*

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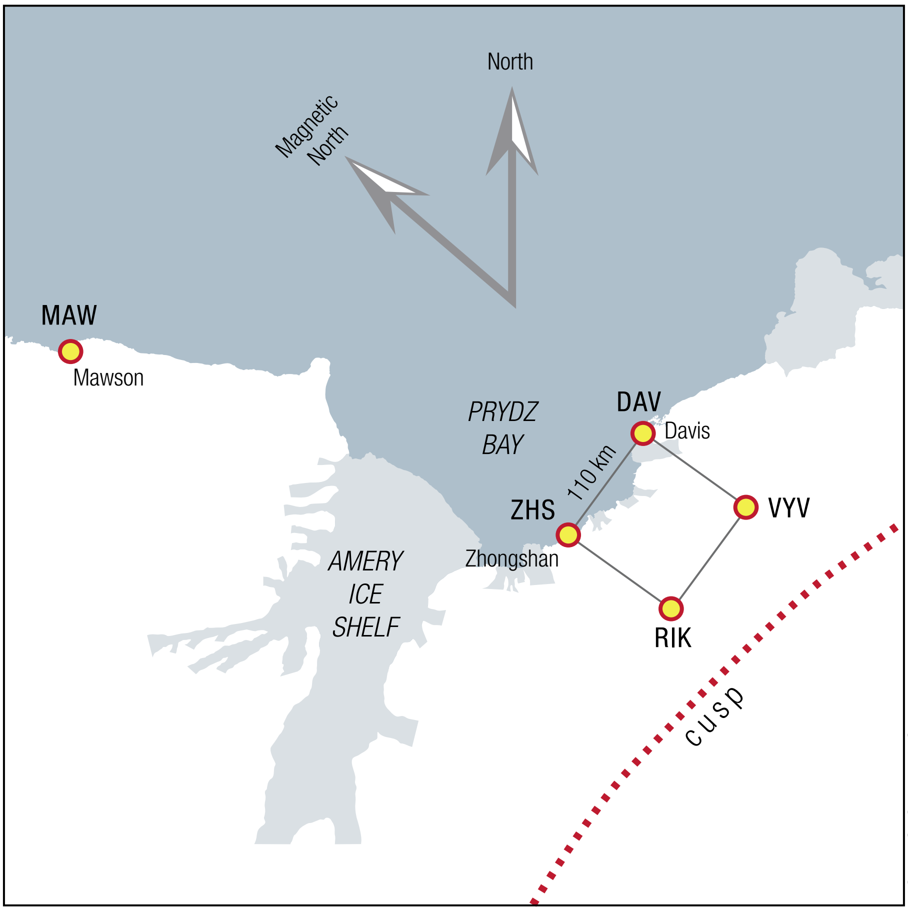



PASHA PONOMARENKO

*The square array of magnetometers in the Davis area*

damage during blizzards, and hopefully to prevent it being buried. During the deployment and subsequent visits to download data, local weather conditions were typically at temperatures near minus 20°C with drifting snow at 15 knots.

The plateau magnetometers were designed for summer deployment with retrieval scheduled some six weeks later, but the units were redeployed in the field at the end of the summer to extend the ground observations for comparison with the Fedsat magnetometer. The 2003–04 summer retrieval revealed that the Narod has coped with the winter conditions, collecting six weeks of bonus data on the palmtop computers. This program will continue for the duration of the FedSat mission.

Several visits to the Chinese station Zhongshan were needed throughout the summer to replace a GPS clock, computer, and to conduct the annual magnetometer calibrations prior to the summer campaign commencement. On all occasions our Chinese colleagues were excellent hosts providing our every need and much more. We shared a common goal and spirit that comes naturally to Antarctic expeditioners working for science and international goodwill.

The Fedsat and Antarctic magnetometers will provide a unique data set for Newcastle University and AAD scientists for their continuing study of polar cusp region magnetic pulsations (waves with periods ranging from parts of a second to several minutes with varying amplitudes). The polar cusp is the region between the last closed magnetic field lines and first open magnetic field lines typically located in the upper atmosphere above Davis and Zhongshan.

Observations beneath this magnetic funnel allow us to monitor processes associated with the coupling between the Sun's and Earth's magnetic fields – similar to two bar magnets connecting or repelling each other – and the subsequent entry of solar particles into the Earth's magnetic envelope and upper atmosphere. Such studies are important for our ability to forecast the conditions of our space weather environment. They contribute practical information to help mitigate damage to both ground-based technologies (electricity production, radio communication, pipeline corrosion) and space-based technologies (satellite electronics, astronaut health, satellite and mobile phone links).


We acknowledge the special contribution of Ward Bremmers, John Gordon, Doug Watts and Jeremy Crawford (Helicopter Resources) for providing excellent helicopter support for this project, and Jeremy Smith (Station Leader, Davis 2003) for coordinating our flight schedule. Thanks are also due to David Mitchell, Lloyd Symons and Richard Groncki for their organisation and technical work, and to the field support team including Paul Saxby, Meredith Nation, Alan Taylor, Danny Ratcliffe, Chris Heath, Ian MacLean and Mark Maxwell. University of Newcastle support was provided by Michael Terkildsen, Andrew Bish and Peter McNabb in the field and with instrumentation, and Fred Menk and Colin Waters with scientific contributions.



*Ray Morris, Space and Atmospheric Sciences Program, AAD & Brian Fraser, University of Newcastle*


DAVID MITCHELL

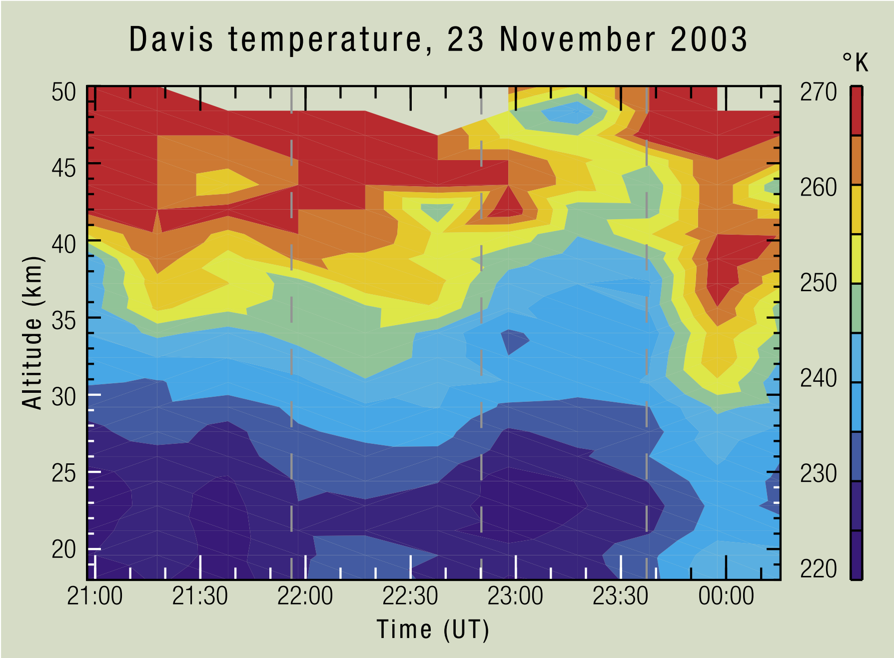
*Deployment of Narod fluxgate magnetometer (housed in the box in the foreground)*

# Ice and fire: A total solar eclipse over Antarctica

The 23rd of November 2003 has been entered in the astronomical record books as the day when a total solar eclipse was first witnessed from Antarctica. The audience for this special event consisted of four main groups of astronomers and eclipse enthusiasts, who were lured to the ends of the Earth by the chance to see the Sun briefly swallowed by the Moon amid a frozen landscape.

The path of the total eclipse, within which the Moon fully covered the Sun, was a thin corridor, 500km in width at its narrowest point, which swept over a remote and harsh region of the Southern Ocean and East Antarctica. From a much broader area, which included Australia and most of Antarctica, the Moon was seen to partly cover the Sun.

In order to observe the eclipse at its best, two commercial aircraft were chartered to intercept the Moon's shadow over Antarctica. Approximately 200 people on these flights were able to view the total eclipse for approximately two minutes and 30 seconds while flying at an altitude of about 11km. At the surface, observers at Mirny and Maitri stations, as well as tour groups on the Russian icebreaker *Kapitan Khlebnikov* near the Shackleton Ice Shelf and Russia's Novolazarevskaya station, were within the path of totality, but were hampered by clouds.




ANDREW KLEKOCIUK

*Atmospheric temperatures (in degrees absolute; 0°C = 273K) measured by the Davis lidar at 20 minute intervals and 1km vertical resolution. The dashed vertical lines refer to the times of the start, maximum, and end of the eclipse. The lowest temperatures were observed approximately 15 minutes after mid-eclipse.*

Aside from the spectacle of seeing the ghostly glow of the Sun's outer atmosphere, or corona, revealed to the naked eye for a fleeting few tens of seconds, the eclipse presented some important scientific opportunities. On one of the eclipse-chasing aircraft, a Qantas 747B chartered by Croydon Travel, noted eclipse experts Dr. Glenn Schneider from the University of Arizona, and Professor Jay Pasachoff from Williams College, Massachusetts, took special photographs for comparison with observations by the SOHO spacecraft.

I was fortunate to be on this flight as the AAD's observer to monitor environmental aspects of the charter. I was specifically interested in looking for elusive noctilucent clouds hanging high in the atmosphere.

*To page 34*

JEAN-LUC DIGHAYE

*The totally eclipsed Sun surrounded by the 2 million degree K glowing plasma of the corona.*

### Total eclipses in Antarctica – how rare are they?

On average, a total solar eclipse is visible from some part of the globe every 16 months or so. Since 1900 there have been 10 total eclipses having at least some part of their path south of 60°S, and of these seven had paths which intersected the Antarctic continent. One of these eclipses was significant for Tasmanians. On 9 May 1910 a total eclipse crossed the Antarctic coast where Casey is today, and passed over southern Tasmania. It was cloudy in Hobart at the time, and coincidentally Halley's comet reached its closest point to the Earth the following day. In more recent times, total eclipses occurred over the Antarctic region in 1957, 1967 and 1985. Despite the steady increase in Antarctic scientific exploration over these years, no observations of totality were attempted for the events owing to the unfavourable location of the eclipse paths.

## EurAstro over Antarctica

The EurAstro team (Dr. Matthew Poulton and I, and guests Professor Jay Pasachoff and his student Zophia Edwards) had booked seats in the first class cabin of the Croydon/Qantas dedicated flight to the total solar eclipse of 23-24 November 2003. Dr. Andrew Klekociuk advised us to look for noctilucent clouds and auroral displays. We saw none, but I nevertheless captured interesting refraction and scattering effects. After having seen a sea of clouds for hours, we were eventually treated with some clearings near the eclipse site. The view was breathtaking and everybody rushed to photograph this landscape, unusual to eclipse chasers, as the plane banked and dived while the partial phase of the eclipse was already in progress. Dr. Glenn Schneider helped bring the plane in perfect alignment with the eclipse track. He announced the onset of the Moon's shadow, the sighting of the solar corona, and the diamond ring. After totality, further sightseeing opportunities were offered to those not already celebrating.

*Jean-Luc Dighaye*, Chairman, EurAstro*

JEAN-LUC DIGHAYE

*Above: Shortly after totality, the Moon's shadow is seen racing away from the aircraft at more than 1km per second.*

JEAN-LUC DIGHAYE

*Right: Looking in the anti-sunward direction, a spectacular Glory was seen near Mirny station. This phenomenon is produced by the diffraction of sunlight on water droplets in the clouds.*

**Jean-Luc Dighaye has witnessed several total solar eclipses from remote corners of the globe. EurAstro is a nonprofit association for European amateur astronomers based in Munich, Germany. The association was established in 1998 and currently comprises approximately 250 members.*

*From page 33*

These clouds form near 85km altitude during the summer over Antarctica, and are sensitive indicators of conditions at the top of the atmosphere. The eclipse provided a unique opportunity to locate the clouds visually, because normally the atmosphere is too bright to see them. It was hoped to compare the location and appearance of the clouds with satellite measurements. Alas, no obvious noctilucent clouds were seen, probably because the atmosphere was not cold enough above our location. Contrary to our normal experience on the ground, the high atmosphere above Antarctica cools down between winter and summer. For noctilucent clouds to form, the temperature needs to be below about -150°C, which normally occurs from late November.

My other interest was in the temperature response of the atmosphere to the advance of the Moon's shadow. At Davis, where at maximum eclipse just over 98% of the Sun's diameter was obscured, the Light Detection and Ranging (lidar) experiment obtained profiles of atmospheric temperature. The measurements showed a cooling of 5 to 15 degrees, depending on altitude, delayed slightly with respect to the time of maximum eclipse. This response is most likely due to reduced heating by ozone while the atmosphere was covered by the Moon's shadow.

FINN OLSEN, AAD

*The thin crescent Sun as seen from Davis near maximum eclipse.*

These measurements are the first to be obtained by lidar at high latitude during an eclipse, and will provide a new insight into atmospheric heating rates.

At Mawson, Davis and Casey, the station webcams were used to transmit live eclipse images over the internet. These images and related information created record public interest in the AAD's website.

The event has now passed, and the enthusiasts have returned home with memories and photographs of the fire-rimmed hole in the sky above Antarctica. Some are thinking of the next such opportunity in December 2021, and wondering what scientific discoveries await us then.

*Andrew Klekociuk, Space and Atmospheric Sciences Program, AAD*

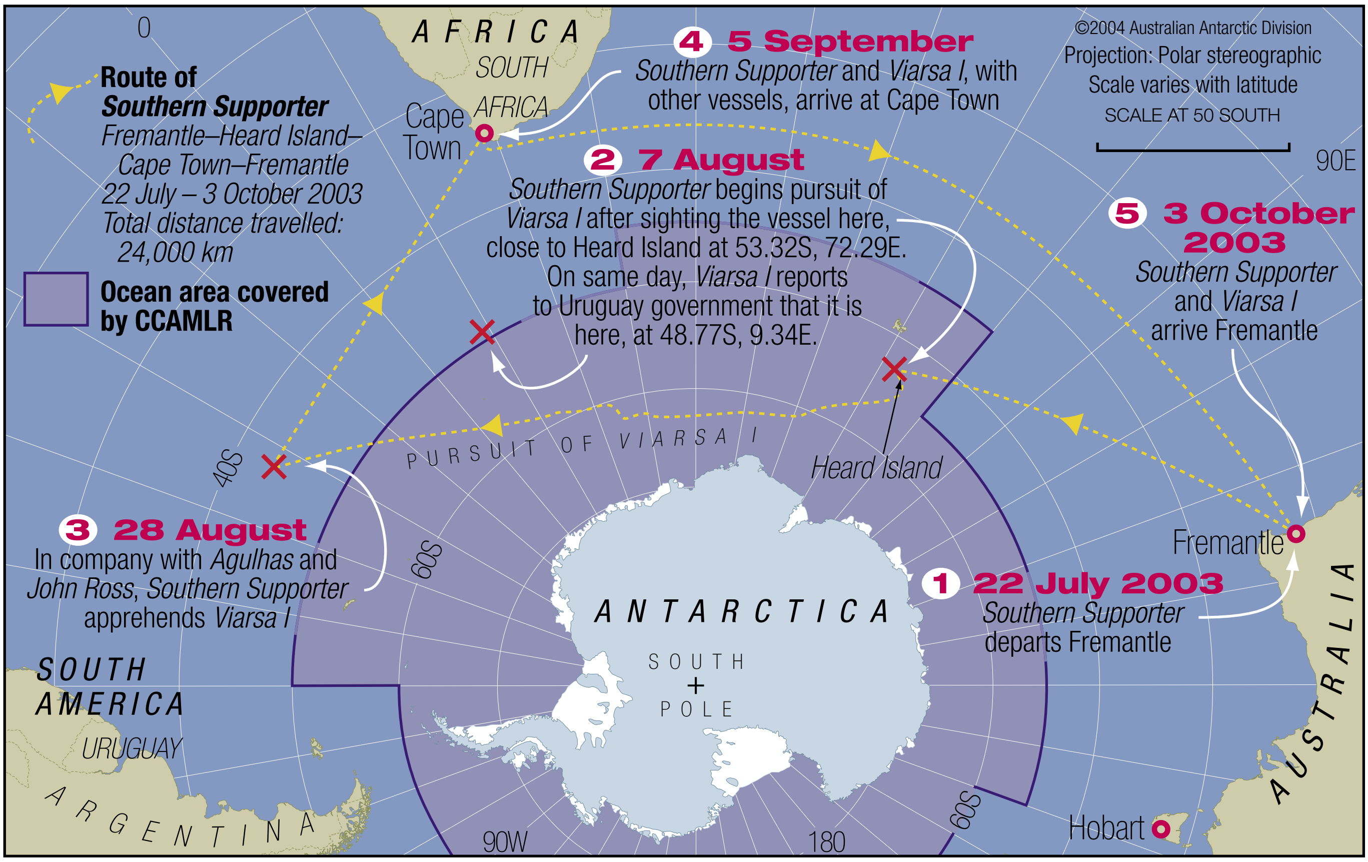
### ▶ Antarctica Online

*Further information*

Eclipse information and images at the AAD: <http://www.aad.gov.au/default.asp?casid=12740>

NASA's eclipse home page: <http://sunearth.gsfc.nasa.gov./eclipse/eclipse.html>

# Poachers pursued over 7,000 kilometres




PETER BOYER

On August 28 2003 Australian Customs and Fisheries officers from the Australian customs and fisheries patrol boat, *Southern Supporter*, backed by armed South African enforcement officers boarded the Uruguayan flagged fishing vessel *Viarsa 1*. The boarding and apprehension ended a record breaking 21-day hot pursuit covering 3,900 nautical miles by *Southern Supporter* and on-the-water support from South Africa and the UK – two nations also concerned about illegal fishing.

On 7 August 2003 *Southern Supporter* sighted *Viarsa 1* allegedly engaged in illegal fishing inside the Australian exclusive economic zone around Heard Island and the McDonald Islands in the Southern Ocean. The pursuit which followed was unprecedented in both distance and level of international cooperation to protect the marine ecosystem and Australia's sovereignty in its waters.

When *Viarsa 1* was first sighted, it had concealed its identity markings. Australian fisheries officers ordered the vessel to accompany *Southern Supporter* eastward to Fremantle to investigate its activities under Australian fisheries law. When the master of *Viarsa 1* ignored the order and started on a westward course, the hot pursuit commenced.

From the time of sighting, diplomatic action also took place behind the scenes as part of the international effort to stop the vessel. Uruguayan officials willingly cooperated, and provided the vessel monitoring data used to verify where the

CUSTOMS/AFMA

CUSTOMS/AUSTRALIAN FISHERIES MANAGEMENT AUTHORITY

*Above right: Taking observations from* Southern Supporter. *Right:* Viarsa 1 *in heavy seas.*

vessel was geographically located. The vessel monitoring data reported that the *Viarsa 1* was 3000 nm west of its actual position, which indicated that the vessel was misreporting its location to the Uruguayan Government. Australia alerted Members of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and key port States about the hot pursuit and the need to ensure that the catch not be off-loaded and traded.

Sixteen days into the hot pursuit, any doubts about the identity of the *Viarsa 1* were answered when crew members repainted the vessel's name, number and port of registration on the hull. The master of *Viarsa 1* advised Australian fisheries officers on board *Southern Supporter* that they had been arrested by the Uruguayan Government and were returning to Montevideo.

At times during the pursuit the vessels headed into Antarctic waters risking their safety amongst the sea ice. At one crucial stage the master of the *Southern Supporter* had to guide the battered fishing vessel out of danger.

Australia sought and obtained the assurances of other concerned CCAMLR Members that *Viarsa 1* would not be allowed to unload its catch or to refuel in their ports. The Governments of South Africa and the United Kingdom also offered on-the-water support to Australia. As a result the South African icebreaker SA *Agulhas*, the South African ocean-going salvage tug *John Ross* and the United Kingdom fisheries patrol vessel *Dorada*, joined the chase in a multi-national enforcement effort .

By 28 August the vessels were south west of South Africa. The *John Ross* launched a boarding party using two small Australian pursuit boats, with Australian fisheries and customs officers and armed South African enforcement officers on board.

Following the apprehension, Australia sought further support from South Africa by re-provisioning both the *Viarsa 1* and the *Southern Supporter* off the coast of South Africa, before returning to Fremantle.

Australia and Uruguay continue to cooperate while gathering evidence. Officials from both countries have worked together to collect evidence collected from the *Viarsa 1* and from Uruguayan fisheries records.

Charges were laid against the master and four crew members on 10 October 2003 under Australia's *Fisheries Management Act 1991*.

The extraordinary pursuit and successful apprehension of this illegal fishing vessel was only possible due to the cooperation from other nations concerned about illegal fishing in the Southern Ocean.

*Antarctic and International Policy Section, AAD*

## Crackdown continues: Maya V apprehended, Lena sunk

Australia sent another clear message to illegal fishing operators around the world after the apprehension on 23 January 2004 of the Uruguayan-flagged fishing vessel *Maya V*. The *Maya V* is suspected of illegal fishing in Australia's Exclusive Economic Zone around Heard Island and McDonald Islands.

The Royal Australian Navy warship, HMAS *Warramunga,* made contact with *Maya V* on 22 January. However, the boarding party was unable to board until the following day due to bad weather conditions.

*Maya V*, under escort from the HMAS *Warramunga*, reached the port of Fremantle on 1 February, where Fisheries officers conducted a full investigation into the allegations of illegal fishing.

If the *Maya V* is successfully prosecuted under the Australian Fisheries Management Act, it may meet the same fate as the *Lena,* a Russian-flagged vessel scuttled off the coast of Bunbury, Western Australia in December 2003. The *Lena,* now a popular dive wreck, rests around five kilometres off shore, about 18 metres below the surface.

Australia will continue its tough approach against illegal, unreported and unregulated fishing. The arrest of the *Maya V*, the sinking of the *Lena* and the recent announcement of armed patrol vessels around Heard Island and McDonald Islands showed that the Australian Government will not hesitate in pursuing illegal vessels fishing in Australian waters.

*Antarctic and International Policy Section, AAD*


DEPARTMENT OF DEFENCE

*Right:* Maya V *is intercepted and boarded by the Royal Australian Navy on 23 January 2004, after alleged illegal fishing in the Australian Exclusive Economic Zone.*
*Below: HMAS* Warramunga*'s Seahawk helicopter during transfer of personnel to the* Maya V.

DEPARTMENT OF DEFENCE

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Australia sought and obtained the assurances of other concerned CCAMLR Members that *Viarsa 1* would not be allowed to unload its catch or to refuel in their ports. The Governments of South Africa and the United Kingdom also offered on-the-water support to Australia. As a result the South African icebreaker SA *Agulhas*, the South African ocean-going salvage tug *John Ross* and the United Kingdom fisheries patrol vessel *Dorada*, joined the chase in a multi-national enforcement effort .

By 28 August the vessels were south west of South Africa. The *John Ross* launched a boarding party using two small Australian pursuit boats, with Australian fisheries and customs officers and armed South African enforcement officers on board.

Following the apprehension, Australia sought further support from South Africa by re-provisioning both the *Viarsa 1* and the *Southern Supporter* off the coast of South Africa, before returning to Fremantle.

Australia and Uruguay continue to cooperate while gathering evidence. Officials from both countries have worked together to collect evidence collected from the *Viarsa 1* and from Uruguayan fisheries records.

Charges were laid against the master and four crew members on 10 October 2003 under Australia's *Fisheries Management Act 1991*.

The extraordinary pursuit and successful apprehension of this illegal fishing vessel was only possible due to the cooperation from other nations concerned about illegal fishing in the Southern Ocean.

*Antarctic and International Policy Section, AAD*

## Crackdown continues: Maya V apprehended, Lena sunk

Australia sent another clear message to illegal fishing operators around the world after the apprehension on 23 January 2004 of the Uruguayan-flagged fishing vessel *Maya V*. The *Maya V* is suspected of illegal fishing in Australia's Exclusive Economic Zone around Heard Island and McDonald Islands.

The Royal Australian Navy warship, HMAS *Warramunga,* made contact with *Maya V* on 22 January. However, the boarding party was unable to board until the following day due to bad weather conditions.

*Maya V*, under escort from the HMAS *Warramunga*, reached the port of Fremantle on 1 February, where Fisheries officers conducted a full investigation into the allegations of illegal fishing.

If the *Maya V* is successfully prosecuted under the Australian Fisheries Management Act, it may meet the same fate as the *Lena,* a Russian-flagged vessel scuttled off the coast of Bunbury, Western Australia in December 2003. The *Lena,* now a popular dive wreck, rests around five kilometres off shore, about 18 metres below the surface.

Australia will continue its tough approach against illegal, unreported and unregulated fishing. The arrest of the *Maya V*, the sinking of the *Lena* and the recent announcement of armed patrol vessels around Heard Island and McDonald Islands showed that the Australian Government will not hesitate in pursuing illegal vessels fishing in Australian waters.

*Antarctic and International Policy Section, AAD*


DEPARTMENT OF DEFENCE

*Right:* Maya V *is intercepted and boarded by the Royal Australian Navy on 23 January 2004, after alleged illegal fishing in the Australian Exclusive Economic Zone.*
*Below: HMAS* Warramunga*'s Seahawk helicopter during transfer of personnel to the* Maya V.

DEPARTMENT OF DEFENCE

# Australian Government gets tough – increased funding to combat illegal fishing

DEPARTMENT OF DEFENCE

*The Royal Australian Navy's supply vessel* HMAS Success *at Heard Island, returning from a successful Southern Ocean patrol in February 2004. The ship was involved in the combined operation to apprehend the suspected illegal fishing vessel* Maya V.

The Australian Government has continued to take a tough stance on illegal fishing in the Australian exclusive economic zone (EEZ) surrounding Heard Island and McDonald Islands by committing $40–$50 million to surveillance and enforcement activities over the next two years.

On 17 December 2003, the Prime Minister, John Howard, the Minister for Fisheries, Forestry and Conservation, Senator Ian Macdonald, and the Minister for Justice and Customs, Senator Chris Ellison announced that Australia would increase its surveillance and enforcement capabilities in the Southern Ocean in order to protect its sovereignty and its marine ecosystem.

An ice-strengthened vessel will carry a deck-mounted .50 calibre machine gun, an armed Customs boarding party, Australian Fisheries Officers and a civilian steaming party. With year round vessel availability, the primary purpose of the Southern Ocean patrols will be to detect and apprehend illegal fishing vessels targeting the valuable Patagonian toothfish. They will also send a strong message that Australia will not tolerate any breaches of its EEZ or its marine reserves, wherever they may occur.

DEPARTMENT OF DEFENCE

*Australian Prime Minister John Howard visits HMAS* Warramunga *at Fremantle Harbour, on its return from apprehending* Maya V *in the Southern Ocean.*

The program will provide the capacity to board vessels and use force if necessary and will help avoid the need to undertake long pursuits of illegal vessels in the future.

Australia will continue to work closely with other nations including South Africa, France, the United Kingdom and New Zealand to combat illegal fishing operations and to protect the Southern Ocean ecosystem.

*Antarctic and International Policy Section, AAD*

# Outcomes of CCAMLR XXII

Governments and non-government organisations interested in the conservation of marine resources and the sustainable management of fishing in the Southern Ocean participate each year in the meeting of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). The 22nd annual meeting took place in Hobart between 27 October and 7 November 2003.

The Australian Government took a number of initiatives to this meeting, including the key initiative of a centralised Vessel Monitoring System (cVMS). A cVMS would allow CCAMLR to independently verify and validate vessels' positions and movements against a common standard of monitoring. This system would track the position of vessels fishing for toothfish to assist in ensuring they are fishing lawfully.

This initiative was brought to the meeting through cooperation with like-minded nations interested in combating illegal fishing, namely New Zealand and the United States. The three nations worked together to develop the concept before and during the meeting and encouraged interest from South Africa, Argentina, Uruguay and the Ukraine. These nations will participate in an open trial cVMS over the next 12 months and will report to the 2004 meeting of the Commission.

The Commission also agreed to a 'black list' of vessels that have been implicated in illegal fishing. Parties cooperating with CCAMLR are encouraged to refuse these vessels access to their ports, thus making it more difficult for illegal fishers to offload their catch. Eight vessels from Uruguay, Belize, Ghana and Seychelles were named on the list.

ANDREW JACKSON

CCAMLR XXII, Hobart, November 2003

Another goal at CCAMLR XXII was improvements to the Catch Documentation Scheme (CDS). The CDS aims to track the trade in toothfish and verify the legality of catches. Australia participated with a number of interested Parties over the previous year on the pilot electronic scheme. Australia supported the United States' call for full implementation of the electronic CDS. However, it was agreed to continue the trial period of the e-CDS for another year.

There was a significant increase in the number of new and exploratory fishing applications received from CCAMLR Members in 2003. This will create a greater challenge to the conservation of the Southern Ocean toothfish stocks in the coming years.

In a positive move, CCAMLR also agreed that the development of avoidance and mitigation measures for by-catch species should be given high priority. As a result fishing vessels are encouraged to use integrated weighted lines that cause baited hooks to sink at a faster rate, reducing incidental mortality of seabirds. The estimated total number of seabirds killed by legal toothfish operators for the 2002–03 fishing season was 15, which represents the lowest estimated seabird by-catch in regulated longline fisheries yet reported for the Convention Area. This is seen as a huge achievement given the thousands of birds which were being killed only a few years ago.

The measures agreed to at the meeting such as the open trial cVMS & e-CDS, and the inclusion of the vessels on the black list were positive steps forward. Full implementation of these trials by the Commission in the future will further protect the Southern Ocean ecosystem. CCAMLR will continue to play an integral role in Southern Ocean conservation.

The Australian Antarctic Division will continue to work with other Government departments, as well as industry and environment representatives during 2004, so that Australia and like-minded nations can achieve the best possible outcome for the conservation of the Southern Ocean ecosystem at CCAMLR XXIII later this year.

*Antarctic and International Policy Section, AAD*

**Apprehensions of foreign fishing vessels for illegal fishing in Australian waters since 2001 (Heard and McDonald Islands zone)**

| Name of vessel | Date of apprehension | Tonnage of toothfish | $value of toothfish | Outcome |
|---|---|---|---|---|
| *South Tomi* | 29/03/01 | ca. 100 | $1,400,000 | Master convicted and fined a total of $136,000. City of Geraldton preparing vessel for dive wreck |
| *Lena* | 04/02/02 | ca. 70 | $1,127,183 | Master convicted and fined a total of $50,000. Two crew members convicted and fined $25,000 each. Vessel scuttled |
| *Volga* | 07/02/02 | ca. 127 | $1,932,579 | Still subject to legal action |
| *Viarsa* | 28/08/03 | ca. 94 | sold in excess of $1,000,000 | Still subject to legal action |
| *Maya V* | 23/1/04 | ca. 150 | estimated worth of $2,200,000 | Still subject to legal action |

# CCAMLR Ecosystem Monitoring Program reviewed

When the CCAMLR Working Group on Ecosystem Monitoring and Management (WG-EMM) last met in Cambridge in July 2003, a major task was to hold a workshop to review the CCAMLR Ecosystem Monitoring Program (CEMP).

CEMP was established in 1984 in response to the development of a krill fishery in the Southern Ocean. The original objectives of CEMP were to (i) detect and record significant changes in critical components of the ecosystem to serve as a basis for the conservation of Antarctic marine living resources, and (ii) distinguish between changes due to the harvesting of commercial species and changes due to environmental variability, both physical and biological.

A broad framework for CEMP was initially established by selecting indicator species, including Adélie penguins, fur seals and black-browed albatross, identifying ecological parameters to be measured, developing standard methods for measurement of parameters, and establishing a network of sites around the continent and three integrated study regions across a latitudinal gradient (South Georgia, Antarctic Peninsula and Prydz Bay). Within this broad framework, a number of major monitoring and directed research programs were established by Australia, Japan, South Africa, UK and the USA, with additional contributions from Argentina, Chile, Germany, New Zealand and the former USSR. These programs have produced a number of long-term time series data sets on selected indicator species and at recognised CEMP sites.

Initial CEMP studies by Australia were undertaken in the late 1980s at Magnetic Island near Davis station. In 1990 the focus for Australia's CEMP work shifted to the Mawson region, where the potential for overlap between the krill fishery and krill predators was greater. From 1990–91 to the present day, monitoring of virtually all of the recommended CEMP parameters for Adélie penguins has been undertaken annually at Béchervaise Island, which has provided a 13-year time series of data. In addition to the CEMP data, surveys of krill availability in the foraging range of the Adélie penguin populations nesting at Béchervaise Island have been undertaken in 2000–01 and 2002–03 to improve our understanding of how each of the parameters varies with food availability.

After some 15 years of application, and the accumulation of much scientific and practical knowledge, a review of CEMP was appropriate and timely. The time series of data were now large enough to assess the extent of natural variation and its likely causes, allowing consideration of whether a critical initial objective of CEMP, distinguishing between changes due to natural variability and harvesting, was possible. In the light of experience gained since its inception, the review also aimed to consider issues such as the strengths and weaknesses of the program in relation to the original objectives, potential additions and improvements to the existing program, the extent to which data from CEMP sites were representative of the areas in which they are located, and the ability to develop management advice from CEMP data. These issues were discussed in Cambridge at a five-day review workshop, the first in a series of WG-EMM workshops aimed toward developing management procedures for the krill fishery, which will include a revised monitoring program.

The workshop agreed that the original objectives of CEMP remained appropriate but recommended that an additional objective, the development of management advice from CEMP data, be adopted. This is an important development as it focuses the program on the problem of providing management advice.

Arguably the most important conclusion reached by those at the workshop was that, with the existing design of CEMP, it may never be possible to distinguish between natural changes and those changes resulting from harvesting. This conclusion recognised the fact that there are multiple sources of

*Adélie parents share chick-rearing duties, alternating guarding the chicks on the nest with foraging at sea. Two eggs are laid, but often only one chick is successfully raised to fledging.*

LYN IRVINE

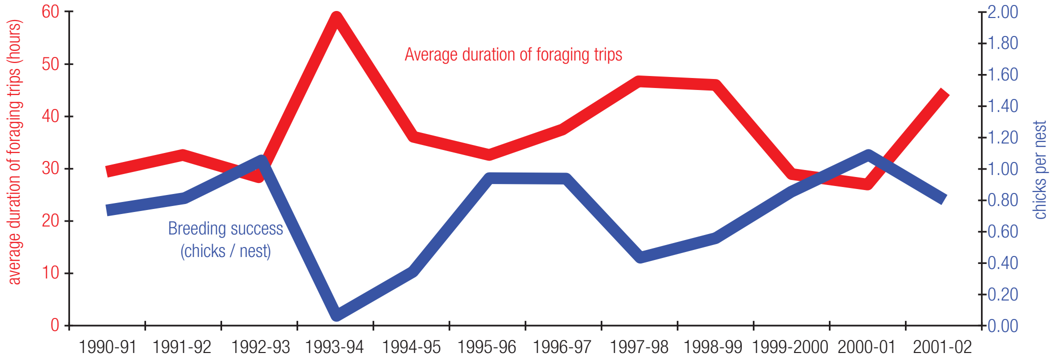
natural environmental variation which could all be confounded with the effects of harvesting. The existing CEMP is also not the result of a rigorous design process but has been formed by the incorporation or development of research within national programs, usually at existing study sites, and so is not optimally configured. This has important consequences for any future CEMP, and recognises that there will always be some level of uncertainty inherent in the provision of management advice.

A second conclusion relating to the lack of an explicit design for CEMP, is that we need to know how representative CEMP sites are of their local areas and regions. Currently, most nations collect data from a single site on the assumption that changes at that site represent changes of a similar nature across a larger region. Collection of data from multiple sites in a region would be desirable, but we would need to find an appropriate balance between increasing the generality and certainty of our understanding of change, with the cost of a larger scale program.

The workshop concluded that the existing CEMP program has many strengths, which include the provision of a detailed quantitative description of Southern Ocean processes, and that data collected through CEMP were appropriate for the recording and detection of change in critical components of the ecosystem. The workshop recommended that further work on the nature, magnitude and significance of changes in CEMP parameters be undertaken, and recognised that the accumulated time series of data across several species and sites will be an extremely valuable resource in this undertaking.

Rather than completing the review of CEMP in a single workshop, CCAMLR has begun a review process that will continue over the next few years along with other CCAMLR developments, as an integrated management procedure for the krill fishery is developed. The findings of the review to date provide a focus for further strategic research, through the analysis of existing data and through the collection of additional data to fill gaps that existing information cannot address. The eventual aim of this process will be to develop a new monitoring program that is an integral component of krill fishery management procedures.

*Colin Southwell, Antarctic Marine Living Resources Program, AAD*




*Breeding success and foraging trip duration have varied considerably over the first 12 years of the CEMP program. Seasons in which the adults have longer foraging trips generally coincide with poor breeding success.*

# AAD gains new responsibilities for whales

In mid-2003, the Australian Government transferred the responsibility for a high-profile international policy from Canberra to the Australian Antarctic Division: the policy of pursuing global protection for whale species.

Australia has promoted and supported an international ban on commercial whaling for a quarter of a century – since Prime Minister Malcolm Fraser announced on 4 April 1979 that whaling would end in Australian waters, and that in future, Australia would seek an international ban. Australia's opposition to commercial whaling applies equally to whaling conducted for commercial purposes under the guise of lethal 'scientific' research. This policy enjoys a high level of public support in Australia.

Interested members of the community include researchers based at universities and research centres around the country, and non-Government organisations that attend regular consultative forums.

The AAD is already actively developing non-lethal techniques to examine the ecology of marine mammals. These include


*Southern right whales (*Eubalaena australis*)*

innovative methods for studying the diets of whales that are more reliable than 'scientific whaling' – in particular by examining DNA traces in faeces, without even touching the animals. Now, the AAD is leading Australia's input to the primary forum for discussing the conservation and management of whales, the International Whaling Commission.

The 56th annual meeting of the IWC will take place in Sorrento, Italy in June–July 2004. Major Australian contributions to the meeting will include research to inform the review of the Southern Ocean Sanctuary (established in 1994), the proposal for a South Pacific Whale Sanctuary (co-sponsored by Australia and New Zealand), and the inaugural meeting of a new Conservation Committee of the IWC.

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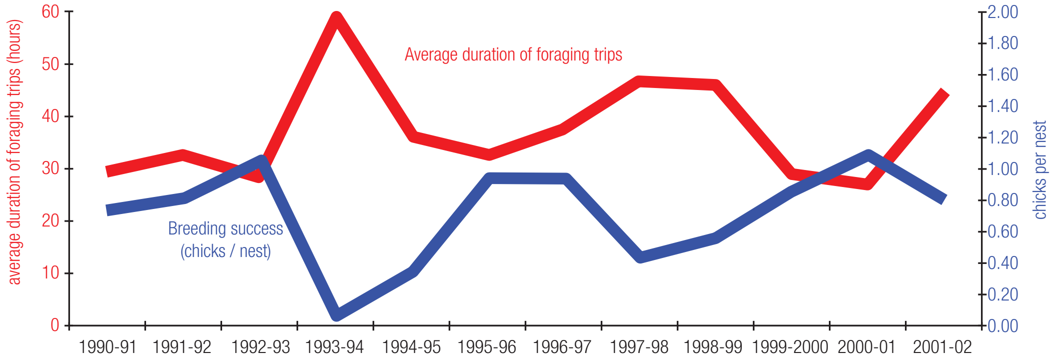
COLIN SOUTHWELL, ANTARCTIC MARINE LIVING RESOURCES PROGRAM, AAD

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STEPHEN POWELL, ANTARCTIC AND INTERNATIONAL POLICY, AAD

# 25 years of whale protection in Australia

NICK GALES

*Humpback whale (*Megaptera novaeangliae*) breaching*

Australia this year celebrated the 25th anniversary of the end of commercial whaling in this country. It was on 4 April 1979 that the then Prime Minister Malcolm Fraser delivered a ministerial statement pledging his government's "total commitment to protect the whale". It was an historic step that led to a total ban on whaling in Australia and the development of policy for the protection of whales further afield in international waters.

At a ceremony in Canberra on 30 March, the Federal Minster for the Environment and Heritage Dr David Kemp praised the efforts of those Australian public service departments which, at the official level, had helped make Australia a leader in whale protection. He also made special mention of the non-Government organisations which played a pivotal role in the development of this policy and the pursuit of its objectives.

In celebration of this silver jubilee and in recognition of the Australian Government's commitment to whale protection, Dr Kemp received a 'Gift To The Earth' award, the highest possible recognition from the World Wide Fund for Nature.

Dr Kemp announced that the Government would be spending over $500,000 this year to support scientists at the Australian Antarctic Division who he said 'are leading the charge with world-first research exposing the lack of scientific justification behind international whaling programs.' He also announced that $350,000 from the Natural Heritage Trust would be spent this year on developing a national approach to whale strandings and studies into the populations, ecology and behaviour of whales.

Dr Kemp expressed the Government's concern at the ongoing slaughter of whales for commercial return, including those animals taken under the guise of so-called 'scientific' whaling (under which members of the International Whaling Commission – the IWC – grant unilateral permits for their nationals to conduct lethal research). Under 'scientific' whaling Iceland took 39 minke whales in 2003, and Japan took a total of 700 whales of various species. Norway's commercial whaling operation targets approximately 700 minke whales per year. He said that whale killing methods involve an unacceptable level of cruelty. In 2002, around one in every five North Atlantic minke whales struck by Norwegian whalers and three in every five Antarctic minke whales struck by Japanese whalers were not killed instantaneously. Some animals took more than 40 minutes to die after being struck by a harpoon.

The Australian Government supports research to increase our knowledge of the ecology of whales provided that research does not involve their killing. It views lethal research on whales as unnecessary to inform IWC management procedures and considers the practice equivalent to commercial whaling, which is prohibited by the IWC. Since its inception in 1996, Australia's Natural Heritage Trust has invested more than $2.7 million in research and other activities to promote whale conservation. Australia has also provided support to the South Pacific Whale Research Consortium to assist its work in the region.

Non-lethal research is increasing our understanding of the complexity of the marine food web. This sort of research can be challenging, especially when it involves obtaining samples from animals that never come ashore. However, boat-based researchers are able to collect skin samples and faecal material, and biologists are developing new techniques to obtain information from the samples.

DNA sampling provides more data than can be obtained through opening a dead whale's stomach and in a form that can be repeatedly and independently verified. Whereas stomach contents represent only a whale's recent intake, a series of whale scats gives a more complex picture of whale feeding habits, and of their internal parasites.

History shows that for more than 150 years Australia was a proud whaling nation. Whaling was good for the economy of the times. However, Dr Kemp made the interesting point in his address that, in today's terms, the final season of whaling in Australia (1978–79) produced direct revenue of around $9.6 million and the company made a loss. This compares unfavourably with the revenues today's very profitable whale watch operators generate, which have been estimated as up to $42.5 million, with an additional flow-on effect to the Australian economy that is harder to calculate, but may amount to between $149 million and $325 million.

| | 1978–79 | 2003–04 |
|---|---|---|
| **Great whales killed** | 28,240 | 1,866 |
| **Whaling nations** | 13 | 7 |
| **% commercial/ scientific** | 99% | 78% |
| **% indigenous hunts** | 1% | 22% |
| **IWC members** | 17 | 49 (at 2003 meeting) |

JAMES SHEVLIN

*Top: Much has changed in 25 years. Above: Japanese whaling vessel with Minke whale catch.*

Australia's last operation – the Cheynes Beach Whaling Station at Albany in Western Australia, which was taking around 600 sperm whales annually – announced in 1978, during a national inquiry into the future of whaling in Australia, that it had decided to close its operations. The inquiry, headed by Sir Sydney Frost, received submissions from 101 organisations and 73 individuals and consulted 28 experts

*to page 42*

# Albatross conservation advanced

Efforts to conserve seabirds took a significant step forward on 6 November 2003 when the Republic of South Africa ratified the Agreement on the Conservation of Albatrosses and Petrels (ACAP) at a ceremony at the Department of Foreign Affairs and Trade in Canberra.

The Republic of South Africa is the fifth country to become a party, meeting the threshold for ACAP's entry into force, which occurred on 1 February 2004. South Africa joins Australia, New Zealand, Ecuador and Spain as a party to ACAP. South Africa played a key role in the negotiation of ACAP and is home to many important populations of albatrosses and petrels, including those on the subantarctic Prince Edward Islands.

Albatrosses and petrels are among the most threatened group of birds in the world. Of the world's 24 species of albatrosses 83% are considered to be endangered, which compares with 11% of bird species overall. For some populations, such as the Macquarie Island wandering albatross and Amsterdam albatross, numbers remain so low (less than 10 and 15 breeding pairs each year, respectively) that they remain threatened with imminent extinction. While individual nations are taking measures to protect albatrosses and petrels, these birds are susceptible to threats throughout their range. Conservation action by one nation acting alone cannot be effective in conserving highly migratory species such as albatrosses and petrels — clearly international action is required.

DFAT

*Above: HE Mr Anthony Mongalo, High Commissioner for the Republic of South Africa, hands the instrument of ratification to the Honourable Mark Vaile MP, Minister for Trade. The ceremony also marked the entry into force of the agreement.*
*Below: Black-browed albatross in flight.*

Albatrosses and petrels are threatened globally at sea and on land. Direct contact with fishing operations, eating or being entangled in marine debris, pollution, and over-fishing of their prey are major threats. In breeding colonies, they are threatened by predators, habitat damage and competition with other animals for nest space, parasites and disease.

The Agreement's entry into force will allow members to implement an action plan to protect critical habitat, control non-native species detrimental to albatrosses and petrels, introduce measures to reduce the incidental catch of seabirds in long-line fisheries, and support research into the effective conservation of albatrosses and petrels.

ACAP also recognises that there are existing international instruments that contain some conservation measures relevant to sea birds, for example, the Convention on the Conservation of Antarctic Marine Living Resources and the Food and Agriculture Organisation's International Plan of Action for reducing incidental catch of birds in longline fisheries.

ACAP is a good example of the way in which cooperative and coordinated working relationships between international instruments can enhance inter-governmental efforts to protect our shared environment.

Australia is currently acting as the Interim Secretariat for the Agreement, and will continue in this role until the first meeting of the parties is held, when the location of the permanent secretariat is determined by the Parties. The Agreement requires that the first meeting of the parties be held with a year of its entry into force.

*Antarctic and International Policy, AAD*

KIERAN LAWTON

*from page 41*

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Meanwhile, the South Pacific Whale Sanctuary, first proposed by Australia and New Zealand in 2000, has received majority support in the IWC, but not yet the three-quarter majority required for its establishment. A similar fate has met Brazil's and Argentina's proposed South Atlantic Whale Sanctuary.

At home, the current Australian Government established the Australian Whale Sanctuary: making it illegal to kill, injure or interfere with whales, dolphins or porpoises in 10.8 million square kms of Australian waters.

Twenty-five years after Australia's decision to bring an end to whaling, the Australian Government has reiterated its commitment to protect whales at home, and to pursue a permanent international ban on commercial whaling.

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# 44575 was a bird on a mission ...

## Satellite tracking Heard Island's albatrosses

ROGER KIRKWOOD

44575 was a bird on a mission. Heading north by northwest, speed 25 knots. Sooty '75 had a belly-full and digestion was not on her mind.

The cold grey dawn failed to budge the blanket of gloom hanging over the Jacka Valley. Roger hit the alarm at 6 am and flicked the switch on the pinger. Nothing. Fifty consecutive days of rain and we were due a tracker.

Grey waves licked the underside of '75's wing. She wheeled her rollercoaster way north, impervious to sleet, hail and headwind. She'd been away for a week – time to go. Krill was hard to come by this year, the fish were unusually small. No, it wasn't great hunting, but '75 had found enough and now she shrieked homeward with the grim determination of a mother with a mouth to feed.

By 8:30 we'd talked to Nick (who had email access to the latest satellite hits) on HF radio and learned the low-down: 'There are in-bound albatrosses lads, stay vigilant'.

We lurked in the lean-to, sheltering and waiting, passing time. We'd spent many days this way; drinking tea, listening for the pinger. Sometimes we'd talk, mostly not. Sitting on our respective boxes we peered out into the gloom. When we did talk it was often about the weather.

'Looks like we'll break 300 mils for the month.'

'Gee.'

'More than the average for Atlas.'

'Aha.'

'Looks sunny at Spit today.'

And then (you guessed it) ping.

Scramble. There were two of us; we had 15 nests to check, and 20 minutes in which to do it. Roger opted for checking the black-browed albatrosses in their colony on the cliff-tops behind camp. To get to them he would have to climb 200 metres up steep loose scree to the start of the fixed ropes. From there he had a 50 metre traverse across exposed ledges to the end of the line, then across another scree, and down to the colony. If Carl Lewis could do it in 19 minutes, Roger could do it under 20. He was away.

I'd drawn the light-mantled sooties. We had satellite trackers on 10 black-browed albatrosses and 5 light-mantled sooties. From the top of the cliff Roger could check all the black-browed nests, but the sooty nests were distributed throughout the valley and checking them involved approaching each one. I checked numbers 73 and 74,

KIERAN LAWTON

*Roger Kirkwood waits in the lean-to. He knew how to pass time.*

the closest to camp, while Roger charged up to the black-browed colony. I then made my way around to the steep tussocky slopes below the nest owned by 44575. I was a few hundred metres short when she came in.

Fresh off a seven-day flight she dropped the landing gear (legs) and planted herself nest-high. Within a minute she was downloading her precious cargo to a hungry chick. There was not a moment to lose. I got on the VHF to Roger: 'It's '75 – I saw her come in'.

'Okay, there's definitely nothing up here. I can't get there in time – you'll have to go for it.'

This was par for the course. We'd timed the download duration of a number of parents and they were averaging eight minutes from start to finish. Therefore if I didn't get myself up to that nest in a jiffy, 44575 would spread her wings and set forth on another 4000-kilometre trip for a piece of squid.

KIERAN LAWTON

*A black-brow with tracker attached. Once in place, the albatross preens the 30-gram tracker in amongst its feathers so that only the aerial remains visible.*

I crept stealthily and with great haste. I was hot. The change from tea-drinking-sloth to tracker-retrieving-athlete would normally require a change of clothes, but there wasn't time. Onward, upward. I slithered on my belly up the steep ridge of azorella, trying to stay out of sight. I could hear the chick begging for food, and the clacking of bills. The theory goes that if you look an animal in the eye it gets spooked – it knows you're coming for it – and will flee. So I don't look up until I'm right beneath the nest. When I do I'm underneath '75's tail feathers and she hasn't seen me. Phew. Double-check, pocket knife, check, catch breath, check.

Then there's the moment you love and you hate. I willed her to give another mouthful of food to her chick, and already felt bad about what I was going to do. I was twitchy at the same time. All she had to do was open her wings and she'd be away. I thought each step through, wished for it to be quick, efficient and painless, took a deep breath… and then she saw me. The wings open and she's gone.

'Hey Roger – I missed her.'

'No worries mate, nothing more you could have done.'

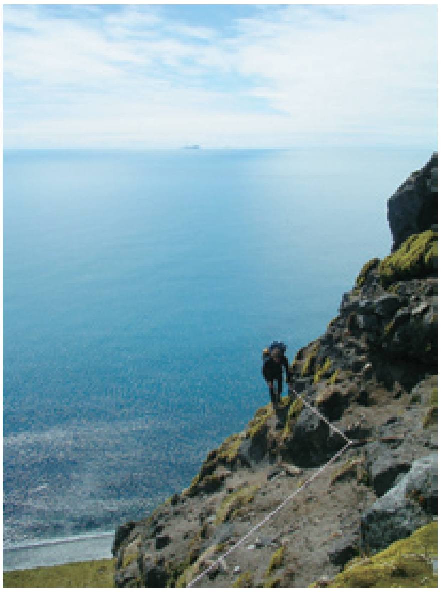
There's a confusion of emotions. I'm disappointed. But there's something else – pride. 'Go you cheeky bugger', I yell after her with a smile. Her chick looks up startled at the noise – and I'm sure I glimpse a snigger.

The final few weeks of our stay were spent on high alert in this way. This was the first time albatrosses breeding on Heard Island had been tracked by satellite telemetry. We were interested in finding out the birds' foraging zones, the hotspots in the ocean that the albatross depend on for a feed during the energy-demanding egg-brooding and chick-rearing periods.

The black-browed albatross of the Jacka Valley are cliff dwellers, they build their mud nests on ledges a few metres wide and several hundred metres above the valley floor. We fixed climbing ropes along the ledges leading to the colony, once there we were lucky enough to be able to access about 30 nests on the highest ledge without the need for safety gear.

Selecting a candidate black-brow for tracker deployment was a tricky business. As with any animal, individuals vary in temperament. We were on the look-out for birds with an easy going nature but with a strong attachment to the nest; individuals that could handle the disruption of being pinned to their nest for a few minutes while a 30-gram tracker was attached to their back with cloth tape and glue. To find the right one we'd slowly approach each potential bird, crawling through the mud, staying low

KIERAN LAWTON



ROGER KIRKWOOD

*Left: The view across the Jacka Valley camp towards Atlas Cove, on a rare occasion when the cloud lifted. The glaciers falling into the ocean from the sides of Big Ben can be seen in the distance, and beyond that there is a patch of blue sky over the Spit Bay camp. The black-brows nest atop the black buttress behind the tents. Right: Kieran follows the hand-line along the cliff top traverse to the black-brow colony.*

and averting our eyes. Once within a few metres of a nest we'd sit by and just observe for a while; if the bird moved, stood up off the egg, or otherwise looked shifty, we'd move on. If it sat tight on its egg and glared back at us we selected it for deployment.

The light-mantled sooty albatrosses are the mild-mannered gentlemen of the albatross world; deploying trackers on them was a delight. They nest individually on the terraces above and around cliffs and there were probably 30 pairs in the amphitheatre of the Jacka Valley itself. Their solitary habit made approaching the nest easy, there was no need to slither past neighbouring birds in the mud as in the black-browed colony. Once close one of us would hold the bird on the nest while the other glued. At times it seemed a token gesture to hold the bird at all, their nature so placid they barely glanced over their shoulder to check we'd lined the tracker up straight. We even had non-breeders come and land next to us mid-deployment, just to see what the fuss was about. I can imagine now what these onlookers were thinking as they flip-flapped (albatross have a peculiarly big-footed way of walking; they walk as if they have just discovered they have feet and are amazed every time the next one hits the ground) around us on the ledge. 'Aha looks like another tracker going on.' 'Yep, I can just read the number now – 44575.' 'Oh boy, they'll have their hands full getting that one back.'

We discovered the black-browed albatross favoured a foraging zone northeast of the island, and about 100 kilometres off-shore. All the black-brows went there every trip, except one. The exception was the outstanding breeder of the season, K-bird (parent of chick on nest marked K). This bird broke the trend and went south, sticking close by the island and foraged off shore not far from Long Beach. Canny K-bird could do return trips in a day, and K chick was correspondingly gigantic.

The sooties meanwhile took long foraging trips, going as far south as the Antarctic continental shelf, over 2000 kilometres distant. They were consistently away for a week or more, at times averaging 45 km/h for 24 hours on the return trip to their waiting chick.

Our study yielded about 60 tracks from black-browed albatrosses and 25 tracks from light-mantled sooty albatrosses, and preliminary analysis indicates that we will be able to determine the foraging zones these birds were dependent upon when raising their chicks, in this year at least. Along the way we scraped poo samples from the sides of nests (these will be used to determine diet composition from genetic signature), counted the numbers, and recovered hooks from long-line fishing that were evident throughout the colony.

Black-brows particularly are susceptible to drowning in long-line fisheries when they dive for baited hooks, and range across the Southern Ocean in the non-chick-rearing period. The knowledge gained during this program will be used in modelling the potential interactions between seabirds and Heard Island and McDonald Islands fisheries (trawl fisheries for toothfish and icefish, and a likely future long-line fishery), and is part of the efforts of the Australian Antarctic Division's Antarctic Marine Living Resources Program to reduce fisheries-related mortality of Southern Ocean seabirds.

Roger Kirkwood and I camped in isolation for 69 days. For us time slowed. Our local environment, the Jacka Valley, took on an unaccustomed immediacy and importance. The animals within developed characters, the landscape moved through a season; a kelp gull that was an egg on our arrival learned to fly. We eventually retrieved

## About the albatrosses

**Black-browed albatross** *Thalassarche melanophrys*

KIERAN LAWTON

**Vital statistics**
Weight: 2.9 - 4.6 kg
Wingspan: 210 - 250 cm
Age of first breeding: 10 years
Longevity: 30+
Breeding frequency: annual

**Distribution and abundance**
*Breeding pairs:*
Falklands (Islas Malvinas): 382,000
Chile: 123,000
South Georgia (Isla Georgia del Sur): 98,000
All other islands: ~15,000
Total: 618,000

**Population status**
- IUCN status recently upgraded from 'vulnerable' to 'endangered'.
- Falklands population has declined from 506,000 pairs in 1980 to 382,000 pairs in 2000.
- South Georgia population has declined 4% per annum since 1975.
- Trends in majority of other populations are unknown.

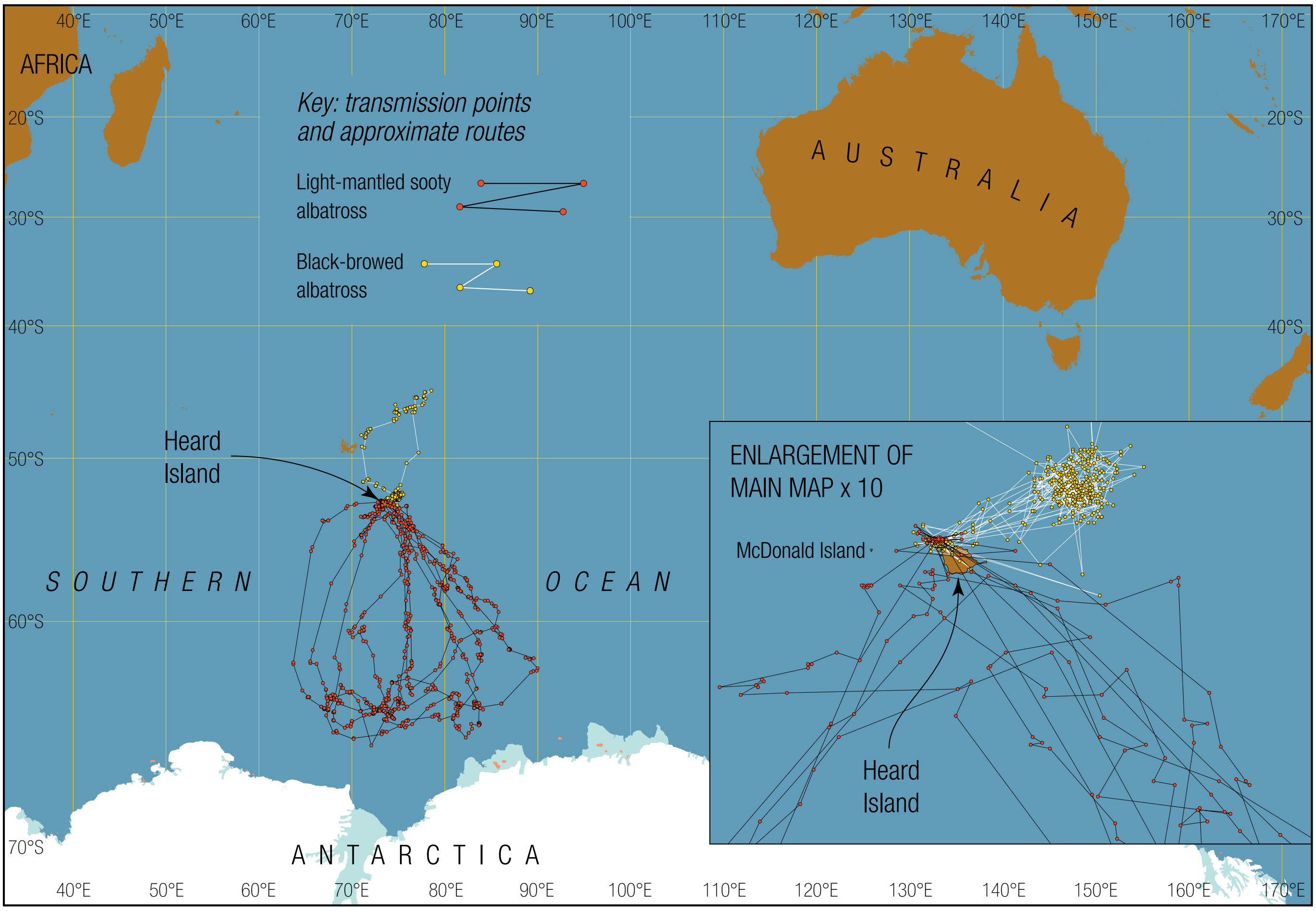
**Light-mantled sooty albatross** *Phoebetria palpebrata*

KIERAN LAWTON

**Vital statistics**
Weight: 2.5 - 3.7 kg
Wingspan: 180 - 220 cm
Age of first breeding: 6 - 8 years
Longevity: 32+
Breeding frequency: biennial

**Distribution and Abundance**
*Breeding Pairs:*
South Georgia (Isla Georgia del Sur): ~6,000
Auckland: ~5,000
Kerguelen: ~4,000
All other islands: ~5,000
Total: 20,000

**Population status**
- IUCN status 'near threatened'.
- Ile de la Possession (Crozet) population has declined 1.7% per annum since 1966.
- Trends in 95% of populations are unknown.




*Above: The foraging tracks of light-mantled sooty 44575 and black-brow 44567, made between mid-December 2003 and mid-February 2004. Light-mantled sooty 44575 made a succession of long excursions along the edge of the Antarctic continental shelf, which was the typical foraging strategy used by all the sootys we tracked. The black-browed albatrosses focused on a foraging zone to the north-east of Heard Island. The season's tracks taken by black brow 44567 illustrate this zone that lies within a few hundred kilometres of the island. As with most animals, the idea of going walkabout on a whim seems never far from the busy parent's mind, and 44567 chose to go on a long trip up past Kerguelen mid-season.*
*Right: Black-browed albatross chicks sit at attention waiting for a returning parent.*


12 of the 15 trackers – the ones we missed all had their stories. Sooty 44575 evaded the web twice more and we take our beanies off to her – she was one wily mother and at last count had a healthy (smug) chick. We chose poorly with Black-brow 44568 who proved to have a naturally timid temperament; neither of us could get within cooee of the colony without spooking her. And Sooty 44577 flew to the South Atlantic and never came back.

*Kieran Lawton, Antarctic Marine Living Resources Program, AAD*

# Through rain, hail and shine, ambitious island program completed successfully

After a little over three months away, the 28 members of the Heard Island expedition arrived at Fremantle aboard *Southern Supporter* early on Saturday 6 March, weary yet happy and satisfied with their three months' labour on the remote island. The summer had been spent in one of the most beautiful, wild and demanding environments possible.

As we arrived back in Australia it seemed like an age ago that we had splashed ashore by amphibious 'LARC' and zodiac, with quite some trepidation, to set up our five field camps. We subsequently closed down one of these camps to see us permanently occupy four locations around the island. Three other small campsites were also set up using various tents and an existing 'Apple' hut to allow us to work at a variety of sites.

We had achieved much over the summer in what was an ambitious program of scientific research. The Antarctic Marine Living Resources team had successfully deployed satellite trackers and collected data on the foraging ecology of fur seals, king penguins, macaroni penguins, black browed albatross and light mantled sooty albatross. This was all integrated with a concurrent marine science voyage by *Aurora Australis* in the waters off Heard Island. The extent and location of seabird populations were also mapped over the summer to further allow us to understand and manage this amazing place.

Three glaciologists spent long and often trying days up on Brown Glacier. Valuable data was collected through GPS surveys, ice coring from inside crevasses, and melt stream surveys. Over the season the individuals in the team ascended well over 30,000m in cumulative altitude gains.

DOUG THOST

*Amphibious craft deliver equipment and supplies to Spit Bay base camp on Heard Island as the* Southern Supporter *waits off-shore.*

Back down on the coast, where the vegetation grows, a team investigated the terrestrial ecology of the island through the collection of soil cores for invertebrate assemblage investigation, the study of plant morphology and phenology, and research into the fluorescence and respiration rates of various botanic species. The changing vegetation limits on the island were also investigated and as part of these investigations a new and 12th vascular plant species was discovered growing on the island.

All this was aided by a team of five support staff who were busy guiding, feeding, powering, repairing and assisting the 23 scientists and their equipment throughout the season.

We travelled across lagoons by small boats, often negotiating large expanses of ice and ever changing conditions. Many kilometres were travelled by foot as we negotiated rocky coastlines, soul-destroying scree slopes and icy glaciers to reach the places our work required us to be. The sun shone, the rain fell, the wind howled and the snow blew throughout the season to provide a constantly changing backdrop to our temporary home.

Sitting on the ship, looking back to where our tents had once stood, it was hard to take it all in. But we took away some wonderful memories and, most importantly, a mountain of valuable research data to better inform our future decisions about this magnificent part of the world.

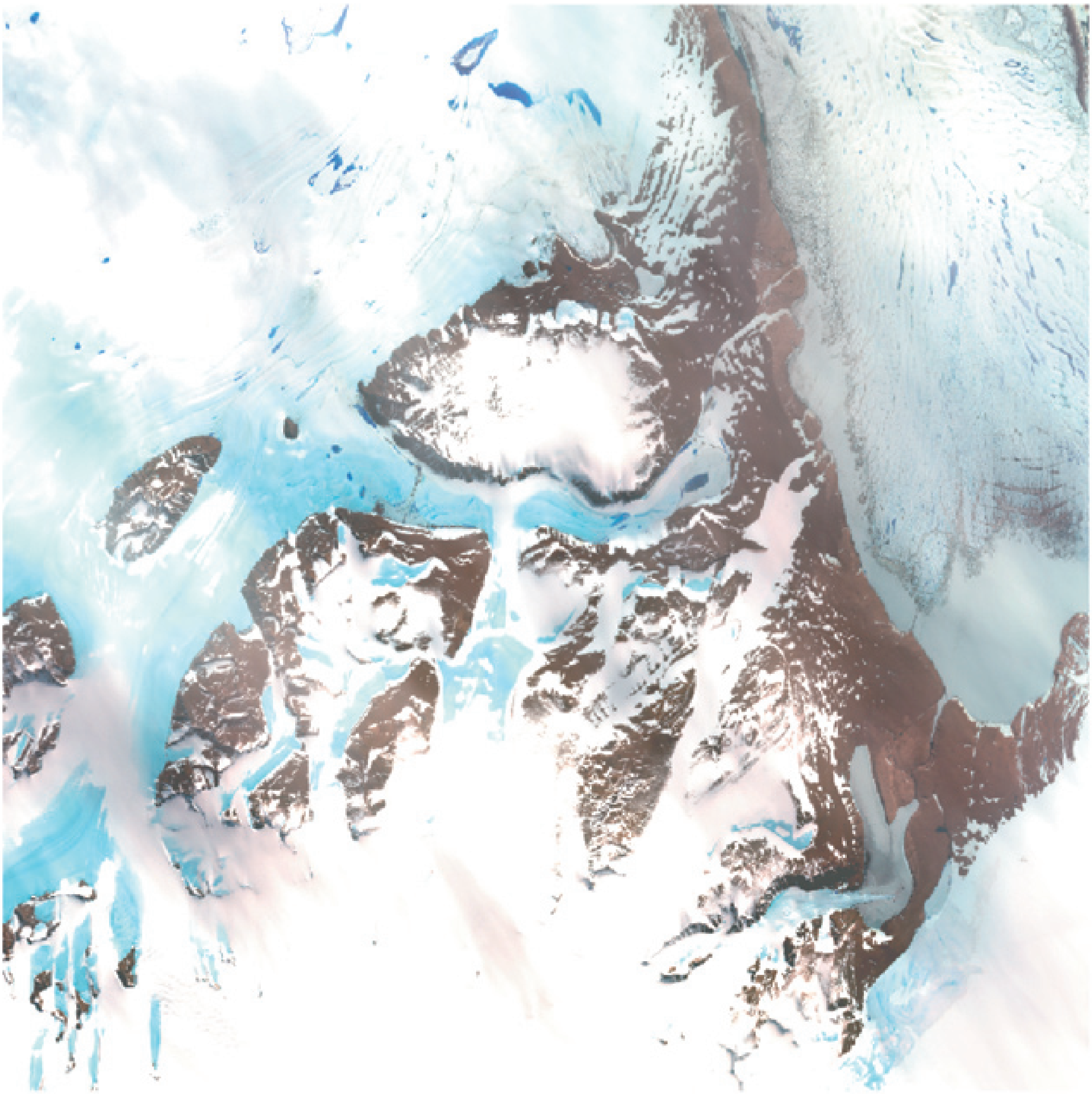
*Robb Clifton, 2003–04 Heard Island Expedition Field Leader*

*Hi Ho Hi Ho ... Glaciologists high on Brown Glacier, roped up to guard against falling into crevasses. The Spit is in the background.*

DOUG THOST

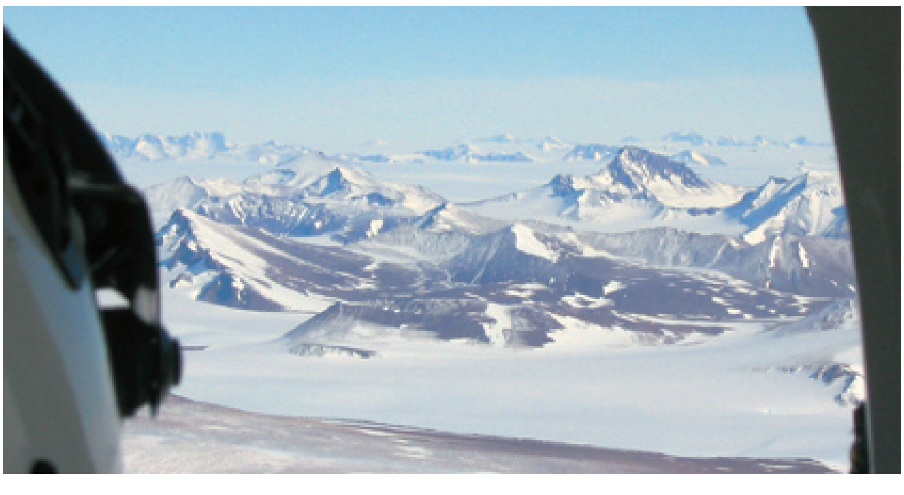
***The next issue of* Australian Antarctic Magazine *will feature Heard Island, and the research programs conducted there in the 2003–04 season.***

# Mapping Beaver Lake



AUSTRALIAN ANTARCTIC DATA CENTRE

One of the mapping projects for the Australian Antarctic Division Mapping Program in Antarctica during the 2003–04 summer, was the acquisition of SPOT 5 high resolution satellite imagery (2.5 metre pixels) of the area to the northwest of Beaver Lake and the



MARTY BENAVENTE

*Top: The SPOT 5 satellite image of the Beaver Lake area. It was acquired on 11 January 2004 at 11:26 Davis time – while the surveyors were still on the Lake and only fifteen minutes before the Twin Otter aircraft landed to take them back to Davis.*
*Right: Enroute from Beaver Lake camp to the Amery Peaks. This terrain is typical of the region being mapped from SPOT 5 and Aster imagery.*

location of ground control points to georeference this imagery. The Australian Antarctic Division map of the area was published in 1990 using geographic information derived from Russian maps of the region published in 1978. How or from which medium the geographic information in the Russian maps was derived is unknown.

The acquisition of satellite imagery and the mapping from this imagery is in support of geoscience and glaciology projects, the creation of geographical information system (GIS) data for the area and the production of a new digital map.

The SPOT 5 satellite imagery will be used to map topographic features such as glaciers, gorges, scree slopes and lakes while Aster satellite imagery (20 metre resolution) will be used in the production of a Digital Elevation Model.

*HENK BROLSMA, MAPPING OFFICER, AAD*

MARTY BENAVENTE

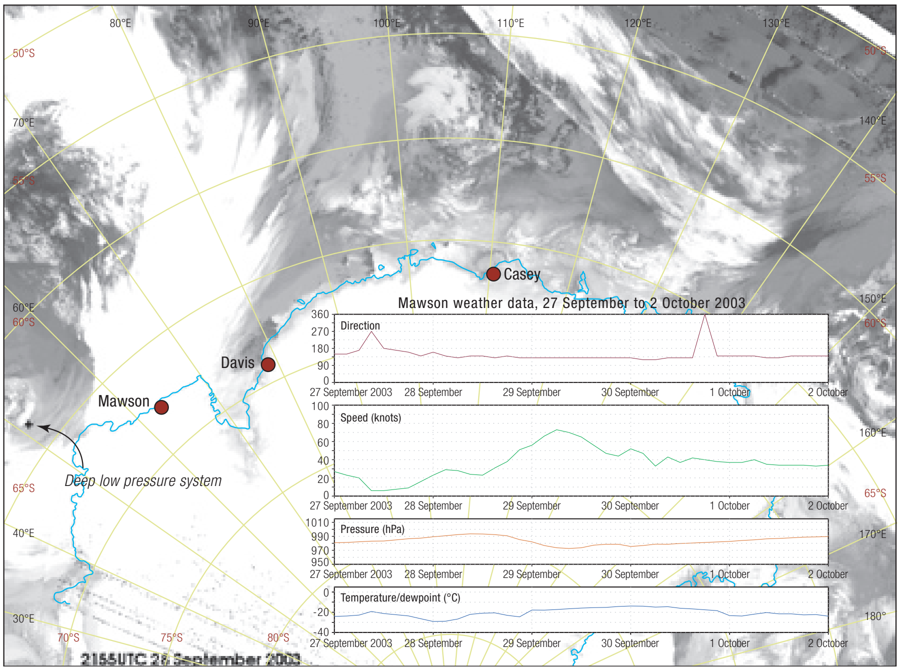
*Adrian Corvino surveys a ground control point, with Loewe Massif in the background.*

# Belgium, the tropics and the Antarctic Treaty System

The 2003–04 austral summer of weather forecasting in the Australian Antarctic Territory was, by all accounts, a very successful blend of international expertise and tropical-based know how! Marc De Keyser from Belgium, and Jane Golding from tropical Darwin, combined to cause one experienced Antarctic practitioner to declare 'Jane Golding and Marc de Keyser are the best forecasters I have ever worked with.'

Marc, who is a Belgian ex-Airforce meteorologist and who has worked with the British Antarctic Survey at Rothera, came to the Bureau's attention when he participated in the first International Symposium on Antarctic Weather Forecasting, which was held in Hobart in 1998. The underlying theme of that symposium was for international collaboration with respect to Antarctic weather forecasting. Accordingly, and in the spirit of part 1(b) of Article III of the Antarctic Treaty (see, for example <http://www.scar.org/Treaty/Treaty_Text.htm>) that states 'scientific personnel shall be exchanged in Antarctica between expeditions and stations', the Bureau asked Marc to assist at Davis station last summer.

The figure above shows a satellite image of a typical 'blow' that Marc and Jane were required to anticipate in their roles as weather forecasters for the Australian Antarctic Program. The time series plot in the lower right hand corner shows the observations taken from Mawson Station around the time of the storm. The mean surface wind at Mawson exceeded 130 km/hr (70 kts) at the height of the storm, early on 29 September 2003.




*The NOAA polar orbiting satellite image taken at 2155UTC on 28 September 2003 shows a deep low approaching Mawson station.*

*STEVE PENDLEBURY, REGIONAL DIRECTOR, BUREAU OF METEOROLOGY, TASMANIA/ ANTARCTICA REGION & NEIL ADAMS, BUREAU OF METEOROLOGY* location of ground control points to georeference this imagery. The Australian Antarctic Division map of the area was published in 1990 using geographic information derived from Russian maps of the region published in 1978. How or from which medium the geographic information in the Russian maps was derived is unknown.

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*Henk Brolsma, Mapping Officer, AAD*

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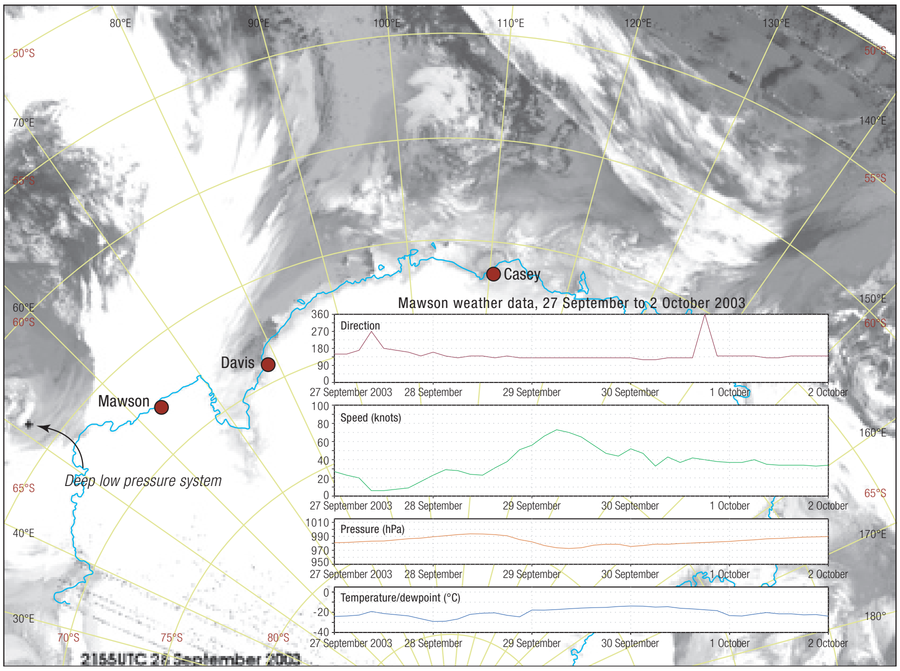



*The NOAA polar orbiting satellite image taken at 2155UTC on 28 September 2003 shows a deep low approaching Mawson station.*

*Steve Pendlebury, Regional Director, Bureau of Meteorology, Tasmania/Antarctica Region & Neil Adams, Bureau of Meteorology*

# 'A remarkable contribution to world science'

An evaluation of Australia's Antarctic science program was completed in May 2003. The evaluation was conducted by the Antarctic Science Advisory Committee (ASAC) by engaging independent teams of internationally recognised scientists from Australia and overseas who were not participants in Australia's Antarctic science program. The evaluation was overseen by a steering committee (chaired by Prof. John White, FAA, FRS) and four discipline-based subcommittees. The final report was written by ASAC and submitted to the Parliamentary Secretary the Honourable Dr Sharman Stone.

The Terms of Reference for the evaluation were:

- To evaluate the quality of the science output against the current Strategic Plan;
- To evaluate the relevance of the scientific output to the goals of the national Antarctic program as measured against the Strategic Plan;
- To evaluate the quality and relevance of the scientific output resulting from research projects supported by Australian Antarctic Science Grants (AASG);
- To evaluate the quality and relevance of the scientific output resulting from research projects ineligible for AASG funding; and
- To provide advice on areas of science that require either a greater or lesser emphasis and/or on new research endeavours to be undertaken.

The evaluation was highly complimentary of the Australian Antarctic science program – the steering committee stated that Australia is 'well served by its Antarctic science program', that it represents 'a remarkable contribution by Australia to world science', and that 'the strengths in the individual components of the program be maintained'. ASAC considered that the program successfully meets its scientific goals, a view that was supported by the steering committee who gave a strong endorsement of the quality of the overall scientific program.

The major recommendation is that the Australian Antarctic science program shift from the current discipline-based programs to overarching Antarctic themes of great scientific merit and practical value. The steering committee identified three themes to which ASAC has added a fourth:

- Ice, Ocean, Atmosphere and Climate
- Southern Ocean Ecosystems
- Adaptation to Environmental Change
- Impacts of Human Activities in Antarctica

The recommendations within ASAC's report 'Evaluation of Australia's Antarctic Science program' have been accepted by the Parliamentary Secretary. The report is available on the AAD's web site at <http://www.aad.gov.au>.

*Gwen Fenton, Planning & Coordination, AAD*

# Australian team recovers NASA balloon

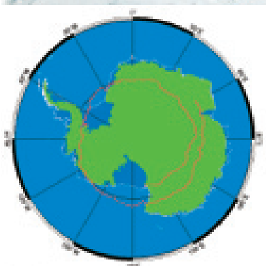
The TIGER-ANITA long duration balloon flight, with its scientific payload, had been circling the Antarctic interior at an altitude of approximately 40 km (130,000 feet) when its trajectory moved to the north. The possibility that its track could take it over the ocean meant that the instruments and data it carried could be lost, so the NASA crew monitoring the balloon brought it to earth by remote control. Its landing site was in the Australian sector, west of the Prince Charles Mountains, south of Mawson station.

In the spirit of international collaboration, a request to assist in the retrieval of the scientific information carried by the balloon was made. Using an AAD chartered Twin Otter aircraft, a group consisting of Canadian aircrew, and Australian scientists, engineers and tradespeople were able to fulfil that request.

The information that was held on the computer drives that hung beneath the balloon was of interest to scientists researching the fabric of our universe. TIGER (Trans Iron Galactic Element Recorder) recorded the direction of arrival and the energy of cosmic rays that had atoms with weights near that of iron. ANITA (Antarctic Impulsive Transient Antenna) used up to a quarter of the Antarctic ice sheet as a neutrino detector. So there was considerable interest in retrieving the data that had been collected.

Fortuitously, the chief pilot of one of the

MIKE WOOLRIDGE



*Above: Retrieving the instrumentation from the balloon's payload. Left: The balloon's track*

Twin Otters that had been working out of Davis, was at McMurdo station for a few days and was able to attend a briefing on the payload and the parts that were to be retrieved. At Davis, the news of the balloon had also tweaked some interest. Studies of the stratosphere often use balloons of this type so there was considerable interest amongst the Space and Atmospheric Science staff. As it was in an exotic location, Bob Jones, the Davis station leader, had numerous people to choose from to assist in the balloon recovery.

The last known landing position of 71°45'S, 58°45'E was a few hours flying west of Beaver Lake and at an elevation of 2.5 km. The air would be cold and thin. On approach to the site, the solar panels of the balloon's payload were easily spotted and the pilot landed the rescue team nearby.

In temperatures of -25°C the site, payload and parachute were photographed so that the scientists and engineers at NASA could study aspects of the landing. Next, the team set to work removing the computers and instrumentation that operated the balloon and its scientific experiments. After about 45 minutes, the balloon's support instrument package and the other items that were required were safely stowed in the aircraft and the team posed for some photographs.

As a result of our efforts, scientists probing the nature of the universe will be united with their data a year before it had previously been thought possible. The Australian Antarctic program has been exposed to some aspects of long distance balloon technology, and the international cooperation that is the centrepiece of Antarctic relations has been reaffirmed.

For more information go to the TIGER website: <http://tiger.gsfc.nasa.gov> or the ANITA website: <http://www.phys.hawaii.edu/~anita/>

*Damian Murphy, Space and Atmospheric Physics Program, AAD*

# You scratch my back, and I'll scratch yours!

The profile that Australia holds in the international arena of Antarctic logistics and operations is high, and the innovation and development in this part of the Australian Antarctic program is something I am very proud of. The ability to share our successes and to learn from those of our partner nations working in Antarctica is I believe of great value to being able to deliver standards of support that are safe, environmentally excellent and resource efficient.

In this regard the Australian Antarctic program is not unique and there are long established processes for the sharing of information. The Council of Managers of National Antarctic Programmes (COMNAP) meets annually and also provides the means for frequent and easy interchange of ideas between national operators; in fact, COMNAP was established in 1988 to facilitate liaison between the managers of national agencies responsible for the conduct of logistics operations in support of Antarctic science. The membership now includes twenty-nine countries from the Americas, Africa, Asia, Europe and Oceania. Representatives meet annually to discuss cooperative logistics and scientific programs, develop standard operational procedures, and formulate technical advice, on request, to Antarctic Treaty Consultative Meetings and its Committee on Environmental Protection.

The AAD works to maintain a high profile in COMNAP and plays an active role in all of its activities. At present four members of our Operations Branch hold leadership positions in COMNAP working groups and networks – as Chair of the Standing Committee of Antarctic Logistics and Operations (SCALOP), and as coordinators of three out of the four COMNAP networks - Energy Management, Training, and Environment.

The interactions we have with our COMNAP colleagues are at a number of levels; at both the policy and the very practical ends of the operational spectrum. In regard to the first of these we are working with our colleagues to help COMNAP develop clear operational advice on matters such as guidelines for field training; for emergency response and contingency planning; on environmental training; on Antarctic shipping; on the operation of aircraft in the vicinity of wildlife; as well as an analysis of Initial Environmental Evaluations and a survey on tourism.

At the same time our representatives have been busy within the networks and at the annual meetings, offering to share our operational experiences and anxious to learn from those of our colleagues. This happens in a number of ways; not only in relation to technical developments and project activity, but in support of day to day operations in Antarctica and also in the period afterwards as we each learn from operational experiences at our stations and in the field.

I think that of the contemporary projects we in the AAD have been managing, three seem to be of most interest to the COMNAP/SCALOP community:

- **Air transport** – This innovative project offers many opportunities for international collaboration and the COMNAP community are keen to learn about each development as it occurs.
- **Thala Valley project** – This project to clean up an old waste site has been extremely demanding and the modest costs belie the complexity and sophistication of the work across government departments, all AAD branches and at Casey station itself; it is ground breaking stuff (sorry – I couldn't resist the pun). We have been learning every step of the way.
- **Station infrastructure** – Our COMNAP colleagues are very interested in the innovations being tested that should allow us to reduce our footprint while increasing the quality and number of science projects able to be supported. The Building Management and Control System, the Davis living quarters and the Mawson wind turbine projects are key parts of this. Each has attracted genuine interest from our COMNAP colleagues; you may not realise that our wind turbine team won an Engineering Excellence Award for their work – well deserved.




*Learning from each other. From top: Australian mechanics assist in French traverses to Dome C; Refuelling Australian-chartered Canadian-owned Twin Otter aircraft at a fuel depot in the remote Grove Mountains; Removing rubbish from the old waste site at Thala Valley, Casey station. Below: At McMurdo (with Mt Erebus steaming in the background) Ivan the Terra bus delivers American and New Zealand passengers (and an Australian observer) to waiting RNZAF Hercules aircraft.*

Overall I believe that Australia's modest level of innovation and special purpose design work, work that is based on our own unique experiences and requirements, adds to the

value of our input to the COMNAP processes and increases our standing in the international Antarctic community.

But this is not all that we do with our COMNAP colleagues. The 'passage way discussions' that COMNAP facilitates are what (perhaps) are of most interest to the people who do the work in Antarctica. They include topics regarding the practical '*what if*' and '*oh really*' and '*how about I do this, if you do that*' interactions between national programs that are important to success in the conduct of day to day operations in Antarctica. For example, the trade that goes on between national operators in 'drums of fuel' that are stored at various Antarctic bases, field camps and caches is pivotal to the success of many programs/projects; just as the sharing of technical/trade support between programs can be important too.

It hopefully will not be surprising to hear that COMNAP provides a valuable means to develop levels of mutual understanding, friendship and familiarity between operators and which allows requests for assistance to be made easily at any hour, and with the assurance that there is a commitment to help out in an emergency if it is at all possible.

In Antarctica there are many more examples of how this support at the operational level works. This season we asked for and received immediate and positive responses for support with flights between Davis and Casey from our Russian colleagues at Mirny; we also received generous advice and assistance with our runway project at Casey from the USAP (I am relieved to report that we gave a little back when the NSF requested our support in the recovery of a data package from a high altitude balloon that landed only 200 km from Mawson); and there was a solid amount of work between the Chinese and Australian programs to deliver and return expeditoners to Zhongshan station. Of course, the longstanding partnership with our neighbouring French colleagues has allowed our project at Commonwealth Bay to progress easily.

In fact, each season the interactions and cooperation shared by the 'operators' allow for better results than would otherwise be possible; they are frequent, regular and operationally very important. I can assure you that we in 'Ops' are extremely grateful for the opportunity to work and share with, and to learn from, the experiences of our colleagues in COMNAP ... the title of this article was chosen with good reason.

*Kim Pitt, General Manager Operations, AAD*

# Mawson: Antarctica's first wind-powered station

On 3 March 2003, the Parliamentary Secretary to the Minister for the Environment, Dr Sharman Stone, opened Antarctica's first wind farm at Mawson. The opening was a culmination of several years' effort by the Australian Antarctic Division to harness the persistent katabatic winds which give Mawson one of the highest average wind speeds in the world. The wind turbines are now generating cost effective, renewable energy to heat and power the station.

Because of the inherent risks of undertaking a major project such as this in Antarctica, the main contractor, the turbine supplier and the AAD agreed to use a partnership agreement for the project – a first for the AAD. The three partners in this endeavour agreed to work together to share the risks and the gains to achieve the most cost effective outcome.

The Darwin-based contractor, Powercorp P/L, supplied new switchboards and engine control systems for the main powerhouse, as well as control software to optimise the wind turbines' and diesel generators' operation against the station heating and electrical load. Powercorp also developed a unique electric boiler-based energy storage system which is used to stabilise the frequency and voltage on the station grid as well as providing for the station's heating needs.

The wind turbine manufacturer, Enercon GmbH from Germany, developed a special cold temperature, high wind version of their E-30 300kW wind turbine, specifically for the Mawson application. The AAD constructed the concrete foundations for the wind turbines and installed the infrastructure and cabling connecting the wind turbines to the powerhouse as well as the new switchboards.

JOHN SMITH

*Wind turbines now provide up to 80% of Mawson station's power requirements.*

Pouring each 80 cubic metre concrete foundation over the 2002–03 summer required the cooperation of the entire station staff. As well as the specialist trades, the station's scientists, chef, communications staff and the station leader were involved in different facets of the batching, transport, placing and finishing of the concrete. A satellite video link back to Kingston was used so that the design engineers could monitor the process and offer advice if necessary. As it transpired this was not necessary and the foundations were successfully poured and more than met the design specifications.

The success of the cooperation between the three partners resulted in the three turbines being delivered to Mawson, and two machines erected and commissioned during a four-week period. The foundations for the third turbine were not completed in time due to a ship besetment in 2001–02 which meant that materials and construction crew did not arrive in time.

The two turbines have been operating successfully for 12 months. During this period fine-tuning of both the wind turbine and powerhouse control systems has been undertaken to optimise the system operation and to maximise the diesel savings and minimise greenhouse gas emissions. Fuel savings during this first 12 month period amounted to 27 percent, with the wind turbines typically providing 60 percent of the station load, and on average 44 percent. At times, the penetration has reached 80 percent. Further fine tuning including single diesel gen-set operation, during the next 12 months is expected to increase the annual fuel savings from two generators to 51 percent.

*Peter Magill, Innovation and Development Engineer, AAD* value of our input to the COMNAP processes and increases our standing in the international Antarctic community.

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# Up, up and away: 2003–04 aircraft operations

## Fixed wing feats

Two DeHavilland DHC-6 (Twin Otter) aircraft and aircrew, supplied by Ken Borek Air Ltd of Calgary, Canada, played a large part in the successful completion of one of the largest and most varied AAD flying programs ever.

Early in the season, in a forerunner to the 2004-05 introduction of CASA 212-400 aircraft, Mawson expeditioners and cargo were flown to and from Davis to connect with Voyage 2. The aircraft, able to be flown solely on instruments and equipped with de-icing gear, completed the flights on schedule despite varying weather conditions.

Twin Otters were based at Davis and Casey as required through the season supporting deep field programs such as AMISOR and ITASE. Areas of operation included the Grove Mountains, Prince Charles and Southern Prince Charles Mountains, Komsomolskiy Peak, Amery Ice Shelf and up to 1000 kms east of Casey. Operation of these aircraft from our stations has given valuable insight into the levels of personnel, types of equipment, fuelling facilities, vehicles and infrastructure required to support future fixed wing flight programs.

The operation of station-based, fixed wing aircraft also resulted in a higher degree of international collaboration with visits to Mirny (Russia), Dome C (Italy/France) and McMurdo (USA) stations. Davis and Casey stations provided logistic support to a visiting Twin Otter operated by the Italians in November and December. The aircraft conducted an ice radar survey over a large area and also performed some specific flights over the Amery Ice Shelf at AAD request. Further international collaboration also occurred late in January with a team from Davis assisting in the recovery of equipment from a NASA weather balloon which was launched from McMurdo and landed south west of Beaver Lake.

## Helicopter operations

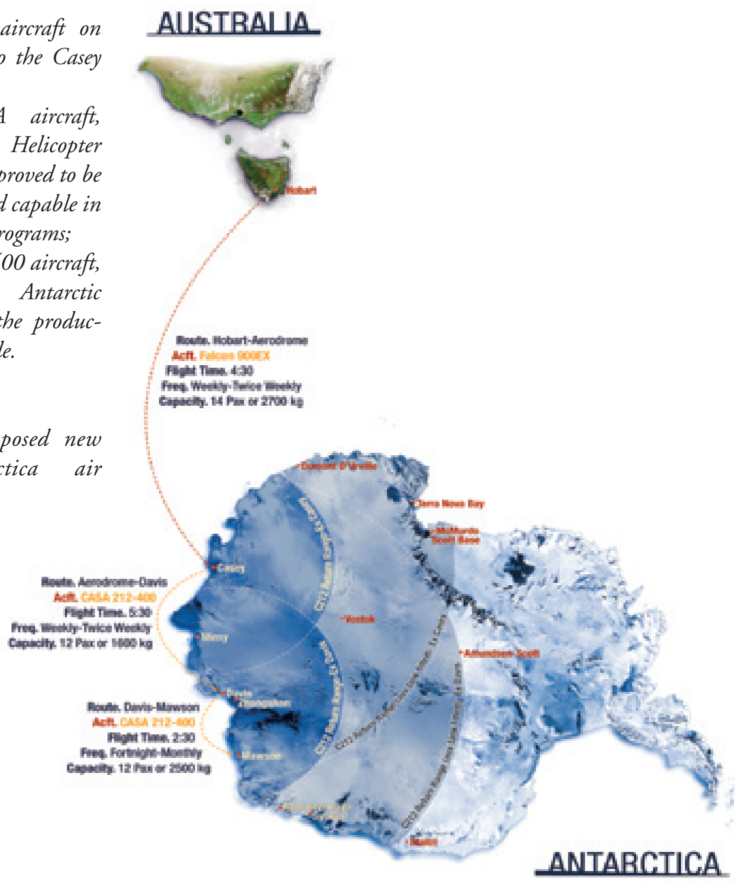
Versatile and efficient AS350BA (Squirrel) helicopters on contract from Helicopter Resources completed yet another busy season for the AAD. These aircraft, used by the AAD since 1986–87, perform a variety of tasks including marine science support, ice reconnaissance (for ship navigation through ice) ship-to-shore resupply of stations, Macquarie Island operations and station-based support.

KAREN KRISTENSEN

MIKE WOOLRIDGE

SKYTRADERS

*From top:*
*A Twin Otter aircraft on final approach to the Casey skiway;*
*The AS-350BA aircraft, operated by Helicopter Resources, again proved to be most versatile and capable in support of field programs;*
*The first C212-400 aircraft, decked out in Antarctic livery, rolls off the production line in Seville.*




*Right: The proposed new Australia-Antarctica air transport system*

VANESSA TUCKER

Initial deployment of three of these aircraft on Voyage 1 saw completion of 150 hours of ship based flying in support of glaciological and oceanographic programs. The aircraft were then operated from Davis between November and February undertaking, amongst other tasks, lake sampling in the Vestfold Hills, geological programs in the Larsemann Hills, glaciological programs on the Amery Ice Shelf and updating of GPS base line and map data in the Prince Charles Mountains. The aircraft also assisted the Chinese Antarctic Research Expeditions (CHINARE) in resupply and change over of personnel at their Larsemann Hills station, Zhongshan. A crucial new role for the Davis based helicopters is supporting Davis fixed wing operations after the sea ice has dispersed providing the link between the station and the plateau skiway 12–13 kms away.

## First C212-400 aircraft rolls off the production line

The first of two new C212-400 aircraft was delivered to Skytraders in early April. The aircraft has since been fitted with skis and undergone a period of test flying in northern Canada in preparation for operations in Antarctica in the coming season.

The aircraft will fly directly from Hobart to Antarctica at the start of the season and be based at Davis and Casey throughout the summer. The range of the aircraft will allow direct flights between Casey, Davis and Mawson and to remote field locations.

### Runway construction trials complete

This season saw the completion of trial construction of the Casey ice runway. A 4000m by 100m area of blue ice was graded and tested to confirm the integral structure of the glacial ice surface to support wheeled aircraft operations. A laser-controlled grader was used to remove undulations on the surface before snow and ice was blown clear by a snow blower. Further testing using a snow compaction roller confirmed that the density and strength parameters required for jet aircraft landings could be met throughout the season.

CHARLTON CLARK, AIR TRANSPORT PROJECT, AAD

MATT FILIPOWSKI

*Grader marks from the 2002–03 season were barely visible on the Casey runway when construction trials commenced this summer.*

# Island exchanges enhance quarantine protection

SANDRA POTTER

*Quarantine Tasmania detector dog inspecting mail bound for Macquarie Island.*

Collaborations involving parties variously interested in preventing the unintentional transfer of plant and animal species into and within Australia are proving that inter-island exchanges can be beneficial on the quarantine front.

Although more than 5,300 km distant from the Territory of Heard and McDonald Islands (HIMI), Quarantine Tasmania, makes an important contribution to the Australian Antarctic Division's management of HIMI as one of the most biologically pristine areas on earth. The absence of a continuous management presence within HIMI makes a multiple-barrier approach to quarantine difficult – the opportunities for post-border surveillance and incursion response being limited. Accordingly, emphasis is placed on ensuring that quarantine requirements are met 'offshore', i.e. well before field parties land in the area. Under an AAD-initiated Memorandum of Understanding arrangement (HIMI sits outside the Quarantine Act), Quarantine Tasmania conducts inspections of Australian Antarctic Program vessels and equipment. After fumigation and/or examination for the presence of soil, plant and animal contamination, cargo is sealed in shipping containers to ensure that appropriate levels of biosecurity are maintained during transportation.

This arrangement is however, just one aspect of a broader program of quarantine management decisions and activities acknowledging that the protection of HIMI is understood to be a responsibility that is shared by expedition planners and participants. Fresh fruit and vegetables are not supplied because they are among food stuffs considered a high-risk pathway for introductions. The AAD issues only new field equipment and clothing, some items of which have been specially designed to avoid the use of seed-harbouring velcro. Field personnel accept that they need to comply with personal and scientific equipment preparation and packing protocols.

The AAD is sharing its experience in the protection of environmentally sensitive areas of high conservation value – on a Panel of Experts providing input to industry on enhancing the current quarantine management system in place at Barrow Island, a 1910-proclaimed Class A Nature Reserve off the Pilbara Coast of Western Australia. The reserve is a producing oilfield and the proposed site of a gas processing plant, the 'Gorgon Joint Venture' – the environmental, social, economic and strategic implications of which have yet to be fully considered by Government. Barrow Island is recognised internationally as a highly important biodiversity repository. It is home to 24 terrestrial species of fauna (five mammals, one bird, two reptiles and sixteen invertebrates) that occur nowhere else in the world, and another five species that are restricted in their distribution.

In more southerly latitudes, AAD-supported assessments of the viability and risk of establishment of plant propagules that may reach Macquarie Island are among mostly monitoring-focussed studies expected to enhance the Tasmanian Parks and Wildlife Service's management of the island as a World Heritage Area and IUCN Category Ia Protected Area (Strict Nature Reserve) managed primarily for scientific research. Deliberate and unintentional introductions, in particular cats, rabbits, rats and mice, have already had a serious and irreversible impact on the island's native fauna, flora and landscape.

SANDRA POTTER, LOGISTICS SECTION, AAD

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# New living quarters for Davis station

The 2003–04 summer saw the start to construction of the foundations for a new living quarters building for Davis station. The new building is a result of much-increased expeditioner numbers since the existing building was completed in 1979.

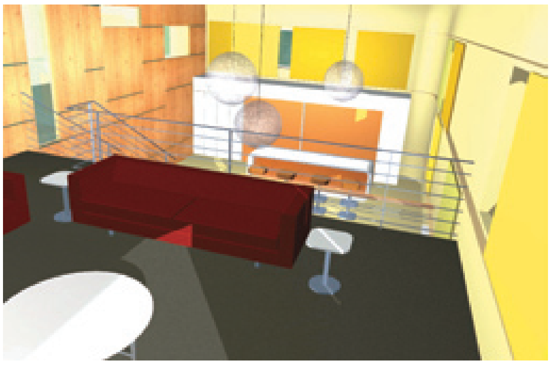
This recent summer's work included set-out and excavation of the building foundations, subfloor area and link foundations, as well as some road diversion and drainage work. Design and certification of the building is estimated to be completed by July 2004 with tendering of works packages during July and August 2004. Present plans are to fabricate and erect the building structure in the summer of 2004–05, with the fit out to be undertaken during the winter of 2005 and commissioning in the summer of 2005–06.

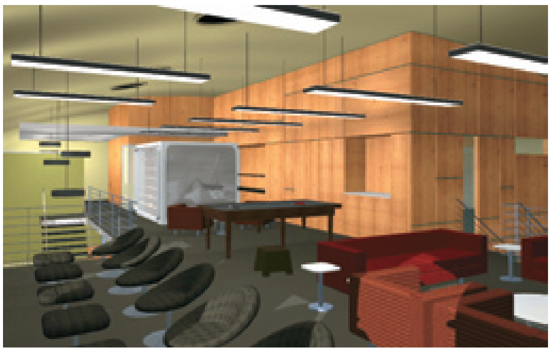
The original Davis living quarters building was intended for a station population of 30 expeditioners. The building at that stage was the first of the AANBUS (Australian Antarctic Building System) buildings which was subsequently used for all later building projects at all three continental stations during the rebuilding program in the 1980s and 1990s. Current Davis populations of 25 to 30 over winter and 70 to 100 expeditioners during the summer meant that the building did not meet current Australian standards for both food preparation and handling. The structure is also showing signs of age and degradation.

At the start of the project the Australian Antarctic Division (AAD) took the opportunity to review the existing building system and look at latest technologies and ideas. Both the structure and building environment systems (such as heating, ventilation and lighting) were analysed and expressions of interests to produce a concept design were invited. The AAD selected four architectural and engineering teams who provided two proposals each on the brief that outlined the basic parameters that the AAD required for the project. The submissions incorporated steel framed insulated building systems similar to AANBUS, modular buildings, and composite structures.

The winning submission, by a Sydney-based architectural firm Allen Jack & Cottier, proposed what may be the world's first fibre composite building shell structure that does not require structural steel work. The newly-developed fibre composite technology is based on knowledge and practices typically used in the boat building industry. The proposal has the potential to reduce both construction times of major buildings in Antarctica and the number of construction people needed in Antarctica. The idea and technology also showed additional possible applications such as field huts and traverse vans. The competitive design phase also revealed that the AAD's 'Building Management and Control System' is at the leading edge of current industry standards.

Much work is needed to complete and document design and certification as well as to develop and test the composite panels. The design team for the project includes Allen Jack & Cottier as the architects and interior designers, structural





*Top: Architect-drawn three-dimensional view of the new Davis living quarters. The green building at left is the existing living quarters which will be connected to the upper floor by a link building. The edges of the new structure are rounded to reduce wind pressure.*

*Above: Architect drawings of 1. The dining area – which seats up to 140 – showing servery on left with kitchen behind; 2. Upper floor lounge, showing bar on mezzanine; and 3. Upper floor lounge featuring theatre and library.*

engineers Hyder Consulting (Melbourne) to design and certify building structures and prepare testing schedules, Jutson Yacht (Sydney) and ATL Composites (Gold Coast) to provide specialist fibre composite advice, SEMF Holding in Hobart to undertake the building services design; WT Partnership (Hobart) to undertake quantity surveying, and Createring (Melbourne) to design kitchen facilities. The University of Sydney has assisted with wind tunnel testing for building pressures and snow drift accumulation, and the AAD is providing experience in construction and maintenance of buildings in Antarctica.

The design team has been working for the past year to develop and refine the scope of the project. Work to apply the fibre composite technology to the unique Antarctic environment and analysis of the shell are nearly complete. The link structure between the new living quarters and the existing sleeping and medical quarters has been fabricated in Devonport by Thompson Fibreglass as a prototype for the new building. This has allowed a review and assessment of the fabrication and construction processes for the design and development of the main structure.

ADRIAN YOUNG

ADRIAN YOUNG

*Top: Fabrication of the link building, 2.6 m wide x 3.4 m high x 23 m long, nears completion. Above: Aerial view of construction site with existing green living quarters at left, January 2004.*

On completion of a detailed testing program beginning in March 2004, analysis and certification of the structure will be confirmed. Interior design work, architectural layouts, structural and building services design are nearly complete and work has begun on tendering documentation.

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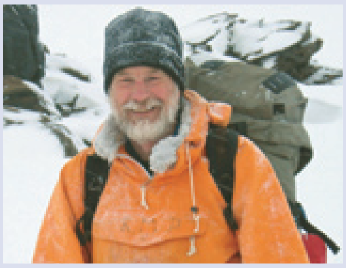
# Station Leaders for 2004



## Bob Jones – Davis

Bob Jones is a veterinary surgeon by profession, graduating from Sydney University in 1970 and London University in 1975.

In the 1980s he made three summer visits to subantarctic Heard Island, as a scientist. In 1983 he investigated whether there was any risk to the gentoo penguins from Australian poultry diseases. In 1985 he was a member of team that conducted the first accurate census of elephant seals on the island. In 1987 the team repeated the census and studied reasons for the decline in the elephant seal population.

In the 1990s he resigned from his position as Director of a Veterinary Research and Diagnostic laboratory in Bendigo to become more involved in Australia's Antarctic Program. He wintered as a station leader at Macquarie Island, Mawson twice and Davis in 1992, 1994, 1997 and 2000 respectively. In 1996 Bob was awarded the Australian Antarctic Medal for leadership and support for science.

## Karen Kristensen – Casey

Karen hails from the south-west of Western Australia. She worked in the mining industry for nine years, her last position being a Fixed Plant Production Supervisor in the processing section of a large gold mine in the north-west of Western Australia. Whilst there she was involved in many different facets of mining life other than management and supervision, such as EEO Grievance Officer, trained Industrial Paramedic and second in charge of a voluntary mines rescue team for five years.

Currently she is undertaking a double major in Environmental Science and Conservation Biology. She has previously worked for the Australian Antarctic Division as the station leader at Macquarie Island in 1999. On her return to Australia she intends to undertake more study and travel.


## Joan Russell – Mawson

This year at Mawson is Joan Russell's fourth year as station leader. She has held the position previously at Casey (1990) and Macquarie Island (1994, 2002). Additionally she went as Camp Manager and Cook to Commonwealth Bay in the summer 1997–98 with the AAP Mawson's Huts Expedition.

In a former life Joan was a senior member of the South Australian public service, holding positions such as Presiding Officer of the Promotion and Grievance Appeals Tribunal, Director of Human Resources, SA Police and CEO SA Aboriginal Health Council.

## Graeme Beech – Macquarie Island

Graeme Beech (Beechy) took over the role of station leader at Macquarie Island on 9 March 2004 and will continue through to April 2005. Graeme has previously worked for the AAD in 1998 when he enjoyed a productive and satisfying year as station leader at Casey. He has worked in the conservation management field in a variety of locations around Australia including Wilson's Promontory, Jervis Bay, Christmas Island and Darwin.

Prior to his Macca posting he was working in Canberra as an Assistant Director in the Marine Protected Areas Section of the Department of Environment and Heritage and was involved in the declaration and management of Commonwealth Marine Protected Areas, including Macquarie Island Marine Park which was declared in 1999. Being selected as station leader for the world heritage Macquarie Island is like the 'icing on the cake'. Graeme has settled in well at Macquarie and with the other seventeen expeditioners is enjoying the challenges, variety and pleasures that come with working and living in such a remote and amazing environment.

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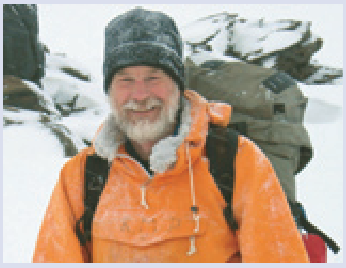

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Bob Jones is a veterinary surgeon by profession, graduating from Sydney University in 1970 and London University in 1975.

In the 1980s he made three summer visits to subantarctic Heard Island, as a scientist. In 1983 he investigated whether there was any risk to the gentoo penguins from Australian poultry diseases. In 1985 he was a member of team that conducted the first accurate census of elephant seals on the island. In 1987 the team repeated the census and studied reasons for the decline in the elephant seal population.

In the 1990s he resigned from his position as Director of a Veterinary Research and Diagnostic laboratory in Bendigo to become more involved in Australia's Antarctic Program. He wintered as a station leader at Macquarie Island, Mawson twice and Davis in 1992, 1994, 1997 and 2000 respectively. In 1996 Bob was awarded the Australian Antarctic Medal for leadership and support for science.

## Karen Kristensen – Casey

Karen hails from the south-west of Western Australia. She worked in the mining industry for nine years, her last position being a Fixed Plant Production Supervisor in the processing section of a large gold mine in the north-west of Western Australia. Whilst there she was involved in many different facets of mining life other than management and supervision, such as EEO Grievance Officer, trained Industrial Paramedic and second in charge of a voluntary mines rescue team for five years.

Currently she is undertaking a double major in Environmental Science and Conservation Biology. She has previously worked for the Australian Antarctic Division as the station leader at Macquarie Island in 1999. On her return to Australia she intends to undertake more study and travel.


## Joan Russell – Mawson

This year at Mawson is Joan Russell's fourth year as station leader. She has held the position previously at Casey (1990) and Macquarie Island (1994, 2002). Additionally she went as Camp Manager and Cook to Commonwealth Bay in the summer 1997–98 with the AAP Mawson's Huts Expedition.

In a former life Joan was a senior member of the South Australian public service, holding positions such as Presiding Officer of the Promotion and Grievance Appeals Tribunal, Director of Human Resources, SA Police and CEO SA Aboriginal Health Council.

## Graeme Beech – Macquarie Island

Graeme Beech (Beechy) took over the role of station leader at Macquarie Island on 9 March 2004 and will continue through to April 2005. Graeme has previously worked for the AAD in 1998 when he enjoyed a productive and satisfying year as station leader at Casey. He has worked in the conservation management field in a variety of locations around Australia including Wilson's Promontory, Jervis Bay, Christmas Island and Darwin.

Prior to his Macca posting he was working in Canberra as an Assistant Director in the Marine Protected Areas Section of the Department of Environment and Heritage and was involved in the declaration and management of Commonwealth Marine Protected Areas, including Macquarie Island Marine Park which was declared in 1999. Being selected as station leader for the world heritage Macquarie Island is like the 'icing on the cake'. Graeme has settled in well at Macquarie and with the other seventeen expeditioners is enjoying the challenges, variety and pleasures that come with working and living in such a remote and amazing environment.

# Mawson station, est. 1954: a signal achievement

Dark specks in an ocean of whiteness. Black and white aerial photographs of the edge of Antarctica, 5000 kilometres and more to the southwest of Australia, showing tiny, rare outcrops of rock all but buried under the continent's immense ice sheet. Images of places that humans never took any notice of till now, now that someone was looking for a reliable landing place on a notoriously unreliable coast.

US NAVY

PHILLIP LAW

LAW COLLECTION

Those photographs, from the US Navy's Operation Highjump some six years previously, formed the basis of a decision by Phillip Law, director of the Antarctic Division of Australia's Department of External Affairs, to take a ship chartered at considerable expense to the Australian taxpayer to the Antarctic coast at 67°36'S, 62° 52'E in the summer of 1953–54. On the strength of a promise of government funding for just one year he aimed to set up a permanent Australian Antarctic settlement – the first by any country south of the Antarctic Circle.

The whole enterprise was little more than a calculated gamble, but it was a gamble that paid off, many times over. The station built on these shores possessed the only natural rocky harbour in thousands of kilometres of icy coastline and gave Australia its first vital foothold on the Antarctic continent.

To get there, the Australian government chartered *Kista Dan*, a 65-metre ice-strengthened ship built in 1952 for the Danish shipping company J. Lauritzen and Co. of Copenhagen, under the command of Captain Hans Christian Petersen and a Danish crew. It was the start of a 34-year association between the company and Australia's Antarctic program that ended with the foundering and scuttling of *Nella Dan* at Macquarie Island in 1987.

Calling at Heard and Kerguelen Islands on the way down, to collect men, sledge dogs and supplies, Law's expedition headed into the ice – the first Australian foray to this part of Antarctica since Mawson's last Antarctic journey nearly a quarter of a century earlier. The ship's besetment, storm damage to the two support aircraft, and the near-loss of an oversnow vehicle which broke through thin sea ice failed to daunt Law and his party.

On Thursday 11 February, Petersen gingerly steered *Kista Dan* into Horseshoe Harbour to begin an Antarctic adventure that continues to this day. Phillip Law's sense of occasion did not let him down. Here is his 2004 recollection (aged nearly 92) of the naming ceremony:

> '…with unloading half finished and construction of huts proceeding, I gathered the men around a flag pole beside the Caravans, raised the Australian flag, and said: 'In the name of Her Majesty Queen Elizabeth II and the Government of the Commonwealth of Australia, I raise the Australian flag on Australian Antarctic Territory and I name the site of this new ANARE station "Mawson" in honour of the great Australian Antarctic explorer and scientist, Sir Douglas Mawson.'

The Royal Australian Air Force aircraft mechanics on board made one aircraft out of the remains of two and the aerial coastal surveys went ahead as planned. The ground party got to work erecting the wooden living hut, the aluminium-clad work hut, the wooden engine room and workshop, and the galvanised-iron store. After less than two weeks the essentials were in place. *Kista Dan* sailed out of Horseshoe Harbour on 23 February leaving behind the shore party under Bob Dovers: Lem Macey, Bill Harvey, Bill Storer, Jeff Gleadell, John Russell, Bruce Stinear, Bob Dingle, Robert Summers and Georges Schwartz (a French observer).

In the relatively recent history of human activities in Antarctica, Australia enjoys a place out of all proportion to the size of its population and economy. Douglas Mawson's Australasian Antarctic Expedition of 1911–14 proved to be the pre-eminent scientific expedition of Antarctica's 'heroic era' of the early 1900s. From 1929 to 1931 Mawson led a combined

R THOMPSON

*From top: 1. The photograph that started it all. From this photograph – taken by the US 'Operation Highjump' in the summer of 1946-47 – Dr Phillip Law picked out with a magnifying glass the site of what was to become Mawson station. The little rocky outcrop in the shape of a horseshoe which looked as though it might be a natural harbour can be seen in the top third of the photograph. 2.* Kista Dan *anchored at Horseshoe Harbour, the best natural harbour on the whole coastline of Greater Antarctica, February 1954. 3. One of the Auster aircraft on the ice with* Kista Dan. *4. Raising the flag and naming Mawson station, 13 February 1954. Phillip Law is standing at the foot of the flagpole.*

PHILLIP LAW

LAW COLLECTION

*Top: A welcome chocolate break from unloading stores. Building materials and supplies were transported over the sea ice by Weasels (the oversnow tracked vehicles on the left) from* Kista Dan *to the site of Mawson station.*

*Above: Mawson station takes shape. Australia's first post-war – and first permanent – station on the Antarctic continent under construction. By the time* Kista Dan *left Mawson on 23 February 1954, three huts were completed. At the end of 1954 the station comprised six elaborate huts, and the power units, radio and some of the meteorological equipment were permanently installed.*

British, Australian and New Zealand expedition that made the first systematic exploration of the East Antarctic coast, laying the foundation of Australia's later claim to the vast land areas beyond. And Australia was a leader of the Antarctic push in the years immediately following the Second World War: in the summer of 1947–48 the first of the Australian National Antarctic Research Expeditions (ANARE) set up bases on subantarctic Heard and Macquarie Islands.

The 1954 landing by Law's *Kista Dan* expedition at Horseshoe Harbour was a culmination of these momentous achievements. It can be argued that it was the single most important event in the long history of Australia's association with the Antarctic. The establishment of the station named for Australia's Antarctic pioneer was the beginning of an Australian presence on the continent that has lasted to this day, with all the scientific advantages allowed by a continuous presence and unbroken observing programs.

It was certainly a high point in the career of Phillip Garth Law. Law's leadership qualities were recognised by the Chifley government when it appointed him the first Antarctic Division Director at the tender age of 36, and the Menzies government which followed continued to support his adventurous southern endeavours until Law's retirement from Antarctic work in 1966. The establishment of Mawson station brought together the old and new: Douglas Mawson, then aged 71, was still alive to enjoy acclaim as the elder statesman of Australia's Antarctic effort, while Law, thirty

THE AGE

*Mawson is briefed on Mawson: Dr Phillip Law shows Sir Douglas Mawson the first published photograph of Mawson station after his return to Melbourne in March 1954.*

years his junior, was in the prime of his life, and his career.

It is fitting that Law and eight of his associates on that great adventure were able to enjoy the celebration of Mawson station's jubilee in 2004. With him on the occasion of an Australia Post commemorative stamp launch on 13 February 2004 were retired Captain Bill Pedersen, who had been Hans Petersen's second officer, along with men from the party that erected Mawson station: Bill Storer from the wintering party, Jim Brooks, Ken Duffell, Fred Elliott, Arthur Gwynn, Ray Seaver and Dick Thompson.

*Peter Boyer, Writer, Historian & Former AAD Manager*

## Australia Post celebrates 50th anniversary of Mawson station

The 50th anniversary of Mawson station is celebrated on this year's set of Australian Antarctic Territory stamps. The first 50c stamp shows the flagraising ceremony, with the pioneer party gathered around barge caravans. The other 50 cent stamp shows, with some artistic licence, Mawson as the station is today. The dollar stamp has men relaxing on packing crates, enjoying a tea break. The Auster emperor penguin rookery about 40 kilometres east-north-east of Mawson is on the $1.45 stamp.

Accompanied at the Australia Post function in Melbourne by several members of the founding party, Dr Phil Law launched the stamps on 13th February — exactly fifty years after he raised the flag on the rocky shores of Horseshoe Harbour.

AUSTRALIA POST

AUSTRALIA POST

*Above: Members of the Mawson pioneer party at the Australia Post stamp launch, 13 February, 2004. Left to right – Arthur Gwynn, Fred Elliott, Ray Seaver, Dick Thompson, Bill Storer, Ken Duffell, Jim Brooks, Bill Pedersen and Phillip Law.*

*Left: Dr Phillip Law inspects the Mawson 50th anniversary stamps at the launch in the National Philatelic Centre.*

# New AAD facilities opened on Mawson station's 50 year anniversary

Friday February 13 2004, marked a major milestone in the Australian Antarctic program with the opening of a major redevelopment at the Kingston headquarters in Tasmania and celebrations to mark the 50th birthday of Australia's first permanent Antarctic station.

Special guests at the Kingston celebrations, hosted by the Parliamentary Secretary to the Minister for the Environment and Heritage Dr Sharman Stone, were Australia's Governor-General Major General Michael Jeffery, AC, CVO, MC (Ret'd) and his wife Marlena.

Expeditioners at Mawson were included in the event through a telephone hook-up where they relayed to the Governor-General and Mrs Jeffery how they were marking the occasion 5475 km away on the frozen continent.

In his address, Major General Jeffery told more than 100 invited guests and the many staff attending that Australia must 'lead the way forward with its Antarctic program – just as Sir Douglas Mawson had done in the early 1900s.

'This graduate of engineering and science was a man of immense courage and determination. And his exploits and travails are the stuff of legend,' Major General Jeffery said.

'Mawson demonstrated exceptional leadership. His efforts are widely seen as crucial to Australia's claim to nearly half of Antarctica. Back home he played a pivotal role in establishing government-led funding for Antarctic research. And he became a dogged lobbyist for a permanent presence on Antarctica.

'His efforts reached fruition with the establishment of a station in Mac.Robertson Land. That station was founded 50 years ago today with the raising of the Australian flag on the rocky shore of Horseshoe Harbour. Fittingly it was named Mawson – in honour of our greatest polar explorer.'

Major General Jeffery told the audience that with the opening of new facilities at Kingston following a $6.2 million redevelopment, the Australian Antarctic Division – already considered an international centre of excellence – steps up to an even higher level of capability.

The upgrading includes world-class biological, ecological and atmospheric science research laboratories and a marine research facility equal to the most advanced in the world for the study of Antarctic marine organisms. The new facilities also provide for important research into the potentially toxic effects of synthetic pollutants on Antarctica's ecology.

PETER WHYTE

PETER WHYTE

PETER WHYTE

*Above: Australia's Governor-General Major General Jeffery signs the visitor's book at the redeveloped AAD headquarters, with Dr Sharman Stone looking on. Right: Major General Jeffery addresses guests at the opening.*
*Right below: The photographic exhibition to mark the 50th anniversary on display at the AAD before moving to Canberra's Parliament House.*

The Governor-General said: 'The Antarctic is vital to the future of our planet and we have a critical, ongoing role to play in its protection. It's an integral part of the planet … but it's actually under threat on several fronts.'

He listed these threats as the plundering of some fisheries by pirates, global warming causing floating ice shelves on the Antarctic Peninsular to disintegrate and tourism – mostly in the form of a growing number of cruise ships.

'I believe these threats to the greatest wilderness on earth must be overcome and with Australia's continuing direct involvement.'

In recognition of the 50th anniversary of the founding of Mawson station, Major General Jeffery said he was delighted to name five of the refurbished buildings at the Kingston headquarters of the Australian Antarctic Division after members of Mawson's 1911-14 expedition. In addition to Mawson these men are John Davis King, Frank Wild, Frank Hurley and Walter Hannam. The new science building is named after Charles Harrisson – the only Tasmanian in Mawson's party.

A major highlight of the anniversary celebrations has been a photographic exhibition in the refurbished display area at Kingston which gives an amazing insight into the people and programs that have shaped the history of Mawson station.

The exhibition, the brainchild of key researcher and writer Elizabeth Haywood and designer Pauline deVos, will go on to display at Parliament House in Canberra in May before featuring in Tasmanian mid-winter celebrations in June. It is then off to the Australian Embassy in Norway later in the year.

*Sally Chambers, Communications Manager, AAD*

# Australian Antarctic Arts fellowships awarded

Antarctica is considered by many to be the most isolated and inhospitable place on Earth. Visitors are largely restricted to the few who can afford the high cost of visiting as a tourist, or to those scientists and support personnel who participate in national Antarctic programs. As a consequence, Antarctica is experienced indirectly by most people – through the work of visiting scientists.

As well as promoting Antarctic science directly to the community, the Australian Antarctic Division looks for other ways of informing and educating Australians about Antarctica and Australia's activities there. The Australian Antarctic Arts Fellowship (formerly Australian Antarctic Humanities Program) provides an alternative, enabling those with a non-science focus to experience Antarctica first-hand so that they may convey their appreciation and understanding to other Australians.

That Antarctica be valued, protected and understood is the Australian Antarctic Program's vision. Considered uppermost during the competitive selection process is the capacity for artists to communicate this to the broader Australian community and internationally.

Since the mid 1980s, more than 70 people have travelled south with the Humanities program. Their disciplines have included the visual arts, imaginative writing, education, history, social research and music as well as print and broadcast journalism.

PETER WHYTE

*Prior to leaving on Voyage 7, three recipients of the 2003–04 Australian Antarctic Arts Fellowship are presented with certificates by Dr Sharman Stone, Parliamentary Secretary responsible for Australia's Antarctic program. From left: Dr Stone, Elle Leane, Sue Lovegrove and Bernadette Hince.*

From a diverse international field of applicants, the following six people were awarded Fellowships for the 1993–04 season:

**Danielle Wood**, a journalist and winner of the 2002 Vogel literary award plans to write her second fiction book set on Macquarie Island.

**Nin Brudermann**, an Austrian artist based in New York, is working on a worldwide project of images taken of and from weather balloons launched from remote places.

**Tim Low**, a widely published nature writer and photographer with an interest in introduced species, will document the ecological and geological links between Australia and Antarctic through a book about birds from the two continents.

**Sue Lovegrove**, a PhD-qualified visual artist with works in the National Gallery of Victoria and Parliament House, will complete a series of 15 to 20 paintings.

**Elle Leane**, a Rhodes scholar with a PhD from Oxford University will study the links between science and literature, particularly science fiction and utopias.

**Bernadette Hince**, natural history writer, science editor and compiler of the *Antarctic Dictionary*, will compare and contrast the ecological history of the subantarctic islands of France, New Zealand and Australia.

CATHY BRUCE, INFORMATION SERVICES, AAD

# 'Overwhelmingly astounding beauty ... '

A previous recipient of an Australian Antarctic Arts Fellowship, Stephen Eastaugh, has recently held an exhibition of his Antarctic work, 'Unmapping – Recent Antarctic paintings' at the William Mora Galleries in Melbourne. Eastaugh completed a four-month summer stay at Davis station in 2002–03, adding to the body of Antarctic work begun after his initial round-trip visit in 1999. His work has been exhibited several times over the last four years.

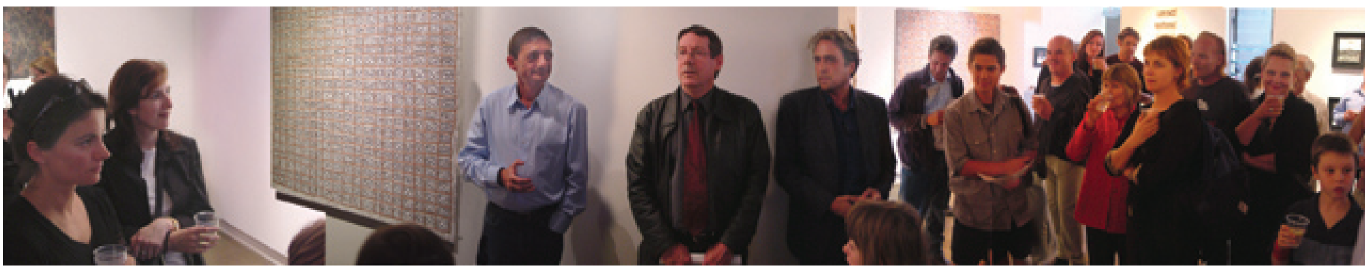
*To some, the Antarctic is just a white wasteland but I definitely see much more,' Eastaugh says. 'Brutal, empty and monotonous it can be but in this extreme expanse you find overwhelmingly astounding beauty. After the deadly winds die down, you find a rich silence. After furious blizzards, you find delicious views. Out of a white void comes visual clarity mixed with a reminder of how fragile we all are. Antarctica sends shivers down your spine.*

*It was a frigid, exotic destination where I sensed a romantic type of cerebral snogging going on between myself and the environment. My brain seems to be drawn to the poles for cold, clear order. The harsh icy abstraction of Being I see out there and I crave it. Do these white terrains mirror the sad human disquiet of my mindscape? Is it this that attracts me? Or the cool seduction that could just as easily kill you? A kind of sexy danger embellished with monstrous iceblocks that make you tipsy at each visual drink.'*

Other Australians who have travelled south under the AAD's Arts Fellowship program include well known authors Nikki Gemmell, Hazel Edwards and Coral Tulloch; broadcasters Vivienne Schenker, Andrew Denton and Tim Bowden; science and environment journalists James Woodford, Bob Beale and Andrew Darby, and visual artists Jorg Schmeisser, Jenni Mitchell, Christian Clare Robertson and Sally Robinson.

## Antarctica Online

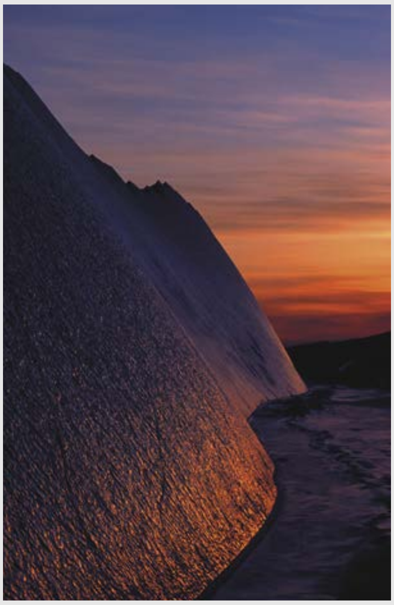
For more information about the program, visit the website at <http://www.aad.gov.au/default.asp?casid=3892>



MIN SIMANKEVICIUS

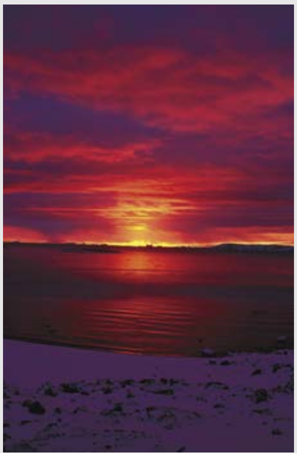
*Director of the AAD, Dr Tony Press (speaking) opens the exhibition of Stephen Eastaugh (closest to Dr Press).*

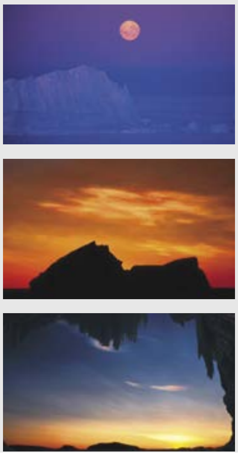
Portfolio

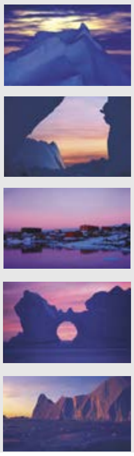


# COLOURS OF ANTARCTICA

Photographer Sean Wicks







**Antarctica** is a photographer's delight. Not simply because of the array of amazing and diverse natural objects that are unfamiliar to those of us living at lower latitudes, but because of the special optical properties of the cold and clean Antarctic atmosphere.

The beautiful colours photographed by Sean Wicks are largely due to the clarity of the Antarctic atmosphere near the surface. The lack of atmospheric aerosols combined with Rayleigh scattering of light by molecular gases enhances the colour contrast in the images, particularly at the blue and red ends of the spectrum.

Rayleigh scattering causes the daytime sky to be blue – atmospheric gases preferentially scatter blue and violet light away from the direction of the sun and to other parts of the sky. This processes causes the sun's disc to take on a yellowish hue, which becomes more pronounced and redder when the path traversed by the light through the atmosphere lengthens, as it does when the sun is lower in the sky. Similar effects occur for light from the moon and other distant sources. Rayleigh scattering also gives bodies of water and icebergs a bluish colour.

The coating of snow on the icebergs and sea ice in Sean's photographs have taken on the colours of the sky. The vivid oranges and pinks seen when the sun is near the horizon arise from a combination of scattering by tiny ice crystals in the clouds and the absence of blue light in the direction of the sun.

Why is the Antarctic atmosphere so clear? This is due to the extreme cold and dryness of the atmosphere, the isolation of the air over the continent afforded by circulation patterns, and the predominance of ice covering the surface. These factors result in low aerosol concentrations, particularly over the interior of Antarctica.

And what are aerosols? They encompass a diverse range of particles that exist at all levels of the atmosphere. The particles are all generally microscopic, ranging in size from the wavelength of visible light (about two-thousandth of a millimetre) upwards, and include smoke, dust, salt and a variety of large molecules. Aerosols scatter and absorb light, and produce the phenomenon we call haze, reducing the brightness and washing out the colours of distant objects. The smaller aerosols provide sites where water molecules can cluster, creating clouds and various other forms of atmospheric water. In the Antarctic, the clouds are generally comprised of icy particles, from tiny crystals through to snow. The light scattering from these particles provides some of the most spectacular colour effects.

Also photographed by Sean is the aurora australis, a natural emission often seen in the polar regions. The aurora occurs when gases above at high altitudes are energised through collision with charged particles guided into the atmosphere by the Earth's magnetic field. The green and red colours arise from the excitation of oxygen atoms.

**Andrew Klekociuk**, Space and Atmospheric Sciences Program, AAD


# Cold, dark and festive

## Celebrating Midwinter in Tasmania

Last year's acclaimed Antarctic Tasmania Midwinter Festival – the third and the biggest so far – drew more than 35,000 people to 119 separate events at 19 locations around Tasmania. Judging by the huge turnout and the enthusiastic participation of organisers and audiences, Tasmanians and visitors alike are eager to celebrate Tasmania's unique connections with Antarctica!

The Midwinter Festival aims to educate, inform, inspire and celebrate the Tasmanian community's involvement with Antarctica and Australia's leading role in Antarctic science and policy. Importantly, festival events are hosted by the local Antarctic community and individuals and organisations again contributed generously to this year's program. Seed funding was provided by the Tasmanian Government, and the festival also attracted 34 corporate sponsors and partners who donated cash and in-kind support. With the active support of icon institutions like the Australian Antarctic Division, the Tasmanian Museum and Art Gallery, the Royal Tasmanian Botanical Gardens, Screen Tasmania, the Tasmanian Symphony Orchestra and P&O Polar, the festival reached a huge new audience. Festival Director Paul Cullen did a tremendous job again last year in coordinating the efforts of the Antarctic community and more than 150 festival volunteers generously gave their time and expertise.

Some of the many highlights last year included 'Expedition South', a concert of Antarctic music performed by the Tasmanian Symphony Orchestra and set to spectacular images of Antarctica. This concert also featured a moving tribute to the late Antarctic photographer Wayne Papps. Exhibitions and events at the Tasmanian Museum and Art Gallery and Royal Tasmanian Botanical Gardens boasted record attendances while many screenings at 'The Longest Night Film Festival' were sold out. Also resoundingly successful were the RSV *Aurora Australis* open day, the Australian Antarctic Division's air-sea rescue demonstration and the re-enactment of Amundsen's husky team racing Scott to the South Pole. The second Phillip Law Lecture was delivered by former Science Minister Dr Barry Jones. Other highlights included the 'Science on Sunday' display at the Hotel Grand Chancellor, photographic exhibitions, the Antarctic Tasmania Midwinter dinner, and the Hobart City Council's 'Cold Fingers' music events.

The festival was an unquestioned success from the first Sunday, when more than 900 people attended a one-day science expo hosted by the Australian Antarctic Division at the Hotel Grand Chancellor, to the last, when more than 3500 people watched a team of huskies race around the Botanical Gardens. During the days in between, 1800 students from around Tasmania descended on Salamanca Square for the 'Antarctic Discovery Days'.

In all respects, the Midwinter Festival has grown in popularity and scope from the inaugural event in 2002, and this year's Midwinter Festival – scheduled for 18-27 June 2004 – promises to be even bigger and better.

*Ben Galbraith,*
Antarctic Tasmania

# 03

**“The students are tuned-in, enthusiastic and talking of a future that involves their own participation in Antarctica.”**

## COMMENTS

The festival’s brought people outside in winter! Great entertainment, and it highlights the connection between Antarctica and Australia

**A great learning hands on experience for children and adults about Tasmania’s special relationship with Antarctica**

A wonderful festival – vastly different to any other festival in Tasmania or Australia

A great way of letting the community know what’s happening in Antarctica

## TEACHERS’ COMMENTS ABOUT SCHOOL DISCOVERY DAYS

*My students came back to school enthralled by the Antarctic experience…the work we have continued with in the classroom has astounded us! Would we do it again? You betcha!!.*
Stephanie Hickey, Grade 5/6 Springfield Gardens Primary

*All my students now want jobs that will allow them to travel to Antarctica on the* Aurora Australis *(despite the stories that they were told!!!).*
Debbie Doyle, St Patrick’s College, Launceston

*I feel that I could have spent 6 months of research and weeks of planning & I still would not have got across as much information as the children received last week.*
Mary Hemming, Grade 6, St Cuthbert’s School

Photographer Chris Crerar

# In the news

## Artist to produce folio of Antarctic fish prints

The internationally acclaimed Japanese artist Boshu Nagase recently visited Hobart to work on a folio of prints of Antarctic fish. These fish prints will illustrate a large-format book on Antarctic fish being edited by Harvey Marchant of the Australian Antarctic Division and Mitsuo Fukuchi of the Japanese National Institute for Polar Research. The launch of the book is planned for the 25th anniversary of CCAMLR in October 2006.

Boshu Nagase has over 40 years' experience of a printing art known as gyotaku (*gyo* = fish; *taku* = print, impression, rubbing). Gyotaku is a distinctively Japanese way of illustrating nature. In its simplest form (the direct method) paint is applied to a fish, shell or plant and a print is taken from the object onto paper or cloth. The indirect method of gyotaku requires much greater skill. Fine paper, not much thicker than tissue paper, is moistened and pressed to the surface of a fish or plant. Coloured inks are then applied to the paper in layers to colour the imprint of the organism. The result is an anatomically exact copy of the organism and coloured either as it is in nature or as the artist chooses.

JAMES KERR, THE MERCURY

Boshu Nagase is perhaps the principal living exponent of the indirect method. He has produced folios of gyotaku of the fish of the Great Barrier Reef, the Mediterranean Sea and the marine and freshwater fish of Japan. He has had many exhibitions and his work is on permanent display at the Australian Institute of Marine Science near Townsville, Queensland, the Monaco Museum of Oceanography, the University of Maine and in various Japanese galleries.

Boshu Nagase's visit was sponsored by the Australian Antarctic Division and the Japanese National Institute of Polar Research.

*Harvey Marchant, Biology Program Leader, AAD*

## AAD scientists win prestigious awards

**Graham Robertson**, a seabird ecologist with the Australian Antarctic Division, has been awarded a prestigious international research award for his work on by-catch mitigation during long-line fishing operations. The Pew Institute of Ocean Science, in conjunction with Miami University has awarded Graham US$150,000 over three

KIERAN LAWTON

years to enable him to expand his work on environmentally safer long-line fishing in the Patagonian toothfish fishery. Announcing the award, Dr Sharman Stone said: 'Graham Robertson has long been recognised internationally for his seabird research and his inclusion as a Fellow of the prestigious Pew Institute for Ocean Science is confirmation of the great esteem in which he is held.' Working with the fishing industry Graham has developed a weighted long-line which sinks fast, quickly dragging the baited hooks to depths where surface-feeding sea birds cannot reach them. Experimental deployment of this gear in New Zealand fisheries over the past few years has demonstrated dramatic reductions in accidental bird deaths. If the method were to be taken up universally by the long-line fishing industry the reduction in the number of albatross and other sea birds drowned each year would be immense, and would be a major advance in marine conservation.

**Karin Beaumont**, a recent PhD graduate, has been awarded an Australian Academy of Science Young Researcher's Award for Scientific Visits to the USA. She will spend six weeks at the University of Massachusetts, Boston, undertaking collaborative research with Associate Professor Juanita Urban-Rich.

Karin's postgraduate research examined how much carbon the faecal pellets of grazers such as copepods and krill contained, and their fate in Antarctic waters. This topic is important

CHRISTIAN GALLAGHER

because faecal pellets are a major pathway of carbon from the surface to deep water and the seafloor. This carbon provides food for bottom-dwelling organisms and is recycled back to the atmosphere over long time periods.

The collaborative research to be undertaken in the USA will further this project, using technology and expertise at the University of Massachusetts to develop a faster, more accurate method to determine the carbon content of faecal pellets. The research will also examine the effect of different diets and degradation processes on faecal pellets produced by a range of zooplankton that are pivotal in oceanic food webs.

## Web-based State of Environment reporting a winner

A web-based State of the Environment reporting system developed by the AAD won a prestigious Technology Productivity Award in September.

The computerised System for Indicator Management and Reporting (SIMR) has replaced a cumbersome paper-based procedure for reporting environmental parameters in the Australian Antarctic Territory. A large book for State of the Environment reporting has been replaced by a computer system that gives the current environmental status of one of the most pristine regions of the world – and is available to everyone via the public web site <http://www.aad.gov.au/default.asp?casid=5612>.

It also enables the AAD to more readily discover relationships between environmental indicators, more quickly interpret data, highlight unusual patterns and pick up any changes.