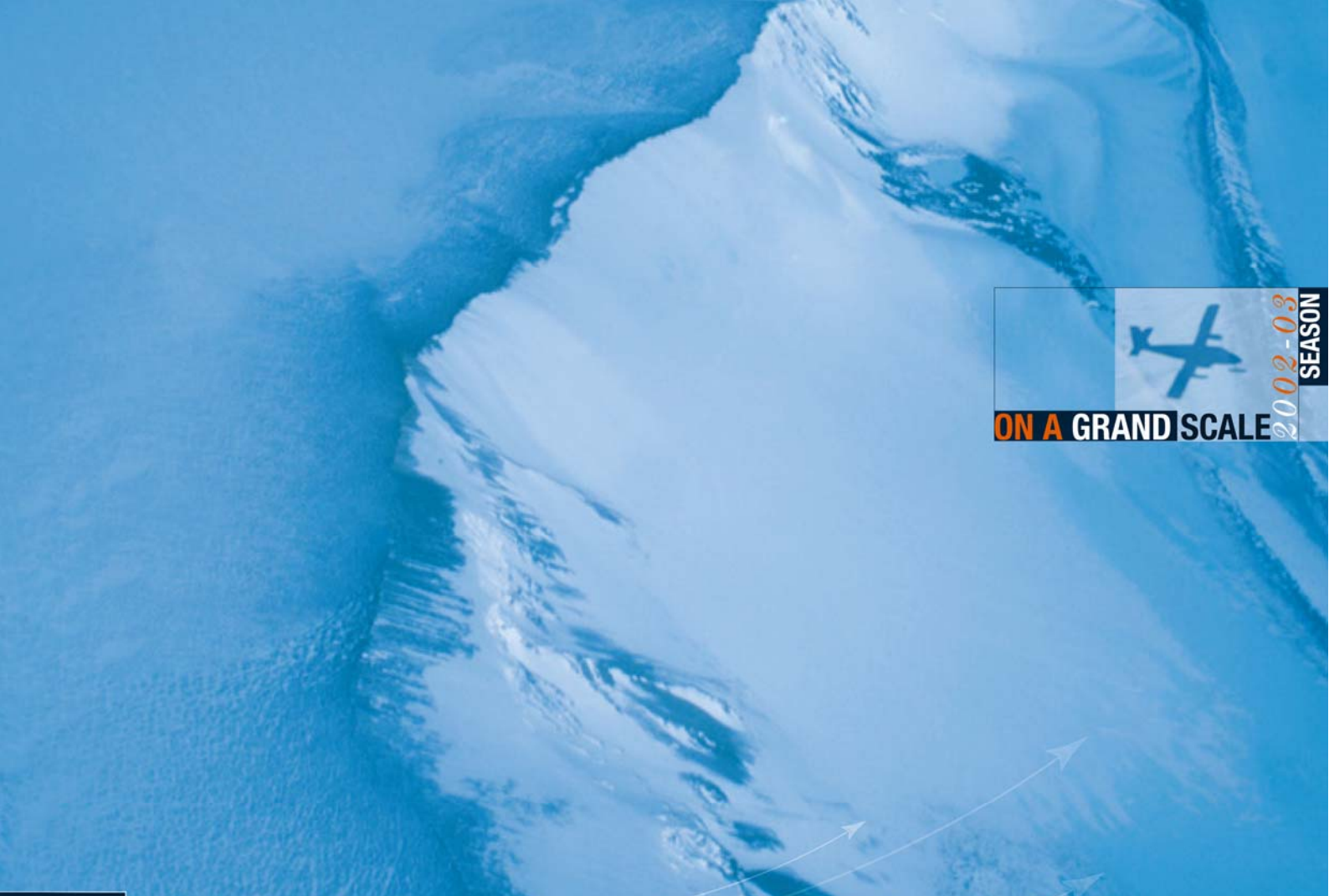


ON A GRAND SCALE 2002-03 SEASON

Prince Charles Mountains Expedition of Germany and Australia

Australian ANTARCTIC MAGAZINE

Expedition

5 Winter 2003

On a grand scale: the 2002-03 season

As I write this we are poised at the start of a new Antarctic season – a big season that will find us returning to Heard Island, undertaking a major marine survey in the waters of the Heard Island and the McDonald Islands region, returning again to the Amery Ice Shelf to drill another hole accessing the underside of the ice, undertaking an early-season marine science voyage, and undertaking a leg of the International Trans-Antarctic Scientific Expedition (ITASE) in which a number of shallow ice cores will be obtained along a transect running inland from Casey.

This comes on top of last year's highly successful program. Among many highlights was the joint collaborative work we conducted with our German partners from the Bundesanstalt für Geowissenschaften und Rohstoffe (the BGR – the German geological survey organisation). The study was undertaken in the southern Prince Charles Mountains and nicknamed 'PCMEGA'. Planning for this project started in 2000 and involved the establishment of fuel and supply caches along a traverse south-east from Mawson. As Professor Chris Wilson, the Australian science leader of the expedition, writes in this magazine "The PCMEGA program has been one of the most comprehensive onshore geoscience projects ever undertaken under the auspices of the Australian Antarctic program". Twenty scientists spent almost fifty days in twenty three field locations scattered around the southern end of the Mountains, ably supported by a team of field staff. Good weather helped with logistics and our use of a Twin Otter fixed-wing aircraft demonstrated to us the versatility of fixed-wing aircraft to support research of this kind. At the recent ATCM meeting in Madrid Australia presented a short paper on the expedition and a number of nations asked us about how we managed to coordinate such a large and successful international collaboration. I have to thank everyone who was involved in PCMEGA over the three years from start to finish, including Chris and his German counterpart, Dr Norbert Roland.

We also undertook a major marine voyage to study how krill swarms move relative to sea currents and other factors. Curiously, the field party named this research voyage 'KAOS' – though I am aware of at least one prior claim to this name made by glaciologists in recent years. I am glad to report the research outcomes were far from chaotic! We were able to demonstrate for the first time that krill swarms can change their position and size very quickly, and that the composition of the swarms changes considerably between day and night. This has great implications for the integrity of the swarm, and for migration. We finished that voyage with an oceanographic survey of the western boundary current that swings around the Kerguelen Plateau, and a measurement of the flow of the Antarctic Circumpolar Current between the Kerguelen Plateau and Davis. As Steve Nicol writes elsewhere in this magazine, "the edge of the Kerguelen Plateau [is] the region with the highest wave height in the world!" It is clear that work in this region is not for the faint-hearted!

GARY KUEHN

STEVE NICOL

Top: Staging post for PCMEGA – Mt Cresswell base camp. Above: Deploying the net on the major marine science voyage in early 2003.

I have picked out only a few of the many projects we undertook last season. The program was highly successful, with significant research and operational goals achieved reflecting credit on everyone involved with every aspect of our work. We enjoyed remarkably favourable operating conditions, and made hay while the sun shone! But good outcomes do not depend upon luck. Once again a wealth of planning and careful attention to detail underpinned our activities resulting in a successful season free from major incidents.

In early June we were all saddened by the death of Wayne Papps, a gifted and talented photographer and a dear colleague. Wayne died doing what he loved doing – taking pictures. Our thoughts and condolences go out to his family and friends. Part of him will live on in the many beautiful photographs he left behind. A full tribute to Wayne appears elsewhere in this magazine.

As the sun slowly repossesses the Southern Hemisphere, our colleagues on the ice and on Macquarie Island can start to look forward to spring, and to a return to Australia. As ever, they have done – and continue to do – a magnificent job keeping our stations functioning and in good shape for the big season ahead. I wish them well for the remainder of their sojourns, and send my best wishes, and thanks, to those who are now preparing themselves to walk in their footsteps. I am confident that the 2003–04 Antarctic season will be as successful as the last.

Tony Press

Unlocking the secrets of the Southern Prince Charles Mountains

In the frozen desert of Antarctica, there lies a mountain range that holds within its lofty peaks and its roots buried deep beneath the ice, a story of the Earth that spans thousands of millions of years. These are the Southern Prince Charles Mountains with rocks over 3.4 billion years old that formed the mighty supercontinents of Rodinia approximately 1000 million years ago, and Gondwana 500 million years ago. Here also is found a great rift valley that hosts the world's largest glacier – the Lambert Glacier. This valley was formed as Gondwana was ripped apart in an event that transported remnants of the supercontinent to form new continents such as Australia and as far away as Africa and Asia.

Despite their importance, much of the Southern Prince Charles Mountain range remained unstudied, due to remoteness and inaccessibility. A few trips had been made there, by Australia in 1960, 1974 and 1998, and by Russia between 1983 and 1991. These expeditions collected enough information to indicate that this is indeed a scientifically critical location, but not enough to provide as many answers as they did questions. In 2000, Professor Chris Wilson from the University of Melbourne and Dr Norbert Roland of the German Federal Republic Geological Survey [Bundesanstalt für Geowissenschaffen und Rohstoffe (BGR)] proposed an expedition to unlock the secrets of these mountains.

GARY KUEHN

Remote geological field parties supported by Squirrel helicopters.

During the 2002–03 Austral summer, an expedition of twenty scientists from five Australian, one Russian, and six German research institutions joined forces with the Australian Antarctic Division to undertake a complete study of the formation of these mountains and their preserved record of the Earth's history. It was christened the Prince Charles Mountains Expedition of Germany-Australia (PCMEGA).

The PCMEGA program has been one of the most comprehensive onshore geoscience projects ever undertaken under the auspices of the Australian Antarctic Program. The work involved several programs, including Australia's first major airborne geophysical investigations into the subglacial structure of the Antarctic continent, its glacial evolution and the impact of climate change. Other programs investigated the geological architecture of the bedrock geology and the control that this geology has on shaping the geomorphic evolution of the continent. A comprehensive sampling program was undertaken to establish the age and evolution of the continent and its relationship to other fragments when they were assembled as part of the supercontinent Gondwana.

Good weather and logistical support enabled an extremely productive field season. Twenty-four sites were investigated in detail, incorporating field camps at Mt Stinear, Cumpston Massif, Clemence Massif, Mt Dummit, Wilson Bluff, Mt Ruker, Mt Rubin and various light-weight camps along the Mawson Escarpment. Detailed observations and maps at 1: 10,000–1:50,000 were made of the ancient bedrock outcrops and early Cenozoic-Recent weathering, glacial, fluvial, biological and lacustrine landforms and sediments. Four tons of hard rock samples were collected for mineralogical and geochemical investigations and age dating, with four hundred sediment samples collected to determine past geomorphic processes and sediment depositional pathways and for cosmogenic exposure age dating.

One of the most interesting features of the Southern Prince Charles Mountains is the presence of a remarkably widespread and ancient land-surface that marks the summit of much of the range. The enigmatic flat plateau-like surfaces of these mountains piercing the Antarctic ice sheet hints at the region's older history. This is a history that has since been disrupted by faulting and uplift, erosion and glaciation.

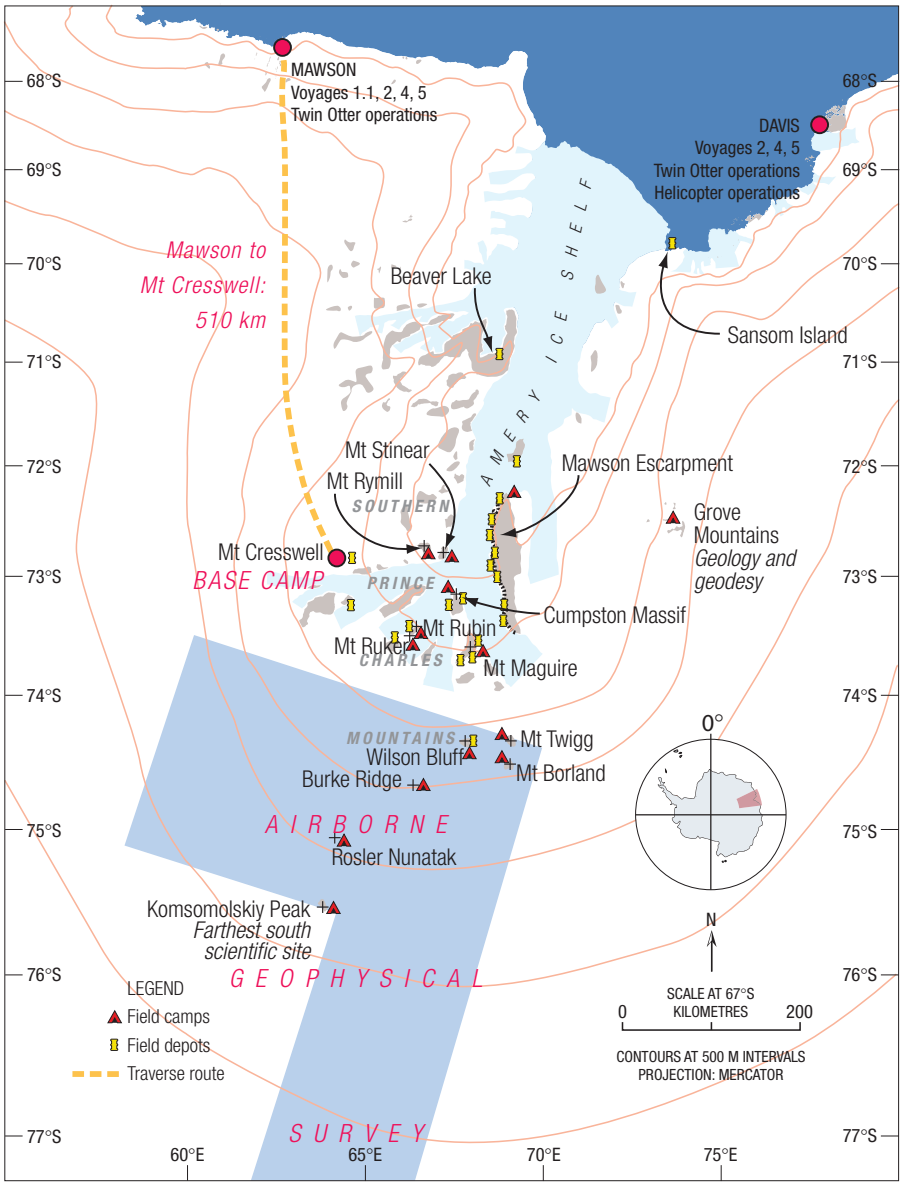
Over the next two years, detailed investigations using a range of isotopic techniques,

in conjunction with structural analysis, will be necessary to determine the magnitudes and rates of the processes that shaped this part of the continent. This will permit reconstructions of key components of the tectonics of Antarctica since before the break-up of Gondwana. Because only a small percentage of the continent is exposed from beneath several thousand metres of ice, the research will use the ice-penetrating radar, as well as subsurface geophysical data collected as part of the PCMEGA program, to establish a regional picture of the crustal geometry and development.

The airborne geophysical program involved a Twin Otter fixed-wing aircraft flying in a surveyed grid over an area of 81,000 square kilometres. This has produced over 30,000 kilometres of high-quality airborne gravity, magnetic and ice-penetrating radar data that has enabled the scientists to map the underlying geology in the sub-glacial basement at depths of up to 3.5 kilometres below the current ice surface, and identify the shape and distribution of the sub-glacial mountains. Importantly, they have been able to locate and identify part of the Gamburtsev Mountains, a major sub-glacial mountain range buried by 1600 metres of ice that acts as a major glacial drainage divide underneath the centre of the east Antarctic ice sheet some 1000 kilometres inland from the continental margin.

As a major bonus to the geophysics program there was the acquisition of some additional 20,000 kilometres of geophysical data from the upper reaches of the Lambert Glacier and its tributary glaciers. This data was acquired during the Twin Otter's daily flights over known areas of outcropping rock from Mount Cresswell to the survey area. The additional high-quality ice radar data and its precise GPS surveyed positions will provide important information on the volume of ice flowing through the Lambert-Amery ice drainage system and any mass-balance calculation of ice volumes. The additional gravity and magnetic data obtained during these flights is also critical as it can be directly correlated with the petrophysical properties of the rocks collected during the geological investigations.

Rock samples were also collected along and across the tops, and in numerous vertical profiles, of many of the 1000 metre high nunataks that penetrate the ice sheet. These mountainside profiles will provide information about Antarctica's history that could otherwise only be recovered by drilling deep boreholes. In essence, individual samples record a portion of the history of the rock column over vast expanses of time (greater than 500 million years). The spectacular three-dimensional exposure in the Southern Prince Charles Mountains also enabled an assessment of the recent structural development of fault blocks that now confine the world's largest glacier – the Lambert Glacier.



PETER BOYER

The PCMEGA team included two geodesists from Geoscience Australia and one from the University of Dresden in Germany. They were responsible for establishing gravity and GPS stations to record long-term uplift, or isostatic rebound, of the Antarctic continent, as a result of ice sheet volume changes. The GPS data collected from all sites will be processed to generate sub-centimetre coordinates. These positions will provide a base data set for the study of tectonic plate movement. The geodesists were also able to record surface flow rates of the Lambert and its tributary glaciers and re-surveyed the position of 20 nunataks, using the highly accurate GPS survey methods. Additional tasks completed during the geodesy campaign included the establishment of a ground calibration grid for the ICESAT satellite launched on the 13th January 2003, and the placement of a Doppler Orbitography Ranging Interfermetric System (DORIS) beacon on the Lambert Glacier to measure the movement upstream (south) of the glacier's grounding line near Cumpston Massif.

The scientists of PCMEGA will be busy over the next months and even years, processing and interpreting the huge amounts of data they collected. In a mere two months, this group accomplished more than the previous expeditions were able to accomplish over several trips. By combining their intellectual and financial resources, they were able to execute a complete study that will expand our knowledge of the processes that have shaped our Earth over billions of years.

Chris Wilson, University of Melbourne

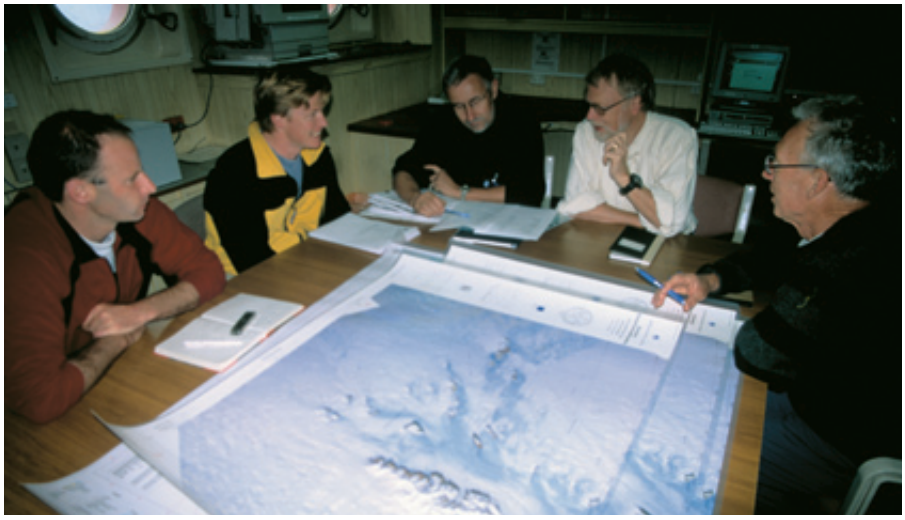
PCMEGA: an ambitious operation

The Prince Charles Mountains Expedition of Germany and Australia was one of the most operationally challenging undertakings of the AAD in recent years. The intention to take Australian and German scientists far into the Southern Prince Charles Mountains (SPCM) to achieve an ambitious science program posed many challenges to the operational support staff.

Over 12 months before the first scientist set foot on Antarctica, equipment had to be dispatched by ship. Predicting what may be needed was met head on with field support staff and the project planning team at Kingston collecting and purchasing gear that was subsequently shipped to Mawson on Voyage 6 in January 2002. This included tents, mountaineering equipment, rations and those small yet essential items such as toilet paper and sewing needles, all of which had to be delivered into the field on the traverse.

Two traverses from Mawson were mounted as part of PCMEGA, one in autumn 2002 and one in spring 2002 (See *Australian Antarctic Magazine* 4:37). The support from the station was invaluable in preparing the vehicles, cargo and personnel for the long haul to establish an expedition base camp at Mt Cresswell over 500 kms south of Mawson.

Another of the challenges faced by the support staff was that of determining the requirements of the science program. With people coming from all around Australia, Germany, the United States and Russia there was little lead time with everyone together to make any last minute changes. Detailed planning by the project team and support staff involved visits to Melbourne University and Hanover, emails and many phone calls. Still, no plan survives long after the lines are cast off in Hobart, and the result was a very busy pace of meetings, talks and planning on the *Aurora Australis* as the expedition steamed south.



GARY KUEHN

Plans become closer to reality as the ship nears Davis and deployment of the expedition.

Support in the field was provided by two helicopters which embarked from Hobart, and a Twin Otter aircraft from Calgary in Canada. It was determined that scientists and field training officers were to be deployed to three locations as soon as possible after arrival at Davis. This information was conveyed via email to the Twin Otter crew and the traverse team, the latter by now established in a base camp at Mt Cresswell. The usefulness of the Twin Otter aircraft soon became apparent as within a week of our request, the aircraft supported by the traverse team had positioned caches at the Rofe Glacier, Mt Stinear and Wilson Bluff on unprepared ground. Vital camp stores were deposited and at Wilson Bluff drums of fuel were deployed for the coming aerial geophysics survey.

After arriving at Davis on the evening of 5 December the pace quickly increased. The next morning the first Twin Otter flight departed for the SPCMs at 0800 and by the end of the day two flights had been completed. We were indeed thrilled to have established a magnetic base station for the geophysicists and to have the first geologists in a field camp at Mt Stinear by the end of day one. The fly-in continued over the next ten days with geologists and geodesists flying in to base camps and field camps to start work.

Aviation fuel was undoubtedly the most precious resource. The fly-in had been carefully orchestrated to use fuel at Sansom Island, cached earlier by Twin Otter, and from Davis, rather than the precious 480 drums that had been traversed in. The Twin Otter was now sent back to Davis to be fitted with geophysics equipment to allow the collection of magnetic, gravity and ice radar data over the next four weeks. It was a race against time for the team as the sea ice at Davis, and as a result the skiway, was fast breaking up. After a few test flights and with 50 knot winds forecast the aircraft departed Davis just prior to midnight on 19 December. The expedition was now fully deployed.

The geologists and surveyors had been busy since their arrival, travelling daily by foot, quad and helicopter to a range of areas. Rock samples were collected and survey marks established. The field training officers were kept busy managing the camps, ensuring safety and facilitating access to the required areas.

Traverse vehicles – fuel sledges, living van, generator van and tractors – at rest for the night while en route to Mt Cresswell.

JAMES DRAGISIC

The traverse team, medical officer and field leader were also called on to assist scientists in the field and to maintain the base camp. A major undertaking was the provision of meals at Mt Cresswell for up to 20 people which fell to two of the traverse mechanics, and a fine feed it was! Communication was the lifeline for coordination and safety and the dedicated communications operator was always busy talking to the three aircraft and the field parties, while also doing three hourly weather observations!

Helicopter flying was planned about five days in advance with nightly updates as the wishes of the field parties changed with weather and what they were finding on the ground. Each day's flying had to be well planned to achieve the maximum as the fuel reserves were monitored carefully. By the end of the season the expedition had occupied 22 different field camps and established survey marks at 23 locations. We had travelled as far south as Komsomolskiy Peak, the most southerly rock in the AAT at 75° 30'S, and covered the SPCMs in detail. This was all achieved with excellent helicopter support and local light vehicle and foot travel.

The geophysics survey operated out of Mt Cresswell for a month. Flights were operated between 1400 and 0200 local time to avoid magnetic disturbance in the area. After long hours collecting data from the air, the team commenced collating and processing back at Mt Cresswell before crawling into tents for some well earned sleep. The split routines of the field parties and geophysics team provided a number of challenges for support staff and aircraft crew that were overcome by flexibility and a good deal of hard work. Over the four weeks of the survey the team achieved an excellent result with 30,000 km flown in the survey area covering some 80,875 km^2. An additional 20,000 km was flown and surveyed en route to the survey area. Each flight was planned to cover maximum ground while best utilising fuel reserves.

The SPCMs are not only an area of rich scientific potential but are also of historical interest. The expedition discovered two old ANARE camps, one from 1974 at Mt Cresswell and one from 1959 at Binders Nunatak. Both of these sites were cleaned up and in the process a good deal of historical material was recovered. The discovery of an original ANARE 'barge caravan' (used to accommodate expeditioners on traverse in the 1950s) with all equipment in place was particularly exciting.

GARY KUEHN

Geological field camp in the Southern Prince Charles Mountains.

The final phase of the expedition was withdrawal from the field. All the waste that had been collected was removed from the field and camp stores were centralised at Mt Cresswell. The geophysics team flew to Mawson at the completion of their program and it was here that the aircraft was reconfigured to carry people and cargo by removing survey equipment and instrumentation.

While the helicopters delivered the field geologists and camp stores to Mt Cresswell the Twin Otter commenced flying stores and people to Mawson. To ease the burden on the stations and with a need to visit the Grove Mountains in mind, the team was split with half going to Mawson and half to Davis. With no sea ice at Davis on which to land the Twin Otter, a reconnaissance flight located an excellent skiway in a valley in the Vestfold Hills, affectionately known as 'Twotter Valley'. This required the use of helicopters to shuttle people and cargo between the station and the landing site. Taking one of the geologists to collect samples at Beaver Lake, Landing Bluff and Sansom Island, the helicopters made the journey from the PCMs to Davis in one long day. Flights to Davis then commenced as those who had flown to Mawson now boarded the *Polar Bird* in Horseshoe Harbour.

Those remaining at Mt Cresswell set about pulling down the base camp. This involved digging out and collapsing the large Weatherhaven tents, decommissioning the shipping container that had accommodated the pilots in order to store cargo once again, preparing traverse vehicles and sleds and packing some 5.5 tonnes of rock samples. The normally windy and cold conditions at Mt Cresswell abated to make this work more pleasant and by 28 January we were ready to go. A party of four was still at Wilson Bluff. They were collected by Twin Otter and flown to Davis via Mt Cresswell. The aircraft then returned the same day as the weather was forecast to deteriorate the following day, and completed the final passenger flight. It was an indication of the value of the excellent forecasting that the subsequent four days were not flyable. Just two days after this last passenger flight the traverse departed for the downhill run to Mawson. Left at Mt Cresswell were four quads and the large tents that were all flown out at the start of February. With these final cargo flights and a visit to the Grove Mountains from Davis we had completed all we had set out to do.

PCMEGA was ambitious and necessarily complicated from an operational and logistic perspective. It was an excellent example of what can be achieved both through international cooperation and teamwork from within the AAD. The words on all expeditioners' lips at the end of the summer were 'When we come back for PCMEGA 2 we will…'

Robb Clifton, Field Leader, PCMEGA

Forecasting for PCMEGA

The challenge

PCMEGA relied on two helicopters and a Twin Otter. Each of these aircraft was required to fly on most if not all days, so any limitations imposed by weather could have shortened the time available to collect scientific data. The main requirement was that conditions be suitable for visual flight, which meant that good horizon and surface definition was essential. Although the Twin Otter could be flown in cloud at high altitude for much of the transit from Davis to Mt Cresswell, most of its flying hours were spent in flying near the ice surface to the south of Mt Cresswell. The helicopters required visual flight conditions at all times.

Why not use instruments?

The surface air pressure and altitude are not known to acceptable accuracy over the ice sheets in Antarctica, so it is impossible to use the aircraft altimeter to maintain a safe altitude at low levels. Low altitude flight over ice requires the ability to detect your height and to be able to maintain the aircraft's flight attitude by eye alone. For these tasks, good horizon and surface definition is essential.

Horizon definition

Straight and level flight requires that an aircraft be flown at a constant altitude with constant power. In visual flight, the pilot maintains flight altitude by watching the horizon. If the horizon starts to rise, the aircraft has nosed down – not a good idea if the aircraft is close to the ice surface. With clear skies, the blue/white horizon boundary is easy to see, but if cloud extends to the horizon there may be no way to tell where the ice ends and the cloud starts. Rocks on the surface can help, but the area where the Twin Otter had to fly was mostly ice.

Surface definition

Pilots must be able to see the surface well enough to see its movement relative to the aircraft. Without that movement, it is impossible to tell how close you are. For helicopters, this is especially dangerous, as they must hover before landing. If a helicopter is moving in any direction when it settles onto the ground it can tip over, with disastrous results. In full sunlight, shadows can be cast by surface features, but if it is overcast at any altitude, the light is diffused in all directions, so all the pilot sees is white. In 'whiteout' conditions, it can be difficult to even walk safely, let alone fly. Even in the absence of cloud, blowing snow can make the surface impossible to see.

The tools

There are very few weather stations in Antarctica. We received only one visual report from the Prince Charles Mountains, sent by Alan Rooke, the comms operator at Mt Cresswell. While there are a few automatic weather stations around the Amery/Lambert basin, they cannot detect cloud, horizon or surface definition. This meant that we had one visual weather report for an area the size of Tasmania. (Tasmania is not a huge state, but even so, forecasting weather at Devonport is not helped much by observations from Hobart!) Even the reports from Mt Cresswell were at three-hour intervals and the workload imposed on the operator meant that it was often six hours or more before we saw a particular report. Other sources of data were essential, and the best available to us was weather satellites.

Forecasters in Australia can expect a satellite picture of their area every hour, sent by satellites stationed over the equator, but these satellites do not see far enough south to give much information over the Prince Charles Mountains. Instead, we had to use 'Low Earth Orbit' satellites, mostly the American NOAA series of satellites. The images were received in real time at Davis and offered images from

MIKE WOOLRIDGE

Stephenson screen houses thermometers used for daily weather observations

both visible and infra-red bands, with acceptable latitude and longitude grids. These gave good coverage during the morning, but in the afternoon there was a gap of about six hours between satellite passes. Fortunately, a Russian satellite, Meteor 3–5, passed overhead during the afternoon for much of the PCMEGA period of operations. While the Russian satellite images could not be gridded satisfactorily, we became familiar with the rock features to the extent that we could detect cloud position given a few identifiable features. The Mawson Escarpment was especially recognisable. If we could not recognise enough surface features to work out where the cloud was, it was generally too bad to fly anyway!

Finally, we used numerical guidance. Computer models of the atmosphere supplied diagnostic data, from which we tried to forecast the movement of cloud over the next few days.

Essentially, we tried to forecast cloud and surface wind conditions. Although we attempted to forecast snowfall, the cloud cover was the most important issue.

The people

Two forecasters were on duty at Davis, Martin Crowe and myself, both from the Bureau of Meteorology from the Adelaide and Hobart offices respectively. We commenced duty between 5.15 and 5.45 each day and covered most of the hours until 10 pm. In addition to the PCMEGA forecast, we provided forecasts to each of the stations and to any field parties requesting support.

The results

We found it difficult to provide an adequate service in the short term. With a six to twelve hour turnaround for information into and out of the Prince Charles Mountains via email, we did not find out about weather deteriorations until too late and most amendments to the forecast would not arrive in time to be of any use. We could not hear the radio traffic to and from the aircraft, so we had no knowledge of what the aircraft were doing or what they were encountering. We attempted to improve the situation by sending small clips of satellite images directly to the comms operator at Mt Cresswell with a brief description of trends, but even these were somewhat delayed.

We found it was more useful to PCMEGA for us to provide a daily forecast in the morning and evening, including an outlook for the next two days. These forecasts and outlooks proved to be the most useful, allowing a degree of planning at Mt Cresswell. Some success was achieved in forecasting the periods of whiteout, with favourable feedback from the people at Mt Cresswell. All in all, the good weather experienced for much of the time during PCMEGA allowed us to provide a forecasting service from Davis that was appreciated by the people who laboured under difficult conditions in the southern Prince Charles Mountains to make PCMEGA a success.

Lance Cowled, Bureau of Meteorology

Behind every successful expedition ...

ROBB CLIFTON

The team photo (above) of members of PCMEGA and helicopters, tractors and the Twin Otter aircraft set against the backdrop of Mt Cresswell and the ice plateau is an evocative image of the most ambitious scientific field program conducted by the AAD in many years.

Almost at the other (eastern) end of Australia's operations, another proud field party posed before the camera at Cape Denison after completing their heritage conservation work on the nearby wooden huts used by Sir Douglas Mawson's Australasian Antarctic Expedition of 1911–14.

Between these geographical points nearly 3,000 kms apart, over 120 scientific projects were in progress, ranging from automated data collection in station laboratories to small groups of glaciologists, biologists, limnologists, ornithologists and botanists roaming away from the continental stations by over-snow transport, boats and by foot as participants in Australia's Antarctic Program.

Planning for even the simplest Antarctic science program begins two years before the departure of the ship. With more complex programs, positioning of essential equipment or aircraft fuel may mean an even longer lead time.

Once applications by Chief Investigators are approved by the Antarctic Research Assessment Committees, the projects are considered by members of the Operations Science Support Working Group in the Operations Branch. Their job is to assess the operational support requirements of all approved programs and assign radios, first aid kits, specialist clothing, food and cooking equipment, tents and field huts, vehicles and aircraft as well as trades support and advice to aspiring scientists. Additional field guides may also be required to guarantee the safety of research expeditioners.

ROBB CLIFTON

Top: The PCMEGA team at Mt Cresswell Base Camp and some of the hardware that made it happen. Above: Departure from Hobart on the Aurora Australis.

With approval of a berth on a ship, there are then medical assessments and psychological suitability tests to be administered, and recruitment of expeditioners to be finalised by staff in the Corporate Branch.

Prior to departure, all expeditioners must undergo community, safety and survival training which is conducted by staff in the Operations Branch. Many undergo trade and technical training specific to their area of expertise as well as training as assistants in essential skills such as anaesthetics and nursing.

Responsibility for managing operational support for the science program is assigned to Station, Field and Voyage Leaders who rely on trade and technical support expeditioners within their teams to carry out the work agreed in the planning stage.

By the time a scientist departs for a period of work in Antarctica or the sub-antarctic, numerous Head Office staff have played a part in some aspect of supporting their research program.

Rob Easther, PCMEGA Project Manager, AAD

The loose tooth: rifting and calving of the Amery Ice Shelf

RICHARD COLEMAN

Eastern end of the active rift looking along the main rift in the direction of propagation (south east), where it is cutting across smaller pre-existing crevasses that have formed upstream as the strain in the ice shelf has accumulated. A huge block of ice has broken from one of the walls and slumped into the rift.

Most of the mass loss from the Antarctic ice sheet takes place at the fronts of ice shelves and glacier tongues, via iceberg calving, or by basal melting from below. Icebergs separate from the parent ice along rifts – fractures through the total thickness of ice – that progressively form with the deformation and flow of the ice. Ice shelf rifting is an important glaciological process about which we know very little. Rifts in floating ice shelves that surround Antarctica are the largest crevasses seen in the glaciological world and understanding the mechanisms of rifting and their formation and evolution is critical to quantifying the overall mass balance of the Antarctic ice sheet and assessing the long term stability of its ice shelves.

Calving in ice shelves happens when large sections of the floating ice shelf break off. The resultant icebergs break up into smaller icebergs, which subsequently melt as the various sections are carried away by the ocean currents. The nature and frequency of such calving events is of interest, especially to understand if any link exists with global climate change – that is, whether the oceans are warming and causing increased calving and melting of the ice shelves.

Our region of study is the Amery Ice Shelf, which is the largest ice shelf in East Antarctica. This ice shelf drains the grounded portion of the Lambert Glacier Basin–Amery Ice Shelf system, which accounts for 1.6 x 10^6 km^2 of the grounded East Antarctic ice sheet – 16% of its total area. The ice that flows out from the Lambert Glacier Basin region passes through the front of the Amery Ice Shelf, which occupies only 2% of the

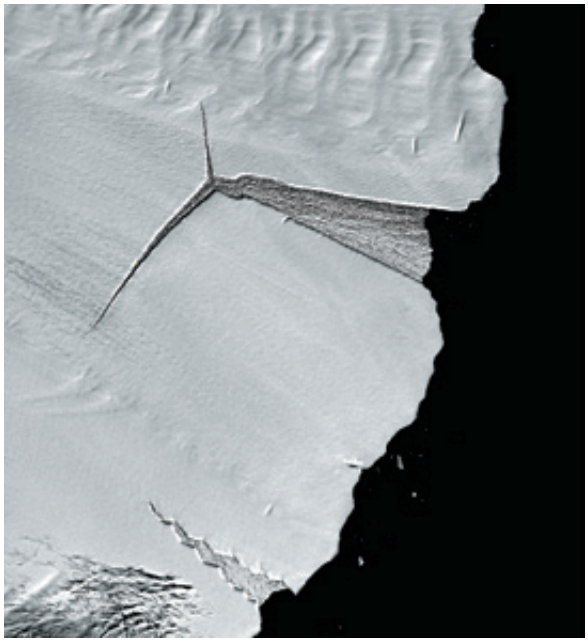


Figure 1: Satellite image detail of the 'loose tooth'. Data acquired 2 March 2003 by the Landsat-7 ETM instrument and supplied by USGS/EDC LP-DAAC.

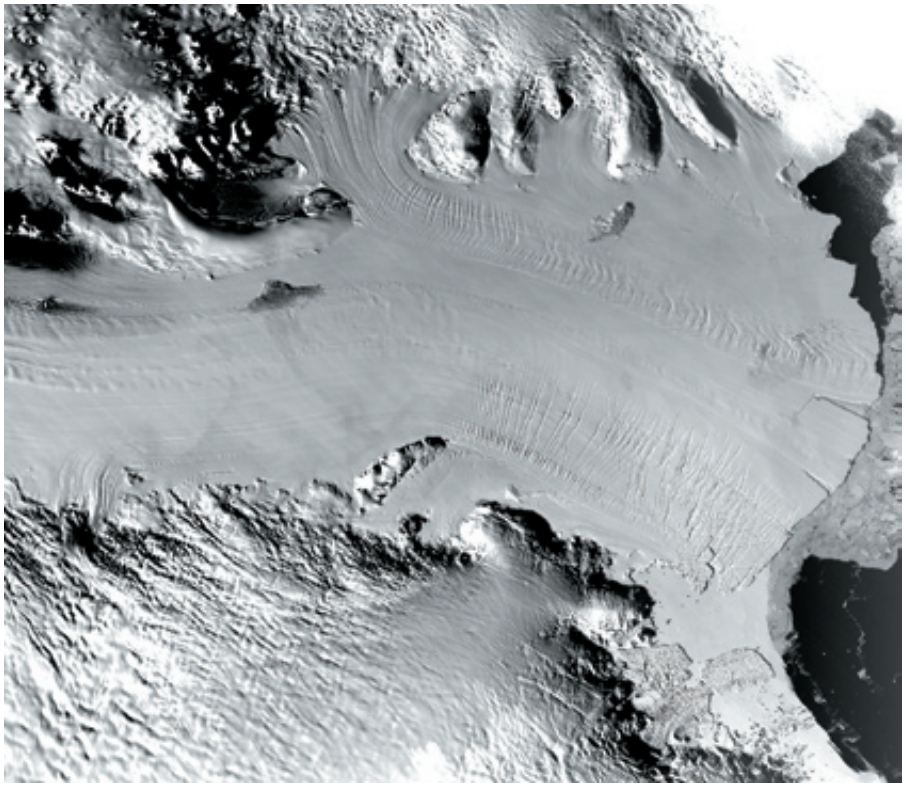


Figure 2: Satellite image showing the Amery Ice Shelf with the 'loose tooth' clearly visible at the front of the shelf. The rate of the transverse fracture suggests that the tooth will calve within the next 5–7 years or so. Data acquired 2 December 2000 by the MODIS instrument on NASA's TERRA satellite, and supplied by NASA/GSFC/DAAC.

East Antarctic coastline, making the Amery an ideal region to study as a sensitive indicator of change in the global climate system.

The last major calving event on the Amery occurred in 1963–64 and we are studying a section at the front of the ice shelf, affectionately termed the 'loose tooth'. The 'loose tooth' is an area of about 30 by 30 km, and consists of two longitudinal-to-flow rifts, which started to open around 15 or more years ago, and two transverse-to-flow rifts that formed about seven to eight years ago. The longitudinal flow lines are clearly seen in Figure 1 and are boundaries of ice streams from the Charybdis Glacier on the western side and the Fisher/Mellor Glacier flows on the east. These latter ice streams have merged together approximately 500 km upstream to form the ice shelf. The rifts at the front of the ice shelf form as the flow lines are forced apart, in regions where the transverse (lateral) strain rate is high. About 30 km from the front of the ice shelf, on the western side, two transverse rifts are seen, with the eastern rift much longer than the western transverse rift. The eastern transverse rift is currently lengthening or opening up at approximately 7–10 m/day (see Figures 1 and 2). In other words, over one year the transverse fracture will extend further eastwards by about 2–4 km and it will widen as the 'loose tooth' progressively separates from the main ice shelf. The ice shelf in this region is moving forwards in a north-easterly direction at about 1200 m/yr.

During the summer season of 2002–2003, we undertook a project to monitor the propagation (widening and elongation) of the rift and vertical displacement of the 'loose tooth' by measuring the horizontal and vertical movements in an area near the tip of the eastern transverse rift. We used Global Positioning System (GPS) units for measurement of displacement across the rift and an array of seismometers was deployed to 'listen' to the cracking and snapping of the rift systems. The GPS array consisted of six sites, positioned around the tip of the rift system (within 10 m to 2 km away), that continuously recorded data every 30 seconds over a seven-week period. Helicopter support was vital to enable us to land in regions close to rifts and crevasses, and made for some interesting fieldwork (see photograph below).

Preliminary analysis of the GPS data from this season indicated a widening of the rift near its tip of about 2–4 metres over the seven-week period and lateral movement across the rift of the order of 12 metres. If the current rate of eastern rift propagation continues, it is likely that the 'loose tooth' section will calve from the Amery Ice Shelf within the next 5–7 years. Further fieldwork is planned for the next two summer seasons to measure the active dynamics of this rift system and to understand the processes involved in ice shelf calving.

This project is being done collaboratively with researchers from the University of Tasmania (Richard Coleman), Scripps Institution of Oceanography, USA (Helen Fricker and Jeremy Bassis), the Cooperative Research Centre for Antarctic Climate and Ecosystems (Neal Young) and the University of Canberra (Peter Morgan).

Richard Coleman, University of Tasmania & ACE CRC; Neal Young, AAD & ACE CRC.

A seismic monitoring station closest to the position of the propagating tip of the rift. The site is at the junction of the recently-formed main rift and one of the smaller cross crevasses, with a Squirrel helicopter for scale. The snow bridge that was previously spanning the smaller side crevasse has slumped into it as summer temperatures have warmed. The rift widened about 2-4 m at this site during the summer season.

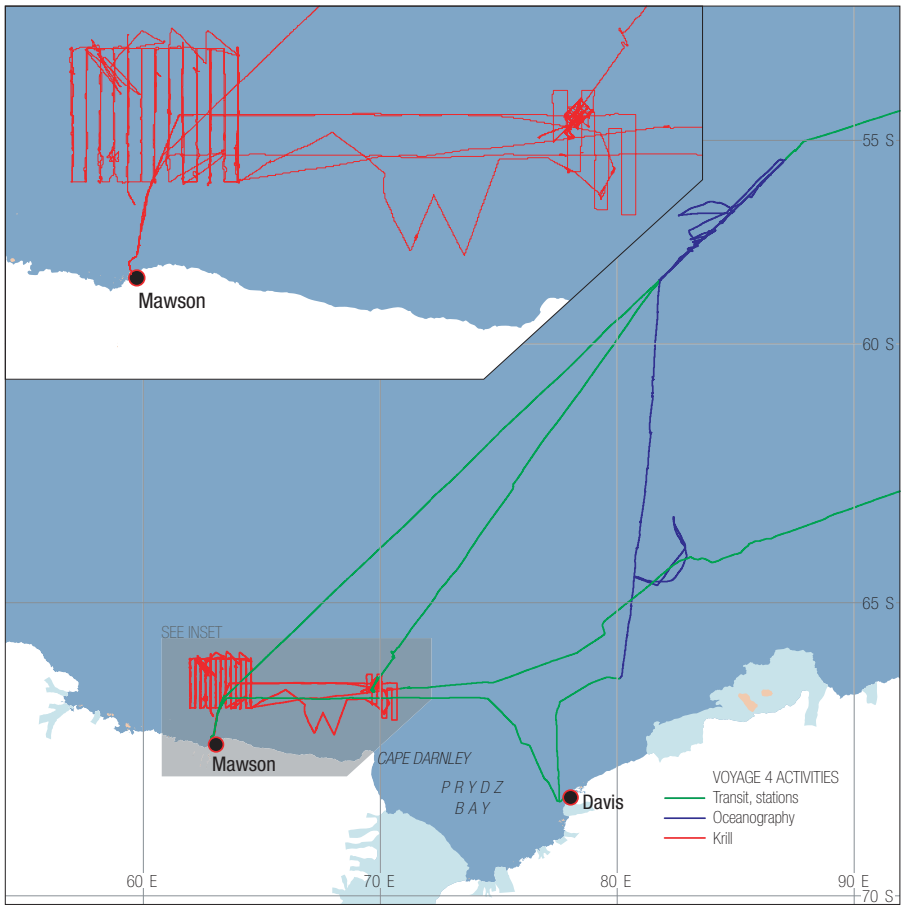
RICHARD COLEMAN

Flux and KAOS: Voyage 4, 2003

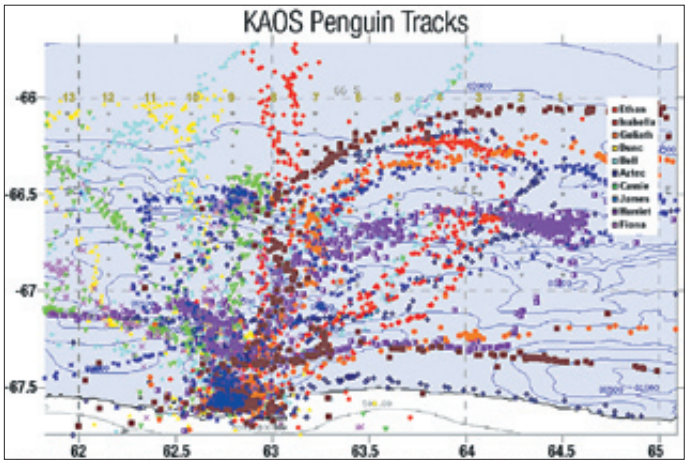
One of the key questions in Antarctic ecology is whether the populations of krill are resident in an area or whether they are merely drifters in the currents – a phenomenon referred to as krill flux. The answer to this question obviously affects our understanding of how animals such as penguins, which have a relatively fixed geographic location during their breeding season, interact with their major food source – krill. It also affects the way in which the krill fishery is managed; if the krill population in an area is transitory and is sourced from production elsewhere then localised fishing effects can be far less serious than if the local population is produced in situ. Unfortunately this is an extremely difficult issue to tackle, requiring concerted study at a number of different time and space scales using a range of complementary techniques. It is made more difficult by the vagaries of Antarctic operations.

In the summer of 2000–01 the first Australian attempt was made to examine the question of krill flux on a voyage called KACTAS (Krill Availability, Community Trophodynamics and AMISOR Surveys) This study occurred in the waters off the Béchervaise Island CCAMLR Ecosystem Monitoring Program site near Mawson where the population biology of Adélie penguins has been studied for 12 years. The idea was to use satellite tracking to define the area of the ocean where penguins were feeding during their breeding season, then to position the *Aurora Australis* in this area and rapidly survey the physical and biological environment of the area a number of times to examine changes that occur with time. In particular, the short term changes in krill distribution were to be examined using the ship's hydroacoustic instruments (see 'The Machine that Goes Ping', *Australian Antarctic Magazine* 2:10) and to relate these changes to currents measured using shipboard instruments and satellite buoys. Unfortunately, as the ship was close to completing the first pass of the survey area it was recalled from scienctific duties to assist the *Polar Bird* which had become beset near Casey. Despite the curtailment of the survey some useful data were obtained and many valuable lessons were learned.

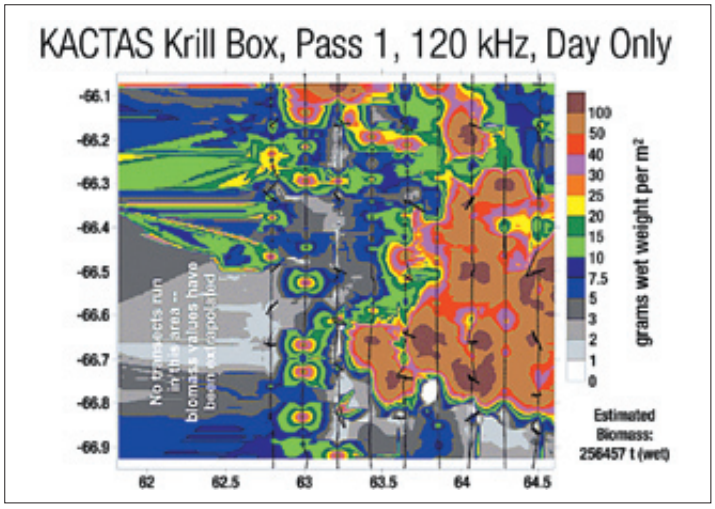
Thus, in the summer of 2002–03 the *Aurora Australis* sailed south to once again examine the krill flux question. The idea was to repeat the survey in the same area, though much more quickly this time. Experience from the curtailed survey had indicated that the krill population can change incredibly rapidly and that there can be considerable differences in the pattern of distribution from day to night. Consequently, on the 2003 survey (now named KAOS – Krill Acoustics and Oceanography Survey), the survey work would only be done by day with any sampling being conducted at night. This made for a complicated survey pattern but has allowed for easier interpretation of the results. In addition to the use of acoustics to study krill, a suite of shipboard instrumentation was used to examine the oceanographic environment where the penguins were foraging and satellite-tracked buoys were used to follow the currents in the area. Nets and water bottles yielded samples which could be used to determine

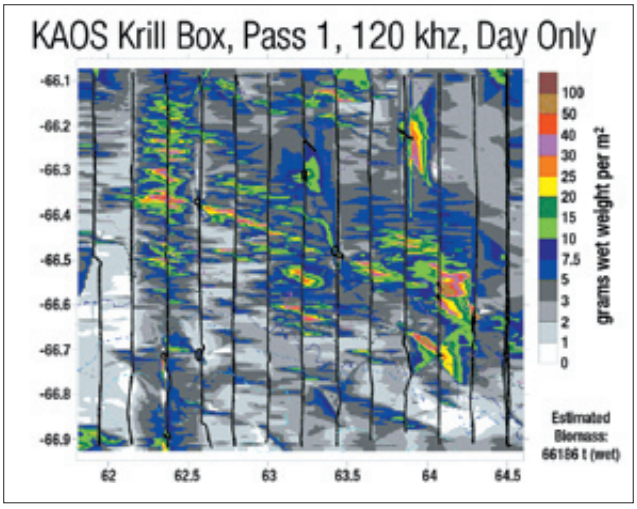


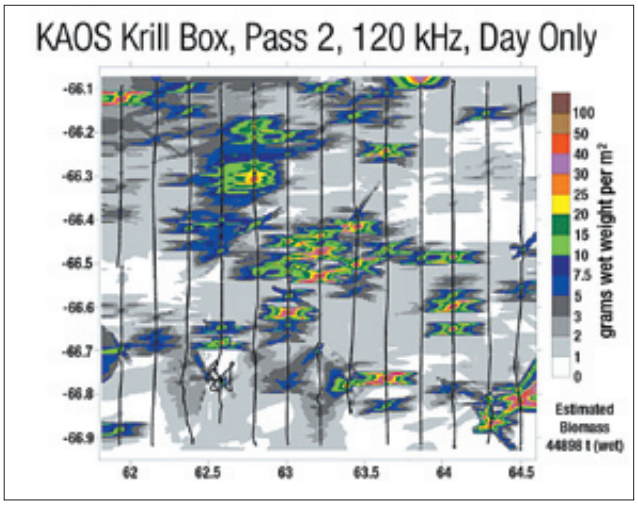
The voyage track during scientific operations showing the survey area off Mawson, the somewhat chaotic fine-scale survey work off Cape Darnley and the more orderly oceanographic research near the Kerguelen Plateau. Some of the irregularities in the ship's track are a result of the ship being hove to in foul weather.



Penguin foraging tracks; in 2003 the general area utilised by the penguins was similar to that of the 2000–01 season but there are differences in the exact locations between the years indicative of the different levels of krill abundance encountered.

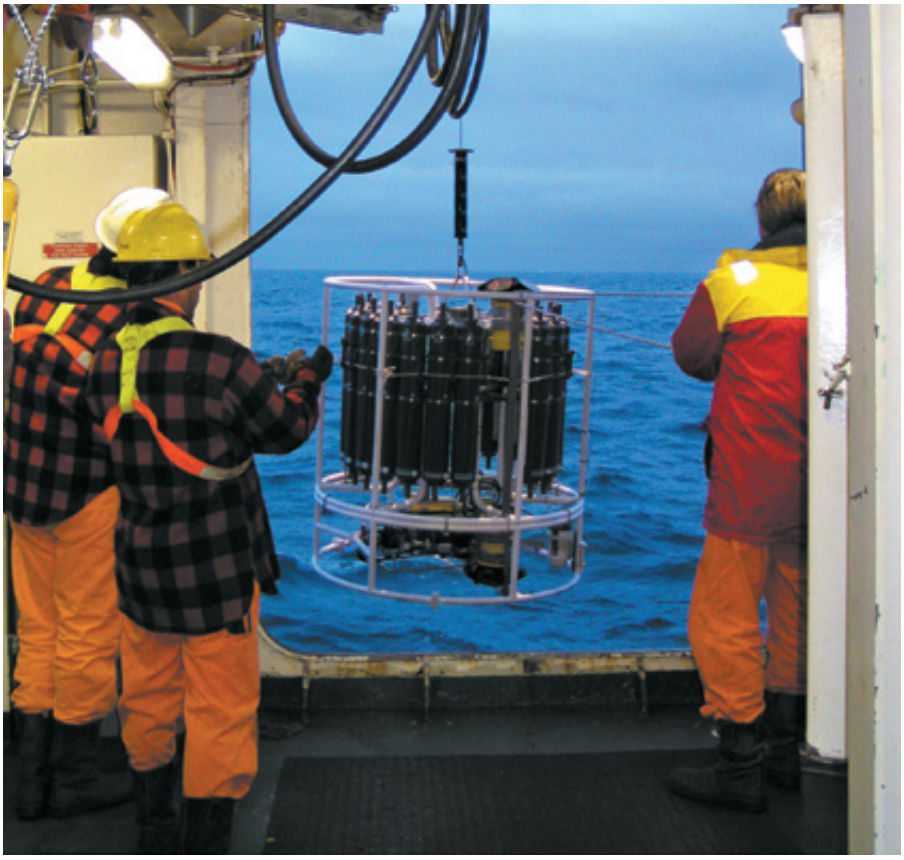






Krill distribution and abundance showing the difference between the 2000–01 season when penguins were in very good condition (above left) and the 2002–03 year when the penguins had more difficulty finding krill (above right and opposite).

Below: Oceanographic sampling during the krill survey. This instrument, the CTD (conductivity, temperature and depth), provides critical information on the physics and chemistry of the water column.



STEVE NICOL

the biological activity of the organisms in the area and sighting surveys of birds and whales completed the picture.

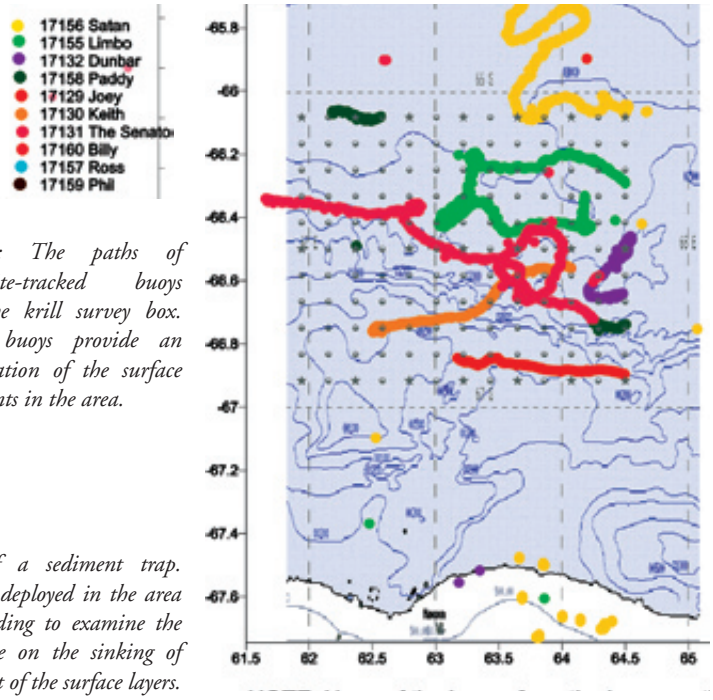
Despite an abundance of low pressure systems which slowed progress the survey went almost to plan. The survey area was essentially the same as that surveyed in 2000–01 because results from penguin tracking had indicated that the same area of ocean was being utilised. This had the added advantage of producing results that were directly comparable between seasons. The first pass of the area was completed in eight days and revealed a scarcity of krill compared to the 2000–01 season – krill were low in abundance generally and there were also fewer large swarms detected. This was also reflected in the way in which the penguins were feeding – they were going further and coming back with less krill. The acoustics and the penguins then seemed to agree on the scarcity of krill which was reassuring. What was less confidence-inspiring were the results of the second pass of the survey area which produced an estimate of krill abundance which was some 30% lower than the first survey which had been completed only a few days earlier. The krill population obviously had the capacity to change rapidly. Initial examination of the results from the current measurements failed to find an obvious oceanographic explanation for the change in krill distribution and abundance. Luckily, the wealth of measurements and observations from the research conducted in 2000–01 and 2002–03 will allow a detailed examination of the relationship between the krill populations and the physical and biological environments and hopefully will shed some light on the issue of krill flux.

A second phase of the krill work took place further to the east, off Cape Darnley, a location where krill are nearly perennially

abundant. This focused down at an even smaller scale on the individual krill swarms and examined how they changed on a daily timescale. Findings from this part of the study indicated that the swarms are highly dynamic and often ephemeral entities, and that their distribution and their movement can in some instances be related to physical phenomena but in others appears to be behavioural. The cruise track for this section of the voyage resembled a plate of spaghetti and the interpretation of these results will take a considerable amount of time, not to mention intense head-scratching.

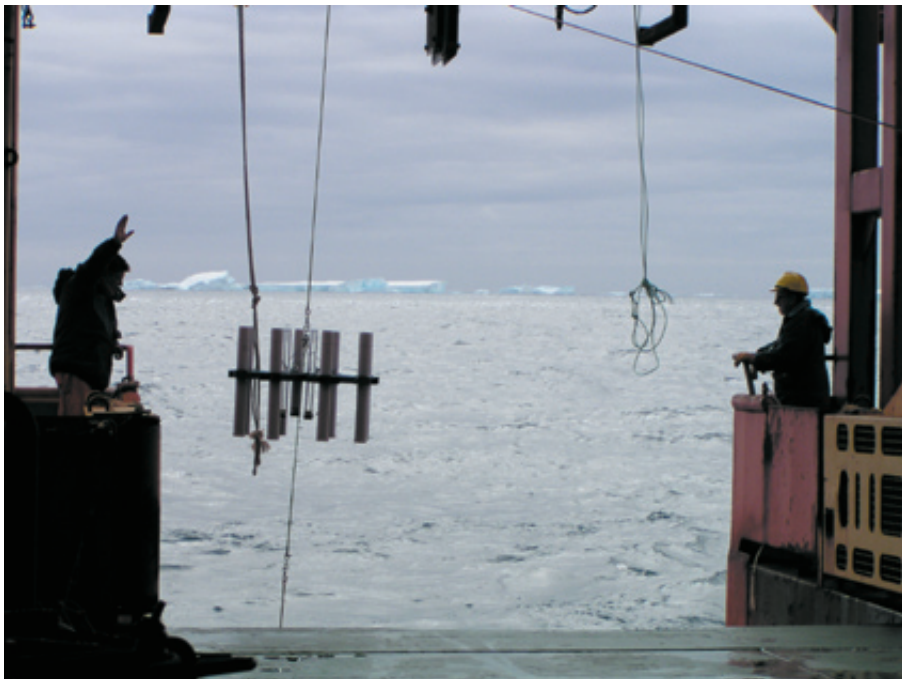
But krill was not the only focus of this voyage; there was a major oceanographic aspect to it as well. The oceanography had two major elements – the deployment of a series of eight current meters off the edge of the Kerguelen Plateau (the region with the highest average wave height in the world!) and a series of 50 CTD sampling stations from the Kerguelen Plateau across the Princess Elizabeth Trough almost down to Davis station. The aim of this program was to measure the flow of the Antarctic Circumpolar Current as it passes through this critical area. Despite the ambitious nature of the program and the expectedly unpleasant sailing conditions, all the current meter moorings were deployed and two thirds of the sampling stations were completed to the oceanographers' satisfaction. The current meters, which are part of a joint Australian-Japanese experiment, will be retrieved in two years time.

The voyage was a highly multicultural affair with participants from 12 countries and, despite the length of the voyage (73 days), the huge distances covered (15,000 nautical miles), the above-average incidence of foul weather (>30% of days experienced wind speeds of >30kts), an unscheduled refueling and a full ship on the return journey, it was deemed by all participants to be a success and the analyses of these results will keep many scientists busy for years to come.



Right: The paths of satellite-tracked buoys in the krill survey box. The buoys provide an indication of the surface currents in the area.

Below: Retrieval of a sediment trap. Sediment traps were deployed in the area where krill were feeding to examine the effect that krill have on the sinking of particulate matter out of the surface layers.



STEVE NICOL

STEVE NICOL

Steve Nicol, Program Leader, Antarctic Marine Living Resources Program, AAD & Voyage Leader, Voyage 4.

Left: Fast rescue craft and fin whales. One of the successes of the voyage was the collection of the greatest number of whale biopsy samples to date – two from humpbacks and four from fin whales. These samples will be used for genetic analyses and for pollutant assays.

Will less sea ice mean hungry krill?

Sea ice provides the productivity engine for the ice-affected regions of the Southern Ocean. The ice effectively blocks out the light to the underlying water column. So plant life, in the form of microscopic algae called diatoms, is limited to living on and within the sea ice. These plants are the only food available for the entire ecosystem over the long winter months. Thus they control the abundance of key grazers such as krill and other zooplankton. They in turn provide the main food source for all other animal life.

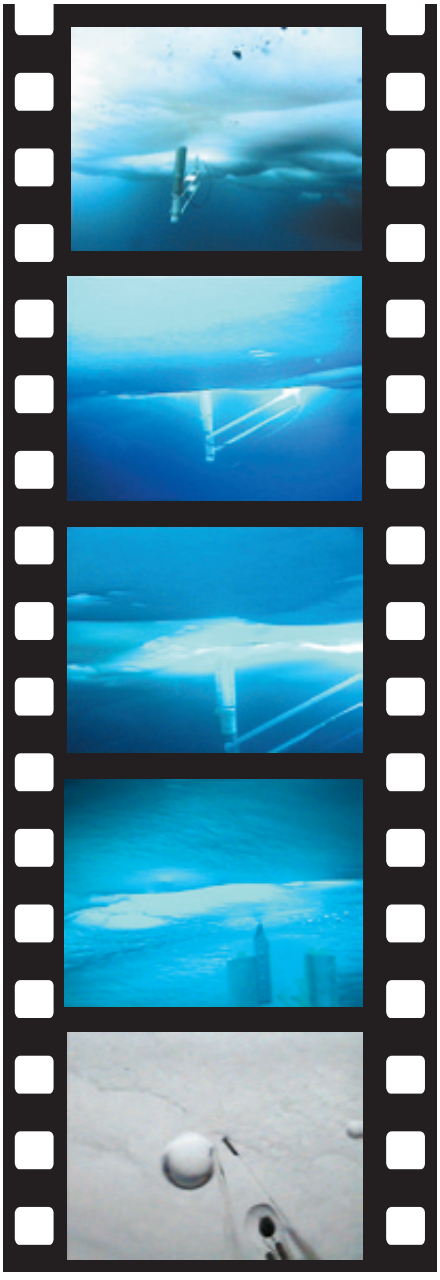
Each year sea ice extends to cover over 10% of the world's oceans, which around Antarctica is 20 million km^2. The sea ice microalgae are thought to contribute between 25% and 50% of the total primary productivity. With global warming reducing the extent of Antarctic sea ice, it is likely that the capacity of the Southern Ocean to support its large biomass of whales, seals and seabirds will reduce.

A team of researchers from the Institute of Antarctic and Southern Ocean Studies (IASOS) at the University of Tasmania have developed innovative methods of measuring photosynthesis to quantify sea ice productivity. Previous techniques have involved removal of samples, melting of the ice and hence destruction of the intricate micro habitats. The new methods use state of the art technology to measure sea ice photosynthesis in situ, using imunoassays, micro electrodes, micro manipulators and fibre optic fluorometers. Equipment is deployed through holes in the ice. Arms move the equipment away from the hole to remove the sensors from the effect of light coming through the hole. The equipment moves up to the under surface of the ice and the microsensors are moved rapidly up and down in the 1-2 mm beneath the ice taking measurements at 10µm (ie one hundredth of a mm) intervals. The electronic equipment was operated from a small tent on the ice. These measurements allow the oxygen flux, and hence photosynthesis, to be measured in situ and in real time. Measurements are made throughout the day and night so the effects of changing daylight can be assessed.

Productivity studies were carried out in the vicinity of the Mertz Polyna, eastern Antarctica, in October and November 2002. Conditions were mostly fine and there was a mix of young ice < 20 cm thick and older ice 60–100 cm thick. Many measurements of productivity were successfully taken and these are contributing to building up a picture of the role sea ice production in Eastern Antarctica. Productivity levels in the area were high although the biomass was generally quite low. We also found that the microalgae were able to rapidly adjust to the changing light and salinity conditions associated with the ice melting and that they were well suited to their changing environment and were very efficient photosynthesisers. These measurements will contribute to providing the basis for determining the effects of future climate change. A reduction in quantity of ice algae or a change in the species composition is likely to lead a reduction in the amount of food available for krill and other grazers. This hypothesis will form a major element of the research program of the new ACE CRC.

Andrew McMinn, University of Tasmania & Antarctic CRC

DOUG THOST



ANDREW McMINN

Above: Portable laboratory on pack ice near the Mertz Polyna. Below: Inside the tent lab taking live productivity measurements. Right: Under-ice productivity measuring equipment. Bottom picture shows electrodes approaching under-ice surface.

Fast-sinking lines reduce seabird mortality in longline fisheries

GRAHAM ROBERTSON

Bullers and white-capped albatrosses fight over fish lost from a longline.

Longline fisheries are implicated in the decreases of many albatross and petrel species worldwide. Seabirds die when they attack baited hooks when lines are being set, become hooked or entangled, pulled underwater and drown. In many longline fisheries seabird fatality is part of 'normal' commercial fishing operations, though the number of birds accidentally killed can vary greatly with location, time of year and type of fishing gear used. We have been addressing this problem by collaborating with fishing industries to develop fishing gear and practices that reduce seabird mortality.

The risks to seabirds are increased by longlines that sink too slowly. Typically, when longlines enter the water they 'float' just beneath the surface, being held aloft by propeller turbulence and wave action. Depending on the vessel and gear type, they might remain in this lofted position for 20 seconds or so and be 50 metres or more astern before they start sinking, making baits easy targets for seabirds. Ideally longlines should start sinking the instant they enter the water and sink as fast as possible.

Longlines with integrated weight (beads of lead woven into the fabric of the line) have the capacity to meet these requirements. To test the effectiveness of longlines with integrated weight the Australian Antarctic Division teamed together with New Zealand Ling Longline (a NZ fishing consortium), Fiskevegn A.S. of Norway (a major longline manufacturer) and the New Zealand Department of Conservation and Ministry for Fisheries. We chose the amount of weight to be inserted into the longline from a previous trial of the sink rates, operational effectiveness and fish catch success of samples of line containing 25 g/m, 50 g/m, 75 g/m and 100 g/m integrated weight. The 50 g/m line performed best – it sank instantly, sank 2.5 times faster than normal line, did not affect fishing efficiency and was easy to use. The next step was to test the performance of the line while under attack from seabirds.

We tested the new line in November 2002 in the ling fishery near Solander Island, south of New Zealand. This was an ideal area for the test because it is frequented by large numbers of shearwaters, albatrosses and white-chinned petrels, species that regularly get killed on longlines. It was important to have white-chinned petrels in the trial because their attacks on longlines are very hard to prevent: they're strong, manoeuvrable fliers and excellent divers and – unlike albatrosses and shearwaters – are caught equally in the day and night. These traits place them at the top of the list of longline-vulnerable seabirds.

We conducted the trial on the F/V *Janas*, a 46.5 m Norwegian-built autoline vessel (hooks are baited automatically) commercially operated as part of New Zealand Ling Longline. The *Janas* fishes with thirty 1,800 m-long magazines of longline which carry a total of 36,000 hooks. We replaced 15 magazines of normal (unweighted) line with 15 magazines of integrated weight line and fished with both longline types side by side. We deployed a bird scaring streamer line over

the longline on all sets to keep seabird mortality on the unweighted longline at levels normally experienced in the fishing operation.

Before each set we collected information on environmental conditions known to affect seabird interactions with gear, such as wind strength and direction, sea state, moon phase and time of day. We recorded the number of seabirds around the *Janas*, attacks on the line by different seabird species, number of seabirds caught on each type of longline and longline sink rates. We also recorded catch rates of ling and non-target fish species, the size of fish caught and incidence of damage from sea lice (marine insects that sometimes eat fish caught on longlines) to demonstrate the effects, if any, of the integrated weight longline on commercial aspects of the fishing operation.

After 16 days fishing and 400,000 hooks set and hauled the work was finished. The results were promising. Although up to 1,200 seabirds surrounded the boat and repeatedly dived on both types of longline (though more so on unweighted gear) the integrated weight longline caught only one seabird compared to 82 by the unweighted longlines. All birds caught were white-chinned petrels except for one sooty shearwater; no albatrosses were caught. Catch rates of ling and non-target fish species on both types of longline were similar, as were the sizes of fish landed. Clearly, the integrated weight longline had greatly reduced seabird mortality while not affecting fishing efficiency, and we had potentially saved the lives of over 80 birds.

The prognosis for the new line looks good, though more research is needed. Fishermen tend to be suspicious of suggested changes to gear, particularly to something as fundamental to fishing as the longline.

GRAHAM ROBERTSON

The FV Janas *hits a wave over the ling grounds off southern New Zealand.*

To alleviate concerns it is necessary to fully understand the efficacy of the gear as seabird deterrent and effects on the economics of fishing. We need to further test the gear and determine the longevity of the line. It is also important to observe underwater interactions between diving seabird species and baited hooks to develop ways to reduce the incidence of 'foul' hooking, which occurs when birds are hooked accidentally in parts of the body other than their bills. We also need to test all aspects of the line in the Patagonian toothfish fishery, which operates in deeper water and on much rougher grounds than the ling fishery.

If further testing yields positive results then at an appropriate time in the future the use of integrated weight longlines will be promoted in other autoline fisheries where vulnerable species of seabird range. These fisheries occur in South Africa, subantarctic France, Australia, New Zealand and various South American nations.

Finally, in the field of seabird by-catch mitigation research, it is rare to develop a technique that could have positive spin offs for both seabird conservation and fishing efficiency. The success achieved thus far is a tribute to the collaborators involved, especially New Zealand Ling Longline. Their commitment to the development of seabird-safe fishing practices is commendable and shows the way forward to longline fishing operators in other regions of the world where vulnerable seabirds range. Work with fisheries in other parts of the world is ongoing to minimise the tragic and unnecessary deaths of beautiful seabirds.

Graham Robertson, Antarctic Marine Living Resources Program, AAD

STOP PRESS: IUU hot spot

Despite the Australian Government's efforts, including fisheries patrols like *Operation Rushcutter* – the first armed civilian fisheries patrol of Australian waters which concluded in May 2003 – illegal, unregulated and unreported (IUU) fishing of the prized Patagonian toothfish in the waters around Australia's Heard Island continues. Legitimate fishing by Australian flagged vessels in Southern Ocean waters outside the Heard Island EEZ were recently compromised with an unexpected encounter by IUU vessels.

The latest incident was as recent as late June 2003 when an Australian flagged fishing vessel, *Janas*, leaving the Heard Island region, sighted a longline fishing vessel within the CCAMLR Area. The vessel was sighted at night and immediately blacked out its lights while radar images indicated that it continued along its course – presumably to haul in its fishing gear. *Janas* later encountered another longline fishing vessel and at least one other vessel engaged in longline fishing in FAO Statistical Area 57, adjacent to the CCAMLR Area. The longline fishing vessel stopped the *Janas* from setting its fishing lines and contributed to the decision to return to port in Tasmania earlier than planned.

Three days later, a second Australian flagged fishing vessel, *Southern Champion,* encountered two longline fishing vessels about 100 m outside the EEZ but still within CCAMLR waters. Both fishing vessels took evasive action to ensure that they were not recognised. The vessels had blanked out their home and port name and their vessel call sign and flag were not visible.

Member States of CCAMLR are investigating evidence to determine the identity of the IUU operators sighted. Australia is continuing its efforts within CCAMLR for strong measures to stamp out IUU fishing in the Southern Ocean.

Illegal fishing in the Southern Ocean: the problem, practices and perpetrators

The Australian government is concerned that within a few years the lucrative Patagonian toothfish fishery around Australia's Heard Island and McDonald Islands (HIMI) could collapse due to unsustainable illegal fishing.

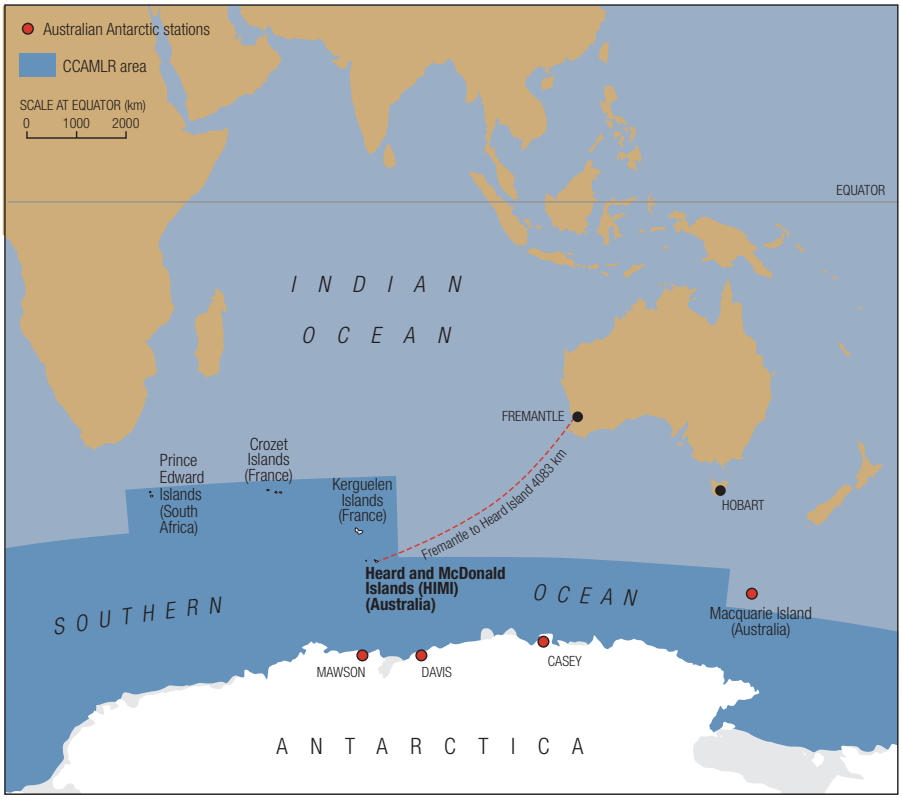
Located 4,100 kilometres from the nearest Australian port, Australia's Exclusive Economic Zone (EEZ) around HIMI lies entirely within the area of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). These remote waters are managed under Australian domestic legislation in accordance with Australia's obligations under CCAMLR and other international agreements, including the United Nations Convention on the Law of the Sea (UNCLOS).

The problem

Illegal, unregulated and unreported (IUU) fishing, commonly referred to as poaching, is the primary threat to the conservation of toothfish stocks. IUU fishing is intrinsically unsustainable as it results in catches that far exceed sustainable limits set for legal fishers and, if it continues unchecked, will cause severe depletion of the spawning fish stock. IUU fishing uses longlines with little or no attention given to avoiding seabird bycatch. This leads to high levels of mortality among seabird populations, some of which are already endangered. Another serious problem with IUU fishing is that there is almost no data reporting for IUU catches, making decisions about the status and future management of fish stocks very difficult.

... it is clear that it is now often a highly sophisticated form of transnational crime.

Toothfish is a high value, quality fish and is mainly sold to the restaurant trade in Europe, the United States and Japan. High consumer demand and the consequent high prices for toothfish and other white-fleshed fish encourage not only the legal fishers, but also illegal fishers to supply products to these markets. It has been estimated that the total IUU catch of toothfish over the past six years is almost equal to the total catch by legal fishers (80,960 tonnes and 83,696 tonnes respectively), and worth about A$1 billion in wholesale value.



Out of sight, but not out of mind: Australia's sovereign territory Heard Island and McDonald Islands.

IUU fishing severely undermines national and international management and conservation measures implemented by Australia and other coastal States, and international regimes such as CCAMLR and UNCLOS, whose goals are to ensure that only sustainable utilisation of the world's oceans occurs. Illegal fishing within the HIMI EEZ also challenges Australia's sovereignty.

The practice

IUU fishing occurs throughout the world. The targeting of toothfish in the Southern Ocean by IUU fishers started in earnest in the mid-1990s. Most IUU fishers have strong links to traditional deep sea fishing nations and, historically, many such fishers and vessels were displaced by the commercial collapse of northern hemisphere fisheries, overcapacity in the global fishing fleet and the introduction of larger maritime jurisdictions for coastal States.

More recently the nature of IUU fishing has changed from the operational styles of the mid-1990s and it is clear that it is now often a highly sophisticated form of transnational organised crime with:

- sophisticated control of vessel movements;
- complex logistics, including chartering tankers to refuel vessels at sea, specially built and modified vessels, and the use of ports in States which give little scrutiny to vessel movements and catch landings;
- use of active intelligence gathering about States' enforcement efforts;
- use of complex corporate arrangements and legal advice to exploit weaknesses in national and international fisheries and corporate law and to disguise the real owners and beneficiaries of IUU fishing;
- use of weak State regulatory regimes to flag vessels and fraudulently obtain validation of catch documents needed for market access;
- use of complex arrangements to 'launder' catches;
- strong evidence of corrupt conduct in support of IUU fishing by some States' officials;
- a small number of beneficiaries controlling nearly all IUU fishing for toothfish; and
- substantial and well-financed legal challenges when vessels are arrested.

The perpetrators

It is estimated that there are currently between twenty and thirty vessels involved in IUU fishing for toothfish. One of the problems is that some vessels are registered under a 'flag of convenience', taking advantage of deficient vessel monitoring by the flag States involved. Other vessels are flagged to CCAMLR Members[1], and all are owned by 'front companies'. These companies are often registered in tax havens or States that are not party to international fisheries agreements (such as Belize, Togo and Bolivia). 'Front companies' are the most visible 'tip' of a usually complex, transnational corporate structure deliberately constructed to disguise the identity of the beneficial owners and controllers and to gain financial advantage, for example through lowering taxation and administrative costs. The beneficiaries are very difficult to link conclusively to the IUU

Illegal fishing activities off Heard Island and McDonald Islands

HIMI provides a legitimate Patagonian toothfish and mackerel icefish fishery worth about A$30 million that directly employs up to 150 people in the capture and post-harvest processes. The marine environment within these waters contains valuable nursery grounds for commercial species, sponge habitats and benthic fauna. In recognition of the rich conservation values, Australia has declared a portion of the HIMI EEZ a marine reserve.

The Australian Fisheries Management Authority has a stringent management plan in place to minimise the impact from fishing to the HIMI environment.

Parallel to the development of the legal fishery, HIMI became the focus of attention for IUU operators. Since the 1995–96 season, IUU fishers have taken an estimated 20,352 tonnes of toothfish from the HIMI EEZ, considerably more than the legal fishery (Table 1). These catches typically enter the market by being misreported as having been caught outside the CCAMLR Area (and consequently outside of HIMI).

Fishing Season (Dec/Nov)	Estimated legal catch (t)	Estimated IUU catch (t)
1995/1996	0	3000
1996/1997	1868	7117
1997/1998	3671	4150
1998/1999	3659	427
1999/2000	3566	1154
2000/2001	2987	2004
2001/2002	1812	2500
Total	17563	20352

Table 1. Estimated IUU catch of Dissostichus eleginoides *from HIMI (CCAMLR Statistical Area 58.5.2).*
Source: CCAMLR. In Press. SC-CAMLR (2002) Report of the Working Group on Fish Stock Assessment (WG-FSA). *Report of the twenty first meeting of the Scientific Committee (SC-CAMLR XXI)*. CCAMLR, Hobart.

Since 1997, Australia has apprehended six foreign vessels fishing illegally within the HIMI EEZ (Table 2). In addition to Australia's efforts in increasing monitoring, surveillance and enforcement activities and successes in apprehending IUU fishing vessels, Australia actively cooperates with other Members of CCAMLR to combat IUU fishing.

'Our action at Heard Island is part of a much broader campaign by Australia, along with its partners in CCAMLR, to stamp out illegal, unreported and unregulated fishing which undermines international efforts to manage the toothfish resource sustainably.' *Dr Sharman Stone, Australia's Parliamentary Secretary to the Minister for the Environment and Heritage*

Table 2. Identifying the perpetrators

Vessel name	Flag State	Nationality of Captain	Nationality of Senior Officers
Salvora	Belize	Spanish	Spanish
Alicia Glacial	Panama	Faeroe Islands	Faeroe Islands
Big Star	Seychelles	Spanish	Spanish
South Tomi	Togo	Russian	Spanish
Lena	Russia	Spanish	Spanish, Russian
Volga	Russia	Russian	Spanish, Russian

ALL PHOTOGRAPHS COURTESY OF ROYAL AUSTRALIAN NAVY

Apprehending the perpetrators – scenes of Australian authorities apprehending IUU vessels in the Southern Ocean.

Global implementation of the CCAMLR Dissostichus Catch Documentation Scheme

The effectiveness of CCAMLR's management regime is seriously undermined by the presence of IUU fishing in the CCAMLR Convention Area. In 1999 CCAMLR established a *Dissostichus* Catch Documentation System (CDS) to follow toothfish from the sea to the dinner plate. The CDS identifies the origins of toothfish catches, gathers statistics on total catches and identifies catches harvested in a manner consistent with CCAMLR requirements. It also aims to prevent IUU catches from entering the territories and markets of CCAMLR Parties. The CDS was designed so that all States involved in the harvesting or trade of toothfish could participate, regardless of whether the fish were harvested inside or outside the CCAMLR Area.

By failing to prevent trade in illegally caught toothfish, those States are also richly rewarding criminals.

Australia recognises the importance of full implementation of the *Dissostichus* CDS by all CCAMLR Members and Parties, and any other States involved in the trade and harvesting of toothfish.

The failure of some flag, port and market States to effectively implement the CDS undermines CCAMLR and the actions of other States committed to combating IUU fishing. By failing to prevent trade in illegally caught toothfish, those States are also richly rewarding criminals. Effective global implementation of the CDS would be a significant step towards eliminating IUU fishing.

Australia encourages all States involved in the trade and harvesting of toothfish to effectively implement the CDS.

DAVE WILLIAMS

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*From the sea to the supermarket, the lucrative Patagonian toothfish (*Dissostichus eleginoides*).*

from page 17

fishing but are relatively few in number and include nationals of CCAMLR members and, more recently, Asian interests, including Hong Kong nationals.

Key ports for landing IUU caught toothfish are all located in States that are not party to CCAMLR, including Tanjong Priok in Indonesia, Hong Kong and Singapore. IUU fishers purposely land catches at these ports for reasons of logistical convenience, to minimise scrutiny of their operations and because these ports do not fully implement the CCAMLR *Dissostichus* Catch Documentation Scheme (CDS), a scheme which aims to prevent IUU catches entering the market. Australia is also concerned that the flag States of such IUU vessels, which include Uruguay and Russia, both CCAMLR Members, are compromising the CDS by failing to adequately monitor their vessels' activities and by validating catch documents for IUU catches, thus allowing them ready access to high value markets.

Conclusion

While the protection of toothfish stocks around HIMI is a high priority, Australia is committed to eliminating all IUU fishing, including elsewhere in the Southern Ocean. This commitment was plain when in late 2002, Senator Ian Macdonald, Minister for Fisheries, Forestry and Conservation stated; 'I would like to put all those illegal fishermen and companies on notice that Australia will sink your boats, confiscate your catches and prosecute you to the full extent of the law if you fish illegally in our waters'.

Promoting greater awareness of the problems of IUU fishing and the need for a widespread and vigorous international response remains a key element of Australia's approach to combating IUU fishing. Australia regards co-operation and exchange of information as fundamental to successfully combating IUU fishing. Australia will continue to pursue initiatives in CCAMLR and other international forums to eliminate this international criminal activity.

Southern Ocean Conservation Unit
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[1] Members refers to States that have acceded to the Convention on the Conservation of Antarctic Marine Living Resources, pay annual fees, have voting rights and are legally bound by CCAMLR decisions.

Conserving our connections: the 2002-03 Mawson's Huts Expedition

On October 25 last year a team of five men and three women arrived at Cape Denison, about 2560 km south of Hobart, to conduct conservation works on Australia's icon of Antarctic heritage: Mawson's Huts. There had been a lot of pre-departure planning – briefings, seminars, even chainsaw training for some – but nothing could adequately convey to us the extraordinary fact that after 90 years these timber huts, the winter base of the 1911-14 Australasian Antarctic Expedition (AAE), are still standing.

This fact was reinforced when we saw some of the roof battens on the Main Hut (the AAE's living quarters) lifting in relatively subdued winds, and then from our own experience of living in 'the home of the blizzard' for nearly eight weeks.

The expedition's focus on conserving the buildings was perhaps the reason why the real surprise came days later, after the conservation team had taken some eight hours to clear away the compacted snow to access the Main Hut (using the aforementioned chainsaw). It was our response to the experience of being inside the Hut that was quite unexpected. The sense of awe, evidenced by our lowered voices, revealed what the pictures had failed to show: our very special feelings of connection with Mawson and his men. Our evocative surroundings reinforced that connection. Amongst the accumulated snow and ice we could see where the former owners had staked out their territory; their initials painted on their bunks. Those bunks marked with two sets of initials paid testimony to those occupants who had elected to remain at Cape Denison for a second winter to search for Mawson, who had failed to return from the far-eastern sledging journey on schedule, rather than return to Australia on the SY *Aurora* with the rest of the AAE. Although Mawson did eventually stagger back to base, arriving just after the departure of the *Aurora*, the sets of initials on the adjoining bunks of his comrades Belgrave Ninnis and Xavier Mertz were reminders of those men's tragic fate.

The placement of the second sets of initials on certain bunks also revealed that

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Above right: Fitting battens to gaps in the tongue and groove baltic pine cladding, southern plane of the main hut roof.
Opposite: Field Leader Diana Patterson and archaeologist Estelle Lazer inspect the recently uncovered bunks of Ninnis and Mertz.


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the western wall of the Hut was the optimum position, close to the warmth of the stove!

In the weeks that followed the Hut became our workplace, and tools and environmental monitoring equipment invaded the space. Our work was defined by a Conservation Works Plan and included:

Main Hut structural investigation

The building structure was found to be intact and in good condition. Concerns raised about the impact of summer melts on the Hut's stability were allayed when little evidence was found of impact on the ice mass both inside and immediately under the structure.

The prevailing snow and ice conditions and presence of artefacts limited the extent of investigations of the sub-floor. However, the condition of timber stumps and building frame was found to be in good condition, as was the condition of the fixings (principally bolted connections).

Ice removal

The removal of ice from the interior of the Main Hut and adjoining Workshop was carried out with due consideration given to the effect of ice removal on the long-term structural integrity of the Hut and its fabric, structures and artefacts. The snow and ice inside the Workshop was removed to approximately one metre below the eaves to allow repairs to the rafters. Further excavation revealed the broken collar ties and original fittings from the rafters. Ice was retained on the northern wall and halfway down the eastern and western walls to provide an 'ice bank' of protection and to minimise the exposure of any artefacts left on the shelves.


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In the Main Hut, soft snow and suspended ice was removed in areas where it threatened the structural integrity of the bunks. A very positive result was achieved in terms of restoring the interiors to reveal the space and fabric of the period of occupation.

Workshop roof structure

New collar ties were installed and the three broken rafters repaired. The original collar tie U-bolts were straightened and refitted and the original collar tie packing blocks reinstated.

Snow and meltwater ingress

The occurrence of a number of blizzards during the expedition provided further opportunities to identify areas of snow ingress and to observe the build-up of snow. There was little evidence of snow ingress to the Workshop, demonstrating that the overcladding of the roof during the 1997–98 expedition had been successful. However, the prevention of snow ingress to the Main Hut remains a challenging task. Of ongoing concern are the considerable shrinkage of timbers and the deterioration of the roof cladding. Repairs of a limited nature were made, including the sealing of the ridge caps and fixing of skylight flashings. Where possible, gaps in the roof cladding were sealed with timber battens; nevertheless, it is recommended that the overcladding of the Main Hut roof be given consideration.

Top to bottom: Expeditioners dig to reveal foundations of the workshop to assess their stability; Roof repairs to the northern plane of the Main Hut; Heritage carpenter Mike Staples and Conservator Linda Clark with environmental monitoring equipment to record temperature and humidity inside the Huts.


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Environmental monitoring

The installation of various sensors and data loggers and the retrieval of data was a significant component of the conservation program. Data about temperature, relative humidity and other aspects of the Hut's internal microclimate are now being transferred weekly from Cape Denison to Australia via satellite telephone. It is anticipated that this information will contribute to the ongoing management of the Huts and the artefacts within.

Archaeology program

An extensive program of artefact cataloguing was undertaken, including the survey, documentation and photographic recording of the artefact scatters around the Main Hut and on Penguin Knob, to the northeast of the Main Hut. Several new artefacts were discovered, including cached seal carcasses and even a copy of the 1911 Nautical Almanac – in near-perfect condition. Comprehensive cataloguing of artefacts was also carried out within both the Main Hut and the Workshop.

The very considerable data gathered from this and previous expeditions now provide an opportunity to interpret and understand the story of the lives of Mawson and his men at Cape Denison.

The team's achievement in completing the Conservation Works Plan directly relates to their skill and commitment. The compatibility of the team members and their co-operative approach to the defined tasks further enhanced productivity during our eight weeks at Cape Denison. These positive results were achieved despite the extremely windy conditions and very cold temperatures that prevailed for a significant period of the expedition – the same conditions in which the AAE lived and worked. While our technology might be a little different to that of the AAE, the core of the Antarctic experience remains the same, and in the evenings members of our team were frequently to be found consulting *Home of the Blizzard* or Mawson's Antarctic Diaries, seeking the connections of our day-to-day work with the past.

The success of our expedition undoubtedly lies in the quality of the team on the ice. But thanks must also go to others who supported the expedition such as AAD staff including Project Manager Rob Easther, the expedition's steering committee, the AAP Mawson's Huts Foundation, and the Australian Heritage Commission. In particular, the expedition depended on the great skill shown by the captain and crew of the French Antarctic vessel *l'Astrolabe* which had been made available by the generous cooperation of the Institut Paul Emile Victor.

Diana Patterson, Mawson's Huts 2002-03 Expedition Field Leader

DAVE KILLICK

Our commitment continues

Cape Denison is an important symbol of the 'heroic age' of Antarctic exploration. One of only six sites on the continent remaining from this time, it is also the most untouched, with the artefacts still lying where Mawson and his men left them all those years ago. But Cape Denison is noteworthy not only for the relative 'authenticity' of its cultural history, but for its scientific significance as well. The achievements of the AAE include some of the earliest and most comprehensive studies of Antarctic geology, geography, terrestrial magnetism, astronomy, meteorology, glaciology, oceanography, zoology and botany. The first major scientific expedition mounted by Australians after this nation's Federation, the AAE also utilised numerous technological innovations and was the first party to send wireless transmissions from Antarctica. Cape Denison was also the base of numerous explorations inland, with the AAE's sledging parties mapping more than 1,000 km of previously uncharted coastline.

At this year's Antarctic Treaty Consultative Meeting, Australia proposed the designation of the whole of Cape Denison as a Historic Site under the Protocol on Environmental Protection to the Antarctic Treaty. Australia also proposed that the site be designated as an Antarctic Specially Managed Area (ASMA), including a Visual Protection Zone over the valley containing the historic AAE huts in order to enhance the area's visual catchment and 'sense of place'.

Australia is also seeking to have the AAE huts afforded more comprehensive protection with their designation as an Antarctic Specially Protected Area (ASPA), embedded within the Cape Denison ASMA. These conditions will assist in minimising the impacts of visitation and related activities on the huts, thereby preserving the rich source of research material they present for study and interpretation.

If agreed, the Cape Denison ASMA will be one of the first ASMAs to ever be formally submitted by an Antarctic Treaty nation to an Antarctic Treaty Consultative Meeting. After consultation and review by Australian stakeholders and by other Treaty nations, the ASMA and ASPA management plans will be re-presented to the Treaty for approval at the next meeting, in South Africa in 2004. Once approved, the protected areas are designated for an indefinite period, although the management plans will be reviewed every five years.

Stephanie Pfennigwerth, Expedition Co-ordinator, Environmental Management and Audit Unit, AAD

AUSTRALIAN ANTARCTIC DATA CENTRE

Mawson station orthophotomap, showing Polar Bird *in Horseshoe Harbour*

Surveying and mapping: the season that was

Australian Antarctic Division surveying and mapping program expeditioners had a busy summer season with surveying, aerial photography and tide gauge projects undertaken at Davis, Casey, Mawson and Macquarie Island.

In the Davis area the main priority was to survey ground control points for the topographic mapping of the Rauer Group. The geographic information derived from this mapping will be used as the basis of a Geographic Information System for the island group. At Mawson Royal Australian Navy hydrographers conducted a hydrographic survey of an alternative shipping route into Mawson station to the west of the existing chart. The survey located a number of 'ship killers' – rock structures rising to one or two metres below sea level surrounded by very deep water. In the Casey area, surveyors were involved for most of the summer months in the surveying and grooming of the blue ice runway to the south-east of Casey.

Other field projects in support of science and operations included aerial photography of Wilkes station, Casey station and Ardery and Odbert Islands, update of station area maps and lake levelling in the Vestfold Hills for contribution to State of the Environment indicators. Mapping projects included a small scale map of the Amery Region for the Prince Charles Mountains Expedition of Germany-Australia (PCMEGA), vegetation mapping of Heard Island, orthophoto maps of Casey and Mawson stations, mapping of islands and coastline in the Commonwealth Bay area from high resolution satellite imagery and mapping of the Larsemann Hills and adjacent islands from aerial photography.

All in all a very busy summer season with fifteen expeditioners occupied in various surveying and mapping activities at all stations.

Henk Brolsma, Mapping Officer, AAD

Looking to the future – signals from the past ...

RICHARD PENNEY

FRANK HURLEY

ERIC WOEHLER

ERIC WOEHLER

Left above: Adélie penguin colony at Whitney Point, Casey in November 1963. Left below: The same colony in November 2001. Right above: Macaroni penguin colony at Heard Island, November 1929. Right below: The same colony in November 2000.

Most seabirds can live for more than 30 years, and some species of albatross can live for more than 60 years. Long-term seabird population trends can signal climate change, human disturbance, interactions with fisheries and effectiveness of management regimes, in addition to natural changes in population sizes. Separating natural changes from human-induced changes is a major focus of many long-term studies around the Antarctic and subantarctic.

A major hurdle however are the time scales involved – the time required to identify long-term trends in seabird populations may well exceed the professional life of the researchers undertaking the work. Archival photographs are a valuable source of information from the time before organised surveys, and may be used to establish historical baselines for 'modern' data sets. Photographs have also supplemented regular surveys, improving the data sets available for analyses, and thus increasing our abilities to detect and understand the signals. This research program is matching historical with contemporary images; two image pairs spanning almost 40 and more than 70 years are shown here.

The first pair of photographs shows Adélie penguin *Pygoscelis adeliae* colonies at Whitney Point, Casey. The original survey and census was undertaken in 1959–60 by an American student undertaking pioneering research on the behaviours of Adélie penguins. As part of his studies, all colonies were mapped, photographed and a census undertaken. Photopoints of each colony were also established at the time with a view to providing a means to compare colonies over time. These photopoints were re-established in 1989–90 and have been used since to continue monitoring these colonies. The photographs complement ground counts that are undertaken every summer to assess long-term population trends. The photographs show the same colony in November 1963 and November 2001. While there have been only minor changes in the near colony, the 2001 photograph shows the presence of a large colony (in excess of 1,000 pairs in 2002–03) that was not apparent in 1963.

The second image pair shows a macaroni penguin colony on Heard Island. The BANZAR Expedition visited Heard Island in November 1929 and photographs of the landscape and wildlife were taken around the Atlas Cove region. During the 2000–01 ANARE to Heard Island, our project mapped and surveyed seabird populations ('Heard Island's seabirds under scrutiny', *Australian Antarctic Magazine* 1:12). One component of our survey was to photograph colonies for which historical images exist, such as this one. The photographs show the same colony in November 1929 and November 2001. It is clear that the colony has extended onto the left and lower areas of the slope.

Further efforts will be made to collect similar historical images from other areas of the Australian Antarctic Territory to enable comparisons to be made for a greater range of species over similar time spans. By examining a range of species from a number of localities, this study will enable the determinations of local and regional trends in breeding seabird populations.

Eric Woehler, IASOS, University of Tasmania; Bill Fraser, Polar Oceans Research Group, USA; Martin Riddle, Human Impacts Program Leader, AAD

Unusual behaviour of the Antarctic ozone hole

Since the mid-1980s, dramatic episodes of stratospheric ozone depletion have been observed each spring over Antarctica. Within these so-called 'ozone hole' events, total column ozone levels have been reduced by up to 70% compared with levels prior to the 1980s. The cause of the ozone hole has been conclusively linked with the release into the atmosphere of certain man-made gases, particularly chlorofluorocarbons (CFCs). Subsequently, we have also recognised a general decline in global ozone levels outside the tropics, as well as 'mini' ozone hole events in the Arctic. In 1987 the Montreal Protocol was enacted to phase out the world-wide production of CFCs and related ozone-depleting gases. However, due to the relatively long atmospheric lifetimes of the gases involved, and the time required for industry to adapt, the first significant signs of recovery in ozone levels are not expected until the end of the present decade. There have been recent indications that concentrations of certain ozone-depleting gases in the troposphere (ground to 10 km altitude) may have peaked. Despite cautious optimism, there is still significant concern as to the immediate and long-term trends in global ozone levels, and the implications for living systems and global climate.

The Antarctic ozone hole of 2001 was the second largest on record, only narrowly eclipsed by 2000. At the peak of the event, almost all ozone was destroyed in the altitude range 13-23 km over an area roughly three times the size of Australia. The hole in 2002 was a complete contrast, being the smallest observed since 1988, and two-thirds the size of the 2001 hole. However, this apparent improvement is not the result of mitigation produced by the Montreal Protocol, but rather a meteorological anomaly that caused the Antarctic stratosphere to be unusually warm during 2002.

Each year after the March equinox, a region known as the polar vortex forms in the stratosphere (10-50 km altitude) above Antarctica. Within the vortex, the polar air is effectively isolated from mixing with air from lower latitudes, and generally cools in the absence of sunlight during the polar night. Temperatures drop below minus 80°C within the vortex, and these conditions favour the formation of stratospheric clouds (at altitudes up to 25 km, near the peak of the ozone layer). The particles within these clouds promote a catalytic reaction that converts certain chemical species, including products derived from CFCs, into ozone-reactive forms. Some ozone loss takes place where the reactive chemicals are produced, but the largest losses occur when the reactions are enhanced by the return of sunlight during spring. The edge of the vortex becomes progressively more unstable during spring because of temperature and wind perturbations associated with planetary wave activity. Planetary waves are a natural form of atmospheric perturbation that are generated in the troposphere at mid and high latitudes and are able to propagate into the stratosphere during winter. Normally the vortex begins to break down in November allowing warm and ozone-rich air to enter from lower latitudes thereby repairing the ozone hole. By December, stratospheric ozone levels across Antarctica return to normal levels.

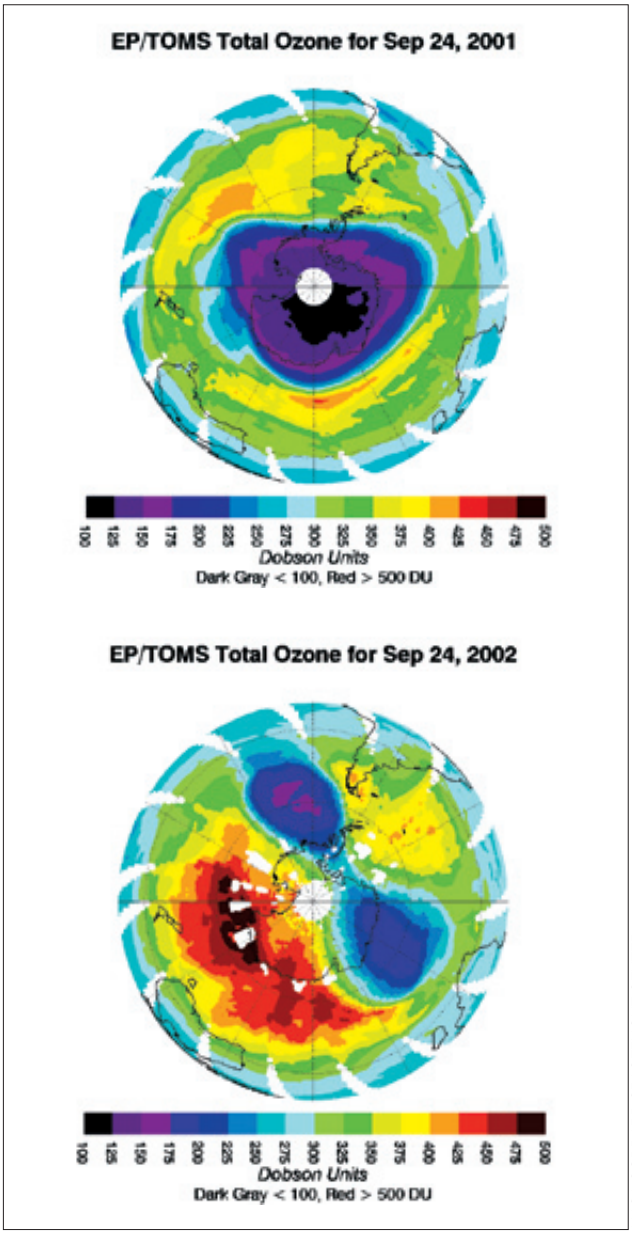


Figure 1: Southern Hemisphere total ozone concentration for 24 September 2001 and 2002 measured by the TOMS instrument on NASA's Earth Probe satellite. Smaller Dobson Unit values represent lower ozone concentrations. In the lower image, the split in the ozone hole during 2002 is visible as the two regions of low ozone concentration (values below 220 Dobson Units) south of South America and Africa. The region of high ozone concentration towards Australia is also unusual, and was associated with warmer than normal stratospheric temperatures.

The temperature structure of the atmosphere is determined by a balance between heating and cooling. In the Antarctic winter stratosphere, cooling is due largely to the loss of energy to space by thermal radiation at infrared wavelengths, while the main heating sources are the absorption of incoming solar ultraviolet light by ozone, and adiabatic compression of the atmosphere due to downwelling. The latter process is governed by the Second Law of Thermodynamics; as a parcel of air descends and thereby moves to a region of increasing pressure, the resulting compression does work on the gas which raises its temperature. Downwelling in the polar stratosphere is restricted to the winter, and is driven by circumpolar planetary wave activity. In the winter polar night, this process is the dominant source of heating.

There is evidence from a variety of global and local observational data sets, including balloon, lidar, radar and optical measurements at Davis, that planetary wave activity at high southern latitudes during the spring of 2002 was unusual. This activity is likely to have contributed to elevated stratospheric temperatures over Antarctica

STOP PRESS: Large ozone hole predicted

A large ozone hole is expected to form over Antarctica this coming spring.

At the end of July, trends in the temperature and dynamics of the Antarctic stratosphere were starting to creating conditions favourable for a large ozone hole to form.

The trends were similar to those observed in 2000 when the ozone hole was of record size, and in complete contrast to 2002 when the hole was the much smaller.

At Davis, stratospheric clouds were detected in late May, which was about six weeks earlier than they were seen in 2001 and 2002. This is directly related to atmospheric temperatures, which this year have generally been a few degrees below average throughout the Antarctic stratosphere.

When the sun returns to Antarctica in the spring, the atmosphere becomes disturbed. The level of disturbance is variable from year to year, and this impacts on the final magnitude of the ozone hole. However, present indications are that the hole this year will be large.

and major disturbances to the polar vortex. Significantly, the vortex broke down during October, several weeks earlier than expected. An unprecedented event occurred on 23 September 2002 when a sudden warming in the vortex caused the ozone hole to split into two components. One part of the hole drifted towards South America and dissipated, while the other portion re-centred itself over the pole before dissipating a few weeks later (Figure 1).

Was 2002 an unusual year and what can we expect in the future? It is possible that 2002 provided us with an example of natural variability in the atmosphere that acts on decadal or longer timescales. Modelling of best-estimate greenhouse gas and ozone depletion scenarios suggest that planetary wave heating of the polar stratosphere should be decreasing. However, a recent analysis of more than 50 years of assimilated stratospheric data for the Arctic found no evidence to support this view. Interestingly, what is becoming clearer is the strong upward dynamical link, driven by planetary wave activity, that exists between the troposphere and stratosphere over the winter pole, and the importance of teleconnections (recurring and persistent large-scale patterns of pressure and circulation anomalies that span vast geographical areas, an example being the El Niño phenomenon) in the global climate system. The 'smoking gun' for 2002 may well be found in a geographical region outside Antarctica.

The Antarctic ozone hole appeared more benign during 2002, but the problem is far from solved.

Andrew Klekociuk, Space and Atmospheric Sciences Program, AAD

Antarctica Online

Australian Antarctic Division ozone fact file: <http://www.aad.gov.au/default.asp?casid=2850>

Other website references:

Scientific Assessment of Ozone Depletion: 2002, United Nations Environment Programme; <http://www.unep.org/ozone/index-en.shtml>

The Ozone Hole Tour, Cambridge University: <http://www.atm.ch.cam.ac.uk/tour/index.html>

Ozone data at NASA/Goddard: <http://toms.gsfc.nasa.gov/ozone/ozone.html>

Investigating ozone depletion above Davis

A new program of stratospheric ozone studies has been established at Davis by the AAD's Space and Atmospheric Science (SAS) group and the Bureau of Meteorology (BoM). This effort represents the first time Australia has made in-situ measurements of stratospheric ozone in Antarctica, and is part of the larger investigation of the composition, dynamics and climate of the middle atmosphere being undertaken at Davis by the SAS program.

The program makes use of balloon-borne ozonesondes launched by BoM staff at Davis to profile ozone concentration from the ground to altitudes of up to 35km. Ozonesondes are a well-established means of measuring ozone, and are regularly launched at about 40 stations world-wide, including 9 in Antarctica. At the heart of each ozonesonde is a chemical cell containing a dilute solution of potassium iodide. Air is passed through the cell by a pump, and a reaction takes place between ozone and the solution which produces an electrical current proportional to the ozone concentration. A standard meteorological radiosonde is incorporated in the balloon payload, and this provides additional data on pressure, temperature and humidity during the flight. The readings, together with signals from an on-board GPS receiver which provide location information for the determination of wind speed and direction, are telemetered to a ground receiving station.

The operational aspects of the Davis program are being coordinated by the Bureau's Ozone Monitoring Unit (OMU). Through the OMU, the Bureau

MARTIN CROWE

Davis Bureau of Meteorology personnel (L-R) Cathie Saunders, Geoff Fulton and David Morgan watch the first ozonesonde ascend.

maintains an extensive and long-term commitment to ozone measurement, including programs of ozonesonde launches at Macquarie Island and Melbourne, and ozone total column abundance measurements at Macquarie Island and five Australian centres. Importantly, Macquarie Island is the only subantarctic site from which ozonesondes are launched.

The Davis ozone study has three main aims;

- To investigate the influence of atmospheric gravity waves and planetary waves on ozone depletion, and the climatology of ozone above Davis. Although there is a broad understanding of the processes that lead to ozone depletion, there are still discrepancies between observations and model predictions. This limits the usefulness of models in predicting future ozone levels. Aspects of these discrepancies may relate to small-scale thermodynamic processes associated with the action of natural wave processes in the atmosphere. The ozone measurements at Davis combined with data from the lidar and the recently commissioned VHF radar will provide new data on these processes.
- To provide local ozone data to aid in the derivation of temperature profiles from the Davis lidar, and to provide in-situ temperature measurements in the upper stratosphere for comparison with lidar observations. These measurements will contribute to assessing the long-term climatology of the stratosphere above Davis.
- To contribute to international efforts in the understanding of ozone depletion through participation in the European Union program 'Qualitative Understanding of Ozone Losses by Bipolar Investigations' (QUOBI), and contribution of data to the World Ozone and Ultraviolet Radiation Data Center.

The ozonesondes are currently being flown monthly, and from mid-June to mid-October the flights will be made at weekly intervals to coincide with the time of maximum interest in ozone levels. The launch schedule will be coordinated with operation of the Davis lidar and activities of the QUOBI program. QUOBI is an international effort led by Germany's Alfred Wegener Institute for Polar and Marine Research that involves regular ozonesonde launches by Antarctic and Arctic stations during their respective winter and spring seasons. The ozonesondes launched by stations in the QUOBI program attempt to sample the ozone concentration in parcels of air that are carried from one observing site to another by the stratospheric flow, thereby providing information for the refinement of chemical models of the atmosphere.

A further important aspect of the Davis program will involve collaborative research with Chinese scientists who are operating a program of ozone total column abundance measurements using a ground-based spectrophotometer at Zhong Shan station near Davis. Comparison of data from the two sites will enable calibration and consistency checks for the different measurement techniques that are employed.

The first ozonesonde was successfully launched on 20 February 2003, and we look forward to the exciting new data to follow.

Andrew Klekociuk, Space and Atmospheric Science Program, AAD

Antarctica Online

Further information:
Description of the QUOBI project; <http://www.nilu.no/quobi/>
Ozone monitoring by the Bureau of Meteorology; <http://www.bom.gov.au/inside/oeb/atmoswatch/aboutozone.shtml>

Beautiful, mysterious polar stratospheric clouds

Polar stratospheric clouds (PSCs) play a central role in the formation of the ozone hole in the Antarctic and Arctic. PSCs provide surfaces upon which heterogeneous chemical reactions take place. These reactions lead to the production of free radicals of chlorine in the stratosphere which directly destroy ozone molecules. Despite two decades of research, the climatology of PSCs is not well described, and this impacts on the accuracy of ozone depletion models. The timing and duration of PSC events, their geographic extent and vertical distributions, and their annual variability are not well understood. The AAD's Space and Atmospheric Sciences group encourages people travelling south to keep a lookout for these clouds, and to report any sightings. This information is potentially useful to compare with observations by the Davis lidar, satellite measurements and predictions of atmospheric models.

MALCOLM LAMBERT

Type I PSC veil at Davis, July 2001

PSCs form poleward of about 60°S latitude during the winter and early spring in the altitude range 10km to 25km. The clouds are classified into Types I and II according to their particle size and formation temperature. Type II clouds, also known as nacreous or mother-of-pearl clouds, are

JOHN INNIS

Type II PSC wave clouds at Mawson, July 1993.

composed of ice crystals and form when temperatures are below the ice frost point (typically below -83°C).

Type I PSCs are optically much thinner than the Type II clouds, and have a formation threshold temperature 5–8°C above the frost point. These clouds consist mainly of hydrated droplets of nitric acid and sulphuric acid.

The PSC season at the ANARE continental stations typically runs from mid-June to mid-October each year. At the subantarctic sites of Macquarie Island and Heard Island, stratospheric temperatures rarely reach the frost point during winter, but observations are still encouraged.

The best viewing time is when the sun is between about 1 and 6 degrees below the horizon (during civil twilight), when the troposphere is in shadow but the stratosphere is illuminated. This increases the contrast of the PSCs against the background sky, and helps to differentiate against any tropospheric cloud which will appear much darker. The clouds will generally be visible in the twilight arch portion of the sky. It may also be possible to discern the clouds in strong moonlight.

During the PSC season at the ANARE continental stations, the sky is generally covered by a thin yellowish veil of Type I clouds. The veil can be hard to identify, being easily confused with cirrostratus clouds or tropospheric haze. You may notice fine horizontal structures in the veil near the horizon, as well as a bright patch of light a few degrees above the horizon scattered from the sun.

The Type II clouds are a less common phenomenon. There is anecdotal evidence that Type II clouds are more prevalent at Mawson compared with the other stations, possibly due to the influence of the nearby mountains. These clouds look distinctly different to tropospheric clouds. They have an overall pearly-white appearance (due to forward-scattering of sunlight), and may also show some delicate interference colours (pinks and greens). A polarising filter may enhance their visibility. Reports of these clouds are the most valuable as they indicate the occurrence of special atmospheric conditions.

The PSCs will generally be travelling in the stratospheric flow, which is predominantly from west to east, and this may help in identification. For example, at Davis the wind direction in the troposphere generally rotates with altitude from north-easterly near the ground, through southerly to be westerly at the tropopause. The motion of the tropospheric clouds may therefore be quite different to the motion of the PSCs. Type II clouds formed by mountain lee-waves may appear at discrete spacings across the sky, and appear quasi-stationary.

Digital images and reports of PSCs can be emailed to <sas_cloud@aad.gov.au> with information on the observer's name, location, viewing direction, the date and time (accurate to the nearest few minutes if possible), the focal length setting of the camera lens, and noting if any filters were used. It is also helpful if the horizon is in the photograph, and the location of the camera is roughly known (eg 'clouds photographed while standing on the front steps of the LQ'). Past observations, even a few years old, may be useful.

The clouds and twilight will usually be reasonably bright, so normal camera exposure metering should be adequate. Normal daylight type film is suitable - ISO 400 film will give you more scope for reducing the exposure time.

Further information on observing PSCs can be found at <http://www.aad.gov.au/default.asp?casid=11200>.

Andrew Klekociuk, Space and Atmospheric Sciences Program, AAD

New VHF radar beams through Davis atmosphere

For years, the shores of Heidemann Valley, about a kilometre behind Davis, have watched a parade of penguins and people pass by but have been largely left in peace. And after a summer of activity, that peace has returned, albeit with a difference; a VHF radar now sits there quietly probing the atmosphere above. This is a result of the efforts of the staff of the AAD's Space and Atmospheric Sciences group and the engineering tradespeople at Davis.

The reasons for all this effort relate to atmospheric radars and their ability to probe the mysteries of the atmosphere. They are widely used and can measure rainfall (for example as a storm approaches the cricket) and wind (using the balloon tethered targets, such as those that used to be released from meteorological observing stations). But in their more common form, their operation is limited by a requirement for a 'hard target'; an object off which to reflect their radio waves. The 55 MHz VHF radar that has been constructed at Davis is able to detect signals from extremely weak reflectors in the atmosphere itself, and so is less affected by these limitations. It can operate continuously, automatically, and largely unattended.

DAMIAN MURPHY

VHF radar antennas after installation at Davis

Raising a radar

The VHF radar consists of 144 Yagi antennas (similar to TV antennas), sited in a 50m by 50m square and all pointing upward. Each antenna needed to be vertical, precisely positioned and able to withstand the high winds that can buffet our Antarctic stations. A building, with power and data connections to the main station infrastructure, was required to house the radar's electronic equipment. And we wanted to do all this with the minimum environmental footprint so that the site could be easily remediated at the end of the life of the radar in a decade or so.

With the help of the AAD engineering section, a design was developed that was simple, easy to build and modular. The usual (but high impact) technique of levelling the radar site was replaced with the pouring of 144 small concrete pads. These provided a regular surface on which to position the precast concrete blocks that hold the base of the antenna support posts. A guy system holds the top of the support post in place and bears the strain of the wind loading.

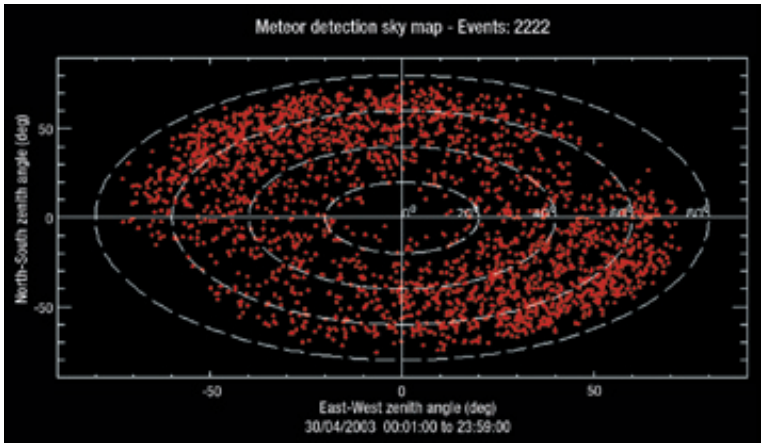
The design of the base blocks and the guy system was based on calculations made by Gandy and Roberts, a Hobart engineering firm. They modelled the radar with a computer and, with the wind data for Davis, calculated the weight of the base blocks, the breaking strain required for the rope guys and the anchors needed to prevent the radar from blowing away. The equipment module was built by Doric Engineering to AAD design standards. Local expertise was also used in completing signal cable entry points and ventilation fittings so that the building could be commissioned at Davis with a minimum of work on-site.

During planning, it became apparent that we would need more of the summer of 2002-03 to build the radar than was available to us after the heavy resupply in December. With the help of the AAD operations branch, construction materials were pre-positioned at Davis during the previous summer in readiness for the arrival of the Kapitan Khlebnikov and the summer expeditioners.

When the radar team started work at the VHF radar site (or the 'ant farm' as it became known) they surveyed the site so that the antenna positions sat exactly in a north-south aligned square. They dug a hole for the footing, poured a small unreinforced slab of concrete, placed a concrete base block on the slab and nudged it into its correct position. Insulating surrounds designed to limit heat flow into the soil were put in place. They cut a pole to the right length for each block position (so that the antennas were horizontal rather than following the lie of the ground) and bolted a base plate to the base block. With the guy system in place and some attachment points affixed to the pole, they set it to vertical and clamped it to the guy system. Three antenna elements were fixed to the pole at the correct height and spacing, and the cables that connect them to the electronics were put in place and protected by a system of poly pipe and cable tray. Finally, the electrical characteristics of the antennas were tuned to match the requirements of the radar electronics. And each of these tasks was carried out 144 times!

Needless to say, it was a big effort, and the dedication and skill of the scientific, technical and trade staff cannot be understated. In exchange for informal lessons on VHF radars, we experienced the skill and finesse of our plant operators, studied the art of concrete mixing with the carpenters and saw our mains electrical cable come to life.

The cooperative spirit that is so much a part of ANARE was also apparent in the generous support of the station community. The chef drove the concrete truck during the concrete pours, a geophysicist awaiting deployment in the field helped lay the cable support tray and almost everyone hauled and carried the power and communications cables when they were laid. The raising of the VHF radar touched the whole station in one way or another.



Skymap of meteor detections. Note that the detections are weaker when end-on to the antennas.

Reflections and detections

The remote sensing capabilities of a VHF radar make it a useful tool for probing the atmosphere at any location, but the southern polar regions offer even greater opportunities. Other than for a few months on a subantarctic island, there have not been any observations using VHF radars of this kind anywhere in the Antarctic. As a result, Australia is poised to make a significant scientific contribution using the first 'permanent' VHF radar in the region.

This is of particular interest because of a phenomenon called a Polar Mesosphere Summer Echo (PMSE). Unexpectedly strong echoes are returned from near 85 km (the upper mesosphere) at VHF frequencies during the summer in the northern hemisphere. But the southern hemisphere's response has remained a puzzle. Knowledge of the characteristics of PMSE over Antarctica will help to unravel the mysteries of what drives that part of the atmosphere into the frigid conditions that are present during summer.

Observations of the troposphere and lower stratosphere are also possible with a VHF radar, and the Davis system has been making observations of the wind speed from a few hundred metres up to around 10 km every few minutes since it was commissioned. In this region, reflections come from inhomogeneities in the clear air. These reflections are extremely weak and the ability of the VHF radar to use them demonstrates the advanced design of the system.

A last minute add-on allows us to use meteors to further our scientific goals. Thanks to the help of our collaborators at the University of Adelaide, we were able to include a meteor detection system in the first phase of the radar project. We now detect reflections from the trails of a few thousand meteors per day above Davis. Most of these are not visible to the naked eye, but they are intense enough to be observed with a VHF radar and to measure the wind speed in the mesosphere all year round. This enables us to verify some aspects of the 2MHz radar system that we also operate at Davis, and will allow us to measure temperature variations.

The summer of 2003/2004 will be a particularly bright one for the radar. The final major upgrade of the radar, which will see the power of the transmitter increase by a factor of about six, is due for completion early in the summer period. This will make an intensive season of observations of PMSE in the Antarctic possible for the first time ever.

JOHN CADDEN

Davis expeditioners help roll out the power cable for the VHF radar installation.

Acknowledgments

As we have said, many people have contributed to the VHF radar project. The assistance of the station community was acknowledged one sunny afternoon at the radar site as the Davis population enjoyed drinks, snacks and wandered among the antennas searching for the one that had been dedicated to them. But there are a few who should be singled out for particular thanks and they include Paul Saxby, the carpenter who worked with us for the summer and electrician Christopher Heath who gave us power. Thanks also to plant operator 'Squizzy' Taylor, and to Janine Lea, the trades supervisor, who was ever enthusiastic and supportive. Thanks also to the SAS team at Davis including Lloyd Symons, Danny Ratcliffe and Rich Groncki. Back in Kingston, thanks go to Jan Adolph, Brett Gogol and Peter Magill, and the staff at Macquarie 4 Cargo Facility and on Voyage 2, who tolerated the ever-changing schedule and ensured the safe delivery of our equipment. The expertise and assistance of the staff of Atmospheric Radar Systems (ATRAD), the radar supplier, is acknowledged. Finally, thanks to Michael Carr, Jeremy Smith and the winter-summer-winterers of 2002–03.

Damian Murphy and Ray Morris, Space and Atmospheric Sciences Program, AAD

A current program at Vostok

Ever wondered what happens to the current that flows in lightning displays during thunderstorms? Well some of it sneaks back to Earth at Vostok, Antarctica. These events form part of the global electric circuit.

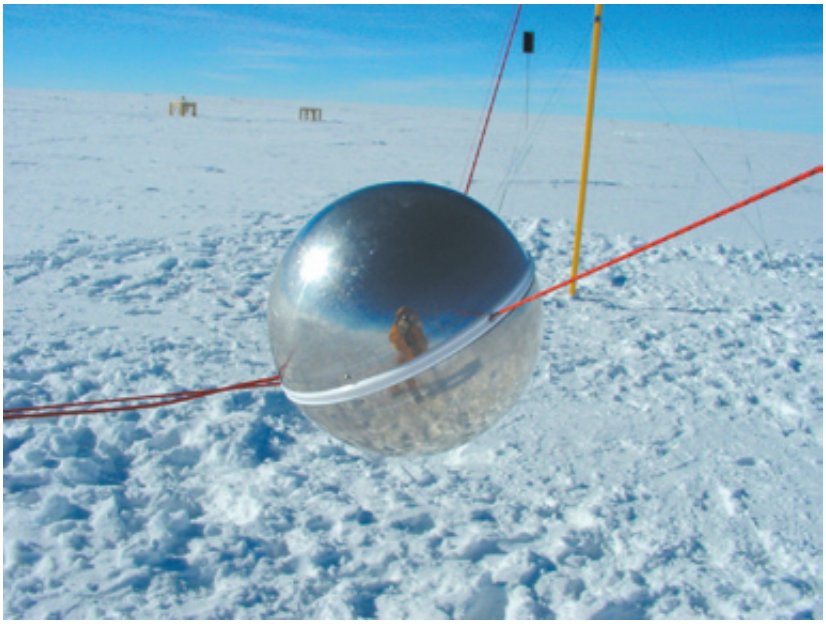
In excess of 1000 thunderstorms at any one time are the batteries of this circuit. Charge is separated from air molecules and ice particles in the strong up-welling drafts at the core of thunderclouds, similar to that achieved by the friction of a comb through hair. The thundercloud accumulates an excess of negative charge at its base and positive charge at its crown. Eventually, the accumulation of charge at the cloud base generates lightning.

The Earth's atmosphere is so densely packed near the ground, that once electric charge has been lifted above 3 km, the 'path of least resistance' to complete the circuit is initially upwards. The charge travels from the top of the thundercloud (~10 km) to the lower reaches of the ionosphere (~80 km) where it spreads around the globe and leaks back to the Earth's surface over the 99% of the globe where thunderstorms are not active at that time. Optical confirmation of the linkage between thunderclouds and the ionosphere was obtained as recently as 1995 with the imaging of 'sprites'.

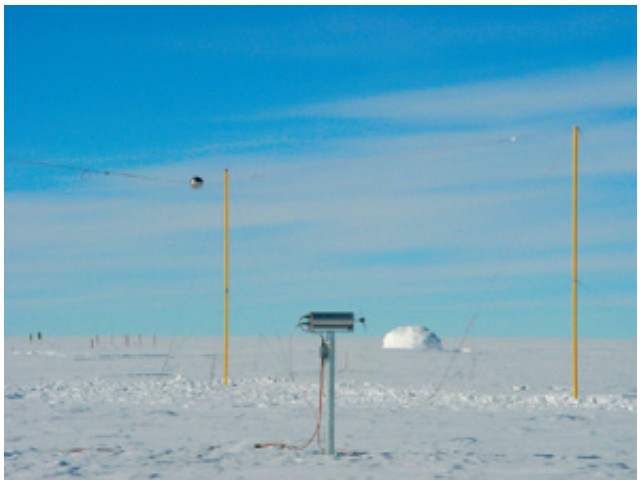
Changes in the sun directly influence the global electric circuit. Cosmic rays control the ease with which current can flow through the atmosphere and these are modulated by changes in the solar wind. In total energy terms, solar variability can have negligible influence on the weather, but the leverage gained via the global electric circuit yields possible mechanisms for meteorological and climatic influence. The aim of our research is to determine the viability of such links.

Vostok is an ideal site to measure the global circuit. It is on a high (3500 m) plateau which improves the linkage to the ionosphere by over 50% compared with sea-level sites. Minimal variation in station weather on time-scales of less than a day is also vital for relating the measurements to the global circuit.

Since 1998, an international research program has been undertaken at Vostok in collaboration with Drs Oleg Troshichev and Alexandr Frank-Kamenetsky of the Russian Institute of Arctic and Antarctic Research in St Petersburg, Dr Edgar Bering from the University of Houston and Dr Volodya Papitashvili of the University of Michigan. We have been able to show an influence of solar variability on measurements of the vertical electric field of the global circuit at this site.



PETER JANSEN



PETER JANSEN

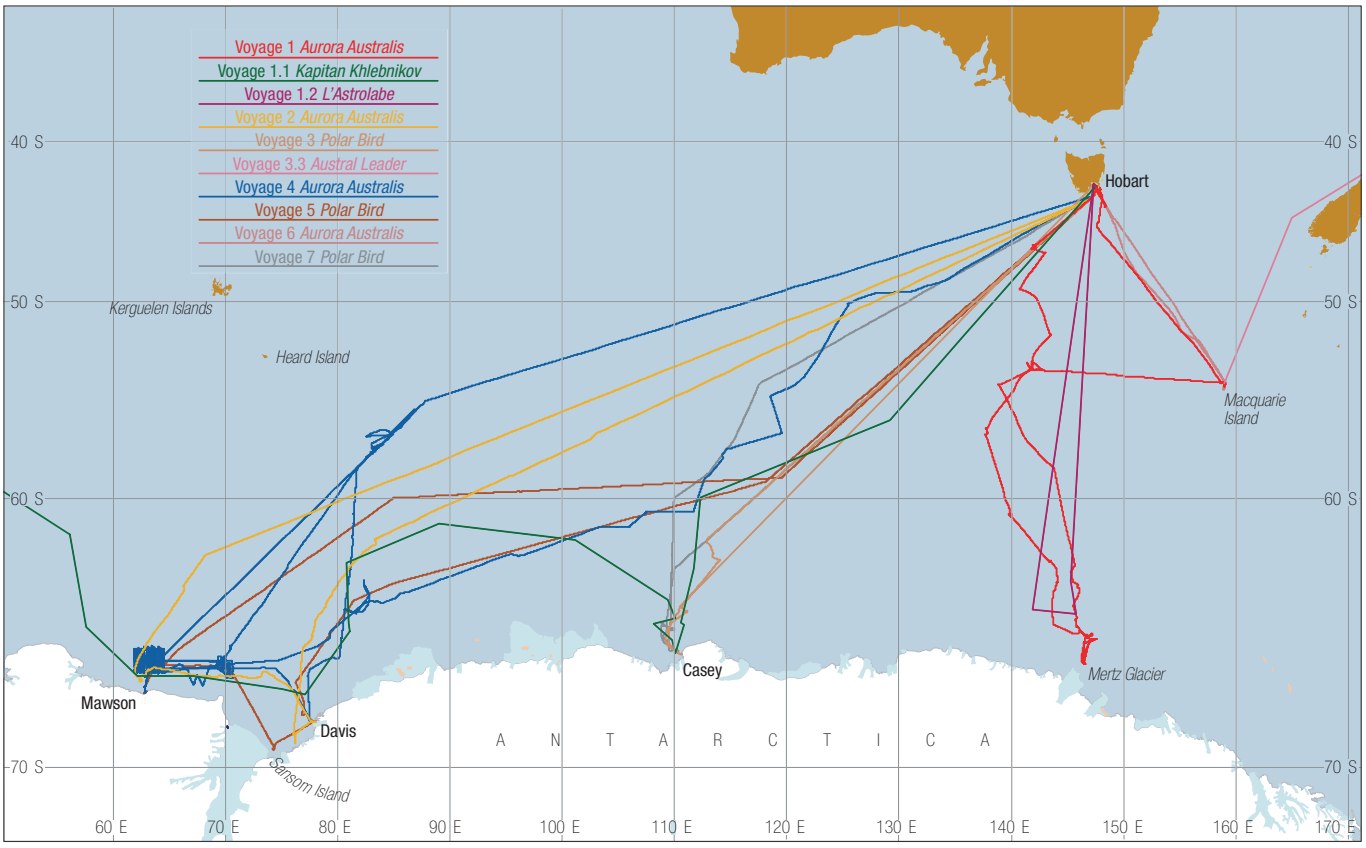
Above: The air-earth current meter ball.
Right: The electric field mill (operating since 1988) in the fore-ground and the air-earth current meter in its deployed position.

A more difficult measurement to make, but one more directly related to the global electric circuit, is of the miniscule current (~3 pico-amps per meter squared, world-wide) that flows from the ionosphere to the ground in regions remote from thunderstorm activity. With the assistance of Dr Edgar Bering, the Australian Antarctic Division Science Technical Support group has developed a split-sphere to measure this current. This instrument was deployed at Vostok on the 28th January 2003 by Peter Jansen utilising United States Antarctic Research Program logistics, via New Zealand. At Vostok, the current through the Air-Earth Current Meter is approximately 160,000,000,000 times smaller than current through a 60 watt light-bulb!

Subsequent to our deployment, a delay has intervened. Vostok was closed and our instruments turned off. It had proved impossible to supply sufficient fuel from Mirny to sustain the winter operation of the station. Our Russian colleagues plan to re-open Vostok in November 2003 and we look forward to resuming our investigations of the global electric circuit.

Gary Burns and Peter Jansen, Space and Atmospheric Sciences Program, AAD

The 2002-03 season a huge success



PETER BOYER

The support of programs in and around Antarctica requires a large and complex logistical effort. The 2002–03 shipping season involved seven voyages by the regular 'work horses' RSV *Aurora Australis* and MV *Polar Bird*; the use of the French program vessel *L'Astrolabe* to deploy and recover a heritage conservation team from Cape Denison, Commonwealth Bay; the charter of IB *Kapitan Khlebnikov* for an early voyage from South Africa to Mawson, Davis and Casey; and the use of berths on cruise ships and a fishing vessel to add flexibility to 'standard' shipping arrangements.

An 'ANARE first' saw the ship-to-ship transfer of fuel – from *Polar Bird* to *Aurora Australis* – a seven-hour, incident-free operation conducted while the vessels moored alongside each other in Horseshoe Harbour, Mawson. An 'ANARE last' saw *Polar Bird* make its final voyage for the Australian Antarctic Program – the end of season Casey summer retrieval during which the vessel distinguished itself by making its way to the anchorage on what was expected to be a fly-off operation. *Polar Bird* (*Icebird*) began its Australian Antarctic career in 1984.

While there were no significant variations from the published shipping schedule, the summer was not without challenges for the teams involved. The voyage out of South Africa, for example, involved tracking over a hundred expeditioners, their 2.5 tonnes of hand-carried excess baggage, and cargo and equipment airfreighted, railed and shipped to Cape Town from Australia, South America, Canada, Germany, USA and The Netherlands. Some of the wind turbine components delivered to Mawson on *Polar Bird* are believed to be the largest units of cargo ever unloaded at our stations. Two cat-eradication program dogs retrieved from the wilds of Macquarie Island were probably the most buoyant items transported.

On an administrative level, changes to Customs legislation necessitated accelerated progress towards a major re-engineering of the AAD's cargo documentation systems to enable the generation of detailed information on the 15,000 plus different commodities packed to go south this summer by AAD Cargo Facility staff. In all, 2376 tonnes of dry cargo and 2,119,500 litres of bulk fuel were delivered to Antarctica and Macquarie Island, and 778 tonnes of cargo were returned to Australia.

Squirrel AS350BA helicopters again proved their versatility and flew 926 hours

MV Polar Bird *leaves Mawson for the last time*


STEVE NICOL

in their seventeenth year of operation in Antarctica. Four summered on the continent, supporting camps at Rofe Glacier, Mt Stinear, Wilson Bluff, Cumpston Massif, Mawson Escarpment, and as far south as Komsomolskiy Peak (75°S). The aviation support of programs was not limited to the use of helicopters. A DHC-6 Twin Otter ferried from Calgary, Canada to Davis at the end of October, completed 475 hours flying in little more than three months on the continent, mainly in support of Australian and German scientists working in the southern Prince Charles Mountains. Experiencing good weather, the aircraft ably demonstrated the abilities of fixed wing aircraft to deploy, support and retrieve remote field parties.

Closer to home and at the end of the season, two helicopters and two LARCs were used to changeover personnel and resupply Macquarie Island. The retrieval of plateau huts at Tiobunga, Mt Eifel and Windy Ridge, and a coastal hut at Davis Point, was a significant achievement given the island's testing flying conditions.

Sandra Potter, Logistics Group, AAD

Australian Antarctic shipping program 2003-04

The following shipping schedule for the 2003-04 season was correct as at 24 July 2003. However, published voyage timings are subject to change without notice and may be brought forward or delayed. The most current information is available on the AAD's website at <http://www.aad.gov.au/shipping0304>.

Voyage 1	Aurora Australis: Marine science, Casey changeover Departing Hobart 9 September 2003, returning Hobart 1 November 2003
Voyage 2	Aurora Australis: Davis changeover and resupply Departing Hobart 3 November 2003, returning Fremantle 5 December 2003
Voyage 3	Southern Supporter: Heard Island deployment Departing Fremantle 2 December 2003, returning Hobart 26 December 2003
Voyage 4	Aurora Australis: Marine science, Davis retrieval Departing Fremantle 8 December 2003, returning Hobart 12 February 2004
Voyage 5	Vasiliy Golovnin: Casey, Mawson, Davis resupply Departing Hobart 30 December 2004, returning Hobart 16 February 2004
Voyage 6	Southern Supporter: Heard Island retrieval Departing Esperance 6 February 2004, returning Fremantle 27 February 2004
Voyage 7	Aurora Australis: Macquarie Island resupply, Casey flyoff Departing Hobart 15 February 2004, returning Hobart 12 March 2004

New ship for Australian Antarctic program

The Australian Antarctic Program will see a new ship next summer: the MV *Vasiliy Golovnin*.

The *Vasiliy Golovnin* has been chartered to replace the MV *Polar Bird*, which was sold following the completion of its final voyage last season. Owned and operated by the Far Eastern Shipping Company of Vladivostok, the *Vasiliy Golovnin* has initially been chartered for one season, with options to extend this charter to a maximum of five years.

At 159.8m long, the *Vasiliy Golovnin* provides the AAD with a cargo capacity greater than any ship it has previously used. The increased capacity will allow the AAD to undertake the resupply of multiple continental stations on the one voyage. This has been a goal for some time, although it has not previously been possible due to the smaller capacities of ships used in the past.

Operations on the *Vasiliy Golovnin* will commence on 26 December when it comes on charter in Hobart. The vessel will then be loaded with cargo for Casey, Mawson and Davis stations, departing for Casey on the 30 December. The voyage will take approximately 48 days, with the vessel expected to arrive back in Hobart on 16 February.

AAD PHOTO

MV Vasiliy Golovnin

The 13,514 tonne ship, registered in Vladivostok, is one of a series of Vitus Bering class icebreaking transport vessels purpose-built for service in Arctic and Antarctic waters. Sister ships are also used to support other nations' Antarctic programs.

MV *Vasiliy Golovnin* was built to carry general and bulk cargo, cargo fuel oil, heavy vehicles and containers. It is fitted with hydraulic electric deck cranes, stern quarter door and landing ramp, helicopter hangar and helipad. Powered by two 5,730 kW diesel electric engines, the vessel has a Russian crew of 39 and can accommodate approximately 27 expeditioners.

Antarctic air transport contract signed

EADS CASA

The C212 aircraft will provide the AAD with unprecedented levels of air support in Antarctica. The aircraft has close to twice the range/payload capabilities of the Twin Otter that was operated in support of PCMEGA last season.

The signing in June 2003 of a 12-year contract for an internal Antarctic air transport system for Australia's Antarctic Program came after a successful 2002–03 season in which runway trials got under way at the planned landing site near Casey.

Announcing the contract between the Australian Antarctic Division (AAD) and the Australian company Skytraders Pty Ltd, the Parliamentary Secretary for the Antarctic, Dr Sharman Stone, said the agreement would enable intra-continental flights between Australia's three Antarctic stations from 2004–05.

Runway construction trials at Casey last summer followed an extensive reconnaissance, led by ice runway specialist George Blaisdell, locating and surveying a runway site on the upper Patterson Glacier.

Trials of plant and construction techniques confirmed the suitability of the site and enabled the team to produce a 3.7km-long laser-levelled foundation. An end-of-season visit by a team from the Australian Civil Aviation Safety Authority and Skytraders resulted in approval for aerodrome plans and the ice runway.

The AAD-Skytraders contract involves the use of two European-made CASA 212 aircraft for transport and field support. In the 2003–04 season, two Canadian Twin Otter fixed wing aircraft will be chartered to test aspects of the intra-continental system.

CASA, a subsidiary of the European Aeronautic Defence and Space company, is a world-leading maker of light and medium transport aircraft. Its C212 aircraft, registered in 42 countries, have a short take-off and landing capability and a reputation for robustness, with more than 2.5 million flight hours logged.

The C212-400 has large, relatively low pressure tyres so it can operate most of the time on ice using its wheels. For Australian service however it will also be fitted with a hydraulic wheel or skis configuration for use on a wider range of surfaces. A large rear door and ramp will enable remote deployment of small ground transport vehicles such as skidoos and quad bikes.

The aircraft will have additional fuel tanks for longer-range operation including aerial survey work, which will virtually eliminate the need for fuel depots in remote locations. Its long range will also allow it to be flown directly from Hobart to Casey between seasons.

The CASA 212-400 aircraft will lessen the AAD's reliance for Antarctic field support on helicopters, which are limited in range, cargo capacity and ability to fly in adverse weather conditions.

Besides serving the CASA 212-400 aircraft, the Casey runway is planned to be the southern terminus for future inter-continental Falcon jet flights linking Hobart and Antarctica.

At right: Runway construction trials at Casey last summer. Top to bottom: a) After finding melt conditions at the proposed runway site, the construction team explored higher up the glacier looking for a colder site. Using satellite photographs and precision GPS equipment the team assessed many sites before identifying an ideal location for the runway; b) Core samples were taken at potential runway sites to assess their suitability to support the weight of heavy aircraft; c) A Unimog was used to push snow and spoil to the edge of the runway, while the grader was used to cut into the ice. The blade of the grader was controlled by a laser levelling device to achieve the finest tolerances possible; d) A Schmidt snow cutter was used to clear the spoil pushed to the edge of the runway. It is vital to ensure that no spoil mounds are left behind as they can quickly accumulate far more wind blown snow than was originally removed from the runway.

GEORGE BLAISDELL

GEORGE BLAISDELL

GEORGE BLAISDELL

GEORGE BLAISDELL

GEORGE BLAISDELL

e) Towards the end of last season the first landing on the runway was made by a ski-equipped Twin Otter. Once a thin snow cap is applied next season the runway will be ready for wheeled aircraft and at 4000m in length it will also be Australia's longest.

Blizzard winds now harnessed at Mawson

This season saw the culmination of many years' work within the renewable energy program with the erection and commissioning of two 300 kW wind turbine generators at Mawson station.

The turbines are presently generating up to 90% of Mawson's instantaneous electrical power, resulting in fuel savings and lower greenhouse gas emissions. The average for the three months to the end of June was 53%. This is beyond what was predicted as being initially achievable by the system modelling.

To complement the two turbines, a new powerhouse control system was installed and commissioned, along with new electric boilers. The original diesel generators are still in use, augmenting the wind power, and through their co-generating heat exchangers are still providing some 'free' waste heat. However, with the reduced load on the diesel generators, there is a corresponding reduction in the production of waste heat, hence the need for the electric boilers.

The initial results are very encouraging, resulting in fuel savings of between 30 and 40%. The planned commissioning of an additional electric boiler in the water services building will provide additional fuel savings by replacing the fuel fired boiler which is presently used to melt ice for the station's water supply.

The project has involved monitoring of wind conditions at all Australian Antarctic stations since 1993, with a detailed feasibility study in 1999 indicating that the installation of wind turbines at Mawson would be possible. Site work has spanned two summer seasons with initial work on the first foundation commencing in the 2001–02 summer. The besetment of the *Polar Bird* in 2001–02 delayed the delivery of steelwork and personnel, and the first foundation was not completed until after the 2002 winter. The new switchboards for the powerhouse upgrade were also delivered to Mawson on the 2001–02 resupply on the *Polar Bird*, along with the 100-tonne crane needed to erect the 34 metre turbine towers.

A very busy 2002–03 summer saw two foundations completed, and the complete replacement of the main powerhouse control system with the new system which had been delivered on the previous season's resupply. The new system allows the integration of the energy produced by the wind turbines with that produced by the diesel generators, and adjusts the diesel generators to make up the difference between what is produced by the wind and what is required by the station.

PETER MAGILL

PETER MAGILL

PETER MAGILL

PETER MAGILL

From top: The new Mawson skyline; towing the bottom tower section to the turbine site; lifting the hub and blade assembly onto the turbine nacelle.

The 2002–03 resupply saw the delivery of the wind turbines themselves, again on *Polar Bird*. A tight five week window between ship visits saw the turbines erected and commissioned. Over the winter, they will be tested further, and fine-tuned to produce the maximum energy (and hence greatest fuel savings) possible.

There are a number of aspects of the project which epitomise the teamwork and ingenuity of our expeditioners which are worthy of mention.

Firstly, the foundations themselves were mass concrete structures, poured in situ, and possibly the largest single pour of concrete ever attempted by any nation in Antarctica. Each foundation contains over 70 cubic metres of concrete, and each pour took over eight hours from start to finish, and required the continuous use of three concrete agitator trucks. Most Antarctic concrete pours are undertaken with a single small truck in a much shorter time.

Another example was the movement of the steel tower sections from the wharf area at Mawson to the erection sites. The sections had been delivered on 40-foot steel

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Casey-Thala Valley cleanup project

Preparation for the Thala Valley clean-up project at Casey station continued this summer with the delivery of the water treatment plant, barriers, a 30-tonne excavator and additional waste containers to Casey on Voyage 3.

The six-person summer project team consisted of staff from the Australian Antarctic Division's Human Impact Section, Environmental Management Section and Operations Branch in conjunction with the University of Melbourne's Department of Chemical Engineering. In addition, the Human Impacts dive team was busy deploying and retrieving equipment associated with the pre-removal monitoring.

The water treatment plant was designed by Melbourne University and built in Hobart under the supervision of AAD's Engineering Section. The plant will remove suspended and dissolved solids from the potentially contaminated melt water collected during the excavation of rubbish from the old tip site.

Preliminary testing of the plant was completed at Kingston prior to deployment. This summer, final commissioning and performance testing was completed at Casey with water collected from the tip face.

In addition, soil samples were taken and analysed during the summer to establish the level of contamination at the site and to determine the boundaries of the material to be removed.

Planning has now commenced for a team of up to twelve people from the project group to spend the 2003–04 summer at Casey removing the rubbish, monitoring the environment, undertaking further soil testing and treating the melt water that collects in the tip while the excavation is in progress.

All this happened during a busy Casey summer amidst many high priority projects all requiring the support of the limited station resources. Our thanks go to all those involved.

TIM PRICE

NICK EDGERTON

Top: Collecting soil samples.
Below: Operating the Water Treatment Plant.

Chris Paterson, Chief Engineer, AAD

from page 34

beds to allow shipping from Germany, and a conventional trailer had been purchased for the task of moving the sections from the wharf to the site. The trailer was unstable on the rough Mawson terrain when moving the lowest, largest and heaviest of the tower sections. As a result, expeditioners manufactured steel skids which were welded to the 40-foot tray, and then using the available 950 loaders, log skidders, and the excavator, dragged the tower section into place.

The success of the project is attributable to a number of people, including the Mawson expeditioners from the 2001–02 and 2002–03 summers, and the 2002 and 2003 winters.

Chris Paterson, Chief Engineer, AAD

Multicultural traverses to Dome C

SCOTT NOBLET

For the last 10 years, three French-led traverses have transported building materials and fuel supplies on tractor-towed sledges from coastal Dumont d'Urville station to Dome C, 1100 km inland and 3200m above sea level. In the past few years diesel mechanics from the Australian Antarctic Program have been invited to participate in these traverses trading knowledge with the French. This year we (John Donaldson and Scott Noblet) participated in the second and third traverses.

It takes 12 days on average to get to Dome C with the loaded sleds and about eight days to return. The start is slow, with large sastrugi and a relatively steep climb keeping the average speed below about 11 km/h. As fuel is used, fuel sleds are left for collection on the return trip. Loss of power to the tractors due to altitude is counteracted by the load getting lighter and the road getting smoother. As the temperature steadily decreases so does the wind, making bearable temperatures of minus 30°–40°.

About 470 tons of 'usable' cargo was delivered to Dome C station by the three traverses this season. After unloading of sleds at Dome C the vehicles are serviced over two days before starting on the return trip. 'Downhill' speeds are at least 14 km/h and usually much more, especially with the help of a snowplough smoothing the sastrugi.

A typical day on traverse involved waking up at 7.15 am, having a quick breakfast, then starting the tractors at 8 o'clock and warming them up for half an hour. By 8.30 am loads were connected and the train ready to start. At 1.30 pm we stopped for one hour for lunch before driving again nonstop until 8.30 pm.

The nine people all had jobs. Two people checked the sleds and loads, two people fuelled up the nine vehicles, three mechanics serviced the vehicles, one person prepared the meals and one did odd jobs like filling the snow melter, cleaning the incinerator toilet and helping out where needed. Food – all pre-cooked in Australia – was prepared by the doctor.

We had a great time. We learned a lot and were made very welcome by both the French and Italian people, who were very patient with our shocking attempts at their language. Most of them have a lot of traverse experience, having been involved for many years, and everything ran very smoothly and efficiently.

Scott Noblet, Engineering Program, AAD

SCOTT NOBLET

SCOTT NOBLET

Top to bottom: Living and generator vans pulling up at sunset before refuelling and servicing the vehicles; Tractors warming up before leaving in the morning. Note condensation from the exhaust in the below -20°C temperatures; Dome C station with Australian melon in foreground, camp and traverse vans in background.

Getting your research application approved

When you apply to conduct any Antarctic or subantarctic research, your application is processed by AAD staff and assessed by research program leaders before being subjected to national and international assessment and environmental and other scrutiny prior to getting final approval. The AAD team responsible for coordinating this process, in the Science Planning and Coordination section, comprises Gwen Fenton, Jenny Foley, Debbie Brown, Ian Hawkins, Jenny Cole and Vicki Cochrane.

The time to apply is May and June for the season after next, which means that this year we are assessing projects for the 2004–05 season. The 18 month lead-time is needed for assessments, approvals and logistical planning.

Applications are open on the AAD's web site <http://www.aad.gov.au/applications> from early May till the end of June each year. The web site carries all the information you need, but remember to discuss your project with the relevant program leader before lodging an application.

It is important that the whole assessment process is transparent and all steps are clearly explained to applicants. Accountability requires that Commonwealth resources are not provided to research projects without a full prior assessment and a progress and/or final report by each successful applicant.

The approval process

Applications are initially peer reviewed for scientific merit, the career experience of chief investigators, and institutional support, and the project's relevance to the Antarctic Science Strategic Plan is assessed. Each chief investigator is then asked to comment on the peer review of their project. Progress or final reports of previous or related projects may also be assessed.

Scientific assessments of each project go to either the life science or physical science Antarctic Research Assessment Committees (ARAC). These committees have independent chairs and members, together with relevant program leaders and the AAD Chief Scientist. Their recommendations are provided to the Science Program Management Committee for final selection of projects to receive resourcing and/or funding through the Australian Antarctic Science Grants Program. Any ethics approvals (for animal and human research) are completed during this time.

Notification of a favourable or unfavourable scientific assessment is done in December, after which operational assessment can begin. Applicants are notified whether their project has all the approvals about 12 months after they first applied.

What support is available?

Grants are available under the Australian Antarctic Science Grants Program. There is an upper cash limit of $30,000 (excluding GST), but actual operational support is substantial with an average value in excess of $500,000 per project. AAS Grants support research undertaken by full or part-time researchers based at Australian universities, by university-funded staff in Cooperative Research Centres (CRCs), and by researchers in other Australian tertiary institutions.

Applicants employed in State museums and State-funded institutions must obtain prior approval from the AAD Chief Scientist before seeking AAS Grant support. Researchers employed by government agencies that normally undertake research, such as CSIRO or Geosciences Australia, are ineligible for AAS Grant support but may receive logistical support.

Future seasons

Science Planning and Coordination section also coordinates Expressions of Interest (EOIs) for future seasons. So if you have a plan to conduct a major research program in 2005–06 and beyond, the sooner you let us know, the better. Projects of this type are classed as 'resource determining' in nature and must be identified at least two years in advance of the nominated science season.

MIKE WOOLRIDGE

STEVE NICOL

This process is necessary to assist the Antarctic Division's long-term operational and science support planning.

Resource determining proposals include those involving:

- Significant levels of ship time
- Significant levels of helicopter time
- Support by fixed-wing aircraft
- Significant numbers of workboats, including inflatable rubber craft
- Diving facilities
- Critical dates
- Specially trained support personnel (for example, field training officers)
- Significant or unusual cargo

To find out more see <http://www.aad.gov.au/default.asp?casid=3779>

Gwen Fenton, Science Planning & Coordination, AAD

International collaboration

The Australian Antarctic science program benefits enormously from international collaboration. The numbers of partners will vary from year to year but in any given year more than half of all projects have international collaborators involved in the research. At times the projects are very large with many international partners, while others have less formal links. In the 2002–03 season there were collaborators from approximately 20 countries with over 80 institutions participating in Australian Antarctic research. The international collaborators came from the USA, Japan, Russia, Norway, China, UK, Canada, Italy, South Africa, Chile, Malaysia, France, Netherlands, Poland, Germany, Denmark, New Zealand, Egypt and Switzerland. These just list the formal links but many of the projects are part of global experiments which include many more international partners.

An example of the international collaboration last season was the Prince Charles Mountains expedition PCMEGA with a group of 35 scientists from Australia and Germany conducting a large field program (see articles on pages 2–7).

Heard Island a focus of 2003-04 science grants

Heard Island in the southern Indian Ocean is to be a major focus of research supported in 2003–04 with Australian Antarctic Science (AAS) Grants. The subantarctic island study includes eight of the 57 projects allocated funding from the $700,000 available from the Federal Government under the scheme.

Announcing the grants, the Parliamentary Secretary for the Antarctic, Dr Sharman Stone, said that research approved for Heard Island would enable the study of land-based predators such as seals, penguins and albatrosses and their prey, important for determining levels of sustainable fishing around the island.

The Heard Island projects are timed to coincide with continuing studies into where predators are feeding, in which scientists are using the Antarctic research vessel *Aurora Australis* to track seabirds and their prey, mainly krill, to provide better information for managing future sustainable fisheries. The studies are part of a larger, wide-ranging examination of the ecosystem of Heard Island which, along with the nearby McDonald Islands, is part of the world's largest marine reserve.

Other Antarctic projects approved for 2003–04 include:

- investigation of climate variability and sea level changes using several sources such as ice cores, 19th century Antarctic plants and data collected from the Amery Ice Shelf;
- comparisons between Antarctic and Arctic middle and upper atmosphere conditions to improve our understanding of how the hemispheres compare;
- determining the level of lead and other contaminants in the Australian Antarctic Territory; and
- ozone depletion and its effect on the Antarctic food web and, through this, on climate.

JENNY SCOTT

Spit Bay field camp, Heard Island – home to four biologists and support staff for the coming season

The 57 projects to receive funding under the AAS grants scheme are among 130 to be undertaken in Australia's Antarctic Territory and subantarctic islands in 2003–04.

Institution: Total funding (with GST)	Chief Investigator	Project Title	Grant (with GST)
Australian National	Reading, Dr Anya	The deep structure of East Antarctica from broad-band seismic data	$3,300
University [ACT]: $63,623	Schortemeyer, Dr Marcus	Heard Island 2003-04: Terrestrial biology carbon acquisition and nitrogen economy of Heard Island plants as affected by climate change	$12,197
	Skotnicki, Dr Mary	Conservation of plant biodiversity in Antarctica - a genetic approach	$19,796
	Skotnicki, Dr Mary	Investigation of virus biodiversity in Antarctic terrestrial plants	$10,822
	Tregoning, Dr Paul	Crustal rebound in the Lambert Glacier area	$17,508
Curtin University [WA]: $29,453	Rosman, Professor Kevin	Climatic and sea-level changes during the glacial/Holocene transition inferred from isotope ratios of trace metals in Law Dome ice cores	$15,989
	Rosman, Professor Kevin	Heavy metal concentrations and isotope ratios in Law Dome snow as indicators of recent climatic and environmental variability	$13,464
Flinders University [SA]: $23,406	Mitchell, Dr Jim	Impact of viscosity on the morphology and swimming behaviour of motile bacterioplankton, phytoplankton and protozooplankton	$6,774
	Tomczak, Professor Matt	Evolution of water mass properties in the Circumpolar Current during 1991-1996	$16,632
La Trobe University	Dyson, Professor Peter	Upper atmosphere dynamics and thermodynamics	$14,108
[VIC]: $118,616	Dyson, Professor Peter	Investigations of space weather and the mesosphere using the TIGER Radar	$17,212
	Essex, Dr Elizabeth	Mapping the GPS total electron content and scintillation activity at southern higher latitudes during high sunspot numbers	$10,296
	Goldsworthy, Dr Simon	The conservation of fur seals in the Antarctic marine ecosystem	$33,000
	Sunnucks, Dr Paul	Molecular studies of the origins and dispersal patterns of invertebrates in the Antarctic and subantarctic	$22,000
	Sunnucks, Dr Paul	Introduced invasive terrestrial invertebrates on Macquarie Island: studies on ecology origins and control	$22,000
Macquarie University	Gore, Dr Damian	Palaeoenvironments of the Antarctic coast, from 50°E to 120°E	$13,419
[NSW]: $20,349	Gore, Dr Damian	Subsurface investigations of Marine Plain	$5,500
	Selkirk, Dr Patricia	Measurement of moss growth rates in Antarctica	$1,430
Museum of Victoria: $6,811	Watson, Dr Jan	Hydroids of the BANZARE Antarctic expeditions 1916-1931	$6,811

Southern Cross University [NSW]: $24,195	Jones, Professor Graham	Factors affecting DMS in the seasonal ice zone	$24,195
Tasmanian Parks & Wildlife Service [TAS]: $18,627	Gales, Dr Rosemary	Status and conservation of albatrosses on Macquarie Island	$18,627
University of Adelaide [SA]:$31,046	Vincent, Dr Bob	Dynamical coupling in the Antarctic middle atmosphere	$31,046
University of Melbourne	Simmonds, Assoc Prof Ian	The nature of the Antarctic Circumpolar Wave and its connections with Australian rainfall variability	$30,935
[VIC]: $71,921	Simmonds, Assoc Prof Ian	The influence of the El Niño-Southern Oscillation on Antarctic and subantarctic climate	$21,369
	Stevens, Professor Geoff	Development and application of technologies for the removal of heavy-metal contaminants from run-off associated with abandoned waste disposal sites	$19,617
University of Newcastle	Fraser, Professor Brian	Observations of ULF space plasma waves in Antarctica	$24,098
[NSW]: $61,952	Fraser, Professor Brian	A Southern Hemisphere imaging riometer experiment (SHIRE)	$14,341
	Goodwin, Dr Ian	East Antarctic and Circum-Antarctic climate history from ITASE ice coring in Eastern Wilkes Land	$23,513
University of New England [NSW]: $12,854	Smith, Dr Steve	Monitoring for human impacts and introduced species in marine communities at Australia's subantarctic islands	$12,854
University of New South Wales [NSW]: $9,312	Burton, Dr Michael	The automated astrophysical site testing observatory	$9,312
University of Queensland	McGowan, Dr Hamish	Frozen dunes: An indicator of climate variability, McMurdo Dry Valleys, Antarctic	$24,633
[QLD]: $37,988	Schmidt, Dr Susanne	Identifying global change : stable isotope composition and cuticle characteristics of Antarctic plants	$13,355
University of Sydney	Clarke, Dr Geoff	The strength of the lower continental crust; evidence from Stillwell Hills-Oygarden Group	$5,665
[NSW]: $20,317	Pile, Dr Adele	Cascading effects of global climate change on near shore benthic communities in the Antarctic	$14,652
University of Tasmania [TAS]: $182,474	Barmuta, Mr Leon	Antarctic freshwater lake fauna: Palaeobiogeography, palaeoecology and applications to climate change studies	$2,833
	Bowman, Dr John	Bacterial hydrocarbon degradation and impacts of hydrocarbon pollutants on microbial communities within Antarctic coastal sediments	$14,375
	Bowman, Dr John	Exopolysaccharides from Antarctic bacteria	$9,062
	Coleman, Prof Richard	Ridging and calving on the Amery Ice Shelf	$19,663
	Davidson, Dr Garry	Geophysical imaging, structural analysis, and alteration geochemistry of the Macquarie Island crust, to constrain the tectonic, and hydrothermal history of the ocean floor	$3,541
	Hindell, Dr Mark	The effect of spatial and temporal variation in marine productivity on energy acquisition in southern elephant seals, *Mirounga leonina*	$21,443
	Howard, DR Will	Oceanographic and climatic evolution of Kerguelen Plateau region: Collaborative research aboard the Japanese research vessel *Mirai*	$13,197
	Kiernan, Dr Kevin	Geomorphological evolution of Heard Island	$3,541
	Kirkpatrick, Prof Jamie	Heard Island 2003-04: Documenting vegetation change on Heard Island	$10,998
	McMinn, Assoc Prof Andrew	Sea ice primary production off eastern Antarctica	$23,100
	McMinn, Assoc Prof Andrew	Role of micronutrients in the sea ice microbial ecosystem	$7,918
	McMinn, Assoc Prof Andrew	Limnological and nearshore diatom communities of Heard Island: proxies of subantarctic climate change?	$2,772
	Michael, Dr Kelvin	Ocean colour measurements in the East Antarctic sea ice zone	$1,320
	Nunez, Dr Manuel	UV climate over the Southern Ocean south of Australia, and its biological impact	$15,331
	Reid, Dr James	Electrical conductivity of sea ice: a comparison of in situ and laboratory measurements	$2,124
	Seen Dr Andrew	Development and application of DGT devices for passive sampling of contaminated waters in the Antarctic environment	$6,373
	Swadling, Dr Kerrie	The fate of primary production in Antarctic sea ice: the role of metazoan grazers	$12,053
	Taylor, Dr Fiona	Response of Antarctic marine diatoms to environment modification	$4,910
	Woehler, Dr Eric	Monitoring for long-term or cumulative impacts in Southern Ocean seabirds	$4,510
	Woehler, Dr Eric	Variability in the distribution and abundance of seabirds in the Southern Indian Ocean	$3,410
University of Western Australia [WA]: $6,336	Shellam, Professor Geoff	South polar skuas as vectors of disease	$6,336
University of Wollongong	Robinson, Dr Sharon	Assessing UV-B induced DNA damage in Antarctic plants: is desiccation a compounding factor?	$12,038
[NSW]: $38,372	Robinson, Dr Sharon	Can remote sensing be used to map vegetation and monitor community change in Antarctica?	$26,334

Heard Island: in search of a friendly card

Scheduling landings anywhere on Heard Island are a challenge for any operational planner. In the coming season, the Heard Island 2003-04 Program requires the placement of six independent field parties from two to ten people at sites that range from the most sheltered anchorage, Atlas Cove, to the most exposed, Capsize Beach on the south-east coast, named to commemorate the dunking of the 1964–65 *Patenela* Expedition as they fled the island.

The beach is steep, so the surf dumps savagely and the longshore drift in the prevailing south westerlies ensures you only get one chance. If all goes well, a party of three biologists will be landed with all their equipment and supplies for two months. If it doesn't, they'll have to be deployed overland from Spit Bay, requiring the support of others in the 28-member expedition.

A few kilometres up the coast, three more biologists, part of the Antarctic Marine Living Resources (AMLR) contingent, will be landed at Doppler Hill onto a pebbled and black sandy beach, slightly more friendly than Capsize but still a significant challenge. The most frequently used landing site outside Atlas Cove is Spit Bay where a further four of the AMLR team will spend the field season. Being on the northern facing coast, it is more protected from the swell and fierce winds but here, the beach is steep and rocky, making a firm footing impossible while trying to pull inflatable rubber boats from the surf. And there's just enough room to land a LARC, off-load and turn into the surf for the trip back to the ship.

Stephenson Lagoon appears from the most recent satellite images, to have expanded enormously since the last ANARE expedition three years ago and a wider, deeper entrance from the sea is anticipated, making deployment of the ten member botanical team possible. Attempts to land two tank huts converted to laboratories will be made but the conditions will need to be just right.

A team of three glaciologists will be landed at Brown Glacier, another pebbled beach and another tank hut for refuge at the end of cold days high on the glacier. The final group of two biologists will be landed at the base of the Jacka Glacier in Atlas Cove, if the fierce willie-waws and swell are kind enough on the day.

Theory and practicality will meet during the six days allowed for deployment with the only certainty that it will be played out by nature's rules and the turn of a friendly card.

ROB EASTHER

The sea off Spit Bay in a less than friendly state – but wait another hour..

Rob Easther, Heard Island Project Manager, AAD

New HIMI management plan being developed

It was reported in *Australian Antarctic Magazine* 4:41 that the Australian Government had declared in October 2002 a 6.5 million hectare, fully protected marine reserve (the world's largest) in the Heard Island and McDonald Islands (HIMI) region of the Southern Ocean. In early 2003 the AAD received formal authority, under delegation from the Director of National Parks, to administer the new reserve and to prepare the management plan required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The new management plan will replace the *Heard Island Wilderness Reserve Management Plan* made under the HIMI Environment Protection and Management Ordinance 1987, which has guided activities in the HIMI Territory since 1996. It will be written to reflect obligations arising from the area's nationally and internationally recognised natural and cultural values, to take into account up-to-date knowledge of these values gained from recent visits, and to ensure a best practice approach to management of the area. The EPBC Act also specifies mandatory inclusions in the management plan, plus a series of management principles which must be taken into account.

One of the greatest threats to the values of the reserve is the human-assisted introduction and spread of non-native species. To ensure that human activities are managed in a way that will not jeopardise the near pristine ecosystems, the AAD has commissioned a formal risk assessment by an independent expert. Recommendations arising from this assessment will contribute to strategies to minimise the risk of introductions. The AAD is also coordinating a research program in some marine areas adjacent to the marine reserve, to assess these areas for possible future inclusion through expansion of the reserve boundaries.

The EPBC Act requires that the public has an opportunity to provide input to the reserve's management, and a comment period on the proposal to prepare a draft management plan was held between March and May. As well as being a statutory requirement, this process allowed the wider Australian community, most of whom are never likely to have the chance to visit HIMI, to voice their opinions about how this remote yet potentially vulnerable external territory should be managed. The AAD received several submissions which will be considered in the preparation of the management plan.

Current intentions are to make a working draft management draft plan available to the 2003–04 AAD research expedition to HIMI, to allow valuable field-testing of proposed management measures and to ensure that what looks good on paper is also meaningful and effective on the ground (and in the water, on the ice, etc). Comments arising from on-ground experiences will be incorporated into the draft plan, which will then be subject to a further round of public comment before presentation to the Minister for the Environment and Heritage for approval and, if approved, consideration by Parliament.

Ewan McIvor, Environmental Management and Audit Unit, AAD

Antarctica Online

Further information about the HIMI Marine Reserve is available from the AAD website at: <http://www.aad.gov.au/himi_marine_reserve>.

What's ahead: Antarctic tourism in 2003–04

Estimates of predicted tourist numbers in Antarctica for the 2003–04 austral summer season indicate continued growth in interest in Antarctic tourism. Initial analyses of tour brochures and schedules published by tour companies for next season indicate that there could be a record number of tourists visiting the Antarctic and subantarctic next season with the focus of activity remaining the Antarctic Peninsula region. The actual number will depend on passenger loadings for vessels and this in turn will depend on international factors affecting the travel market such as the world economic situation, the SARS outbreak and security concerns.

The potential increase in tourist numbers is a result of an increase in the number of tour ships that will be operating in Antarctic waters next season and the carrying capacity of those vessels. The increase is expected to affect the Antarctic Peninsula area, while tourist numbers in the Pacific and Indian Ocean sectors, south of Australia, New Zealand and South Africa, are likely to be similar to those in 2002–03.

There could be a record 31 vessels operating a total of almost 170 Antarctic tourist cruises in 2003–04. Of these, 27 will undertake cruises in the Antarctic Peninsula area, with up to 150 voyages planned. Of these vessels 22, possibly 24, could make passenger landings. There is also a trend towards larger average passenger capacity for the vessels. Six will have passenger capacities less than 100, two fewer vessels than last season; eleven will have capacities between 100 and 200, five more than 2002–03; two have capacities between 200 and 500; and eight have capacities above 500. Six of these eight 500-plus vessels will be visiting Antarctica for the first time. Up to ten commercially operated yachts are also likely to operate in the Antarctic Peninsula area next season.

KATE KIEFER

Tourists admire the spectacular peaks of Heard Island's Big Ben from the deck of Akademik Shokalskiy

There are about 12 cruises scheduled in the Pacific and Indian Ocean Antarctic and subantarctic sectors that will be undertaken by four vessels: the 112-passenger *Kapitan Khlebnikov* and the 46-passenger *Akademik Shokalskiy* have respectively scheduled four and five voyages each, some of which will travel to the Ross Sea area; and the 128-passenger *Clipper Odyssey* will conduct a single subantarctic cruise.

Of strong interest to enthusiasts in 2003–04 will be a total eclipse of the sun that will occur over parts of Eastern Antarctica on 24 November, local time. Eclipse watchers are being catered for by a number of tour companies. Australian-based Croydon Travel, which plans four Antarctic overflights in 2003–04 using a chartered Qantas 747, will operate the first of these from Perth to view the eclipse. The US-based company Travel Quest International is chartering a Lan Chile Airbus A340 to undertake an eclipse overflight from Punta Arenas, Chile. In addition to the two overflights, the first voyage of the *Kapitan Khlebnikov* for the season will depart from South Africa to visit some of the Indian Ocean subantarctic islands before heading south to the coast of Queen Mary Land to witness the event near the Russian Mirny station. An on-the-ground viewing experience, departing from Cape Town, South Africa, has been organised by US-based company Astronomical Tours. The company proposes using logistic support provided by South African based company, Antarctic Logistics Centre International to fly its clients to and from Dronning Maud Land. The eclipse watchers will watch the eclipse late on the evening of 23 November, local time, and stay overnight at the Russian Novolazarevskaya station, and in other temporary accommodation if needed, before flying back to Cape Town on the morning of 24 November.

Dave Moser, Policy Officer, AAD

XXVIth Antarctic Treaty Consultative Meeting

The twenty-sixth Antarctic Treaty Consultative Meeting was held from 9–20 June, 2003 in Madrid, Spain. As usual, the meeting of the Committee for Environmental Protection (CEP) was held during the first week, from 9–13 June. It was the sixth meeting of the CEP.

Major issues discussed at ATXM XXVI included the development of a regime on liability for environmental damage, the establishment of the Antarctic Treaty Secretariat, and management of tourism and non-government operations in the Antarctic. In addition, the meeting continued the review of past recommendations of Treaty meetings and examined measures to improve the efficiency of its meetings.

In the lead-up to ATCM XXVI Australia was active on inter-sessional working groups and other forums in progressing these issues and a number of working papers was submitted by Australia to assist consideration of these issues at ATCM XXVI.

Significant issues discussed at CEP VI included the review of Annex II to the Madrid Protocol, consideration of draft comprehensive environmental evaluations (CEE), and the review and approval of management plans for protected areas.

Wayne Papps Antarctic and wilderness photographer

Born Christchurch 14 December 1959, died in a cliff fall, Cloudy Bay, Tasmania, 1 June 2003

Cloudy Bay on Tasmania's Bruny Island is aptly named. The rocky headlands flanking its beautiful beach are frequently enveloped in mist and rain sweeping up from the subantarctic. It faces south, across the stormy Southern Ocean toward Antarctica. There can be no better reminder of Australia's ancient affinity with the southern continent.

No-one would have appreciated this more than Wayne Papps, whose death while photographing on this lonely coast brings to an abrupt end an artistic life that promised something truly special in the long history of Antarctic and wilderness photography.

Those lucky enough to have worked closely alongside Wayne in Australia and Antarctica knew this. They knew that such dogged determination as his, such vision, such an unerring eye for the extraordinary lifted Papps above the pack of Antarctic photography and into the company of the very best.

Powerful images of wild New Zealand landscapes (a beloved subject to which he frequently returned over the years) and Australian and European streetscapes were evidence of Wayne's photographic skills when he first came to the Australian Antarctic Division in Tasmania in the mid-1990s. There was a hint of the extraordinary in the gaze and grave demeanour of this compact, intense man.

Antarctica seems always to have been in his sights. From Christchurch he went to live in Melbourne, and from there moved to Hobart. His all-too-brief Antarctic experience was limited to ship travel and visits to Australia's Casey and Mawson stations, but the quantity and quality of his output of a few weeks ashore suggested a stay of a full summer or a year.

Short-term visitors are usually treated with scant respect in Antarctica, but Wayne was an exception. This visitor truly knew his trade, and even the most hardened Antarctic veterans responded to his passion to give him the support he needed. That support could be demanding: ever-conscious of the severe constraints of time, weather and light, Wayne regularly rose at 3 am to catch that matchless moment.

Wayne Papps had the heart of a polar poet – simple and unadorned. He respected Antarctica's implacable indifference to human visitors but was never overawed by it. His images are uplifting and challenging, but never frightening: they celebrate Antarctica's colour and light and life, and the sheer joy of every moment spent there.

Technical excellence was integral to Wayne's artistry. A traditional film photographer, he relished the opportunities presented by digital technology. His outstanding 'virtual reality' panoramic images gave people everywhere the chance to 'be there' via their computer screens. At the Australian Antarctic Division he dealt with others' images – few of them approaching his own standards – with the utmost respect, applying the highest technical standards to their digital reproduction.

The powerful images that resulted from his short Antarctic sojourns have placed Wayne Papps in the vanguard of contemporary Antarctic and wilderness photography. His work is featured in the Australian Wilderness Photography Gallery as it is at the Vivendi Corporation's international headquarters in Paris. It has enjoyed successful showings

Wayne discovered Antarctica through new eyes. He uncovered and captured the beauty of Antarctica like no other photographer before or currently. His keen sense of nature's beauty is reflected in his photography – around you is Wayne's photographic story for the world to see.

Kevin Bell, Multimedia Unit Manager, AAD

in Sydney and Melbourne and has for several years graced the walls of Canberra's Parliament House.

Wayne's photographs enriched his Hobart community's Antarctic experience in last year's annual Midwinter Festival. This midwinter, Wayne was to be especially celebrated for his unique contribution to our collective vision of the south, with his images adorning a full gallery in the State art museum. The occasion will tragically be remembered by his absence. We are all immeasurably poorer.

(The author, Peter Boyer, is a Tasmanian writer and a former Australian Antarctic Division manager)

Ever-conscious of the severe constraints of time, weather and light, Wayne regularly rose at 3 am to catch that matchless moment.

A new era for Antarctic cooperative research

In December we were all thrilled to find out that the Cooperative Research Centre for Antarctic Climate and Ecosystems (ACE CRC) had been granted seven years of funding to build upon the work carried out by the current Antarctic CRC.

The Cooperative Research Centres, generally known as CRCs, bring together researchers from universities, CSIRO and other government laboratories, and private industry or public sector agencies, in long-term collaborative arrangements which support research and development and education activities that achieve real outcomes of national, economic and social significance.

The renewed funding for Antarctic cooperative research is an accolade for the current CRC and also recognition of the evolution of the CRC into ACE and the exciting new research and delivery programs that were proposed. The partners worked hard together to achieve this. The core participants are: Australian Antarctic Division, University of Tasmania, CSIRO (Marine and Atmospheric Research) and the Bureau of Meteorology. Supporting partners include three international polar and marine science agencies, Australian Greenhouse Office, Australian National University, Tasmanian Department of Economic Development and Silicon Graphics International.

The new ACE CRC has refocused its programs based on the input from the users of the research. One particular change of emphasis will be that the research will be directed at producing outcomes rather than just outputs. That is to say the researchers will work with end-users, such as the Australian Greenhouse Office, to shape the research to deliver tangible benefits to the user.

The scientific research programs that the new Centre will carry out are primarily in climate and oceanographic research and the interaction of these with biological productivity. Specifically they are:

- Climate Variability and Change
- Antarctic Marine Ecosystems
- Ocean Control of Carbon Dioxide and
- Sea Level Rise

Each program has several different projects to achieve its outcomes.

From these scientific efforts will emerge new understanding of the forces that have shaped the Antarctic, Australian and global environment. We will also gain new capacities to predict changes and to incorporate this understanding into the national effort to develop sustainable management of our environmental, economic, and social resources.

In addition there will be a strong education program, with many PhD students carrying out their research within the CRC. One of the goals of the CRC program is to improve the training of researchers and give them a broad range of skills. ACE CRC has a range of extra training programs that will make life as an ACE PhD student both much more fun and challenging as well as being much more valuable to the student in terms of a broad training.

It's exciting times for Antarctic research. The Centre has been funded to an even greater level than before. The users are directly involved in defining the research needs and the spirit of collaboration is very high. The new CRC for Antarctic Climate and Ecosystems is poised to have a major impact on Australian (and international) understanding of the importance to global climate of the Southern Ocean and to understanding how natural variability of the Southern Ocean influences ecosystems. In these days of conflicting opinions about the state of the world's climate and oceans, the results from the ACE CRC research will provide some sound data on which to base future understandings and shape future policies for the good of Australia and the planet.

WAYNE PAPPS

Katherine Woodthorpe, Chair of the Cooperative Research Centre for Antarctic Climate and Ecosystems

KATHERINE WOODTHORPE, CHAIR, ACE CRC

FRED KOOLHOFF

The Board of the Cooperative Research Centre for Antarctic Climate and Ecosystems. Back (left to right): Bill Trestrail (Director, Silicon Graphics International, SGI Inc.), Tony Haymet (CEO, CSIRO Marine Research), Howard Bamsey (CEO, Australian Greenhouse Office, AGO), John Fisher (Representing Tasmanian Department Economic Development), Michael Stoddart (Chief Scientist, AAD). Front (left to right): Tony Press (Director, AAD), Katherine Woodthorpe (Chair, ACE), Andrew Glenn (Pro Vice Chancellor of Research, University of Tasmania), Bill Downey (Deputy Director, Bureau of Meteorology).
Note: The Tasmanian Government board position has now been taken by Greg Johannes (Director, Antarctic Tasmania).

In the news

New herbarium to house valuable plant collection

KATE KIEFER

Professor Rod Seppelt, curator of the AAD's new herbarium

June marked the official opening of the new herbarium at Kingston that houses one of the most valuable assets of the AAD – the taxonomic plant collection. This herbarium houses over 25,000 specimens of mainly mosses, liverworts and lichens, collected from locations in Antarctica and subantarctic islands as well as many alpine and arctic localities. The specimens are a valuable record of life at the ecological extreme.

The new herbarium contains a specially designed specimen vault to protect the specimens from fire and water damage. Regular pest control measures are also in place to protect the specimens from insects such as silver fish, dermestid beetles, weevils and other small insects that may sneak through the door when the vault is open, and which could easily destroy the collection. Coupled with stringent quarantine rules regarding new material, these measures will ensure that the collection remains pest free. Adjacent to the vault is a new laboratory for taxonomic research.

The specimens are linked to a state-of-the-art Antarctic biodiversity database which contains 10,205 plant specimen records so far. A current project is in place to curate a collection of a further 5,000 specimens from Heard Island and botanist Perpetua Turner has joined the AAD to assist with this enormous task. Curator of the herbarium, Professor Rod Seppelt described his studies as being 'fundamental to our understanding of biodiversity and conservation in Antarctica – we need to know what is there and where it is before we can develop a sensible and informed management and protection policy'.

Dana Bergstrom, Biology program, AAD

New Australian Antarctic Territory ship stamps released

To mark the 50th anniversary of the *Kista Dan*'s first voyage to the Antarctic, Australia Post has released four stamps featuring the distinctive *Dan* ships – *Kista Dan, Thala Dan, Magga Dan* and *Nella Dan.*

The *Kista Dan* was the first of four 'Dan' ships built by the Danish firm J Lauritzen and chartered by Australian National Antarctic Research Expeditions (ANARE) for Australian Antarctic exploration and scientific research.

50c *Kista Dan*: The charter of *Kista Dan* opened the door to Antarctica for ANARE. Much subantarctic research had been done since 1947 but in early 1954 the ice-strengthened *Kista Dan* allowed the establishment of Australia's first continental station – Mawson. On the return voyage *Kista Dan* weathered a 12-hour hurricane in Prydz Bay, when winds of over 100 knots and huge seas rolled her to 70°. *Kista Dan* is recognised in the naming of Kista Rock, west of Davis and Kista Strait, west of Mawson.

50c *Magga Dan*: *Magga Dan* sailed down the Thames in November 1956 for her maiden voyage – to deploy the Commonwealth Trans-Antarctic Expedition, and the Royal Society's Antarctic Expedition, to the Weddell Sea. In her ANARE service from 1959 to 1961, *Magga Dan* with Director Phil Law, surveyors, scientists and pilots, explored most of the coastline of Australian Antarctic Territory, from Mawson to Oates Land. The Australian flag was raised near Magga Peak in February 1959.

$1 *Thala Dan*: *Thala Dan* was launched in 1957, and was chartered by Australia later that year, working with ANARE until early 1982. On her voyage to Macquarie Island in late 1958 she carried the first helicopter used by ANARE. *Thala Dan* was extended six metres, rebuilt and modernised in 1975. The top superstructure deck was removed, a new deck built, and the old deckhouse replaced one level higher. This increased expeditioner accommodation to 50. New facilities included a larger helicopter deck, more deep-freeze storage space, and enclosed bridge wings. The new length overall was 81 metres. This $1 stamp features *Thala Dan* in her original layout. Thala Fjord, Thala Hills, Thala Rock and Thala Valley were named for *Thala Dan*.

$1.45 *Nella Dan*: The most famous of the Dan ships to serve ANARE was the *Nella Dan,* named in honour of Nel Law. During its 26 years with ANARE it supported major exploratory and scientific activities. While resupplying Macquarie Island in December 1987, the *Nella Dan* was driven aground and eventually scuttled. The *Nella Dan* is shown anchored in the Antarctic.

Australia Post has released AAT stamp issues since 1957. Stamp products released for the Antarctic Ship issue include a first day cover, stamp pack and 'maximum' cards (pre-stamped postcards featuring one of the new isssue). All products are available nationally from Australia Post outlets.

Antarctic Approvals Online – a 'one stop shop'

The Antarctic Approvals Online (AAO) system, when fully developed, will be the new face of Antarctic approvals and support processes administered by the Australian Antarctic Division, providing a 'one stop shop' for environmental and science approvals and operational and logistical support. The AAO system, which is being jointly developed by IT Services and the Antarctic Approvals Project Team, will be the first system of its kind in Australia, and is expected to commence full operation in mid 2004.

The AAO system will use the same platform as the Australian Antarctic Research Applications, which currently caters for scientific and some operational projects. Important features of the research applications system will be maintained, but its functionality will be increased and it will cater for a wider audience.

The AAO system proposes to include the following features:

- **single entry point** – the AAO system will cater for all applicants for Antarctic approvals and/or support, including all scientists, operational and support personnel, VIPs and humanities program applicants with the Australian Antarctic Program, as well as tourists and others participating in non-government activities;
- **a tracking system for approval and support** – to allow applicants and administrators to keep track of relevant approval and support, and culminating in a virtual 'boarding pass' for applicants;
- **two-stage application process** – to increase flexibility, information will be gathered when it is needed; broad level information needed to start advance planning and assessment tasks will be gathered earlier than more detailed information;
- **personal and project profiles** – to integrate the collection of information required for a number of approvals and support processes and therefore reduce the time spent by applicants filling out forms and prevent duplicate requests for information;
- **twelve month availability** – to cater for a broader range of applicants, a two-stage application process and variations to proposals;
- **formalised process for variations** – to provide for a fair, predictable, transparent process for the variation of proposals; and
- **comprehensive reporting capability** – to help meet the AAD's international and domestic reporting requirements and to increase utility for applicants and administrators.

If you would like to know more about the AAO system, you can contact Ian Hay on (03) 6232 3509.

ROB BRYSON

Antarctic science and operations go on tour

A concerted drive to get the message across to key beneficiaries in major Australian centres about recent developments to enhance the value of Australia's Antarctic program has been rated a great success. In each State capital in April and May, about 200 people with a strong stake in Antarctic research attended briefings by senior Australian Antarctic Division representatives.

The AAD Chief Scientist, Prof Michael Stoddart, its General Manager of Operations, Kim Pitt, and the manager of the air transport project, Charlton Clark, provided the audience with an overview of the science program and details of the operational support provided to scientists, including dedicated marine science voyages and the future implementation of a comprehensive air transport system.

Each group consisted of scientists who regularly participate in the Antarctic program, university staff, younger scientists and interested members of the public. Around half of the audience in each city was new to the program, with many graduate students keen to find out how to become involved.

Scientists at the meetings agreed that the proposed air transport system would greatly improve the prospects of both research success and their capacity to be involved. Several senior scientists said they had not participated in the Australian science program but had used New Zealand or U.S. air support to fly to the Antarctic. Scientists welcomed both the prospect of flying from Hobart to Casey and the intra-continental transport. The latter would be particularly valuable for atmospheric chemistry research.

Many questions raised at the meetings concerned logistics, such as how air transport changes affect getting equipment in and samples out. Marine scientists were reassured that the introduction of air transport would not have a negative impact on ship-based research but would provide some notable benefits.

The sessions enabled many scientists already in the program to meet each other for the first time, including some who discovered they had colleagues in their own department conducting Antarctic research. In response to audiences requests, the AAD is preparing email lists to help scientists make contact with others. Scientists were urged to contact the AAD with any thoughts, ideas or comments to help improve the air transport service.

The presentation is now available in portable document format (PDF) on the Australian Antarctic Division web site at <http://www.aad.gov.au/default.asp?casid=10220> or in hard copy by emailing <planning@aad.gov.au>.

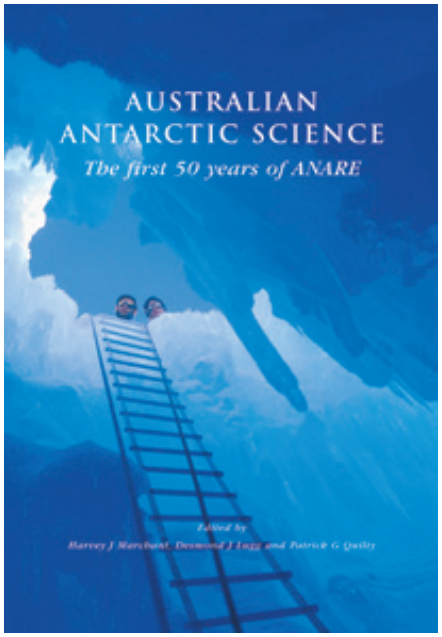
Gwen Fenton, Science Planning &

DAVE KILLICK

Defibrillator trialled at Commonwealth Bay

With advancing medical technology the Australian Antarctic Division's Polar Medicine Unit is continually reviewing procedures and remote area medical equipment to ensure appropriate medical and emergency care for Australian Antarctic expeditioners. Dr Geoff Couser, the 2002 Mawson's Hut expedition doctor, trialled a new MRL automatic external defibrillator and heart monitor during the expedition at Commonwealth Bay.

This type of equipment can be used for possible complications of unexpected heart conditions or even the effects of accidental electrocution on the heart. Although not used in anger on this occasion, it was comforting for this small extremely isolated field camp to have available as part of the comprehensive medical kit this small battery powered defibrillator and heart monitor unit. Successful testing occurred at operating temperatures of minus 7°C and storage temperatures as low as minus 24°C. Similar equipment may be used in future Antarctic field operations.



Australian Antarctic science puts its record on the line

1997 was the fiftieth anniversary of the Australian National Antarctic Research Expeditions (ANARE). A significant part of that year's celebrations was the 'ANARE Jubilee Science Symposium', a week in July 1997 in which Antarctic scientists from around Australia gathered to mark a milestone of their own.

The symposium was an unprecedented opportunity for reflection. Antarcticans old and new paused to look at the status of Antarctic science in light of a national research record that compares favourably with that of any Antarctic country.

The discussions covered changes in science over the years. Veterans recalled the highs and lows of opportunistic science. They examined the role of science in the age of exploration of unvisited lands and seas – when physicists became glaciologists and surveyors took on multidisciplinary roles. In these early times research programs had to be invented, with no knowledge of what was to be studied, to justify sending scientists south at all.

The results of this 1997 Antarctic science gathering – 20 considered views on the full gamut of Australian Antarctic science – have been compiled by three veterans, Harvey Marchant, Des Lugg and Pat Quilty. The book was launched at the Australian Antarctic Division earlier this year.

This 622-page volume is a weighty tome, not just in paper but in the demands it places on its readers. Its detailed analysis of some highly esoteric branches of Antarctic science is daunting to the lay reader, but the effort of digging into it brings some rich rewards.

The approach of each contributing author varies, as is the nature of such compendiums, and readers will be drawn to one or the other depending on their particular interest. For me, the papers which stood out were those in the fields of glaciology (the Antarctic ice sheet and marine glaciology) and Southern Ocean processes, with discussions of new technology, marine geology and aquatic microbiology also of great interest.

But the real value of this book is in its comprehensive coverage and its opportunity for reflection.

The papers cover the full range of Antarctic studies, taking in all the major research areas – atmospheric and space physics, geology and geophysics, terrestrial, aquatic and marine biology, continental and marine glaciology, oceanography and environmental science – as well as technological support and the broader research environment.

The book's coverage of change over time is no less valuable. From tentative early subantarctic work through continental studies to current broad-scale programs focused largely on the Southern Ocean, this book provides an unmatched perspective on modern Antarctic research.

Reflection is scarce in quickly-changing modern times, and because of that increasingly precious. When the opportunity comes to reflect it is to be seized and treasured. It is to the great credit of the editors, and particularly the principal coordinator of the symposium, Harvey Marchant, that they have seen this need and acted on it. The result is an essential reference for all who value the Antarctic and its study.

Marchant HJ, Lugg DJ and Quilty PG (ed.), *Australian Antarctic Science: the first 50 years of ANARE*, Australian Antarctic Division, Hobart 2002, 622pp. Hardbound, RRP $A96.00.

Australian Achievement Medallions awarded to EMS team

The efforts of AAD personnel to protect the Antarctic environment were recently recognised with the award by the Secretary of Environment Australia of a 2003 Australia Day Achievement Medallion. The team responsible for the development of an environmental management system (EMS) were presented with this prestigious award by the Director, Dr Tony Press, at a staff meeting in April.


WAYNE PAPPS

AAD Director Dr Tony Press presents EMS team members with their 2003 Australia Day Achievement Medallion. From left Ewan McIvor (EMS Coordinator), Simon Cash (Facility Manager), Dr Press, Bob Jones (Support and Coordination Officer), Neil Sorensen (Property Coordinator) and Trevor Bailey (Laboratory Manager). Other recipients (not pictured) were Tom Maggs (EMS Manager), Chris Paterson (Chief Engineer), Camille Boxall (Engineering Project Officer), Geoff Dannock (Logistics Manager), Sandra Potter (Senior Logistics Officer), and Richard Mulligan (Support and Coordination Manager).

The EMS was designed to address the need for a systematic approach to the management of the AAD's diverse environmental responsibilities. The EMS team, a combination of coordinators, key section managers and other staff, was responsible for identifying significant environmental aspects, identifying regulatory compliance requirements, developing environmental objectives and targets, and identifying environmental training needs. The team's immense achievement in gaining certification to the Australian/New Zealand Standard 14001 – with no non-conformances – made Australia the first Antarctic Treaty party to implement such a system.

Although the EMS remains relatively simple, given the complex operations the AAD undertakes, it is based on mature environmental management processes. Continual improvement in environmental performance is at the heart of AAD operations, and implementation of the EMS has provided a fresh perspective on how effectively the AAD functions and how innovative technologies, policies and practices can continue to be adopted. More efficient ways of managing the environment are already emerging, such as an improved environmental incident reporting system, a review of the methodology used for ensuring regulatory compliance, and development of an AAD environmental audit program.

As part of the review, the AAD's Environmental Policy – the foundation of the EMS – was recently re-assessed by staff and interested external parties to ensure that it continues to

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reflect the AAD's visions and responsibilities. The updated policy is now posted throughout the AAD's Tasmanian sites, and will be placed on our ships and in the stations on the first voyage south next season.

To ensure the EMS stays on track a series of external surveillance audits are scheduled over the next three years, prior to recertification. The first audit was undertaken in March this year and NCSI, the auditing body, again noted the AAD's positive commitment to the environment and the EMS.

Further information on the AAD's EMS is available at <http://www.aad.gov.au/default.asp?casid=46>

BELINDA HARDING, ENVIRONMENTAL MANAGEMENT AND AUDIT UNIT, AAD

Inspecting the new aquarium (from left) are Antarctic Marine Living Resources Program Leader Dr Steve Nicol, Parliamentary Secretary for the Antarctic Dr Sharman Stone and AAD Chief Scientist Professor Michael Stoddart

New Antarctic marine research aquarium equals best in world

The new Antarctic Marine Research Aquarium at the Australian Antarctic Division was officially opened in May by the Parliamentary Secretary for the Antarctic, Dr Sharman Stone.

The state-of-the-art aquarium and laboratory cost nearly $1 million and is part of a multi-million dollar upgrade of AAD's facilities at Kingston, Hobart. The facility is now equal to any laboratory in the world used for the study of Antarctic krill and other marine organisms.

Dr Stone said that AAD scientists could now continue research in the land-based laboratory that was previously limited to the ocean-caught organisms that did not always last long or reproduce in holding tanks.

"This innovative aquarium and laboratory complex means that large numbers of krill can be bred allowing scientists to study their reproduction, growth, behaviour and larval biology. Understanding Antarctic krill in particular is critical to understanding the interdependencies and vulnerabilities in the Antarctic food chain." Dr Stone said.

Research on krill has been especially challenging in the past, since krill are extremely sensitive to environmental conditions. Longer term and more detailed studies of the Antarctic's unique marine life will now be possible, with krill given their own 'home away from home' in a specially chilled and carefully lit environment.

This research will provide vital information for helping to plan a sustainable fishery for the future. This planning and management is critical as over-exploitation of krill would pose an enormous threat to the Antarctic ecosystem.

"Australia plays a pivotal role in Antarctic research, and these new facilities will allow the AAD to continue to be a key international centre for the study of Antarctic marine organisms," Dr Stone said.

'Antarctic Impressions' on show at Parliament House

An exhibition showcasing Australia's Antarctic Humanities Program was held at Parliament House in Canberra from 1 May to 25 June.

In opening 'Antarctic Impressions', Parliamentary Secretary for the Antarctic Dr Sharman Stone said that the Humanities Program was a perfect vehicle to help promote Australia's vital role in the protection of Antarctica and of our science program.

"Each year, through its Humanities Program, the Australian Antarctic Division (AAD) offers the chance of a berth to Antarctica for visual artists, writers, historians, journalists, poets, musicians, film makers, teachers and those from similar occupations. So far, almost 70 have participated in the scheme," said Dr Stone.

This is the first exhibition to bring together an extensive range of artistic and other works that have resulted from the AAD's Humanities Program since it began in 1984, and included paintings, photographs, educational resources, books, travel guides, histories, video excerpts from documentaries and interactive exhibits.

Unusual mortality investigation kits assembled

Although staff at the Australian Antarctic Division had been considering the occurrence of a disease outbreak among Antarctica's wildlife we were unprepared when an unusual mortality event occurred among the Adélie penguins near Mawson. The event initially appeared to be caused by infectious disease however we were fortunate that it proved otherwise for we were ill prepared for such an occurrence. We had no contingency plan to activate, no protective clothing, no suitable sanitising agents and very little sampling equipment. However the *Protocols for collection of samples for pathological analysis in the event of disease being suspected among monitored species of birds* published by CCAMLR (1997) proved particularly useful in the collection and storage of samples.

We have now published a response plan for an unusual mortality event and have assembled investigation kits which are located at each of the Australian Antarctic stations and Macquarie Island and carried on ships used by Australia in Antarctica. The kits contain protective clothing, sanitising agents, media for the culture and transport of microorganisms and sampling and post mortem equipment. The container is a lockable waterproof plastic case (see photo above). Also included is a copy of the response plan and instructions on carrying out an investigation. A video will be added later which shows among other things how make up the culture media and carry out a post mortem on a bird.

A copy of the response plan, all documentation relating to the contents and use of the kit are available at <http://www.aad.gov.au/default.asp?casid=2993>.

It is planned that the kits will be updated every three years and the antibiotics replaced. New diagnostic kits will be added as they become available.

KNOWLES KERRY, ANTARCTIC MARINE LIVING RESOURCES PROGRAM, AAD