

# Antarctica in the environmental era

**This volume honours the life and  
Antarctic endeavours of Michael Prebble**

Michael Prebble, known to his friends as Mike, was one of New Zealand's foremost "Antarcticans". He made seven trips to Antarctica, in a wide range of roles. His first visit to the continent was in 1960-61 as the youngest member of the well-known expedition led by Les Quartermain, which uncovered and began the restoration of the historic huts at Cape Royds and Cape Evans on Ross Island, bases for the expeditions of the famous British Antarctic pioneers, Shackleton and Scott. The following summer, he returned to New Zealand's Scott Base as a field assistant and principal dog handler for surveying and geological parties. In the 1964-65 summer he was appointed deputy leader of Scott Base, and the following year was promoted to the position of officer-in-charge of the base for both the summer and winter periods. He was again leader of Scott Base in the ill-fated summer of 1979-80, playing a key role in the recovery mission following the tragedy on Mount Erebus when an airliner crashed during a tourist scenic overflight. In the 1990s Mike was on two tourist expeditions to Antarctica, one as an observer aboard the *Bremen* and the other in 1997-98 as an official representative of the government aboard the *Kapitan Khlebnikov*.

His interest and experience in the Antarctic prompted him to complete a Masters degree in Geography at Victoria University of Wellington in 1966, writing a thesis on New Zealand's exploration of the Ross Dependency 1957-1965. Having been awarded a Rotary Foundation Fellowship, he spent the 1967-68 period at Darwin College and the Scott Polar Research Institute at the University of Cambridge in England doing post-graduate research on the physical geography of the McMurdo Sound area and the Dry Valleys. Mike was a long-standing member of the New Zealand Antarctic Society, and in 1970 was awarded the Polar Medal for his efforts in Antarctic affairs.

In 1989 Mike joined the Ministry for the Environment in Wellington, where his responsibilities included policy development for Antarctic environmental management. In ensuing years he served on the New Zealand delegation to several Antarctic Treaty Consultative Meetings and to special Treaty meetings for the negotiations on the Madrid Protocol. On joining the Royal Society of New Zealand in 1996, as Manager of the Marsden Fund, Mike continued his Antarctic policy work on behalf of the Society and assisted in its administration of the Christchurch-based International Centre for Antarctic Information and Research. During his time as a government official Mike also made important contributions to the restructuring of Antarctic administration and the establishment of Antarctica New Zealand; to the development of the 1994 Antarctica (Environmental Protection) Act, New Zealand's ratifying legislation for the Madrid Protocol; to the drafting of guidelines for management of visitors to the Ross Sea region and to the revision of management plans for protected areas in the Ross Sea region.

Mike Prebble died suddenly at Piha near Auckland on 18 April 1998.

# Antarctica in the environmental era

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# Foreword

Management of Antarctica has entered a new era with the coming into force of the Environmental Protocol to the Antarctic Treaty. Environmental management is now a third pillar on which the Antarctic Treaty System rests, alongside peace and science. New Zealand, together with other Treaty Parties, has committed itself to the comprehensive protection of the Antarctic environment and dependent and associated ecosystems. But the challenge is a global one. How humanity relates to and interacts with this last near-pristine wilderness will be a test of restraint and maturity. How we identify and promote the *values* of Antarctica will define what happens: Antarctica is a mirror of our soul, a challenge for how we exist on our planet, and how we will confront the challenge of living in outer space. *Perceptions* are also important. Will we approach Antarctica with a sense of humility and awe and, for those few of us able to visit it, a sense of deep privilege? Or will greater knowledge and accessibility simply strip away the veil of mystery and lead us to see the continent as just another part of mankind's realm to be exploited to the full?

How to manage the inevitable human interaction with Antarctica so the continent and its surrounding seas, its dependent and associated ecosystems are protected into the future demands from us stewardship of the highest order. After all, we might protect the continent from the visible despoliation of, for example, mining, while “loving it to death” through the cumulative impact on vulnerable sites of too many visitors, however careful and respectful.

The essays in this collection touch on some of the principal current challenges facing the Antarctic Treaty governments as they take up their responsibilities under the Protocol for protection of the Antarctic environment:

- **Paul Dingwall**, a leading New Zealand “Antarcticist”, reflects on the challenges of implementing the Protocol in his essay “Environmental Management for Antarctic Wilderness”. He outlines the principles and major provisions of the Protocol’s comprehensive environmental management regime, set against the background of the conservation values of Antarctica’s natural resources and the growing human interest in the region. He draws attention to the pressures on Antarctica, including from private sector activities. He notes the reorientation of thinking that will be needed if these pressures are to be successfully managed. As he says, “the real test lies ahead” in how the Treaty copes with greater usage and exploitation of Antarctica. The present “free-for-all” catching of toothfish in Antarctic waters is indicative of the speed with which a challenge can arise, and the complexities of trying to deal with it.
- **David Walton**, a key player in the Scientific Committee for Antarctic Research, reflects in his essay “Environmental monitoring in Antarctica — measuring the damage” on the inevitable consequence of human interaction with the continent. He reveals some of the ways in which the Antarctic science community is responding to the need for greater scientific understanding of the local, regional and global impacts on the Antarctic environment. He demonstrates the significance of establishing baselines

against which human impacts can be measured. The work of SCAR will be one of the significant inputs into the State of the Antarctic Environment (SAER) reporting process identified by the Committee for Environmental Protection (CEP) as one of its major priorities. New Zealand's own Ross Sea Region State of the Environment Report (RSR-SOER 2000) to be published in the year 2000 and being managed by Antarctica New Zealand and the Royal Society of New Zealand at the direction of the Officials' Antarctic Committee will also contribute to this process.

- **Janet Dalziell and Maj de Poorter**, leading contributors to the international non-governmental organisation movement which has played a significant role in bringing Antarctica to public attention, reflect in their essay on "Managing cumulative environmental impacts: Antarctica's challenge for the 21st century". They point to the particular challenge of information exchange and management for a Treaty System which has no central repository or store of information. The complex problem of cumulative impacts is a priority issue for the CEP in its work on Environmental Impact Assessment (EIA). The CEP is also beginning to grapple with the daunting, but not impossible, challenge of information management.
- **Gordon Cessford**, drawing on first-hand experience from his specialist social science role in the Department of Conservation, in his essay on "Antarctic tourism — a frontier for wilderness management", deals with the small but burgeoning tourist industry, the fastest growing human activity in the Antarctic and apart from fishing the only significant commercial enterprise in the region. He introduces the important subject of values, and rightly notes that effective management of visitors to Antarctica involves partnerships and consensus between the private and public sectors.
- **Rosamunde Codling**, a student at the prestigious Scott Polar Research Institute, touches, in her essay "Concepts of wilderness in the Antarctic", on the need for planning, balance and restraint. As she notes, if any form of human activity on the continent is to continue, there will be a continuing necessity for buildings, ships, aeroplanes and motorised vehicles. She describes a possible conceptual framework for planning and managing the variety of human interests and activities in Antarctica, aimed at maximising the benefits while minimising any associated conflicts and detrimental impacts on the pristine Antarctic landscape and wildlife.

Central to the success of the future environmental management in Antarctica will be the role of the newly-established Committee for Environmental Protection, the Antarctic Treaty's specialist environmental advisory body. The Committee has a daunting task as it sets out to discharge the mandate given it by the Protocol to provide advice and formulate recommendations to Treaty parties on the implementation of the Protocol and its annexes. New Zealand is committed to contributing in full measure to the successful development of this Committee.

Geography and history make New Zealand an Antarctic nation. Vision, passion, commitment, interest and enthusiasm have not only established a remarkable national record of interaction with Antarctica, they have also made our small country one of the leaders in the development of the Antarctic Treaty regime. The international mana that we have earned from our decades in Antarctica, in



exploration, science and now environmental management, position us well to assist the Treaty to move forward into the new millennium as a vital, relevant international agreement. We must strive to do so with vigour, imagination and an eye to the future.

Discharging the responsibilities of our guardianship of the Ross Dependency and Antarctica for the benefit of present and future generations is an exciting, not to say breathtaking challenge. Globalisation, interdependence, the communications revolution and rapid technological development make it also an urgent challenge. We need to understand how such developments *might* affect Antarctica, and work hard to shape what *can* and *does* happen by taking advantage of new opportunities.

For example, the opportunity to create “virtual Antarctica” by bringing the activities of scientists and others on the continent into people’s living rooms through real-time visual links, has the potential to transform international awareness and understanding of what the Antarctic Treaty and its Protocol regime are all about. Pictures can truly speak a thousand words. They can be used to gain and keep public support for the protective, precautionary, management of Antarctica. This is another area in which New Zealand is taking an international lead.

It is impossible to think of the management of Antarctica without acknowledging the importance of the human element. Antarctica can, and does, bring out the best in people. “Antarcticans” come from all walks of life and span all ages and races. The continent is protected not by fleets and armies, but by the passion, commitment and advocacy of individuals and nations working together to achieve the common goal of wise stewardship.

At the personal level, stewardship demands practicality, common-sense, decency, integrity and a sense of personal responsibility. These qualities were typified by our friend and colleague, the late Mike Prebble, to whom this collection of essays is dedicated.

Stuart Prior  
Head, Antarctic Policy Unit,  
Ministry of Foreign Affairs and Trade  
and Chairman, Officials’ Antarctic Committee

# Preface and acknowledgments

Last year Gordon Cessford and I were asked by Vance Martin, international editor of the *International Journal of Wilderness*, to arrange the writing and editing of some articles for a special issue of the journal on the subject of Antarctic wilderness. Subsequently, in September 1997 the Antarctic theme issue of the *IJW* was published (Vol. 3, No. 3). *IJW* is widely distributed in North America and elsewhere among wilderness managers, but it is not likely to be read by those involved in consultations under the Antarctic Treaty or members of national Antarctic science programmes. We, therefore, sought and were readily granted permission from Vance to republish the essays as a scientific monograph of our own organisation, the New Zealand Department of Conservation, with a view to circulating the information more widely within the Antarctic community and to the growing numbers of people with an interest in Antarctica. Moreover, with the sudden and untimely death of our colleague Michael Prebble in April of this year, it seemed particularly fitting that we should dedicate this volume of essays to his memory. I had the pleasure of working closely with Mike on Antarctic matters for more than seven years, enjoying the benefit of both his knowledge and his friendship. Publication of these essays presents an appropriate opportunity for friends and colleagues to honour Mike's life and his very considerable Antarctic endeavours.

The five essays included are essentially unchanged from those originally published, though the opportunity has been taken to include several of Mike Prebble's excellent photographs resulting from his two recent voyages to the Antarctic aboard tourist cruise ships. In selecting the authors and topics for the essays, we chose to focus on aspects of the implementation of the 1991 Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol), which entered into force this year following ratification by all Antarctic Treaty Consultative Parties.

Stuart Prior's preface serves to tie the essays together, and to update them according to progress made in the two Antarctic Treaty meetings since they were written. Of particular significance is the emphasis now being given to the development of an overall state of the environment report for Antarctica, which will provide a detailed picture of the health of the Antarctic environment and a vital ecological benchmark against which to measure future natural and human-induced changes to it. Stuart also draws attention to the magnitude of the challenge facing the Treaty Parties in their future environmental stewardship of Antarctica under the Protocol, and notes that New Zealand is fully committed to its success.

Colin Monteath, New Zealand's leading Antarctic photographer, generously provided the cover photograph. Antarctica New Zealand provided several photographs. Chris Edkins, science illustrator in the Department of Conservation, produced the graphical figures, Nesta Black typed the manuscripts and Ian Mackenzie was the production editor for this volume.

Paul Dingwall  
Science & Research Unit  
Department of Conservation

Figure 1. Antarctica and the Southern Ocean, showing the boundary of Antarctic Treaty Area, Antarctic Convergence, and relationship to major southern land masses.

# Environmental management for Antarctic wilderness

by Paul R. Dingwall

**The most barren and inhospitable wilderness on earth, Antarctica is of vital importance to humanity. Its rocks and enveloping ice sheet hold the keys to unlocking our planet's history; its huge landmass and surrounding seas exert great influence on the world's oceans and weather systems; its waters nourish vast quantities of marine life of growing importance as food for sustaining human societies; and its immense scenic beauty has the power to inspire and uplift those who visit it, and the many more who will never experience it first-hand. Today, however, in this the world's last great wilderness, we face a monumental challenge: How can we safeguard the immeasurable conservation values of Antarctica in the face of mounting economic, commercial and political interest in the region and its resources, and the attendant threat of environmental deterioration? Recent agreement, among the countries who collectively govern Antarctica, on comprehensive rules for environmental management holds great promise that the challenge can be successfully met.**

## ANTARCTICA'S SPECIAL WILDERNESS VALUES

Antarctica is a world of its own (Figure 1). It is the coldest, iciest, windiest, highest and remotest of the world's continents, girded by the stormiest ocean. Equivalent in area to the U.S.A. and Mexico combined, it expands to more than double its size each winter as the surrounding seas turn to ice. The ancient continental rocks, forming the core of the supercontinent of Gondwana, are a key to unlocking the World's geological history. The vast Antarctic ice sheet, on average 2,000 m thick, offers a window for observing changes in global climate over tens of thousands of years. It also stores about 90% of the world's fresh water—enough to raise the global sea level by 60m if all the ice melted. Ice covers virtually everything, and life on the few scattered patches of bare land is very impoverished. Only primitive forms of vegetation can survive—lichens, mosses, liverworts and algae—and there are only two higher plants; one a low-growing cushion plant and the other a small grass. The largest true land animals are two kinds of tiny wingless midges, while the sparse, stony soils harbour only small nematode worms and a variety of springtail insects. Life in the freshwater lakes is confined to tiny shrimps and other small forms of aquatic animals.

In contrast, life in the Antarctic seas is abundant. The nutrient-rich southern waters sustain a massive web of life, at the base of which are large numbers of plankton, which in turn sustain fish, squid, seabirds, seals and whales. About half of the biomass of animal plankton is made up of just one species — a small

crustacean, krill *Euphausia superba*—occurring as vast swarms in surface waters. Krill is the staple food of the great whales, and the multitudes of seals, penguins and other seabirds.

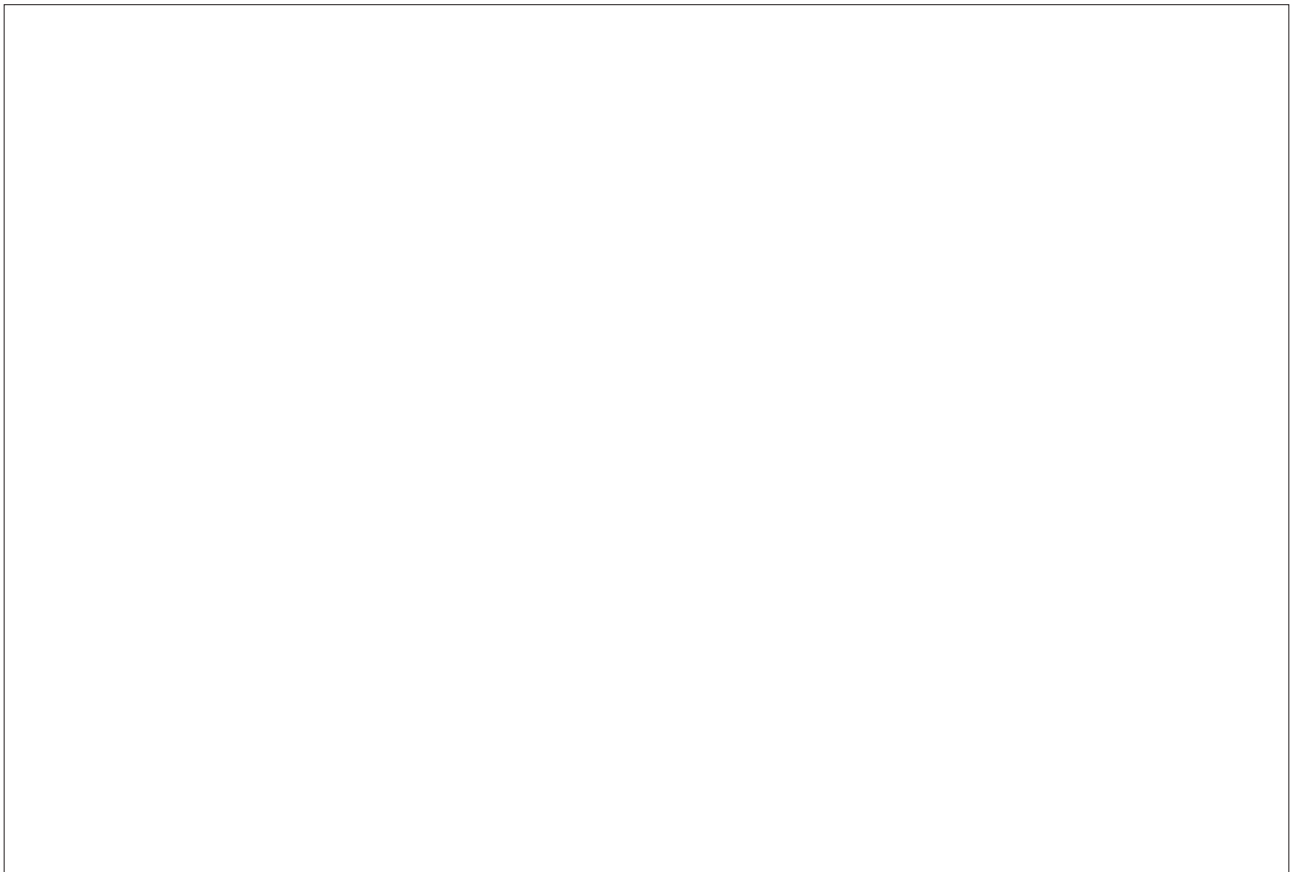
The total population of crabeater seals *Lobodon carcinophagus*, which are the most numerous of the six types of Antarctic seals, may be about 20 million individuals, while there are around 10 million breeding pairs of penguins (seven species) and in excess of 100 million pairs of albatrosses and petrels.

Antarctica and its surrounding seas exert a remarkable influence on human life on earth through their regulating effect on the atmosphere and oceans of the world. The huge mass of cold air produced over the Antarctic ice sheet undergoes a complex exchange with the Southern Ocean. Such large-scale exchanges of mass and energy profoundly influence global weather, climate and ocean circulation.

## HUMAN INTEREST IN ANTARCTICA

The history of human contact with Antarctica is a very short one. The English navigator and explorer James Cook, who in the late 18th Century was the first to penetrate the Antarctic realm, dismissed *terra australis incognita* as “not worth the discovering” though he reported the coast of South Georgia teeming with seals. Not surprisingly, it was sealers who first set foot on the continent, in the 1820s, and they were followed in quick succession by whalers, explorers, scientists and, in the last 30 years or so, by tourists. Scientist/explorers opened up the continent in the so-called “heroic era” around the turn of this century, but the major catalyst for scientific research was the International Geophysical Year of 1957–58. In turn this gave rise in 1959 to the Antarctic Treaty, a unique international agreement among 12 nations who pledged to maintain Antarctica as a realm of peaceful scientific co-operation. When the Treaty entered into force in 1961, Antarctica became, as it remains today, the only significant region on earth, apart from the high seas, governed under international law.

Today, the number of Treaty States has grown to include 26 Consultative Parties (who have active research programs in Antarctica and full decision-making powers) and a further 17 Non-consultative (acceding) Parties. They meet together annually and make decisions, expressed as resolutions, by consensus. Treaty resolutions are normally hortatory and require enactment in domestic law to make them binding on citizens of the Treaty nations. While the Treaty covers all land and sea poleward of latitude 60 degrees south, the legal system was extended north into the Southern Ocean in 1980 by the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), established to regulate sustainable fisheries in Antarctic waters. Similarly, the Convention for the Conservation of Antarctic Seals (CCAS) of 1972 provides regulations for management of commercial sealing, should such activities ever resume. The Antarctic Treaty Parties are advised by a Scientific Committee on Antarctic Research (SCAR) established in 1958, while co-operative action and information exchange among national Antarctic research programmes are promoted by a Council of National Antarctic Program Managers (COMNAP), which draws together managers of government Antarctic programmes.



Tour ship, penguins, and ice —  
the key ingredients of an  
Antarctic tourism experience.  
*Photo by Michael Prebble*

## HUMAN IMPACT ON ANTARCTICA

Located well beyond the frontier of permanent human settlement, Antarctica remains for the most part an untrammelled wilderness — but it is by no means pristine. Soon after it was discovered, Antarctica felt the onslaught of human exploitation, which first targeted the marine resources. In just a few decades of the early 19th century, Antarctica's fur seals were brought to the brink of extinction, and the subsequent onset of whaling this century saw the stocks of the great whales exhausted one species after the other. Today, although the whales are protected by a moratorium on commercial harvesting and establishment of a hemisphere-wide sanctuary under international law, the recovery of whale populations may never be complete. In contrast, with the cessation of the sealing industry, Antarctica's fur seals have rebounded spectacularly to at least their pre-exploitation populations. From the late 1960s, new fisheries commenced in the Southern Ocean for the massive swarms of surface-living krill, and for rock cod and ice fish. All these experienced the classic short-term episodes of 'boom and bust', which are neither economically nor ecologically sustainable. Today the new target is the highly valuable Patagonian toothfish, and already there is evidence of excessive harvest, much of it taken illegally in breach of agreed catch limits set under CCAMLR.

On land, steadily expanding research programs have witnessed establishment of more than 40 scientific stations, including buildings, airstrips and other facilities, and increased ship and air traffic. These support a population of some



4,000 scientists and associated staff who work in Antarctica each year. A small, but burgeoning tourist industry, currently bringing about 10,000 people to Antarctica annually, is adding to the traffic congestion particularly around scientific stations, and raising concerns about cumulative human impacts. Local pollution from garbage, and other disposed wastes and fuels has been added to by pollutants such as DDT and polychlorinated biphenyls (PCBs), originating from distant industrialised areas. Even more concerning is the recognition that multi-source global pollution from chlorofluorocarbons and other chemicals causes serious depletion of stratospheric ozone over Antarctica, and the impact of 'greenhouse' gases on global warming may be having a significant impact on the melting of Antarctic glaciers and ice shelves.

Taken together, these pressures and risks of environmental damage make the case for urgent action to ensure that the wilderness qualities of the Antarctic region are not damaged by further uncontrolled human exploitation. The Antarctic Treaty nations took action accordingly.

Port facilities at McMurdo Station present a significant localised intrusion in the Antarctic wilderness, now subject to careful management.  
*Photo by Gordon Cessford.*

## ENVIRONMENTAL MANAGEMENT

In 1991, on the 30th anniversary of the Antarctic Treaty, the governing nations of Antarctica introduced one of the most sweeping reforms in the Treaty's history. In signing the Protocol on Environmental Protection to the Antarctic Treaty (the Madrid Protocol), the Treaty parties declared Antarctica to be "a natural reserve devoted to peace and science", and committed themselves to the ". . . protection of the Antarctic environment and its dependent and associated ecosystems, and the intrinsic value of Antarctica, including its wilderness and aesthetic values . . ." The wide-ranging provisions of the Protocol assemble and revise all existing environmental regulations under the Treaty, and establish new rules applying to all human activities in the Antarctic. The body of the Protocol establishes the fundamental environmental principles; imposes a ban on mining in the Antarctic for 50 years; promotes co-operative planning and conduct of activities in the Treaty Area; establishes an institutional framework for implementing the Protocol; and specifies the legal obligations on the Parties in respect of compliance, inspection, reporting and dispute settlement, among others. Specific environmental rules are set out in a series of five technical annexes, dealing in turn with environmental impact assessment, conservation of flora and fauna, waste disposal, prevention of marine pollution and area protection and management.

## **Environmental impact assessment**

All activities are subject to environmental impact assessment procedures, though differing restrictions apply depending on whether a proposed activity is assessed as having less than or more than a minor or transitory impact. Activities with lesser impacts proceed through an Initial Environmental Evaluation (IEE) only, while those of greater potential impact undergo a Comprehensive Environmental Evaluation (CEE), which includes public notification, consultation among all Consultative Parties and final approval at an Antarctic Treaty Consultative Meeting. Once an approved activity has begun, monitoring and reporting procedures must be set in place so as to determine whether or not an activity is being conducted in accordance with the CEE and the principles of the Protocol.

## **Conservation of flora and fauna**

Rules established for conservation of native flora and fauna require that permits be obtained to authorise scientific collections, sampling and any research activity that might cause harmful interference to plants and animals and their habitats. There are special provisions governing interference with a listed group of Specially Protected Species, and strict rules for avoiding the introduction to Antarctica of non-native species, parasites and diseases. Controversially, this included a requirement for the removal by 1994 of all dogs from Antarctica, including the huskies traditionally used to pull the sleds of field expeditions.

## **Waste disposal**

The Protocol requires that the amount of waste produced, or disposed of, in the Antarctic be reduced as far as is practicable. Past and present waste disposal sites, including abandoned work sites, are to be cleaned up. Some materials, such as polychlorinated biphenyls (PCBs), non-sterile soil, polystyrene beads used in packaging, and pesticides (except for approved scientific or hygienic purposes) are prohibited in Antarctica, while others have to be removed, including radio-active materials, electrical batteries, excess liquid and solid fuels and containers, rubber, lubricating oils and plastics. Burnable wastes not removed have to be incinerated in ways that reduce harmful emissions, and open burning of rubbish is to be completely phased out by the 1998–99 season. Sewage and domestic liquid wastes must not be disposed of on to sea ice or ice shelves, but may be discharged directly into the sea where conditions exist for rapid dispersal. Waste management plans, supervised by a designated officer, are required for all scientific stations and work sites.

## **Marine pollution**

Rules for preventing marine pollution are intended to reduce the impacts of ship operations on marine and littoral ecosystems, by prohibiting discharges of oil, noxious substances, plastics and all other garbage. Moreover, it is forbidden to discharge untreated sewage or food wastes (which must be passed through a grinder) into the sea within 12 nautical miles of the land or ice shelves—though small vessels such as yachts are exempted.



## **Area protection and management**

Under the Antarctic Treaty all sovereignty claims are set aside, and ordinary rules of ownership of territory do not apply. However, special protection and management provisions are required for areas acknowledged as having significant natural, scientific, historic, or landscape values, or for areas where multiple uses might cause undesirable environmental impact or give rise to disruption between conflicting activities. Thus, the Protocol provides for designation of Antarctic Specially Protected Areas (ASPAs) to protect unique terrestrial or marine ecosystems, key wildlife breeding sites, and important historic sites, such as huts from the heroic era of exploration. Management plans are required for ASPAs, which may restrict access or the types of activities conducted in them, and permits are required to enter ASPAs. Similarly, Antarctic Specially Managed Areas (ASMAs) may be designated where additional planning and co-ordinated management of activities are required. Typical examples include areas where scientific stations, historic sites, research areas, and popular tourist landing destinations coincide, and there are risks from mutual interference or cumulative environmental impacts. Management plans are also required for ASMAs but entry is not controlled by permit. Already considerable progress has been made in systematically reviewing and redesignating as ASPAs the 55 existing protected areas and more than 70 historic sites, and several areas, such as Ross Island in the Ross Sea Region, are proposed for designation as ASMAs.

## **FUTURE REQUIREMENTS**

The Madrid Protocol establishes an environmental management regime which is as sophisticated as any comparable regime in any other major region of the world. But it is not yet complete. Six years after its adoption the Protocol has still not entered into force, as there remains one Consultative Party, Japan, which has not yet ratified it (though ratification is apparently imminent). Thus, the work done to date in implementing the Protocol has been undertaken on a voluntary basis by the Treaty countries. A Transitional Environmental Working Group has conducted the work to be done eventually by the principal institution created under the Protocol—the Committee for Environmental Protection (CEP). This Committee, representative of all Protocol parties, is charged with providing advice to the Antarctic Treaty Consultative Meetings on implementation of the Protocol. It is to provide advice on, among others, application of environmental impact procedures, operation and elaboration of the protected area system, inspection and reporting procedures, collection and exchange of information, and the need for scientific research and monitoring. The Committee is encouraged to consult as appropriate with SCAR and the Scientific Committee of CCAMLR, the heads of which are invited observers at meetings of the CEP. Other relevant scientific, environmental and technical organisations, such as the United Nations Environment Program (UNEP) and the World Conservation Union (IUCN), may also be invited to participate as observers at meetings of the CEP.

Issues of compliance also remain incomplete. In particular, the rules and procedures to address liability for environmental damage and remedial response



The unique ice-free Dry Valleys of Antarctica's Ross Sea region, often likened to an extraterrestrial environment. *Photo by Antarctica NZ*

action have yet to be decided. Several meetings of a group of experts of the Treaty parties have worked on the development of an Annex on Liability for the Protocol, but an agreement on rules governing this complex, but vital, element of the regime remains elusive.

There also remain some questions about the adequacy of the coverage of the Protocol. For example, the Protocol doesn't apply to activities carried out under other legal instruments of the Antarctic Treaty System, such as CCAS and CCAMLR, which govern sealing and fishing activities, respectively. Moreover, jurisdiction under the Protocol is confined to the Antarctic Treaty Area, bounded by 60° south latitude. But this area doesn't entirely encompass the natural feeding range of important Antarctic wildlife species, such as petrels and penguins. Given the Protocol's aim to protect the totality of the Antarctic environment, including its dependent and associated ecosystems, there is a strong argument for extending the boundary of the Protocol at least as far north into the Southern Ocean as the Antarctic Convergence—the natural outer limit of the Antarctic marine realm at 45°–55° south (Figure 1).

Nor is it clear whether the Protocol applies in the case of the sea floor, or whether jurisdiction of the seabed is confined to the International Seabed Authority under the UN Law of the Sea Convention. In a worst-case scenario, deep seabed mining for oil or other resources, might be able to proceed legally in Antarctica despite the Protocol's ban on mining.

Some concerns have also been expressed that the Protocol doesn't specifically address the management of tourism, which is the fastest growing human activity

in Antarctica and, apart from fishing, the only commercial one. The Protocol's provisions, in fact, apply to all human activities, but Treaty countries which are either "gateways" for tourists to the Antarctic, or which have major tour companies organising Antarctic expeditions, will be required to elaborate on the Protocol to provide rules to govern the growing tourist traffic. New Zealand, for example, has recently developed a set of guidelines and procedures for visitors to the Ross Sea Region, based on its own ratifying legislation, covering aspects of environmental impact assessment, notification and approval of activities, environmental codes of conduct, reporting procedures and the placement of official Government representatives aboard tour vessels (see Cessford in this issue).

Thus, there are several issues yet to be resolved before the Protocol is fully elaborated and firmly established in law, so that its implementation can begin in earnest. But it signifies recognition by the Treaty countries of the global significance of Antarctica, and their commitment to environmental protection and sustainable use of its resources. The real test, however, lies ahead. In the face of an ever-increasing human presence in Antarctica and mounting pressure for use of its resources, can Antarctica remain wild and beautiful with its biota and landscapes intact? The promise of the Madrid Protocol gives much confidence for an affirmative answer.

#### SUGGESTED READING

Bonner, W.N.; Walton, D.W.H. (Eds) 1985. Key environments: Antarctica. Pergamon Press, Oxford/New York, 381 p.

(This remains among the best instructional texts on Antarctica.)

Two of the few published sources of the Madrid Protocol are:

Watts, Arthur 1992. International law and the Antarctic Treaty System. Grotius Publications Ltd., Cambridge, U.K. (Hersch Lauterpacht Memorial Lecture Series 11) 469 p.

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# Environmental monitoring in Antarctica — measuring the damage

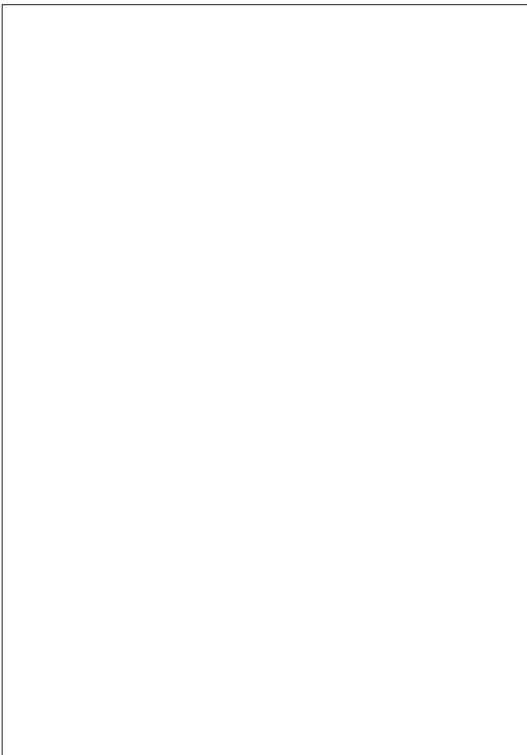
by David W.H. Walton

**The pure white of the snow is often assumed to imply that Antarctica is a pristine wilderness. Yet recently there have been increasing reports of how the continent is being seriously polluted. The truth lies somewhere between these extremes. Only through monitoring the changes occurring can the ‘environmental health’ of Antarctica be established confidently. Recently, there has been a rapid increase in many types of environmental monitoring in Antarctica. Why is this, and what wider relevance does it have?**

## HUMAN IMPACTS ON ANTARCTICA: GLOBAL, REGIONAL, AND LOCAL

### Global impacts

Scientific drilling of ice cores reveal the history of environmental changes in Antarctica and elsewhere in the world.  
*Photo by Antarctica NZ*



In trying to understand changes in the world's environment we need to know what is natural and what is induced by our activities. The best place to measure the elements of change is a place free of industrial activities and people — and Antarctica has no industry and very few people. Atmospheric mixing transports pollutants around the world and incorporates many of them in the snow falling on Antarctica, thereby providing a record of the atmospheric changes. The snow turns to ice, preserving an historical record stretching back almost 500,000 years. Analysis of these snow and ice samples has identified long-term patterns of change in the greenhouse gases CO<sub>2</sub> and methane, and recent changes in global levels of radionuclides (from atmospheric nuclear testing) and lead (from mining and leaded fuel). Combining these historical data with current daily atmospheric measurements enhances our ability to identify current trends in CO<sub>2</sub>, CH<sub>4</sub>, nitrogen oxides, and CFCs. For example, such measurements have already alerted the world to serious depletion in levels of atmospheric ozone. The Antarctic data provide the baselines against which changes in the rest of the world are measured.

There are also other global baselines established by Antarctic monitoring. Nobody uses pesticides in Antarctica, so measurements there can establish the baseline for global levels of these pollutants (Bidleman *et al.* 1993). Organochlor-

ine pesticides, polychlorobiphenyls (PCBs) and mercury have been clearly detected in penguins and petrels (Luke *et al.* 1989), fish (Subramanian *et al.* 1983), and even mosses and lichens (Bacchi *et al.* 1986). Increasingly sensitive and sophisticated analytical equipment is even providing leads to where the pesticides might have originated.

## Regional impacts

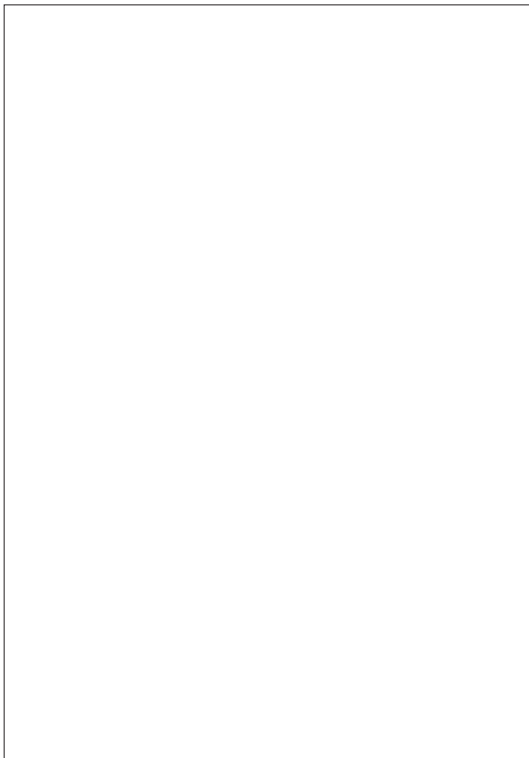
So there is detrimental impact on the environment of Antarctica by the natural transfer of pollutants manufactured elsewhere. The next stage is to ask what changes are occurring, traceable to human activities, at a regional level in Antarctica? There are three areas of concern — one on land and two in the sea.

On land, the use of leaded fuel by aircraft has provided trails of lead contamination in the snow below the regular flight paths, as has the burning of leaded fuel in station generators (Wolff 1990). However the extent of this problem is rapidly declining as newer aircraft are introduced and stations change to cleaner fuel. In the Southern Ocean, the problems are both associated with fishing and involve monitoring organised by the Convention for the Conservation of Marine Living Resources (CCAMLR). There is international agreement that the fisheries around Antarctica should be managed sustainably and in manner which protects the integrity of the marine ecosystem. To check that catches are not too large, thus endangering the food supplies for seabirds and marine mammals, CCAMLR runs an international monitoring programme which measures changes in the populations of indicator species. These at present include fur seals and four species of penguins (Adelie, chinstrap, gentoo and macaroni) as well as Antarctic petrels and blackbrowed albatross. The second area of concern is the

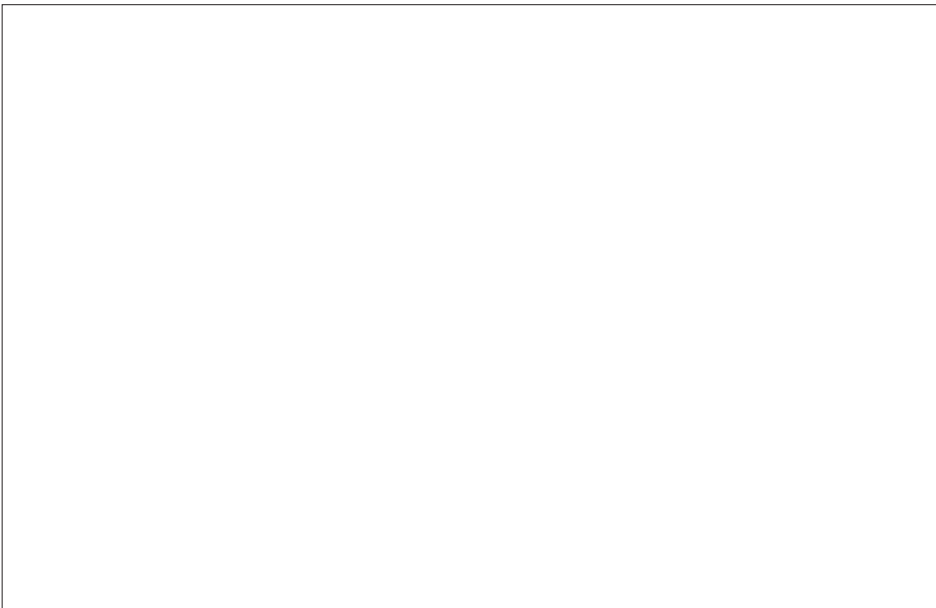
increasing amount of marine litter found throughout the Southern Ocean. Plastic straps entangle fur seals (Croxall *et al.* 1990) and plastic bags and granules are eaten by birds, filling their crops and causing starvation. Regular surveys of particular beaches around the Antarctic, using a standardised recording format, document the amount and possible origin of the wide range of materials discarded overboard, mostly by the fishing fleets.

## Local impacts

Most publicity and public concern has focused on the localised impacts caused by scientific research and its logistical support operations. Impacts are largely limited to the areas directly around the research stations, but concern has also been expressed about remote field camps, as well as the activities from research vessels. There is no doubt that at some stations with a long period of occupancy (in some cases over 50 years) there is evidence of activities undertaken in a less environmentally enlightened age (Lenihan 1992). Carefully angled photographs and a degree of media hype have drawn attention to waste dumps at several stations, which do need serious attention, but these waste dumps are highly localised and are not significant sources of continental-scale pollution.



Open burning of waste, now banned under the Madrid Protocol. Photo by Antarctica NZ



Today, with a much heightened responsibility for a clean environment, these historical rubbish dumps are gradually being removed. Far more important is the change in mentality brought about by the Madrid Protocol (see Dingwall in this issue). The requirement that all activities must be subject to Environmental Impact Assessment before being undertaken has brought with it a change of attitude among all the nations op-

The American McMurdo Station on Ross Island, the largest of the more than 40 scientific bases in Antarctica. *Photo by Michael Prebble*

erating on the continent. The acceptance of good waste management, such as recycling schemes and oil-spill contingency planning, in the conduct of all operations is a very positive leap forward.

### **Monitoring of impacts**

Along with this emphasis on good stewardship comes the need to monitor impacts to ensure that predictions of their effects are accurate. In undertaking this more applied monitoring, a partnership is being developed between the Antarctic science community and the national operators of Antarctic research programs, to ensure that the measurements made are critical, scientifically defensible and useful, both for understanding ecosystem processes and for modifying human activities.

Deciding what to monitor as measures of local impacts is at present the subject of considerable discussion and research. The continent is a biological desert. There is less than 1% ice-free ground and it is on this that essentially all the terrestrial flora and fauna occur. However, the diversity is low in both the plants (only two flowering plants and around 300 species of lichens and mosses) and animals (about 120 species of invertebrates with the largest being only a few mm long). All the birds are seabirds, coming ashore only to breed and moult, as do the seals. In the sea there is much greater diversity but all the species grow very slowly because of the low water temperature.

One of the most effective forms of monitoring undertaken outside Antarctica is to measure the success of a key species known to be sensitive to specific stress or disturbance. However, our knowledge of the biology of many Antarctic species is too limited at present to be able to choose any key species with a degree of certainty. A focus of research at present is establishing whether particular species of fish or mollusc can be key indicators. A second monitoring method is to look for changes in community structure or the abundance of several species. Here again the slow growth and reproduction of many Antarctic species makes this difficult, although long-term measurements can provide important indicators.

## CHOOSING WHAT TO MONITOR

What are the most important local impacts that human activities can produce? We can consider three categories: direct disturbance and damage, chemical pollution by local activities or accidents, and introduction of alien species.

### Disturbance

Penguins are abundant in many areas of the Antarctic and are known to react to disturbance by humans. Various investigations have been undertaken recently to see if this can be quantified either physiologically (Culik *et al.* 1990, Nimon *et al.* 1995) or in terms of breeding success (Fraser & Patterson 1997). The study of Culik used implanted electrodes to measure heart rate and showed that attacks of other penguins, and the presence of people and helicopters, all indicated increased stress. However, there was some evidence that birds could become habituated to the presence of humans. The study by Nimon used heartbeat measured by an artificial egg. These measures indicated increased stress when people approached the brooding bird, eventually resulting in desertion of the

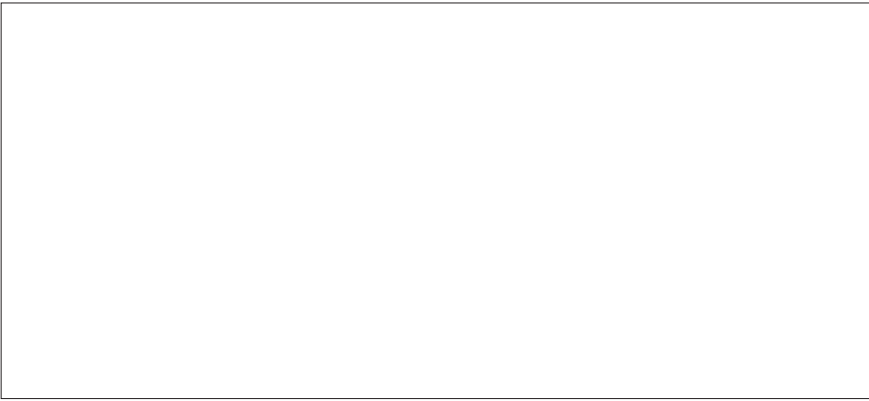
nest. Additionally, their data indicated that attacks by other penguins also produced elevated heart rates as the penguin defended its nest. Both studies concluded that these stresses might impair the ability of the parents to raise viable chicks, especially if the disturbance occurs frequently.

Other researchers have tested the hypothesis that rookeries

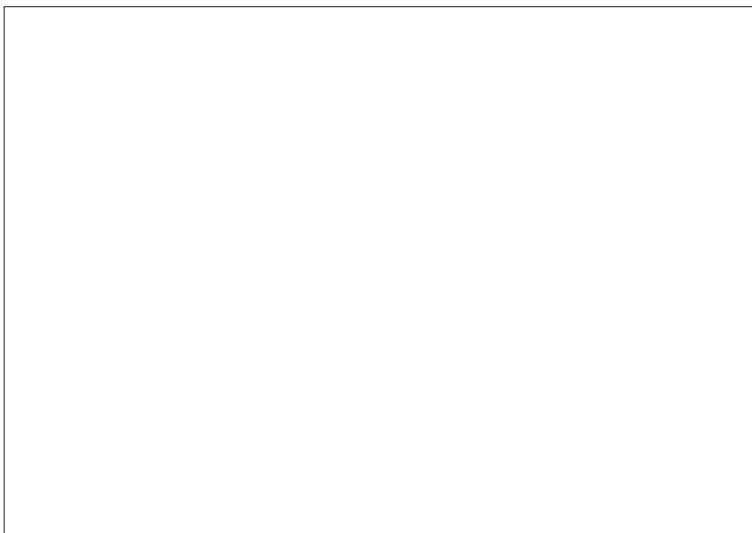
visited frequently by tourists are likely to show lower breeding success than those not visited at all. Fraser & Patterson (1997) measured the size of two such rookeries of Adelie penguins at Anvers Island on the west side of the Antarctic Peninsula over a period of 13 years. Their data show that it was the non-visited control site rather than the tourist site that suffered major decline in breeding success. This suggests there may be wider environmental changes significantly affecting the lifecycle of these penguins.

### Pollution

Pollution of the environment can be attributed to poor waste management, carelessness or accidents. Small fuel spills have occurred at many stations over the years but more rigorous controls and careful monitoring now provide a great deal more protection against this. Sometimes an accident occurs and provides a ready-made test of how the ecosystem responds to large-scale pollution. Such an accident was the sinking of the Argentine supply ship *Babia Paraiso* at Anvers Island in 1989. The ship spilt an estimated 600,000 litres of diesel fuel, causing slicks which dispersed over 100 km<sup>2</sup> of sea surface among the surrounding islands and bays (Kennicutt 1990). An international monitoring effort was undertaken over several years to assess the effects of this and came to some surprising conclusions (Penhale *et al.* 1997). First, after a period of only two



Life and work in Antarctica depend on fuel and supplies brought in from the outside world. *Photo by Gordon Cessford*



Modern and environmentally secure fuel storage facilities at McMurdo Station. *Photo by Michael Prebble*

months there was no evidence in the subtidal benthic communities that the spill had ever happened, with only minor traces of hydrocarbons in the sediments (Hyland *et al.* 1994). Second, there was evidence for rapid uptake into limpets, with up to 50% mortality in some areas. This probably caused a secondary effect of immediate food shortage for Dominican gulls, but surprisingly the population has continued to decline rather than showing long-term recovery as might be expected. Similarly, cormorants lost 100% of their chicks that year and active nests have since shown an

85% decline. Other birds suffered from the direct effects of the oil, with Adelie penguins losing 13% of their numbers immediately, but no further decline in later years. Giant petrels were not directly affected by oil on the water, or uptake via the food chain. However, the high level of helicopter activity around the wreck, and the continuing disturbance by attempts to recover other materials, frightened the birds away from their breeding grounds.

### **Introduced species**

In the species-poor Antarctic environment the introduction of alien species could cause important changes in community structure if the introduced species survived. A considerable concern is at the microbiological level. What happens to the faecal bacteria flushed out into the Southern Ocean in the sewage outfalls of the scientific stations? Studies by McFeters *et al.* (1993) suggested low water temperature might aid long-term viability, especially if the bacteria were incorporated into sediments. However, recent experiments by Statham & McMeekin (1994) have shown that faecal *E. coli*, *Salmonella*, and *Streptococcus* are always inactivated by solar radiation, so the problem may only exist when bacteria are discharged under the protection of an ice cover. More recently there have been reports of viruses in penguins (Gardner *et al.* 1997). As yet we have insufficient data to decide if there is a problem, but keeping Antarctic animals free of introduced disease may prove to be increasingly difficult.

## **CONCLUSIONS**

Under the Madrid Protocol we have an excellent set of rules for sensible management of the Antarctic environment. Environmental monitoring in Antarctica plays an important part in ensuring that local impacts are minimised, regional impacts are identified and traced to source, and for enabling global pollution baselines to be identified and maintained. In addition the long-term measurements of atmospheric composition can give us clear warnings of the patterns of future climatic change. The Antarctic is the world's last great wilderness and, with the judicious use of monitoring, we can not only keep it that way but use it as a control area for assessing damage to the rest of the earth.



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# Managing cumulative environmental impacts: Antarctica's challenge for the 21st century

by Janet C. Dalziell and Maj De Poorter

As we approach a century of human contact with Antarctica, the quantity and range of human activities in the frozen continent are rapidly expanding. While hardy adventurers are still emulating the Antarctic explorers of the "heroic era", we now also see increasingly Caribbean-style seaborne cruises, the movement and storage of vast quantities of diesel fuel, the possibility of drilling into sub-glacial lakes millions of years old, the introduction of jetskis, and the filming of a tobacco advertisement.

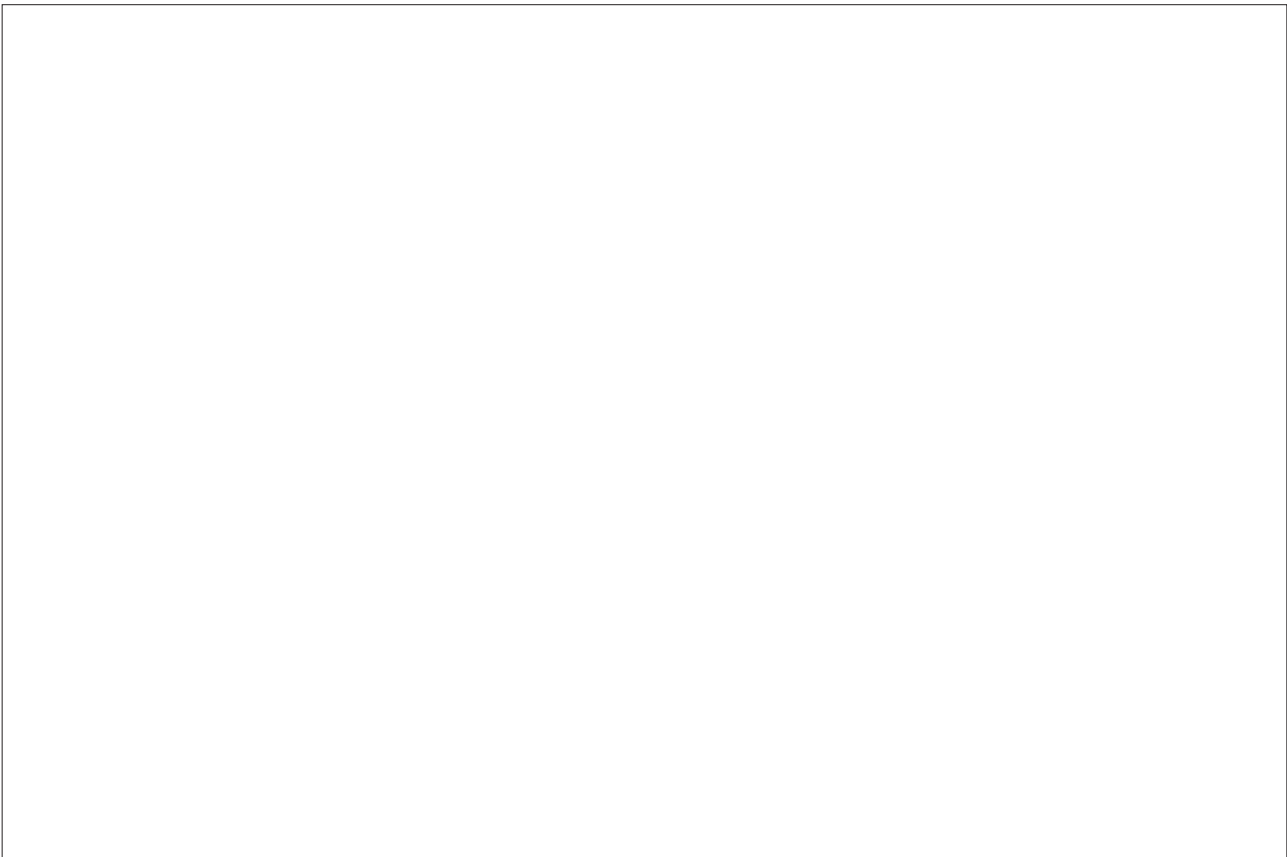
## THE FRAUGHT QUESTION OF CUMULATIVE IMPACTS

To ensure that the ever-widening range of activities and players in Antarctica does not threaten its wilderness values, rules and regulations are increasingly being introduced in this, the world's last "unowned" continent. The Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol) states that the protection of the Antarctic environment and dependent and associated ecosystems, and the intrinsic values of Antarctica (including wilderness, aesthetic, and scientific values) shall be fundamental considerations in the planning and conduct of all activities in the Antarctic Treaty Area.

The Protocol provides for a process of environmental impact assessment (EIA) as a key way in which potential impacts are identified in advance of an activity proceeding, with the intention of avoiding or mitigating the impacts.

So far, so good. But in a continent where individual operators—both governmental and non-governmental—run largely discrete and independent operations, and where each government considers itself sovereign within its own programme, how can the whole range of activities in Antarctica be effectively managed to avoid or mitigate environmental impacts? Environmental impact assessments, done by individual operators for their own activities, do not offer mechanisms by which the additive impact of an activity, when combined with those of other activities, can be assessed.

In September 1996 the World Conservation Union (IUCN) organised an international workshop of invited experts to discuss and stimulate progress on practical aspects of minimisation and management of cumulative environmental impact in Antarctica (De Poorter & Dalziell 1997). A high priority was placed on



A meeting of the past and present of human contact with Antarctica — heroic era hut and a modern base on Ross Island. *Photo by Michael Prebble*

the generation of ideas and recommendations that would be of direct use to Antarctic operators, policy makers and scientists. This paper presents the principal conclusions of the workshop.

## WHAT ARE CUMULATIVE IMPACTS?

Changes to the environment caused by human activities are not simply the product of individual impacts occurring independently of each other, but the consequence of many interacting factors, the combined effects of which are not always well understood (Cocklin 1989). Human activities may produce environmental impacts that are considered insignificant, but the interaction and combination of these impacts over time and place may well be significant. This has sometimes been referred to as “the nibbling effect” or “destruction by insignificant increments” (Dupuis 1997). The existence of such cumulative impacts means that dealing only with individual environmental impacts will not result in adequate environmental management. There are several components to the concept of cumulative impacts:

- Small actions whose impacts seem “insignificant” when viewed alone, can contribute to significant cumulative impacts when viewed along with other past, present or foreseeable future actions.

- Larger-scale activities can produce a “stream” of impacts, and the totality of impact from actions includes indirect and secondary impacts and any activities or impacts which may be induced by the original activity. (Dames *et al.* 1981, quoted in Martin 1991).
- The interaction of impacts can be additive or interactive (e.g., synergism, antagonism, biomagnification).
- Impacts may spread in time and/or space.
- Several different operators may be involved.

Although the existence of cumulative environmental impact has long been acknowledged, the formal study of it is relatively recent (Cocklin 1989, Damman *et al.* 1995). The earliest Antarctic study specifically focussing on cumulative impact did not take place until the early nineties (Martin 1991).

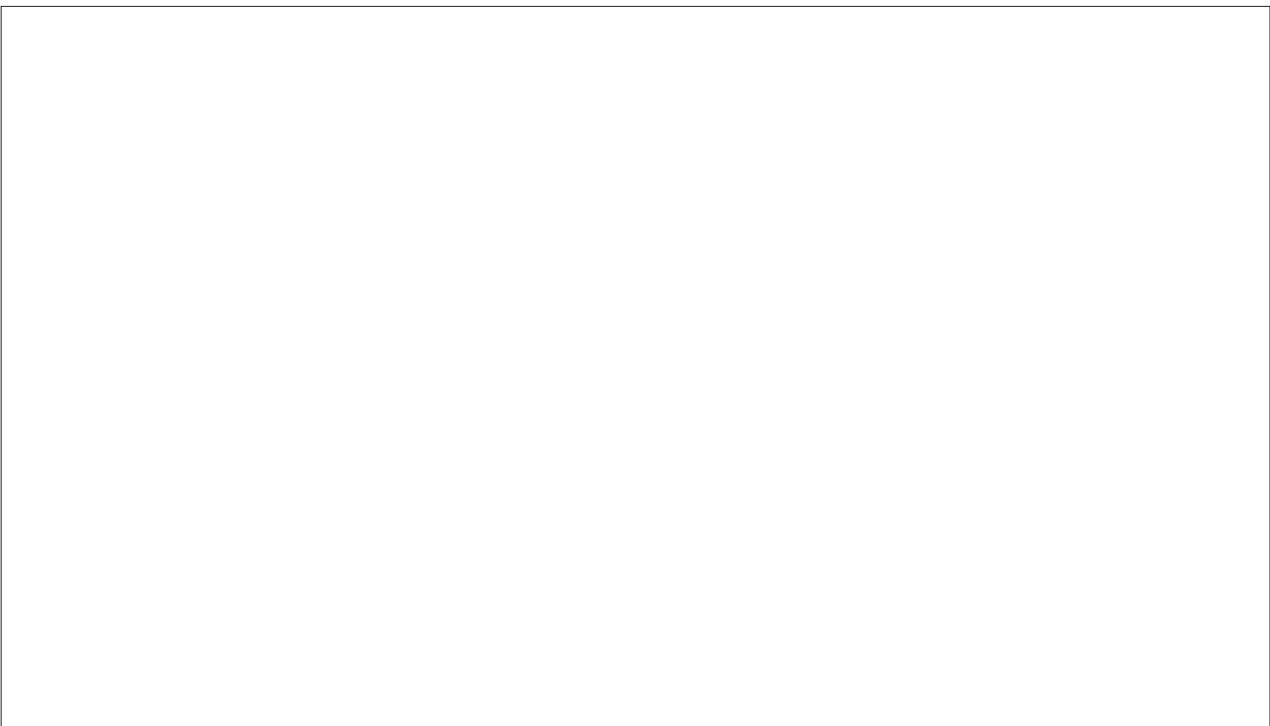
## DEFINITION OF CUMULATIVE IMPACT IN THE ANTARCTIC CONTEXT

Workshop participants adopted the following definition of cumulative impact in the Antarctic context: **a cumulative impact is the impact of combined past, present and reasonably foreseeable activities. These activities may occur over time and space.**

Cumulative impact may, for example, be the result of:

- The repetitive occurrence of a single activity
- The combined effect of multiple activities by one or several agents
- Individually minor, but collectively significant activities

Cumulative human impacts from scientific base facilities and tourist visits are evident in places such as this Adelie penguin colony at the French Dumont D'Urville base.  
*Photo by Paul Dingwall*



Cumulative impact may be additive or interactive (e.g., synergistic, antagonistic, biomagnified).

## MINIMISING AND MANAGING CUMULATIVE IMPACTS

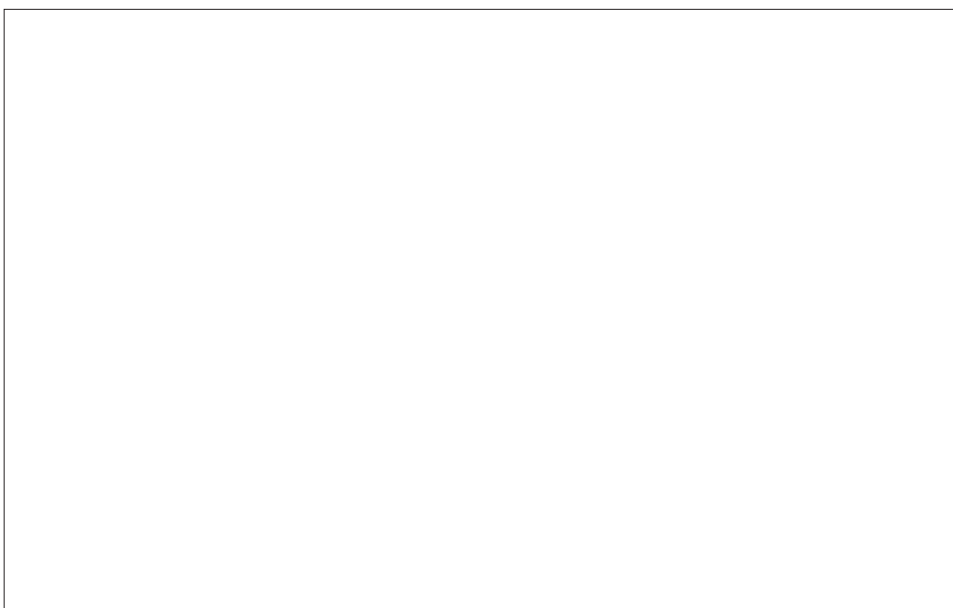
The workshop identified five existing mechanisms that provide opportunities for addressing cumulative impacts. Cumulative impacts can be assessed, managed and avoided through:

- Use of the environmental impact assessment processes under the Protocol
- Innovative use of existing area protection mechanisms
- Improved information exchange and management
- Increased international co-operation
- Specific and targeted research and monitoring

## ENVIRONMENTAL IMPACT ASSESSMENT PROCESSES

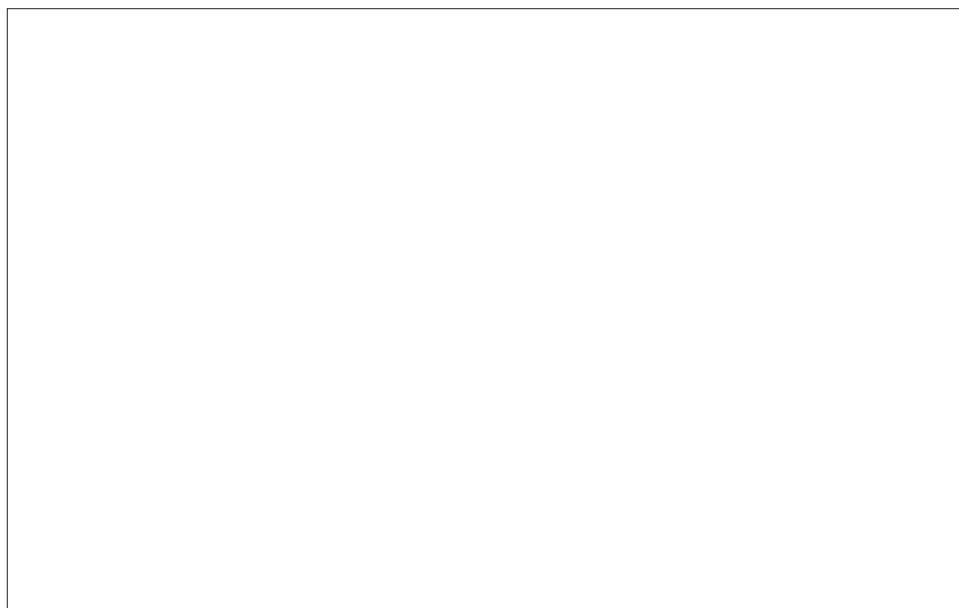
The Madrid Protocol sets in place a tiered system of environmental impact assessment as one of the primary means by which activities in Antarctica come under scrutiny. However, the system works on a project-by-project basis, and does not immediately and obviously provide mechanisms for assessing cumulative impacts. Environmental impact assessment done jointly by governmental and/or non-governmental operators could overcome some of the problems inherent in this piecemeal approach.

Another mechanism frequently employed by national Antarctic programmes—although not required by the Protocol—is that of environmental reviews or au-



Essential but intrusive infrastructure supporting research in the Dry Valleys — managed environmental risks. *Photo by Michael Prebble*

Impacts of past Antarctic human activities have become the attractions for current human activities and impacts.  
*Photo by Michael Prebble*



ditioning, where the environmental impacts of existing projects or programmes are assessed. These studies are also subject to the same shortcomings with respect to cumulative impacts as are EIAs. However, they could, if constructed in the right way, be used to **assess** the cumulative impacts of multiple activities over time and/or space.

The workshop agreed that in order to ensure that environmental impact assessments and reviews or audits better address cumulative impacts:

- Wherever obligations regarding environmental impact are identified, it should be taken that this includes **cumulative** impacts.
- Environmental audits, along with monitoring programmes, should be encouraged as a way of assessing cumulative impacts from existing activities.

## PROTECTED AREA MECHANISMS

Another major component of the Protocol is its system for designating Antarctic Specially Protected Areas (ASPAs) which restrict entry for scientific and/or protection reasons; and Antarctic Specially Managed Areas (ASMAs) which are areas subject to high and/or multiple uses. In both cases, management plans are the key to ensuring that the values of the area are protected. It is the ASMA category, however, which seems to offer a particularly good means of addressing area-specific cumulative impacts. Essentially, the processes of writing and operating a management plan for a multiple-use area will “internalise” the impact. By widening the scope of the activities being considered in a single plan, the likelihood increases that activities whose impacts are contributing to the overall impact are considered and managed within that plan. Permits are required to authorise activities in ASMAs, and, by providing a record of activities, they could contribute to better management of cumulative impacts.

Other ways in which protected area mechanisms could and should be used in the management of cumulative impacts include:

- Designation of short-term ASPAs to provide interim protection while long-term operations are developed
- Identification of pristine or near-pristine areas and the setting aside of large areas to protect the integrity of remote regions
- Designation to allow time for recovery of areas degraded in the past

However, it cannot be over-emphasised that these mechanisms will work effectively only in a climate of strong and effective co-operation and communication among all operators in the area in question.

## INFORMATION EXCHANGE AND MANAGEMENT

Effective and efficient exchange and management of information among operators are critical for the minimisation of cumulative environmental impacts. Those unfamiliar with Antarctica would probably be surprised at the difficulty faced in trying to build up a picture of activities that are taking place, or have taken place, in a particular location. On closer consideration, however, this is not so surprising, given the diversity of governmental and non-governmental organisations that conduct activities in Antarctica — and the complete absence of a central repository for this sort of information.

Antarctic Treaty governments have developed some rudimentary forms of information exchange, but they are not geared towards the requirements of environmental protection and management. One of the workshop's recommendations was that this system be reviewed in order to provide information more useful for these purposes. For example, there needs to be timely and frequent distribution of lists of completed and planned environmental impact assessments and permits issued, so that someone considering an activity can identify potential overlaps or conflicts.

Along with increased information exchange comes an ever-increasing call for effective systems of managing the information so that it can be accessed quickly and easily by those that need it. Workshop members noted that it will not be possible to meet cumulative impact obligations without an effective data management system. This statement is easily made, but in practice such a system will require:

- Links with national Antarctic programme data systems
- Links with data from Antarctic scientists and operators
- Consistency of data for comparability
- Cost and cost effectiveness
- Ensuring public access
- Global information systems (GIS)

The workshop also suggested that in areas with multiple operators (for example, where there are several stations), a common database of activities in the area would be very useful.

## INTERNATIONAL CO-OPERATION

It is obviously preferable if cumulative impacts can be avoided from the start. A key way in which the overall impact of human activities in the Antarctic can be reduced is through a reduction in duplication of activities, particularly the logistical infrastructure.

As well as the clear benefits that accrue to the environment from different operators pooling their logistic resource (e.g., through sharing stations), a wider concept of international co-operation should also be considered. In particular, in areas of high and multiple-operator use, there is room for considerably more inter-operator co-operation and even joint planning. It will not be possible for operators planning an activity to be able to assess and mitigate cumulative impacts unless they have full knowledge of activities conducted in the past and planned for the future by other operators in the area.

To address these needs, one could envisage regional planning and management groups composed of all those who operate in a given area. Such groups would jointly plan activities so as to avoid overlaps and conflicts, and would be able to foresee where, for

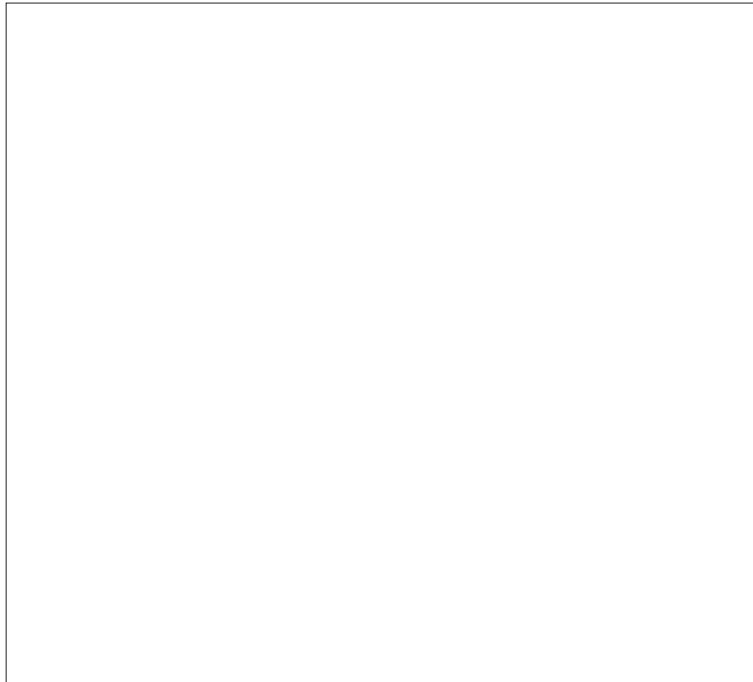
example, multi-programme environmental impact assessment exercises would be useful. Such work might lead, for example, to tourist operators deciding to vary their routes, scientists choosing a different study site, or two stations sharing new fuel facilities.

It will also be important that all operators, even those that may not (yet) be inside the Antarctic Treaty System, plan and conduct their activities in the same spirit of international co-operation.

## FURTHER RESEARCH

Many aspects of cumulative impacts are not well understood, and a wide field of research is opened up by questions such as:

- What are the mechanisms, pathways and processes by which impacts accumulate?
- Which parameters should be studied or monitored to measure impacts on wildlife? For example, changes in population seem obvious, but other measures such as habituation of recruitment or age distribution may be just as important.



The vast Antarctic marine resources are also attracting the world's commercial and conservation interests. *Photo by Paul Dingwall*



## LONG-TERM CHALLENGES

In the long term, yet another level of complexity will need to be addressed. For example, the effect on dependent and associated ecosystems, including the marine ecosystem and Subantarctic islands, from Antarctic activities will have to be included in any assessment and management of cumulative impacts. The effects of activities outside Antarctica (such as global climate change and transboundary contamination) will also be need to be tackled eventually.

Management of cumulative impacts is undeniably a major challenge for those who have guardianship over Antarctica. Almost by definition, cumulative impacts are difficult to foresee and avoid or mitigate. But the obligations set by the Protocol mean that these are challenges that must be met.

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# Antarctic tourism—A frontier for wilderness management

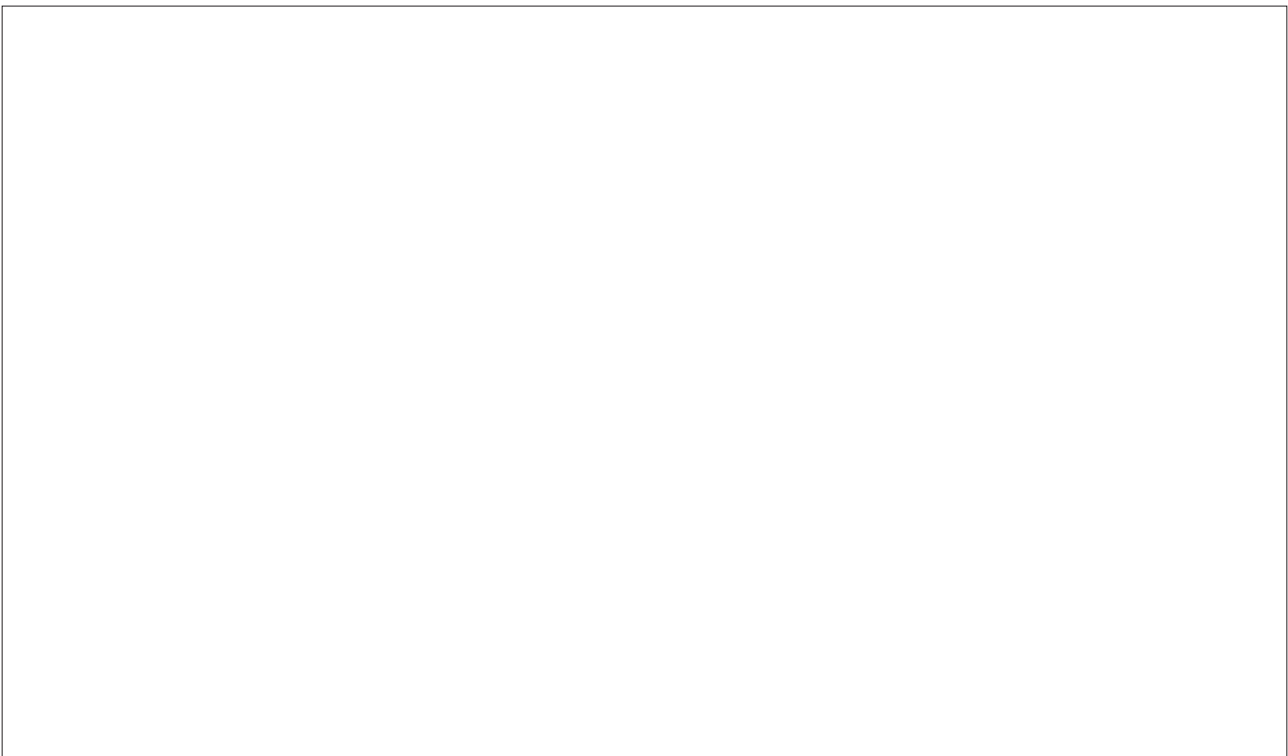
by Gordon R. Cessford

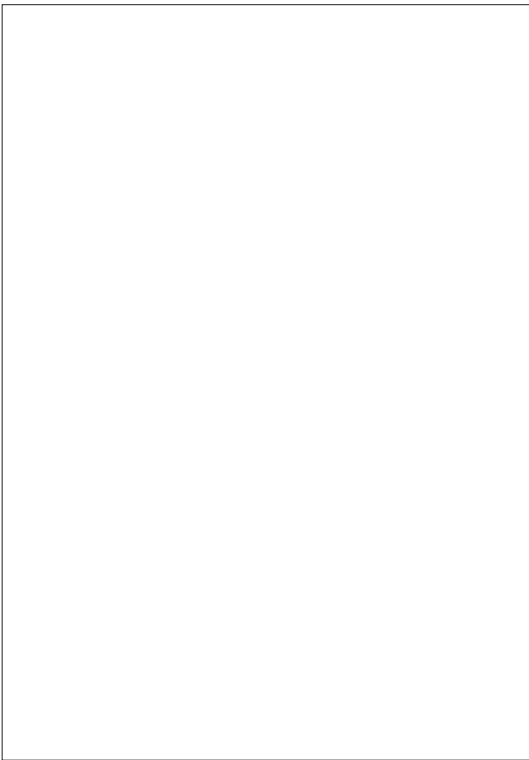
Antarctic tourism has grown rapidly in recent years bringing an influx of new visitors to add to the traditional scientific occupants of the continent. To date tourism impacts on the wilderness environment have been relatively benign, and tourists accept that their visits may be subject to limitations. But the prospect of continued growth and diversity of activities brings some concerns about the adequacy of existing rules for managing tourists, and calls for continued surveillance and research.

## ANTARCTIC TOURISM ISSUES

Debate over whether Antarctic tourism is good or bad is not much help. The Antarctic Treaty governments have accepted it as a legitimate activity, tourist numbers are growing steadily, and recently a comprehensive tourism guidebook for Antarctic travellers has even been published (Rubin 1996). All the signs are that Antarctic tourism is here to stay. Now, the important discussion required centres on how tourism can be encouraged to operate in ways which minimise disturbance, and further enhance the wilderness and scientific values already attributed to Antarctica. This may require determining how tourism activities take place on-site, promoting better interactions between tourism and the

Do tour vessels at heavily visited historic sites on the Antarctic Peninsula represent ecotourism overcrowding? The *Lindblad Explorer* and *World Discoverer* at the former Norwegian whaling station on Deception Island. *Photo by Antarctica NZ*





The tourist experience in Antarctica begins before land is even sighted — tourists view pack ice from the bow of the *Kapitan Kblebnikov*. Photo by Michael Prebble

operation of scientific programmes and stations, and identifying ways to enhance the experiences of tourists so they become stronger advocates for Antarctic conservation and science after their return home. To gain a perspective on how this could occur, it is helpful first to understand the current features of Antarctic tourism and tourists.

When asked the main things she would tell other people about her Antarctic experience, one Antarctic tourist's response was:

“The vastness and peace. The importance of the Antarctic in determining climate, weather and oceanic features in the rest of the world. The necessity of international planning and co-operation to protect this area.”

This succinctly captures some of the key issues about Antarctica as a growing tourism destination and as a place valued by humans. A visit to Antarctica is a unique and wonderful experience; understanding Antarctica will tell us much more about the global processes affecting the world environment and our place in it; and a special regime of international co-operation is required to manage our

interactions with Antarctica—it is not “owned” by anyone.

## THE CONTEXT FOR ANTARCTIC TOURISM

Although growing rapidly, Antarctic tourism is only a tiny fraction of the global tourism industry. While hundreds of millions of tourists travel internationally each year, in Antarctica numbers are only now reaching 10,000 annually, most of them visiting in the four-month summer season (Figure 1). This may seem a small number for a wilderness continent larger than the USA and Mexico combined (14 million km<sup>2</sup>), but visits are focused on only a few accessible natural and historic features. Most are in the less than 0.5% of the surface area (56000 km<sup>2</sup>) which is free of permanent ice, an area equivalent in size to Denmark, Sri Lanka, or West Virginia. But the largest single ice-free area (the Dry Valleys) is only 2,500 km<sup>2</sup>, approximately the same size as Yosemite National Park. The remaining ice-free areas are mainly mountain tops and coastal outcrops speckled widely over the vast Antarctic continent. Antarctica's sparse terrestrial life is highly concentrated on these rocky ‘islands’ in a ‘sea’ of ice, particularly in the coastal areas close to the life-support provided by the sea. The direct human influences that occur in Antarctica are also highly concentrated in the more accessible of these ice-free coastal areas, including past and present scientific stations and current tourism activities. So while the continent is vast and the human numbers low, the interaction of people and environment occurs largely in the very limited ecosystems most important for the marginal life that exists. In this situation, the presence and behaviour of even relatively small numbers of people take on added significance.

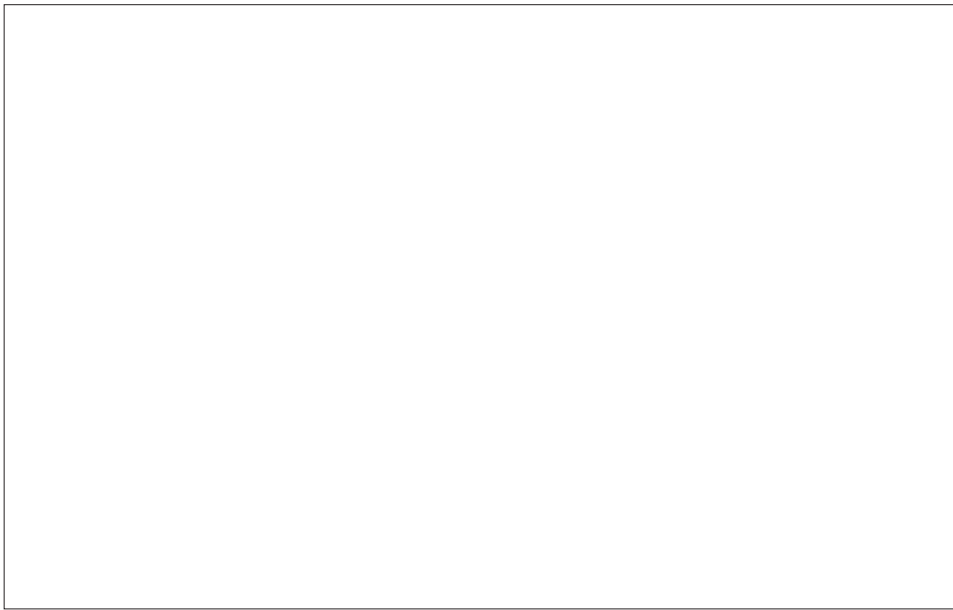
Figure 1. Recent and predicted (IAATO 1997) growth in Antarctic shipborne tourism.

## THE PATTERN OF ANTARCTIC TOURISM

Human activity in Antarctica is overwhelmingly concentrated on the Antarctic Peninsula (see Dingwall this issue for map), which contains almost half the 40 or so scientific stations in Antarctica, and over 90% of tourism activity (Table 1). In essence, Antarctic tourism consists of ship visits to the Antarctic Peninsula, combining scenic cruising with brief visits ashore to view unique wildlife and historic sites. Most Antarctic tourists voyage from Punta Arenas (Chile) or Ushuaia (Argentina) in vessels ranging from comfortable cruise ships carrying

TABLE 1. CHARACTERISTICS OF MAIN ANTARCTIC TOURIST DESTINATIONS.

MAIN VISIT AREAS	ANTARCTIC PENINSULA	ROSS SEA
Visit gateway	Southern Chile/Argentina	New Zealand/Australia
Distance	1000 km	3000 km
Summer sea-ice	Generally open	Often variable ice-pack
Access types	Ice-breakers, ice-strengthened ships, cruise liners, private yachts. Aircraft inland	Ice breakers, ice-strengthened ships
Main sites	Deception Is., King George Is., around Anvers Is., Weddell Sea, Patriot Hills (inland)	Capes Adare, Hallett and Evans, Ross Is., Dry Valleys, Commonwealth Bay
Main attractions	Historic huts/whaling sites, many stations, wildlife variety, adventure recreation inland, scenic water/ice/mountains	Historic 'heroic-age' huts, Adelle penguin colonies, occasional other wildlife, Ross Sea scenery and ice-shelf, Dry valleys
En-route islands (subantarctic)	South Georgia, South Orkneys, South Shetlands, Falklands	Aucklands, Campbell, Snares, Macquarie
Tourist numbers	9000-10000	300-600



Close encounters with penguins are a particular highlight of almost all Antarctic visits. *Photo by Antarctica NZ*

400 or more passengers, to expedition-style yachts carrying fewer than 10. Most vessels between these extremes are chartered craft, especially a variety of ice-strengthened Russian research vessels and icebreakers, which have been converted for tourism use and carry from 30 to 100 passengers. The availability of these vessels from the early 1990s, and the increasing use of ship-borne helicopters, has significantly increased the volume and scope of sea-borne tourism options, and the range of sites able to be reached. Due to ease of accessibility and the concentration of attractions on the Peninsula, most future growth in all types of Antarctic tourism is likely to occur there.

Smaller numbers of vessels travel from ports in New Zealand (principally Bluff) and Australia (principally Hobart) to destinations mainly in the Ross Sea region, usually complemented by visits to the New Zealand and Australian Subantarctic islands (the latter recently attaining World Heritage status). However, this involves about 10 days voyaging across the notoriously stormy Southern Ocean, compared with the three to five days of travel to the Antarctic Peninsula. The longer sea-time raises travel costs, reduces the proportion of time spent ashore, is less comfortable for passengers, and limits the types of vessels that may safely visit (Figure 2). In addition, there is often uncertainty about reaching some sites when ice-conditions are unfavourable. It is unlikely that sea-borne tourism to the Ross Sea will grow substantially in the next few years unless more voyages using Russian vessels become available.

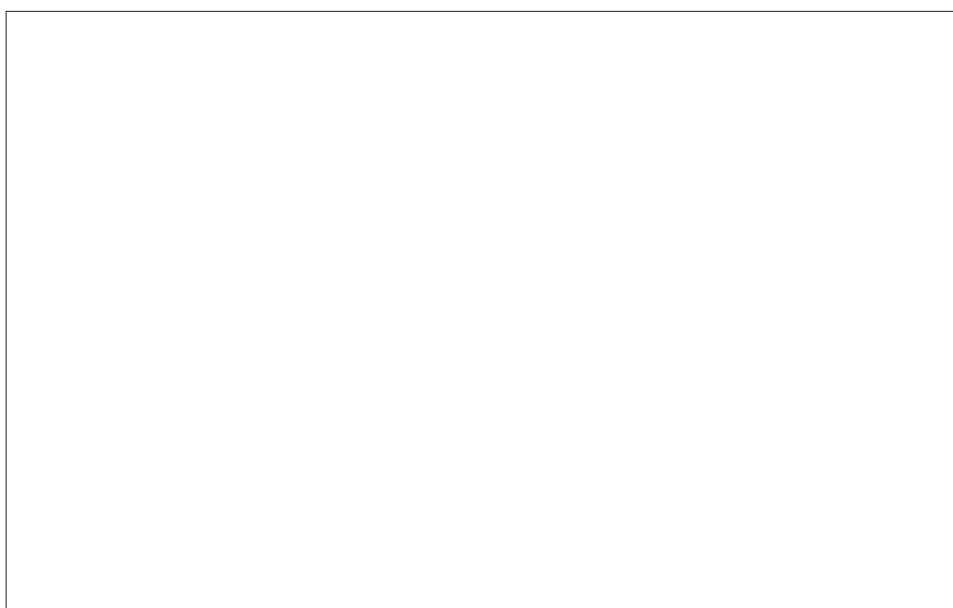
Aircraft also operate from South America, particularly carrying small numbers of adventure-oriented tourists to inland sites for climbing, skiing and wilderness expeditions. Other opportunities for airborne access are currently being investigated elsewhere in the antarctic, including trials of flights from South Africa (IAATO 1997). Antarctic sightseeing overflights from New Zealand were also proving popular before ceasing in 1979 after a tragic crash. These have resumed recently from Australia and are again proving popular. Even when viewed from great height, and at considerable expense, Antarctica is a highly attractive tourist destination, reflecting the commonly stated desire of people to visit it someday. In recent years the opportunities to fulfil such a desire have become increasingly diverse and progressively cheaper.

## THE IMPACTS OF ANTARCTIC TOURISM

Any wilderness manager confronted with a tourist demand for visiting rare and highly specific natural and historic features, would have difficulty coping with a series of sites spread widely over a vast continent. Adding complexity is the lack of on-site management presence, the commercial pressures driving tour providers, and the lack of a clear mandate to make binding management decisions. For those concerned about the continued viability of Antarctic ecosystems and the integrity of the many historic sites, the prospect of growing tourism numbers in these circumstances is not a welcome one. Tourist visitors will inevitably have impacts, and these may be particularly acute because tourists specifically seek the most valued natural and historic features. People may try and get 'just a little bit closer' for their penguin photograph; want to pick up that historic hut item for a closer look; collect just a few wind-sculptured stones as souvenirs; or walk 'just a little' way into that specially protected area and, maybe unknowingly, trample on soil or rock features, or damage unnoticed lichens and mosses.

However, the localised impacts of tourism on features at Antarctic sites should be seen in the wider context of natural environmental fluctuations; global and regional human activities; and the ongoing localised effects of station operations and science programmes. Although tourists greatly outnumber scientists, Headland (1994) compared the relative tourist and non-tourist 'presence-days' in Antarctic environments (i.e., how many people were present, what they were doing, and for how long), and estimated that less than 1% of direct human effects in Antarctica could be attributed to tourists. This does not mean that tourism impacts should be ignored, as they add to the cumulative effects of stations and science programmes (see Dalzeill and De Poorter in this issue), but suggests that there should be a focus on station operations when prioritising actions to reduce human impacts. Tourist impacts should be subject to exclusive focus only where they in particular threaten the natural and/or historic values. In the vicinity of existing stations, it is unlikely that environmental impacts from tourist activity would be more significant than those associated with the station.

Antarctica is huge, but people and wildlife intersect at the few ice-free fragments. *Photo by Michael Prebble*



The most pervasive impact from tourism has actually been on the operation of the stations themselves. Tourists display a particular interest in station visits, and these are usually seen as an integral part of the Antarctic experience. In positive terms, this provides welcome changes in station routines, allows more direct advocacy of the research being done to an interested audience, pro-

vides opportunities for generating revenue from postal and souvenir services, and has enabled greater logistical co-operation between station and tour operations. In some cases, tour vessels have provided transportation of staff and materials for management and research purposes.

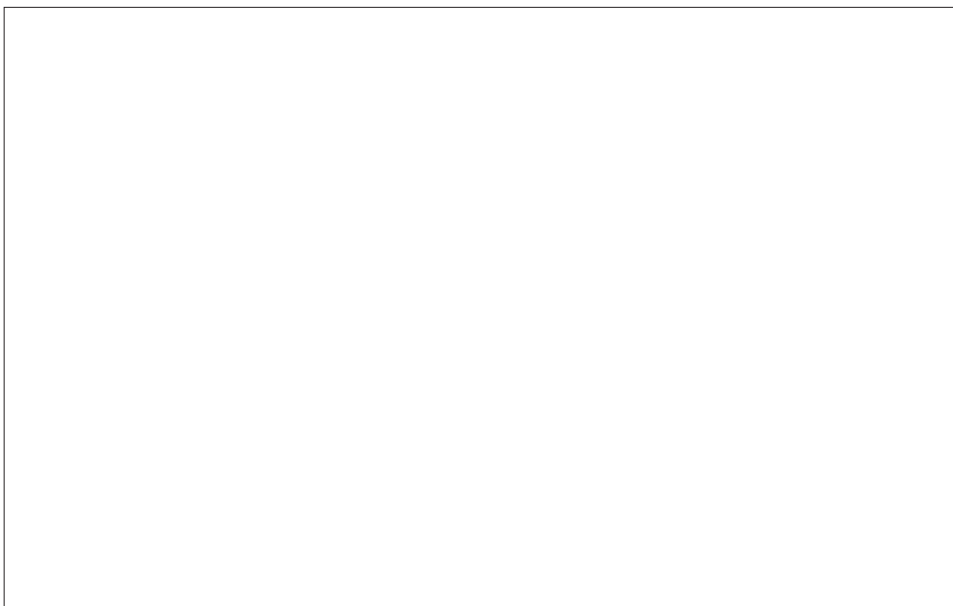
However, as the number of tourist visits has increased, the physical disturbance of station operations and scientific programmes has become particularly acute at stations on the Antarctic Peninsula. Some stations now impose limits on visits allowed, or at least require considerable advance notice and visitor adherence to strictly enforced codes of conduct while ashore. This provides the control required to ensure that both the tourists and the managers can obtain the benefits of station visits, without seriously compromising station operations. This outcome can be achieved for station visits because of the on-site presence of management authority, and the acceptance of this by both tourists and tour providers. Achieving the same outcome at those sites where no direct management control by official authorities is possible represents the main challenge for Antarctic tourism management. But how do you stop tourists from going closer to get that penguin photograph when there is nobody there to inform or monitor them?

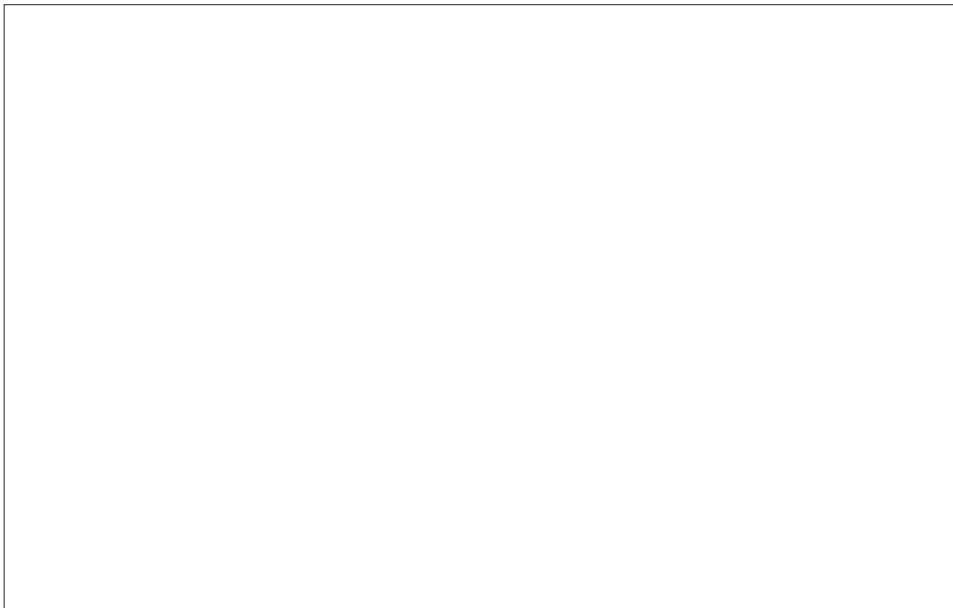
## MANAGING ANTARCTIC TOURISM IMPACTS

Part of the answer to this question lies with the tourists themselves. A high degree of Antarctic interest and motivation is suggested by their choice of an Antarctic trip in the first place. They are making an expensive choice compared with other tourism options, and in most cases are accepting the probability of experiencing long periods of considerable discomfort at sea for few relatively short visits ashore. Coming from the more affluent and better educated sectors of society (predominantly from Europe and North America), generally being from older age-groups, and mostly having professional and managerial backgrounds, these tourists have high expectations of quality visit-experiences featuring spectacular scenery, fascinating wildlife and significant heritage in an essentially wilderness context.

The few studies made of Antarctic and Subantarctic tourists have indicated that these high expectations are being achieved. Furthermore, a research programme by Cessford and Dingwall (1996) found that there was a high degree of tourist acceptance of the regulations imposed for controlling visits ashore, and no real demand for development

The typical pattern of Antarctic tourist visits — zodiac landings from a cruise ship. *Photo by Michael Prebble*





Ice-breakers provide unique access opportunities for tourist landings while spreading the scope of intrusions to more areas. *Photo by Michael Prebble*

of any visit-related facilities. Apart from some interest in provision of toilet options while on-shore, a need which all public space and wilderness managers would recognise, the only notable developmental preferences expressed were for enhancing the already extensive interpretation and information opportunities associated with visits. In general, it appears that in many ways Antarctic tourists are already par-

ticularly receptive to the need for some regulation of visits ashore, to the types of regulations managers would wish to apply, and to the types of conservation and environmental messages managers may wish to convey. In essence, there does not appear to be any significant “customer-demand” pressures on tour operators to undertake their tours in ways which might seriously compromise Antarctic wilderness values or ecological integrity.

Since almost all Antarctic tourism visits are on self-contained ships, there is no need for any onshore facilities. This removes the main source of most possible impacts from human activity at sites, and places the focus more specifically on simply minimising the effects of the brief site-visits. In turn this requires more specific and localised tasks for research and monitoring, related to impact assessment and site management. To achieve the best management of sites, more understanding of specific human-environment interactions is required. For example, how do different wildlife species perceive the repeated presence of humans, and what are the long-term consequences of their short-term behavioural responses? While recognising that there is much to learn, and acknowledging the vulnerability of the values involved, there is still need to establish some provisional working guidelines.

Substantial progress has been made toward achieving site management guidelines. On the one hand, the nations administering activities in Antarctica under the Antarctic Treaty have adopted the Madrid Protocol, which provides a system under international law for environmental management of all human activities in Antarctica (see Dingwall, this issue). While not distinguishing between different types of human activity, the Protocol does provide a basis for Treaty nations to develop their own management policies specific to Antarctic tourism. For example, New Zealand recently passed domestic legislation providing for regulations and guidelines governing visits to the Ross Sea region (Anon. 1997). In this situation, New Zealand has extended its ability to promote these regulations by requiring that an official government representative accompanies each visiting ship. While this requirement can be legally enforced in New Zealand’s Subantarctic island territories, in the international realm of



Antarctica it can only be achieved through mutual agreement between the authorities and tourist operators. To date this arrangement has worked well, despite the costs involved for both parties. The managers establish some oversight of visits, while the operators achieve a greater measure of official endorsement, and sometimes the added interpretative services of an experienced professional.

On the other hand, the International Association of Antarctic Tour Operators (IAATO), which includes almost all Antarctic tour operations, has also developed its own bylaws, codes of conduct and visit guidelines. Thus in most cases, visits to Antarctic sites will be by controlled groups under the supervision of experienced guides who are applying established visit protocols. This enables visitors to enjoy an informative, interesting and safe experience, while avoiding sensitive areas or inappropriate behaviours. These voluntary codes and guidelines also extend beyond the normal competitive behaviours of business, going as far as including co-operation between different tour operations to minimise visit congestion at particularly popular sites.

## CONCLUSION

Clearly, a growing consensus between tourism and management interests, combined with the willingness of most tourists to accept environmental controls on their visits, is an encouraging basis for achieving an environmentally sustainable tourism industry in Antarctica. Following the precautionary approach represented by the Madrid Protocol and IAATO initiatives, the working rules represented by the developing guidelines can continue to be applied as the best practices available. But ongoing research, monitoring and consensus will still be required to continue improving our understandings of the impacts and, if necessary, further refine these working rules.

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# Concepts of wilderness in the Antarctic

by Rosamunde Codling

**Antarctica is often referred to as a wilderness. But what does this term actually mean in the Antarctic context and how does it relate to the use of the term elsewhere? Some of the countries that have signed the 1991 Protocol on Environmental Protection to the Antarctic Treaty, have no areas that could be accurately described as “wilderness”. Thus transferral of ideas directly to the Antarctic community, without taking into consideration both national differences and the geographical uniqueness of the Antarctic, can cause confusion. An attempt is made to clarify the issue by looking at comments of some of the early Antarctic explorers, before examining what the Antarctic Treaty System has said about wilderness. These interpretations are then examined in the context of wider wilderness thinking, and possible directions for future conservation planning are developed.**

## HOW EARLY EXPLORERS VIEWED ANTARCTICA

In their writings early Antarctic explorers, especially in the “heroic age” at the beginning of this century, give a fascinating account of the physical environment and of their personal responses to the polar landscape. In 1903, famous British Antarctic explorer Robert Falcon Scott wrote that the interior of Victoria Land:

“. . . must be considered the most desolate region in the world. There is none other that is at once so barren, so deserted, so piercingly cold, so windswept or so fearsomely monotonous.” (Scott 1929, p.607).

Yet Scott also wrote of the continent in more favourable terms. Even when sledging on the arduous three-month Southern Journey in 1902, he recorded the beauty of snow crystals falling on a calm night:

“As one plods along towards the midnight sun, one’s eyes naturally fall on the plain ahead, and one realises that the simile of a gem-strewn carpet could never be more aptly employed than in describing the radiant path of the sun on the snowy surface. It sparkles with a myriad points of brilliant light, comprehensive of every colour the rainbow can show, and is so realistic and near that it often seems one has but to stoop to pick up some glistening jewel.” (Scott 1929, p.441).

For those exploring the coast, such as the French naval captain Charcot in 1910, the ever-present ice brought both danger and beauty:

“The mighty sea and the monstrous icebergs are playing their giant’s games under the grey and lowering sky, caressing or fighting, and in the midst of these marvellous manifestations of nature, which are not made for man, we

feel that we are merely tolerated, although a kind of intimacy may be created between us and our magnificent hosts.” (Charcot 1978, p.289).

While many of the early visitors to the Antarctic graphically described their surroundings in great detail, they rarely used the word “wilderness”. This term has appeared regularly only during about the last thirty years, and is now frequently used in descriptions of the continent, especially in environmental and popular writings.

## WILDERNESS CONSIDERATIONS UNDER THE ANTARCTIC TREATY

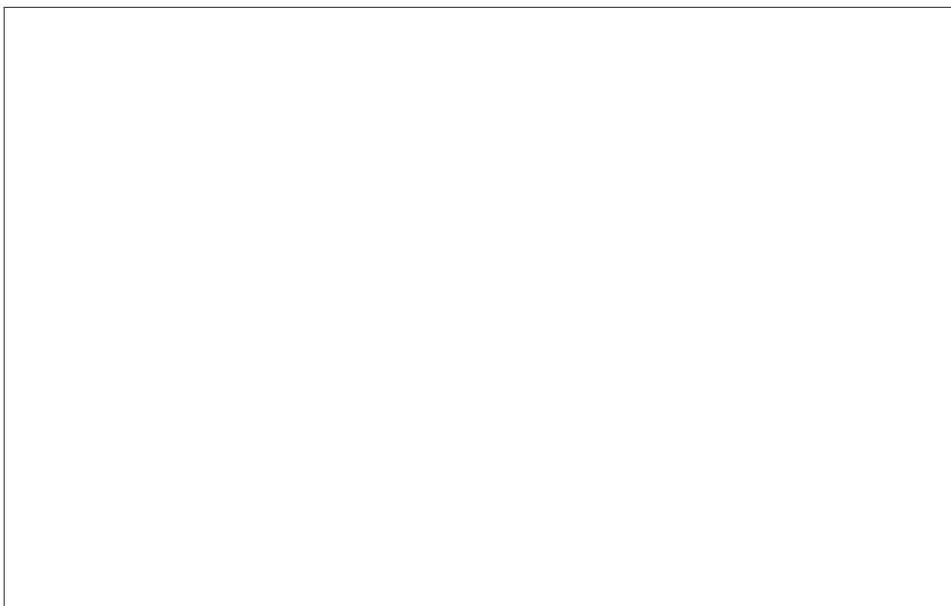
In the more than 35 years since the Antarctic Treaty entered into force, a vast collection of documents has amassed including those from the Treaty’s Scientific Committee on Antarctic Research (SCAR). From these we can find that the concept of wilderness in the Antarctic has only gradually emerged.

Initially, the Treaty nations focused on the development of scientific research. As other activities such as tourism began to develop (Reich, 1980) concerns widened. In 1980 SCAR produced “A visitor’s introduction to the Antarctic and its environment”, a 28-page booklet, which included recognition of: “a general awareness of the value of unspoilt nature or wilderness. The last remaining extensive wilderness is the Antarctic.” (SCAR 1980, p.26). Reference was also made to the uniqueness of the continent’s scenery and wildlife, but the statements were very general.

Shortly after, SCAR and the World Conservation Union (IUCN) jointly produced “Conservation in the Antarctic” (IUCN/SCAR 1986). This report recognised the need to explore protected area concepts such as wilderness or park designation, but the subject was still being treated in a broad-brush manner. One of the most expansive comments from the Antarctic Treaty System concerning wilderness came from the SCAR document “Objectives of conservation in the Antarctic” (1989). The authors of this document considered it necessary “. . . to minimise

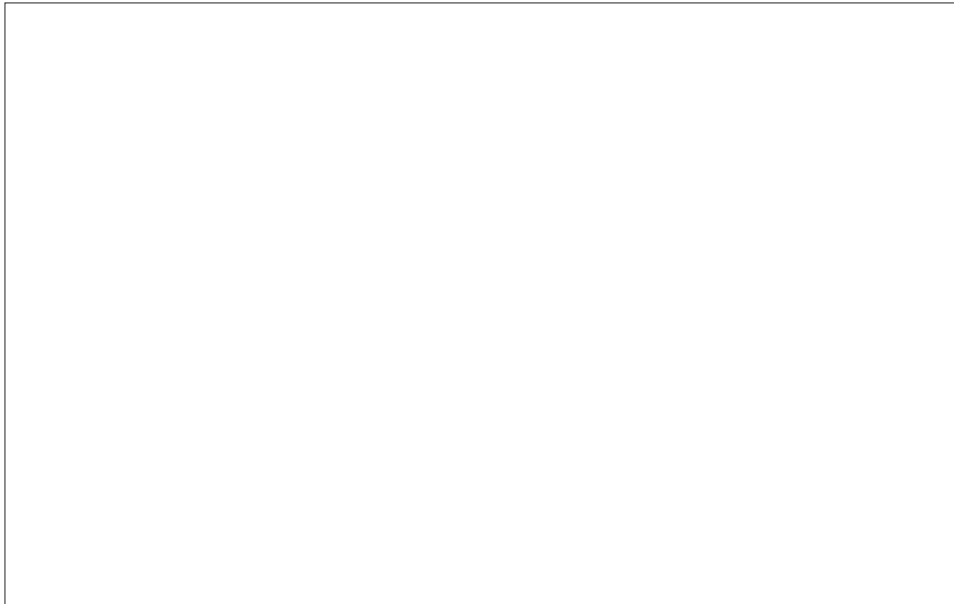
disturbance by human activity so that . . . unique features, localities or complexes of features and sites of scientific importance are undisturbed . . . cultural values, such as scenic beauty, inspirational quality, wilderness status and recreational potential can be maintained.” (SCAR 1989, p.182). However, no attempt was made to define methodology to as-

A volatile landscape — the icy grandeur of the active Mount Erebus volcano on Ross Island, fronted by tidal ice ridges.  
*Photo by Antarctica NZ*



sess such values, or suggest appropriate management plans to protect them.

These generalisations continued in the late 1980s, including a Recommendation from the XV Antarctic Treaty Consultative Meeting, in Paris in October 1989, calling for comprehensive measures for the protection of the Antarctic environment and dependent and associated ecosystems. In turn, this led to development of the Protocol on Environmental Protection to the Antarctic Treaty which was adopted in Madrid in 1991.



At the heart of the Protocol is Article 3, which provides a range of principles applying to all Antarctic activities. The opening section of the Article refers to the intention to protect “. . . the Antarctic environment . . . and the intrinsic value of Antarctica, including its wilderness and aesthetic values.” Similar phraseology occurs three more times in the Protocol or its Annexes,

Tourists aboard an inflatable craft are dwarfed by the grandeur and vastness of the Antarctic landscape. *Photo by Antarctica NZ*

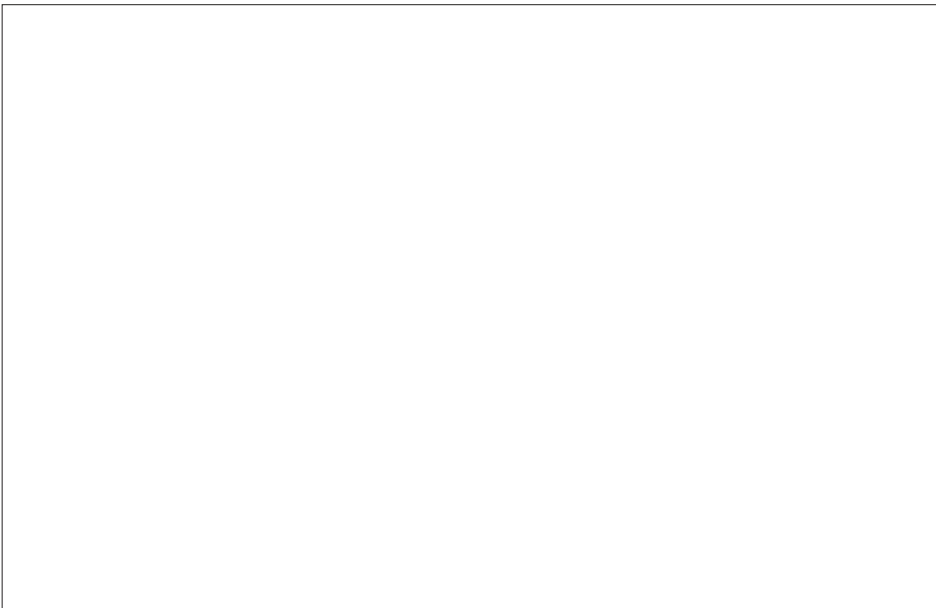
but no closer definition is offered for these terms (Article 3, section 2(b)vi; Annex V, Article 3.1 and Article 3.2(g)).

These examples illustrate the picture that has emerged from examination of the more formal Antarctic documents. While it is commendable that there has been a growing recognition of wider environmental concerns, there is as yet no firm understanding as to how they are to be considered. Moreover, although the term “wilderness value” is now well-established in the Antarctic Treaty lexicon, there have been no attempts to define what it means, or to identify specific wilderness areas or develop comprehensive management safeguards.

## EXPLAINING THE CONCEPT OF POLAR WILDERNESS

Three writers have endeavoured to expound on the concept of polar wilderness. Mosley (1986) defined the “value of the Antarctic wilderness” as maintenance of natural benefits, political co-operation, and long-term environmental stability, although he did not identify potential conflicts, such as erection of permanent structures and the issue of unrestricted use of motorised transport.

Roots (1995) took an approach that was historically wider, giving an analysis that separated the European fascination with polar wilderness from the indigenous people’s view. He suggested that native northern peoples had been able



Scientific bases are highly visible components of the modern Antarctic landscape — Scott Base and Crater Hill.  
*Photo by Antarctica NZ*

to prosper within the Arctic environment because they had become part of the ecosystem. He concluded:  
“What do polar wildernesses contribute? They have provided essential elements of history, culture, knowledge, psyche, and spirit, for better or for worse, for at least the past 2300 years. Today, particularly, they are important to our self-awareness, our environment, and to what actions we can take towards a sustainable future. To whom do they contribute? To each of us, no matter where we live.” (Roots 1995, p.127).

The most analytical examination came from Watts:

“Any human activity in Antarctica will have some environmental impact, and the only form of complete protection for the Antarctic environment would be one which excluded human activity there altogether (and even then, the environment would remain susceptible to influences from outside Antarctica). The questions to be faced in practice are whether the value of the activity to be undertaken outweighs the environmental impact which will inevitably accompany it, and whether those impacts can be minimised without undermining the value of the activity giving rise to it. In short, a balance has to be struck.” (Watts 1992, p.253).

## THE DILEMMA OF HUMAN DEVELOPMENT

Wilderness areas are usually thought of as having minimal incursion from human development, and associated technologies and structures. How can this generally accepted requirement for wilderness be married with the needs of survival of any human being in the region? It may be difficult for those who have not experienced the southern polar environment to realise that safety is fundamental to the discussion. Inadequate clothing or equipment, which might cause temporary discomfort in another wilderness area, may lead to serious injury or death in the Antarctic. The hostility of the environment cannot be ignored and this raises the question of accommodation. So far, most non-scientific visitors come in the austral summer, with the greatest numbers being tourists aboard cruise ships. Other recreational visitors, such as mountaineers, are able to use tents for relatively long periods. Fieldwork parties may also use such accommodation. But without the backup of more substantial station buildings, the variety and quality of scientific studies would be seriously affected.

As far as Antarctic transport is concerned, there has been no truly feasible and environmentally acceptable alternative to the internal combustion engine. Huskies, beloved by many, were removed from the continent in 1994, and although some visitors such as the mountaineer Messner, have occasionally been able to use parachute sails to assist them when skiing, the scope of, say, scientific work would be considerably limited by the absence of aeroplanes and vehicles.

Tourists visiting by ship carry their accommodation and their means of propulsion with them, but while they may be spectators to the terrestrial wilderness they live and move through the oceanic wilderness. The adventurers, whether mountaineers or skiers, also come either by ship or aeroplane. They may not depend on further transport if their plans go well, but all responsible expeditions have to have emergency back-up. The conclusion is simple. If any form of human activity is to continue on the continent, there will be a continuing necessity for buildings, ships, aeroplanes and motorised vehicles.

## WILDERNESS IN ANTARCTIC CONSERVATION PLANNING

For conservation planning purposes, a working approach to the concept of wilderness in the Antarctic could consider the following propositions:

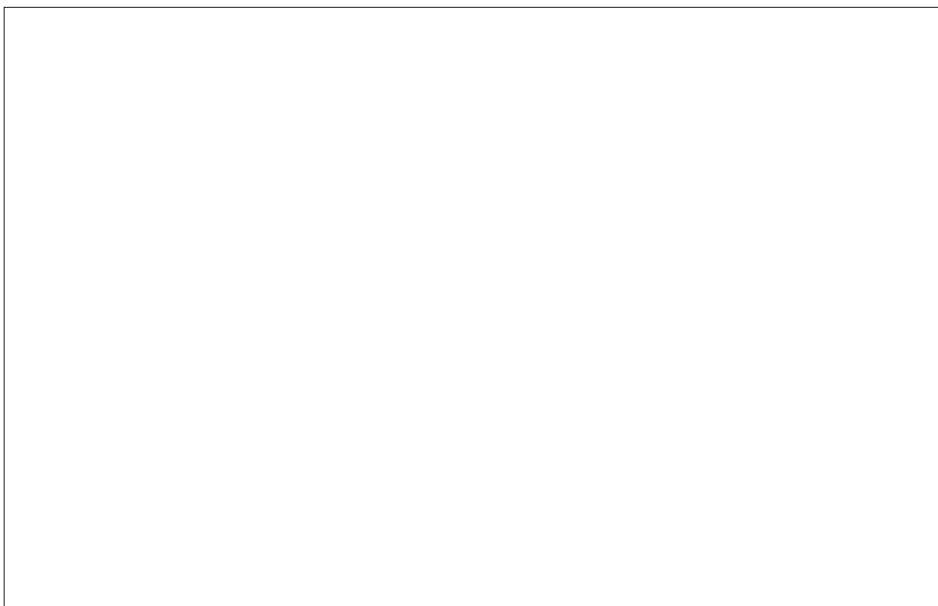
- Begin by the acceptance of the Antarctic, including its surrounding seas and islands, as a wilderness.
- Declassify from this area only those parts which do not confirm to generally accepted definitions of wilderness, such as scientific stations and transport corridors.

A giant Starlifter on the ice runway at McMurdo Station provides a vital link in the management and scientific operations of national Antarctic programmes. *Photo by Gordon Cessford*

### Scientific stations

The methodology used by the Australian National Wilderness Inventory (Lesslie *et al.* 1993) offers some help in this regard. In this system, four indicators are

applied—remoteness from settlement, remoteness from access, apparent naturalness, and biophysical naturalness. The first two, dealing with remoteness, merge in the Antarctic, as roads and tracks on the continent are limited to settlements (taken to include both existing and former stations) and their immediate surroundings. Any modifications resulting from the third indicator, apparent naturalness, will also be predominantly



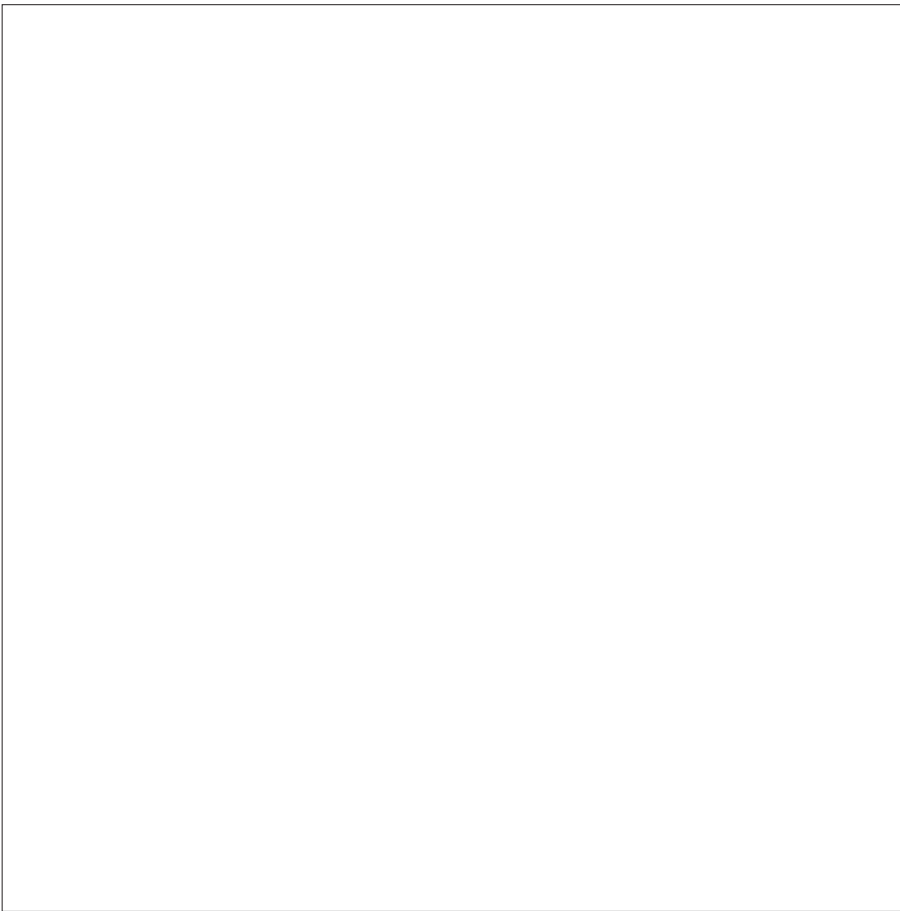


Figure 1. A conceptual model for defining Antarctic Wilderness Areas.

linked to stations, although there may also be isolated areas elsewhere which have been modified by human action. Thus, three of the four indicators coalesce into a single indicator suggesting evidence of the presence of people.

On the ground, this would correspond to the total station area, including all outlying structures such as refuges, masts etc., plus an “assessment of visibility” from the surrounding land and sea. As shown diagrammatically in Figure 1, an “Area of human influence” could be represented by the outer of two circles although in practice the actual area would be influenced by local topography. In the case of Rothera, a British coastal station, the

whole Rothera Point would be included, with a somewhat arbitrary outer line at 5 km radius, suggesting an “assessment of visibility”.

The final indicator in the Australian system is biophysical naturalness. Ecologists may identify areas on the continent, over and above the defined “Areas of human influence”, which show degradation of “biophysical naturalness”. If such areas are present, grading of their condition could modify wilderness values, suggesting greater or lesser quality. However, it seems more likely that a straightforward designation of “Antarctic wilderness” could be made in all areas where there is no indication of human presence.

### **Transport corridors**

With present technology, there seems to be no adequate alternative to the use of motorised transport in the Antarctic for scientific work and the support of recreation and tourism. Yet there is continued pressure for enjoyment by “simple, quiet, non-polluting and non-intrusive means of travel”—the description offered by the World Conservation Union (IUCN 1994, p.18). Given this alternate preference, perhaps the following proposal might be debated. Some have called for the establishment of inviolate or pristine control areas for scientific comparison with other localities that have been disturbed by humans (Lewis Smith 1994; Protocol 1991, Annex V, Article 3.2(a)). Taken to the logical conclusion, motorised transport and over-flying would also be prohibited in these areas, so as to avoid contamination. These locations, with a surrounding buffer zone would lie within the greater “Antarctic wilderness”. Perhaps motor-free recreation could be permitted within the buffer zone.

## CONCLUSION

Wilderness needs to be seen in a global context, as part of a spectrum of human impact with highly urban areas at one extreme and with remaining pristine regions at the other. If this hierarchy of “paved to pristine” is recognised, then each element should be valued for the part it can play in the life and work of people. In the case of the Antarctic, there may be the temptation to assume that the areas of human influence are of little or no consequence. However, some of the problems associated with cumulative impacts have already been identified (Dalziell and de Porter, in this issue). The wise use of **all** areas to the highest environmental standards is essential, even if they appear to be “only an odd hectare of two” in the middle of a continent 14 million km<sup>2</sup> in size. A possible planning approach to assist in meeting these ends is suggested above, the implications of which go beyond the remit of the 1991 Madrid Protocol.

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