

# **REVIEW OF THE SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME**

## **REPORT**

### **Reviewers**

David Walton (Prof), British Antarctic Survey, United Kingdom

Jörn Thiede (Prof), Alfred Wegener Institute, Germany

Leslie Manley (Mr), Department of Foreign Affairs

Albert Hoffmann (Judge), International Tribunal for the  
Law of the Sea

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*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

**“....an ideal opportunity to engage the youth, who are our next cohort of researchers and the drivers of a powerful science and technology-based economy that South Africa is aspiring towards.”**

Minister of Science and Technology Mosibudi Mangena, at the DST Antarctic Month Event aboard the *SA Agulhas*, on June 20, 2005 in Cape Town

## **TABLE OF CONTENTS**

**Executive Summary**

**List of Recommendations and Conclusions**

**Preface**

**Acknowledgements**

**1. Introduction**

**2. Terms of Reference**

**3. Antarctic, Marine and Atmospheric Sciences**

**4. Resource Management & Innovative Technologies**

**5. Infrastructure**

**6. Governance**

**7. Funding & Human Resources**

**8. Education, Outreach & Empowerment**

**9. International Relations**

**10. Antarctic Treaty System**

**Appendices 1. Committee Composition**

**2. Terms of Reference**

**3. List of interviewees**

**4. Documentary Evidence and Bibliography**

**5. Glossary**

## EXECUTIVE SUMMARY

South Africa has been an active participant in Antarctic research for fifty years and is a founder member of the Antarctic Treaty. It has made and is making substantial contributions to our understanding of the continent and its surrounding seas and has considerable investments in infrastructure to support this research.

An assessment of the health and standing of its present Antarctic science community shows that its overall output is good and that the best scientists are on a par with those from leading Antarctic countries in Europe and North America. However, there are important areas of science that are missing or declining and these need to be recovered to allow an integrated view of the Antarctic to be developed. The critical mass of some groups needs enhancing and more cross-disciplinary work needs to be encouraged. An important way to encourage scientific initiatives and enhance training would be to establish a new Institute of Antarctic Earth System Science. International linkages in biology and physics appear good and improving, whilst those in oceanography will be stimulated by research possibilities on the new ship.

Future science strategy should be developed to ensure that government has its long term monitoring needs defined, that thematic fields such as climate change are linked both to topical concerns and international programmes, and that blue skies proposals continue to be funded. Data needs to be recognised as a valuable resource and an Antarctic National Data Centre nominated.

Crucial to all Antarctic work is the support of the ship, for both science and logistics. There is a very strong case to replace SA *Agulhas* with a new state-of-the-art oceanographic research vessel and integrate its capabilities to also serve other research requirements of government. Logistic supply could be undertaken in other ways on less expensive vessels. Broad band communications at SANAE and Marion Island are crucial to their future development and success. The future of the station at Gough Island should be subjected to a cost/benefit analysis before any further investment is made.

Governance of the programme needs to be more coherent and transparent, in order to provide all stakeholders with a robust and consultative decision-making process. The present management structure for SANAP across two departments is confusing and should be simplified and made more effective by establishing SANAP as a National Facility lead by a senior scientist and reporting through a single department.

In the Antarctic Treaty System South Africa needs to assume a more positive role, ensuring that it is included in developing new initiatives and making other countries more aware of the African contribution.

Provided a new ship is purchased the Review Panel concludes that the future research programme is not simply sustainable but provides a basis on which to build enhanced educational opportunities and possible economic gains.

These changes form an integrated package which is intended to re-vitalise science and open up new opportunities, improve consultation and management, and capitalise on South African leadership in a field where it already has an established track record.

## **RECOMMENDATIONS AND CONCLUSIONS**

### **CHAPTER 3: ANTARCTIC, MARINE AND ATMOSPHERIC SCIENCES**

**REC. 3.1 :** The Panel concludes that the total science output is very satisfactory, given the size of the community. It recommends however, that the major disparity between biology and all other sciences be addressed by SANAP in order to ensure a healthy distribution of Antarctic research disciplines.

**REC. 3.2:** The Panel concludes that much of the output of South African Antarctic science, in all disciplines, has been globally competitive and recommends that all efforts are made to maintain this position.

**REC. 3.3:** The Panel concludes that, on the basis of this limited survey, the best South African researchers in biology, oceanography and physics do indeed appear globally competitive.

**REC. 3.4:** The Panel concludes that, whilst all of these subjects have been derived from bottom-up proposals, they have proven to be relevant to the development of their disciplines and to wider policy issues.

**REC. 3.5:** The Panel recommends that in the future the development of thematic programmes should focus on cross-disciplinary collaboration. A modest attempt to stimulate this has been undertaken through the formulation of ARESSA, but this needs further work.

**REC. 3.6:** The Panel concluded that the South African Antarctic science community now shows good evidence of strong international links and is adequately represented in senior roles in international organisations.

**REC. 3.7:** The Panel recommends that the ARESSA document should be revised, with a Mission and Vision that recognise science quality and cost effectiveness as well as the value of international links, substantially shortened and simplified to enable a wider audience to read it, with the research themes clearly linked to national and international objectives, and a recognition of ATS requirements.

**REC. 3.8:** The Panel recommends that the new scientific leadership of SANAP should undertake a careful review of which disciplines are needed for a modern systems approach to Antarctic and Southern Ocean science.

**REC. 3.9:** The Panel recommends that, for geosciences research, a decadal research perspective is developed in an attempt to relate new data from the African mainland to relevant geological provinces in Antarctica.

**REC. 3.10:** The Panel recommends that marine geosciences (both marine geology and geophysics), which were once an important research discipline in South Africa, but have since dwindled away, are urgently needed to study the properties of the continental margins and contribute to the body of scientific data and expertise needed to define the continental margins around the South African mainland and the Prince Edward Islands

**REC. 3.11:** The Panel recommends that Marion Island should be considered as a part of the SAEON network for measuring global change. In addition, the development of this new facility would appear to allow proper curation and archiving of other publicly funded data on climate change.

**REC. 3.12 :** The Panel recommends that the availability of all South African Antarctic data and its management is reviewed and that a National Antarctic Data Centre is nominated to provide advice on quality control and availability. Metadata need to be generated for the major data sets and stored on Global Climate Monitoring Data (GCMD).

**REC. 3.13:** The Panel recognises the importance of long term monitoring and recommends that the South African contributions to present and future global atmospheric, marine and terrestrial monitoring programs which cover an important segment of the Southern Hemisphere should be continued and further developed. It further recommends that all monitoring should be listed and the value of the data sets subject to peer review.

**REC. 3.14:**The Panel recommends that oceanography expertise is rebuilt, that geoscience is drawn back into the programme, that data management is placed on a firm and continuing basis, that cross-disciplinary programmes are encouraged and that, where ever possible and appropriate, South African programmes integrate themselves into the major international initiatives.

## **CHAPTER 4: RESOURCE MANAGEMENT & INNOVATIVE TECHNOLOGIES**

**REC. 4.1:** The Panel recommends that the important contributions of South African scientists to the scientific investigations and monitoring programs as contributions to CCAMLR should be further increased. This should include a careful assessment of any changes occurring in the intended MPA at Marion Island.

**REC. 4.2:** The Panel recommends that South Africa prioritises the formal proclamation of a MPA around the Prince Edward Islands and proceeds with the implementation of the conservation and management plan for the islands as soon as possible.

**REC. 4.3:** Given the expectation that krill will shortly become a major fishery and could be a new development for the South African fishing industry, the Panel recommends that South African marine biologists should become more involved in assessing how the sustainable use of living marine resources can be achieved, and they should increase their efforts to provide advice to CCAMLR. This would also require research to separate the effects of exploitation from ecosystem changes due climate change.

**REC. 4.4:** The Panel notes that South African research groups specialized in the field of marine biogeochemistry are active and productive and recommends that their efforts should be further encouraged under the auspices of SANAP.

**REC. 4.5:** The Panel recommends a careful examination of marine faunas and floras for their potential of possibly beneficial and commercially exploitable natural substances and properties in the ocean basins around South Africa should be undertaken by a group of specialists in order that other nations do not harvest the riches of the seas alone.

**REC. 4.6:** The Panel recommends the application and development of technologies for alternative, sustainable energy production for supplying the SANAP-run stations with alternative energy in addition to existing diesel-generators would fit well with carbon reduction initiatives and long term fuel saving.

**REC. 4.7:** The Panel recommends that the Department of Science and Technology considers how best the South African satellite program can be utilised to support scientific research in Antarctica and the Southern Ocean.

## **CHAPTER 5: INFRASTRUCTURE**

**REC. 5.1:** The Panel concludes that *Agulhas*, *Algoa* and *Africana* all have to be replaced in a timely fashion, and with South African ownership. Without modern and state-of-the-art research platforms South Africa would quickly lose its ability to support its own initiatives and its independence as an Antarctic and marine research nation in its own right. In addition, logistic services to Antarctica and to the Marion Island station require substantial transport capacities at a regular basis during the summer months.

**REC. 5.2:** The Panel recommends to explore the option of separating the multi-purpose uses (research, supply logistics, passenger transport) of the replacement for the *Agulhas* by single-purpose vessels, namely a dedicated ice-strengthened, modern, state-of-the-art marine research vessel owned/managed by South Africa (deployable during all seasons) and to an ice-strengthened cargo vessel (to be used during the summer months for SANAP logistics, with the potential for money-earning charter for other purposes during the remainder of the year).

**REC. 5.3:** The Panel recommends to explore the potential of this new research vessel to fulfil the combined research needs from SANAP and MCM to achieve an annual deployment of 300-320 days/y. This will be best done through a joint stakeholder ship time assessment and management panel with a 2-3 year planning horizon.

**REC. 5.4:** The Panel recommends to explore the possibilities of fulfilling the logistics needs of SANAP, of other South African research institutions with activities in Antarctica and on the sub-Antarctic islands, as well as of passenger transport (ecotourism) through buying space on DROMSHIP, through chartered tonnage or

through another (South African or foreign, new or existing) ice-strengthened cargo vessel.

**REC. 5.5:** If solutions as suggested through REC. 5.2.-5.4 are not acceptable the Panel recommends that *Agulhas* be replaced by a similar hybrid vessel as already outlined in the Scoping Study for DEAT. The Panel is of the opinion that this is a viable option, but not the optimal or most cost-effective option and misses the opportunity for innovation. It would allow for the continuation of SANAP logistical and research activities, but would not provide the spring-board for both re-building the once well-established South African marine research community and assuming leadership in this research field.

**REC. 5.6:** If the South African marine research community is to be rebuilt (in particular in oceanography, marine geology and geophysics, etc.), it will need access to a marine instrument pool to be administered by a suitable institution (?MCM). The Panel recommends the establishment of a marine instrument pool (with the necessary technical support) for all publicly funded research.

**REC. 5.7:** The Panel recommends that for safety reasons any research vessel used by SANAP for oceanographic or marine biology cruises must have suitably recruited, trained and experienced deck personnel for the handling of winches and heavy instruments during the cruises.

**REC. 5.8:** The Panel recommends that operations at SANAE be improved immediately. Safety at SANAE/Qualifications and training of personnel working at SANAE: A rigorous, systematic program to train personnel (overwintering and visiting summer projects) for survival, station regulations for the SANAE area, environmental care and technical maintenance of the station has to be reinstated. An „emergency“ booklet with all relevant information has to be developed and the station commander has to exercise discipline on and around the station during all times.

**REC. 5.9:** The Panel recommends that the runway at SANAE and purchase of aircraft (long range and feeder) is not pursued since DROMLAN provides a functioning air link. There was no proper justification given for the proposal either to establish a new runway at SANAE and or to purchase airplanes (long-range or feeder). Substantial cost savings can be achieved.

**REC. 5.10:** The Panel recommends the improvement of satellite communications to broad band standard at SANAE immediately to satisfy presently unfulfilled scientific needs and to allow for state-of-the-art communications with home institutions.

**REC. 5.11:** The Panel recommends that SANAE and Marion Island stations should both be marketed vigorously to both national and international users to ensure a high intensity of use for scientific research and that this should also include the possibility of using Marion Island for training purposes.

**REC. 5.12:** The Panel recommends that a plan for equipping the Marion Island station with routine scientific facilities and equipment should be established immediately so that



additional sophisticated equipment has to be transported to the station only in exceptional cases.

**REC 5.13:** The Panel recommends that basic scientific support (clothing, technical support, field support and training) on the Marion Island Station should be improved for safety reasons. A user-group of stake holders should advise SANAP on these matters.

**REC. 5.14:** The Panel recommends an improvement in communications for scientific and personal purposes to make the Marion Island station more attractive for scientific visitors and for long range monitoring projects.

**REC. 5.15:** The Panel recommends requesting SAWS to immediately initiate a cost-benefit analysis of the continuation of support for the station on Gough Island versus the alternative suggested of installing an automatic weather station and moving the upper air balloons to Tristan da Cunha.

**REC. 5.16:** The Panel recommends exploring the possibilities of how South Africa can make better use of DROMLAN and DROMSHIP, and possibly acquire a significant commercial share in the business, with the concomitant creation of new jobs.

**REC. 5.17:** The Panel recommends establishing the SANAP Research and Logistics Centre as a National Facility. It should report through one Minister, be located in Cape Town, to serve as the core institution to safeguard the continued development of the scientific perspectives of South African research in Antarctica and the adjacent ocean basins, to provide the environmental management of South African activities in the Antarctic Treaty area as well as logistic support for SANAP and other research projects. The Research and Logistics Centre should be supervised by a Board (with a Chair) and lead by a Chief Executive Officer with strong scientific credentials.

**REC. 5.18:** The Panel recommends that the interest in founding a new academic institute devoted to Antarctic Earth System Science should be explored with a university or group of universities in the Antarctic Gateway area.

## **CHAPTER 6: GOVERNANCE**

**REC. 6.1:** The Panel recommends that a new management structure is organised to bring all elements of South African Antarctic activities into a single unified system, improving decision making and information flow as well as allowing for the representation of all interests in a structured framework.

It is recommended that the body to oversee all South African Antarctic activities be called the South African Antarctic Policy and Research Committee (SAAPRC).

The following SAAPRC subcommittees are to be established:

- science subcommittee (including SCAR) to be chaired by the SCAR delegate;
- management and logistics subcommittee (including COMNAP) to be chaired by SANAP;
- ATCM subcommittee to be chaired by DFA;

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

- CCAMLR subcommittee to be chaired by DEAT (MCM)

Membership of each of the subcommittees to be determined by the chair.

Membership of SAAPRC to include:

- Chair (D-G of the Department responsible for the Antarctic Research & Logistics Centre)
- CEO of Antarctic Research & Logistics Centre
- CEO of the Gateway Project
- Chair of science subcommittee (Universities)
- Chair of management & logistics subcommittee (SANAP)
- Chair of ATCM subcommittee (DFA)
- Chair of CCAMLR subcommittee (DEAT MCM)
- Independent member from the business community.

**REC. 6.2:** The Panel recommends that the process for appointing the members and chair of the SA SCAR Committee is reviewed to ensure that it is appropriate, timely and transparent.

## **CHAPTER 7: FUNDING AND HUMAN RESOURCES**

**REC. 7. 1:** The Panel recommends that a costed Business Plan for a three year cycle for D:A&I is publicly available to allow a continuing oversight of the cost effectiveness of logistics operations.

**REC. 7.2 :** The Panel recommends that efforts are made by NRF to encourage more applications from young researchers.

**REC. 7.3:** The Panel notes that some South African Antarctic scientists have been extraordinarily successful in attracting funding from abroad and recommends that they should be encouraged to continue to do so.

**REC. 7.4:** The Panel recommends that a package is designed to attract students to the programme and is promoted initially by the established grant holders.

## **CHAPTER 8: EDUCATION, OUTREACH & EMPOWERMENT**

**REC. 8.1:**The panel recommends that the Directorate : Antarctica and Islands continues to pursue empowerment of the previously disadvantaged communities through the goals set by the Employment Equity Plan and the Promotion of Sustainable Broad Based Black Economic Empowerment.

**REC. 8.2:** The Panel recommends that the Chief Directorate: Research, Antarctica and Islands revisits their Learner, Bursary and Internship program as well as the Budget and investigates the extent to which an extended program could be utilised to attain the goals of promoting Science and Technology, Empowerment and BEE.

**REC. 8.3:** The Panel recommends, given the overall international status of SANAP, that the stakeholders in government, research institutions and the universities undertake a joint and concerted outreach campaign to the public and especially to learners, to promote the attractions of a career in science, with a special emphasis on Antarctica and the Southern Ocean.

## **CHAPTER 9: INTERNATIONAL RELATIONS**

**REC. 9.1:** The Panel recommends marketing SANAE and the research station on Marion Island vigorously as an unconventional, but stimulating venue to other African nations to introduce them to Antarctic research and science, and to educate and motivate a new decisive generation of African natural science researchers.

**Rec. 9.2:** The Panel recommends that South Africa holds discussions within the Southern African Development Community and the African Union to establish the extent of the need in the Southern African region and in Africa for collaborative research projects and training programmes associated with Antarctica and the Southern Ocean.

## **CHAPTER 10: ANTARCTIC TREATY SYSTEM**

**REC. 10.1:** The Panel recommends:

- that the Head of the ATCM delegation is always from Department of Foreign Affairs,
- that the National Operator is always part of the delegation
- that the CEP delegation is lead either by a senior scientist or by an environmental officer
- that continuity of membership in the delegation will strengthen the South African position by accruing experience
- that DFA consults with both the science community and SANAP to determine what papers will be commissioned for submission each year.

**REC. 10.2:** The Panel recommends that the CCAMLR Commissioner consults with the scientific community to ensure that appropriate South African scientists are able to contribute to the development of bioregionalisation techniques, fisheries developments and the criteria for the selection and management of marine protected areas in the Southern Ocean.

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

## **PREFACE**

Antarctic ships typically have an operating life of 30-35 years before it becomes impossible to maintain them effectively and keep them in their Lloyds class. Recognising that the *SA Agulhas* was approaching this period SANAP made an application to Treasury for capital funds in 2004 to pay for a replacement ship. They were asked to undertake an assessment of how this could be achieved under a Public Private Partnership (PPP) agreement and this project was undertaken with PricewaterhouseCoopers as Transactions Advisors in 2005-6. Although they advised government in 2006 that a PPP was feasible, DEAT could not accept this recommendation, as the annual cost was too high, the fuel price risk and the foreign exchange risks would both be retained by DEAT. Despite the rejection of the PPP approach the exercise generated valuable information on functional needs and alternative solutions. On reporting to Treasury and repeating the request for capital funds the Treasury response was to request an independent international review of the SANAP programme, an assessment of its future and the role that the ship would play in this before discussing the application for funds. The application for funds is now postponed until the outcome of this review is known.

The responsible government body, the Department of Environmental Affairs and Tourism (DEAT), contracted the National Research Foundation (NRF) to manage the review for them. The review was undertaken by Professor DWH Walton (British Antarctic Survey, UK), Professor J Thiede (Alfred Wegener Institute, Germany) and Mr AL Manley (Department of Foreign Affairs), with some assistance from Judge AJ Hoffmann (International Tribunal for the Law of the Sea, Germany). Mrs S Naidoo was the NRF Evaluation Officer who made all the arrangements for the Panel.

The Review Panel met in Cape Town 30 July – 1 August 2007 and then moved to Pretoria for the period 2 – 10 August 2007. Professor Walton (convenor) was present throughout the period whilst Professor Thiede was present from 1 August 2007 onwards. Mr Manley stood in for the duration of the review for Judge Hoffmann who was called away to Hamburg and was only able to join the Panel on 8 August 2007.

The Panel were provided with a major Commissioned Report written by Professor SL Chown and Dr JH de Beer (which was of great value in framing the key questions) and a range of government documents including the report of the last panel to review SANAP. In addition they were able to talk to three groups of university stakeholders, the Directors-General and senior staff from DEAT and DST, the Director of Directorate: Antarctica and Islands, as well as staff from other government departments and agencies, and members of Parliament. They were able to visit the *SA Agulhas* and discuss the ship with the Master and staff from Smit Amandla Marine (Pty) Ltd who currently manage the vessel under contract.

This report and its recommendations represent the consensus views of the Panel. A presentation of its principal recommendations was given to senior staff from NRF, DEAT and DST on 8 August 2007.

## **ACKNOWLEDGEMENTS**

The Review Panel is grateful to many people for providing their time and thoughts on how SANAP functions and how it can be improved. We are especially grateful to Mrs Saloshana Naidoo of the NRF for the effort she put into organising the review. The NRF hosted the Panel very well and responded quickly to all our requests.

We are grateful to Dr P Dastidaar for his analyses of the South African publication record.

The Panel is grateful for the candid approach of many interviewees and appreciate their enthusiasm in helping to promote change and development.

## 1. INTRODUCTION

### Scientific Research

South Africa has a long history of Antarctic research, stretching back to the annexation of the Prince Edward Islands (PEI) in 1947, the International Geophysical Year (IGY) of 1957/8, and the signing of the Antarctic Treaty in 1959. The themes of past Antarctic research have varied substantially, with the emphasis on different disciplines varying between atmospheric physics, geology, physical oceanography, and both terrestrial and marine biology. South Africa has never had a strong glaciology or ice-coring programme, though some of its scientists have been and continue to be involved in the investigation of periglacial processes and the biological impacts of past glaciations. Even within particular programmes, distinct phases of research can be identified. Thus, Smith (1991) identified four phases in the terrestrial biological programme at the PEI: the reconnaissance, whole ecosystems, national priorities, and climate change phases, with the latter becoming more interdisciplinary in the last decade.

All of the early work took place within the political context of an increasingly beleaguered national science system, suffering from the consequences of the policies of an apartheid state. This political context had far reaching consequences for the science system and for the South African National Antarctic Programme (SANAP). The change in government in 1994 resulted, *inter alia*, in the visionary establishment of a Department of Science and Technology (DST), a portfolio previously missing from formal government Department structures. The DST showed all the vigour of a youthful department, and by 2002 had published, after careful research, a National Research and Development Strategy (Anonymous 2002). This strategy recognized that without the development of human resources, and especially from the previously disadvantaged groups (virtually everyone except the white males already over-represented in the science system), South Africa would not be in a position to reap the benefits of a competitive, innovative national science, engineering and technology system.. The R&D strategy also emphasized that a wide variety of innovative interventions would be required not only to develop these human resources, but also to ensure that research and development benefited all South Africans. ‘Antarctic, Islands and Ocean’ was recognized as a key science focus area that can be used to attract learners into science and technology, and that is of strategic significance because of the country’s key geographical advantage in the Antarctic, being the only African country participating in research in the region .

On this basis, on the basis of South Africa’s recognition of the political and environmental significance of the Antarctic region, and in consultation with its partners within the SANAP, the DST then developed an Antarctic Research Strategy for South Africa (ARESSA) published early in 2007. ARESSA research themes redefine numerous individual research projects supported under SANAP into a common strategy which allows to link up to the large scale international strategic research programmes which have been defined under the Scientific Committee for Antarctic Research (SCAR) and which are vigorously pursued during the ongoing International Polar Year (IPY).

The ARESSA is firmly rooted in the South African National R&D Strategy, the global recognition that an understanding of environmental variability is essential to ensure equality of life via sustainable interactions with the earth system that supports human existence, and widespread acceptance of the fact that the Antarctic and the Southern Oceans present a unique opportunity for investigating this variability, and in many case shightly significant drivers of

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

the variation. The ARESSA also seeks to broaden the participation of the social sciences and humanities in research in the region. In keeping with South Africa's strengths in the geosciences, physical sciences and lifesciences, the ARESSA includes three key research themes that are structured around variability in these systems on a variety of spatial and temporal scales. A fourth theme explores the requirements for and consequences of a suitably engineered and sustainable presence in the Antarctic, and the fifth theme is concerned with knowledge about the Antarctic from outside the science disciplines.

### **National policies and priorities**

South Africa has been steadily revising and renewing its policy and governance objectives since 1994. These objectives are intended to transform the opportunities for its citizens, enhance its global competitiveness, strengthen its position on the world stage and allow it to provide assistance and leadership to its fellow African countries. Many of these policies are general and underpin all government activities and so need to be recognised as drivers for change in the context of South Africa's role in Antarctica.

Black economic empowerment (BEE) requires all employers to move towards an increasing percentage of employees from the disadvantaged black and female groups. Thus, affirmative action to attract these groups into higher education, into a wide range of jobs and into entrepreneurial roles, needs to be part of the planning for SANAP as for everyone else.

The concept of the National System of Innovation was developed as part of the White Paper on Science and Technology in 1996. It aims to develop a culture within which the advancement of knowledge is valued as an important component of national development. In particular the resources and information from engineering and the natural sciences, amongst others, are used for problem solving, policy development and decision making.

### **National Policy Making and Management**

The Department of Environmental Affairs and Tourism (DEAT) is the parent department for SANAP, which sits in the Directorate: Antarctica & Islands (D:A&I) of the Marine and

Coastal Management Programme (MCM). However, its science functions are vested in the Department of Science and Technology (DST) who use the National Research Foundation (NRF) to manage the annual grants programme. All government funded science and technology institutions must demonstrate human resource development, increasing performance and generally the potential to generate income in its widest sense.

The primary Antarctic objective in the DEAT Strategic Plan is to "Maintain a strategic South African presence in Antarctica". Within the D:A&I Business Plan there are a wide range of individual objectives which are not all logistic although many do deal with the redevelopment of Marion Station, replacement of the *S.A. Agulhas*, operational logistics, investigation of a runway at SANAE IV, promotion of the Cape Town Gateway, etc. There are also several elements in the Plan which seem to be more directly about science and thus should be in the DST Plan.

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

The present review of the future of Antarctic and marine research in South Africa is therefore of crucial importance. There is no question that the portfolio of scientific disciplines present at South African institutions of research and higher education has to be broad enough to satisfy the needs of ongoing and future programs such as ARESSA, that they have to have enough critical mass to produce high quality results, and that infrastructure as a base for these activities has to be constantly renewed, updated or even newly developed.

The research topics discussed in the review are of national (many also of international or global) importance and they provide an important frame for a sustainable development of the nation in many aspects of its livelihood.

## **2. TERMS OF REFERENCE**

The complete terms of reference as communicated to the Review Panel are listed in the Appendices. Strangely enough, the replacement of *SA Agulhas* was not specifically emphasised in the ToR and the Review Panel found there to be some redundancy in the elements described, interpreting the document as requiring a focus on the following issues:

- the Panel was to assess past performances in
  - ecological and other scientific contributions and their scientific quality;
  - value of international collaborations;
  - value and quality of the research output as determined through peer review and international benchmarking;
- the Panel was to assess for the future (approximately. one decade ahead)
  - scientific plans, targets and priorities of South African research programmes or strategies;
  - options for international partnerships;
  - potential value of such research in terms of strategic considerations;
- finally the Panel was expected to evaluate
  - the content and potential impact of current science plans and future strategies (such as ARESSA);
  - current and future strategies for international collaborations, and
  - the future sustainability of the programme.

The documents which were formally provided to the Review Panel have been listed in Appendix 4. In addition the Review Panel has been given formal or informal access to a number of documents addressing partial or various aspects of the evidence needed to compile this report. Where data were lacking we have still been able, for the most part, to develop conclusions and recommendations from available documents and from a long series of personal interviews conducted in August 2007 in Cape Town and Pretoria. The only major piece of evidence missing (as spelled out in the ToR) was a strategic plan for future international collaborations.



### **3. ANTARCTIC, MARINE AND ATMOSPHERIC SCIENCES**

#### **Introduction**

The geographical position of South Africa, its long term interest in the Prince Edward Islands and the Antarctic, and the proximity of the South Atlantic, Indian and Southern oceans, are major potential drivers for its scientific research. With a rapidly growing economy, and a need not only to be innovative in science and technology but also to use science as an element of policy making in many spheres, the South African Government has given considerable attention to growing its science capabilities. The production in 1996 of the White Paper on Science and Technology “Preparing for the 21<sup>st</sup> century” has been followed by the publication of South Africa’s first National Research and Development Strategy in August 2002.

Antarctica and its surrounding ocean are now recognised as key elements in Earth System Science, the holistic approach to investigating the integration of global processes which produce a dynamic and complex Earth. The current climate change models need significant scientific inputs from the Antarctic continent as well as from surrounding ocean areas in order to allow refinement of their grid size and an improvement in their predictions. Southern Hemisphere nations have a major role to play in this, not least because the present predictions of the Global Change Models for areas such as Southern Africa are alarming.

It is already clear how science on the PEI underpins both good management and national sovereignty. The South African Government has seen over the past 50 years how a strong science base enhances the status of any Party in the Antarctic Treaty System (ATS), and also secures its continuing role as a Consultative Party. With an experienced and diverse community of Antarctic scientists it has recognised the need to develop both a clear future strategy for its science, and an educational and training initiative to consolidate this expertise for the future. One of the reasons for drawing attention to the Antarctic in the National Research and Development Strategy was its potential for attracting school leavers and university students to a career in science where the science is allied with a unique life experience.

#### **Conclusions on Science in 2000 Review**

A review of SANAP was undertaken in 2000 as part of the extensive review of all parts of the Public Service to assess their effectiveness and future role in the structures of government. Its Terms of Reference were broad but focussed on the future of SANAP, where it should be sited with respect to the structure of the Public Service, its potential for agentisation, and the most appropriate site for all South Africa’s Antarctic activities. It was conducted by a team of four, two members of which were from overseas.

The present Review Panel felt it was essential to consider the conclusions of this earlier review and the extent to which its recommendations had been actioned.

2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)

The primary findings of the 2000 Review can be summarised as follows:

- *Research was internationally acceptable*
- *Science community was enthusiastic*
- *Some researchers were ranked amongst the best in their fields*
- *Antarctica provided an excellent training for young scientists in areas and disciplines of direct relevance to SA economic future*
- *Lack of money hampered research*
- *Insufficient capacity building in younger researchers*
- *Logistics dominated SANAP to the detriment of science*
- *Insufficient attention had been paid to stimulating multidisciplinary programmes*
- *Research management system was inadequate with no science*
- *Co-ordinator in SANAP to manage the development of science policy*
- *Inadequate exploitation of global linkages*
- *An emphasis on “bottom up” approach to science initiatives might leave national objectives unaddressed*
- *There was a lack of coherent and comprehensive Antarctic national policy and strategy.*

The Recommendations proposed that:

1. *South Africa should continue to support a national Antarctic entity.*
2. *South Africa should develop a comprehensive national policy and strategy for Antarctic and the Southern Ocean.*
3. **That D:A&I (SANAP) be moved out of DEAT, made a statutory body with its own management Board and sited in Cape Town (our emphasis).**
4. *The body should develop, manage and execute the scientific research strategy, provide logistical support and develop outreach programmes.*
5. *The possibility of enhanced air access to Antarctic should be investigated.*
6. *The potential for establishing an Antarctic experience and education centre in Cape Town linked to the Gateway concept should be investigated.*

All of these recommendations were meant to simplify and clarify management, and make it more efficient and effective in order to deliver more and better science. Recommendations 1, 5 and 6 have been actioned, whilst parts of 4 are still being satisfactorily taken forward by DEAT. The major issue of making SANAP a National Facility outside DEAT was modified with the transfer of science to DST but SANAP being left in DEAT. This has added a further layer of complexity to management. Recommendation 2 has been partly met by the DST ARESSA strategy but this is far from a comprehensive national policy and strategy.

## Current Review of Science Outputs

Various approaches were used to assess science output including the analysis by number with discipline, the analysis by quality using citation indices as a proxy, and an assessment of leading scientists against their peers elsewhere in the world. In addition there was an attempt to assess the degree of international collaboration as measured both from the historical publications and from known existing links.

### Quantity by Discipline

The Commissioned Review covered the period 1998-2007 and listed 426 peer reviewed publications. The disciplinary breakdown shows biology + biological oceanography 73%, physics 13%, physical oceanography 7%, geology 6% and engineering 1%. Grouping all oceanography together gives c. 26%. All the top five publishing authors are biologists with mean annual publication rates of between 7.5 and 3.3 papers. Of the total 75% were in international journals and 25% in local journals. The lack of publications from geology and oceanography may be linked to a cessation of field work by geologists and a decrease in ship availability for oceanography. The low number of publications in physics is worrying in the light of the costs of supporting this type of research.

**REC. 3.1 :The Panel concludes that the total science output is very satisfactory, given the size of the community. It recommends however, that the major disparity between biology and all other sciences be addressed by SANAP in order to ensure a healthy distribution of Antarctic research disciplines.**

### Quality by discipline

The list of all publications demonstrated that a wide range of ISI journals were used, ranging from *Science* and *Nature* to local South African journals. Many of the journals are highly rated within their fields –e.g *Geophysical Research Letters*, *Global Change Biology*, *TREE*, *Molecular Ecology*, *Journal of Geophysical Research*. In terms of mean Impact Factors for the SANAP publications 1998-2007 physics was highest at 1.88 with biology close behind at 1.85, physical oceanography at 1.38 and geology only 1.21.

In a different approach an analysis of contributions to Antarctic science by Dastidaar & Persson (2005) used ISI data from 1980 to 2003 to rank countries by citations. This was an incomplete listing of all the relevant papers but on the 256 papers attributed to South Africa it ranked 11<sup>th</sup> in productivity, ahead of Argentina, Chile and South Korea as well as the Netherlands and all the Nordic countries. In the citation analysis it showed a negative result with more citations given than received.

**REC. 3.2: The Panel concludes that much of the output of South African Antarctic science, in all disciplines, has been globally competitive and recommends that all efforts are made to maintain this position.**

#### **Quality by Key Researchers**

The previous review concluded, from anecdotal comments, that South African scientists were amongst the leaders in some fields but were not able to substantiate that numerically. In order to gain some objective assessment of this a comparison was made between 12 selected SA researchers and ten well known researchers from USA, Germany, UK and France using the *h*-index (Hirsch 2005, Kelly & Jennions 2006). This index is defined as the maximum number of papers *h* by a scientist where each paper has received *h* or more citations. This approach shows a range of 36-10 for the foreign researchers compared with 28-9 for South Africans.

**REC. 3.3: The Panel concludes that, on the basis of this limited survey, the best South African researchers in biology, oceanography and physics do indeed appear globally competitive.**

#### **Relevance and Impact**

One of the most important elements of any assessment is to consider the relevance and impact of the science supported. In the Commissioned Report the authors provided a detailed assessment of the relevance of much of the biology by setting its contribution against the conclusions of the Millenium Ecosystem Assessment (2005). In this example four major drivers of biodiversity loss were identified and the contribution to understanding of each was examined in the light of South African research. The four drivers are : Climate Change, Invasive Species, Over-exploitation, and Pollution.

A combined approach of sophisticated land-based work on pelagic predators and ship-based oceanography has provided insight into the direct and indirect effects of climate change in the sub-Antarctic, allowing population trends to be explained, decisions taken about Marine Protected Areas (MPA) and predictions made about community structure and invasion. Some of the most detailed studies of invasive species on island ecosystems have been undertaken by SANAP scientists, informing conservation policy and decisions as well as contributing to the theoretical development of invasion biology. A better understanding of oceanography and foraging has helped inform interpretation data on exploited species in the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) context, whilst work on eutrophication has provided new insights into the relationships between abundance and species richness. It would appear that similar arguments can be made for the key contributions from physics and oceanography.

**REC. 3.4: The Panel concludes that, whilst all of these subjects have been derived from bottom-up proposals, they have proven to be relevant to the development of their disciplines and to wider policy issues.**

**REC. 3.5:** The Panel recommends that in the future the development of thematic programmes should focus on cross-disciplinary collaboration. A modest attempt to stimulate this has been undertaken through the formulation of ARESSA, but this needs further work.

### Evidence for International Networks

Measuring the extent and effectiveness of international networks in any field of science is difficult. In Dastidaar & Persson (2005) there is an analysis of multinational collaboration, using the authors' addresses on the papers as proxies for the network. The overall collaboration map which they then generated demonstrates a strong central core of countries deeply involved in multinational projects (UK, USA, France, Australia, Germany, France) with other countries more peripherally involved. A new analysis of the data set for the Panel by Dastidaar (Fig 1) with South Africa in the centre shows strong indications of activity with the UK and USA but less with other countries. His dataset extends only to early 2004. A preliminary analysis of the publication list shows, for more recent publications, continuing collaborations with a wide range of SCAR countries including UK, USA, France, Germany, Canada, Netherlands, Australia, Norway, and New Zealand.

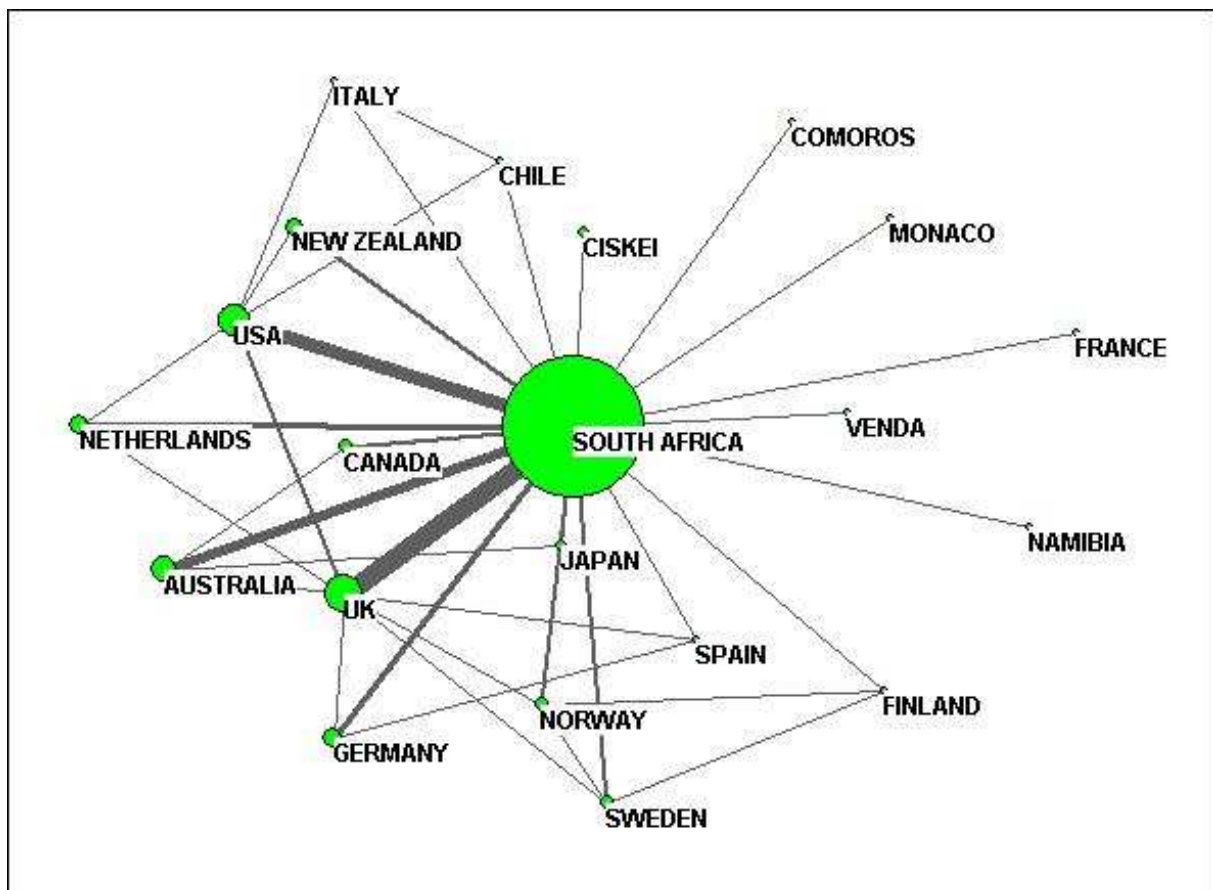


Fig 1. International relationships determined from South African science publications 1980-2004 (Courtesy of P. Dastidaar).

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

The terrestrial biologists were active members of the SCAR RiSC programme and have now aligned most of their research with the new programme Evolution and Biodiversity in the Antarctic. The leadership of the new IPY programme „Aliens in Antarctica“ is with South Africa which is developing a new network that runs outside the normal academic limits to include the Council of Managers of National Antarctic Programs (COMNAP) and the International Association of Antarctic Tour Operators (IAATO). The physics group from KZN are still an important part of the Super-DARN SHARE radar programme with strong links to the other countries involved (Japan, USA, UK, France, Australia, Canada). The Panel recognises that this is not a complete list but is indicative of the interest in international links.

Leading South African Antarctic scientists currently occupy important roles internationally (S.L. Chown - Chair of SCAR ATS Standing Committee, A.D.M. Walker - recently retired as SCAR Vice-President, DG Miller - Executive Secretary of CCAMLR) and there may be others.

**REC. 3.6: The Panel concludes that the South African Antarctic science community now shows good evidence of strong international links and is adequately represented in senior roles in international organisations.**

### **Economic and Human Resource Implications for Science**

At present SANAP still operates from within the government departmental system, precluding any direct benefit from any income generation. Under Recommendation 5.17 SANAP would be reconstituted as the SANAP Research and Logistics Centre National Facility which would make it possible for any income to be retained.

The science proposed for SANAP has a range of important economic implications and will provide a sound basis for policy development. Thus, studies on climate change help with improving model predictions, studies on invasive species provide methodologies for alien controls and biodiversity protection, whilst a better understanding of the Southern Ocean helps in managing fish stocks sustainably. Most of the science at present seems unlikely to have direct exploitable benefits. We propose an investigation of sustainable power systems for Marion and we see a yet uninvestigated potential for bioprospecting that may yield useful economic spin offs.

### **Future Science Objectives**

#### **Science Strategy as defined by ARESSA**

Published in 2007 by DST the “Antarctic Research Strategy for South Africa” is a major step forward in defining national needs for the future, within the frame of large interdisciplinary and coordinated research themes. It begins by stating the Mission, Vision and Strategic Objectives of the science programme. Whilst it is clear that these incorporate many of the objectives set by government in other documents they lack some key statements about science quality, value for money, leadership, etc. that the Panel expected to find there, but it is considered a first and very important step in the right direction.

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

ARESSA devotes 75% of its pages to a summary of previous and present research by SANAP, which, for a document supposedly focussed on the future, appears strange. Only the last five pages are devoted to future research where the proposed five research themes are briefly described. There is no indication in any of them of any essential infrastructure developments required, they are all described as of equal weight and importance, there is no indication of links to existing or proposed international programmes and there is no linkage to ATS requirements. The language of the document is at present at an academic science level but it could be made more suitable for more general use to interest a wider public in the proposed science if it were simplified. The Panel regards the document as a useful first step but it falls significantly short of what is needed to re-vitalise SANAP and exploit its research potential.

**REC. 3.7: The Panel recommends that the ARESSA document should be revised, with a Mission and Vision that recognise science quality and cost effectiveness as well as the value of international links, substantially shortened and simplified to enable a wider audience to read it, with the research themes clearly linked to national and international objectives, and a recognition of ATS requirements.**

#### **Scientific Disciplines at Research Institutions**

There is no question that the portfolio of scientific disciplines present at South African institutions of research and higher education has to be both broad enough to satisfy the needs of ongoing and future programs such as ARESSA. They also have to have enough critical mass to produce high quality results. From the documentation provided it was clear that biology and some other scientific disciplines were exceptionally strong, but it was also clear that some other disciplines has been declining over the years (for example oceanography because of the lack of sufficient ship time; or geosciences from SANAP possibly because of the failure of the Convention for the Regulation of Antarctic Mineral Resource Activities [CRAMRA]) or that some had disappeared almost completely from the portfolio of South African research institutions (for example marine geosciences – both geology and geophysics; marine chemistry; glaciology).

At present there is a wide spread of grant holders across most but not all South African universities. Each individual scientist or group is pursuing their own field of interest and there appears to have been little interest so far in bringing much of this research together in an Earth Systems Science approach as has been done successfully in other countries.

**REC. 3.8: The Panel recommends that the new scientific leadership of SANAP should undertake a careful review of which disciplines are needed for a modern systems approach to Antarctic and Southern Ocean science.**

**REC. 3.9: The Panel recommends that, for geosciences research, a decadal research perspective is developed in an attempt to relate new data from the African mainland to relevant geological provinces in Antarctica.**

**REC. 3.10: The Panel recommends that marine geosciences (both marine geology and geophysics) which were once an important research discipline in South Africa, but have since dwindled away are urgently needed to study the properties of the continental margins and contribute to the body of scientific data and expertise needed to define the continental margins around the South African mainland and the Prince Edward Islands**

### **Data management**

As in many national systems where the researchers sit within higher education there has been little consideration of the value of data from the programme. The onus has rested on individual researchers or on sponsoring organisations, like SAWS, to manage, curate and archive data as they saw fit. The Panel found no evidence in the documents provided that government had addressed this problem at the highest level but the establishment of South African Environmental Observing Network (SAEON) at Grahamstown by NRF was a major practical step forward. In several instances researchers complained bitterly about the state of affairs with respect to the accessibility of important data sets. The development of this new facility would appear to allow proper curation and archiving of at least the publicly funded data on climate change. The establishment of its network of sites at which routine long term data will be collected is also important and the Panel believed that this should include at least Marion Island.

**REC. 3.11: The Panel recommends that Marion Island should be considered as a part of the SAEON network for measuring global change. In addition, the development of this new facility would appear to allow proper curation and archiving of other publicly funded data on climate change.**

For many years SCAR has been trying to ensure the availability and interchange of data from all Antarctic programmes. Jointly with COMNAP they established Joint Committee on Antarctic Data Management (JCADM) as an organising committee to seek the establishment of National Antarctic Data Centres which both held their own data and were a portal through which metadata could be provided to the Antarctic Master Directory hosted on the Global Change Master Directory (GCMD) in the USA. South Africa does not appear to have established such a nominated data centre although the Panel recognised that for some programmes – like Super-DARN – there were already well defined data management systems.

**REC. 3.12: The Panel recommends that the availability of all South African Antarctic data and its management is reviewed and that a National Antarctic Data Centre is nominated to provide advice on quality control and availability. Metadata need to be generated for the major data sets and stored on Global Climate Monitoring Data (GCMD).**



**REC. 3.13: The Panel recognises the importance of long term monitoring and recommends that the South African contributions to present and future global atmospheric, marine and terrestrial monitoring programs which cover an important segment of the Southern Hemisphere should be continued and further developed. It further recommends that all monitoring should be listed and the value of the data sets subject to peer review.**

### **Future development of South African Antarctic science**

With the existing stations finally redeveloped and a replacement marine platform to support marine research and oceanography South Africa will have the Antarctic infrastructure to support a broadly based science programme for the next 20 years. The proposed re-organisation of the governance will allow a much better linkage between science objectives and logistics whilst the establishment of a new Institute of Antarctic Earth System Science (see Chapter 5) will give academic impetus to the whole of the research portfolio.

The Panel believes that the future science programme should focus on re-building some areas of past expertise, enhance the opportunities for education and training, recognise data and survey as a continuing element in the programme, strengthen existing networks with meetings and workshops in South Africa, and look for innovative ways of applying the science outcomes to policy development and, where practical, economic achievements.

**REC. 3.14: The Panel recommends that oceanography expertise is rebuilt, that geoscience is drawn back into the programme, that data management is placed on a firm and continuing basis, that cross-disciplinary programmes are encouraged and that, where ever possible and appropriate, South African programmes integrate themselves into the major international initiatives.**

The future sustainability of the programme relies on the continuing interest and enthusiasm of the scientific community as well as on the effective management of the supporting logistics and infrastructure. The Panel believes that there is every indication that the disciplinary range and size of the present community is now poised to grow, that its contribution to education, empowerment and policy making will increase and that the proposed facilities and new governance structures will make it more effective and underpin South African leadership in several different ways.

#### 4. RESOURCE MANAGEMENT & INNOVATIVE TECHNOLOGIES

This chapter is incomplete because of insufficient information on the subject and because non-living resources cannot be exploited in the Antarctic Treaty area. Hence, commercially oriented activities are not well developed under the framework of SANAP and many of the open ocean marine research activities originating from South Africa are not easily evaluated for their economic perspectives. There may be substantial activities under the auspices of DEAT's MCM which would not be in the remit of the Panel's review.

**REC. 4.1: The Panel recommends that the important contributions of South African scientists to the scientific investigations and monitoring programmes as contributions to CCAMLR should be further increased. This should include a careful assessment of any changes occurring in the intended MPA at Marion Island.**

It is clear, however, that many routine monitoring programmes conducted by the South African Weather Service (SAWS), MCM and other relevant South African institutions are indispensable for weather and sea state forecasting (short time scales), of direct importance and commercial value for South African (and international) shipping companies, airlines and other means of commercial transport. South Africa has a very extensive responsibility for the Safety of Life at Sea (SOLAS) area around southern Africa. Over longer time scales South African monitoring stations (in Antarctica, on the sub-Antarctic islands, on the African mainland and through contributions to Global Oceanographic Observing System (GOOS)) provide or will provide long time series from poorly documented regions of the world, which will be very important in evaluating the impact of real time global change in this part of the Southern Hemisphere, as well as at the same time completing the relevant global data sets.

The MPA around PEI provides important baseline data about changes in the marine ecosystems which may occur because of global change or because of the exploitation of living resources. Besides the meteorological station, which had been established earlier, biologists have been studying birds and seals on Marion Island since October 1951. The Biological Sciences Programme started on Marion Island in 1965. On the basis of the high quality of South African research and information on marine resources over many years, it has built up a significant reputation in a number of international organizations associated with Antarctica and the Southern Ocean, including CCAMLR. In the future a commercial fishery for King Crabs may develop in the PEI region, and continued monitoring of the marine biota in a wide region around the MPA is therefore required.

The South African National Environmental Management Act, together with Acts relating to Protected Areas and Biological Biodiversity, are applicable to PEI. Special attention is paid to the impact of invasive species, both on the islands and potentially also in the surrounding marine areas. A new Environmental Management Plan for the islands has been developed and approved in terms of this legislation and needs to be implemented. South Africa has designed an effective MPA for PEI which has yet to be promulgated. In recent years, however, there has been a noticeable drop in South Africa's contribution to the Scientific Committee of CCAMLR, despite a considerable increase in funding made available by the Department of Science and Technology (DST) for research.

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

**REC. 4.2: The Panel recommends that South Africa prioritises the formal proclamation of a MPA around the Prince Edward Islands and proceeds with the implementation of the conservation and management plan for the islands as soon as possible.**

South Africa has a long tradition in exploiting living marine resources, both in the coastal, near-shore and shelf regions of the African mainland and of its sub-Antarctic islands, and substantial efforts related to fisheries and stock assessments are being carried out by MCM of DEAT, employing to a large degree its own fleet of research vessels. In addition SANAP scientists have contributed to assessments of exploitable stocks of the Southern Ocean. This work must be continued to avoid further disasters such as the overexploitation of the Patagonian Toothfish (which may also have other reasons) and careful thought has to be given to a sustainable exploitation of marine living resources.

The biological disciplines comprise some of the largest and the most productive research groups in SANAP. This convinces the Review Panel that young scientists can be recruited in sufficient numbers and with the right balance of previously underprivileged groups. However, success in such marine monitoring programmes requires substantial time on sophisticated ships, in order to collect the complete suite of essential parameters. Based on their experience South African biologists under the framework of SANAP should continue to be involved in assessing how the sustainable use of living marine resources can be achieved, and they should increase their efforts to provide advice to CCAMLR. This will require them also to separate the effects of exploitation from ecosystem changes due climate change, and apply this to regions outside the areas which are considered by CCAMLR.

**REC. 4.3: Given the expectation that krill will shortly become a major fishery and could be a new development for the South African fishing industry, the Panel recommends that South African marine biologists should become more involved in assessing how the sustainable use of living marine resources can be achieved, and they should increase their efforts to provide advice to CCAMLR. This would also require research to separate the effects on stocks of exploitation from ecosystem changes due climate change.**

Aquaculture is in its infancy in and around South Africa, despite its varied and extensive coastal waters. It may hold substantial potential for commercial activities and new jobs which should be carefully evaluated by relevant specialists. The current Review Panel has seen this potential but lacks the needed expertise or even data and therefore refrains from recommendations.

Pollution phenomena have been studied for many years in localized areas in Antarctica and in the Southern Ocean because they could be linked immediately to anthropogenic impacts on natural systems. At least on a local scale, eutrophication is also driven by nutrient run-off from large concentrations of sea birds and seals at breeding colonies. More recently, human-generated fertilisation experiments have been carried out on small to intermediate scales in the open Southern Ocean, in attempts to stimulate biological production and hence to contribute to our understanding of processes controlling carbon fixation in the ocean and carbon dioxide sequestration. Such studies require substantial insight into biogeochemical processes and they

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

may be of great commercial importance in the future as climate change in real time gains in importance.

**REC. 4.4: The Panel notes that South African research groups specialized in the field of marine biogeochemistry are active and productive and recommends that their efforts should be further encouraged under the auspices of SANAP.**

Marine living resources have to be studied intensively for their biodiversity and standing stocks to allow for sustainable exploitation. However, marine pelagic and benthic biota may also carry a great potential for the production of „natural substances“ (bioprospecting) and „bionic“ applications, approaches which are extensively exploited by other nations but have yet to catch the attention of the South African scientific community. The oceans around South Africa extend from tropical to Antarctic (polar) latitudes and therefore a large number of potentially promising organisms are available for investigation. A careful examination of marine faunas and floras for their potential of possibly beneficial natural substances in the ocean basins around South Africa should be undertaken by a group of specialists in order that other nations do not harvest the riches of the South African seas alone.

**REC. 4.5: The Panel recommends that a careful examination of marine faunas and floras for their potential of possibly beneficial and commercially exploitable natural substances and properties in the ocean basins around South Africa should be undertaken by a group of specialists in order that other nations do not harvest the riches of the seas at the expense of South Africa.**

Energy for the stations under SANAP-control (SANAE, Marion and Gough islands) is supplied entirely through conventional production methods (diesel-powered generators), a reliable and stable mode of powering stations in remote locations. No attempts have been made to develop alternative and unconventional modes of sustainable energy production, with the aim of safeguarding the environment and to reduce the increasing costs of diesel. Even though these techniques are presently probably more expensive than conventional energy production, there seems to be a potential for the development of small to medium-sized alternative power supplies (for example fuel cells, etc.), which could then be deployed not only on SANAP-run stations, but in many remote locations throughout South Africa. If successful such a development would be of great commercial value.

**REC. 4.6: The Panel recommends the application and development of technologies for alternative, sustainable energy production for supplying the SANAP-run stations with alternative energy in addition to existing diesel-generators, which would fit well with carbon reduction initiatives and long term fuel saving.**

South Africa houses an increasingly ambitious satellite programme with the aim of acquiring remote sensing data and providing for modern communications. Scientific applications are being developed mainly through the co-operative efforts of university departments, public research institutions including the South African Council for Space Affairs and commercial companies such as SunSpace. Various missions are providing for maritime observation

2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)

systems (such as altimeters, optical and infrared imagers, etc.) and they provide essential data for coastal management, chlorophyll mapping, observations of 'red tides' and extreme weather forecasting, to name a few. These new technologies have yet to be introduced into SANAP.

**REC. 4.7: The Panel recommends that the Department of Science and Technology considers how best the South African satellite programme can be utilised to support scientific research in Antarctica and the Southern Ocean.**

## 5. INFRASTRUCTURE

An ambitious research program in the Antarctic and in the adjacent waters of the Southern Ocean as commented on above requires substantial expensive and technically sophisticated infrastructure to provide for scientifically productive, environmentally and physically safe working conditions. The South African SANAP over the years has successfully acquired a range of major research platforms which in part are globally unique and state of the art. They enable the South African research parties to conduct a wide range of scientific investigations in many polar and marine research disciplines. In part, however, they need renovation and/or replacement, as well as best-practice management. The main infrastructure assets are presently *S.A. Agulhas*, the SANAE-Station on Antarctica and the research station on Marion Island. A modest meteorological station on Gough Island will soon not be suitable for further use because of its poor condition. In general it has to be stated that SANAP and most other presently ongoing South African scientific activities in Antarctica, the Southern Ocean as

well as the SE Atlantic and SW Indian oceans will not be feasible without access to such infrastructure.

**In short “no ships, stations – no SANAP”.**

### **The ship *S.A. Agulhas***

The ice-strengthened *SA Agulhas* (6123 gross T, 112 m long, built in 1977/78) is presently the main means to provide logistic and scientific support to SANAP as far as logistic operations in Antarctica and on the sub-Antarctic islands (Marion and Gough islands) and oceanographic work between South Africa and Antarctica is concerned. She also provides logistic support to other activities such as those of SAWS, limited supply to Tristan da Cunha or activities for foreign partners of SANAP on a case by case basis. At times she may also provide berths for tourists to/from Antarctica.

The ship is now close to 30 years old and can only be kept in service for another approximately five years at maximum because of her classification and because of the rapidly increasing maintenance costs. In general, she has been providing excellent and stable logistic services to SANAP and its national as well as international partners, in particular after her

2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)

management and maintenance had been transferred to a private shipping company. Her scientific capabilities have always been very limited, as she provides only for limited deck space, few, but usable winches (which however have to be operated by unexperienced user guests financed through the participating scientific projects), bare laboratories of limited dimensions to be equipped with scientific instrumentation essentially to be provided by participating scientific institutions from outside SANAP.

Over the past years she has been deployed to sea for roughly 140-180 days/y, to say much less than her capacity because of insufficient funding. At present she is engaged in addition to her regular duties in supporting the building activities of the new Marion Island station, in part at the expense of research activities, but this will end in 2008 after the station has been completed. To a large degree she has and is fulfilling the purposes she has been originally been planned and built for, but dual purpose vessels are always compromises between competing user needs.

In this context it is noteworthy (but beyond the formal remit of this review) that *Algoa* and *Africana*, the other major research vessels of DEAT (dedicated to fisheries studies) are also close to 25-30 years old. Their use is controlled by MCM of DEAT, and they are said to be used for approximately up to 200 days/y (hence also underused because of financial constraints). They will have to be replaced shortly after S.A. *Agulhas*. The South African oceanographic research programmes have already suffered substantially over the past decade because of difficulties in the access to suitable ships. Hence, if *Agulhas*, *Algoa* and *Africana* are not replaced in a timely fashion, South African researchers will lose their abilities to initiate and conduct research in Antarctica, the Southern Ocean and the adjacent basins of the Atlantic and Indian oceans. Naturally, part of these needs could be covered through the shared use of foreign vessels or chartered tonnage.

**REC. 5.1: The Panel concludes that *Agulhas*, *Algoa* and *Africana* all have to be replaced in a timely fashion, and with South African ownership. Without modern and state-of-the-art research platforms South Africa would quickly lose its ability to support its own initiatives and its independence as an Antarctic and marine research nation in its own right. In addition, logistic services to Antarctica and to the Marion Island station require substantial transport capacities at a regular basis during the summer months.**

Options for the *Agulhas*-replacement:

1. Separate research and logistics (to be dealt with further below) purposes of *Agulhas* and plan for a powerful ice-strengthened dedicated research vessel (with excellent bad weather capabilities) to satisfy South African research needs (all marine disciplines) in the Southern Ocean as well as in the South Atlantic and Indian oceans. The new ship should be planned for and equipped with sophisticated instruments such as multi-swath echosounders from the beginning because any subsequent installation would be unnecessary costly. It should be explored if the combined needs for research ship-time from *Agulhas*, *Algoa* and *Africana* could not be served by this new vessel, thereby guaranteeing a modern research vessel used to complete capacity. A vessel of such unique capabilities does presently not exist in Southern Hemisphere countries and would catapult South Africa into a leading international role. It would also be an

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

important asset for South Africa to provide assistance/ cooperation in marine research and training to many African nations thereby firming up its position as the leading African nation in marine and Antarctic research.

Logistics of supplying SANAE and the island stations (needed only during the summer months): Explore the possibility to employ DROMSHIP (and DROMLAN, both are presently functioning at economically viable terms) to cover South African needs. DROMSHIP presently uses the chartered Russian vessel PAPANIN – technical details of the ship are known to Sam Oosthuizen of SANAP. If SANAP would offer to procure a better (newly built or chartered) logistics vessel to DROMSHIP to run out of Cape Town, a leading role to further develop DROMSHIP as an international organisation for the supply of all research stations in East Antarctica would fall on SANAP, thereby strengthening Cape Town's position as an important gateway to the South. Such a move would require substantial political support to establish binding and longlasting agreements between South Africa and interested nations (f. e. Scandinavian countries, Germany, Russia, India, Japan, etc.). The entire DROMSHIP-operation can probably be run as a commercial enterprise, linked to SANAP and its international partners through long-term charter.

2. Plan for a modern dual purpose vessel (logistics and research) much like the present *Agulhas* but with much improved research facilities. Details of the present plans for the replacement of *Agulhas* are described in Appendix 5 of the Commissioned Report for the 2007 Review of SANAP (compiled by S. L. Chown & J. H. de Beer). It cites as conclusion of the Project Team that the procurement of a purpose built, ice strengthened vessel, with helicopter, cargo, research and passenger facilities met the DEAT requirements with the lowest risk. The review panel is of the opinion that this is a viable, if not the optimal and most cost effective option.

**REC. 5.2: The Panel recommends to explore the option of separating the multi-purpose uses (research, supply logistics, passenger transport) of the replacement for the *Agulhas* to single-purpose vessels, namely a dedicated ice-strengthened, modern, state-of-the-art marine research vessel owned/managed by South Africa (deployable during all seasons) and an ice-strengthened cargo vessel (to be used during the summer months for SANAP logistics, with the potential for money-earning charter for other purposes during the remainder of the year).**

**REC. 5.3: The Panel recommends to explore the potential of this new research vessel to fulfil the combined research needs from SANAP and MCM to achieve an annual deployment of 300-320 days/y. This will be best done through a joint stakeholder ship time assessment and management panel with a 2-3 year planning horizon.**

**REC. 5.4: The Panel recommends to explore the possibilities of fulfilling the logistics needs of SANAP, of other South African research institutions with activities in Antarctica and on the sub-Antarctic islands, as well as of passenger transport (ecotourism) through buying space on DROMSHIP, through chartered tonnage or through another (South African or foreign, new or existing) ice-strengthened cargo vessel.**

**REC. 5.5: If solutions as suggested through REC. 5.2.-5.4 are not acceptable the Panel recommends that *Agulhas* be replaced by a similar hybrid vessel as already outlined in the Scoping Study for DEAT. The Panel is of the opinion that this is a viable option, but not the optimal or most cost-effective option and misses the opportunity for innovation. It would allow for the continuation of SANAP logistical and research activities, but would not provide the spring-board for both re-building the once well-established South African marine research community and assuming leadership in this research field.**

During the discussions with SANAP PI's concerns were raised about the availability of modern marine research instrumentation (with the exception of fisheries under the umbrella of MCM) as well as the degree of technical services/assistance and support on *Agulhas*. It was considered directly dangerous that the winches were operated at times by students, or by persons provided through the participating research projects without experience of operating heavy equipment at sea. In most instances such personell would belong to the crew of the ship. There was virtually no space/technical installations for improving the research potential of the existing research vessel with sophisticated lab containers for specific missions; it is an important improvement of the planned new vessel that provisions are planned for the installations of dedicated research containers.

**REC. 5.6: If the South African marine research community is to be rebuilt (in particular in oceanography, marine geology and geophysics, etc.), it will need access to a marine instrument pool to be administered by a suitable institution (?MCM). The Panel recommends the establishment of a marine instrument pool (with the necessary technical support) for all publicly funded research.**

**REC. 5.7: The Panel recommends that for safety reasons any research vessel used by SANAP for oceanographic or marine biology cruises must have suitably recruited, trained and experienced deck personnel for the handling of winches and heavy instruments during the cruises.**

## **The Stations**

As another key part of its infrastructure SANAP supports three stations in the sub-Antarctic and the Antarctic. Marion Station is on the South African territory of Marion Island whilst SANAE IV is at Vesleskarvet on the Antarctic continent. The third and smallest station is on the British territory of Gough Island, in the Tristan da Cunha group. It is the responsibility of SANAP to manage all the stations and provide the logistic support and over-wintering staff, whilst PWD owns the buildings and provide summer maintenance staff.

### **SANAE IV**

This is a large station built on a remote (inland) nunatak in Dronning Maud Land, primarily to support physics. It was constructed in 1997 and replaced SANAE III which was situated at the coast, originally built in 1962. The station was designed for a winter population of 20 and a summer population of 60. Sections can be shut down for the winter season to conserve fuel.



*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

The station was constructed to a high standard and the environmental impact assessment prior to building as well as the environmental management of the building itself were exemplary. Maintaining such a remote station will always be expensive and by and large South Africa has done an excellent job on this front. At the design stage it would appear that too many untested requirements for space were allowed to influence the design. The expected science users have not materialised and thus the station has suffered from under-utilisation since completion. Despite some attempts to find projects to take up the space, this continues.

The position of the station at the edge of a cliff makes the topography a challenge whilst the often poor weather adds further safety considerations. Last year a new recruit died in a skidoo accident. All this puts a premium on the safety culture and we have learnt from stakeholders that this is at present not satisfactory. The lack of any professionally trained field guides there and the reliance on the over-wintering party (whose competence may vary) providing all field training to new personnel suggests to us that further accidents are inevitable in such a challenging environment. The Panel has learned that a substantial programme to prepare newcomers to SANAE is already in place based on a substantial amount of documentation, but this does not seem to be enough.

**REC. 5.8: The Panel recommends that operations at SANAE be improved immediately. Safety at SANAE/ Qualifications and training of personnel working at SANAE: A rigorous, systematic program to train personnel (overwintering and visiting summer projects) for survival, station regulations for the SANAE area, environmental care and technical maintenance of the station has to be reinstated. An „emergency“ booklet with all relevant information has to be developed and the Station Commander has to exercise discipline on and around the station at all times.**

The re-supply to SANAE IV is taken from the ice edge to the station on sledges pulled by tractors. The increasing height of the shelf ice at the normal landing area has forced SANAP to consider unloading cargo and people at the German Neumayer station in future seasons and an overland route has been scouted. Although South Africa is not a founder member of the international DROMLAN air service from Cape Town in order to bring staff in earlier than through the (expensive) visits from the *SA Agulhas* seats have been bought on DROMLAN, with staff reaching SANAE via a feeder flight in a ski equipped aircraft landing on a snow runway just below the station. There is now a proposal for an investigation of the development of a South African runway at SANAE, which we have not been able to find any justification for nor for the purchase of any aircraft to use this facility.

**REC. 5.9: The Panel recommends that the runway at SANAE and purchase of aircraft (long range and feeder) is not pursued since DROMLAN provides a functioning air link. There was no proper justification given for the proposal either to establish a new runway at SANAE or to purchase airplanes. Substantial cost savings can be achieved.**

One major feature which attracted overall criticism was the poor state of the communications from SANAE. Not only does this at present make it impossible to return the radar data in real time (as is done by all other SHARE operators) but the lack of bandwidth makes it impossible to recommend the installation of any other real time experiments until a major upgrade has been undertaken. Although SANAP assured us this was already included in their Business

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

Plan its completion remains uncertain. The present limited communications has also had a morale withering effect of the scientists at the station.

**REC. 5.10: The Panel recommends the improvement of satellite communications to broad band standard at SANAE immediately to satisfy presently unfulfilled scientific needs and to allow for state-of-the-art communications with home institutions.**

### **Marion Island Station**

Marion Island, part of the Prince Edward Islands, is a strict nature reserve under new South African legislation. Thus tourism is banned and all activities must be subjected to environmental impact assessments before being agreed. The original station was established in the 1960s and rebuilt and refitted over the following decades. A complete redesign and rebuild is now in its final stages. This will provide one of the most modern research stations in the sub-Antarctic.

There have been some unfortunate problems with this new station. A error similar to that at SANAE appears to have occurred with the new Marion station in that summer capacity has been assumed to be approx.70, a figure that seems most unlikely to be reached not only because of the size of the biological community using the station but also because of the availability of ship berths. This may be alleviated in future if a greater number of ship calls are possible. In other parts of the world such stations are also used as a base for training on the graduate and post-graduate level; possibilities of organizing course work and lab exercises for trainees from South African and other countries on the Marion station should be explored.

**REC. 5.11: The Panel recommends that SANAE and Marion Island stations should both be marketed vigorously to both national and international users to ensure a high intensity of use for scientific research, and that this should also include the possibility of using Marion Island for training purposes.**

The project is now very seriously behind schedule, due in part to a change in construction methods when it was discovered that the helicopters could not lift the modular panels proposed for its construction. This has also resulted in cost over-runs by PWD. Disagreements have already arisen over the extent to which the new station will be provided with scientific

equipment as part of the fit-out of the laboratories, with PWD insisting that only “fixed equipment” will be supplied by them and DEAT insisting that all other equipment, even when for general use (like balances, microscopes, standard analytical equipment), must come from PIs grants.

**REC. 5.12: The Panel recommends that a plan for equipping the Marion Island station with routine scientific facilities and equipment should be established immediately so that additional sophisticated equipment has to be transported to the station only in exceptional cases.**

Again, the lack of professional field assistants has led to suggestions that, given the nature of the terrain and the unpredictability of the weather, the safety of field work is not taken seriously enough. The clothing provided has also been criticised by most of those with experience on the island as inadequate for the rough terrain, with the failure of gloves being of special concern.

**REC. 5.13: The Panel recommends that basic scientific support (clothing, technical support, field support and training) on the Marion Island Station should be improved for safety reasons. A user-group of stake holders should advise SANAP on these matters.**

In questioning why the station will rely entirely on diesel generators rather than on at least a proportion of sustainable energy it appeared that this was due to Treasury rules. The installation of sustainable energy would have been more expensive now in capital terms than the diesel system and the future savings in recurrent expenditure on oil over the life of the station are an ineligible trade off. However, in these days of imminent global change environmental concerns have to be taken into consideration and young scientists have to be educated to conduct their research in a responsible fashion; this is impossible if the station operation does not adhere to strict environmental standards.

Communications are again a problem and have been poor for quite some time. In the 21<sup>st</sup> century it is entirely inappropriate for a modern research station not to be designed around the expectation of regular or even continual access to the Internet for emails and data. The present situation is demotivating both for those people working on the islands and does nothing to encourage busy university staff or overseas visitors to apply to work there.

**REC. 5.14: The Panel recommends an improvement in communications for scientific and personal purposes to make the Marion Island station more attractive for scientific visitors and for long range monitoring projects.**

### **Gough Island Station**

The small station on Gough Island is there entirely for meteorological purposes, supporting regular synoptic data collection by three SAWS personnel, supported by four SANAP personnel. The island is a World Heritage site and the agreement between the UK and South Africa forbids research other than meteorology unless sanctioned in advance. The present station is in a very poor state of repair. Unless SAWS obtains the necessary capital finance from Treasury very rapidly it seems likely that the present station will be condemned as unsuitable for use and the programme closed.

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

Given the considerable costs associated with rebuilding this station and its potential impact on the availability of ship time we considered the future importance of Gough to SAWS. There are undoubtedly some elements of the present synoptic data collection that cannot be easily transferred to an automatic weather station (like visibility and cloud type) but many can. The chief importance of the observers there is in the launching of the two upper air balloons each day. Through questioning meteorologists the Panel tried to clarify the question if part of the Gough monitoring programme could be conducted from Tristan da Cunha, but no clear answer could be obtained. By closing the station and installing an automatic weather station and transferring the balloon launch to Tristan substantial savings are possible:

- no capital rebuild costs
- potential saving of four SANAP support salaries
- potential saving of at least one SAWS salary
- no routine stopovers at Gough during supply-runs to Tristan.

There are costs involved in removing the station and cleaning the site, but these would be necessary anyway even if the station was rebuilt. The services provided by SANAP (power, water, paramedic etc) are already all provided for the community on Tristan. It would be necessary to seek a new agreement with the Governor of St Helena for such a move and consider if the living and working space required could be rented on Tristan.

**REC. 5.15: The Panel recommends requesting SAWS to immediately initiate a cost-benefit analysis of the continuation of support for the station on Gough Island versus the alternative suggested of installing an automatic weather station and moving the upper air balloons to Tristan da Cunha.**

### **Cape Town as an Antarctic Gateway**

Global Antarctic activities are currently served by several gateways, viz., Cape Town in South Africa, Christchurch in New Zealand, Hobart in Australia, Punta Arenas in Chile, depending upon which sector of Antarctica is to be reached.

Cape Town is by virtue of its geographic location and the fact that it is a large modern city with sophisticated port facilities and has an international airport, is strategically situated to serve the ten nations currently working in the Dronning Maud Land region of Antarctica. A number of countries, namely the Federal Republic of Germany, the Russian Federation, Norway and South Africa as well as others already use the facilities offered. The international research and supply vessels employ local, but well experienced ships agents, the docking, bunker and repair facilities in the harbour. They also use other logistic services (waste disposal, servicing of motor vehicles and other routine equipment). Although a limited number of Antarctic supply ships currently use these facilities each year and bring in an annual income of only about R16 million, Cape Town is economically competitive with alternative cities and has rapidly growing expertise in all aspects of Antarctic activities.

Relatively recently transport to and from the Antarctic has been facilitated through the establishment of DROMLAN (international airlink between Cape Town and blue ice fields in

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

Antarctica close to the the Russian Novolazarevskaja and the Norwegian Troll stations; airplanes deployed comprised a commercial Russian Ilyushin as well as military Hercules from the Swedish and Norwegian air forces) and DROMSHIP (employing a supply vessel out of Cape Town to serve logistically the scientific stations of various countries in Dronning Maud Land; DROMSHIP presently employs the Russian ice-strengthened cargo vessel PAPANIN, which is not ideally suited for this purpose). Both organisations have additional capacity but appear commercially viable. South African organisations have been hesitant to assume a leading role in both organisations.

**REC. 5.16: The Panel recommends exploring the possibilities of how South Africa can make better use of DROMLAN and DROMSHIP, and possibly acquire a significant commercial share in the business, with the concomitant creation of new jobs.**

From the documentation supplied from SANAP it is clear that ecotourism and other touristic activities in close connection to visits in Antarctica are considered to generate additional income. This could result in services provided (clothing, information programs, event tours to the South Atlantic and Antarctica), would imply that Cape Town uses existing and future facilities (Antarctic Museum) and activities to raise its national and international profile as a center of Antarctic activities, thus generating substantial additional income from private sources. The Panel did not feel competent and prepared enough to make a judgement of the general perspectives of tourism to/from Antarctica.

The Gateway concept for Cape Town has been mooted at various times over the past ten years and the DST commissioned a pre-feasibility study by KPMG Services in 2006. The study suggested that the establishment of a formalized Antarctic Gateway in Cape Town is long overdue but that the harbour would, regardless of any initiatives to coordinate activities, continue to be used by Antarctic programs because of its geographic location and competitiveness. A formal Antarctic Gateway (as a portal) holds considerable potential for Cape Town, its harbour as well as airport and could serve as valuable support for the proposed creation of an Institute of Antarctic Earth System Science in Cape Town as well as the SANAP Antarctic Research and Logistics Centre as an arm of government (see below).

The panel is of the view that the development of a Cape Town Gateway could be the catalyst for the promotion of greater interest in Antarctica in South Africa. It holds the potential of generating considerable economic benefits in terms of commerce, tourism and greater use of the harbor and a pro-active Antarctic outreach and educational program should be implemented to attract learners to the sciences associated with a sophisticated Antarctic research program. Although government should pursue the acquisition of a modern facility to house the Gateway, the main commercial activities associated therewith should be left to the Western Cape Government, the City of Cape Town and the private sector to develop. Since the Panel is reporting to DEAT and most of these activities would have to be organized through other, partly non-governmental actors, no specific recommendations have been formulated (except those listed below).

## **Antarctic Research and Logistics Centre**

There was considerable support for the creation of an SANAP Antarctic Research and Logistics Centre as a National Facility to give SANAP a well structured home, firmly establishing its place in the South African research landscape. The premises on the Waterfront in Cape Town where SANAP is presently housed and which have very recently upgraded through a major renovation program, are a prime site and a highly suitable location with the potential for considerable expansion in the future. The Panel has conducted part of its meetings at these premises and was highly impressed by location and qualities of the presently available building.

Now that the bulk of the necessary construction work at SANAE and on Marion Island has either been completed or is nearing completion, it is imperative the South Africa's Antarctic programme should revert to its core business of planning, developing, financing and executing scientific research in Antarctica, the Southern Ocean, including Marion Island. The completion of the construction work, which has taken up the bulk of the funding and the utilization of time on the *SA Agulhas* in recent years, will free up much needed funds and ship time for scientific research.

The opportunity therefore now presents itself for the South African Government to create a new centre of excellence (=the Antarctic Research and Logistics Centre) which will not only serve to reinstate South Africa's position as a leading contributor to the development of Antarctic science but will, moreover, serve to promote science more generally amongst potential students and in the minds of the public. This proposal was made during the last international review of SANAP seven years ago, and has been ably argued for, but had subsequently not been vigorously pursued. We repeat this recommendation and refer to the convincing arguments presented in the 2000-review.

**REC. 5.17: The Panel recommends establishing the SANAP Antarctic Research and Logistics Centre as a National Facility. It should report through one Minister, be located in Cape Town, to serve as the core institution to safeguard the continued development of the scientific perspectives of South African research in Antarctica and the adjacent ocean basins, to provide the environmental management of South African activities in the Antarctic Treaty area as well as logistic support for SANAP and other research projects. The Research and Logistics Centre should be supervised by a Board (with a Chair) and lead by a Chief Executive Officer with strong scientific credentials.**

Further core areas of responsibility for an Antarctic Research and Logistics Centre would be the establishment of continuously updated research programmes, environmental management and maintenance of the key infrastructure. The Centre would also have overall control over the logistics associated with the annual programme of supply and research activities in Antarctica, the Southern Ocean and in the seas adjacent to South Africa. This is a considerable task which will possibly require the outsourcing of some activities to the private sector.

The Centre would need to develop and implement an outreach programme to schools and the public in South Africa as well as to the neighboring countries in Southern Africa and further abroad in Africa. Brazil and India already have their own Antarctic programmes and it is

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

suggested that areas of cooperation and for collaborative research in the context of IBSA be investigated. This could create a platform for outreach to other developing countries to encourage them to involve themselves in Antarctic research.

### **Institute of Antarctic Earth System Science**

Antarctic research in South Africa is spread over many institutions inside and outside the universities and a rich research landscape has developed since the IGY 50 years ago. The scientific working groups conducting this research are highly variable in size and in some cases do not comprise enough tenured staff to have critical mass. To improve the visibility of Antarctic research in support of the Antarctic Gateway concept of South Africa and Cape Town, in support of its international standing as a potential member of the International Antarctic Institute (IAI) in Hobart/ Tasmania, of systematic and high level/ quality graduate and postgraduate training in Antarctic Sciences the Panel has therefore considered the possibility that a new department/institute at a relevant university or group of universities in close proximity to the Antarctic Gateway and with the relevant natural science disciplines already in the portfolio of its faculties should be founded. The Panel noted with great interest the offer of DST (see minutes of the SANAP SC Feb. 28, 2007) to establish two SANAP Research Chairs; they (under dual appointment) could provide a nucleus for this new institute, if an interested university (or a group of them) would match them with a similar number of professorships.

The new institute should provide for

- an excellent and internationally competitive academic research environment to develop and conduct Antarctic research projects;
- academic training at the top level of graduate and postgraduate studies in Antarctic research disciplines;
- seek outside funding to maintain national and international graduate schools for specific Antarctic research themes, with the intention of achieving quick progress on gender and underprivileged students balance.

**REC. 5.18: The Panel recommends that the interest in founding a new academic institute devoted to Antarctic Earth System Science should be explored with a university or group of universities in the Antarctic Gateway area.**

## 6. GOVERNANCE

Much of the present South African Government system is comparatively recent, blended with elements of the previous system. This combination has provided fertile ground for possible confusion as the roles, objectives and assets of Departments are assigned and as a range of non-departmental institutions have appeared, each looking to establish their boundary conditions.

The history of SANAP exhibits many aspects of this confusion, making it difficult for the Review Panel to be certain exactly where boundaries lay, and what responsibilities had been assigned to whom. SANAP, as a logistic group, originally sat in the Department of Transport. It was later moved to the Marine and Coastal Management Programme within the Department of Environmental Affairs and Tourism (DEAT). At this point the *Agulhas* was directly managed by SANAP, its helicopters and medical services were provided by the South African National Defence Force, and its buildings belonged to and were maintained by the Public Works Department (PWD). Science policy and grants at this time were handled by the Department of Arts, Culture, Science and Technology (DACST). Since then the Department of Science and Technology (DST) has been split off from DACST and is now the parent department for South African Antarctic science. The National Research Foundation (NRF) is part of the DST and manages the granting process and researcher evaluation for them.

The South African Weather Bureau was originally part of DEAT but has now been made into an agency called the South African Weather Service (SAWS) and although it reports to Parliament through the DEAT Minister it is functionally independent of the government departments.

At present SANAP has outsourced the management of *Agulhas* to Smit Amandla Marine Ltd. and now recruits its own medical staff.

The complexity in governance arises not simply from the developmental changes in departmental structures but also from the wide range of stake holders in Antarctic science and logistics. At present major stake holders include:

- Universities and Institutes (currently at least 10); DEAT; DST (including NRF); SAWS; PWD; Department of Foreign Affairs (DFA).
- More minor stake holders include the South African National Defence Force; Department of Land Affairs; Department of Minerals and Energy.

Management structures involving all or some of these participants have evolved in various ways. At present it appears that there are, or were, three relevant committees (although not all are now functional):

- Antarctic Management Committee – provided an annual forum for inter-departmental discussions on policy;
- South African Committee on Antarctic Research - provided advice on the science and grant proposals;
- SANAP Steering Committee – provides decisions on routine management issues.



*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

The terms of reference of these committees seem to be partly in conflict and they do not offer the holistic synthesis that is needed to bring the whole range of South African Antarctic issues and interests together for effective and informed decision making. The Panel therefore proposes a new structure.

**REC. 6.1: The Panel recommends that a new management structure be established to bring all elements of South African Antarctic activities into a single unified system, improving decision making, transparency and information flow as well as allowing for the representation of all interests in a structured framework.**

**It is recommended that the body to oversee all South African Antarctic activities be called the South African Antarctic Policy and Research Committee (SAAPRC).**

**The following SAAPRC subcommittees are to be established:**

- **science subcommittee (including SCAR) to be chaired by the SCAR delegate;**
- **management and logistics subcommittee (including COMNAP) to be chaired by SANAP;**
- **ATCM subcommittee to be chaired by DFA;**
- **CCAMLR subcommittee to be chaired by DEAT (MCM)**

**Membership of each of the subcommittees to be determined by the chair.**

**Membership of SAAPRC to include:**

- **Chair (D-G of the Department responsible for the Antarctic Research & Logistics Centre)**
- **CEO of Antarctic Research & Logistics Centre**
- **CEO of the Gateway Project**
- **Chair of science subcommittee (Universities)**
- **Chair of management & logistics subcommittee (SANAP)**
- **Chair of ATCM subcommittee (DFA)**
- **Chair of CCAMLR subcommittee (DEAT MCM)**
- **Independent member from the business community.**

This structure is intended to answer some of the difficulties apparent in the present system. It allows for high level discussion linking science, logistics and policy after informed discussion in the subcommittees; it provides a linkage between initiatives at the ATCM and CCAMLR which are undertaken by different departments; it links the academic leadership of the new Research Centre and the CEO of the Gateway Project into the broader thinking and it provides for an independent voice from the business community. This last feature is now a common characteristic of many governmental organisations around the world.

The SAAPRC would meet as necessary but long enough in advance to allow preparations for the ATCM in May/June each year and the CCAMLR meetings in November each year. It should also provide transparency to the scientific community at large.

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

The South African SCAR Committee would normally expect to be appointed by the National Academy of Sciences. The parent body of SCAR is ICSU, a non-governmental body with no political attachments, whose formal relationships at national level are never normally with governments in order to preserve their independence from political agendas. In South Africa, the ICSU link is through a small international unit at NRF which is the adhering organisation to ICSU. Thus the appointment of the SCAR Committee is not through a peer group of academics. In recent years there has been inadequate management of appointments to this committee so that on several occasions both the mandate of the Chair and the membership has lapsed. The Panel considers that this committee plays an important role in the interface between SCAR international activities and the South African research community and needs to be fully staffed and mandated at all times.

**REC. 6.2: The Panel recommends that the process for appointing the members and chair of the SA SCAR Committee be reviewed to ensure that it is appropriate, timely and transparent.**

## **7. Funding & Human Resources**

### **Funding**

Expenditure on Antarctica is spread across several institutions so compiling a total cost for all activities proved to be beyond the abilities of the Panel. The two primary channels of expenditure are the funds provided to D:A&I through the DEAT budget to support the logistics, and the grants managed by NRF for university research. In addition there are costs associated with the ATS which are borne in part through the DEAT budget for CCAMLR and the ATCM Secretariat contribution and a minor amount through the DFA budget for ATCM. The SAWS budget also includes Antarctic costs for salaries and equipment, whilst PWD holds the maintenance budget for the buildings.

The budget for D:A&I is composed of a core element to support on-going costs, specific extra funds requested in the Mid-term Budget Review and extra capital costs provided through the Medium-term Expenditure Framework.

Annual Expenditure by D:A&I and NRF on Antarctic logistics and grants

	2005	2006	2007
NRF	11,956,097	10,224,660	19,985,437
D:A&I core	30,000,000	31,000,000	32,500,000
ship	26,000,000	28,000,000	30,000,000

The rebuild of Marion Island station has an estimated cost of R200 million over four years. The capital assets of the D:A&I (the three stations, SA *Agulhas*, vehicles and scientific equipment) are currently estimated as having a replacement value of around R1.5 billion. D:A&I has begun developing the basis for a cost recovery programme for institutions benefiting from support from the programme. An early candidate for this must be SAWS now it has moved to agency status.

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

There are other variable income streams supporting Antarctic work in the forms of grants from overseas agencies, as well as the value of equipment provided to SANAP from outside South Africa.

The completion of the rebuild of Marion Island this season will remove a large capital element from the budget but this will be replaced by the capital required for ship replacement and, if it is decided to go ahead with construction, a rebuild of Gough Island (which the Panel believe has yet to be decided).

The financial documents supplied to the Panel and the material available on the DEAT web site would not allow either the Panel or the public to gain any accurate estimate of the cost of Antarctic logistics supported by South Africa. The Panel believes that providing such information would encourage helpful dialogue and ensure transparency in priority setting.

**REC. 7. 1: The Panel recommends that a costed Business Plan for a three year cycle for D:A&I is publicly available to allow a continuing oversight of the cost effectiveness of logistics operations.**

In terms of possible future savings in expenditure the Panel has advised strongly against the development of a runway at SANAE and any work towards the acquisition of aircraft, as well as noting the closure of Gough Island could bring significant savings. There may also be significant cost savings in the ship replacement programme once a scoping study has established the specifications and estimated build costs.

The pattern of grant awards by NRF for the last three years has shown an annual total of usually 14/15 awards. The abrupt rise in costs in 2007 was due to an increase in grants to physics for geospace research which is more expensive than biology. The latest grant round has been less successful in terms of numbers of grants awarded.

The success rate for applicants in the grant round is very high (probably c.70%) compared to the expectation in any European country (usually 25% or less). It seems to the Panel that the list of successful applicants is dominated year on year by senior researchers and it seems a major effort is needed to grow the community by encouraging more applications by young researchers.

**REC. 7.2 : The Panel recommends that efforts are made by NRF to encourage more applications from young researchers .**

#### **Additional Income/ International Funding**

The Antarctic Programme grant holders have been active in seeking funds from outside countries, using its international standing to leverage quite significant sums. The US Agency for International Development funded a capacity building programme for Climate Research, providing R2.5 million which allowed for the training of 23 extra science students. The UK Darwin Initiative provided R1.27 million to fund the Gough Island Invertebrate Biodiversity Survey, employing South African field assistants as well as supporting the production of a popular book on Gough. In some cases the economic gain is in the loan of expensive

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

equipment for science. Dr PG Ryan estimated that he borrowed equipment worth at least R500,000 for his marine mammal programme whilst he has also benefited from large grants from the Foreign & Commonwealth Office Overseas Territories Environment programme and the UK Royal Society for the Protection of Birds. There may be others.

**REC. 7.3: The Panel notes that some South African Antarctic scientists have been extraordinarily successful in attracting funding from abroad and recommends that they should be encouraged to continue to do so.**

### **Human Resources**

The ToRs for the Panel makes mention of a South African resource of around 200 people from science, logistics and technical fields who are involved in various ways in the programme. The Panel sees this as simply one way of judging human resources, and suggests that even then the figure may well be too low. There is continuous gain and attrition in all parts of the programme suggesting that, since the programme has been running for almost 50 years, the pool of people familiar with it and its activities must by now number thousands.

The more pressing problem is how to use SANAP for human capacity development. Considerable efforts are already being made to try and attract a greater number of young students and researchers from disadvantaged groups in order to spread the basis of participation more widely and to build up a corpus of young scientists enthusiastic about Antarctica and the Southern Ocean.

The overall stagnation of employment opportunities in the R & D sector in South Africa at present is hardly a motivating factor in getting young people to choose science, and the higher salaries paid by the commercial sector are continuing to attract many of the best science graduates away from research. However, the Panel did note that grant holders had been successful in improving the black:white ratio in some fields (notably biology) but considers that major improvements in the physics field are unlikely in the short term as the discipline attracts only a limited number of students.

A number of interviewees suggested to the Panel that the benefits to the students, in terms of life skills and confidence, of working in a SANAP programme are frequently overlooked. Others pointed out that many graduates from SANAP work have gone on to senior positions in many spheres of life in South Africa. This concurs with the experience of the Panel in other countries and suggests that more needs to be made of the life-enhancing experiences of working .

**REC. 7.4: The Panel recommends that a package is designed to attract students to the programme and is promoted initially by the established grant holders.**

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

## 8. EDUCATION, OUTREACH & EMPOWERMENT

The attention of the Panel was drawn to the contention that young South African scientists who had conducted Antarctic Research through SANAP had, generally speaking, excelled in their future careers both inside science and elsewhere. This is a glowing tribute to the program, the universities but most importantly to the researchers themselves.

In the Business Plan for the Directorate : Antarctica and Islands for the period 01 April, 2007 to 31 March, 2008, there are Key Performance Areas relating to the implementation of an Employment Equity Plan (+70% representivity for expeditions/ 20% women) and the Promotion of Sustainable Broad Based Black Economic Empowerment(BEE) (60% BEE through a preferential procurement strategy for the purchase of supplies and services).

There is also provision in the Strategic Plan of the Chief Directorate : Research, Antarctica and Islands, for the facilitation of skills development through Learnerships, Full-time Bursaries, Part-time Bursaries and Internships. The targets for 2008 are - none(0); 60; 40; and 65 respectively. As some of these will be allocated to areas in the Chief Directorate outside of SANAP, it was not possible to determine, from the figures, the exact numbers which were specifically allocated to the D:A&I.

Nevertheless, given the importance placed on the promotion of science by the South African government, the capital investment in SANAP and the generally high performance in the program, the Panel was struck by the low level of these numbers.

Evidence was presented to show that, within SANAP-supported students, there has been a steady increase from 2004 to 2006 in White Females for PhDs and in Black Males and Black Females for Masters degrees. The demographics for those taking part in research on the stations shows an uneven pattern with % representivity fluctuating markedly year on year.

**Table 1: Demographics of expeditioners (students & field assistants) undertaking research on the SANAP stations 1997-2006**

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Black Female	0	0	0	18	0	0	0	9	23	0
Black Male	10	18	36	18	17	50	22	45	23	33
White Female	20	18	27	18	83	20	22	18	23	33
White Male	70	64	36	45	0	30	56	27	31	33
<b>% REPRESENTIVITY</b>	<b>10</b>	<b>18</b>	<b>36</b>	<b>36</b>	<b>17</b>	<b>50</b>	<b>22</b>	<b>55</b>	<b>46</b>	<b>33</b>
<b>% DESIGNATED GROUPS</b>	<b>30</b>	<b>36</b>	<b>64</b>	<b>55</b>	<b>100</b>	<b>70</b>	<b>44</b>	<b>73</b>	<b>69</b>	<b>67</b>

*\* Representivity is % Black, Indian and Coloured; Designated groups includes White females as well.*

There is clearly scope for an extensive, aggressive and coordinated outreach program to be launched by all of the government departments, research institutions and universities involved, to bring home to the public and especially to the schools that Antarctica and the

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

Southern Ocean offers a world of new experiences and research opportunities that can make a meaningful contribution to the physical world around us.

**REC. 8.1: The panel recommends that the Directorate: Antarctica and Islands continues to pursue empowerment of the previously disadvantaged communities through the goals set by the Employment Equity Plan and the Promotion of Sustainable Broad Based Black Economic Empowerment.**

**REC. 8.2: The Panel recommends that the Chief Directorate: Research, Antarctica and Islands revisits their Learner, Bursary and Internship program as well as the Budget and investigates the extent to which an extended program could be utilised to attain the goals of promoting Science and Technology, Empowerment and BEE.**

**REC. 8.3: The Panel recommends, given the overall international status of SANAP, that the stakeholders in government, research institutions and the universities undertake a joint and concerted outreach campaign to the public and especially to learners, to promote the attractions of a career in science, with a special emphasis on Antarctica and the Southern Ocean.**

## **9. INTERNATIONAL RELATIONS**

It should be pointed out that South Africa, as the only African country in the Antarctic Treaty System, could and should be playing a role commensurate with this position. The promotion of science and technology are amongst the top priorities of the South African government, the Southern African Development Community (SADC) and the New Partnership for African Development (NEPAD), which is an integral part of the African Union (AU). Article 13 of the AU Constitutive Act calls upon the Executive Committee of the AU to formulate policies that promote science and technology cooperation and Article 21 of the SADC treaty calls for the establishment of joint research facilities and regional centres of excellence.

There is therefore an identified need and a policy framework to develop a critical mass of science researchers to respond to the social and economic challenges of the continent and there would clearly be opportunities for collaborative research projects between South Africa and other African scientists working in the same field but who are without the opportunities and facilities available to South African scientists and universities in Antarctica and the Prince Edward Islands. In his opening address at ATCM XXVII in Cape Town on 24 May, 2004, the Minister of Environmental Affairs and Tourism, Mr. Marthinus van Schalkwyk, in the context of the new facilities at SANAE 1V, offered the capacity at the base as a platform for joint research. The Panel thinks that the exotic nature of Antarctica and the sub-Antarctic Islands may be sufficiently attractive to other African nationals that they could be motivated to participate in SANAP's activities; this avenue could bring additional users (both as visiting scientists as well as participants in training programmes) to the SANAE and Marion Island stations. This will not necessarily be easy for them and will require patience and perseverance as well as passion.

**REC. 9.1: The Panel recommends marketing SANAE and the research station on Marion Island vigorously as an unconventional, but stimulating venue to other African nations to introduce them to Antarctic research and science, and to educate and motivate a new decisive generation of African natural science researchers.**

The location of the ICSU Regional Office for Africa on the premises of NRF is considered to be very helpful for establishing a systematic assistance and training programme in marine sciences in their widest sense. In the long run this will also be important for building up a network of monitoring stations for meteorological and marine data in a region of our globe which is under-represented in most global networks. It will require diligent political preparation to define the modes and mechanisms of such cooperative programmes (during discussions with a parliamentarian we were told that a conference of delegates of all interested African coastal nations was being convened to consider climate change implications), but there is no question that the scientific expertise and potential as well as the necessary infrastructure can only be made available to other African partner countries through South African universities and other public research institutions. Such training programmes may also be instrumental in introducing marine science to scientists from other African countries, especially where the expertise is needed by other African coastal states to define the extent of their continental shelf regions, as well as steering them towards the sustainable exploitation of the living resources in their Exclusive Economic Zones.

**Rec. 9.2: The Panel recommends that South Africa holds discussions within Southern African Development Community and the African Union to establish the extent of the need in the Southern African region and in Africa for collaborative research projects and training programmes associated with the East Atlantic and West Indian oceans as well as Antarctica and the Southern Ocean.**

SANAE and the stations on Marion as well as on Gough islands also serve as anchor points for providing essential data for national and international services, such as weather forecasting, which are of great commercial importance. A representative of NECSA explained how the station on Marion Island would be equipped with sophisticated radionuclide monitoring devices to fulfill South African obligations towards the Comprehensive Test Ban Treaty Organisation (CTBTO) which would require a very stable, but also demanding energy supply of the station to guarantee the functionality of the measuring devices for more than 95 % of their operational time.

## **10. ANTARCTIC TREATY SYSTEM**

It has been brought to the Panel's attention that although South Africa is highly regarded in the Antarctic Treaty System, its participation in and contributions to ATCM and the CEP are not what they used to be. This is reflected in the composition of delegations, continuity of membership, submission of documents and in interventions.

The Panel was informed by various stakeholders that the head of the South African delegation to ATCM meetings, going back many years, came from the DFA and that there had been

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

continuity in the person of the leader. This is the general practise with other ATCM delegations because of the predominantly legal and political nature of the meetings. A few years back, however, this practise changed and a succession of leaders of delegation from DEAT and DFA ensued which appeared to undermine the cohesion of the delegation. The general practice with the head of CEP delegations to ATCM meetings is that she/he is drawn from the scientific community or is an environmental officer. The National Operator is also routinely a member of delegation because of the length of time devoted to Safety and Operations in Antarctica during ATCM meetings.

Regarding the submission of papers at ATCM meetings, which the Panel notes has been sadly few in recent years, the head of the South African delegation should consult with academic institutions, scientists working in the field and with SANAP as to the ways and means of rectifying this situation.

A similar situation obtains and should be addressed in respect of CCAMLR, as there is some innovative work being done in the field of the identification and management of marine protected areas and the possibilities for fisheries development around PEI.

**REC. 10.1: The Panel recommends:**

- 1. that the Head of the ATCM delegation is always from Department of Foreign Affairs,**
- 2. that the National Operator is always part of the delegation**
- 3. that the CEP delegation is lead either by a senior scientist or by an environmental officer**
- 4. that continuity of membership in the delegation will strengthen the South African position by accruing experience**
- 5. that DFA consults with both the science community and SANAP to determine what papers will be commissioned for submission each year**

**REC. 10.2: The Panel recommends that the CCAMLR Commissioner consults with the scientific community to ensure that appropriate South African scientists are able to contribute to the development of bioregionalisation techniques, fisheries developments and the criteria for the selection and management of marine protected areas in the Southern Ocean.**

It should be emphasised that South Africa, as the only African voice in the Antarctic Treaty System at this time, has a unique role to fulfill in ATCMs and in CCAMLR in articulating the contemporary state of scientific research in the context of Antarctica and the Southern Ocean.



## Appendices

### 1. Committee Composition

**Prof David WH Walton (Convenor)**

Emeritus Fellow  
Environment and Information Division  
British Antarctic Survey  
High Cross  
Madingley Road  
Cambridge CB3 0ET  
**UNITED KINGDOM**

Tel +44 1223 221592  
Fax +44 1223 302093  
[dwhw@bas.ac.uk](mailto:dwhw@bas.ac.uk)

**Prof Jörn Thiede**

Director  
Alfred Wegener Institute for Polar and  
Marine Research in the Helmholtz Association  
Am Handelshafen 12  
27570 Bremerhaven  
**GERMANY**

Tel +49 (0) 4 71-48 31-11 00  
Fax +49 (0) 4 71-48 31-11 02  
[joern.thiede@awi.de](mailto:joern.thiede@awi.de)

**Mr A Leslie Manley**

Acting Chief Director:  
Economic and Social Affairs  
Department of Foreign Affairs  
Private Bag X152  
**PRETORIA**  
0001

Tel (012) 351 1360  
Fax (012) 351 1651  
Cell 082 387 8400  
[manleya@foreign.gov.za](mailto:manleya@foreign.gov.za)

**Judge Albert J Hoffmann**

International Tribunal for the  
Law of the Sea,  
Hamburg, Germany

Extraordinary Professor  
Faculty of Law  
Centre for Human Rights  
University of Pretoria  
**PRETORIA**  
0001

Tel (012) 351 0851  
Fax (012) 342 5141  
Cell 083 259 5587  
[nicreat@telkomsa.net](mailto:nicreat@telkomsa.net)

## **2. Terms of Reference (extract of relevant paragraphs)**

### **THE SCOPE OF THE REVIEW**

Based on the considerations of the previous review, the 2007 review should cover:

- an assessment of the economic, ecological, scientific, and other contributions of the Antarctica and the Islands programme over the last decade;
- an analysis and proposals for the programme (plans, targets, priorities) for the decade ahead; and
- a review of options for greater international partnership in taking the programme forward.

### **THE PURPOSE OF THE REVIEW**

The purpose of the review is an updated assessment of the benefits and costs of the Antarctic with special emphasis on:

- The relevance, quality and impact of SANAP science, including human resource development, publications and their impact factor, and the value of international scientific collaboration;
- The adequacy of infrastructure support to the programme with special reference to Polar research and the supply vessel SA Agulhas;
- The potential economic, social and strategic value of the SANAP programme; and
- Treaty obligations and the value of potential international collaboration.

### **REVIEW PARAMETERS**

The methodology for conducting the review will involve the generation of a review report, based on firstly, a SANAP commissioned report prepared by the DEAT and, secondly, on interaction with stakeholders through written submissions, interviews and site visits to Cape Town and Pretoria. A list of stakeholders will be provided by the DEAT. The review panel is requested to conduct the review and to determine:

- The value of the research output facilitated by SANAP, as determined by peer review and benchmarked internationally;
- The potential value of the programme to South Africa in terms of strategic considerations;
- The potential economic and social value of involvement in Antarctic and Southern Oceans;
- An evaluation of the current strategic plan for logistical support;
- An evaluation of the content and impact of the current science plan since the previous review, as well as the future science strategy (plans, targets and priorities); and
- A review of the current and future strategy for international cooperation and the extent to which such cooperation enhances the effectiveness and impact of the programme. In particular, the following issues will need to be addressed;
- Adequacy of infrastructure (with emphasis on the vessel) and resources to fulfill its dual mandate as a polar/supply research vessel retrospectively and prospectively;
- International Treaty obligations;
- Sustainability of SANAP in respect of achieving its mandate; and
- Economic significance of logistical cost sharing/joint ventures and future potential.

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

### **3. Interviewees and those who provided evidence**

Akkers Frantz, Theresa Mrs	Director: Off-shore Resource Management, DEAT
Archary, Byren Mr	Deputy-Director, Science Platform Unit, DST
Augustyn, Johann Dr	Chief Director, DEAT
Bester, Marthán Prof	University of Pretoria (UP), Dept of Zoology
Bossenger, Tracy Ms	NRF
Calvert, Ian Mr	SVMS, Fleet Manager
Canca, Anati Ms	General Manager: Human Capital and Science Platforms Unit, DST
Chalmers, Judy Mrs	Parliamentary Portfolio Committee, DST
Chown, Steven Prof	Stellenbosch University (SU), Director: DST-NRF Centre of Excellence for Invasion Biology
Cilliers, Pierre Dr	Hermanus Magnetic Observatory (HMO)
Collier, Andrew Dr	UKZN, Department of Physics
Combrinck, Ludwig Dr	Associate Director: Space Geodesy, HARTRAO
Cowan, Donald Prof	University of the Western Cape, Dept of Microbiology
Crawford, Rob Dr	Director: Ecosystems Utilisation Conservation
Dave Hall, Dave Cap	Master of the <i>SA Agulhas</i>
de Wet, Sandea Adv	Chief State Law Adviser (International Law), Department of Foreign Affairs
Dyson, Liesl Ms	Dept of Geography, Geoinformatics and Meteorology, University of Pretoria
Engelbrecht, Francois Dr	Dept of Geography, Geoinformatics and Meteorology, University of Pretoria
Erasmus, Lynn Mrs	NRF
Faanhof, A Dr	CTBTO, National Energy Corporation of South Africa (NECSA)

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

Glazewski, Jan Prof	University of Cape Town (UCT), Institute of Marine & Environmental Law
Godfroid, Jacques Prof	UP, Veterinary Science
Grantham, Geoff Dr	Senior Specialist Scientist, Council for Geoscience
Hendrikse, Dave Mr	Department of Public Works
Hermes, Juliet Dr	SAEON
Hunter, Ian Mr	Principal Researcher, South African Weather Service
Jansen van Vuuren, Bettine Dr	SU, Dept of Botany & Zoology
Kamper, MJ Prof	SU, Dept of Engineering
Kaniki, Andrew Dr	Executive Director: Knowledge Management & Strategy, National Research Foundation (NRF)
Kennicutt, MC Prof	Office of the Vice President for Research, TAMU
Kleinhans, A Lt Col (Dr)	South African National Defence Force
Klopper, J Mr	Nautical Superintendent
Levieux, Candice Ms	Manager, NRF
Lutjeharms, Johan Prof	UCT, Department of Oceanography
Magnus, LG Dr	HMO
Malinga, Sandile Dr	UKZN, Physics Department
Manley, Leslie Mr	Economic and Social Affairs, Dept of Foreign Affairs
Mayekiso, Monde Dr	Deputy Director-General, DEAT
McGeoch, Melodie Prof	SU, Departments of Entomology & Conservation Ecology
McQuaid, Christopher Prof	Rhodes University, Dept of Zoology and Entomology
Meiklejohn, Ian Dr	UP, Dept of Geography/Geology
Miller, Denzil Dr	CCAMLR
Mjwara, Phil Dr	Director-General: Department of Science and Technology (DST)
Monday, P Lt Col	South African National Defence Force

*2007 REVIEW OF THE  
SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)*

Moraal, Harm Prof	North-West University, Dept of Physics
Mostert, S Prof	SU, Dept of Engineering
Muhongo, Sospeter Prof	Director: ICSU Regional Office for Africa, International Council for Science
Orheim, Olav Dr	Norwegian Polar Institute
Oosthuizen, Sam Mr	Manager DEAT
Pakhomov, E Dr	University of British Columbia, Vancouver
Ras, Nico Mr	Department of Public Works
Robertson, Alan Mr	Project Manager: New Vessels, DEAT
Schoeman, Hanlie Mrs	Deputy-Director: Environmental Affairs, National Treasury
Slager-Bastos, Amanda Dr	UP, Dept of Zoology
Smith, Velden Prof	SU, Depts of Entomology & Conservation Ecology
Stander, Johan Mr	Acting Manager (Western Cape) – South African Weather Services (SAWS)
Stassen, Hennie Mr	Consulting Structural Engineer, ENDECON
Tempelhoff, D Col (Dr)	South African National Defence Force
Valentine, Henry Mr	Director, DEAT
van der Westhuisen, Andre Mr	Previous SANAP coordinator
van Rensburg, C Lt Col (Dr)	South African National Defence Force
von Gruenewaldt, Gerhard, Dr	NACI Survey on Science Infrastructure
Walker, Dave Prof	Chair: National International Polar Year (IPY) Committee; University of KwaZulu-Natal (UKZN), Physics Department
Walker, Eric Mr	Ship Vessel Management Services (SVMS), Technical Manager
Wonnacott, Richard Mr	Director: Survey Services Department of Land Affairs
Yako, Pamela Ms	Director-General, Department of Environmental Affairs and Tourism (DEAT)
Zita, Langa Mr	Chairperson Parliamentary Portfolio Committee, DEAT

## 4. Documentary Evidence and Bibliography

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## **5. Glossary**

AMD	–	Antarctic Master Directory
ARESSA	–	Antarctic Research Strategy for South Africa
ATCM	–	Antarctic Treaty Consultative Meeting
ATS	–	Antarctic Treaty System
AU	–	African Union
CCAMLR	–	Commission for the Conservation of Antarctic Marine Living Resources
CEP	–	Committee for Environmental Protection
COMNAP	–	Council of Managers for National Antarctic Programs
CRAMRA	–	Convention for the Regulation of Antarctic Mineral Resource Activities
D:A&I	–	Directorate: Antarctica and Islands
DACST	–	Department of Arts, Culture, Science and Technology
DEAT	–	Department of Environmental Affairs and Tourism
DFA	–	Department of Foreign Affairs
DST	–	Department of Science and Technology
EEZ	–	Exclusive Economic Zone
GCMD	–	Global Change Master Directory
GOOS	–	Global Oceanographic Observing System
IAATO	–	International Association of Antarctic Tour Operators
IAI	–	International Antarctic Institute at Hobart
ICSU	–	International Council for Science
IGY	–	International Geophysical Year
IPY	–	International Polar Year
MCM	–	Marine and Coastal Management Programme
MPA	–	Marine Protected Area
NRF	–	National Research Foundation
PEI	–	Prince Edward Islands
PWD	–	Department of Public Works
SADC	–	Southern African Development Community
SAEON	–	South African Environmental Observing Network
SANAP	–	South African National Antarctic Programme
SAWS	–	South African Weather Service
SCAR	–	Scientific Committee for Antarctic Research