Jlooper

16th

PEIMC

Meeting

29 August 2003

2. Minutes of the 15th PEIMC meeting
3. 2003 Marion relief voyage: Conservation Officer's report
4. Interim progress reports
5. New SACAR1 project proposals

AGENDA

of the

16th PRINCE EDWARD ISLANDS MANAGEMENT COMMITTEE MEETING

****

VENUE: ***Department of Environmental Affairs & Tourism***
Directorate: Antarctica & Islands Conference Room
Southern Life Building (4th Floor)
44 Hertzog Boulevard
Foreshore
CAPE TOWN

DATE: ***Friday 29 August 2003***

TIME: ***08:30***

****

1. WELCOME AND OPENING

2. MINUTES OF THE 15th PRINCE EDWARD ISLANDS MANAGEMENT COMMITTEE (19 February 2003) *Doc 2*

Matters arising:

2.1	Tourism Impact Management Plan (IMP) (par. 2.1) *(Mr H R Valentine)*	
	- Draft Protected Areas Bill	***Doc 2.1A***
	- Draft Biodiversity Bill	***Doc 2.1B***
2.2	Removal of rubble and building waste ("Country clean-ups" at Marion) (par. 2.2) *(Mr J Cooper)*	***Doc 2.2***
2.3	Building of new and decommissioning of old Marion Island base (par. 2.4)	
	- Appointment of Environmental Project Officer (EPO) *(Mr H R Valentine)*	***Doc 2.3***
2.4	- Invasive species on Marion Island (par. 2.5) *(Prof S L Chown)*	***To be tabled***
	- Quarantine measures to halt alien invasions of Southern Ocean Islands: The South African experience *(Prof M A McGeoch / Mr J Cooper)*	***Doc 2.4B***
2.5	World Heritage Site (WHS) status for the Prince Edward Islands (par. 2.6) *(Mr H R Valentine)*	
2.6	Prevention of the transmission of diseases in the Prince Edward Islands' wildlife (par. 2.7) *(Prof M A McGeoch)*	***To be tabled***
2.7	Update on progress of Prince Edward Islands maps (par. 2.8) *(Mr H R Valentine)*	***To be tabled***
		To be tabled
2.8	IEE/EIA for Radionuclide Station (par. 2.9) *(Mr H R Valentine)*	***Doc 2.8***
2.9	Feedback on illegal fishing (par. 2.10) *(Mr H R Valentine)*	
	- National Plan of Action – Seabirds to reduce long lining mortality *(Mr J Cooper)*	

2.10 Revision of the Prince Edward Management Plan (par. 2.12) *(Mr J Cooper)*
- Discussion of quarantine procedures and recommendations for improvements

2.11 Science and Management at the Prince Edward Islands (Monitoring) (par. 2.13) *(Prof M A McGeoch)*

2.12 Proposed filming policy for the Prince Edward Islands (par. 2.14) *(Ms A van Wyk)* ***Doc 2.12***

× 2.13 Extension of Special Nature Reserve status of the PEIs to include territorial waters out to 12 nautical miles (par. 2.16) *(Mr J Cooper)* ***To be tabled***

× 2.14 RAMSAR Wetland Reserve Status for the PEIs (par. 2.17) *(Mr J Cooper)* ***To be tabled***

× 2.15 Penguin request from National Zoological Gardens of South Africa (par. 4.2) *(Mr H R Valentine)* ***To be tabled***

Removal of crashed aircraft from Marion Island (par. 4.3) *(Mr J Cooper)*

2.16 Progress on the Agreement on the Conservation of Albatrosses and Petrels *(Mr J Cooper)*

3. REPORTS

For the entries

3.1 2003 Marion relief voyage: Conservation Officer's report and recommendations *(Mr J Cooper)* ***Doc 3.1***

3.2 Marion construction voyage (August 2003): Environmental Project Officer's report *(Mr J Cooper)* ***To be tabled***

4. INTERIM PROGRESS REPORTS *(FOR INFO)*

4.1 Comparative population *ecology* of Southern Elephant Seals *(Prof M N Bester)* ***Doc 4.1***

4.2 Satellite-linked identification and characterisation of Southern Elephant Seal foraging areas *(Prof M N Bester)*

4.3 Biocomplexity and change: The role of a long-lived keystone species, *A. Selago* *(Prof M A McGeoch)* ***Doc 4.3***

4.4 Monitoring seabirds at Marion Island *(Dr R J M Crawford)* ***Doc 4.4***

4.5 Threats to biodiversity and ecosystem functioning at the Prince Edward Islands: developing a conservation strategy for endemic and keystone insect species *(Dr A D Slager-Bastos)* ***Doc 4.5***

4.6 Moss flora of Marion Island *(Prof V R Smith)* ***Doc 4.6***

4.7 Structure and trophic ecology of fish community *(Prof E A Pakhomov)* ***Doc 4.7***

4.8 Environmental responses to climate change on Marion Island *(Dr P Sumner)* ***Doc 4.8***

4.9 Marion Offshore Variability Ecosystem Study (MOVES) *(Prof C D McQuaid)* ***Doc 4.9***

4.10 Dynamics of Eddy Impacts on Marion's Ecosystem (DEIMEC) *(Prof J R E Lutjeharms)* ***Doc 4.10***

4.11 Measurements and regional model studies of ocean-atmosphere interaction in the Southern Ocean in order to improve our understanding of the ocean boundary layer's contribution to sub-tropical and weather systems *(Dr C J de W Rautenbach)* ***Doc 4.11***

5. NEW SACAR1 PROJECT PROPOSALS

5.1 Physiology of extreme fasting in subantarctic fur seal *(Arctocephalus tropicalis)* pups *(Prof M N Bester)* **Doc 5.1**

5.2 Biodiversity at the Prince Edward Islands: Extent, Threats and Management *(Prof S L Chown)* **Doc 5.2**

5.3 Cumulative impacts of environmental stress on indigenous and introduced species *(Prof S L Chown)* **Doc 5.3**

5.4 Microbiology of Marion Island soils *(Prof D A Cowan)* **Doc 5.4**

5.5 Genetic profiling of pinniped populations at the Prince Edward Islands *(Dr A D Slager-Bastos)* **Doc 5.5**

5.6 Moisture and nutrients as determinants of soil respiration rate of Marion Island *(Prof V R Smith)* **Doc 5.6**

C 5.7 The effects of human disturbance on the behaviour and physiology of breeding seabirds and seals at Marion Island *(Dr M S de Villiers)* **Doc 5.7**

5.8 Revision of the Prince Edward Islands Management Plan (Phase Two) *(Mr J Cooper)* **Doc 5.8** Contract

Reduce costs

5.9 SADC GPS and Earth Monitoring Network: Marion Island Node *(Dr L Combrinck)* **Doc 5.9**

Longer?

6. NEW ITEMS

6.1 Development of "contingency plans" for:
- prevention and amelioration of oil spills
- reporting and sampling of disease outbreaks
- supply of "eradication kits" for combating aliens arriving on the island

(Mr J Cooper)

6.2 Scientific and environmental management visit to Prince Edward Island *(Mr J Cooper)* **Doc 6.2**

× 6.3 Prince Edward Island expedition suite of papers and overview paper *(Mr J Cooper)* ***To be tabled*** ***To be tabled***

6.4

6.5

7. DATE OF NEXT MEETING

8. CLOSING

Doc 2

15th PRINCE EDWARD ISLANDS MANAGEMENT COMMITTEE (PEIMC) MEETING

MINUTES OF THE MEETING HELD ON 19 FEBRUARY 2003 AT THE DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM, DIRECTORATE: ANTARCTICA AND ISLANDS, FEDSURE FORUM, 8TH FLOOR, ROOM 816, 315 PRETORIUS STREET, PRETORIA

PRESENT

Mr H Valentine (*Chair*)	-	Department of Environmental Affairs and Tourism (DEAT)
Prof S L Chown	-	University of Stellenbosch (US)
Prof C T Chimimba	-	University of the Pretoria (UP)
Mr J Cooper	-	University of Cape Town (UCT)
Dr N Mjoli	-	Hlati Development Consultant
Ms A van Wyk	-	S A National Parks
Prof M A McGeoch	-	US
Mr J Lexow	-	National Department of Public Works (NDPW)
Mr J A Dreyer	-	DEAT
Mr H Stassen	-	Endecon Engineering *(presentation on item 2.4 only)*
Ms H Raath	-	Ixixi Architects *(presentation on item 2.4 only)*
Ms C A Jacobs (*Minutes Secretary*)	-	DEAT

APOLOGIES

Mr M Majodina	-	S A Weather Service (SAWS)
Mr M Murphy	-	National Department of Public Works (NDPW)

1. WELCOME AND OPENING

The Chair thanked the continuing members for attending and extended a special word of welcome to the new committee members, Prof McGeoch and Dr Mjoli. He tendered apologies from Mr Majodina and stated that Prof Chown was attending in his capacity as the PEIMC representative on the Marion base building committee. Mr Lexow was attending on behalf of Mr Murphy, who was on standby for the emergency voyage to Gough Island to repair the refrigerators.

Items 2, 2.2 – 2.4, 3 and 4.1 – 4.3 (pertaining to the 2003 Marion relief voyage) were handled first, after which Mr Dreyer was excused to attend another meeting.

A short presentation on the progress made with the replacement of the Marion Island base was given by the consultants on this project, namely Mr Stassen and Ms Raath.

2. MINUTES OF THE 14TH PEIMC MEETING (6 AUGUST 2002)

The following amendments were made to the minutes:

Item 2.3, 1st par., p. 3
- *Sentence amended to read - "Mr Cooper stated that the damage, if these structures were removed, as opposed to their remaining in place, needed to be considered."*

Item 2.7, 2nd sentence, p. 4
- *"to" amended to "of" – "... Protection (CEP) of the Antarctic ..."*

Item 4.2, 2nd par., p. 7
- *"Procellius scaba" amended to read "Porcellio scaber"*

In view of the changes made, the minutes were accepted as a reasonable reflection of deliberations at the previous meeting, and signed accordingly by the Chair.

MATTERS ARISING:

2.1 Tourism Impact Management Plan (IMP)
- **Draft National Environmental Management: Protected Areas Bill and explanatory memorandum**
- **Dr P G Ryan's request for tourist landing - October 2003 *(for information)***

Mr Cooper stated that should the draft Protected Areas Bill enter into force, the Minister would not be able to approve tourism to the PEI's, and only science and logistics would be permitted. There would thus be no need to draft an IMP, and this problem may have indirectly been solved on a higher level. If, however, the PEI's were reclassified as a National Park, there would be huge implications. Prof Chown stated that the previous PEIMC had requested an audit on the biodiversity of Marion Island in accordance with the draft Biodiversity Bill. In the interim, whilst awaiting the approval of the Protected Areas and Biodiversity Bills, no tourism would be permitted and the Islands would remain a Special Nature Reserve. Ms W Lutsch and Mr G Cowan within DEAT were driving these processes respectively, and could be consulted informally.

Scientists could comment on these draft bills and the PEIMC could advise on alien species, etc. Mr Cooper added that the benefit of having the PEI's included in these bills needed to be determined. Prof Chown enquired as to the relation between the National Biodiversity Institute, DEAT and the PEIMC and that it be recommended to the Director-General (DG) or Minister that a member of the PEIMC serve on this Institute's Board. The Chair stated that the PEIMC needed to engage with this Institute in a preliminary fashion to identify potential interactions/cooperation. Mr Cooper supported this course of action and asserted that the PEI's fulfilled the requirements of a bioregion, but that the implications needed to be determined. Prof McGeoch stated that bioprospecting may also be an issue, as well as endangered and invasive species. These three aspects would be followed up. Prof Chown stated that the Rhodes University oceanography group was bioprospecting and that it was important to ascertain whether they were listed as one of the Institute's formal activities.

With regard to Dr Ryan's request, Ms Jacobs advised that he would let DEAT know if he was still interested in such a visit.

2.2 Removal of rubble and building waste ("Country clean-ups" at Marion)

Mr Cooper stated that "country clean-ups" on Marion had been undertaken for the last 2-3 years, and that it was going really well - 12 containers of rubble had been removed in 2002. This was an ongoing project and the team members had been asked to provide GPS positions of rubble sites. A consolidated list would be produced for the Marion Planning Meeting on 21 February 2003. Mr Cooper would be participating as the Conservation Officer for the 2003 relief voyage to continue with clean-up operations. The oceanographers would assist in this process when they came ashore. Helicopter support would also be required for cleaning up further afield. Mr Cooper had two sited in mind, namely (1) the rondavel-type hut between Mixed Pickle and Kampkoppie and (2) the two hydroshacks. Both sites would need to be inspected to asses the possiblilty of removal. Mr Lexow added that Mr Murphy (NDPW Group Leader) was willing to assist, but that the construction process would receive priority. Mr Dreyer (Departmental Coordinating Officer – DCO) confirmed that support would be provided as far as possible. This process would thus be coordinated between Messrs Dreyer, Murphy and Cooper.

With reference to Doc 2.2, a procedure regarding the unmarked stakes would be put in place and Dr N Gremmen would identify the long-term monitoring sites. As regards types of markers to be used on Marion, Prof Chown stated that plastic droppers (with a tag indicating the date and contact person) could be used as they did not rust. These markers were also lighter to carry and Mr Cooper would investigate the availability thereof. Everyone would be advised accordingly.

2.3 Revised Environmental Management Plan (EMP) for removal of hydroelectric pipeline

Mr Cooper stated that Doc 2.3 had been addressed as far as possible and that this item could be removed from the agenda.

2.4 Building of new and decommissioning of old Marion Island base

Mr Dreyer suggested that an update, such as the one by Mr Stassen earlier, should be provided at each meeting. As regards the EIA conditions, he confirmed that they were more or less in place and added that the comments made on the scoping study were taken into consideration. Prof Chown added that these details had been thrashed out at a meeting and workshop with the DEAT environmental audit committee. The Chair stated that the DG would be advised on the acceptance of the scoping document, with Mr Dreyer adding that the DG had been kept informed on the process and progress made. The scooping document would enter into force on 1 August 2003, for the first construction voyage to Marion Island. Copies of this document were to be forwarded to all SANAP role players to adhere to.

2.5 Invasive species on Marion Island

Prof Chown reported that, due to discussions at the previous meeting, he had submitted an application to undertake some work, which would contribute to the revision of the Prince Edward Islands Management Plan (PEIMP) and the World Heritage Site nomination. He motivated that South Africa needed to be aware of what was on the Islands, especially in terms of alien species. As the PEIMC had agreed that an expert be appointed, Dr Gremmen had been identified to assist with this task and a proposal had been formally submitted. Prof Chimimba supported that this important work needed to be done. The Chair felt that this was a well-written and well-motivated proposal. Ms van Wyk enquired regarding "state of the environment (SOE) indicators". Prof Chown confirmed that this had been included, and that as a result of this work they would know exactly what the SOE was and information and trends would be readily available. In terms of taxa, etc. from Prince Edward, Mr Cooper stated that Dr R J M Crawford was in the process of completing a suite of papers with the latest numbers on this Island. This proposal was supported by the committee.

2.6 World Heritage Site (WHS) status for the Prince Edward Islands

Ms Jacobs stated that the WHS nomination report was due for submission by the end of this year and that the current nomination document had been included in the meeting documentation for the PEIMC's comments. Mr Cooper asserted that the extent of the inclusion of the new base, relevant Acts (e.g. Protected Areas), etc. all needed to be considered when updating the document. Regarding establishing an authority and regulations (see Doc 2.6, p. 2), Ms van Wyk commented that the PEIMC and PEIMP were already in place, but that perhaps this needed to be formalized. Ms Jacobs would follow this up within DEAT and convey the relevant deadlines to the committee.

2.7 Prevention of the transmission of diseases in the Prince Edward Islands' wildlife

Prof Chown reported that the document presented on the transmission of diseases had been turned down by the Committee for Environmental Protection (CEP) and the Scientific Committee on Antarctic Research (SCAR). These committees had decided that there should be monitoring and Prof Chown would forward a useful document for tabling at the next meeting. He added that Marion Island's regulations were far more stringent and that in this regard South Africa was far ahead.

2.8 Update on progress of Prince Edward Islands maps

Ms Jacobs advised that a "Name that feature" competition had been launched by US to obtain names for some of the unnamed features on the Marion map that were indicative of the South African population – i.e. names in languages other than English and Afrikaans were required for submission to the South African Geographic Names Council (SAGNC) for approval, so that the map could be finalized. Prof Chown added that a good response had been received, and the Chair commended Prof Chown and his group for driving this process.

Ms Jacobs mentioned that she had consulted with Mr R Wonnacott of the Department of Land Affairs regarding producing a map of Prince Edward. He had indicated that it would not be possible to use satellite images and that aerial photographs of the Island would be required.

2.9 IEE/EIA for Radionuclide Station

The Chair reported that the radionuclide station had been considered in the building of the new base. Ms Jacobs mentioned that there was pressure to have the station up and running earlier. The Chair advised that this would be discussed with Mr Stassen before any decision was made in this regard.

2.10 Feedback on illegal fishing

The Chair reported that Patagonian toothfish stocks were on the increase, as the legal fishing industry was reporting improved catches. There were few legal vessels at the Prince Edward Islands, due to the limited catches as a result of the killer whales. He hoped that Marine and Coastal Management (MCM) of DEAT would soon have its patrol vessels in place. Mr Cooper advised the committee that when the French pilot had been collected from the Island, a number of illegal vessels had been observed. He added that from a conservation perspective, the legal fisheries had the best record in terms of longline fishing, and that a plan was in place to hopefully further reduce seabird mortality. Prof Chimimba asked whether satellite policing was possible. Mr Cooper said that the legal vessels were required to have VMS (Vessel Monitoring System), which they were not allowed to switch off, but that the illegal vessels did not have this system. Prof Chown stated that there were no procedures available, with Mr Cooper supporting that illegal fishing was difficult to prove. The Chair hoped that some of these problems would be alleviated by the patrol vessels.

2.11 Non-takeover visits to Prince Edward Island (PEI)

The Chair stated that procedures for non-takeover visits to PEI needed to be formalized. Mr Cooper agreed that these measures needed to be included in the PEIMP when it was revised, and that much had been included in the scoping document.

2.12 Revision of the Prince Edward Islands Management Plan (PEIMP)

In terms of the way forward, Mr Cooper stated that there were two ways to proceed, namely (1) as per the first version, the various pieces could be written up and collated, or (2) the job could be put out on contract, but this would have cost implications. The Chair felt that the latter was a feasible option, provided that the contractor had the necessary background. He added that this task could be undertaken if it cost less than R 10 000, but if it was more than that it would have to go out on tender. Ms van Wyk asserted that the Islands would have to be managed in terms of the scoping document and the PEIMP. Prof Chown said that the PEIMC had previously discussed that the PEIMP could be published as a file, which could be updated, i.e. a living document. Ms Jacobs queried whether the PEIMC could not task someone to undertake this project. The committee agreed this was a good idea, and Mr Cooper undertook to submit a SACAR1 project proposal, including costs and deadlines.

2.13 Science and Management at the Prince Edward Islands (Monitoring)

Prof Chown stated that presently there was no formal monitoring process for biota, terrestrial systems, etc., and that this was required to manage the PEIs diversity. Prof McGeoch agreed that this would be of unquestionable value and needed to be centrally coordinated. She continued that the taxa that required monitoring needed to be identified and a process put in place. Ms van Wyk mentioned that research, management and monitoring were the three pillars of this process. Prof Chown suggested that a scientific protocol be set up during the biodiversity audit and revision of the PEIMP, mentioning the importance of the mice and Kerguelen cabbage. Prof Chimimba reiterated the importance of a permanent Conservation Officer for these Islands.

Prof Chown supported that when a group of his had visited Cape Hallet, they had received a protocol, and that it was thus necessary to undertake this task. Prof McGeoch offered to coordinate the development of the monitoring process and compile the required list. Mr Cooper enquired whether a computer database could be set up, especially for newcomers. Prof Chown stated that this would be a huge task. He hoped that a list of species and protocols would be available by the end of 2004, and that the way forward could be decided from then.

2.14 Overview of filming policy: S A National Parks

Ms van Wyk undertook to adapt this policy (Doc 2.14) for the PEIs, for inclusion in the revised PEIMP.

2.15 Draft Final Project Report: House Mouse project – Prof R J van Aarde

The Chair indicated that the PEIMC and SANAP Review Panel's comments and suggestions had been conveyed to Prof van Aarde, but that he was not willing to amend his final report. He suggested that Prof van Aarde be advised that DEAT noted his approach with regret and that it be left at that. Prof Chown felt that the committee needed the mouse information, but that if he refused to comply, there was little that could be done. He suggested that Prof van Aarde should be requested to submit his data to DEAT and that the committee await any forthcoming publications.

2.16 Extension of Special Nature Reserve (SNR) status of the Prince Edward Islands to include the territorial waters out to 12 nautical miles

Mr Cooper proposed a change in the conservation status of the PEIs, in extending the SNR to include the territorial waters out to 12 nautical miles, which would also coincide with the WHS nomination. This proposed extension would need to be published in the Government Gazette, in terms of marine protected areas, etc., for public/stakeholder comments. Should the PEIMC endorse the proposal, the matter would need to be discussed further within DEAT. Mr Cooper agreed that this would be a consultative process. The Chair stated that presently there were a number permit holders authorized to fish in these waters, and that this would need to be discussed with MCM's Compliance Section as well. He also undertook to set up a meeting for Mr Cooper and himself with the Rights Allocation Division at MCM to sensitise them in considering this request.

2.17 RAMSAR Wetland Reserve Status for the Prince Edward Islands

Mr Cooper had liaised with Mr J Dini of DEAT and stated that RAMSAR aimed to protect wetlands of importance, for any biota. He continued that in terms of the RAMSAR Convention's requirements, the PEIs met six of the eight criteria. He added that Mr Dini had indicated that a review would be required before anything could be submitted. The Directorate: Antarctica and Islands should indicate interest and obtain the necessary form from Mr Dini. Mr Cooper offered to assist with this process.

3. SACAR 3 APPLICATIONS
**** Requesting a visit to Prince Edward Island (PEI)***
 # Oceanographic cruise (ship-based)

Mr Dreyer stated that 71 persons wished to participate in the 2003 Marion relief voyage and the PEIMC authorized that the Emergency Base be used for additional accommodation. Mr Cooper commented that two chefs would be a great help.

* As regards the visit to Prince Edward, all personnel and equipment would be deployed on PEI, before any flights were undertaken to Marion, and there would only be one flight in and one flight out. Five persons for four days were authorized. On the out flight, all PEI personnel would offoad all their equipment on the ship and only then proceed to Marion. Prof Chown felt that a strong message should be conveyed to Prof Smith, in that he had previously violated several management committee policies and that he must ensure proper planning in future. Mr Cooper also added that no food would be drawn from the Marion stores and that all provisions must be allocated before departure. All visitors to PEI were also to be issued with two sets of clothing. A Group Leader for the PEI visit would be identified at the Marion Planning Meeting on 21 February 2003.

Prof Chown requested that it be ascertained from all participants whether they wished to have their passports stamped with the team, CHC and ship stamps. Mr Dreyer would be advised accordingly.

3.1 Mr R Mercer (for Prof S L Chown) *

The nine persons requested were accepted. Prof McGeoch queried the transfer of soil samples from PEI to Marion. Prof Chown advised that this had been done in the past, provided that the soil did not touch ground and went straight to the laboratory, and that it was disposed of at sea or incinerated back in South Africa. Mr Cooper asserted that the laboratory members were to be made aware of this quarantine.

3.2 Prof M N Bester

The SACAR3 was approved by the committee.

3.3 Prof V R Smith *

The Marion particulars were approved by the committee, and the PEI visit was to be arranged as outlined above (see 3 *).

3.4 Prof E A Pakhomov #

The requested Collection Permit was approved, as well as a Standard Entry Permit to allow the sixteen ship-based oceanographers (see 3.5 and 3.5) to visit the Island.

3.5 Dr S Kaehler (for Prof C D McQuaid) #

The SACAR3 was approved by the committee.

3.6 Dr I Ansorge (for Prof J R E Lutjeharms) #

The shoreline study was queried, as there were no run-offs at the part of the Island alluded to in the SACAR3.

3.7 Prof M A McGeoch

The SACAR3 was approved by the committee.

3.8 Mr H Grobler (SAWS)

The SACAR3 was approved by the committee, for Zone 2 only.

3.9 Capt V R Hilland (CHC Helicopters (Africa))

The SACAR3 was approved by the committee for all Zones, specifically for the inspection and removal of the crashed aircraft.

3.10 Mr J A Dreyer (DEAT)

The SACAR3 was approved by the committee.

3.11 Mr M Murphy (NDPW)

The SACAR3 was approved by the committee, for Zones 1 – 3, and Zone 4 for selected personnel to assist with the removal of the crashed aircraft.

3.12 Ms L Upfold (for Dr R J M Crawford)

Prof Chown queried the 90 stomach contents requested, as Rockhopper penguins were "vulnerable species". Mr Cooper stated that the 90 samples would be done during the year, not during takeover, and that the group must exercise a precautionary approach and select birds from reasonably sized colonies only.

3.13 Ms L Janse van Rensburg (for Dr A Slager-Bastos) *

The SACAR3 was approved by the committee.

3.14 Mr P Sumner

The SACAR3 was approved by the committee.

3.15 Mr H Stassen

The SACAR3 was approved by the committee, for Zones 1 and 2 only.

3.16 Prof M A McGeoch (Request to sample mice on Marion Island)

The SACAR3 was approved by the committee.

4. NEW ITEMS

Requests to participate in Marion Construction Voyage – August 2003 (see items 4.1 & 4.2):

Mr Dreyer agreed that all applications submitted should be considered on an *ad hoc* basis and supported both requests received, provided that the PEIMC approved.

4.1 Dr M N Bester

Dr Bester's request was approved by the committee.

4.2 Penguins request from National Zoological Gardens of South Africa (Pretoria Zoo)

Prof Chown indicated that the Norwegian request received a few years ago had been turned down, and that they had had facilities far better than those proposed in Doc 4.2. He was of the opinion that the birds were dying as it was too hot. Mr Cooper suggested that more information was required, such as: (1) were they looking at trends and current best practices world-wide, (2) was the Pretoria Zoo affiliated to international organizations, (3) the taxon advisory committee was to be consulted, (4) they should attempt to understand why the birds were not breeding, and (5) the quality of the facilities needed to be spelt out. He continued that this appeared to be a purely commercial need and wondered whether the Protected Areas Bill allowed the collection of animals in a SNR. The Chair was to ascertain whether educational visits were permitted in accordance with the Bill. As regards abiding with Animal Welfare prescripts, Prof McGeoch required details on the transport of the birds on the SA Agulhas and to Pretoria. Prof Chown suggested that the Zoo be advised accordingly and that a complete and detailed proposal be re-submitted for consideration.

4.3 Removal of crashed aircraft from Marion - procedures and precautions

Mr Dreyer confirmed that the removal of the crashed aircraft would be planned in consultation with the CO, CHC and NDPW once they were on the Island, and that permits would be allocated accordingly. He did not recommend the visit to Marion requested by the French pilot, Mr H Chororz. The committee agreed, however, if the visit was authorized, Mr Chororz was to remain ship-based. The Chair indicated that Mr Chororz's flight plan had been approved by Washington (USA) and not Civil Aviation (RSA), and that he would be advised that his request had not been approved.

4.4 Appointment of Assistant Conservation Officer (CO) – 2003 Marion relief voyage

Mr Cooper explained that due to the hard work required and for safety reasons, as it was necessary to go further afield, an additional CO was required. He undertook to find someone to undertake this task. Prof Chimimba said that filing this his students could assist, as no-one on the PEIMC was in a position to do so. Mr Cooper was also to be advised on the team CO for the year.

4.5 Visit to Marion Island (Capt D Johnson – B A pilot)

This visit was not approved by the PEIMC and Prof Chown suggested that Capt Johnson be sent some information documents and pictures, and that he was to acknowledge SANAP and the photographers accordingly.

4.6 Marion Island Conservation Officer's report – December 2002

As regards the blackout blinds, Prof Chown advised that glue, Velcro and blackout material was to be purchased to go down for installation by the team CO and Diesel Mechanic, but that in the interim black plastic bags on Marion were to be used. The CO report (Doc 4.6) could be sent to Mr D Oschadleus of SAFRING for advice. As regards the isopods, Prof Chown recommended that the whole area under the Wet Laboratory be sprayed immediately, as well as under the Brown Store (with the Diesel Mechanic's approval). He would provide more information, if necessary.

4.7 Feedback on SANAP's future

With reference to the future of SANAP, the Chair stared that there were various options currently under consideration, as a result of the DG and Minister's recent visit to Antarctica, which had been a great success. Dr A Paterson from the Department of Science and Technology would become involved in the management of SANAP and a Cabinet Memorandum would be submitted in due course.

5. DATE OF NEXT MEETING

No date was set for the next meeting.

6. CLOSING

The Chair thanked the committee members for their time and effort in attending the meeting, as he was aware that they were working within very tight schedules. Prof Chown thanked the Chair on behalf of the PEIMC.

Mr H Valentine
CHAIR: PEIMC

DATE:

Doc 2.1A

REPUBLIC OF SOUTH AFRICA

NATIONAL ENVIRONMENTAL MANAGEMENT: PROTECTED AREAS BILL

(As introduced in the National Assembly as a section 76 -Bill; explanatory summary of Bill published in Government Gazette No. of) (The English text is the official text of the Bill)

(MINISTER OF ENVIRONMENTAL AFFAIRS)

[B - 2003]

BILL

To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co- operation and public consultation in matters concerning protected areas; for the continued existence, governance and functions of South African National Parks; and for matters in connection therewith.

BE IT THEREFORE ENACTED by the Parliament of the Republic of South Africa as follows:—

ARRANGEMENT OF SECTIONS

Sections

CHAPTER 3

DECLARATION OF PROTECTED AREAS

Part 1

Special nature reserves

Part 2

National parks

CHAPTER 1

INTERPETATION, OBJECTIVES AND APPLICATION OF ACT

Definitions

1. (1) In this Act, unless the context indicates otherwise—

"aircraft" means an airborne craft of any type whatsoever, whether self-propelled or not, and includes a hovercraft;

"Biodiversity Act" means the National Environmental Management: Biodiversity Act, 2003;

"biological diversity" or **"biodiversity"** has the meaning ascribed to it in section 1 of the Biodiversity Act;

"biological resource" means any resource consisting of—

(a) a living or dead animal, plant or other organism of an indigenous species;

(b) a derivative of such an animal, plant or other organism, as defined in section 1 of the Biodiversity Act; or

(c) any genetic material of such animal, plant or other organism, as defined in section 1 of the Biodiversity Act;

"Board" means the Board of South African National Parks referred to in section 57;

"Chief Executive Officer" means the Chief Executive Officer of South African National Parks appointed in terms of section 72;

"declare", when used in relation to—

(a) the Minister, means declare by notice in the *Government Gazette*; and

(b) the MEC, means declare by notice in the *Provincial Gazette* ;

"delegation", in relation to a duty, includes an instruction to perform the duty;

"designate", when used in relation to—

(a) the Minister, means designate by notice in the *Government Gazette*;

(b) the MEC, means designate by notice in the *Provincial Gazette*;

"Department" means the national Dep artment of Environmental Affairs and Tourism;

"Director-General" means the Director- General of the Department;

"ecological integrity" means the sum of the biological, physical and chemical components of an ecosystem, and their interactions which maintain the ecosystem and its products, functions and attributes;

"ecosystem" means a dynamic complex of animal, plant and micro-organism communities and their non-living environment interacting as a functional unit;

"*Gazette*", when used in relation to—

(a) the Minister, means the *Government Gazette*; and

(b) the MEC means the *Provincial Gazette* of that province;

"habitat", in relation to a specific species, means a place or type of site where such species naturally occurs;

"indigenous species", in relation to a specific protected area, means a species that occurs, or has historically occurred, naturally in a free state in nature within that specific protected area, but excludes a species introduced in that protected area as a result of human activity;

"local community" means any community of people living or having rights or interests in a distinct geographical area;

"local protected area" means a nature reserve or protected environment managed by a municipality;

"management", in relation to a protected area, inclu des control, protection, conservation, maintenance and rehabilitation of the protected area with due regard to the use and extraction of biological resources, community based practices and benefit sharing activities in the area in a manner consistent with the Biodiversity Act;

"management authority", in relation to a protected area, means the organ of state or other institution in which the authority to manage the protected area is vested;

"marine protected area" means an area declared as a marine protected area in terms of section 43 of the Marine Living Resources Act, 1998 (Act No.18 of 1998);

"MEC" means the member of the Executive Council of a province in whose portfolio provincial protected areas in the Province fall;

"Minister" means the Cabinet member responsible for national environmental management;

"municipality" means a municipality established in terms of the Local Government: Municipal Structures Act, 1998 (Act No. 117 of 1998);

"National Environmental Management Act" means the National Environmental

Management Act, 1998 (Act No. 107 of 1998);

"national environmental management principles" means the principles contained in section 2 of the National Environmental Management Act;

"national park" means—

(a) an area which was a park in terms of the National Parks Act (Act No.57 of 1976), immediately before the repeal of that Act by section 90(1) of this Act, and includes a park established in terms of an agreement between a local community and the Minister which has been ratified by Parliament;

(b) an area which was a lake development area in terms of the Lake Areas Development Act, 1975 (Act No.39 of 1975), immediately before the repeal of that Act by section 90(1) of this Act; or

(c) an area declared or regarded as having been declared in terms of section 20 as a national park,

and includes an area declared in terms of section 20 as part of an area referred to in paragraph *(a)*, *(b)* or *(c)* above;

"national protected area" means—

(a) a special nature reserve;

(b) a national park; or

(c) a nature reserve or protected environment—

(i) managed by a national organ of state; or

(ii) which falls under the jurisdiction of the Minister for any other reason;

"nature reserve" means—

(a) an area declared, or regarded as having been declared, in terms of section 23 as a nature reserve; or

(b) an area which before or after the commencement of this Act was or is declared or designated in terms of provincial legislation for a purpose for which that area could in terms of section 23(2) be declared as a nature reserve,

and includes an area declared in terms of section 23(1) as part of an area referred to in paragraph *(a)* or *(b)* above;

"organ of state" has the meaning assigned to it in section 239 of the Constitution;

"prescribe" means prescribe by the Minister by regulation in terms of section 86;

"protected area" means any of the protected areas referred to in section 9;

"protected environment" means–

(a) an area declared, or regarded as having been declared, in terms of section 28 as a protected environment; or

(b) an area which before or after the commencement of this Act was or is declared or designated in terms of provincial legislation for a purpose for which that area could in terms of section 28(2) be declared as a protected environment,

and includes an area declared in terms of section 28(1) as part of an area referred to in paragraph *(a)* or *(b)* above;

"provincial protected area" means a nature reserve or protected environment—

(a) managed by a provincial organ of state; or

(b) which falls under the jurisdiction of a province for any other reason;

"Public Finance Management Act" means the Public Finance Management Act, 1999 (Act No. 1 of 1999);

"special nature reserve" means—

(a) an area which was a special nature reserve in terms of the National Conservati on Act (Act No.73 of 1989), immediately before the repeal of section 18 of that Act by section 92(1) of this Act; or

(b) an area declared, or regarded as having been declared, in terms of section 18 as a special nature reserve,

and includes an area declared in terms of section 18 as part of an area referred to in paragraph *(a)* or *(b)* above;

"species" means a kind of animal, plant or other organism, including any subspecies, cultivar, variety, geographic race, strain, hybrid or geographically separate population;

"subordinate legislation" means any regulation made or notice issued under or in terms of this Act;

"this Act" includes any subordinate legislation;

"wilderness area" means an area designated in terms of section 22 or 26 for the purpose of retaining an intrinsically wild appearance and character, or capable of being restored to such and which is undeveloped and roadless, without permanent improvements or human habitation;

"world heritage site" means a world heritage site in terms of the World Heritage Convention Act, 1999 (Act No. 49 of 1999).

(2) In this Act, words or expressions derived from words or expressions defined in subsection (1) have corresponding meanings unless the context indicates otherwise.

Objectives of Act

2. The objectives of this Act are—

(a) to provide, within the framework of national legislation, including the National Environmental Management Act, for the declaration and management of protected areas;

(b) to provide for co-operative governance in the declaration and management of protected areas;

(c) to effect a national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity;

(d) to provide for a representative network of protected areas on state land, private land and communal land; and

(e) to provide for the continued existence of South African National Parks.

State trustee of protected areas

3. In fulfilling the rights contained in section 24 of the Constitution, the state through the organs of state implementing legislation applicable to protected areas, must—

(a) act as the trustee of protected areas in the Republic; and

(b) implement this Act in partnership with the people to achieve the progressive realisation of those rights.

Application of Act

4. (1) This Act also applies—

(a) in the Prince Edward Islands referred to in section 1 of the Prince Edward Islands Act, 1948 (Act No. 43 of 1948); and

(b) to the exclusive economic zone and continental shelf of the Republic, respectively referred to in sections 7 and 8 of the Maritime Zones Act, 1994 (Act No. 15 of 1994).

(2) This Act binds all organs of state.

Application of National Environmental Management Act

5. (1) This Act must—

(a) be interpreted and applied in accordance with the national environmental management principles; and

(b) be read with the applicable provisions of the National Environmental Management Act.

(2) Chapter 4 of the National Environmental Management Act applies to the resolution of conflicts arising from the implementation of this Act.

Application of Biodiversity Act in protected areas

6. This Act must, in relation to any protected area, be read, interpreted and applied in conjunction with the Biodiversity Act.

Conflicts with other legislation

7. (1) In the event of any conflict between a section of this Act and —

(a) other national legislation, the section of this Act prevails if the conflict specifically concerns the management or development of protected areas;

(b) provincial legislation, the conflict must be resolved in te rms of section 146 of the

Constitution; and

(c) a municipal by-law, the section of this Act prevails.

(2) In the event of any conflict between subordinate legislation issued in terms of this Act and—

(a) an Act of Parliament, the Act of Parliament preva ils;

(b) provincial legislation, the conflict must be resolved in terms of section 146 of the Constitution; and

(c) a municipal by-law, the subordinate legislation issued in terms of this Act prevails.

(3) For the proper application of subsection (2)*(b)* the Minister must, in terms of section 146(6) of the Constitution, submit all subordinate legislation issued in terms of this Act and which affects provinces, to the National Council of Provinces for approval.

Status of provincial legislation on provincial and local protected areas

8. This Act does not affect the implementation of provincial legislation regulating matters with regard to provincial or local protected areas to the extent that such legislation—

(a) regulates matters not covered by this Act;

(b) is consistent with this Act; or

(c) prevails over this Act in terms of section 146 of the Constitution.

CHAPTER 2

SYSTEM OF PROTECTED AREAS IN SOUTH AFRICA

Kinds of protected areas

9. The system of protected areas in South Africa consists of the following kinds of protected areas:

(a) special nature reserves, national parks, nature reserves and protected environments;

(b) world heritage sites;

(c) marine protected areas;

(d) specially protected forest areas, forest nature reserves and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act No. 84 of 1998); and

(e) mountain catchment areas declared in terms of the Mountain Catchment Areas Act,1970 (Act No. 63 of 1970).

Register of Protected Areas

10. (1) The Minister must maintain a register called the Register of Protected Areas.

(2) The Register must—

(a) contain a list of all protected areas;

(b) indicate the kind of protected area in each case; and

(c) contain any other information determined by the Minister.

(3) For the purposes of subsection (2) *(b)* a protected area declared in terms of provincial legislation must be included in the Register as a nature reserve or protected environment depending on the purpose for which it was declared.

(4) The Cabinet member responsible for the administration of the National Forests Act, 1998 (Act No. 84 of 1998), and the MEC must notify the Minister of all areas declared as protected areas in terms of that Act or provincial legislation, as the case

may be.

Norms and standards

11. (1) The Minister may prescribe–

(a) norms and standards for the achievement of any of the objectives of this Act, including for the management and development of protected areas referred to in section 9*(a)*, *(b)* and *(c)*;

(b) indicators to measure compliance with those norms and standards; and

(c) the requirement for the management authorities of those protected areas to report on these indicators to the Minister.

(2) Before issuing norms and standards and setting indicators for provincial or local protected areas, the Minister must consult—

(a) the MEC of each province in which those norms and standards will apply; and

(b) the relevant local government.

(3) Norms and standards may apply—

(a) nationwide;

(b) in a specific protected area only;

(c) to a specific management authority or category of management authorities only.

(4) Different norms and standards may be issued for—

(a) different areas; or

(b) different management authorities or categories of management authorities.

Provincial protected areas

12. A protected area which immediately before this section took effect was reserved or protected in terms of provincial legislation for any purpose for which an area could in terms of this Act be declared as a nature reserve or protected environment, must be regarded to be a nature reserve or protected environment for the purpose of this Act.

World heritage sites

13. (1) Chapter 1 and this Chapter apply to world heritage sites, declared as such in terms of the World Heritage Convention Act, 1999 (Act No. 49 of 1999).

(2) The other provisions of this Act do not apply to world heritage sites except where expressly or by necessary implication provided otherwise.

Marine protected areas

14. (1) Chapter 1, this Chapter and section 48 apply to marine protected areas, declared as such in terms of section 43 of the Marine Living Resources Act (Act No. 18 of 1998).

(2) The other provisions of this Act do not apply to marine protected areas, but if a marine protected area has been included in a special nature reserve, national park or nature reserve, such area must be managed and regulated as part of the special nature reserve, national park or nature reserve in terms of this Act.

Specially protected forest areas, forest nature reserves and forest wilderness areas

15. (1) Chapter 1, this Chapter and section 48 apply to specially protected forest areas, forest nature reserves or forest wilderness areas, declared as such in terms of section 8 of the National Forests Act, 1998 (Act No. 84 of 1998).

(2) The other provisions of this Act do not apply to specially protected forest areas, forest nature reserves or forest wilderness areas, but if any such area has been declared as or included in a special nature reserve, national park or nature reserve, such area must be managed as, or as part of, the special nature reserve, national park or nature reserve in terms of this Act in accordance with an agreement concluded between the Minister and the Cabinet member responsible for forestry.

Mountain catchment areas

16. Chapter 1 and this Chapter apply to mountain catchment areas, declared as such in terms of the Mountain Catchment Areas Act, 1970 (Act No. 63 of 1970).

CHAPTER 3

DECLARATION OF PROTECTED AREAS

Purpose of protected areas

17. The purposes of the declaration of areas as protected areas are—

(a) to adequately protect ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes in a system of protected areas;

(b) to preserve the ecological integrity of those areas;

(c) to conserve biodiversity in those areas;

(d) to adequately protect areas representative of all ecosystems, habitats and species naturally occurring in South Africa;

(e) to protect South Africa's threatened or rare species;

(f) to protect an area which is vulnerable or ecologically sensitive;

(g) to assist in ensuring the sustained supply of environmental goods and services;

(h) to provide for the sustainable use of natural and biological resources;

(i) to create or augment destinations for nature based tourism;

(j) to manage the interrelationship between natural environmental biodiversity, human settlement and economic development; or

(k) generally, to contribute to human, social, cultural, spiritual and economic development.

Part 1

Special nature reserves

Declaration of special nature reserves

18. (1) The Minister may by notice in the *Gazette*—

(a) declare an area specified in the notice—

(i) as a special nature reserve; or

(ii) as part of an existing special nature reserve; and

(b) assign a name to such special nature reserve.

(2) A declaration under subsection (1)*(a)* may only be issued—

(a) to protect highly sensitive, outstanding ecosystems, species, geological or physical features in the area; and

(b) to make the area primarily available for scientific research or environmental monitoring.

(3) A notice under subsection (1)*(a)* may be issued in respect of private land if the owner has consented to the declaration by way of a written agreement with the Minister.

(4) An area which was a special nature reserve immediately before this section took effect must for purposes of this section be regarded as having been declared as such in terms of this section.

Withdrawal of declarations or exclusion of parts of special nature reserves

19. The declaration of an area as a special nature reserve, or as part of an existing special nature reserve, may not be withdrawn and no part of a special nature reserve may be excluded from the reserve except by resolution of the National Assembly.

Part 2

National parks

Declaration of national parks

20. (1) The Minister may by notice in the *Gazette* –

(a) declare an area specified in the notice–

(i) as a national park; or

(ii) as part of an existing national park; and

(b) assign a name to the national park.

(2) A declaration under subsection (1)*(a)* may only be issued—

(a) to protect—

(i) the area if the area is of national or international biodiversity importance or is or contains a viable, representative sample of South Africa's natural systems, scenic areas or cultural heritage sites; or

(ii) the ecological integrity of one or more ecosystems in the area;

(b) to prevent exploitation or occupation inconsistent with the protection of the ecological integrity of the area;

(c) to provide spiritual, scientific, educational, recreational and tourism opportunities which are environmentally compatible; and where feasible,

(d) to contribute to economic development.

(3) A notice under subsection (1)*(a)* may be issued in respect of private land if the owner has consented to the declaration by way of a written agreement with the Minister or South African National Parks.

(4) The Minister must notify the relevant MEC of any declaration of an area in terms of subsection (1).

(5) An area which was a national park when this section took effect must for purposes of this section be regarded as having been declared as such in terms of this section.

Withdrawal of declaration or exclusion of part of national park

21. (1) A declaration under section 20 may only be withdrawn—

(a) by resolution of the National Assembly; or

(b) in terms of subsection (2).

(2) If the Minister, or the other party to an agreement, withdraws from an agreement referred to in section 20(3), the Minister must withdraw the declaration in terms of which the land in question was declared a national park or part of an existing national park.

Designation of national park as wilderness area

22. (1) The Minister may by notice in the *Gazette* designate any national park, or part thereof, as a wilderness area.

(2) A designation under subsection (1) may only be issued—

(a) to protect and maintain the natural character of the environment, biodiversity, and associated natural and cultural resources;

(b) to provide outstanding opportunities for solitude;

(c) to control access which, if allowed, may only be by non-mechanized means.

(3) Before issuing a designation under subsection (1), the Minister must consult the management authority of the park.

Part 3

Nature reserves

Declaration of nature reserve

23. (1) The Minister or the MEC may by notice in the *Gazette* –

(a) declare an area specified in the notice –

(i) as a nature reserve; or

(ii) as part of an existing nature reserve; and

(b) assign a name to the nature reserve.

(2) A declaration under subsection (1)*(a)* may only be issued—

(a) to supplement the system of national parks in South Africa;

(b) to protect the area if the area –

(i) has significant natural features or biodiversity;

(ii) is of scientific, cultural, historical or archaeological interest; or

(iii) is in need of long term protection for the maintenance of its biodiversity;

(c) to provide for a sustainable flow of natural products and services to meet the needs of a local community;

(d) to enable the continuation of such traditional consumptive uses as are sustainable; or

(e) to provide for nature based recreation and tourism opportunities.

(3) A notice under subsection (1)*(a)* may be issued in respect of private land if the owner has consented to the declaration by way of a written agreement with the Minister or the MEC.

(4) No area which is or forms part of a special nature reserve or national park may be declared as a nature reserve or as part of an existing nature reserve.

(5) An area which was a nature reserve immediately before this section took effect must for purposes of this section be regarded as having been declared as such in terms of this section.

Withdrawal of declaration or exclusion of part of nature reserve

24. (1) A declaration under section 23(1) may only be withdrawn—

(a) in the case of a declaration by the Minister, by resolution of the National Assembly;

(b) in the case of a declaration by an MEC, by resolution of the legislature of the relevant province; or

(c) in terms of subsection (2).

(2) If the Minister or MEC, or the other party to an agreement, withdraws from an agreement referred to in section 23(3), the Minister or MEC must withdraw the notice in terms of which the land in question was declared a nature reserve or part of an existing nature reserve.

Designation of nature reserve as specific type

25. The Minister or the MEC may, by notice in the *Gazette*, designate a nature reserve as a specific type of nature reserve in accordance with such uniform system of types as may be prescribed.

Designation of nature reserve as wilderness area

26. (1) The Minister or MEC may, by notice in the *Gazette*, designate a nature reserve or part thereof as a wilderness area.

(2) A notice under subsection (1) may only be issued—

(a) to protect and maintain the natural character of the environment, biodiversity, and associated natural and cultural resources;

(b) to provide outstanding opportunities for solitude;

(c) to control access which, if allowed, may only be by non-mechanized means.

(3) Before designating a nature reserve or part of nature reserve as a wilderness area, the Minister or MEC must consult the management authority of the nature reserve.

Notice to be given to Minister of provincial declarations

27. The MEC must promptly forward to the Minister a copy of each notice issued under section 23, 24, 25 or 26.

Part 4

Protected environments

Declaration of protected environment

28. (1) The Minister or the MEC may by notice in the *Gazette*—

(a) declare any area specified in the notice—

(i) as a protected environment; or

(ii) as part of an existing protected environment; and *(b)* assign a name to the protected environment.

(2) A declaration under subsection (1)*(a)* may only be issued—

(a) to regulate the area as a buffer zone for the protection of a special nature reserve, national park, world heritage site or nature reserve;

(b) to enable owners of land to take collective action to conserve biodiversity on their land and to seek legal recognition therefor;

(c) to protect the area if the area is sensitive to development due to its —

(i) biological diversity;

(ii) natural characteristics;

(iii) scientific, cultural, historical or archeological value; or

(iv) scenic value;

(d) to protect a specific ecosystem outside of a special nature reserve, national park, world heritage site or nature reserve;

(e) to ensure that the use of natural resources in the area is sustainable; or

(f) to control change in land use in the area if the area is earmarked for declaration as, or inclusion in, a national park or nature reserve.

(3) A notice under subsection (1)*(a)* may be issued in respect of private land if the owner has requested or consented to a declaration contemplated in subsection (1)(a) and the Minister or the MEC has given the owner notice in writing in terms of section 33.

(4) No area which is or forms part of a special nature reserve, national park or nature reserve may be declared as a protected environment or as part of an existing protected environment.

(5) The declaration of an area as a protected environment for purposes of subsection (2)*(f)*, lapses at the expiry of three years from the date of publication of the notice contemplated in subsection (1), but the Minister or the MEC may by notice in the *Gazette* extend that period for not more than one year.

(6) An area ceases to be a protected environment if that area is declared as, or included into, a national park or nature reserve or part thereof.

(7) An area which was a protected environment immediately before this

section took effect must for purposes of this section be regarded as having been declared as such in terms of this section.

Withdrawal of declaration or exclusion of part of protected environment

29. The Minister or the MEC may by notice in the *Gazette*—

(a) withdraw the declaration, issued under section 28, of an area as a protected environment or as part of an existing protected environment; or

(b) exclude any part of a protected environment from the area.

Notice to be given to Minister of provincial declarations

30. The MEC must promptly forward to the Minister a copy of each notice issued under section 28 or 29.

Part 5

Consultation process

Consultation by Minister

31. Subject to section 34, before issuing a notice under section 18(1), 20(1), 23(1), 28(1) or 29 (1), the Minister may follow such consultative process as may be appropriate in the circumstances, but must—

(a) consult all national organs of state affected by the proposed notice;

(b) in accordance with the principles of co-operative government as set out in Chapter 3 of the Constitution, consult—

(i) the MEC of the province concerned; and

(ii) the municipality in which the area concerned is situated; and

(c) follow a process of public participation in accordance with sec tion 33.

Consultation by MEC

32. Subject to section 34, before issuing a notice under section 23(1), 28(1) or 29(1), the MEC may follow such consultative process as may be appropriate in the circumstances, but must—

(a) consult in accordance with the p rinciples of co-operative government as set out in Chapter 3 of the Constitution—

(i) the Minister and other national organs of state affected by the proposed notice; and

(ii) the municipality in which the area concerned is situated;

(b) consult all provincial organs of state affected by any proposed notice; and

(c) follow a process of public participation in accordance with section 33.

Public participation

33. (1) The Minister or the MEC must—

(a) publish the intention to issue a notice contemplated in section 31 or 32, in the *Gazette* and in at least two newspaper distributed in the area in which the affected area is situated; and

(b) if it is proposed to declare any private land as a protected environment, send a copy of the proposed notice by registered post to the last known postal address of each owner of land within the area to be declared, as well as to each holder of rights to such land.

(2) The publication contemplated in subsection (1) must—

(a) invite members of the public and the persons referred to in subsection (1)*(b)*, if applicable, to submit to the Minister or MEC written representations on or objections to the proposed notice within 60 days from the date of publication in the *Gazette*; and

(b) contain sufficient information to enable me mbers of the public to submit meaningful representations or objections, and must include a clear indication of the area that will be affected by the declaration.

(3) The Minister or MEC may in appropriate circumstances allow any interested person to present oral representations or objections to the Minister or the MEC, or to a person designated by the Minister or MEC, but such representations or objections must be allowed where the proposed notice will affect the rights or interests of a local community.

(4) The Minister or MEC must give due consideration to all representations or objections received or presented before publishing the relevant notice.

Affected organs of state, communities and beneficiaries

34. (1) If it is proposed to declare an area under section 18(1) or 20(1) as a special nature reserve or a national park, or as part thereof, and that area consists of or includes—

(a) land owned by the state, the Minister may declare that area only—

(i) with the concurrence of the Cabinet member responsible for the administration of that land, if that land is administered by the national executive; or

(ii) after consultation with the MEC responsible for the administration of that land, if that land is administered by a provincial executive;

(b) land which is held in trust by the state or an organ of state for a community or other beneficiary, the Minister may declare that area only with the concurrence of the trustee.

(2) If it is proposed to declare an area under section 23(1) or 28(1) as a nature reserve or a protected environment, or as part thereof, and that area consists of or includes—

(a) land owned by the State, the Minister or the MEC may declare that area only with the concurrence of the Cabinet member or MEC responsible for the administration of that land;

(b) land which is held in trust by the state or an organ of state for a community or other beneficiary, the Minister or the MEC may declare that area only with the concurrence of the trustee.

Part 6

General

Initiation of declaration

35. (1) The declaration of private land as a special nature reserve, national park, nature reserve or protected environment, or as part thereof, may be initiated either by the Minister, the MEC or the owners of that land acting individually or collectively.

(2) Any request received by the Minister or an MEC from the owners of private land for their land to be declared must be considered by the Minister or MEC.

Endorsement by Registrar of Deeds

36. (1) The Minister or the MEC, as the case may be, must in writing notify the Registrar of Deeds whenever an area is declared as a special nature reserve, national park, nature reserve or protected environment, or as part thereof, or in respect of which a declaration has been withdrawn or altered.

(2) The notification must include a description of the land involved.

(3) On receipt of the notification, the Registrar of Deeds must record any such declaration, withdrawal or alteration in relevant registers and documents in terms of section 3(1)(w) of the Deeds Registries Act, 1937 (Act No. 47 of 1937).

CHAPTER 4

MANAGEMENT OF PROTECTED AREAS

Application of Chapter

37. Except where expressly stated otherwise in this Chapter, this Chapter only applies to a protected area which is a special nature reserve, national park or nature reserve, and the expressions "protected area", "national protected area", "provincial protected area" and "local protected area" must be construed accordingly.

Part 1

Management authorities and management plans

Management authorities

38. (1) *(a)* The Minister must assign, in writing, the management of a national protected area to an organ of state or any other institution.

(b) Notwithstanding paragraph *(a)* the Minister must assign the management of a national park to—

(i) South African National Parks; or

(ii) another organ of state, subjects to the prescripts set by the Minister.

(2) The MEC must assign, in writing, the management of a provincial protected area in the province to an organ of state.

(3) The organ of state or other institution to whom the management of a protected area has been assigned in terms of subsection (1) or (2) is the management authority of the area for the purposes of this Act.

Preparation of management plan

39. (1) The Minister or the MEC may make an assignment in terms of section 38(1) or (2) only with the concurrence of the prospective management authority.

(2) The management authority assigned in terms of section 38(1)(or (2) must, within 12 months of the assignment, submit a management plan for the protected area for approval by the Minister or the MEC.

(3) When preparing a management plan for a protected area, the prospective management authority must consult municipalities, other organs of state and affected parties which have an interest in the area.

(4) A management plan must take into account any applicable aspects of the integrated development plan of the municipality in which the protected area is situated.

Management criteria

40. (1) The management authority must manage the area—

(a) exclusively for the purpose for which it was declared; and

(b) in accordance with—

(i) the management plan for the area;

(ii) this Act, the Biodiversity Act, the National Environmental Management Act and any other applicable national legislation;

(iii) any applicable provincial legislation, in the case of a provincial protected area; and

(iv) any applicable municipal by-laws, in the case of a local protected area.

(2) The management authority may amend the management plan by agreement with the Minister or the MEC, as the case may be.

Management plan

41. (1) The object of a management plan is to ensure the protection, conservation and management of the protected area concerned in a manner which is consistent with the objectives of this Act and for the purpose it was declared.

(2) A management plan must contain at least—

(a) a co-ordinated policy framework;

(b) such planning measures, controls and performance criteria as may be prescribed;

(c) a programme for the implementation of th e plan and its costing; and

(d) procedures for public participation.

(3) Management plans may include subsidiary plans, and the Minister or MEC may approve the management plan or any subsidiary plan in whole or in part.

Co-management of protected area

42. (1) *(a)* The management authority may enter into an agreement with another organ of state, a local community, an individual or other party for—

(i) the co-management of the area by the parties; or

(ii) the regulation of human activities that affect th e environment in the area.

(b) The co-management contemplated in paragraph *(a)* may not lead to fragmentation or duplication of management functions.

(2) A co-management agreement may provide for—

(a) the delegation of powers by the management authority to the other party to the agreement;

(b) the apportionment of any income generated from the management of the protected area or other form of benefit sharing between the parties;

(c) the collection, catching or use of biological resources in the area;

(d) access to sites of cultural or religious significance in the area;

(e) occupation of the protected area or portions thereof; and

(f) any other relevant matter.

(3) A co-management agreement must—

(a) provide for the harmonisation and integration of th e management of cultural heritage resources in the protected area by the management authority; and

(b) be consistent with the other provisions of this Act.

(4) The Minister or the MEC, as the case may be, may cancel a co - management agreement after giving reasonable notice to the parties if the agreement is not effective or is inhibiting the attainment of any of the management objectives of the protected area.

Part 2

Monitoring and supervision

Performance indicators

43. (1) The Minister may establish indicators for monitoring performance with regard to the management of national protected areas and the conservation of biodiversity in those areas.

(2) The MEC may establish indicators for monitoring performance with regard to the management of provincial and local protected areas and the conservation of biodiversity in those areas.

(3) The management authority of a protected area must—

(a) monitor the area against the indicators set in terms of subsection (1) or (2); and

(b) annually report its findings to the Minister or MEC or a person designated by the Minister or MEC.

(4) The Minister or MEC may appoint external auditors to monitor a management authority's compliance with the overall objectives of the management plan.

Termination of mandate to manage protected area

44. (1) If the management authority of a protected area is not fulfilling its duties in terms of the management plan for the area, or is under-performing with regard to the management of the area or the biodiversity of the area, the Minister or the MEC, as the case may be, must—

(a) notify the management authority in writing of the failure to fulfill its duties or of the under-performance; and

(b) direct the management authority to take corrective steps set out in the notice within a specified time.

(2) If the management authority fails to take the required steps, the

Minister or MEC may—

(a) terminate that management authority's mandate to manage the protected area; and

(b) assign another organ of state as the management authority of the area.

(3) The Minister implements this section in relation to national protected areas and the MEC implements this section in relation to provincial and local protected areas.

Part 3

Access to protected areas

Access to special nature reserve

45. (1) No person may—

(a) enter a special nature reserve;

(b) reside in a special nature reserve; or

(c) perform any activity in a special nature reserve.

(2) Subsection (1) does not apply to—

(a) an official of the Department or another organ of state designated by the Minister in writing to monitor—

(i) the state of conservation of the reserve or of the biodiversity in the reserve; or

(ii) the implementation of the management plan and this Act;

(b) any police, customs or excise officer entering the area in the execution of official duties; or

(c) a person acting in terms of an exemption granted under subsection (3).

(3) The management authority of a special nature reserve may, in writing and on conditions determined by it after consulting the Minister, grant exemption from a provision of subsection (1) to—

(a) a scientist to perform scientific work;

(b) a person to perform an activity related to the conservation of the reserve or of the biodiversity in the reserve;

(c) an official of the management authority to perform official duties; or

(d) an official of an organ of state to perform official duties

Access to national park, nature reserve and world heritage site

46. (1) Despite any other legislation, no person may without the written permission of the management authority of a national park, nature reserve or world heritage site enter or reside in the park, reserve or site.

(2) Subsection (1) does not apply to—

(a) an official of the Department or of another organ of state designated by t he Minister, or, in the case of a provincial or local nature reserve, a person designated the MEC, to monitor—

(i) the state of conservation of the park, reserve or site or of the biodiversity in the park, reserve or site; or

(ii) the implementation of the management plan and this Act;

(b) an official of the management authority to perform official duties in the park, reserve or site;

(c) any police, customs or excise officer entering the park, reserve or site in the execution of official duties;

(d) the holder of a vested right to enter the park, reserve or site, or

(e) a person traveling through the park, reserve or site by rail, as long as that person stays on the train or within the precincts of any railway station.

(3) If the management authority of a national park, nature reserve or world heritage site refuses permission to an official of an organ of state to enter the park, reserve or site for the performance of official duties, the Minister may—

(a) reconsider the matter; and

(b) either confirm the refusal or grant the permission.

Use of aircraft in special nature reserve, national park or world heritage site

47. (1) A special nature reserve, national park or world heritage site includes the air space above the reserve, park or site to a level of 1500 feet above ground level.

(2) No person may land or take off in an aircraft in a special nature reserve, national park or world heritage site, except—

(a) on or from a landing field designated by the management authority of that special nature reserve, national park or world heritage site; and

(b) with the permission of, and on conditions determined by, the management authority.

(3) No person may fly over a special nature reserve, national park or world heritage site at an altitude of less than 1500 feet, except as may be necessary for the purpose of subsection (2).

(4) Subsections (2) and (3) do not apply—

(a) in an emergency; or

(b) to a person acting on the instructions of the management authority.

(5) The Minister, acting with the concurrence of the Cabinet member responsible for civil aviation, may prescribe further reasonable restrictions on flying over protected areas.

Part 4

Restrictions

Prospecting and mining activities in protected area

48. (1) Despite other legislation, no person may conduct commercial prospecting or mining activities—

(a) in a special nature reserve, national park or nature reserve;

(b) in a protected environment without the written permission of the Minister and the Cabinet member responsible for minerals and energy affairs; or

(c) in a protected area referred to in section 9 *(b)*, *(c)* or *(d)*.

(2) Subsection (1) does not affect mining activities which were lawfully conducted immediately before this section took effect.

Regulation or restriction of activities in special nature reserve, national park and nature reserve

49. Activities in special nature reserves, national parks and nature reserves are regulated or restricted to the extent prescribed by—

(a) regulations made under section 86;

(b) regulations made under section 87, in the case of provincial and local nature reserves;

(c) by-laws made by the relevant municipality, in the case of local nature reserves; and

(d) internal rules made by the managing authority of the area under section 52.

Commercial and community activities in national park, nature reserve and world heritage site

50. (1) The management authority of a national park, nature reserve or world heritage site may, despite any regulation or by-law referred to in section 49, but subject to the management plan of the park, reserve or site—

(a) carry out or allow—

(i) a commercial activity in the park, reserve or site; or

(ii) an activity in the park, reserve or site aimed at raising revenue;

(b) enter into a written agreement with a local community inside or adjacent to the park, reserve or site to allow members of the community to harvest in a sustainable manner biological resources in the park, reserve or site; and

(c) set norms and standards for any activity allowed in terms of paragraph *(a)* or *(b)*.

(2) An activity allowed in terms of subsection (1) *(a)* or *(b)* may not negatively affect the survival of any species in or significantly disrupt the integrity of the ecological systems of the national park, nature reserve or world heritage site.

(3) The management authority of the national park, nature reserve or world heritage site must establish systems to monitor—

(a) the impact of activities allowed in terms of subsection (1)*(a)* or *(b)* on the park,

reserve or site and its biodiversity; and

(b) compliance with—

(i) any agreement entered into in terms of subsection (1)*(b)*; and

(ii) any norms and standards set in terms of subsection (1)*(c)*.

(4) Any activity or harvesting contemplated in subsection (1) *(a)* or *(b)* must be regarded as having been approved in terms of this section if that activity or harvesting was lawfully being carried out on the date immediately before—

(a) this section took effect; or

(b) the declaration of the area as a national park, nature reserve or world heritage site or as part of an existing national park, nature reserve or world heritage site.

(5) No development, construction or farming may be permitted in a national park, nature reserve or world heritage site without the prior, written approval of the management authority.

Regulation or restriction of development and other activities in protected environment

51. The Minister or the MEC may, by notice in the *Gazette*, restrict or regulate in a protected environment under the jurisdiction of the Minister or the MEC—

(a) development that may be inappropriate for the area given the purpose for which the area was declared; and

(b) the carrying out of other activities that may impede such purpose.

Internal rules

52. (1) The management authority of a national park, nature reserve or world heritage site may, in accordance with prescribed norms and standards, make rules for the proper administration of the area.

(2) Rules made under subsection (1)—

(a) must be consistent with this Act and the management plan for the area;

(b) bind all persons in the area, including visitors; and

(c) may, as a condition for entry, provide for the imposition of fines for breaches of the rules.

Certain rights and entitlements to be respected

53. (1) Sections 45, 46, 49, 50, 51 or 52 may not be applied in a manner that would obstruct the resolution of issues relating to land rights dealt with in terms of—

(a) the Restitution of Land Rights Act, 1994 (Act No. 22 of 1994), and on the basis that a protected area should be retained in its original state in order to achieve the effective conservation of the area having regard to economic sustainability and holistic and coherent management by the management authority; and

(b) the provision of essential services and the acquisition of ser vitudes for that purpose.

(2) A person may exercise a right that that person may have to water in a public stream in a protected area, but subject to such conditions as may be prescribed by the Minister with the concurrence of the Cabinet member responsible for water affairs.

CHAPTER 5

SOUTH AFRICAN NATIONAL PARKS

Part 1

Continued existence and functions of South African National Parks

Continued existence

54. (1) South African National Parks established by section 5 of the National Parks Act, 1976 (Act No. 57 of 1976), continues to exist as a juristic person despite the repeal of that Act by section 90 of this Act.

(2) As from the repeal of the National Parks Act, 1976, South African National Parks functions in terms of this Act.

Functions

55. (1) South African National Parks must—

(a) manage the national parks and other protected areas assigned to it in terms of Chapter 4 and section 94 in accordance with this Act;

(b) protect, conserve and control those national parks and other protected area s, including their biological diversity; and

(c) on the Minister's request, advise the Minister on any matter concerning –

(i) the conservation and management of biodiversity; and

(ii) proposed national parks and additions to or exclusions from existing national parks; and

(d) on the Minister's request, act as the provisional managing authority of protected areas under investigation in terms of this Act.

(2) South African National Parks may in managing national parks—

(a) manage breeding and cultivation programmes, and reserve areas in a park as

breeding places and nurseries;

(b) sell, exchange or donate any animal, plant or other organism occurring in a park, or purchase, exchange or otherwise acquire any indigenous species which it may consider desirable to re-introduce into a specific park;

(c) undertake and promote research;

(d) control, remove or eradicate any alien species which it considers undesirable to protect and conserve in a park;

(e) carry out any development, and construct or erect any works, necessary for the management of a park, including roads, bridges, buildings, dams, fences, breakwaters, seawalls, boathouses, landing stages, mooring places, swimming pools, oceanariums and underwater tunnels;

(f) allow visitors to a park;

(g) take reasonable steps to ensure the security and well-being of visitors and staff;

(h) provide accommodation and facilities for visitors and staff, including the provision of food and household supplies;

(i) carry on any business or trade or provide other services for the convenience of visitors and staff, including the sale of liquor;

(j) determine and collect fees for –

(i) entry to or stay in a park; or

(ii) any service provided by it;

(k) authorise any person, subject to such conditions and the payment of such fees as it may determine, to—

(i) carry on any business or trade, or to provide any service, which South African National Parks may carry on or provide in terms of this section; and

(ii) provide the infrastructure for such business, trade or service;

(l) by agreement with—

(i) a municipality, provide any service in a park which that municipality may or must provide in terms of legislation; or

(ii) any other organ of state, perform a function in a park which that organ of state may or must perform in terms of legislation; or *(m)* perform such other functions as may be prescribed.

(3) Subsection (2) applies also to other protected areas managed by South African National Parks, and the powers contained in that subsection may be exercised by it to the extent that those powers are consistent with the purpose for which any such area was declared as a protected area.

General powers

56. South African National Parks may for the purpose of performing its functions—

(a) appoint its own staff, subject to section 73;

(b) obtain, by agreement, the services of any person, including any organ of state, for the performance of any specific act, task or assignment;

(c) acquire or dispose of any right in or to movable or immovable property, or hire or let any property;

(d) open and operate its own bank accounts;

(e) invest , subject to section 76, any of its money, including money in the fund referred to in section 77;

(f) borrow money, subject to section 66 of the Public Finance Management Act;

(g) charge fees for any work performed or services rendered by it or collect fees resulting from any intellectual property rights;

(h) insure itself against—

(i) any loss, damage or risk; or

(ii) any liability it may incur in respect of Board members or staff members in the application of this Act;

(i) perform legal acts, including acts in association with or on behalf of any other person or organ of state; and

(j) institute or defend any legal action.

Part 2

Governing board, composition and membership

Composition

57. (1) South African National Parks is governed by a board consisting of—

(a) no fewer than nine and no more than twelve members appointed in terms of section 59;

(b) the Director-General or an official of the Department designated by the Director-General; and

(c) the Chief Executive Officer.

(2) The Minister—

(a) must determine the number of members to be appointed in terms of subsection (1) *(a)*; and

(b) may alter from time to time the number determined in terms of paragraph *(a)*, but a reduction in the number may be effected only when a vacancy in the Board occurs.

(3) The Board takes all decisions in the performance of the functions of South African National Parks, except—

(a) those decisions taken in consequence of a delegation in terms of section 71; or

(b) where the Public Finance Management Act provides otherwise.

Qualifications

58. (1) A member of the Board must—

(a) be a fit and proper person to hold office as a member; and

(b) have appropriate qualifications or experience.

(2) A person is disqualified from becoming or remaining a member of the Board if that person—

(a) is holding office as a member of Parliament or a provincial legislature; or

(b) has been removed from office in terms of section 65.

Appointment procedure

59. (1) Whenever it is necessary to appoint a member of the Board, the Minister must –

(a) through advertisements in the media circulating nationally and in each of the provinces, invite nominations; and

(b) compile a list of the names of persons nominated, setting out the prescribed particulars of each individual nominee.

(2) Any nomination made pursuant to an advertisement in terms of subsection (1) *(a)* must be supported by—

(a) the personal details of the nominee;

(b) particulars of the nominee's qualifications or experience; and

(c) any other information that may be prescribed.

(3) The Minister must make the required number of appointments from the list referred to in terms of subsection (1)*(b)*, but if the list is inadequate, the Minister may appoint any suitable person.

(4) When making an appointment the Minister must have regard to the need for appointing persons disadvantaged by unfair discrimination.

(5) Appointments must be made in such a way that the Board is

composed of persons covering a broad range of appropriate expertise.

Chairperson

60. (1) The Minister must appoint a member of the Board as the Chairperson.

(2) The Chairperson is appointed for such period as the Minister may determine which may, in the case of a member referred to in section 57(1)*(a)*, not extend beyond his or her term as a member.

(3) The Minister may appoint a member of the Board as acting chairperson of the Board if—

(a) the Chairperson is absent for a substantial period; or

(b) the appointment of a Chairperson is pending.

Term of office

61. (1) Members of the Board referred to in section 57(1)*(a)* are —

(a) appointed for a term of three years or, if section 66(2) applies, for a term determined in terms of that section;

(b) on completion of any term contemplated in paragraph *(a)*, eligible for re-appointment for one additional term of three years; and

(c) after a break of at least three years after a term has ended, eligible for appointment in terms of paragraph *(a)* again and, if appointed, eligible for re-appointment in terms of paragraph *(b)*.

(2) Any appointment in terms of subsection (1) may be extended by the Minister for a specific period not exceeding one year.

Conditions of appointment

62. (1) The Minister must determine the conditions of appointment of members of the Board referred to in section 57(1)*(a)*.

(2) *(a)* The conditions of appointment of members who are not in the employ of a national, provincial or local organ of state may provide for the payment of remuneration and allowances determined by the Minister with the concurrence of the Cabinet member responsible for finance.

(b) Such remuneration and allowances are payable by South African National Parks.

(3) Members who are in the employ of a national, provincial or local organ of state are not entitled to remuneration and allowances, but must be compensated for out of pocket expenses by South African National Parks.

(4) Members are appointed part-time.

Conduct of members

63. (1) A member of the Board—

(a) must perform the functions of office in good faith and without favour or prejudice;

(b) must disclose to the Board any personal or private business interest that that member, or any spouse, partner or close family member of that Board member, may have in any matter before the Board, and must withdraw from the proceedings of the Board when that matter is considered, unless the Board decides that the interest of that Board member in the matter is trivial or irrelevant;

(c) may not use the position, privileges or knowledge of a Board member for private gain or to improperly benefit another person; and

(d) may not act in any other way that compromises the credibility, impartiality, independence or integrity of South African National Parks.

(2) A member of the Board who contravenes or fails to comply with subsection (1) is guilty of misconduct.

Termination of membership

64. (1) A person referred to in section 57(1)*(a)* ceases to be a member of the Board when that person—

(a) is no longer eligible in terms of section 58 to be a memb er;

(b) resigns; or

(c) is removed from office in terms of section 65.

(2) A member may resign by giving at least three month's written notice to the Minister, but the Minister may accept a shorter period in a specific case.

Removal from office

65. (1) The Minister may remove a member of the Board referred to in section 57(1)*(a)* from office on the ground of—

(a) misconduct, incapacity or incompetence;

(b) absence from three consecutive meetings of the Board without the prior permission of the Board, except on good cause shown;

(c) insolvency; or

(d) conviction of a criminal offence without the option of a fine.

(2) A member of the Board may be removed from office on the ground of misconduct or incompetence only after a finding to that effect has been made by a board of inquiry appointed by the Minister.

(3) The Minister may suspend a member under investigation in terms of this section.

Filling of vacancies

66. (1) A vacancy in the Board is filled—

(a) in the case of a vacating Chairperson, by appointing another member in terms of section 60(1) as the Chairperson; and

(b) in the case of a vacating member referred to in section 57(1)*(a)*, by following the procedure set out in section 59.

(2) A person appointed to fill a vacancy holds office for th e unexpired portion of the term of the vacating Chairperson or member.

Part 3

Operating procedures of Board

Meetings

67. (1) The Chairperson of the Board decides when and where the Board meets, but a majority of the members may request the Chairperson in writing to convene a meeting at a time and place set out in the request.

(2) The Chairperson presides at meetings of the Board, but if absent from a meeting, the members present must elect another member to preside at the meeting.

Procedures

68. (1) The Board may determine its own procedures subject to the other provisions of this Act.

(2) The Board must keep a record of its proceedings and of decisions taken.

Quorum and decisions

69. (1) A majority of the serving members of the Board constitutes a quorum for a meeting of the Board.

(2) A matter before the Board is decided by the votes of a majority of the members present at the meeting.

(3) If on any matter before the Board there is an equality of votes, the member presiding at the meeting must exercise a casting vote in addition to that person's vote as a member.

Committees

70. (1) The Board may establish one or more committees to assist it in the performance of its functions.

(2) When appointing members to a committee, the Board is not restricted to members of the Board.

(3) The Board—

(a) must determine the functions of a committee;

(b) must appoint the chairperson and other members of the committee;

(c) may remove a member of a committee from office at any time; and

(d) may determine a committee's procedure.

(4) The Board may dissolve a committee at any time.

(5) *(a)* Section 62 applies with the changes required by the context to the conditions of appointment of committee members.

(b) A staff member of South African National Parks appointed to a committee serves on the committee subject to the terms and conditions of that person's employment.

Delegation of powers and assignment of duties

71. (1) When necessary for the proper performance of its functions the Board may delegate any of its powers or assign any of its duties, excluding those mentioned in subsection (2), to—

(a) a Board member;

(b) a committee referred to in section 70; or

(c) a staff member of South African National Parks.

(2) The following powers and duties may not be delegated or assigned by the Board:

(a) the appointment or re-appointment of a person as the Chief Executive Officer in terms

of section 72(1) or (2);

(b) the determination of the conditions of service of the Chief Executive Officer in terms of section 72(3);

(c) the determination of an employment policy in terms of section 73(1);

(d) the setting of financial limits in terms of section 73(2)*(a)* or (3); and

(e) the approval of the budget.

(3) A delegation or assignment in terms of subsection (1)—

(a) must be in writing;

(b) is subject to such limitations, conditions and directions as the Board may impose;

(c) does not divest the Board of the responsibility concerning the exercise of the delegated power or the carrying out of the a ssigned duty; and

(d) does not prevent the exercise of the assigned power or the carrying out of the assigned duty by the Board.

(4) The Board may confirm, vary or revoke any decision taken in consequence of a delegation in terms of this section, subject to any rights that may have accrued to a person as a result of the decision.

Part 4

Administration of South African National Parks

Appointment of Chief Executive Officer

72. (1) The Board, acting with the concurrence of the Minister, must appoint a person with appropriate qualifications and experience as the Chief Executive Officer of South African National Parks.

(2) The Chief Executive Officer—

(a) is appointed for a term not exceeding five years; and

(b) may be re-appointed by the Board with the concurrence of the Minister.

(3) The Chief Executive Officer is employed subject to such terms and conditions of employment as the Board may determine in accordance with a policy approved

by the Minister with the concurrence of the Cabinet member responsible for finance.

(4) The Chief Executive Officer—

(a) is responsible for the management of South African National Parks;

(b) must perform such duties and may exercise such powers as the Board may assign or delegate to the Chief Executive Officer; and

(c) must report to the Board on aspects of management, the performance of duties and the exercise of powers at such frequency and in such manner as the Board may determine.

(5) *(a)* Whenever the Chief Executive Officer is for any reason absent or unable to carry out his or her functions, or whenever there is a vacancy in the office of the Chief Executive Officer, the Chairperson of the Board may appoint another staff member of South African National Parks as acting Chief Executive Officer for a period not exceeding six months.

(b) Whilst acting as Chief Executive Officer, such staff member—

(i) has the powers and duties of the Chief Executive Officer; and

(ii) is employed subject to such terms and conditions of employment as the Chairperson of the Board may determine in accordance with the policy referred to in subsection (3).

Employment of staff

73. (1) The Board, acting with the concurrence of the Minister, must determine an employment policy for South African National Parks.

(2) The Chief Executive Officer—

(a) within the financial limits set by the Board, must determine a staff establishment necessary to enable South African National Parks to perform its functions; and

(b) may appoint persons in posts on the staff establishment.

(3) An employee of South African National Parks is employed subject to the terms and conditions of employment determined by the Chief Executive Officer in

accordance with the employment policy of and within the financial limits set by the Board.

(4) *(a)* A person in the service of another organ of state may be seconded to South African National Parks by agreement between the Chief Executive Officer and such organ of state.

(b) Persons seconded to South African National Parks perform their functions under the supervision of the Chief Executive Officer.

(5) A person in the service of South African National Parks may, with the consent of that person, be seconded to another organ of state by agreement between the Chief Executive Officer and such organ of state.

Part 5

Financial matters

Financial accountability

74. South African National Parks is a public entity for the purposes of the Public Finance Management Act, and must to that end comply with the provisions of that Act.

Funding

75. The funds of South African National Parks consist of —

(a) income derived from the performance of its functions;

(b) money appropriated for its purposes by Parliament;

(c) grants received from organs of state;

(d) voluntary contributions, donations and bequests;

(e) money borrowed in terms of section 56 *(f)*;

(f) income derived from investments;

(g) fines received or recovered in respect of offences committed within national parks; and

(h) money derived from any other source, with the approval of the Cabinet member responsible for finance.

Investments

76. South African National Parks may invest any of its funds not immediately required—

(a) subject to any investment policy that may be prescribed in terms of section 7(4) of the Public Finance Management Act; and

(b) in accordance with any criteria set by the Minister.

National Parks Land Acquisition Fund

77. (1) The National Parks Land Acquisition Fund established by section 12A of the National Parks Act, 1976 (Act No. 57 of 1976), continues to exist as a separate fund under the administration of South African National Parks despite the repeal of that Act by section 90 of this Act.

(2) The Fund is administered by South African National Parks and consists of –

(a) any voluntary contributions, donations and bequests received by South African National Parks for the purpose of the Fund;

(b) money appropriated by Parliament for the purpose of the Fund;

(c) the proceeds of land sold by South African National Parks which it has acquired in terms of section 81;

(d) income derived from investing any credit balances in the Fund;

(e) money borrowed by South African National Parks in terms of section 56*(f)* for the purpose of the Fund; and

(f) money derived from any other source for the purpose of the Fund.

(3) The money in the Fund may be used—

(a) to finance—

(i) the acquisition of private land or a right in or to private land in terms of section 80 or 81; or

(ii) the cancellation of a servitude or a right in land in terms of section 82 or 83; or

(b) to defray expenses incurred by South African National Parks in connection with the management of the Fund.

(4) The Chief Executive Officer must—

(a) keep account of the Fund separately from the other money of South African National Parks; and

(b) comply with the Public Finance Management Act in administering the Fund.

Part 6

General

Minister's supervisory powers

78. (1) The Minister—

(a) must monitor the performance by South African National Parks of its functions;

(b) may determine norms and standards for the performance by South African National Parks of its functions;

(c) may issue directives to South African National Parks on measures to achieve those norms and standards;

(d) may determine limits on fees charged by South African National Parks in the performance of its functions; and

(e) may identify land for new national parks and extensions to existing national parks.

(2) South African National Parks must perform its functions subject to the norms and standards, directives and determinations issued by the Minister in terms of subsection (1).

Absence of functional Board

79. In the absence of a functional Board, the functions of the Board revert to the Minister who, in such a case, must perform those functions until the Board is functional again.

CHAPTER 6

ACQUISITION OF RIGHTS IN OR TO LAND

Acquisition of private land by State

80. (1) The Minister, acting with the concurrence of the Cabinet member responsible for land affairs, may acquire private land, or any right in or to private land, which has been or is proposed to be declared as or included in a national protected area, by—

(a) purchasing the land or right;

(b) exchanging the land or right for other land or rights; or

(c) expropriating the land or right in accordance with the Expropriation Act, 197 5 (Act No.63 of 1975), and subject to section 25 of the Constitution, if no agreement is reached with the owner or holder of the right.

(2) The MEC, acting with the approval of the Executive Council of the province, may acquire private land, or any right in or to private land, which has been or is proposed to be declared as or included in a provincial protected area, by—

(a) purchasing the land or right;

(b) exchanging the land or right for other land or rights; or

(c) expropriating the land or right in accordance with the Expropriation Act, 1975, and subject to section 25 of the Constitution, if no agreement is reached with the owner or holder of the right.

Acquisition of private land by South African National Parks

81. (1) South African National Parks, with the approval of the Minister acting with the concurrence of the Cabinet member responsible for land affairs, may acquire private land, or any right in or to private land, which has been or is proposed to be declared as or included in a national park—

(a) by purchasing the land or right; or

(b) if the land or right is donated or bequeathed to it, by accepting the donation or bequest.

(2) If the parties fails to agree on a purchase price for the land or right contemplated in subsection (1)*(a)*, the Minister may on behalf of South African National Parks or the State expropriate the land or right in accordance with the Expropriation Act, 1975 (Act No. 63 of 1975), subject to section 25 of the Constitution.

Cancellation of servitude on, or privately held right in or to, state land

82. (1) The Minister, acting with the concurrence of the Cabinet member responsible for public works, may take any steps necessary to cancel a servitude on state land, or a privately held right in or to state land, which has been or is proposed to be declared as or included in a national protected area.

(2) The MEC, acting with the concurrence of the MEC responsible for public works in the province, may take any steps necessary to cancel a servitude on provincial land, or a privately held right in or to provincial land, which has been or is proposed to be declared as or included in a provincial protected area.

(3) If the Minister or MEC fails to reach an agreement with the owner of the property in whose favour the servitude is registered or with the person holding the right, the Minister or MEC may expropriate the servitude in accordance with the Expropriation Act, 1975 (Act No.63 of 1975), subject to section 25 of the Constitution.

Cancellation of servitude on, or privately held right in or to, land owned by South African National Parks

83. (1) South African National Parks may take any steps necessary to cancel a servitude on land owned by South African National Parks, or a privately held right in or to such land, which has been or is proposed to be declared as or included in a national park.

(2) If South African National Parks fails to reach an agreement with the owner of the property in whose favour the servitude is registered or with the person holding the right, the Minister may on behalf of South African National Parks or the State expropriate the servitude or right in accordance with the Expropriation Act, 1975 (Act No. 63 of 1975), and subject to section 25 of the Constitution.

Mineral right

84. The Minister may in accordance with section 80(1) *(c)*, 81(2), 82(3) or 83(2), and the MEC may in accordance with section 80(2) or 82(3), acquire or cancel a mineral right by way of expropriation only with the concurrence of the Cabinet member responsible for mineral and energy affairs.

Financing

85. (1) The Minister may finance the acquisition of private land or a right in or to private land in terms of section 80, or the cancellation of a servitude on, or a privately held right in or to, state land in terms of section 82, from—

(a) money appropriated for this purpose by Parliament; or

(b) the National Parks Land Acquisition Fund, by agreement with South African National Parks.

(2) South African National Parks may finance the acquisition of private land or a right in or to private land in terms of section 81, or the cancellation of a servitude on, or a privately held right in or to, land owned by South African National Parks in terms of section 83, from—

(a) the funds of South African National Parks; or

(b) the National Parks Land Acquisition Fund, by agreement with the Minister.

CHAPTER 7

ADMINISTRATION OF ACT

Regulations by Minister

86. (1) The Minister may make regulations that are not in conflict with this Act—

(a) regarding any matter that may or must be prescribed in terms of this Act;

(b) conferring additional powers or assigning additional duties to management

authorities;

(c) regulating –

(i) biodiversity management and conservation in protected areas;

(ii) the use of biological resources in protected areas;

(iii) access to protected areas;

(iv) tourism in protected areas where tourism is allowed;

(v) activities that may be carried out in terms of section 50; or

(vi) the use of land and water in protected areas;

(d) prohibiting or restricting –

(i) activities that have an adverse effect in protected areas;

(ii) the use of biological resources in protected areas;

(iii) land uses in protected areas that are harmful to the environment;

(e) providing for the establishment of advisory committ ees for protected areas, the appointment of members and their role;

(f) setting norms and standards for the proper performance of any function contemplated in this Act, and the monitoring and enforcing of such norms and standards;

(g) regarding any other matter which it is necessary or expedient to prescribe for the proper implementation or administration of this Act.

(2) Any regulation with material financial implications must be made with the concurrence of the Cabinet member responsible for finance.

(3) Before publishing any regulation contemplated in subsection (1), the Minister must publish the draft regulations in the *Gazette* for public comment.

Regulations by MEC

87. (1) The MEC may, in relation to provincial and local protected areas, make regulations not in conflict with this Act regarding any matter referred to in section 86, except a matter referred to in section 86(1)*(f)* .

(2) Any regulation made under subsection (1) must be consistent with

the norms and standards prescribed under section 11 or 86(1)*(f)*.

(3) Any regulation with substantive financial implications for the province, must be made with the concurrence of the MEC responsible for finance in the province.

(4) Before publishing any regulation contemplated in subsection (1), the MEC must publish the draft regulations in the *Gazette* for public comment.

General

88. (1) Regulations made under section 86 or 87 may—

(a) restrict or prohibit any act either absolutely or conditionally;

(b) apply—

(i) generally throughout the Republic or province, as the case may be, or only in a specified area or category of areas;

(ii) generally to all persons or only a specified category of persons; or

(iii) generally with respect to all species or only a specified species or category of species; or

(c) differentiate between—

(i) different areas or categories of areas;

(ii) persons or categories of persons; or

(iii) species or categories of species.

(2) Regulations made under section 86 or 87 may provide that any person who contravenes or fails to comply with a provision thereof is guilty of an offence and liable on conviction to a fine or to imprisonment for a period not exceeding five years or to both a fine and such imprisonment.

CHAPTER 8

OFFENCES AND PENALTIES

Offences and penalties

89. (1) A person is guilty of an offence if that person—

(a) contravenes or fails to comply with a provision of section 45(1), 46(1), 47(2) or (3), 48(1) or 50(5);

(b) contravenes a notice issued under section 51;

(c) hinders or interferes with a management authority or a member or staff member of a management authority in the execution of official duties; or

(d) falsely professes to be a member or staff member of a management authority, or the interpreter or assistant of such an officer.

(2) A person convicted of an offence in terms of subsection (1) is liable on conviction to a fine or to imprisonment for a period not exceeding five years or to both a fine and such imprisonment.

CHAPTER 9

MISCELLANEOUS

Repeal of laws

90. (1) Subject to subsection (2), the laws mentioned in the second column of Schedule 1 are hereby repealed to the extent set out in the third column thereof.

(2) Sections 16 and 17 of the Environment Conservation Act, 1989 (Act No. 73 of 1989), are repealed in a province with effect from the date of publication by the MEC of regulations under section 87 prescribing matters covered by the said sections16 and 17.

Savings

91. (1) Anything done in terms of a law repealed by section 90 which can or must be done in terms of this Act must be regarded as having been done in terms of this Act.

(2) A person who, immediately before the repeal of the National Parks Act, 1976, was –

(a) a member of South African National Parks, becomes a member of the Board for the unexpired part of the term for which that person was appointed as a member of South African National Parks; or

(b) the chairperson of South African National Parks, becomes the chairperson of the Board for the unexpired part of the term for which that person was appointed as the chairperson of South African National Parks.

Protected areas existing before commencement of section

92. (1) South African National Parks—

(a) is the management authority for any protected area it managed immediately before

this section took effect, unless otherwise assigned by the Minister in terms of this Act; and

(b) must manage such area in accordance with—

(i) this Act, and any management plan in terms of Chapter 4 for the area; and

(ii) any condition and agreement which existed immediately before this section took effect and which were applicable to the area.

(2) The organ of state managing a protected area immediately before this section took effect, other than a protected area referred to in subsection (1), must continue managing the area until the management of the area is assigned either to it or another management authority in terms of Chapter 4.

Short title and commencement

93. This Act is called the National Environmental Management: Protected Areas Act, 2003, and takes effect on a date determined by the President by proclamation in the *Gazette*.

SCHEDULE

REPEAL OF LAWS

(Section 90)

No. and year of Act	Short title of Act	Extent of repeal
Act No. 39 of 1975	Lake Areas Development Act, 1975	The repeal of the whole
Act No. 57 of 1976	National Parks Act, 1976	The repeal of the whole, except section 2(1) and Schedule 1
Act No. 60 of 1979	National Parks Amendment Act, 1979	The repeal of the whole
Act No. 9 of 1980	Lake Areas Development Amendment Act, 1980	The repeal of the whole
Act No. 13 of 1982	National Parks Amendment Act, 1982	The repeal of the whole
Act No. 23 of 1983	National Parks Amendment Act, 1983	The repeal of the whole
Act No. 43 of 1986	National Parks Amendment Act, 1986	The repeal of the whole
Act No. 111 of 1986	National Parks Second Amendment Act, 1986	The repeal of the whole
Act No. 60 of 1987	National Parks Amendment Act, 1987	The repeal of the whole
Act No. 73 of 1989	Environment Conservation Act, 1989	The repeal of sections 16, 17 and 18
Act No. 23 of 1990	National Parks Amendment Act, 1990	The repeal of the whole
Act No. 52 of 1992	National Parks Amendment Act, 1992	The repeal of the whole
Act No. 91 of 1992	National Parks Second Amendment Act, 1992	The repeal of the whole
Act No. 38 of 1995	National Parks Amendment Act, 1995	The repeal of the whole
Act No. 70 of 1997	National Parks Amendment Act, 1997	The repeal of the whole
Act No. 106 of 1998	National Parks Amendment Act, 1998	The repeal of the whole
Act No. 54 of 2001	National Parks Amendment Act, 2001	The repeal of the whole

DOC 2.1B

REPUBLIC OF SOUTH AFRICA

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY BILL

(As introduced in the National Assembly as a section 76-Bill; explanatory summary of Bill published in Government Gazette No. of) (The English text is the official text of the Bill)

(MINISTER OF ENVIRONMENTAL AFFAIRS AND TOURISM)

[B - 2003]

050403se

BILL

To provide within the framework of the National Environmental Act, 1998, for the management and conservation of South Africa's biodiversity; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting of genetic material derived from indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.

BE IT ENACTED by the Parliament of the Republic of South Africa, as follows:—

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CHAPTER 1

INTERPRETATION, OBJECTIVES AND APPLICATION OF ACT

Definitions

1. (1) In this Act, unless the context indicates otherwise–

"alien species" means –

(a) a species that is not an indigenous species; or

(b) an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention;

"biological diversity" or **"biodiversity"** means the variability among living organisms from all sources including, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems;

"bioprospecting" means the systematic search, collection, gathering, extraction, development or application of, or research on, genetic resources for commercial or industrial exploitation;

"bioregion" means a geographic region which has in terms of section 40(1) been determined as a bioregion for the purposes of this Act;

"Board" means the board referred to in section 13;

"competent authority", in relation to the control of an alien or invasive species, means –

(a) the Minister;

(b) an organ of state in the national, provincial or local sphere of government designated by regulation as a competent authority for the control of an alien species or a listed invasive species in terms of this Act; or

(c) any other organ of state;

"components", in relation to biodiversity, includes species, ecological communities, genes, genomes, ecosystems, habitats and ecological processes;

"control", in relation to an alien or invasive species, means –

(a) to combat or eradicate an alien or invasive species; or

(b) where such eradication is not possible, to prevent, as far as may be practicable, the recurrence, re-establishment, re-growth, multiplication, propagation, regeneration or spreading of an alien or invasive species;

"critically endangered ecosystem" means any ecosystem listed as a critically endangered ecosystem in terms of section 51;

"critically endangered species" means any indigenous species listed as a critically endangered species in terms of section 55;

"delegation", in relation to a duty, includes an instruction to perform the duty;

"Department" means the national Department of Environmental Affairs and Tourism;

"derivative", in relation to an animal, plant or other organism, means any part, tissue or extract of an animal, plant or other organism, whether fresh, preserved or processed;

"Director-General" means the Director-General of the Department;

"ecological community" means an integrated group of species inhabiting a given area;

"ecosystem" means a dynamic complex of animal, plant and micro-organism communities and their non-living environment interacting as a functional unit;

"endangered ecosystem" means any ecosystem listed as an endangered ecosystem in terms of section 51;

"endangered species" means any indigenous species listed as an endangered species in terms of section 55;

"environmental management inspector" means a person authorised in terms of the National Environmental Management Act to enforce the provisions of this Act;

"export", in relation to the Republic, means to take out or transfer, or attempt to take out or transfer, from a place within the Republic to another country or to international waters;

"Gazette", when used –

(a) in relation to the Minister, means the *Government Gazette*; or

(b) in relation to the MEC for environmental affairs of a province, means the *Provincial Gazette* of that province;

"genetic material" means any material of animal, plant, microbial or other biological origin containing functional units of heredity;

"genetic resource" includes –

(a) any genetic material; or

(b) the genetic potential or characteristics of any species;

"habitat" means a place where a species or ecological community naturally occurs;

"import", in relation to the Republic –

(a) means to land on, bring into or introduce into the Republic, or attempt to land on, bring into or introduce into the Republic; and

(b) includes to bring into the Republic for re-export to a place outside the Republic;

"indigenous biological resource" means any resource consisting of –

(a) any living or dead animal, plant or other organism of an indigenous species;

(b) any derivative of such animal, plant or other organism; or

(c) any genetic material of such animal, plant or other organism;

"indigenous species" means a species that occurs, or has historically occurred, naturally in a free state in nature within the borders of the Republic, but excludes a species that has been introduced in the Republic as a result of human activity;

"Institute" means the South African National Biodiversity Institute established in terms of section 10;

"introduction", in relation to a species, means the introduction by humans, whether deliberately or accidentally, of a species to a place outside the natural range or natural dispersal potential of that species;

"introduction from the sea", in relation to a specimen of any species, means the transportation into the Republic of a specimen taken from a marine environment not under the jurisdiction of any state;

"invasive species" means any species whose establishment and spread outside of its natural distribution range –

(a) threaten ecosystems, habitats or other species or has demonstrable potential to threaten ecosystems, habitats or other species; and

(b) may result in economic or environmental harm or harm to human health;

"issuing authority", in relation to permits regulating the matters mentioned in section 84, means –

(a) the Minister; or

(b) an organ of state in the national, provincial or local sphere of government designated by regulation in terms of section 94 as an issuing authority for permits of the kind in question;

"listed ecosystem" means any ecosystem listed in terms of section 51(1);

"listed invasive species" means any invasive species listed in terms of section 69(1);

"listed threatened or protected species" means any species listed in terms of section 55(1);

"local community" means any community of people living or having rights or interests in a distinct geographical area;

"management authority", in relation to a protected area, means an authority to whom the management of a protected area has been assigned;

"MEC for environmental affairs" means a member of the Executive Council of a province who is responsible for the conservation of biodiversity in the province;

"migratory species" means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries;

"Minister" means a Cabinet member responsible for national environmental management;

"municipality" means a municipality established in terms of the Local Government: Municipal Structures Act, 1998 (Act No. 117 of 1998);

"national botanical garden" means land declared or regarded as having been declared as a national botanical garden in terms of section 33, and includes any land declared in terms of section 33 as part of an existing botanical garden;

"National Environmental Management Act" means the National Environmental Management Act, 1998 (Act No. 107 of 1998);

"national environmental management principles" means the principles referred to in section 7;

"non-detriment findings" means the determination of the non-detrimental impact of an action on the survival of a species in the wild;

"organ of state" has the meaning assigned to it in section 239 of the Constitution;

"permit" means a permit issued in terms of Chapter 7;

"prescribe" means prescribe by regulation in terms of section 94;

"protected area" means a protected area defined in the Protected Areas Act;

"Protected Areas Act" means the National Environmental Management: Protected Areas Act, 2003;

"protected ecosystem" means any ecosystem listed as a protected ecosystem in terms of section 51;

"protected species" means any species listed as a protected species in terms of section 55;

"Public Finance Management Act" means the Public Finance Management Act, 1999 (Act No. 1 of 1999);

"re-export", in relation to a specimen of a listed threatened or protected species, means the export from the Republic of a specimen of a listed threatened or protected species previously imported into the Republic;

"restricted activity" –

(a) in relation to a specimen of a listed threatened or protected species, means –

(i) hunting, catching, capturing or killing any living specimen of a listed threatened or protected species by any means, method or device whatsoever, including searching, pursuing, driving, lie in wait, luring, alluring, discharging a missile or injuring with intent to hunt, catch, capture or kill any such specimen;

(ii) gathering, collecting or plucking any specimen of a listed threatened or protected species;

(iii) picking parts of, or cutting, chopping off, uprooting, damaging or destroying, any specimen of a listed threatened or protected species;

(iv) importing into the Republic, including introducing from the sea, any specimen of a listed threatened or protected species;

(v) exporting from the Republic, including re-exporting from the Republic, any specimen of a listed threatened or protected species;

(vi) having in possession or exercising physical control over any specimen of a listed threatened or protected species;

(vii) growing, breeding or in any other way propagating any specimen of a listed threatened or protected species, or causing it to multiply;

(viii) conveying, moving or otherwise translocating any specimen of a listed threatened or protected species;

(ix) selling or otherwise trading in, buying, receiving, giving, donating or accepting as a gift, or in any way acquiring or disposing of any specimen of a listed threatened or protected species; or

(x) any other prescribed activity which involves a specimen of a listed threatened or protected species; and

(b) in relation to a specimen of an alien species or listed invasive species, means –

(i) importing into the Republic, including introducing from the sea, any specimen of an alien or listed invasive species;

(ii) having in possession or exercising physical control over any specimen of an alien or listed invasive species;

(iii) growing, breeding or in any other way propagating any specimen of an alien or listed invasive species, or causing it to multiply;

(iv) conveying, moving or otherwise translocating any specimen of an alien or listed invasive species;

(v) selling or otherwise trading in, buying, receiving, giving, donating or accepting as a gift, or in any way acquiring or disposing of any specimen of an alien or listed invasive species; or

(vi) any other prescribed activity which involves a specimen of an alien or listed invasive species;

"species" means a kind of animal, plant or other organism that does not normally interbreed with individuals of another kind, and includes any sub-species, cultivar, variety, geographic race, strain, hybrid or geographically separate population;

"specimen" means –

(a) any living or dead animal, plant or other organism;

(b) a seed, egg, gamete or propagule or part of an animal, plant or other organism capable of propagation or reproduction or in any way transferring genetic traits;

(c) any derivative of any animal, plant or other organism; or

(d) any goods which –

(i) contain a derivative of an animal, plant or other organism; or

(ii) from an accompanying document, from the packaging or mark or label, or from any other indications, appear to be or to contain a derivative of an animal, plant or other organism;

"subordinate legislation", in relation to this Act, means –

(a) any regulation made in terms of section 94; or

(b) any notice published in terms of section 9, 33, 34, 40(1), 42(2), 43(3), 45 (2), 51(1), 52(1), 54, 55(1), 56(2), 57, 65(1), 66(1), 67, 69(1), 71, 78(2) or 97(1);

"sustainable", in relation to the use of a biological resource, means the use of such resource in a way and at a rate that –

(a) would not lead to its long-term decline;

(b) would not disrupt the ecological integrity of the ecosystem in which it occurs; and

(c) would ensure its continued use to meet the needs and aspirations of present and future generations of people;

"this Act" includes any subordinate legislation issued in terms of a provision of this Act;

"threatening process" means a process which threatens, or may threaten –

(a) the survival, abundance or evolutionary development of an indigenous species or

ecological community; or

(b) the ecological integrity of an ecosystem,

and includes any process identified in terms of section 52 as a threatening process;

"vulnerable ecosystem" means any ecosystem listed as a vulnerable ecosystem in terms of section 51;

"vulnerable species" means any indigenous species listed as a vulnerable species in terms of section 55.

(2) In this Act, words or expressions derived from words or expressions defined in subsection (1) have corresponding meanings unless the context indicates that another meaning is intended.

Objectives of Act

2. The objectives of this Act are –

(a) within the framework of the National Environmental Management Act, to provide, for –

(i) the management and conservation of biological diversity within the Republic and the components of such biological diversity;

(ii) the use of indigenous biological resources in a sustainable manner; and

(iii) the fair and equitable sharing of benefits arising from bioprospecting of genetic material derived from indigenous biological resources;

(b) to give effect to ratified international agreements relating to biodiversity which are binding on the Republic;

(c) to provide for co-operative governance in biodiversity management and conservation; and

(d) to provide for a South African National Biodiversity Institute to assist in achieving the above objectives.

State's trusteeship of biological diversity

3. In fulfilling the rights contained in section 24 of the Constitution, the state through its organs that implement legislation applicable to biodiversity, must–

(a) manage, conserve and sustain South Africa's biodiversity, its components and genetic resources; and

(b) implement this Act to achieve the progressive realisation of those rights.

Application of Act

4. (1) This Act applies –

(a) in the Republic, including –

(i) its territorial waters, exclusive economic zone and continental shelf as described in the Maritime Zones Act, 1994 (Act No. 15 of 1994); and

(ii) the Prince Edward Islands referred to in the Prince Edward Islands Act, 1948 (Act No. 43 of 1948); and

(b) to human activity affecting South Africa's biological diversity and its components.

(2) This Act binds all organs of state –

(a) in the national and local spheres of government; and

(b) in the provincial sphere of government, subject to section 146 of the Constitution.

Application of international agreements

5. This Act gives effect to ratified international agreements affecting biodiversity to which South Africa is a Party, and which bind the Republic.

Application of other biodiversity legislation

6. (1) This Act must be read with any applicable provisions of the National Environmental Management Act.

(2) Chapter 4 of the National Environmental Management Act applies to the resolution of conflicts arising from the implementation of this Act.

National environmental management principles

7. The application of this Act must be guided by the national environmental management principles set out in section 2 of the National Environmental Management Act.

Conflicts with other legislation

8. (1) In the event of any conflict between a section of this Act and–

(a) other national legislation in force immediately prior to the date of commencement of this Act, the section of this Act prevails if the conflict specifically concerns the management of biodiversity or indigenous biological resources;

(b) provincial legislation, the conflict must be resolved in terms of section 146 of the Constitution; and

(c) a municipal by-law, the section of this Act prevails.

(2) In the event of any conflict between subordinate legislation issued in terms of this Act and –

(a) an Act of Parliament, the Act of Parliament prevails;

(b) provincial legislation, the conflict must be resolved in terms of section 146 of the Constitution; and

(c) a municipal by-law, the subordinate legislation issued in terms of this Act prevails.

(3) For the proper application of subsection (2)*(b)* the Minister must, in terms of section 146(6) of the Constitution, submit all subordinate legislation issued in terms of this Act which affects provinces to the National Council of Provinces for approval.

Norms and standards

9. (1) The Minister may, by notice in the *Gazette* –

(a) issue norms and standards for the achievement of any of the objectives of this Act, including for the –

(i) management and conservation of South Africa's biological diversity and its components;

(ii) restriction of activities which impact on biodiversity and its components; and *(b)* set indicators to measure compliance with those norms and standards.

(2) Before issuing norms and standards and setting indicators to measure compliance with those norms and standards, the Minister must consult the MEC for environmental affairs in each province in which those norms and standards will apply.

(3) Norms and standards may apply –

(a) nationwide;

(b) in a specific area only; or

(c) to a specific category of biodiversity only.

(4) Different norms and standards may be issued for –

(a) different areas; or

(b) different categories of biodiversity.

CHAPTER 2

SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE

Part 1

Establishment, powers and duties of Institute

Establishment

10. (1) A South African National Biodiversity Institute is established.

(2) The Institute is a juristic person.

Functions

11. (1) The Institute –

(a) must monitor and report regularly to the Minister on –

(i) the status of the Republic's biodiversity;

(ii) the conservation status of all listed threatened or protected species and listed ecosystems; and

(iii) the status of all listed invasive species;

(b) may act as an advisory and consultative body on matters relating to biodiversity to organs of state and other biodiversity stakeholders;

(c) must coordinate and promote the taxonomy of South Africa's biodiversity;

(d) must manage, control and maintain all national botanical gardens;

(e) may establish, manage, control and maintain–

(i) herbaria; and

(ii) collections of dead animals that may exist;

(f) must establish facilities for horticulture display, environmental education, visitor amenities

and research;

(g) may establish, maintain, protect and preserve collections of –

(i) plants in national botanical gardens and in herbaria; or

(ii) animals and micro-organisms in appropriate enclosures;

(h) must collect, generate, process, coordinate and disseminate information about biodiversity and the sustainable use of indigenous biological resources, and establish and maintain databases in this regard;

(i) may allow, regulate or prohibit access by the public to national botanical gardens, herbaria and other places under the control of the Institute, and supply plants, information, meals or refreshments or render other services to visitors;

(j) may undertake and promote research on indigenous biodiversity and the sustainable use of indigenous biological resources;

(k) may coordinate and implement programmes for –

(i) the rehabilitation of ecosystems; and

(ii) the prevention, control or eradication of listed invasive species;

(l) may coordinate programmes to involve civil society in –

(i) the conservation and sustainable use of indigenous biological resources; and

(ii) the rehabilitation of ecosystems;

(m) on the Minister's request, must assist him or her in the performance of duties and the exercise of powers assigned to the Minister in terms of this Act;

(n) on the Minister's request, must advise him or her on any matter regulated in terms of this Act, including –

(i) the implementation of this Act and any international agreements affecting biodiversity which are binding on the Republic;

(ii) the identification of bioregions and the contents of any bioregional plans;

(iii) other aspects of biodiversity planning;

(iv) the management and conservation of biological diversity; and

(v) the sustainable use of indigenous biological resources;

(o) on the Minister's request, must advise him or her on the declaration and management of, and development in, national protected areas; and

(p) must perform any other duties –

(i) assigned to it in terms of this Act; or

(ii) as may be prescribed.

(2) When the Institute in terms of subsection (1) gives advice on a scientific matter, it may consult any appropriate organ of state or other institution which has expertise in that matter.

General powers

12. The Institute may for the purpose of performing its functions –

(a) appoint its own staff, subject to section 29;

(b) obtain, by agreement, the services of any person, including any organ of state, for the performance of any specific act, task or assignment;

(c) acquire or dispose of any right in or to movable or immovable property, or hire or let any property;

(d) open and operate its own bank accounts;

(e) establish a company which has as its object the production and supply of goods or the rendering of services on behalf of the Institute, subject to the Public Finance Management Act;

(f) invest any of its money, subject to section 32;

(g) borrow money, subject to section 66 of the Public Finance Management Act;

(h) charge fees–

(i) for access to national botanical gardens, herbaria and other places under its control;

(ii) for any work performed or services rendered by it, except for any such work performed or services rendered in terms of section 11(1)*(m)*, *(n)* or *(o)*; or

(iii) for access to the results of, or to other information in connection with, any research performed by it;

(i) collect royalties resulting from any discoveries, inventions or computer programmes;

(j) insure itself against –

(i) any loss, damage or risk; or

(ii) any liability it may incur in the application of this Act;

(k) perform legal acts, including acts in association with, or on behalf of, any other person or organ of state; and

(l) institute or defend any legal action.

Part 2

Governing board, composition and membership

Composition

13. (1) The Institute is governed by a Board consisting of –

(a) not less than seven and not more than nine members appointed in terms of section 15;

(b) the Director-General or an official of the Department designated by the Director-General; and

(c) the Chief Executive Officer of the Institute.

(2) The Minister –

(a) must determine the number of members to be appointed in terms of subsection (1)*(a)*; and

(b) may alter, from time to time the, number determined in terms of paragraph *(a)*, but a reduction in the number may be effected only when a vacancy in the Board occurs.

(3) The Board takes all decisions in the performance of the duties and exercise of powers of the Institute, except –

(a) those decisions taken in consequence of a delegation in terms of section 27; or

(b) where the Public Finance Management Act provides otherwise.

Qualifications

14. (1) A member of the Board must –

(a) be a fit and proper person to hold office as a member; and

(b) have appropriate qualifications and experience in the field of biodiversity.

(2) The following persons are disqualified from becoming or remaining a member of the Board:

(a) A person holding office as a member of Parliament or a provincial legislature; or

(b) a person who has been removed from office in terms of section 21.

Appointment procedure

15. (1) Whenever it is necessary to appoint members of the Board referred to in section 13(1)*(a)*, the Minister must –

(a) through advertisements in the media circulating nationally and in each of the provinces, invite nominations for appointment as such a member; and

(b) compile a list of the names of persons nominated, setting out the prescribed particulars of each individual nominee.

(2) Any nomination made pursuant to an advertisement in terms of subsection (1)*(a)* must be supported by –

(a) the personal details of the nominee;

(b) particulars of the nominee's qualifications or experience; and

(c) any other information that may be prescribed.

(3) The Minister must, subject to subsection (4), appoint—

(a) the required number of persons from the list compiled in terms of subsection 1*(c)*; and

(b) if such list is inadequate, any suitable person.

(4) When making appointments the Minister must –

(a) consult the MECs for environmental affairs; and

(b) have regard to the need for appointing persons to promote representivity.

(5) Appointments must be made in such a way that the Board is composed of persons covering a broad range of appropriate expertise in the field of biodiversity.

Chairperson

16. (1) Whenever necessary the Minister must appoint a member of the Board as a Chairperson of the Board.

(2) A Chairperson is appointed for a period which is determined by the Minister which may, in the case of a member referred to in section 13(1)*(a)*, not extend beyond the period of his or her term as a member.

(3) The Minister may appoint a member of the Board as acting chairperson of the Board if –

(a) the Chairperson is absent for a substantial period; or

(b) the appointment of a Chairperson is pending.

Term of office

17. Members of the Board referred to in section 13(1)*(a)* –

(a) are appointed for a period of three years or, if section 22(2) applies, for a term determined in terms of that section;

(b) on completion of that term, are eligible for re-appointment for one additional term of three years; and

(c) may have their appointment in terms of paragraph *(a)* or *(b)* extended by the Minister for a specific period not exceeding one year.

Conditions of appointment

18. (1) The Minister must determine the conditions of employment of members of the Board referred to in section 13(1)*(a)*.

(2) *(a)* The Minister may, with the concurrence of the Minister of Finance, determine the terms and conditions of employment of members of the Board who are not in the employment of the Government.

(b) Their remuneration and allowances are paid by the Institute.

(3) Members who are in the employ of the Government are not entitled to remuneration and allowances, but must be compensated for out of pocket expenses by the Institute.

(4) Such members are appointed on a part-time basis.

Conduct of members

19. (1) A member of the Board –

(a) must perform the duties of office in good faith and without favour or prejudice;

(b) must disclose to the Board any personal or private business interest that that member, or any spouse, partner or close family member of that Board member, may have in any matter before the Board, and must withdraw from the proceedings of the Board when that matter is considered, unless the Board decides that the interest of that Board member in the matter is trivial or irrelevant;

(c) may not use the position, privileges or knowledge of a member for private gain or to improperly benefit another person; and

(d) may not act in any other way that compromises the credibility, impartiality, independence or integrity of the Institute.

(2) A member of the Board who contravenes or fails to comply with subsection (1) is guilty of misconduct.

Termination of membership

20. (1) A member of the Board referred to in section 13(1)*(a)* ceases to be a member when that person –

(a) is no longer eligible in terms of section 14 to be a member;

(b) resigns; or

(c) is removed from office in terms of section 21.

(2) A member may resign only by giving at least three month's written notice to the Minister, but the Minister may accept a shorter period in a specific case.

Removal from office

21. (1) The Minister may remove a member of the Board referred to in section 13(1)*(a)* from office, but only on the ground of –

(a) misconduct, incapacity or incompetence; or

(b) absence from three consecutive meetings of the Board without the prior permission of the Board except on good cause shown;

(c) insolvency; or

(d) conviction of a criminal offence without the option of a fine.

(2) A member of the Board may be removed from office on the ground of misconduct or incompetence only after a finding to that effect has been made by a board of inquiry appointed by the Minister.

(3) The Minister may suspend a member under investigation in terms of this section.

Filling of vacancies

22. (1) A vacancy in the Board is filled –

(a) in the case of a vacating Chairperson, by appointing another member in terms of section 16(1) as a Chairperson; and

(b) in the case of a vacating member referred to in section 13(1)*(a)*, by following the procedure set out in section 15.

(2) A person appointed to fill a vacancy holds office for the remaining portion of the term of the vacating Chairperson or member.

Part 3

Operating procedures of Board

Meetings

23. (1) A Chairperson of the Board decides when and where the Board meets, but a majority of the members may request the Chairperson in writing to convene a Board meeting at a time and place set out in the request.

(2) A Chairperson presides at meetings of the Board, but if absent from a meeting, the members present must elect another member to preside at the meeting.

Procedures

24. (1) The Board may determine its own procedures subject to the provisions of this Act.

(2) The Board must keep records of its proceedings and of decisions taken.

Quorum and decisions

25. (1) A majority of the members of the Board serving at any relevant time constitutes a quorum for a meeting of the Board.

(2) A matter before the Board is decided by the votes of a majority of the members present at the meeting.

(3) If on any matter before the Board there is an equality of votes, the member presiding at the meeting must exercise a casting vote in addition to that person's vote as a member.

Committees

26. (1) The Board may establish one or more committees to assist it in the performance of its duties or the exercise of its powers.

(2) When appointing members to a committee, the Board is not restricted to members of the Board.

(3) The Board –

(a) must determine the duties of a committee;

(b) must appoint a chairperson and other members of the committee;

(c) may remove a member of a committee from office at any time, taking into account the provisions of the Promotion of Administrative Justice Act, 2000 (Act No. 3 of 2000); and

(d) must determine a working procedure of a committee.

(4) The Board may dissolve a committee at any time.

(5) *(a)* Section 18 read with the necessary change as the context may require, applies to the terms and conditions of employment of committee members.

(b) A staff member of the Institute appointed to a committee serves on the committee subject to the terms and conditions of that person's employment.

Delegation of powers and duties

27. (1) When necessary for the proper performance of its duties, the Board may, subject to subsection (2), delegate any of its powers or duties to–

(a) a member of the Board;

(b) a committee referred to in section 26; or

(c) a staff member of the Institute.

(2) The following powers and duties may not be delegated by the Board:

(a) The appointment or re-appointment of a person as a Chief Executive Officer in terms of section 28(1) or (2);

(b) the determination of the terms and conditions of service of a Chief Executive Officer in terms of section 28(3);

(c) the determination of an employment policy in terms of section 29(1); and

(d) the setting of financial limits in terms of section 29(2)*(a)* or (3).

(3) A delegation in terms of subsection (1) –

(a) is subject to any limitations, conditions and directions that the Board may impose;

(b) must be in writing;

(c) does not divest the Board of the responsibility concerning the exercise of the delegated power or the carrying out of the delegated duty; and

(d) does not prevent the exercise of the delegated power or the carrying out of the delegated duty by the Board.

(4) The Board may confirm, vary or revoke any decision taken in consequence of a delegation in terms of this section, subject to any rights that may have accrued to a person as a result of the decision.

Part 4

Administration of Institute

Appointment of Chief Executive Officer

28. (1) The Board, acting with the concurrence of the Minister, must appoint a person with appropriate qualifications and experience as a Chief Executive Officer of the Institute.

(2) A Chief Executive Officer –

(a) is appointed for a term not exceeding five years; and

(b) may be re-appointed by the Board with the concurrence of the Minister, but only for one additional term not exceeding five years.

(3) A Chief Executive Officer is employed subject to such terms and conditions of employment as the Board may determine in accordance with a policy approved by

the Minister with the concurrence of the Cabinet member responsible for finance.

(4) A Chief Executive Officer –

(a) is responsible for the management of the Institute;

(b) must perform such duties and may exercise such powers as the Board may delegate to him or her; and

(c) must report to the Board on aspects of management, the performance of duties and the exercise of powers, at such times or intervals and in such manner, as the Board may determine.

(5) *(a)* A chairperson of the Board may appoint another employee of the Institute as acting Chief Executive Officer for a period not exceeding six months, whenever—

(i) a Chief Executive Officer if for any reason absent or unable to carry out his or her duties; or

(ii) there is a vacancy in the office of the Chief Executive Officer.

(b) Whilst acting as Chief Executive Officer, such employee –

(i) has the powers and duties of the Chief Executive Officer; and

(ii) is employed subject to such terms and conditions of employment as the Chairperson may determine in accordance with the policy referred to in subsection (3).

Employment of staff

29. (1) The Board, acting with the concurrence of the Minister, must determine an employment policy for the Institute.

(2) The Chief Executive Officer –

(a) within the financial limits set by the Board, must determine a staff establishment necessary for the work of the Institute; and

(b) may appoint persons in posts on the staff establishment.

(3) An employee of the Institute is employed subject to the terms and conditions of employment determined by the Chief Executive Officer in accordance with the employment policy of and within the financial limits set by the Board.

(4) *(a)* A person in the service of another organ of state may be seconded to the Institute by agreement between the Chief Executive Officer and such organ of state.

(b) Persons seconded to the Institute perform their duties under the supervision of the Chief Executive Officer.

(5) A person in the service of the Institute may, with the consent of that person, be seconded to another organ of state by agreement between the Chief Executive Officer and such organ of state.

Part 5

Financial matters

Financial accountability

30. The Institute is a public entity for the purposes of the Public Finance Management Act, and must comply with the provisions of that Act.

Funding

31. The funds of the Institute consist of –

(a) income derived by it from the performance of its duties and the exercise of its powers;

(b) money appropriated by Parliament;

(c) grants received from organs of state;

(d) voluntary contributions, donations and bequests;

(e) money borrowed in terms of section 12*(g)*;

(f) income derived from investments referred to in sections 32; and

(g) money derived from any other source, subject to the Public Finance Management Act.

Investments

32. The Institute may invest any of its funds not immediately required –

(a) subject to any investment policy that may be prescribed in terms of section 7 (4) of the Public Finance Management Act; and

(b) in such a manner that the Minister may approve.

Part 6

National botanical gardens

Declaration

33. (1) The Minister, acting with the approval of the Cabinet member responsible for the administration of the land in question may, by notice in the *Gazette,* declare any state land described in the notice as a–

(a) national botanical garden; or

(b) part of an existing national botanical garden.

(2) The Minister, acting in accordance with an agreement with the owner of the land described in that agreement may, by notice in the *Gazette* declare that land as a–

(a) national botanical garden; or

(b) part of an existing national botanical garden.

(3) A notice in terms of subsection (1)*(a)* or (2)*(a)* must assign a name to the national botanical garden.

(4) The sites described in Schedule 1 of the Forest Act, 1984 (Act No.122 of 1984), must be regarded as having been declared as national botanical gardens in terms of this section.

Amendment or withdrawal of declarations

34. (1) The Minister may, by notice in the *Gazette* –

(a) amend or withdraw a notice referred to in section 33, subject to subsection (2) of this section; or

(b) amend the name assigned to a national botanical garden.

(2) The declaration of state land as a national botanical garden, or part of an existing national botanical garden, may not be withdrawn and a part of a national botanical garden on state land may not be excluded from it except by resolution of each House of Parliament.

Part 7

General

Minister's supervisory powers

35. (1) The Minister –

(a) must monitor the exercise and performance by the Institute of its powers and duties;

(b) may set norms and standards for the exercise and performance by the Institute of its powers and duties;

(c) may issue directives to the Institute on policy, planning, strategy and procedural issues to ensure its effective and efficient functioning;

(d) must determine limits on fees charged by the Institute in the exercise and performance of its powers and duties; and

(e) may identify land for new botanical gardens and extensions to existing botanical gardens.

(2) The Institute must exercise its powers and perform its duties subject to any norms and standards, directives and determinations issued by the Minister in terms of subsection (1).

Absence of functional Board

36. In the event of absence of a functional Board, the powers and duties of the Board revert to the Minister who, in such a case, must exercise those powers and perform those duties until the Board is functional again.

CHAPTER 3

BIODIVERSITY PLANNING AND MONITORING

Purpose of Chapter

37. The purpose of this Chapter is to–

(a) provide for integrated and co-ordinated biodiversity planning;

(b) provide for monitoring the conservation status of various components of South Africa's biodiversity; and

(c) promote biodiversity research.

Part 1

Biodiversity planning

National biodiversity framework

38. (1) The Minister –

(a) must prepare and adopt a national biodiversity framework within three years of the date on which this Act takes effect;

(b) must monitor implementation of the framework;

(c) must review the framework at least every five years; and

(d) may, when necessary, amend the framework.

(2) The Minister must, by notice in the *Gazette*, publish the national biodiversity framework and each amendment of the framework.

Contents of national biodiversity framework

39. (1) The national biodiversity framework must –

(a) provide for an integrated, co-ordinated and uniform approach to biodiversity management by organs of state in all spheres of government, non-governmental organisations, the private sector, local communities, other stakeholders and the public;

(b) be consistent with –

(i) this Act;

(ii) the national environmental management principles; and

(iii) any relevant international agreements binding on the Republic;

(c) identify priority areas for conservation action and the establishment of protected areas; and

(d) reflect regional co-operation on issues concerning biodiversity management in Southern Africa.

(2) The national biodiversity framework may determine norms and standards for provincial and municipal environmental conservation plans.

Bioregions and bioregional plans

40. (1) The Minister or the MEC for environmental affairs in a province may, by notice in the *Gazette* –

(a) determine a geographic region as a bioregion for the purposes of this Act if that region contains whole or several nested ecosystems and is characterised by its landforms, vegetation cover, human culture and history; and

(b) publish a plan for the management of biodiversity and the components of biodiversity in such region.

(2) The Minister may determine a region as a bioregion and publish a bioregional plan for that region either –

(a) on own initiative but after consulting the MEC for environmental affairs in the relevant province; or

(b) at the request of a province or municipality.

(3) The MEC for environmental affairs may determine a region as a bioregion and publish a bioregional plan for that region only with the concurrence of the Minister.

(4) Any person or organ of state may, on the request of the Minister or MEC for environmental affairs, assist in the preparation of a bioregional plan.

(5) The Minister –

(a) may enter into an agreement with a neighbouring country to secure the effective implementation of the plan; and

(b) must submit to Parliament a copy of any agreement entered into in terms of paragraph *(a)*.

Contents of bioregional plans

41. A bioregional plan must –

(a) contain measures for the effective management of biodiversity and the components of biodiversity in the region;

(b) provide for monitoring of the plan; and

(c) be consistent with –

(i) this Act;

(ii) the national environmental management principles;

(iii) the national biodiversity framework; and

(iv) any relevant international agreements binding on the Republic.

Review and amendment of bioregional plans

42. (1) The Minister or the MEC for environmental affairs in the relevant province, as may be appropriate, must review a bioregional plan published in terms of section 40(1)*(b)* at least every five years, and assess compliance with the plan and the extent to which its objectives are being met.

(2) The Minister or MEC may, when necessary, by notice in the *Gazette*, amend a bioregional plan or the boundaries of the bioregion.

(3) The MEC may amend a bioregional plan or the boundaries of the bioregion only with the concurrence of the Minister.

Biodiversity management plans

43. (1) Any person, organisation or organ of state desiring to contribute to biodiversity management may submit to the Minister for his or her approval a draft management plan for –

(a) an ecosystem –

(i) listed in terms of section 51; or

(ii) which is not listed in terms of section 51 but which does warrant special conservation attention;

(b) an indigenous species –

(i) listed in terms of section 55; or

(ii) which is not listed in terms of section 55 but which does warrant special conservation attention; or

(c) a migratory species to give effect to the Republic's obligations in terms of an international agreement binding on the Republic.

(2) Before approving a draft biodiversity management plan, the Minister must identify a suitable person, organisation or organ of state which is willing to be responsible for the implementation of the plan.

(3) The Minister must –

(a) publish by notice in the *Gazette* a biodiversity management plan approved in terms of subsection (1);

(b) determine the manner of implementation of the plan; and

(c) assign responsibility for the implementation of the plan to the person, organisation or organ of state identified in terms of subsection (2).

Contents of biodiversity management plans

44. A biodiversity management plan must –

(a) be aimed at ensuring the long term survival in nature of the species or ecosystem to which the plan relates; and

(b) be consistent with –

(i) this Act;

(ii) the national environmental management principles;

(iii) the national biodiversity framework;

(iv) any applicable bioregional plan;

(v) any plans issued in terms of Chapter 3 of the National Environmental

Management Act;

(vi) any municipal integrated development plans;

(vii) any other plans prepared in terms of national or provincial legislation that are affected; and

(viii) any relevant international agreements binding on the Republic.

Review and amendment of biodiversity management plans

45. (1) The Minister must review a biodiversity management plan published in terms of section 43(3) at least every five years, and assess compliance with the plan and the extent to which its objectives are being met.

(2) The Minister, either on own initiative or on request by an interested person, organisation or organ of state, may by notice in the *Gazette*, amend a biodiversity management plan published in terms of section 43(3).

(3) Before amending a biodiversity management plan, the Minister must consult –

(a) a person, organisation or organ of state implementing the plan; and

(b) any organ of state whose activities are affected by the implementation of the plan.

Consultation

46. (1) Before adopting or approving a national biodiversity framework, a bioregional plan or a biodiversity management plan, or any amendment to such a plan, the Minister must follow a consultative process in accordance with sections 96 and 97.

(2) Before adopting a bioregional plan, or any amendment to such a plan, the MEC for environmental affairs in the relevant province must follow a consultative process substantially in accordance with sections 96 and 97.

Part 2

Co-ordination and alignment of plans, monitoring and research

Co-ordination and alignment of biodiversity plans

47. (1) The national biodiversity framework, a bioregional plan and a biodiversity management plan prepared in terms of this Chapter may not be in conflict with –

(a) any environmental implementation or environmental management plans prepared in terms of Chapter 3 of the National Environmental Management Act;

(b) any integrated development plans adopted by municipalities in terms of the Local Government: Municipal Systems Act, 2000 (Act No. 32 of 2000);

(c) any spatial development frameworks in terms of legislation regulating land use management, land development and spatial planning administered by the Cabinet member responsible for land affairs; and

(d) any other plans prepared in terms of national or provincial legislation that are affected.

(2) An organ of state that must prepare an environmental implementation or environmental management plan in terms of Chapter 3 of the National Environmental Management Act, and a municipality that must adopt an integrated development plan in terms of the Local Government: Municipal Systems Act, 2000, must –

(a) align its plan with the national biodiversity framework and any applicable bioregional plan;

(b) incorporate into that plan those provisions of the national biodiversity framework or a bioregional plan that specifically apply to it; and

(c) demonstrate in its plan how the national biodiversity framework and any applicable bioregional plan may be implemented by that organ of state or municipality.

(3) The Institute may –

(a) assist the Minister and others involved in the preparation of the national biodiversity framework, a bioregional plan or a biodiversity management plan to comply with

subsection (1); and

(b) make recommendations to organs of states or municipalities referred to in subsection (2) to align their plans referred to in that subsection with the national biodiversity framework and any applicable bioregional plan.

Monitoring

48. (1) The Minister must for the purposes of this Chapter designate monitoring mechanisms and set indicators, to determine –

(a) the conservation status of various components of South Africa's biodiversity; and

(b) any negative and positive trends affecting the conservation status of the various components.

(2) The Minister may require any person, organisation or organ of state involved in terms of subsection (1) in monitoring the matters referred to in that subsection, to report regularly to the Minister on the results of such monitoring measured against the predetermined indicators.

(3) The Minister must –

(a) annually report to Parliament on the information submitted to the Minister in terms of subsection (2); and

(b) make such information publicly available.

Research

49. (1) The Minister must promote research done by the Institute and other institutions on biodiversity conservation, including the sustainable use, protection and conservation of indigenous biological resources.

(2) Research on biodiversity conservation may include –

(a) the collection and analysis of information about –

(i) the conservation status of the various components of biodiversity;

(ii) negative and positive trends affecting the conservation status of various components; and

(iii) threatening processes or activities likely to impact on biodiversity conservation;

(b) the assessment of strategies and techniques for biodiversity conservation;

(c) the determination of biodiversity conservation needs and priorities; and

(d) the sustainable use, protection and conservation of indigenous biological resources.

CHAPTER 4

THREATENED OR PROTECTED ECOSYSTEMS AND SPECIES

Purpose of Chapter

50. The purpose of this Chapter is to–

(a) provide for the protection of ecosystems that are threatened or in need of national protection to ensure the maintenance of their ecological integrity;

(b) provide for the protection of species that are threatened or in need of national protection to ensure their survival in the wild;

(c) give effect to the Republic's obligations under international agreements regulating international trade in specimens of endangered species; and

(d) ensure that the utilization of biodiversity is managed in an ecologically sustainable way.

Part 1

Protection of threatened or protected ecosystems

Ecosystems that are threatened or in need of national protection

51. (1) The Minister and the MEC for Environmental Officer may, by notice in the *Gazette,* publish a national list and provincial list respectively, of –

(a) critically endangered ecosystems, being any ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversibly transformation;

(b) endangered ecosystems, being any ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystem;

(c) vulnerable ecosystems, being any ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and

(d) protected ecosystems, being and ecosystems that are of such high conservation value or national importance, although they are not listed in terms of paragraphs *(a)*, *(b)* or *(c)*.

(2) A list referred to in subsection (1) must describe in sufficient detail the location of each ecosystem on the list.

(3) The Minister and the MEC for environmental affairs in any relevant province must, review respectively, the national and provincial lists published in terms of subsection (1) at least every five years.

(4) An MEC may publish or amend a provincial list only with the concurrence of the Minister.

Threatening processes in listed ecosystems

52. (1) The Minister may by notice in the *Gazette* identify any process or activity in a listed ecosystem as a threatening process.

(2) A threatening process identified in terms of subsection (1) must be regarded as a specified activity contemplated in section 24(2)*(b)* of the National Environmental Management Act and a listed ecosystem must be regarded as an area identified for the purpose of that section.

Certain plans to take into account protection of listed ecosystems

53. An organ of state that must prepare an environmental implementation or environmental management plan in terms of Chapter 3 of the National Environmental Management Act, and a municipality that must adopt an integrated development plan in terms of the Local Government: Municipal Systems Act, 2000 (Act No. 32 of 2000), must take into account the need for the protection of listed ecosystems.

Amendment of notices

54. The Minister or the MEC for environmental affairs in any relevant province may, by notice in the *Gazette*, amend or repeal any notice published by him or her in terms of section 51(1) or 52(1).

Part 2

Protection of threatened or protected species

Listing of species that are threatened or in need of national protection

55. (1) The Minister may by notice in the *Gazette* publish a list of –

(a) critically endangered species, being any indigenous species facing an extremely high risk of extinction in the wild in the immediate future;

(b) endangered species, being any indigenous species facing a high risk of extinction in the wild in the near future, although they are not a critically endangered species;

(c) vulnerable species, being any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future, although they are not critically endangered species or endangered species; and

(d) protected species, being any species which are of such high conservation value or national importance that they require national protection, although they are not listed in terms of paragraphs *(a)*, *(b)* or *(c)*..

(2) The Minister must review the lists published in terms of subsection (1) at least every five years.

Restricted activities involving listed threatened or protected species

56. (1) A person may not without a permit issued in terms of Chapter 7 carry out a restricted activity involving a specimen of a listed threatened or protected species.

(2) The Minister may, by notice in the *Gazette*, prohibit or prohibit without a permit issued in terms of Chapter 7, the carrying out of any activity –

(a) which is of a nature that may negatively impact on the survival of a listed threatened or protected species; and

(b) which is specified in the notice.

(3) Subsection (1) does not apply in respect of a specimen of a listed threatened or protected species conveyed from outside the Republic in transit through the Republic to a destination outside the Republic, provided that such transit through the Republic takes place under the control of an environmental management inspector.

Amendment of notices

57. The Minister may by notice in the *Gazette* amend or repeal any notice published in terms of section 55(1) or 56(2).

Part 3

Trade in listed threatened or protected species

Functions of Minister

58. The Minister –

(a) must monitor –

(i) compliance with section 56(1) insofar as trade in specimens of listed threatened or protected species is concerned; and

(ii) compliance in the Republic with an international agreement regulating international trade in specimens of endangered species which is binding on the Republic;

(b) must consult the scientific authority on issues relating to trade in specimens of endangered species regulated by such an international agreement;

(c) must prepare and submit reports and documents in accordance with the Republic's obligations in terms of such an international agreement;

(d) may provide administrative and technical support services and advice to organs of state to ensure the effective implementation and enforcement in the Republic of such an international agreement;

(e) may make information and documentation relating to such an international agreement publicly available; and

(f) may prescribe a system for the registration of institutions, ranching operations, nurseries, captive breeding operations and other facilities.

Establishment of scientific authority

59. (1) The Minister must establish a scientific authority for purpose of assisting in regulating and restricting the trade in specimens of listed threatened or protected species.

(2) The Institute must provide logistical, administrative and financial support for the proper functioning of the scientific authority.

Functions of scientific authority

60. (1) The scientific authority must –

(a) monitor in the Republic the legal and illegal trade in specimens of listed threatened or protected species;

(b) advise the Minister and any other interested organs of state on the matters that it monitors;

(c) make recommendations to an issuing authority on applications for permits referred to in section 56(1) or (2);

(d) make non-detriment findings on the impact of actions relating to the international trade in specimens of listed threatened or protected species;

(e) advise the Minister on –

(i) the registration of ranching operations, nurseries, captive breeding operations and other facilities;

(ii) whether an operation or facility meets the criteria for producing species considered to be bred in captivity or artificially propagated;

(iii) the choice of a rescue centre or other facility for the disposal of forfeited specimens;

(iv) any amendments to a notice published in terms of section 55(1) or 56(2);

(v) the nomenclature of species; or

(vi) any other matter of a specialised nature;

(f) assist the Minister or an environmental management inspector in the identification of specimens for the purpose of enforcing the provisions of this Act;

(g) issue certificates in which the identification of a specimen is verified as being taxonomically accurate;

(h) perform any other function that may be –

(i) prescribed; or

(ii) delegated to it by the Minister in terms of section 47D of the National Environmental Management Act; and

(i) deal with any other matter necessary for, or reasonably incidental to, its powers and duties.

(2) In performing its duties, the scientific authority must –

(a) base its findings, recommendations and advice on a scientific and professional review of available information; and

(b) consult, when necessary, organs of state, the private sector, non-governmental organisations, local communities and other stakeholders before making any findings or recommendations or giving any advice.

Annual non-detriment findings

61. (1) The scientific authority must publish in the *Gazette* any annual non-detriment findings on trade in specimens of listed threatened or protected species in accordance with an international agreement regulating international trade in specimens of listed threatened or protected species which is binding on the Republic.

(2) Any interim findings of the scientific authority must be published in the *Gazette* for public information within 30 days after the decision has been made.

Part 4

General provisions

Consultation

62. (1) Before publishing a notice in terms of section 51(1), 52(1), 55 (1) or 56(2), or amending or repealing such a notice in terms of section 54 or 57, the Minister must follow a consultative process in accordance with sections 96 and 97.

(2) Before publishing a notice in terms of section 51(1), or amending or repealing such a notice in terms of section 54, the MEC for environmental affairs in the relevant province must follow a consultative process substantially in accordance with sections 96 and 97.

CHAPTER 5

ALIEN AND INVASIVE SPECIES

Purposes of Chapter

63. (1) The purpose of this Chapter is to–

(a) prevent where possible the introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur;

(b) manage and control alien species and invasive species to prevent or minimize harm to the environment and to biodiversity in particular; and

(c) eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats.

(2) For the purposes of this Chapter, "specimen" has the meaning assigned to it in paragraphs *(a)* and *(b)* of the definition of "specimen" in section 1(1).

Part 1

Alien species

Restricted activities involving alien species

64. (1) A person may not without a permit issued in terms of Chapter 7 carry out a restricted activity involving a specimen of an alien species.

(2) A permit in terms of subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity are carried out.

Exemptions

65. (1) The Minister may, by notice in the *Gazette,* exempt from the provisions of section 64–

(a) any alien species specified in the notice; or

(b) any alien species of a category specified in the notice.

(2) Any person may carry out a restricted activity involving a specimen of an exempted alien species without a permit mentioned in section 64 (1).

Restricted activities involving certain alien species totally prohibited

66. (1) The Minister may, by notice in the *Gazette,* publish a list of those alien species in respect of which a permit mentioned in section 64(1) may not be issued.

(2) A person may not carry out any restricted activity involving a specimen of an alien species published in terms of subsection (1).

(3) The Minister must regularly review a list published in terms of subsection (1).

Amendment of notices

67. The Minister may, by notice in the *Gazette*, amend or repeal any notice published in terms of section 65(1) or 66(1).

Duty of care relating to alien species

68. (1) A person authorised by permit, in terms of section 64(1), to carry out a restricted activity involving a specimen of an alien species must –

(a) comply with the conditions under which the permit has been issued; and

(b) take all required steps to prevent or minimize harm to biodiversity.

(2) A competent authority may, in writing, direct any person who has failed to comply with subsection (1), or who has contravened section 64(1) or 66(2), to take such steps –

(a) as may be necessary to remedy any harm to biodiversity caused by the actions of that person; and

(b) as may be specified in the directive.

(3) If that person fails to comply with a directive issued in terms of subsection (2), the competent authority may –

(a) implement the directive; and

(b) recover from that person all costs incurred by the competent authority in implementing the directive.

(4) Should an alien species establish itself in nature as an invasive species because of the actions of a specific person, a competent authority may hold that person liable for any costs incurred in the control and eradication of that species.

Part 2

Invasive species

List of invasive species

69. (1) The Minister may, by notice in the *Gazette*, publish a list of invasive species to which this Chapter applies.

(2) The Minister must regularly review a list published in terms of subsection (1).

Restricted activities involving listed invasive species

70. (1) A person may not without a permit issued in terms of Chapter 7 carry out a restricted activity involving a specimen of a listed invasive species.

(2) A permit in terms of subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity are carried out.

Amendment of notices

71. The Minister may, by notice in the *Gazette*, amend or repeal any notice published in terms of section 70(1).

Duty of care relating to listed invasive species

72. (1) A person authorised by permit in terms of section 70(1) to carry out a restricted activity involving a specimen of a listed invasive species must –

(a) comply with the conditions subject to which the permit has been issued; and

(b) take all the required steps to prevent or minimize harm to biodiversity.

(2) A person who is the owner of land on which a listed invasive species occurs must –

(a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;

(b) take steps to control and eradicate the listed invasive species and to prevent it from spreading; and

(c) take all the required steps to prevent or minimize harm to biodiversity.

(3) A competent authority may, in writing, direct any person who has failed to comply with subsection (1) or (2), or who has contravened section 70(1), to take such steps –

(a) as may be necessary to remedy any harm to biodiversity caused by –

(i) the actions of that person; or

(ii) the occurrence of the listed invasive species on land of which that person is the owner; and

(b) as may be specified in the directive.

(4) If that person fails to comply with a directive issued in terms of subsection (3), a competent authority may –

(a) implement the directive; and

(b) recover all costs reasonably incurred by a competent authority in implementing the directive–

(i) from that person; or

(ii) proportionally from that person and any other person who benefited from implementation of the directive.

Requests to competent authorities to issue directives

73. (1) Any person may request a competent authority, in writing, to issue a directive in terms of section 72(3).

(2) A competent authority must reply to the request, in writing, within 30 days of receipt of the request.

(3) Should a competent authority fail to respond to the request within the stated period or refuses the request, the person who made the request may apply to a court for an order directing that competent authority to issue the directive.

Control and eradication of listed invasive species

74. (1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.

(2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.

(3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

(4) The Minister must ensure the Coordination and implementation of programmes for the prevention, control or eradication of invasive species.

(5) The Minister may establish an entity consisting of public servants to coordinate and implement programmes for the prevention, control or eradication of invasive species.

Invasive species control plans of organs of state

75. (1) The management authority of a protected area preparing a management plan for the area in terms of the Protected Areas Act must incorporate into the management plan an invasive species control and eradication strategy.

(2) All organs of state in all spheres of government must prepare an invasive species monitoring, control and eradication plan for land under their control, as part of their environmental plans in accordance with section 11 of the National Environmental Management Act. The invasive species control and eradication plans of municipalities must be part of their integrated development plans.

(3) The Minister may request the Institute to assist municipalities in complying with their duties in terms of subsection (2).

(4) An invasive species control and eradication plan must include –

(a) a detailed list and description of any listed invasive species occurring on the relevant land;

(b) a description of the parts of that land that are infested with such listed invasive species;

(c) an assessment of the extent of such infestation;

(d) a status report on the efficacy of previous control and eradication measures;

(e) the current measures to control and eradicate such invasive species; and

(f) measurable indicators of progress and success, and indications of when, the control plan is to be completed.

Invasive species status reports

76. (1) The management authority of a protected area must at regular intervals prepare and submit to the Minister or the MEC for environmental affairs in the province a report on the status of any listed invasive species that occurs in that area.

(2) A status report must include –

(a) a detailed list and description of all listed invasive species that occur in the protected area;

(b) a detailed description of the parts of the area that are infested with listed invasive species;

(c) an assessment of the extent of such infestation; and

(d) a report on the efficacy of previous control and eradication measures.

Part 3

General provisions

Consultation

77. The Minister must, before publishing a notice in terms of section 65(1), 66(1) or 69(1), or amending or repealing such a notice in terms of section 68 or 72, follow a consultative process in accordance with sections 96 and 97.

CHAPTER 6

BIOPROSPECTING, ACCESS AND BENEFIT-SHARING

Purpose and application of Chapter

78. (1) The purpose of this Chapter is to–

(a) regulate bioprospecting of genetic material derived from indigenous biological resources; and

(b) provide for a fair and equitable sharing of benefits arising from bioprospecting of genetic material derived from indigenous biological resources.

(2) This Chapter applies to –

(a) bioprospecting of genetic material derived from any indigenous biological resources; and

(b) the export from the Republic, for the purpose of research or bioprospecting of any indigenous biological resources listed by the Minister by notice in the *Gazette*.

(3) In this Chapter –

"indigenous biological resources" –

(a) includes –

(i) any indigenous biological resources defined in section 1, whether gathered from the wild or accessed from any other source, including any animals, plants or other organisms of an indigenous species cultivated, bred or kept in captivity or cultivated or altered in any way by means of biotechnology;

(ii) any cultivar, variety, strain, derivative, hybrid or fertile version of any indigenous species or of any animals, plants or other organisms referred to in subparagraph (i); and

(iii) any exotic animals, plants or other organisms, whether gathered from the wild or accessed from any other source which, through the use of biotechnology, have been altered with any genetic material or chemical compound found in any indigenous species or any animals, plants or other organisms referred to in subparagraph (i) or (ii); but

(b) excludes –

(i) genetic material of human origin;

(ii) any exotic animals, plants or other organisms, other than exotic animals, plants or other organisms referred to in paragraph *(a)* (iii); and

(iii) indigenous biological resources listed in terms of the International Treaty on Plant Genetic Resources for Food and Agriculture; and

"listed indigenous biological resources" means any indigenous biological resources listed in terms of subsection (2)*(b)*.

(4) This Chapter must be interpreted in terms of any applicable law.

Bioprospecting involving indigenous biological resources

79. (1) A person may not without, a permit issued in terms of Chapter 7, engage in bioprospecting of genetic material derived from indigenous biological resources.

(2) A permit referred to in subsection (1) may be issued only if –

(a) a person or community providing or giving access to the relevant indigenous biological resources for the purpose of such bioprospecting, has consented to the terms and conditions of a benefit-sharing agreement that will regulate such provision or access; and

(b) the Minister has in terms of section 80(2) approved the proposed benefit-sharing agreement between the parties.

(3) Consent referred to in subsection (2) *(a)* must be based on full disclosure of all relevant information, including the intended use of those indigenous biological resources.

(4) An issuing authority prescribed in terms of section 94–

(a) may engage the person applying for a permit and the other parties on the terms and conditions of the benefit-sharing agreement;

(b) may facilitate negotiations between the applicant and the other parties and ensure that those negotiations are conducted on an equal footing;

(c) on request by the Minister, must ensure that the benefit-sharing arrangement agreed upon between the applicant and the other parties is fair and equitable;

(d) may make recommendations to the Minister; and

(e) must perform any other duties functions that may be prescribed.

Benefit-sharing agreements

80. (1) A benefit-sharing agreement must –

(a) be in a prescribed format;

(b) determine –

(i) the type of indigenous biological resources to which the relevant bioprospecting relates;

(ii) the area or source from which the indigenous biological resources is to be collected or obtained;

(iii) the quantity of indigenous biological resources that is to be collected or obtained; and

(iv) the present potential uses of the indigenous biological resources;

(c) name the parties to the benefit-sharing agreement;

(d) set out the manner in which and the extent to which a indigenous biological resources is

to be utilised or exploited for purposes of such bioprospecting; and

(e) set out the manner in which and the extent to which a person or community providing those indigenous biological resources may share in any profits, revenues or other benefits that may arise from the commercialisation through bioprospecting of such indigenous biological resources; and

(f) record the particulars of any such benefits.

(2) A benefit-sharing agreement –

(a) must be submitted to the Minister for approval; and

(b) does not take effect unless approved by the Minister.

Export of listed indigenous biological resources

81. (1) A person may not, without a permit issued in terms of Chapter 7, export from the Republic any listed indigenous biological resources for the purpose of research or bioprospecting.

(2) A permit referred to in subsection (1) may be issued only if –

(a) a person or community providing or giving access to the relevant indigenous biological resources for the purpose of such export has consented to the terms and conditions of a material transfer agreement that regulates such provision or access; and

(b) the Minister has in terms of section 82(2) approved the proposed material transfer agreement between the parties.

(3) Consent referred to in subsection (2) *(a)* must be based on full disclosure of all relevant information, including the intended use of those indigenous biological resources.

(4) An issuing authority prescribed in terms of section 94–

(a) may engage the applicant and the other parties on the terms and conditions of the material transfer agreement;

(b) may facilitate negotiations between the applicant and the other parties, and ensure that those negotiations are conducted on an equal footing;

(c) on request by the Minister, must ensure that the benefit-sharing arrangement agreed upon between the applicant and the other parties is fair and equitable;

(d) may make recommendations to the Minister; and

(e) must perform any other duties that may be prescribed.

Material transfer agreements

82. (1) A material transfer agreement must –

(a) be in a prescribed format;

(b) determine –

(i) particulars of the provider, exporter and recipient of the indigenous biological resources;

(ii) the type of indigenous biological resources to be exported;

(iii) the area or source from which the indigenous biological resources is to be collected, obtained or provided;

(iv) the quantity of indigenous biological resources that is to be exported;

(v) the purpose for which such indigenous biological resources is to be exported;

(vi) the present potential uses of the indigenous biological resources; and

(vii) specify conditions under which the recipient may provide any such indigenous biological resources, or their progeny, to a third party.

(2) A material transfer agreement–

(a) must be submitted to the Minister for approval; and

(b) does not take effect unless approved by the Minister.

Establishment of Bioprospecting Trust Fund

83. (1) A Bioprospecting Trust Fund is established into which all moneys arising from benefit-sharing agreements or material transfer agreements, and due to owners and providers of indigenous biological resources, must be paid, and from which all payments to those beneficiaries must be made.

(2) All moneys paid into the bioprospecting trust fund is trust money within the meaning of section 13(1)*(f)*(ii) of the Public Finance Management Act.

(3) The Director-General –

(a) must manage the Fund in the prescribed manner; and

(b) is accountable for the money in the Fund in terms of the Public Finance Management Act.

CHAPTER 7

PERMITS

Purpose of Chapter

84. The purpose of this Chapter is to provide for the regulation of issue of permits authorising –

(a) restricted activities involving specimens of –

(i) listed threatened or protected species in terms of section 56(1);

(ii) alien species in terms of section 64(1); or

(iii) listed invasive species in terms of section 70(1);

(b) activities regulated in terms of a notice published in terms of section 56(2); or

(c) bioprospecting involving indigenous biological resources in terms of section 79(1); or

(d) the export of indigenous biological resources for research or bioprospecting in terms of section 81(1).

Part 1

Permit system

Application for permits

85. (1) A person may apply for a permit by lodging an application on the prescribed form to the authority.

(2) An issuing authority may –

(a) request the applicant to furnish any additional information before it considers the application;

(b) require the applicant to comply with such reasonable conditions as it may impose before it grants the application;

(c) issue a permit unconditionally or issue it subject to conditions; or

(d) refuse a permit.

(3) A decision of the issuing authority to issue or refuse a permit or to issue it subject to conditions, must be consistent with –

(a) the applicable provisions of this Act;

(b) the national environmental management principles;

(c) the national biodiversity framework;

(d) any other relevant plans adopted or approved in terms of Chapter 3;

(e) any applicable international agreements binding on the Republic;

(f) the Promotion of Administrative of Justice Act, 2000 (Act No. 3 of 2000);

(g) any requirements that may be prescribed.

(4) If compulsory conditions are prescribed for any kind of permit, an issuing authority may not issue a permit of that kind other than subject to those conditions.

(5) If an application is rejected, the issuing authority must give reasons for the decision in writing to the applicant.

Risk assessments and expert evidence

86. Before issuing a permit, the issuing authority may in writing require the applicant to furnish it, at the applicant's expense, with an independent risk assessment or expert evidence as the issuing authority may determine.

Permits

87. (1) A permit –

(a) must specify –

(i) the purpose for which it is issued;

(ii) the period for which it will remain valid; and

(iii) any other matters that may be prescribed;

(b) may be issued on conditions specified in the permit; and

(c) must be in the form and contain such other particulars as may be prescribed.

(2) A permit issued in terms of section 88 does not absolve the holder or any other person from complying with the provisions of any other applicable legislation.

Additional requirements relating to alien and invasive species

88. An issuing authority may issue a permit for a restricted activity involving a specimen of an alien species or of a listed invasive species only if –

(a) adequate procedures have been followed by the applicant to assess the risks and potential impacts associated with the restricted activity;

(b) the relevant species has been found to have negligible or no invasive potential;

(c) the benefits of allowing the activity are significantly greater than the costs associated with preventing or remedying any resultant damage to the environment or biodiversity; and

(d) it is satisfied that adequate measures have been taken by the applicant to prevent the escape and spread of the species.

Integrated permits

89. (1) If the carrying out of an activity mentioned in section 87 is also regulated in terms of other legislation, the authority empowered under that other legislation to authorise that activity and the issuing authority empowered under this Act to issue permits in respect of that activity may –

(a) exercise their respective powers jointly; and

(b) issue a single integrated permit instead of a separate permit and authorisation.

(2) An authority empowered under that other legislation may issue an integrated permit for the activity in question if that authority is designated in terms of this Act also as an issuing authority for permits in respect of that activity.

(3) An integrated permit may be issued only if –

(a) the relevant provisions of this Act and that other legislation have been complied with; and

(b) the permit specifies the–

(i) respective provisions in terms of which it has been issued; and

(ii) authority or authorities that have issued it.

Cancellation of permits

90. An issuing authority which issued a permit may cancel the permit if—

(a) the permit was issued as a result of misleading or false representations by the applicant or a person acting on behalf of the applicant; or

(b) the applicant or permit holder has contravened or failed to comply with –

(i) any condition of the permit;

(ii) any provision of this Act or other legislation governing the permitted activity; or

(iii) any foreign law governing the permitted activity.

Part 2

Appeals

Appeals to be lodged with Minister

91. (1) An applicant who feels aggrieved by the decision of an issuing authority in terms of section 85(2)*(c)* or *(d)*, or a permit holder whose permit has been cancelled in terms of section 90, may lodge with the Minister an appeal against the decision within 30 days after having been informed of the decision.

(2) The Minister must either –

(a) consider and decide the appeal;

(b) redirect the appeal to the MEC for environmental affairs in the relevant province to consider and decide the appeal; or

(c) designate a panel of persons to consider and decide the appeal.

(3) An appeal does not suspend the decision against which the appeal is lodged unless the Minister, MEC or appeal panel considering the appeal directs otherwise.

Appeal panels

92. (1) If the Minister decides that the appeal must be considered and decided by an appeal panel, the Minister must designate –

(a) a number of persons with appropriate knowledge as members of the panel; and

(b) one of the panel members as the presiding member.

(2) The presiding member of the appeal panel decides when and where the panel meets.

(3) An appeal panel must –

(a) consider and decide the appeal in accordance with a prescribed procedure; and

(b) keep a record of its proceedings and decisions.

Decisions

93. (1) The Minister, MEC or appeal panel considering an appeal may –

(a) either uphold or refuse the appeal; and

(b) when upholding or refusing the appeal, make such other orders as may be appropriate.

(2) If the appeal is upheld against –

(a) a refusal to issue a permit, the Minister, MEC or appeal panel may issue the permit unconditionally or subject to conditions;

(b) a condition subject to which the permit was issued, the Minister, MEC or appeal panel may withdraw or amend the condition; or

(c) the cancellation of a permit, the Minister, MEC or appeal panel may restore the permit.

CHAPTER 8

ADMINISTRATION OF ACT

Part 1

Regulations

Regulations by Minister

94. (1) The Minister may make regulations relating to –

(a) monitoring compliance with, and enforcement of norms and standards referred to in section 9;

(b) (i) designating organs of state which may be issuing authorities for permits referred to in section 56(1) or (2);

(ii) facilitate the implementation and enforcement of section 56(1) or any notice published in terms of section 56(2);

(iii) the carrying out of a restricted activity involving a specimen of a listed threatened or protected species;

(iv) facilitate the implementation and enforcement of an international agreement regulating international trade in specimens of listed threatened or protected species which is binding on the Republic;

(v) minimise the threat to the survival in the wild of a listed threatened or protected species;

(vi) minimise the threat to the ecological integrity of a listed ecosystem;

(vii) the composition and operating procedure of the scientific authority; or

(viii) that the utilization of biodiversity is managed in an ecologically sustainable way;

(c) (i) designating organs of state which may be issuing authorities for permits referred to in section 66(1) or 70(1);

(ii) designating organs of state which may be competent authorities for implementing and enforcing the provisions of this Chapter;

(iii) facilitating the implementation and enforcement of section 64, 66 or 70;

(iv) prescribing compulsory conditions for any permit issued in terms of section 64(1) or 70(1);

(v) the assessment of risks and potential impacts on biodiversity of restricted activities involving specimens of alien species or of listed invasive species; and

(vi) the control and eradication of listed invasive species;

(d) (i) designating organs of state that may be issuing authorities for permits referred to in section 81;

(ii) the form and contents of, and the requirements and criteria for, benefit-sharing agreements and material transfer agreements;

(iii) moneys payable in connection with benefit-sharing agreements and material transfer agreements; and

(iv) the administration of the Bioprospecting Trust Fund;

(e) (i) the conditions subject to which issuing authorities may issue permits in terms of this Act;

(ii) the procedure to be followed and the fees to be paid in connection with the lodging and consideration of applications for permits;

(iii) the powers of issuing authorities when considering and deciding such applications;

(iv) the conditions with which applicants must comply before or after the lodging of their applications;

(v) appropriate consultation processes;

(vi) the authorities whose consent is required before permits may be issued;

(vii) the factors that must be taken into account when deciding applications;

(viii) the circumstances in which applications must be refused or may be approved;

(ix) the form and contents of permits;

(x) the conditions on which permits must be issued, or guidelines as to determining conditions on which permits may be issued;

(xi) methods, procedures and conditions of enforcing compliance with the conditions of a permit;

(xii) the giving of security in respect of any obligation that may arise from carrying out a restricted activity authorised by a permit, and the form of such security;

(xiii) the period of validity of permits;

(xiv) the transferability of permits;

(xv) the duties of the permit holders;

(xvi) the procedure to be followed and the fees to be paid in connection with the lodging and consideration of appeals; and

(xvii) any other matter that may be necessary to facilitate the implementation of this Chapter;

(f) any other matter that may be prescribed in terms of this Act; and

(g) any other matter that may be necessary to facilitate the implementation of this Act.

(2) Any regulation with direct fiscal implications may be made only with the concurrence of the Minister of Finance.

(3) Before publishing any regulations in terms of subsection (1), or any amendment to the regulations, the Minister must follow a consultative process in accordance with sections 96 and 97.

(4) Subsection (3) need not be applied to a non-substantial change to the

regulations.

General

95. (1) Regulations made in terms of section 94 may –

(a) restrict or prohibit any act either absolutely or conditionally;

(b) apply –

(i) generally throughout the Republic or a province, as the case may be, or only in a specified area or category of areas;

(ii) generally to all persons or only to a specified category of persons;

(iii) generally with respect to all species or only to a specified species or category of species; or

(iv) generally with respect to all permits or appeals or only to a specified category of permits or appeals; or

(c) differentiate between different –

(i) areas or categories of areas;

(ii) persons or categories of persons;

(iii) species or categories of species; or

(iv) categories of permits or appeals.

(2) Regulations made in terms of section 94 may provide that any person who contravenes or fails to comply with a provision thereof is guilty of an offence and liable on conviction to –

(a) imprisonment for a period not exceeding five years;

(b) an appropriate fine; or

(c) both a fine and such imprisonment.

Part 2

Consultation process

Consultation

96. (1) Before exercising a power which, in terms of a provision of this Act, must be exercised in accordance with this section and section 97, the Minister must follow a consultative process as may be appropriate in the circumstances.

(2) The Minister must, as may be appropriate in terms of subsection (1) –

(a) consult all Cabinet members whose areas of responsibility may be affected by the exercise of the power;

(b) in accordance with the principles of co-operative governance set out in Chapter 3 of the Constitution, consult the MEC for environmental affairs of each province that may be affected by the exercise of the power; and

(c) allow public participation in the process in accordance with section 97.

Public participation

97. (1) The Minister must give notice of the proposed exercise of the relevant power –

(a) in the *Gazette;* and

(b) in at least one newspaper distributed nationally, or if the exercise of the power may affect only a specific area, in at least one newspaper distributed in that area.

(2) The notice must –

(a) invite members of the public to submit to the Minister, within 21 days of publication of the notice in the *Gazette*, written representations on, or objections to, the proposed exercise of the power; and

(b) contain sufficient information to enable members of the public to submit meaningful representations or objections.

(3) The Minister may in appropriate circumstances allow any interested person or community to present oral representations or objections to the Minister or a person

designated by the Minister.

(4) The Minister must give due consideration to all representations or objections received or presented before exercising the power.

CHAPTER 9

OFFENCES AND PENALTIES

Offences

98. (1) A person is guilty of an offence if that person contravenes or fails to comply with a provision of –

(a) section 56(1), 64(1), 66(2), 70(1), 79(1) or 81(1);

(b) a notice published in terms of section 56(2); or

(c) a directive issued in terms of section 68(2) or 72(3).

(2) A person who is the holder of a permit is guilty of an offence if that person –

(a) contravenes or fails to comply with a provision of 68(1) or 72(1);

(b) performs the activity for which the permit was issued otherwise than in accordance with any conditions subject to which the permit was issued; or

(c) permits or allows any other person to do, or to omit to do, anything which is an offence in terms of paragraph *(a)* or *(b)*.

(3) A person is guilty of an offence if that person –

(a) fraudulently alters any permit;

(b) fabricates or forges any document for the purpose of passing it as a permit;

(c) passes, uses, alters or has in possession any altered or false document purporting to be a permit; or

(d) knowingly makes any false statement or report for the purpose of obtaining a permit.

Penalties

99. (1) A person convicted of an offence in terms of section 98 is liable to a fine, or to imprisonment for a period not exceeding five years, or to both such fine and such imprisonment.

(2) A fine in terms of the subsection (1) may not exceed –

(a) an amount prescribed in terms of Adjustment of Fines Act, 1999 (Act No. 101 of 1991); or

(b) if a person is convicted of an offence involving a specimen of a listed threatened or protected species, an amount determined in terms of paragraph *(a)* or which is equal to three times the commercial value of the specimen in respect of which the offence was committed, whichever is the greater.

CHAPTER 10

MISCELLANEOUS

Repeal of Act 122 of 1984

100. The Forest Act, 1984, is repealed by this Act.

Savings

101. (1) Anything done in terms of the Forest Act, 1984 (Act No. 122 of 1984), which can or must be done in terms of this Act must be regarded as having been done in terms of this Act.

(2) A person who immediately before the repeal of the Forest Act, 1984, by section 100 of this Act was –

(a) a member of the board of the National Botanical Institute, becomes a member of the Board of the South African National Biodiversity Institute and remains such a member until the Minister appoints the members of the Board in terms of section 15;

(b) the chief executive officer of the National Botanical South African becomes the acting chief executive officer of the National Biodiversity Institute and remains the acting chief executive officer until the Board appoints a person as the chief executive officer of the Institute in terms of section 29; and

(c) all employees of the National Botanical Institute, including its chief executive officer, must be regarded as having been appointed in terms of section 30 as employees of the South African National Biodiversity Institute subject to the same conditions of services which applied to them immediately before the repeal of the Forest Act, 1984.

(3) Subsection (2) *(c)* does not affect pension, leave and other benefits which accrued to employers referred to in that subsection before the repeal of the Forest Act, 1984, and such benefits must be respected as if there were no break in their service and no change of employer.

(4) As from the date of repeal of the Forest Act, 1984 –

(a) all assets and liabilities and all rights and obligations of the National Botanical Institute are vested in the South African National Biodiversity Institute; and

(b) any balance in the National Botanical Institute Fund referred to in section 64 of that Act must be paid to the South African National Biodiversity Institute.

Existing bioprospecting projects

102. (1) Any party involved at the commencement of Chapter 6 in a bioprospecting project to which section 80 applies, may despite that section continue with the project pending the negotiation and entry into force of an appropriate benefit-sharing agreement in terms of that Chapter.

(2) Subsection (1) lapses one year after Chapter 6 took effect.

Short title and commencement

103. This Act is called the National Environmental Management: Biodiversity Act, 2003, and takes effect on a date determined by the President by proclamation in the *Gazette*.

Doc 2.2

APPENDIX ONE

COUNTRY CLEAN-UPS: REMOVAL OF RUBBLE IN 2003

ZONE 1 (BASE VICINITY)

PRION VALLEY (46° 52.616'S, 37° 51.543'E)

Large number of redundant aerial anchors (poles, shackles and concrete blocks in wooden plank frames). Some metal items and wood cladding removed by hand on 3-4 April to a container and flown to ship. NDPW support required. **Site partially cleared.**

E-BASE

Scattered material on burnt ground and in sink holes behind the building, including partially buried solidified cement bags, wood, nails, screws, broken glass, an old shoe and porcelain and battery fragments, plus wooden cladding, shackles and wire from nearby anchor points for dismantled aerials. Large amount of material collected together on 8 April and placed in container S42 on 10 April. More material placed in container on 21 April. Container flown to ship on 23 April. Site requires further attention in 2004 to remove newly exposed and still buried material. **Surface of sites cleared.**

BOLUG BUILDING AND LOWER HELICOPTER PAD

Two nearby old dump sites. Material (glass, metal, wood, batteries, etc.) visible on the surface removed on 13 and 21 April to adjacent container. Container flown to ship on 23 April. Sites require further attention in 2004 to remove newly exposed and still buried material. A NDPW container at the helicopter pad, to be left on the island, was noticed to be shedding paint fragments. It was then covered in plastic wrapping. It is recommended that it be painted in August. **Surface of sites cleared.**

BASE BUILDINGS

Assorted rubble underneath and surrounding buildings. Some material, mainly wood, removed from below Bird Lab, E-Base and old food store floor **Sites partially cleared.**

ZONE 2

OLD WATER PIPELINE (46° 52.768'S, 37° 49.468'E; 160 m)

Plastic water pipe (partially buried) cut up into sections and loaded into container S21 on 11 and 15 April. A few pieces of wood, wire mesh and a glass bottle found in the vicinity. Container flown to ship on 22 April. One *c*. 20-m buried section at above co-ordinates remains to be removed, perhaps by direct attachment to a helicopter. Two piles of long pieces of water pipe on surface of mire at 46° 52.765'S, 37°

49.805'E; 156 m and 46° 52.664'S, 37° 49.994'E; 144 m placed in slings and removed to the ship on 24 April. **Site partially cleared.**

VAN DEN BOOGAARD DAM (46° 52.536'S, 37° 49.755'E)

Water plastic pipe sections, old spade and two piles of stone chips and sand, some in plastic bags present. Overgrown electric cable from dam to base: the exposed end is at 46° 52'S, 37° 49.866'E; 101 m. Two containers were loaded on 9 April with sections of water pipe and stone chips, some in original plastic bags, wooden shuttering, three concrete lumps from below dam and a *c*. 30-m nearby section of the power cable. A third container was loaded with stone chips and concrete fragments on 15 April, when a further section of the power cable (*c.* 4 m) was taken to base. Bamboo canes marking old photo points around the top of the peat slip were removed on 15 April. Containers flown to ship on 22 April. Wire and metal strapping removed from dam waters on 24 April. A further five containers are required in 2004 to remove remaining stone chips and plastic piping and *c*. 10 concrete lumps from immediately below dam wall. **Site partially cleared.**

HYDRO-ELECTRIC BUILDINGS (46° 52.186'S, 37° 50.46'E)

Metal and wooden superstructures of two buildings, steel poles, wooden planked deck and steps, incineration site and partially buried concrete lumps. NDPW support required to remove superstructures. Plank removed from ridge above shacks by foot on 1 April. Redundant albatross nest markers from Goney Plain placed at container on 7 April. One container placed next to incineration site and loaded on 9 April. Incineration site fully dug up and burnt materials ready for loading on 10 April. Cladding in small shack removed, along with some wooden planks in large shack. About 25 stone chip and sand bags and a metal pole dug up at large shack on 10 and 13 April. Container flown to ship on 22 April. Accumulated material (three containers required) remains on site due to lack of available containers. **Site partially cleared.**

CABLE DRUM No. 1 (46° 52.309'E, 37° 50.759E; 62 m)

Rotten wood and metal rods of a collapsed and partially buried cable drum between hangar and hydroshacks next to path in a hollow. Two pack loads carried out on foot on 1 April, three each on 3 and 4 April, two on 6 April, one on 7 April, all to base. Last load (10th) carried to hydroshack container on 9 April. **Site fully cleared.**

CABLE DRUM No. 2 (46° 52.432'S, 37° 51.115'E; 42 m)

Partially burnt and buried cable drum (waterlogged wood and metal rods) between hangar and hydroshacks removed in five pack loads on foot on 21 April. Fuel smell and oil trace (probably diesel) noticeable. **Site fully cleared.**

HYDROSHACK POWER CABLE (46° 52.449'S, 37° 51.178'E; 36 m)

Power cable from hydroshack exposed at this point and intermittently towards base, where exposed near hangar at 46° 52.548'S, 37° 51.478'; 40 m. Needs to be dug out and cut up into sections. Lifting out by helicopter without cutting may be feasible.

Four cut sections found near site of cable drum #1 and taken to hydroshack, on 22 and 23 April, where they remain on site (see above). **Sites partially cleared.**

SHIP'S COVE (46° 51.248'E, 37° 49.468'E; 50 m)

Two embedded metal anchor poles on top of bluff at northern end of cove inspected. Cannot be removed by hand.

JUNIOR'S KOP (No GPS)

Several wooden markers reported present at summit. Not investigated.

ZONE 3 (EAST COAST)

THIRD SISTER (46° 51.548'S, 37° 48.816'E; 136 m)

Large roll of chicken wire mesh (cat exclosure from early 1980s). Metal fence poles and droppers in vicinity moved to this site on 14 April. Flown out in cargo net by helicopter along with material in plastic bags from Bill Brigg's Beacon and elsewhere (see below) on 24 April. **Site fully cleared.**

BILL BRIGG'S BEACON (46° 51.997'S, 37° 48.050'E; 395 m)

This partially cleared site was visited on 14 April and a pack load of rusted metal objects (angle iron, shackles, wire, eye bolts, pole, etc.) and some rotten canvas were removed in a plastic bag to the site of wire mesh near the Third Sister (see above). **Site fully cleared.**

FIRST RED HILL (No GPS)

Large piece of canvas material in right-hand gully near the top (JC knows the site). Not visited.

NEAR KATEDRAALKRANS HUT (hut at 46° 53.893'S, 37° 46.483; 754 m)

Small wire mesh structure with metal rod supports close to hut on inland side of ridge. Not seen on 31 March during a brief hut inspection. Removed by the hut-restocking party to Base on 23 April. The toilet was not replaced. **Site fully cleared.**

N.B. A defunct AWS tripod may exist somewhere near the hut (V.R. Smith pers. comm.).

NEAR ARCHWAY BAY (46° 54.086'S, 37° 54.227'E)

Eleven concrete blocks on the coastal slope south of the King Penguin colony. Carried by hand on 13 April using a steel pipe away from the colony to container S9 previously placed at a distance (*c.* 200 m) by helicopter to avoid disturbance to penguins. Steel anchor pole taken from King Penguin colony to container on 8 April. Container with six blocks flown to ship on 22 April. Five remaining blocks loaded into a cargo net dropped at the site on 23 April and flown out the next day. **Site fully cleared.**

N.B. A large amount of what is assumed to be mainly drift wood is present at the back of the King Penguin colony at Archway Bay, along with a number (12-20?) of disused concrete blocks within the colony, once used as quadrat markers. A decision needs to be made as how to treat these various objects.

SEALERS' CAVE (No GPS)

Two aluminium ladders next to the "sealer's lookout" (a historical site). Not inspected. Will need to be flown out by helicopter.

KILDALKEY BAY (No GPS)

Six to eight embedded steel anchor poles on Green Hill side of King Penguin colony. Not inspected during take-over. Will need to be carried on foot to the Kildalkey Hut prior to removal by helicopter. NDPW support required.

KILDALKEY HUT (46° 57.291'S, 37° 51.211'E; 81 m

Large amount of partially buried wet wooden planks, two rolls aerial wire, plastic bag fragments, steel poles, glass fragments, buried spade, etc. collected together at hut entrance from hut and toilet surrounds on 19 April. Needs to be flown out during next take-over. **Site partially cleared.**

ZONE 3 (WEST AND SOUTH COASTS)

WATERTUNNEL STREAM HUT (46° 57.44'S, 37° 44.56'E)

Whole hut to be replaced. Especial care needs to be taken with any exposed polystyrene material. Site inspected on 31 March (via helicopter) and again on 9 April (on foot).

GREY-HEADED ALBATROSS RIDGE HUT (No GPS)

Rusted fence pole and a koskassie box full of wood from several cat trap sites and the collapsed Santa Rosa Valley signpost on the "Golden Highway", and asbestos and glass fragments from Rook's Peninsula hut site (see below) collected together on 17 and 18 April. To be removed by helicopter during the next take-over. **Site partially cleared.**

ROOK'S PENINSULA HUT SITE (46° 57.997'S, 37° 40.976'E; 79 m)

Eight embedded anchor poles found on 18 April. All visible asbestos sheeting and glass was then collected and removed to Grey-headed Albatross Ridge Hut save one large piece, left on site with a *c.* 4-m steel anchor pole. NDPW support required. **Site partially cleared.**

ROOK'S BAY HUT (46° 58.021'S, 37° 39.597'E)

A few planks and a wooden catwalk to be removed when the new hut is positioned.

NEAR KAMPKOPPIE (46° 52.992'S, 37° 37.828'E; 67 m)

Old rondawel hut remains with metal base frame 75 m north. Site inspected on 31 March by helicopter. Material (steel base (cut up by NDPW), scattered and part-buried asbestos sheeting, wood and glass fragments, one anchor pole, etc.) collected and part-flown out to base in container M9 on 5 April. A pile of cut-up steel is still to be removed from the base frame site in a cargo net, along with nine embedded anchor poles and a part-buried metal frame and a 1-metre long asbestos sheet fragment. This removal, with NDPW assistance required, should be undertaken during hut restocking of the nearby Mixed Pickle Bay hut in 2004. **Site partially cleared.**

BETWEEN SWARTKOP AND MIXED PICKLE (No GPS)

Metal grids. Site not known. Is this the Kampkoppie site? If not reported by the next take-over, suggest it be deleted from this list.

LAEKOP HUT SITE (No GPS)

Vicinity inspected for presence of rubble from helicopter without landing on 31 March. No signs seen but site not exactly identified from the air. Requires a ground inspection in 2004.

CAPE DAVIS HUT (46° 49.703E, 37° 42.263E; 47 m)

A few planks and a metal pipe removed from old rondawel hut site to hut on 31 March. Two rusted drums containing burnt material close to hut along with a quantity of wet wood and metal pipes, etc. around hut removed by helicopter on 5 April. **Site reported as fully cleared.**

ZONE 4

THE FAULT (46° 52.741'S, 37° 50.137'E)

Three concrete blocks together with 'plane site material (see below). All material loaded into a cargo net on 23 April and flown to ship the next day. Rotten rope at the ladder removed on foot on 8 April. **Site fully cleared.**

ALBATROSS LAKES (46° 53.411'S, 37° 52.410'E; 55 m)

The crashed aeroplane in the Macaroni Bay Wandering Albatross Monitoring Colony south of the Fault was flown out by helicopter on 2 April and placed temporarily at the base. The nose wheel, battery, broken window and various loose pieces were removed by foot the same day. The poles, guy cables, plastic sheeting and a wooden plank were carried on foot to the blocks near the Fault (see above) on 8 April.

Displaced plant material was used to fill partially the scars made by the plane. The plane was flown to the ship on 23 April. **Site completely cleared.**

SCIENTIFIC FIELD MARKERS IN ZONES 2-4

Plastic 20-mm electrical conduit piping in soft ground and non-rusting metal rods in hard ground are recommended as environmentally inert and long-lasting field markers. Use of painted and wooden field markers should cease, to halt paint fragments and decomposed wood from entering the environment over time.

Scientific group leaders to identify with GPS positions and plot on map markers currently in use (see appendices) All others to be removed when found. Cat stone walls to be left in place for their historical interest. When visited, GPS positions should be collected.

Doc 2.4B

Quarantine measures to halt alien invasions of Southern Ocean islands: the South African experience

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Southern Ocean islands are no stranger to alien species invasions. Even the most remote of these have experienced rates of new species introductions two to three orders of magnitude greater than background levels (Gaston *et al.* 2003). For example, conservative estimates for winged insects only are of one successful establishment every three to four landings. Across Southern Ocean islands as a whole the total number of introduced species (of all taxa) is strongly related to the number of human occupants (Chown *et al.* 1998), and concerns have thus been raised about of tourism to these islands (Heydenrych & Jackson 2000; Chown & Gaston 2000).

South Africa's Prince Edward Islands (Marion, which supports a research station and programme and Prince Edward, uninhabited and near-pristine) in the southern Indian Ocean also have their share of introduced species (Watkins & Cooper 1986, Gremmen & Smith 1999, Chown *et al.* 2002). Since the 1970s, South Africa has undertaken measures to eradicate established alien species from these islands. Brown Trout *Salmo trutta* were removed from Marion Island in 1984 (Cooper *et al.* 1992). Feral cats *Felis catus* were eradicated on Marion in 1991 following a long and sustained effort with full governmental support and funding (Bester *et al.* 2002). Efforts are underway to eradicate small populations of the alien grass *Agrostis gigantea* (first recorded in 1994) and the isopod *Porcellio scaber* (first recorded in 2001) before they spread from founder sites (Gremmen & van der Meijden 1995, Gremmen & Smith 1999, Slabber & Chown 2002). For other alien species, eradication has either not as yet been attempted (e.g. for the house mouse *Mus musculus* on Marion Island; Chown & Cooper 1995, Cooper 1995) or is not considered feasible (e.g. for the well-established grass *A. stolonifera* and slug *Deroceras caruanae* on Marion Island and the pearlwort *Sagina procumbens* on both Marion and Prince Edward Islands; Smith 1992, Gremmen *et al.* 1998, Ryan *et al.* 2003).

Despite some quarantine measures, new alien invertebrates and plants have been discovered at Marion Island in recent years, mainly in the vicinity of the research station (Hänel *et al.* 1998, Gremmen & Smith 1999). Each new incident identifies loopholes in existing quarantine procedures, and suggests additional strategies for employment. The development of effective quarantine procedures is thus an ongoing process, and increased vigilance by the islands' management committee, biologists and annual conservation officers has helped raised awareness. In most years on Marion Island at the time of the annual relief alien moths are noticed in and around the research station, when immediate efforts are made to kill the usually singletons observed (pers. obs.). These unwelcome visitors have undoubtedly arrived on the relief vessel: it is usual for the ship to leave its port, Cape Town, with a few flying insects still aboard. Although efforts are made to kill these on the four-day southward journey, it is clear that these are not always successful. Occasionally, the ship has inadvertently carried larger invertebrate populations to the islands, as described below.

During the April 2002 relief it became apparent the day after sailing that the ship was infested with house crickets *Gryllus bimaculatus*. It is believed that these had flown aboard the ship one or two nights before sailing, perhaps attracted by lights. At the time Cape Town and environs were experiencing a plague of these crickets. Using their characteristic chirping as a clue to their presence, 46 specimens was caught and killed by repeated searches of interior spaces during the southward voyage. IN addition the ship's exterior was washed down with seawater to flush out survivors and a glutaraldehyde solution was sprayed into channels and scuppers prior to the ship arriving at Marion Island. Despite these on-the-spot efforts, a few live crickets were observed aboard after the ship had spent several days at the island off-loading personnel and cargo (Cooper 2002).

During the following year's relief voyage, cardboard trays holding canned drinks that were being removed from sealed metal containers on the island, shortly after their offloading from the relief ship were found to be infested with the cockroach *Blatella germanica*. The containers were immediately resealed and flown back the ship, where they were inspected, all discovered cockroaches killed, the cardboard removed for incineration aboard ship, and the containers sprayed with a pyrethroid-based insecticide, repacked and resealed. Several days later the containers were returned to the island where all plastic-wrapped "six packs" of canned drinks were once more inspected before immersion in a bleach (sodium hypochlorite) solution. Fortunately no more cockroaches were found. In all, *c*. 40 live cockroaches were collected (Cooper & de Villiers 2003).

At the time of writing (July 2003), no further observations of crickets or cockroaches have been made at Marion Island (where neither species previously occurred). It would appear that the eradication procedures devised on the spot succeeded. However, such "finger in the dyke" reactions are not the best way to stop new alien species reaching the islands. Infestations should be halted at source, and for this to work successfully a comprehensive set of quarantine measures must be in place and rigorously and continuously applied by all involved. Over the period 2003 to 2006, South Africa will be constructing a new research station at Marion Island that will require the transport of very large amounts of materials and large contingents of construction workers to the island. Two dedicated construction voyages each year will triple the number of annual visits. It is probable that without concerted quarantine efforts, all this new activity will result in further alien species arriving and some becoming established at Marion Island.

In terms of the islands' management plan (PEIMPWG 1996) and the environmental study for the new research station (Environomics 2002), strict quarantine procedures to prevent alien invasions must be adopted during the whole construction period. To implement and manage these procedures the senior author has been appointed as the Environmental

Project Officer. Responsibilities include inspecting manufacturing and storage facilities on the mainland and accompanying all eight planned construction voyages to the island over the next three years. A full set of operational procedures is still being finalized but they are to be wide-ranging, to cover activities in Cape Town, aboard the ship and on the island (Table 1). With the expected full commitment of all involved with the construction of the new research station, it is hoped that come its inauguration in 2006, Marion and Prince Edward Islands will to welcome new suites of researchers without the unwelcome presence of new aliens.

Acknowledgements

We thank all who have helped keep the Prince Edward Islands relatively alien-free over the years. Research and conservation management at the Prince Edward Islands is supported financially and logistically by the South African Department of Environmental Affairs and Tourism.

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TABLE 1

Quarantine measures currently in force and recommended for implementation (in italics) for visits to the sub-Antarctic Prince Edward Islands

A. Mainland South Africa

- Regular inspections of storage facilities
- Cleaning of reusable metal transport containers
- No exchange of containers between Marion and Gough Islands
- Fumigation, and *provision of electronic fly traps* and rodent bait stations at storage, packing, *manufacturing* and *supply* facilities
- Packing of foodstuffs and most other supplies into sealed containers
- *No paper or cardboard-based packaging materials to be used*
- Cleaning of issued and personal clothing and field equipment (packs, tents, etc.)
- *Phasing out of use of Velcro on issued protective clothing*
- Transport of materials in covered vehicles
- Education of personnel

B. Aboard ship

- Rodent bait stations, de-ratting exemption certification and hawser rat guards prior to sailing
- Compulsory "boot-washing ceremony" (scrubbing footwear in bleach solution; inspection and cleaning of protective clothing, back packs, day packs and camera and video bags, especially pockets and Velcro strips, for plant and animal propagules)
- Inspection and cleaning of helicopter interiors, landing skids and wheels
- Compulsory education and information session presented by Conservation Officer to shore-going personnel
- *Provision of electronic fly traps, insecticides, fumigants and rat traps for emergency use*

C. Ashore at Marion Island

- Inspection of all off-loaded materials and supplies on arrival and during unpacking
- Banning of all fresh vegetables and fruits
- Supply of irradiated eggs and deboned poultry
- Freezing and return to mainland of all poultry wastes, including eggshells
- On-going inspections of base buildings and environs for alien plants and invertebrates
- *Provision of pesticides, fumigants, rodent bait stations and rat traps for emergency use*

D. Special provisions for Prince Edward Island

- Limitation on number and size of visits (maximum of six persons for four days per year)
- No fresh food or foods containing whole seeds allowed ashore
- Provision of new or cleaned, dedicated protective clothing, footwear and camping equipment
- All packing under supervision of a Conservation Officer
- Landings from ship only and not via Marion Island
- No interchange of protective clothing, footwear, back packs, camping equipment and biotic materials between the two islands
- *Freezing of selected items aboard ship*

Doc 2.8

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The 2003 Investigation

On

Conditions that may influence the sustainable operation of the CTBTO Radionuclide Particulate and Noble Gas Monitoring Infrastructure on Marion Island (RN62)

Compiled by: Dr Arnaud Faanhof

Executive Summary

The Site Survey for the Radionuclide particulate and noble gas monitoring station planned for Marion Island (RN62) to fulfil the monitoring mandate of the Comprehensive nuclear Test-Ban Treaty, has been performed by NECSA and presented to the CTBTO in 2000. This study basically concluded that for the required infrastructure:

- No suitable space was available within the existing infrastructure of the Base,
- No adequate power capacity was available to the needs of the monitoring infrastructure,
- Harsh environmental conditions and limited access required a thorough design and rugged equipment to ensure sustainable operation and accordingly data contribution to the Treaty network
- The South African Government anticipated to upgrade the Base in the foreseeable future.

Ongoing discussions with the South African Department of Environmental Affairs and Tourism (DEAT), the Department of Public Works and other parties concerned, provided a model for the establishment of the infrastructure for RN62 on Marion Island. The proposed model includes:

- A location well away from the newly build main infrastructure of the base to avoid that air intake will be influenced by disturbances due to the aerodynamics and/or exhaust air of the base camp,
- The use of an existing concrete foundation to make the infrastructure less prone to wind-driven resonance,
- Application of an independent power generator, making the station less prone to power instabilities and/or outages, and
- The location of the radionuclide monitoring station will be rebuild after the new main infrastructure of the base has been established and accordingly the station can start its operation by 2005/2006.

In order to prepare for the establishment of the monitoring station, NECSA started a design study in 2002 to prepare for the final installation, operation and maintenance of RN62. This study involves:

- An extended design for the establishment of an anticipated infrastructure on Marion Island including cost calculations,
- A design of a training facility at NECSA to prepare operators for their one-year duty on the Island, which includes operation and maintenance of the station including training materials and course outlay, and
- Facilitating discussions between the South African Government and the CTBTO on costs to be borne.

The objective of this study is to gather information on a variety of environmental conditions at the site of the anticipated location of RN62 in preparation to the extended design study.

The conclusions from this study provide both new information and support existing insight in the design of the infrastructure of RN62. They are:

- The radon concentration at the monitoring station is so low that no special precautions are regarded necessary to reduce radon background levels at the location used for monitoring (***new information not available in prior considerations***).
- Temperature and humidity control as well as vibration and noise reduction are mandatory to assure optimal performance of the electronic equipment used for radionuclide monitoring at Marion Island (***new information in support of prior considerations***).
- Power is an important factor to allow sustainable operation of the system, also during scheduled maintenance of generator equipment (***new information in support of prior considerations***).

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2 Objective of the Study

To investigate environmental and physical conditions at the base camp on Marion Island in preparation of the design of the CTBTO Radionuclide Particulate and Noble Gas Monitoring Infrastructure on Marion Island (RN62). Data obtained may improve the sustainable operation of the station.

3 Background Information

Preliminary discussions with the South African Department of Environmental Affairs and Tourism provided a "best choice" for the establishment of the infrastructure for RN62 on Marion Island. The proposed location has the following advantages and disadvantages compared to an earlier anticipated plan to incorporate the infrastructure of RN62 in the new base to be designed and build between 2003 and 2006.

- The radionuclide monitoring station will be located well away from the newly built main infrastructure of the base and accordingly air intake will not be influenced by disturbances due to the aerodynamics and exhaust air of the base camp.
- The radionuclide monitoring station will be housed on a concrete foundation while the newly build main infrastructure of the base will be anchored on poles driven though a thick peat layer. Accordingly, RN62 will be less prone to wind-driven resonance.
- The radionuclide monitoring station will be supplied with an independent power generator, making it less prone to power instabilities and/or outages as expected at the newly build main infrastructure of the base.
- The radionuclide monitoring station will be located a few hundred meters away from the newly build main infrastructure of the base and accordingly daily access will be less convenient, especially under the harsh climatic conditions on the Island.
- The radon concentration may be higher at the radionuclide monitoring station compared to the newly build main infrastructure of the base due to the lesser moderating effect of the peat layer, although former studies indicated that the radon concentration will be minimal anyway on the Island.

- The existing structure at the anticipated site of the radionuclide monitoring station will be rebuild after the new main infrastructure of the base has been established and accordingly the radionuclide monitoring station can start its operation only by 2005/2006.

4 Conditions Evaluated

The location chosen for the study during the 2003 relief voyage was adjacent to the envisaged future location of RN62. The main difference of the location chosen is that this building has no concrete foundation and accordingly influences of wind driven resonance could be evaluated as well. The following environmental and physical conditions were monitored:

- Radon concentration
- Wind speed and direction,
- Temperature,
- Humidity,
- Air-pressure,
- Vibration and/or Noise,
- Power stability.

5 Results and discussion

Data have been compiled based on average hourly observations during a three-week period between 31 March 2003 and 22 April 2003.

5.1 Radon measurement

To evaluate the validity of the radon measurement (i.e. the performance of the instrument):

- Radon measurements were done at NECSA's Radioanalytical Laboratories prior to and after the measurements on Marion Island (see Figure 1). It should be noted that different locations were monitored at NECSA prior to and after the measurements on Marion Island. Laboratory data provided represent a four to five day period and typical diurnal changes in radon concentrations can be observed, while for Marion Island the radon concentrations are virtually nil.

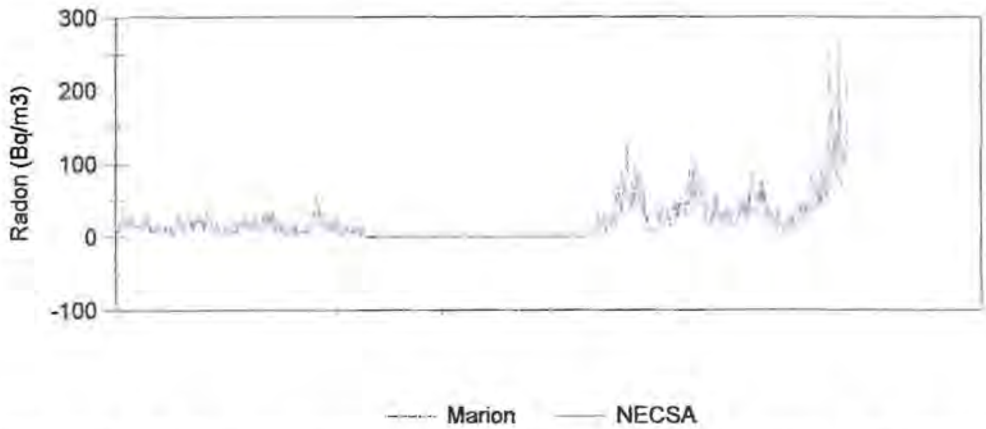

Figure 1: Radon concentration measured at NECSA, prior and after measurements performed on Marion Island
-------- Radon (Bq/m3) Marion Island -------- Radon (Bq/m3) NECSA

- Evaluation of vibration and/or noise data did not provide a positive indication that the radon measurement (instrument) was influenced by vibration and/or noise (see Figure 2).

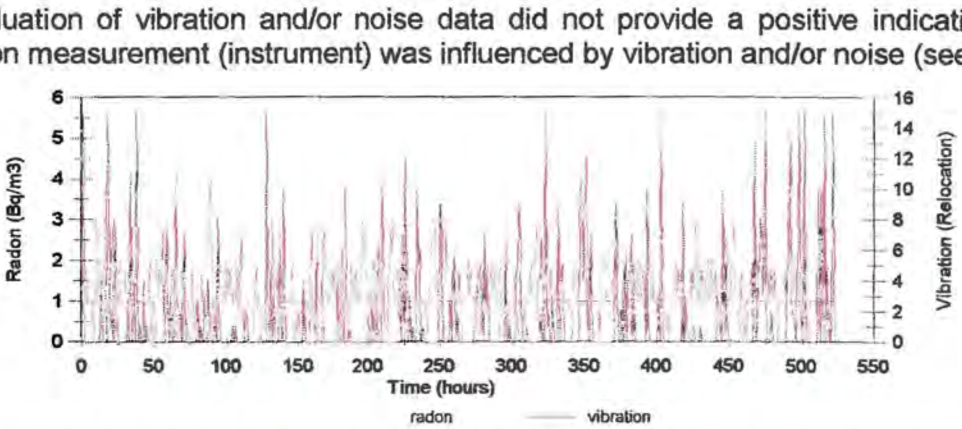

Figure 2: Correlation between radon concentration and vibration and/or noise
-------- Radon (Bq/m3) -------- Vibration and/or noise

- Evaluation of the power stability data did not provide a positive indication that the radon measurement (instrument) is influenced by power outages (see Figure 3).

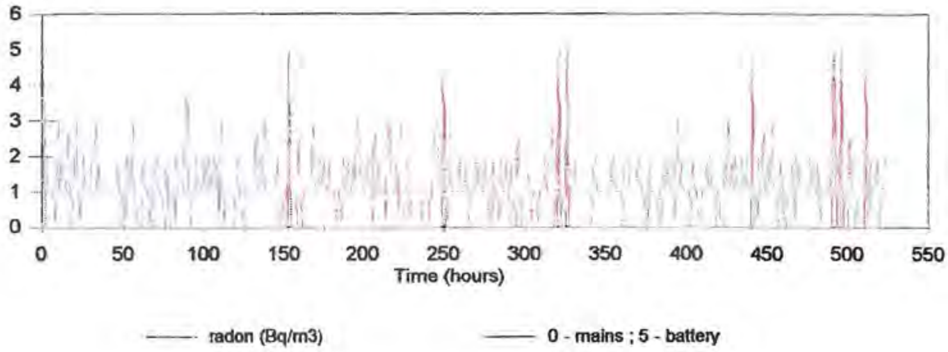

Figure 3: Correlation between radon concentration and power stability
-------- Radon (Bq/m3) -------- Power stability

General conclusion on the Radon measurements

From the variables evaluated it may be concluded that the radon measurements can be regarded reliable.

5.2 Radon concentration

The average radon concentrations measured during the 2003 relief period inside the building was 1,19 ± 0,78 Bq/m^3, which is low compared to world average ranges of around 30-50 Bq/m^3. As the radon concentration on Marion Island is close to the lower limit of determination of the equipment we will only be able to evaluate if radon concentrations are significantly influenced by external conditions to be taken into consideration in the design and construction of RN62.

- Evaluation of the wind data did not provide a positive indication that the radon concentration is influenced by either wind speed or air blown from overland or from the direction of the sea (see Figures 4a and 4b). ***Note that weather data from the meteorological station on Marion Island for day five of the survey were corrupted and accordingly omitted from evaluation.***

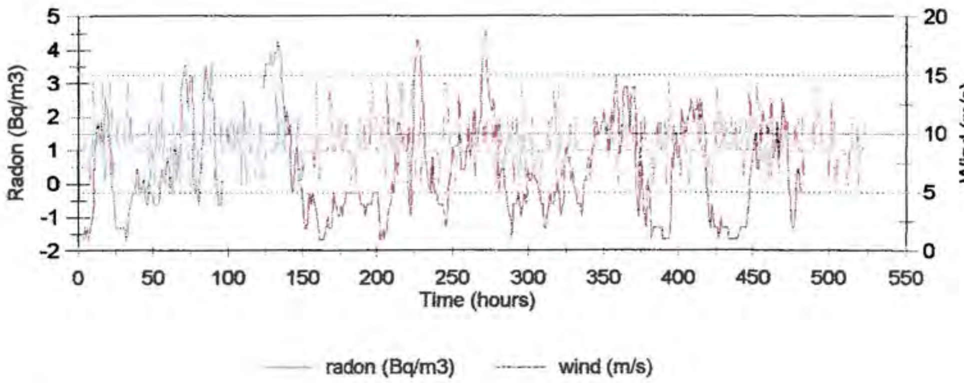

Figure 4a: Correlation between radon concentration and wind speed
-------- Radon (Bq/m3) ------- Wind speed

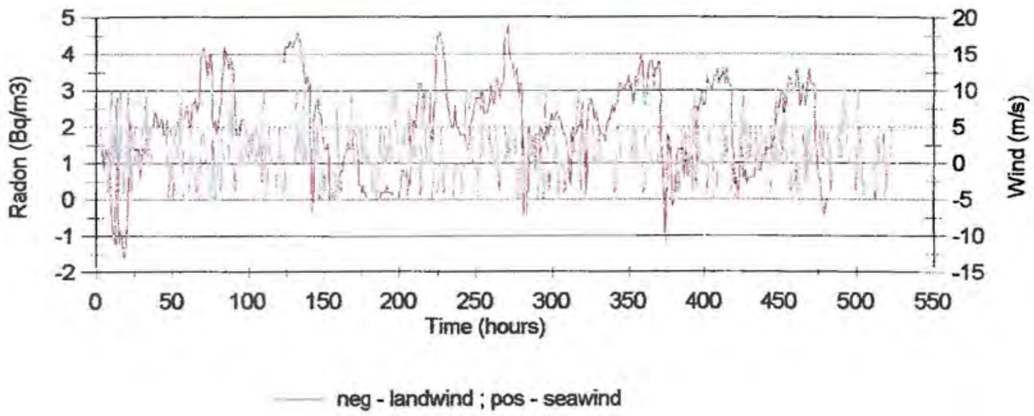

Figure 4b: Correlation between radon concentration and wind direction and speed
-------- Radon (Bq/m3) ------- Wind direction and speed

- Evaluation of the temperature data did not provide a positive indication that the radon concentration is influenced by temperature changes (see Figure 5).

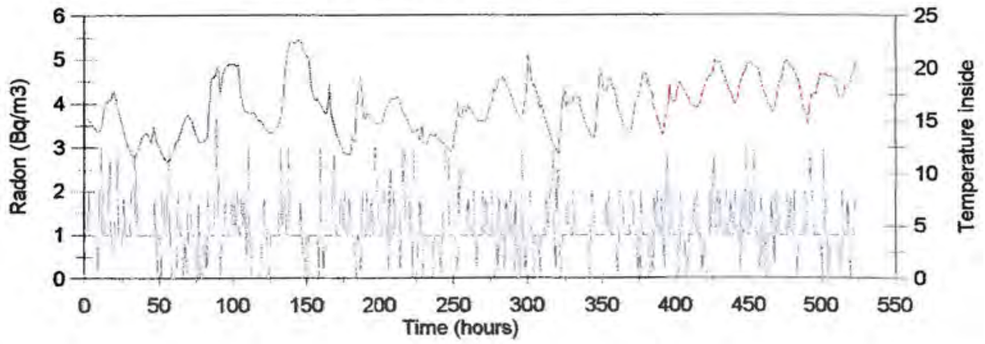

Figure 5: Correlation between radon concentration and inside temperature
-------- Radon (Bq/m3) -------- Inside temperature

- Evaluation of the humidity data did not provide a positive indication that the radon concentration is influenced by humidity changes (see Figure 6).

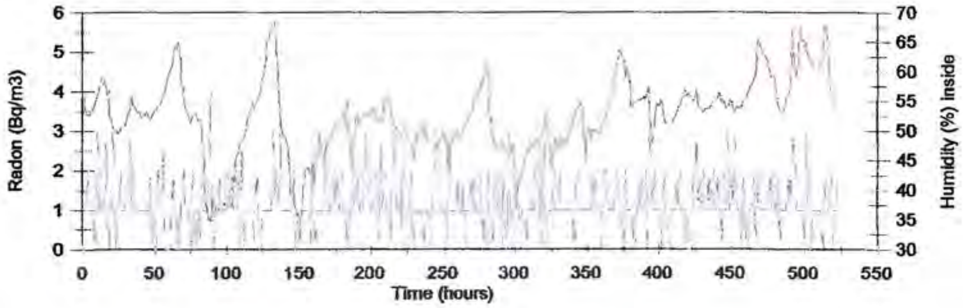

Figure 6: Correlation between radon concentration and humidity
------- Radon (Bq/m3) ------- Inside humidity

- Evaluation of the air-pressure data did not provide a positive indication that the radon concentration is influenced by air-pressure changes (see Figure 7).

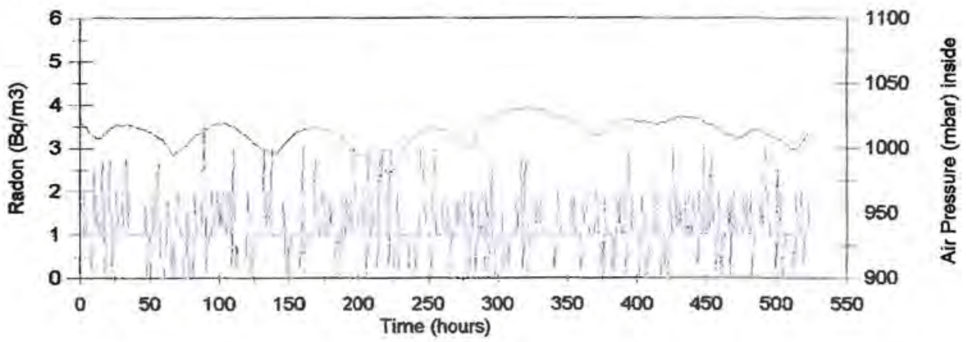

Figure 7: Correlation between radon concentration and air-pressure
------- Radon (Bq/m3) —— Air-pressure

General conclusion on the Radon concentration

From the variables evaluated it may be concluded that the radon concentration is not measurable influenced by external factors and to all-reasonable assumptions may be regarded low. Accordingly, no special precautions are to be taken to reduce the natural radon background for the gamma-ray measurement equipment to be installed at RN62.

5.3 Wind speed and direction

The average wind speed measured during the 2003 relief period at the weather station of the base camp was 7,4 ± 4,5 m/s, with maximum and minimum speed measured at 19 m/s and 1m/s respectively.

- Evaluation of the wind speed data indicated that the outside temperature is to a certain degree related to wind speed (see Figure 8). No direct indication was obtained that the wind direction (sea- or land-wind) had an influence on temperature (graph not shown).

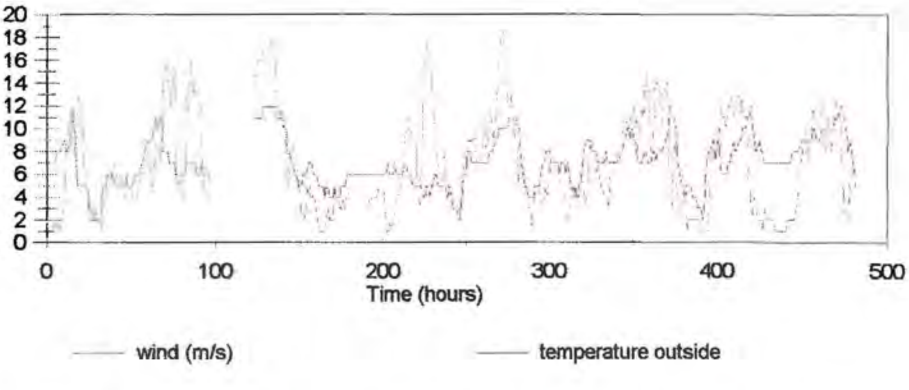

Figure 8: Correlation between wind speed and outside temperature
-------- Wind speed (m/s) -------- Temperature outside

- Evaluation of the wind speed data did not show any direct correlation with humidity (see Figure 9). No direct indication was obtained that the wind direction (sea- or land-wind) had an influence on humidity.

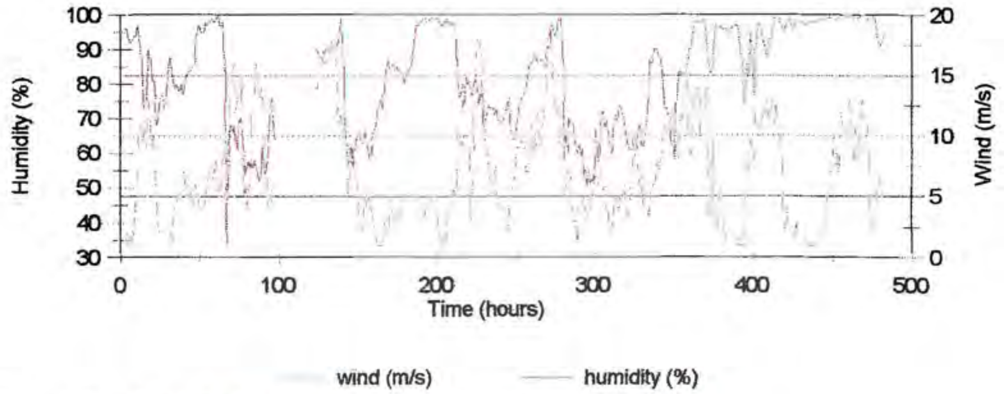

Figure 9: Correlation between wind speed and humidity
-------- Wind speed (m/s) -------- Humidity

- Evaluation of the wind speed data did show an approximate inverse correlation with air pressure (see Figure 10).

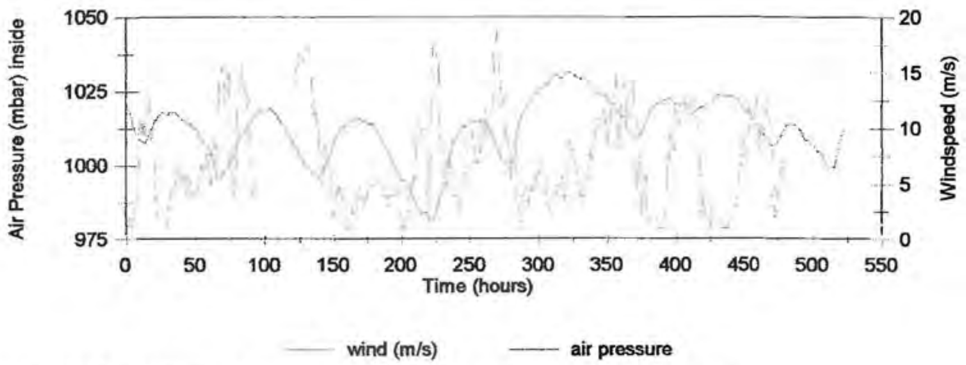

Figure 10: Correlation between wind speed and air pressure
-------- Wind speed (m/s) -------- Air pressure

* Evaluation of the wind speed data did not show a correlation with instrument vibrations (see Figure 11).

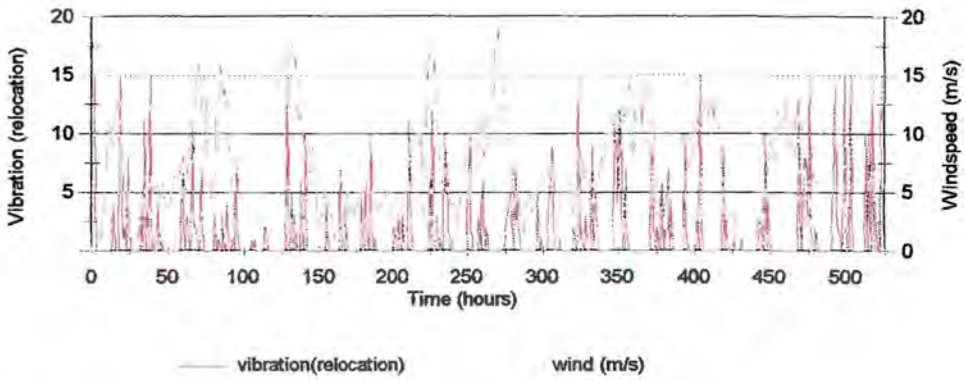

Figure 11: Correlation between wind speed and instrument vibration
-------- Wind speed (m/s) -------- Vibration

* Evaluation of the power stability data (see 5.7) indicated that power interruptions were mainly due to maintenance on the generators. As they were not regarded to be caused by environmental factors, no evaluations against weather data were made.

General conclusion on the Wind data
From the variables evaluated it may be concluded that wind speed, outside temperature and air-pressure are related in the commonly experienced way, i.e. a low-pressure system is normally associated with high wind speed and low temperature.

5.4 Temperature

The average temperature measured during the 2003 relief period at the weather station of the base camp was 7,1 ± 2,2 ^{0}C, with maximum and minimum of 12 ^{0}C and 2 ^{0}C respectively. During the same period the average temperature at the location of the monitoring site inside an existing structure was 16,3 ± 2,6 ^{0}C, with maximum and minimum of 22,8 ^{0}C and 11,2 ^{0}C respectively. Figure 12 shows that there is a fair correlation between in and outside temperatures although the inside temperature varies more than expected, which is most likely caused by heating during work-hours.

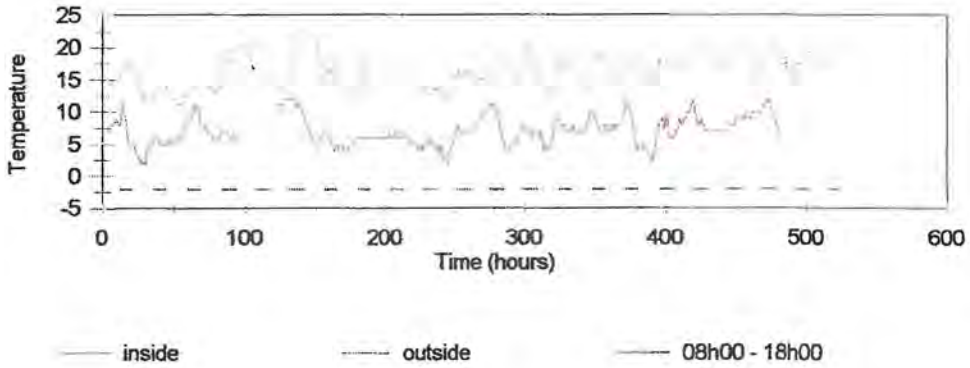

Figure 12: Correlation between inside and outside temperature
-------- Inside ^{0}C -------- Outside ^{0}C

General conclusion on the Temperature data

Inside temperature may vary considerable. Electronic equipment used for CTBTO radionuclide monitoring purposes requires a better temperature control to allow sustainable and reliable operation. Temperature control equipment should be installed to keep the inside temperature constant at ± 1,0 ^{o}C (e.g. 17-19 ^{o}C).

5.5 Humidity

Data were collected on both the humidity inside the building and at the weather station at the base camp some 500 meters away from the anticipated location of RN62 (see Figure 13). Evaluation of the humidity data shows that there is a slight correlation between inside and outside humidity. Average inside humidity over the 2003 relief voyage was (52.5 ± 6.5)%, while minimum and maximum values of 35% and 68% were measured respectively

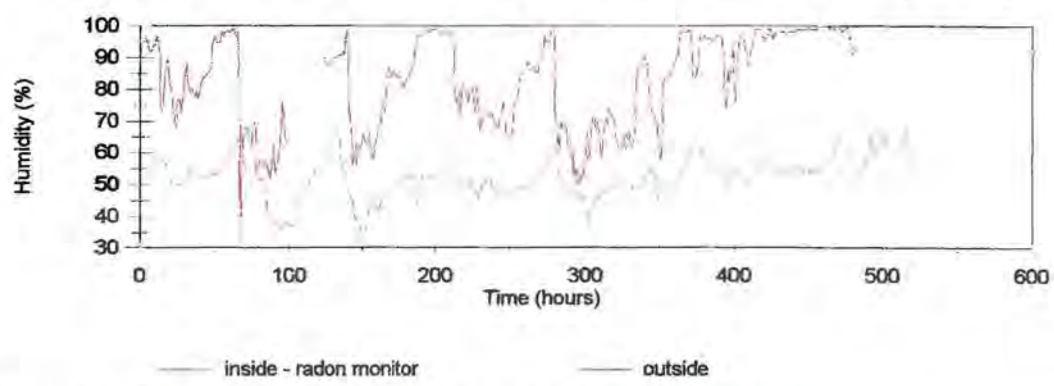

Figure 13: Correlation between inside and outside humidity
-------- Inside humidity -------- Outside humidity

General conclusion on the Humidity data

Inside humidity may vary considerably. Electronic equipment used for CTBTO radionuclide monitoring purposes requires a better humidity control to allow sustainable and reliable operation. Humidity control equipment should be installed to keep the inside more constant at e.g. (50 ± 5)% humidity, i.e. not more than 55% or less than 45%. It is recognized that more stringent temperature control may also regulate humidity to the extent required.

5.6 Vibration and noise

Data were collected on observed vibrations and/or noise in the building where radon measurements were performed. Evaluation against wind speed and direction data did not show a positive correlation. The regular vibration pattern, however, indicated a strong relation with normal working hours at the laboratory/building concerned (see Figure 14). As the equipment could only distinguish vibration influences, access in and out of the building has been monitored during the first four days of the relief voyage on the island. Results provided in Figure 15 indicate that the observed interference is most likely due to physical work at the laboratory causing vibrations and noise at the location of the radon monitor (on top of a laboratory workbench).

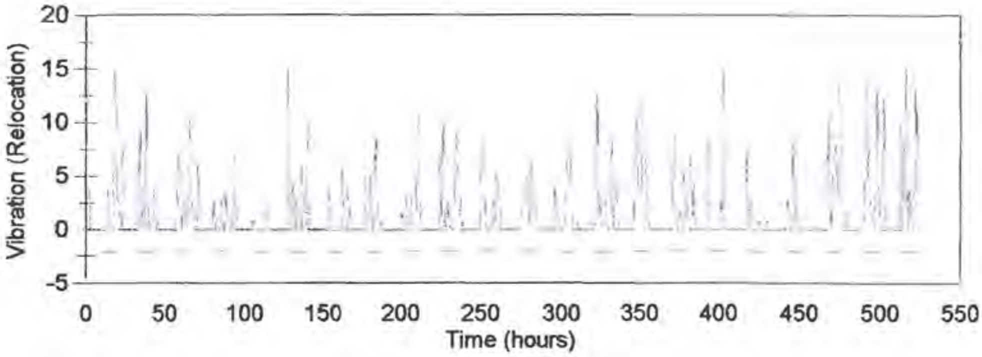

Figure 14: Correlation between vibration/noise and occupancy
-------- Vibration/noise ——— Day/night pattern

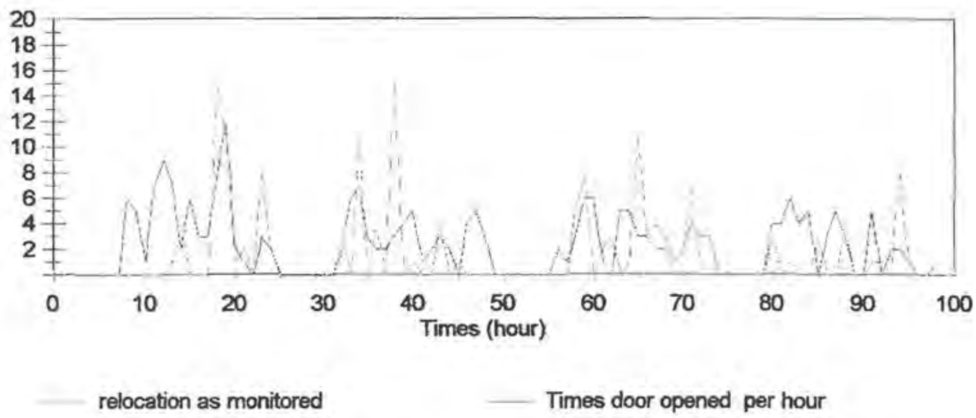

Figure 15: Correlation between vibration/noise and occupancy
-------- Vibration/noise -------- In/Out movement

General conclusion on Vibration/Noise data

As the stability of nuclear instrumentation is known to be influenced by vibration and noise, it is mandatory to construct the building in such a way that wind and human driven vibrations and/or noise are kept to a minimum. It is difficult at this stage to quantify maximum vibration and noise levels for the CTBTO radionuclide-monitoring infrastructure. However, the envisaged concrete foundation will help to reduce wind-driven vibrations and the new building envisaged should be constructed in such a way to minimize vibration and noise levels inside the building (e.g. a lock-chamber entrance, use of noise and vibration reducing building materials, placing equipment on vibration reducing floor mountings, limiting personnel access, etc.). It is recognized that the use of materials is limited to those allowed according to the environmental restrictions as applicable to the conservation of Marion Island as a world heritage nature site.

5.7 Power outages

Data were collected on the frequency and duration of the power outages as observed at the radon-monitoring site (see Figure 16).

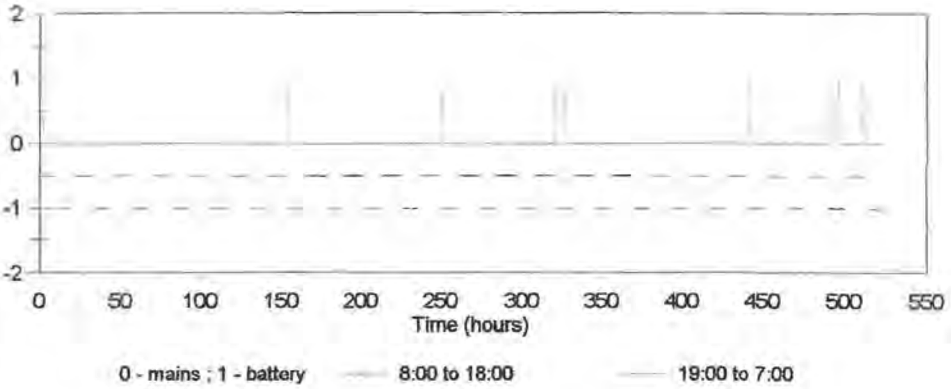

Figure 16: Frequency and duration of power outages
-------- Battery/Mains -------- Time of the day

General conclusion on Power outages

Power outages during the yearly three-week relief period are mainly due to scheduled maintenance of the power generators. Electronic equipment used for CTBTO radionuclide monitoring purposes requires stable and sustainable power throughout the year, which includes the three-week relief period. Power is one of the most crucial factors to allow sustainable operation of the system, especially for the cryogenic coolers used for the gamma-ray detection equipment. It will therefor be of great advantage, if not mandatory, that the CTBTO radionuclide particulate and noble gas monitoring station will be supplied with an independent power generator, backed-up by the Base's back-up system and supported by a powerful UPS infrastructure.

6 Recommendations

The following compilation of the general conclusions made in this report is applicable:

- The radon concentration at the monitoring station is so low that no special precautions are regarded necessary to reduce radon background levels at the location of the gamma-ray crystals used for monitoring.
- Temperature and humidity control as well as vibration and noise reduction are mandatory to assure optimal performance of the electronic equipment used for radionuclide monitoring at Marion Island.
- Power is an important factor to allow sustainable operation of the system, also during scheduled maintenance of generator equipment.

Dr Arnaud Faanhof
Specialist Scientist
NECSA

Doc 2.11

PRELIMINARY REPORT ON THE ESTABLISHMENT OF A MONITORING PROGRAMME AT THE PRINCE EDWARD ISLANDS

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At the 15th Meeting of the Prince Edward Islands Management Committee, the request was made for a preliminary assessment of the likely scope and key indicators to be included in a proposed Monitoring Programme for the PEI, and I was tasked to do this. I identified five categories of current research and monitoring activities (Table 1), and selected researchers were requested to comment on the initiative and on appropriate key indicators within their disciplines (Appendices 1 and 2).

The response to the proposed initiative was overwhelmingly and exclusively positive. All respondents were of the opinion not only that such a programme is vital to the long-term sustainability of the PEI and its biota, but that a sustained, centrally co-ordinated monitoring programme would add significant value to individual research projects conducted on the PEI, as well as to the status and profile of the PEI as a national asset.

In addition to the identification of a network of key indicators (Appendix 1), the importance of the following was emphasized:

1. drawing on international experience and guidelines
2. designing the programme so that it addresses national needs, continues to meet international agreements in this regard, and fits into existing global monitoring schemes
3. ensuring data quality and sampling consistency
4. setting short, medium and long-term objectives for the programme
5. providing opportunities for independent evaluation of progress and scientific quality
6. central co-ordination of activities, data collation, data management and reporting.

Recommendation: In continued discussion with interested and affected parties, to design a programme for monitoring environmental change at the PEI, using the information in this document as a departure point. The proposal should include procedures for: the implementation of key indicator monitoring; alignment and compliance with related national and international monitoring programmes; data quality control, management and reporting; programme assessment and review; budgetary and personnel requirements.

Table 1.

CATEGORIES OF KEY INDICATORS FOR MONITORING ENVIRONMENTAL CHANGE IN AND AROUND THE PRINCE EDWARD ISLANDS

APPENDIX 1. RESPONSES

I. METEOROLOGY

Meteorology	Elizma Yelverton (e-mail: elizmay@webmail.co.za)
Your views/opinions on such an initiative	This is a very good initiative. From a meteorologists' point of view I can see the wealth of information that comes from 50 years of meteorological data. I think that this can be applied to any other field of study.
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	1. Air temperature. 2. Relative humidity. 3. Air pressure. 4. Wind direction and speed. 5. Rainfall. 6. Sunshine. 7. Global and diffuse radiation. 8. Meteorological parameters of the upper air. 9. Environmental Measurements Laboratory (EML) of the U.S. Department of Energy. The EML monitor nuclear fallout. 10. Drifting buoy system (LUT) – The LUT collects air pressure, air temperature and sea surface temperature data, via polar orbiting satellites, from the drifting buoys in the Southern Ocean. 11. International Atomic Energy Agency (IAEA) – The IAEA collects rainwater samples.
Variable/s measured (e.g. daily min and max, annual population size)[2]	As above.
Units of measurement (e.g. °C, no.individuals /ha)	1. ºC 2. % 3. mb 4. Degrees and m/s 5. mm 6. Total amount of hours. 7. W/m^2 8. Pressure, air temperature, relative humidity, wind direction and wind speed at different levels of the atmosphere. 9. to 11. No information available.
Frequency of record taking[3]	1 to 5 and 7: Five minute intervals. 5: Also daily. 6: Daily. 8: Currently once a day. If more funding is available it will be twice a day. 9: Three times a week on a Monday, Wednesday and Friday. 10: Several times daily.

	11: Daily and monthly.
Locality/ies of record taking[3]	The meteorological camp. E-base. Meteorological office. Upper air building.
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Matric with the necessary training although a B.Sc. or a higher qualification will be more sufficient.
Human-induced drivers of change in above variable (e.g. climate change) [3]	
Currently available time series data[3]	Rainfall and sunshine: Daily. Upper air data: Twice a day at 12:30 SAST and 01:00 SAST Other meteorological parameters: Every 5 minutes.
Key publications outlining methods and/or historic records	Climatological data since 1960 is available from the South African Weather Service (SAWS). Contact the Climate Information section at the SAWS. EML: Contact Mr. Colin G. Sanderson and Mr. Fabin Raccah. Mr. Colin G. Sanderson e-mail address: colin.sanderson@eml.doe.gov Mr. Fabin Raccah e-mail address: raccah@eml.doe.gov LUT: Contact the Climate Information section at the SAWS for further information. IAEA: Contact address: Isotope Hydrology Section, International Atomic Energy Agency, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria.
Additional /related comments:	None.

II. OCEANOGRAPHY

OCEANOGRAPHY	Dr Isabelle Ansorge (e-mail: ansorge@ocean.uct.ac.za)
Your views/opinions on such an initiative	**In agreement.** **While the Southern Ocean dynamics is suspected to have a major role in the global ocean circulation and an important impact on present day climate, our understanding of its complex three-dimensional dynamics, variability and the impact of such variability on the climate system is rudimentary. In order to partially fill in this knowledge gap it is necessary to establish a programme of periodic observations across a line between South Africa and Sub/Antarctica. The objectives of this programme are the following:** 1. *The comprehension of Indo-Atlantic inter-ocean exchanges (in terms of water masses, heat and fresh water budgets) and their impact on the global thermohaline circulation and present day climate.* 2. *The impact of these exchanges on the local climate of the Southern Hemisphere African continent.* 3. *To monitor the variability of Southern Ocean frontal systems.* 4. *The local air-sea heat exchanges and their role on the global heat budget.*
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	Water Masses, Frontal systems, Mesoscale variability
Variable/s measured (e.g. daily min and max, annual population size)[2]	Temperature, salinity, oxygen, nutrients
Units of measurement (e.g. °C, no.individuals /ha)	°C, psu, ml/l, umol/kg
Frequency of record taking[3]	Annual
Locality/ies of record taking[3]	Transect between Cape Town and Prince Edward Islands.
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	The monitoring programme will be incorporated into the UCT honours course. At present the PEI programme is undertaken as the main sea going module in which honours students gain a first hand experience of collection, analysis and interpretation of all hydrographic data collected. In addition, application will be made for both MSc and PhD bursaries.

Human-induced drivers of change in above variable (e.g. climate change) [3]	The global thermohaline circulation often referred to as the ocean's "conveyor belt", is vital in the transport of heat from the tropics to higher latitudes. The physical structure of this circulation belt and its efficiency in regulating climate is substantially influenced by the nature of water mass exchange between ocean basins. The ACC is by far the largest conduit for such exchange, however it has also been suggested that water mass differences between major ocean basins would be far more prominent were it not for various smaller inter-ocean links, such as the influence of the Agulhas Current system. The sources, pathways and characteristics of these exchanges are not well-enough established to allow their influence on the climate system to be quantified. A key question is the role played by Southern Hemisphere mode and intermediate waters in the global thermohaline overturning, especially in the light of the recent observed freshening of these waters. The Southern Ocean is dominated by the major fronts of the Antarctic Circumpolar Current. The northernmost front is the Subantarctic Front (SAF), which lies close to the zero wind-stress curl line and hence is the southern boundary of the subtropical gyres. North of the SAF, the winter mixed layers known as Subantarctic Mode Water (SAMW) can reach to a thickness of >700 m. The salinity minimum associated with the SAMW acts as a major source of fresh water for the world oceans, and hence an important role in maintaining the water budget. At higher latitudes the convection of less saline deep water masses is less vigorous than that of contrasting higher salinity waters. Modifications in the saline characteristic of the SAMW will play an important role in the extent of sea ice and subsequently on global climate. Estimates of the amount of mode and intermediate waters entering the Atlantic via the Agulhas Current system range from 0% to 50%. Recently, it has been estimated that there exists a 15 ± 2 Sv northward transport for the intermediate layers in the Benguela current. Recent modelling results on the global ocean circulation suggests that Indo-Atlantic interocean exchanges through the Agulhas current system are far more important for the thermohaline circulation than the direct input of water from the Drake Passage. This Atlantic "Indian" connection conveys water of Indian and Pacific origins, and from the surface to intermediate layers. In agreement with McCartney [1982], fresh, SAMW penetrates the subtropical ocean in the eastern edge of the subtropical gyres where the dynamical contrast (fronts) between the ACC and the subtropical circulation are weaker compared to the western regions. The numerical findings propose the existence of a dynamical westward connection between all three wind-driven subtropical gyres resulting in a very efficient conveyor of SAMW and AAIW for the Atlantic and Indian oceans (Figure 1). Thus in order to understand the nature of global climate change, the quantification, physical understanding and long-term monitoring of the inflow of Indian waters into the Atlantic Ocean is unavoidable. The physical comprehension of SAMW/AAIW exchanges south of Africa and their variability constitute our first goal. The most obvious way to achieve this goal is through long term monitoring.

Currently available time series data[3]	Underway measurements were undertaken during the 1997, 1998 and 1999 PEI voyages, however the cost of these measurements have prevented further data being collected. If the DEAT are committed to implementing a long term monitoring programme then sufficient funds must be made available for the entire period.
Key publications outlining methods and/or historic records	McCartney, M. S., Subantarctic Mode Water. *Deep Sea. Res.*, *24* , 103-119, 1977. The subtropical circulation of mode waters. *J. Mar. Res.*, *40* (suppl.), 427-464, 1982. Speich, S., B. Blanke, P. de Vries, K. Döös, S. Drijfhout, A. Ganachaud, and R. Marsh, 2002 : Tasman Leakage: A new route for the global conveyor belt. *Geophys. Res. Letters, 29, 10.*
Additional /related comments:	

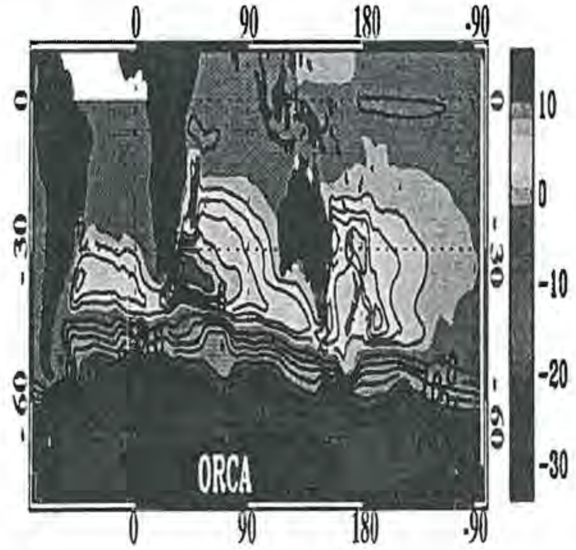

Figure 1: Lagrangian stream function for the world's oceans (Speich et al. 2002)

III. GEOMORPHOLOGY

Geomorphology	**Dr J. Boelhouwers (e-mail: jan.boelhouwers@natgeog.uu.se)**
Your views/opinions on such an initiative	An long-term monitoring commitment is long overdue as short-term (<5 years) projects cannot fulfill all scientific objectives. Long-term monitoring often does not feature in short-term objectives and should be viewed as an independent science objective and activity. Standardized long-term data sets are essential to answering questions related to natural-system responses to current climate change. Commitments to long-term monitoring are a national responsibility to international science efforts in understanding global change questions. They also allow for inter-disciplinary correlations and system interactions to be understood that cannot be achieved otherwise. Essential in establishing a successful monitoring activity is the data management (capturing, archiving, retrieval, accessibility). This must be done centrally and be well-organized and thought-through from the start.
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	From a geomorphological perspective, key abiotic parameters on Marion are: i) ground temperature, ii) ground moisture Ground temperature monitoring should follow the protocols of the Global Terrestrial Network-Permafrost of GCOS (see separate fax). A recent GTN-P workshop recognised soil moisture as the key element currently lacking in international monitoring efforts (Brown, pers.comm.). Climate on the west-side of the island is virtually unknown and significantly different from lee-side. Climate monitoring would not be justified for geomorphological purpose alone, but would provide very useful background data. Ice-mass balance monitoring has been attempted, but is logistically very difficult and practically unfeasible given summit weather conditions.
Variable/s measured (e.g. daily min and max, annual population size)[2]	Temperature: hourly instantaneous values at -2cm, -10cm, -50cm, -1m, -1.5m and -2m. Soil moisture: hourly instantaneous values at -10cm, -50cm, -1m, -2m.
Units of measurement (e.g. °C, no.individuals /ha)	Temperature: degree Celsius (MCS thermistor probes, c. 300Rand) Soil moisture: volumetric water content using dielectric permittivity probe (eg Decagon ECH_2O, c.1000Rand) or TDR method (Theta probe, c.4500Rand)
Frequency of record taking[3]	Hourly instantaneous values
Locality/ies of record taking[3]	Three stations should be placed along an altitudinal transect: i) Tafelberg (c.250m asl), ii) Katedraalkrans (c.750m asl), iii) island summit: Ice plateau-Bald Peak (c.1100m asl)
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Automated data collection using data logger. Once a year off-loading, battery replacement and re-installation by technician. Informal training is sufficient, based on following a step-by-step protocol.
Human-induced drivers of change in	See separate fax. Boelhouwers, J., Holness, S, Sumner, P., 2003: The maritime

above variable (e.g. climate change)[3]	Subantarctic: a distinct periglacial environment, *Geomorphology*, 52, 39-55. Boelhouwers, J., in press. Sensitivity and responses to climate change in the Subantarctic periglacial environment, Proceedings, 8th International Permafrost Conference, Zürich, 2003.
Currently available time series data[3]	Holness, S. 2000: Periglacial slope processes, landforms and environment at Marion Island, maritime sub-Antarctic, unpublished PhD, Dept. Earth Sciences, University of the Western Cape, Bellville. Boelhouwers, J., Holness, S., Sumner, P. and Nel, W. 2001: Geocryogenic processes and landforms on Marion Island. Final report to SACAR (April 1996 – March 2001)
Key publications outlining methods and/or historic records	Holness, S. 2000: Periglacial slope processes, landforms and environment at Marion Island, maritime sub-Antarctic, unpublished PhD, Dept. Earth Sciences, University of the Western Cape, Bellville. Brown, J., Hinkel, K.M. and Nelson, F.E., 2000: The Circumpolar Active Layer Monitoring (CALM) Program: Research designs and initial results, *Polar Geography*, 24(3), 165-258.
Additional /related comments:	

GEOMORPHOLOGY	**Paul Sumner (e-mail: sumner@scientia.up.ac.za)**
Your views/opinions on such an initiative	An excellent initiative, with substantial long-term benefits i.t.o. southern seas and towards global monitoring. The suggestions below outline three thrusts on the geomorphic-climatologic interface: First, an improved record and understanding of the contemporary climatic conditions on the island that will facilitate indications of, and projections for, climatic change scenarios. Second, monitoring of surface micro-climatic and permafrost conditions as indicators for change; specifically along an altitudinal gradient which indicates altitudinal movement of the surface freezing levels. Third, monitoring of the fluctuations of ice mass on the Ice Plateau.
Biotic / Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	1. Weather conditions (west coast) 2. Ground and rock surface temperatures (altitudinal transect) 3. Ice-mass fluctuations (Ice Plateau)
Variable/s measured (e.g. daily min and max, annual population size)[2]	1. Air T, wind speed, wind direction, rainfall, radiation. 2. Min and max T. 3. Relative surface height, surface area (photographic record).
Units of measurement (e.g. °C, no. individuals /ha)	1. °C, ms-1 etc 2. °C 3. m, m2
Frequency of record taking[3]	1. Hourly (or shorter interval) on automatic logger (downloading every 4-6 months). 2. Daily on automatic logger (downloading once a year).

	3. Seasonal (every three months), or end summer and end winter.
Locality/ies of record taking[3]	1.West coast (Mixed Pickle hut or Swartkop hut) air temperature, daily min max on an automated logger. [Preferably a more complete weather station to include automated rainfall, solar radiation, wind speed and wind direction monitoring. Inspection and data downloading every 4-6 months.] 2. Ground (4 sensors to 0.50m depth), rock surface and air temperature at Tafelberg (~250m a.s.l.), Katedraalkrans (~750m) and summit area (~1100m eg. Delta Kop-Bald peak vicinity) 3. Ice body at Ice Plateau. Photographic record from fixed points; semi-permanent reference stakes on ice mass and at peripheries.
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	On-site informal training, initially during takeover by "installer" (see additional comments below) and thereafter passed on between consecutive over-winter field "caretakers".
Human-induced drivers of change in above variable (e.g. climate change)[3]	Climate change 1. West coast station for: (a) Comparison with the meteorological conditions on the east coast; question: what influence has land mass on observed data record from Met station? (b) Sensitive climatic change indicators (such as air temperature, precipitation) may be more readily apparent from the potentially more severe (dynamic?) climatic conditions on the west coast. 2. Monitoring of permafrost thinning and increase/decrease in active (freeze-thaw) layer. 3. Monitoring of ice mass fluctuations, seasonal and annual trends.
Currently available time series data[3]	Boelhouwers, Holness, Sumner and Nel (2001). Geocryogenic processes and landforms on Marion Island. Final Report to SACAR (April 1996 – March 2001). Holness (2001). PhD thesis, University of the Western Cape. Boelhouwers, Holness and Sumner (in press). The sub-Antarctic: a distinct periglacial environment. Geomorphology, 49. Met station data and associated publications.
Key publications outlining methods and/or historic records	Holness (2001). PhD thesis, University of the Western Cape.
Additional /related comments:	Data ownership and "access" to data needs to be clarified; essentially: who publishes the original data? Consider a "Caretaker Committee" to co-ordinate the programme, made up of individuals or "caretakers" (those who actually start/install the long-term monitoring) of the various components. Specifically for the monitoring suggestions outlined above, one

	takeover by the co-ordinator and an assistant will be required. Preferably, an overwinter field assistant to ensure that the setup is running correctly and to indicate improvements/modifications to be undertaken on the next visit. Installation and the first few years data can be used as a higher degree project, which will assist in ensuring proper running of equipment. More frequent visits to the island during the construction of the new base will help with this, both in terms of field staff and instrumentation maintenance/ improvements at the start of the monitoring period.

IV. RADIOANALYSIS

Radioanalysis	**Jay le Roux (e-mail: jayleroeks@yahoo.com)** **Head of program:?**
Your views/opinions on such an initiative	Imperative for management and planning, and keeping track of all projects and their results.
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	1. In 2001: Rock, sediment, peat, grass (mainly *A. magellanica*) and skeletons. 2. Currently: Air
Variable/s measured (e.g. daily min and max, annual population size)[2]	1. To measure low radionuclide concentrations on the island; 2. Including natural occurring radioactive material on the island; and 3. Radon concentration in the air.
Units of measurement (e.g. °C, no.individuals /ha)	Bq/m^3
Frequency of record taking[3]	Every hour (automatically)
Locality/ies of record taking[3]	1. Ornithology Laboratory
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training sufficient.
Human-induced drivers of change in above variable (e.g. climate change) [3]	Nuclear testing or Nuclear events conducted in the Southern Hemisphere.
Currently available time series data[3]	None, except for the natural occurring radioactive material (NORM) which evolved from the 2001 programme or survey; and Radon concentrations in the air taken during take-over 2003.
Key publications outlining methods and/or historic records	
Additional /related comments:	Results obtained will be published in combination of NORM background values obtained during the 2001 survey.

V. BIOLOGY

1. Marine

MARINE BIOLOGY	**Prof. EA Pakhomov (e-mail: epakhomov@ufh.ac.za)**
Your views/opinions on such an initiative	It is definitely good idea. The PEI's have one of the longest environmental records and adding other parameters would be ideal if one wants to understand/predict ecosystem responses to climate changes
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	Seawater temperature measurements must be certainly continued. Nearshore chlorophyll-a measurements, phytoplankton composition and density, and POM stable isotope signatures could be introduced (at least twice per month) without excessive financial expenditures (essentially it would be one off investment and very modest, in excess of couple of thousand rands, annual running costs. Indeed, further taxonomical analysis and stable isotope measurements, could run into ± R15000-00 pr year). In addition, every year relieve voyage could be used to collect phytoplankton/POM samples and chlorophyll measurements.
Variable/s measured (e.g. daily min and max, annual population size)[2]	Variables could be measured during the relieve voyage (annually) and bi-monthly in nearshore area from the base.
Units of measurement (e.g. °C, no.individuals /ha)	Phytoplankton: water samples could be collected and fixed with formalin for further identification and enumeration in the lab. Units – cells per litre. Chlorophyll-a: certain amount of water filtered trough filters and analysed immediately. Units - ìg per litre.
Frequency of record taking[3]	There are some records on phytoplankton composition and chlorophyll-a between the islands starting from 1980-s and regularly taken from 1996 till present.
Locality/ies of record taking[3]	The above records have been taken between the islands, sometimes just near the base at depth of approximately 100-150 m
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training will be sufficient for collection POM, chlorophyll-a and phytoplankton samples. Phytoplankton taxonomical identification will require trained personnel, which could be arranged within the ongoing SANAP project.
Human-induced drivers of change in above variable (e.g. climate change)[3]	Not applicable
Currently available time series data[3]	There are some records on phytoplankton composition and chlorophyll-a between the islands starting from 1980-s and regularly taken from 1996 till present.
Key publications outlining methods and/or historic records	Froneman, P.W., Pakhomov, E.A. and Meaton V. (1998) Surface distribution of microphytoplankton of the south-west Indian Ocean along a repeat transect between Cape Town and the Prince Edward Islands. *South African Journal of Science*, 94: 124-129. Pakhomov, E.A. and Froneman, P.W. (1999) The Prince Edward Islands

	pelagic ecosystem, south Indian Ocean: a review of achievements, 1976-1990. *Journal of Marine Systems*, 18(4): 355-367. Froneman, P.W. and Pakhomov, E.A. (2000) Spatial and temporal variability in chlorophyll-*a* and diatom distribution in the south-east Indian Ocean. *Vie et Milieu*, 50(4): 275-288.
Additional /related comments:	Since 1980-s, underway observations, including surface chlorophyll-a, phytoplankton, water temperature and salinity,..., have been conducted between Cape Town and Marion Island. This is not a continuous record. However, it was done on annual basis since 1996 till present and could be continued during future relieve voyages to Marion Island.

2. Invasive plants

BOTANICAL/INVASIVE PLANTS: Dr Niek Gremmen (e-mail: gremmen@wxs.nl)

Long-term monitoring is the only way to systematically detect critical changes in the biota and ecosystems of te islands. Therefore I believe the development of a long-term monitoring programme is of the utmost importance, both for understanding the islands' ecology as for providing timely information for the management of the islands.

The present monitoring initiative centres on direct and indirect changes caused by human activities, both local and global. Therefore records should be kept of all human activities or of the environmental or biological variables directly affected by such activities, both on the islands, as well as elsewhere, which may affect the islands' ecosystems (e.g. fisheries in the surrounding oceans, changes in climatic variables, local habitat destruction, etc.).

Parameters:

A. Human activities

1. Number of visitors to the islands
   base-bound
   with field-activities
   location of fieldwork
2. Building activities on the islands
   base
   fieldhuts
3. Transport within the island
   helicopter visits from base to other areas
   field trips
4. Visits by ships (and other means of transport) + previous ports visited

B. Environmental parameters

Climate parameters

1. Temperature
2. Precipitation

Soil parameters

1. Soil moisture

Biological parameters

C. Introduced vascular plants + species of uncertain status
1. Species list
2. Distribution of selected species
3. Phenology of selected species
4. Production of viable propagules (i.e. seeds)
Comment: little point in montoring widespread alien species, rather monitor those with narrow distributions for which there remains a chance of future control.

D. Native vascular plants
1. Distribution of selected species (esp. highest altitudinal limit, using series of transects)
2. Phenology of selected species
3. Production of viable propagules (i.e. seeds)

E. Mosses, liverworts, lichens
1. Distribution of selected species
2. Production of spore capsules

F. Plant communities
1. Species composition of selected communities – all lowland
2. Distribution of communities
Comment: results of recent annual monitoring of plant community plots over a period of around 5 years will provide information of the extent of annual variation, which may guide decisions on the frequency of monitoring required.

Comment: D-F are currently of scientific interest, the results of which have little apparent management application. However these results may provide the basis for furture management options.

Currently available data
Climate
- Weather Station data since 1948

Soil moisture
- Data from a series of sample plots since 1975, taken at irregular intervals (Gremmen, unpublished data)

Community composition
data from ca. 70 permanent plots on Marion Island, studied at irregular intervals since 1975 (Gremmen 1996, and unpublished data), as well as 10 plots on Marion and 12 on Prince Edward Island, studied since 1993 (how frequently?).

Introduced species distribution
data from a number of surveys: 1965 (Huntley 1971), 1975 (Gremmen 1975; Gremmen & Smith 1981), 1981 (Gremmen 1982) 1987 (Bergstrom & Smith 1989), 1995 - 1997 (Gremmen 1997; Gremmen & Smith 1999) and 2001-2003 (Prince Edward Island only: Ryan et al in press).

Seed production of introduced species:

incidental data since 1975 (Gremmen, unpublished data; Gremmen 1997)

Methods

Climate
Soil moisture (Gremmen 1981)
Plant species composition (Gremmen 1981; Gremmen & Cannone 1993)
Alien plant distribution (Gremmen & Smith 1999)
Phenology and seed production (ITEX manual 1996?)

Frequency

A. Human activities - whenever they occur, at least annually

B. Environmental parameters

Climate parameters
1. Temperature - hourly
2. Precipitation - daily

Soil parameters
1. Soil moisture - annually

Biological parameters

C. Introduced vascular plants + species of uncertain status
1. Species list - annually (base area survey: once every month)
2. Distribution of selected species - once per ca. 5 years, except for species which pose grave threat and/or are subject of eradication. These should be monitored once per year, or once per month, depending on their ecology.
3. Phenology of selected species - once per ca. 5 years, except for species which pose grave threat and/or are subject of eradication. These should be monitored once per year, or once per month, depending on their ecology.
4. Production of viable propagules (i.e. seeds) - once per ca. 5 years, except for species which pose grave threat and/or are subject of eradication. These should be monitored once per year, or once per month, depending on their ecology.

D. Native vascular plants
1. Distribution of selected species - once per ca. 5 years
2. Phenology of selected species - annually
3. Production of viable propagules (i.e. seeds) - annually

E. Mosses, liverworts, lichens
1. Distribution of selected species - once per ca. 5 years
2. Production of spore capsules - annually

F. Plant communities

1. Species composition of selected communities - once per ca. 5 years
2. Distribution of communities - once per ca. 5 years

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Invasion and eradication of *Sagina procumbens* L. (Procumbent pearlwort) on Gough Island. *ALIENS* 14: 19-20.

Gremmen N.J.M. & R. van der Meijden (1995)
Introduced Agrostis species at sub-Antarctic Marion Island. *South African Journal of Antarctic Research* 25: 85-86

Gremmen, N.J.M. & V.R. Smith (1981)
Agrostis stolonifera L. on Marion Island (sub-Antarctic). *S.Afr.J.Antarct.Res.* 10/11: 33-34

Gremmen, N.J.M. & Smith V.R. (1999)
New records of alien vascular plants from Marion and Prince Edward Islands. *Polar Biology* 21: 401-409

3. Entomology /Invasive species

Entomology / Invasive species	**Prof. SL Chown (e-mail: slchown@sun.ac.za)**
Your views/opinions on such an initiative	Long overdue
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	1. Population densities of key invertebrate taxa (springtails might be easiest but *Pringleophaga marioni* and *Ectemnorhinus similis* are also taxa of concern). These should be both indigenous and exotic species. Actual list subject of negotiation given often destructive sampling required. 2. Climatic variables at a minimum of five sites across the altitudinal gradient at Marion Island. 3. Five-yearly monitoring of invasions at PE Island. 4. Collapse of periglacial structures around ice plateau
Variable/s measured (e.g. daily min and max, annual population size)[2]	1. Population density or repeatable surrogate 2. Temperature (hourly) and precipitation (size of events and amount of rainfall on monthly basis). 3. Species list and density (quantitative or ranked). 4. Specialized, contact Jan Boelhouers (jan.boelhouwers@natgeog.uu.se)
Units of measurement (e.g. °C, no.individuals /ha)	1. Individuals.m-2 2. °C, mm 3. ind.ha-1, ha covered, etc. 4. A large variety, contact Boelhouers.
Frequency of record taking[3]	1. Annual 2. Hourly 3. 5 years 4. Boelhouers has detail.
Locality/ies of record taking[3]	1. West coast (Mixed Pickle/Swartkop area) and East Coast (Station Area) 2. Five altitudes between Base and 1000 m. 3. PEI 4. 1000 m on Marion.
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	1. Collections can be done by B.Tech, or Dip Tech staff, interpretation requires PhD. 2. B. Tech or Dip Tech would be fine for taking measurements, Ph.D. for interpretation. 3. Experienced Ph.D. or long-term researchers. 4. Ph.D. as I understand it.
Human-induced drivers of change in above variable (e.g. climate change)[3]	1. Climate change and local disturbance and introductions or interactions between invasives and indigenous species. 2. Climate change 3. Local invasions and climate change. 4. Climate change.
Currently available time series data[3]	1. Some data back to 1970s, but frequency of collection irregular. New invasions searched for annually. 2. 1 year for soil temp. and ongoing, previous record at 3 altitudes by Bruce Blake and Valdon Smith, some work by Geomorphologists. Most

	data scattered and rarely available for longer than 1 year. No official programme. Stevenson Screen data at base available since 1947, but met screen has changed position at least once and possibly twice, and will change again with new base!
Key publications outlining methods and/or historic records	Barendse, J., Chown, S.L., 2000. Abundance and seasonality of mid-altitude fellfield arthropods from Marion Island. Polar Biology 24, 73-82. **Barendse, J., Mercer, R.D., Marshall, D.J. & Chown, S.L. 2002. Habitat specificity of mites on sub-Antarctic Marion Island. Environmental Entomology 31, 612-625.** Blake, B.J., 1996. Microclimate and prediction of photosynthesis at Marion Island. Free State, Bloemfontein. Burger, A.E., 1978. Terrestrial invertebrates:a food resource for birds at Marion Island. South African Journal of Antarctic Research 8, 87-99. Chown, S.L., Crafford, J.E., 1992. Microhabitat temperatures at Marion Island. South African Journal of Antarctic Research 22, 51-58. Chown, S.L., Avenant, N., 1992. Status of *Plutella xylostella* at Marion Island six years after its colonization. South African Journal of Antarctic Research 22, 37-40. Crafford, J.E., Scholtz, C.H., 1987. Quantitative differences between the insect faunas of Sub-antarctic Marion and Prince Edward Islands: A result of human intervention? Biological Conservation 40, 255-262. Gabriel, A.G.A., Chown, S.L., Barendse, J., Marshall, D.J., Mercer, R.D., Pugh, P.J.A., Smith, V.R., 2001. Biological invasions on Southern Ocean islands: the Collembola of Marion Island as a test of generalities. Ecography 24, 421-430. Hänel, C., 1999. The distribution and abundance of macro-invertebrates in the major vegetation communities of Marion Island and the impact of alien species. University of Pretoria, Pretoria. Hänel, C., Chown, S.L., Davies, L., 1998. Records of alien insect species from sub-Antarctic Marion and South Georgia Islands. African Entomology 6, 366-369. Slabber, S., Chown, S.L., 2002. The first record of a terrestrial crustacean, *Porcellio scaber* (Isopoda, Porcellionidae), from sub-Antarctic Marion Island. Polar Biology 25, 855-858.
Additional /related comments:	None

4. Invasive insects

INVASIVE SPECIES	*(Sarette Slabber, University of Stellenbosch)*
Your views/opinions on such an initiative	I feel that it a very good idea to start monitoring alien species on a regular, controlled basis. It is the only way in which the PEIMC can keep a tab on what is happening with the fauna and flora of the PEI.
Biotic/Abiotic parameter [1] to be measured (e.g. air temperature, *Mus musculus*)	*Porcellio scaber*
Variable/s measured (e.g. daily min and max, annual population size)[2]	Monthly total removed
Units of measurement (e.g. °C, no.individuals /ha)	Number of individuals for the different sites infested
Frequency of record taking[3]	At least 1 h every fifteen days at base Twice a year on a round-island trip at all the field huts
Locality/ies of record taking[3]	North of the Wetlab Gym Site of the old monument Boulders Beach & La Grange Cave
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training sufficient
Currently available time series data[3]	September 2001-April 2003
Key publications outlining methods and/or historic records	Slabber, S. and S. L. Chown (2002). "The first record of a terrestrial crustacean, *Porcellio scaber* (Isopoda, Porcellionidae), from sub-Antarctic Marion Island." Polar Biology 25: 855-858.
Additional /related comments:	All specimens found should be collected and preserved in absolute ethanol. Specimens should be kept at a central facility to allow us to monitor the body size and reproductive status of populations. The pesticide that is currently used in the control of this species is not effective, as gravid individuals have been recorded since the infected area was sprayed. I recommend that an expert should be consulted to ascertain the best product, method and application technique of the suggested pesticide for the eradication of *Porcellio* from Marion Island with its unique weather conditions. This species should be eradicated before they increase their still limited distribution (as has been seen for other large invasive invertebrates, such as the slug, *Deroceras carunae*).

5. Ecology

ECOLOGY	**Prof. M.A. McGeoch (E-mail: mcgeoch@sun.ac.za)**
Your views/opinions on such an initiative	This is one of the most critical investments to make if we are to effectively manage medium to long-term environmental change to maintain biodiversity and environmental quality
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	*Azorella selago* and the arthropods that inhabit it
Variable/s measured (e.g. daily min and max, annual population size)[2]	Annual growth, population structure, cushion vitality, specific leaf area, trichome density, epiphyte density, microclimate (temperature, relative humidity, sunshine hours)
Units of measurement (e.g. °C, no.individuals /ha)	mm; cushion size structure, natality and mortality rates, age-specific vitality and mortality; vitality score (Huntley 1972) and cushion photograph; mm^2/g; no. per mm^2; no. *Agrostis magellanica* per m^2 ; °C, %RH, no. hours
Frequency of record taking[3]	annual (may be conducted during takeover), except for microclimate
Locality/ies of record taking[3]	13 plots of 50 cushions each Skua Ridge
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	BSc + informal training Field fit and experienced
Human-induced drivers of change in above variable (e.g. climate change) [3]	Climate Change
Currently available time series data[3]	2001-2002: 3 plots 2002-2003: 12 plots (including 3 adjacent to above three)
Key publications outlining methods and/or historic records	le Roux, P.C. & McGeoch, M.A. submitted. Evaluating the efficacy of *Azorella selago* (Apiaceae) for ageing landscapes in the sub-Antarctic. Huntley, B. J. 1972. Notes on the ecology of *Azorella selago* Hook. f. Journal of South African Botany 38: 103-113.
Additional /related comments:	

6. Ornithology

Ornithology	Dr P. Ryan (e-mail: pryan@botzoo.uct.ac.za)
Your views/opinions on such an initiative	Excellent – what we have been calling for for ages
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	Restricting it to birds, I'd suggest that this is largely in place, although some of the methods could be refined. Key indicators are: Annual breeding populations of key surface-nesting seabirds or subsets of these populations if hard to census (e.g. Rockhoppers, Sooty Albatrosses)
Variable/s measured (e.g. daily min and max, annual population size)[2]	Annual breeding effort; breeding success in selected species; diet and chick growth rates in some species
Units of measurement (e.g. °C, no.individuals /ha)	Numbers of birds; breeding success;
Frequency of record taking[3]	Annual for most parameters on Marion Island; 5-yearly on Prince Edward
Locality/ies of record taking[3]	Whole island for most parameters; selected colonies for some species
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	BSc and appropriate field skills for working with seabirds
Human-induced drivers of change in above variable (e.g. climate change)[3]	Fishing impacts on marine systems; climate change; introduced predators and competitors (mice)
Currently available time series data[3]	For several species we have data series for about the last 20 years; for others only 5-10 years
Key publications outlining methods and/or historic records	MCM has an exhaustive seabird monitoring manual for seabird field workers on Marion Island. Ryan et al. (2003) summarise counts for Prince Edward
Additional /related comments:	Monitoring seabirds and seals provides the most cost-effective method of monitoring changes in the marine environment around the islands out to distances of >1000 km. This is even more important given the desire to expand the EEZ to extend the 200 nm boundary from shelf waters, (rather than land edge), which will make the PEI more important than the rest of continental SA in terms of the amount of ocean they confer to the nation. One of the points raised in the expansion will be the need to show ongoing interests in these areas, and an ability to assess their status; the seabird and seal monitoring programmes would go some way to meeting these needs.

6. Mammalogy

Mammals	Prof. M.N. Bester (e-mail: mnbester@zoology.up.ac.za)
Your views/opinions on such an initiative	The initiative is a good one, as long as the actual monitoring is done according to a strict format, by competent fieldworkers, and under continual supervision. The resultant data analyses must be the responsibility of an institution(s) driving the particular research. The more involved the fieldworkers are with the data collection (e.g. the data will be used by the fieldworkers themselves for postgraduate study), the better the quality of data collection will be.
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	***Arctocephalus tropicalis* and *A. gazella***
Variable/s measured (e.g. daily min and max, annual population size)[2]	**Pup production**
Units of measurement (e.g. °C, number of individuals /ha)	Estimated number of pups per breeding site / beach on both Marion Island and Prince Edward Island.
Frequency of record taking[3]	Every 5 years.
Locality/ies of record taking[3]	All the beaches (Wilkinson & Bester 1990; Hofmeyr *et al.* 1997).
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training sufficient, but additional expertise recommended.
Human-induced drivers of change in above variable (e.g. climate change) [3]	Climate Change; Biological and Operational Interactions with Fisheries (Hofmeyr *et al.* 2002).
Currently available time series data[3]	1951/52, 1974/75, 1981/82, 1988/89, 1994/95, 2000/01 (Marion) 1981/82, 1987/88, 2001/2002 (Prince Edward)
Key publications outlining methods and/or historic records	WILKINSON, I.S. & BESTER, M.N. 1990. Continued population increase in fur seals, *Arctocephalus tropicalis* and *A. gazella*, at the Prince Edward Islands. *S. Afr. J. Antarct. Res.* 20: 58 – 63. HOFMEYR, G.J.G., BESTER, M.N. & JONKER, F.C. 1997. Changes in population sizes and distribution of fur seals at Marion Island. *Polar Biol.* 17: 150 – 158. HOFMEYR, G.J.G, DE MAINE, M., BESTER, M.N., KIRKMAN, S.P., PISTORIUS, P.A. & MAKHADO, A.B. 2002. Entanglement of pinnipeds at Marion Island, 1996-2000. *Aust. Mammal.* 24: 141-146. BESTER, M.N., RYAN, P.G. & DYER, B.M. 2003. Counts of fur seals at Prince Edward Island, Southern Ocean. *Afr. J. mar. Sci.* 25: In press.
Mammals	**Prof. M.N. Bester (e-mail: mnbester@zoology.up.ac.za)**

Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	***Arctocephalus tropicalis* and *A. gazella***
Variable/s measured (e.g. daily min and max, annual population size)[2]	**Seasonal Pup growth**
Units of measurement (e.g. °C, number of individuals /ha)	Estimated growth rate and weaning mass of pups on selected breeding sites / beaches on Marion Island.
Frequency of record taking[3]	Annually.
Locality/ies of record taking[3]	Watertunnel Beach & Sealer's Beach (Cape Davis).
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training sufficient, but additional expertise recommended.
Human-induced drivers of change in above variable (e.g. climate change)[3]	Climate Change; Biological Interaction with Fisheries (Kirkman *et al.* 2002; Hofmeyr *et al.* 2002).
Currently available time series data[3]	1981/82, 1988, 1993 - 2003 (Marion)
Key publications outlining methods and/or historic records	KIRKMAN, S.P., BESTER, M.N., HOFMEYR, G.J.G., PISTORIUS, P.A. & MAKHADO, A.B. 2002. Pup growth and maternal attendance patterns in Subantarctic fur seals. *Afr. Zool.* 37: 13-19. HOFMEYR, G.J.G, DE MAINE, M., BESTER, M.N., KIRKMAN, S.P., PISTORIUS, P.A. & MAKHADO, A.B. 2002. Entanglement of pinnipeds at Marion Island, 1996-2000. *Aust. Mammal.* 24: 141-146.
Mammals	**Prof. M.N. Bester (e-mail: mnbester@zoology.up.ac.za)**
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	***Arctocephalus tropicalis* and *A. gazella***
Variable/s measured (e.g. daily min and max, annual population size)[2]	**Female attendance patterns**
Units of measurement (e.g. °C, number of individuals /ha)	Feeding trip durations and onshore attendance periods in days/ hours during summer (January – March, both species) and winter (June – August, *A. tropicalis* only).
Frequency of record taking[3]	Annually.

Locality/ies of record taking[3]	Formerly at Rook's Bay and Landfall Beach for both species, currently Trypot Beach (*A. gazella*) & Rockhopper Bay (*A. tropicalis*).
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training sufficient, but additional expertise recommended.
Human-induced drivers of change in above variable (e.g. climate change)[3]	Climate Change; Biological Interaction with Fisheries (Bester & Bartlett 1987; Kirkman *et al.* 2002; 2003).
Currently available time series data[3]	1986/87; 1997/98, 1998/99, 1999/00; 2002/03 (Marion Island)
Key publications outlining methods and/or historic records	BESTER, M.N. & BARTLETT, P.A. 1990. Attendance behaviour of Antarctic and subantarctic fur seal females at Marion Island. *Antarct. Sci.* 2: 309 – 312. KIRKMAN, S.P., BESTER, M.N., MAKHADO, A.B. & PISTORIUS, P.A. 2003. Female attendance behaviour of Antarctic fur seals at Marion Island. *Afr. Zool.* 38: In press. KIRKMAN, S.P., BESTER, M.N., HOFMEYR, G.J.G., PISTORIUS, P.A. & MAKHADO, A.B. 2002. Pup growth and maternal attendance patterns in Subantarctic fur seals. *Afr. Zool.* 37: 13-19.
Mammals	**Prof. M.N. Bester (e-mail: mnbester@zoology.up.ac.za)**
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	***Arctocephalus tropicalis* and *A. gazella***
Variable/s measured (e.g. daily min and max, annual population size)[2]	**Diet**
Units of measurement (e.g. °C, number of individuals /ha)	Frequency of Occurrence (FO) and Frequency of Abundance (FA) of prey species in scats.
Frequency of record taking[3]	Fortnightly.
Locality/ies of record taking[3]	Watertunnel Stream (*A. gazella*) & Sealer's Beach, Cape Davis (*A. tropicalis*).
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training sufficient for scat collection; prey identification requires specialist attention.
Human-induced drivers of change in above variable (e.g. climate change)[3]	Climate Change; Biological Interaction with Fisheries (Klages & Bester 1998).

Currently available time series data[3]	1989 - 2003 (Marion Island)
Key publications outlining methods and/or historic records	KLAGES, N.T.W. & BESTER, M.N. 1998. The fish prey of fur seals *Arctocephalus* spp. at subantarctic Marion Island. *Marine Biol.* 131: 559-566.
Additional /related comments:	

Mammals	**Prof. M.N. Bester (e-mail: mnbester@zoology.up.ac.za)**
Your views/opinions on such an initiative	The initiative is a good one, as long as the actual monitoring is done according to a strict format, by competent fieldworkers, and under continual supervision. The resultant data analyses must be the responsibility of an institution(s) driving the particular research. The more involved the fieldworkers are with the data collection (e.g. the data will be used by the fieldworkers themselves for postgraduate study), the better the quality of data collection will be.
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	*Mirounga leonina*
Variable/s measured (e.g. daily min and max, annual population size)[2]	Breeding population size and Pup production
Units of measurement (e.g. °C, number of individuals /ha)	Estimated number of adults and pups per breeding site / beach on Marion Island and Prince Edward Island.
Frequency of record taking[3]	Annually on Marion during October; every 5 years on Prince Edward Island.
Locality/ies of record taking[3]	East coast beaches (Cape Davis – Rook's Peninsula).
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training sufficient, but additional expertise recommended.
Human-induced drivers of change in above variable (e.g. climate change) [3]	Climate Change; Biological and Operational Interactions with Fisheries (Bester 1988; Hofmeyr *et al.* 2002; Pistorius *et al.* 1999).
Currently available time series data[3]	Main Study Area (Ship's Cove – Archway), 1974 – 2003; Total Island Count (Marion), 1976, 1983 – 2003. No data for Prince Edward Island.
Key publications outlining methods and/or historic records	BESTER, M.N. 1988. Marking and monitoring studies of the Kerguelen stock of southern elephant seals *Mirounga leonina* and their bearing on biological research in the Vestfold Hills. *Hydrobiologia* 165: 269 – 277. HOFMEYR, G.J.G, DE MAINE, M., BESTER, M.N., KIRKMAN, S.P., PISTORIUS, P.A. & MAKHADO, A.B. 2002. Entanglement of

	pinnipeds at Marion Island, 1996-2000. *Aust. Mammal.* 24: 141-146. PISTORIUS, P.A., BESTER, M.N. & KIRKMAN, S.P. 1999. Dynamic age-distributions in a declining population of southern elephant seals. *Antarct. Sci.* 11: 446-451.
Additional /related comments:	
Mammals	**Prof. M.N. Bester (e-mail: mnbester@zoology.up.ac.za)**
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	*Mirounga leonina*
Variable/s measured (e.g. daily min and max, annual population size)[2]	**Pup weaning mass**
Units of measurement (e.g. °C, number of individuals /ha)	Kg
Frequency of record taking[3]	Annually in October/November
Locality/ies of record taking[3]	East coast beaches (Transvaal Cove – Archway Beach).
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training sufficient, but additional expertise recommended.
Human-induced drivers of change in above variable (e.g. climate change)[3]	Climate Change; Biological Interactions with Fisheries (Bester 1988; McMahon *et al.* 2003).
Currently available time series data[3]	Main Study Area (Ship's Cove – Archway), 1986 – 1988; 1992 – 1994; 1997 –1999; 2002 – 2003.
Key publications outlining methods and/or historic records	BESTER, M.N. 1988. Marking and monitoring studies of the Kerguelen stock of southern elephant seals *Mirounga leonina* and their bearing on biological research in the Vestfold Hills. *Hydrobiologia* 165: 269 – 277. McMAHON, C.R., BURTON, H.R. & BESTER, M.N. 2000. Weaning mass and the future survival of juvenile southern elephant seals, *Mirounga leonina*, at Macquarie Island. *Antarct. Sci.* 12: 149-153. McMAHON, C.R., BURTON, H.R. & BESTER, M.N. 2003. A demographic comparison of two southern elephant seal populations. *J. Anim. Ecol.* 72: 61-74. WILKINSON, I.S. & BESTER, M.N. 1990. Duration of post-weaning fast and local dispersion in the southern elephant seal, *Mirounga leonina*, at Marion Island. *J. Zool., Lond.* 222: 591 – 600.
Additional /related comments:	
Mammals	**Prof. M.N. Bester (e-mail: mnbester@zoology.up.ac.za)**

Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	*Mirounga leonina*
Variable/s measured (e.g. daily min and max, annual population size)[2]	**Age-specific Survival and Fecundity through Mark-Recapture.**
Units of measurement (e.g. °C, number of individuals /ha)	Fractions/Percentages.
Frequency of record taking[3]	Tagging in October/November and resightings of tagged animals every 7 days (breeding season) to 10 days (moulting & winter seasons) throughout every year.
Locality/ies of record taking[3]	East coast beaches (Cape Davis – Rook's Peninsula).
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training sufficient for tagging (weaned pups) and resighting (all age classes) of elephant seals, but additional expertise recommended.
Human-induced drivers of change in above variable (e.g. climate change)[3]	Climate Change; Biological Interactions with Fisheries (Bester 1988; McMahon *et al.* 2003).
Currently available time series data[3]	1983 – 2003.
Key publications outlining methods and/or historic records	BESTER, M.N. 1988. Marking and monitoring studies of the Kerguelen stock of southern elephant seals *Mirounga leonina* and their bearing on biological research in the Vestfold Hills. *Hydrobiologia* 165: 269 – 277. PISTORIUS, P.A., BESTER, M.N. & KIRKMAN, S.P. 1999. Survivorship of a declining population of southern elephant seals, *Mirounga leonina*, in relation to age, sex and cohort. *Oecologia* 121: 201-211. PISTORIUS, P.A., BESTER, M.N., KIRKMAN, S.P. & BOVENG, P.L. 2000. Evaluation of age- and sex-dependent rates of tag loss in southern elephant seals. *J. Wildl. Manage.* 64: 373-380. PISTORIUS, P.A., BESTER, M.N., KIRKMAN, S.P. & TAYLOR, F.E. 2001. Temporal changes in fecundity and age at sexual maturity of southern elephant seals at Marion Island. *Polar Biol.* 24: 343-348. McMAHON, C.R., BURTON, H.R. & BESTER, M.N. 2003. A demographic comparison of two southern elephant seal populations. *J. Anim. Ecol.* 72: 61-74.
Additional /related comments:	

Mammals	**Prof. M.N. Bester (e-mail: mnbester@zoology.up.ac.za)**
Biotic/Abiotic	*Orcinus orca*

parameter to be measured (e.g. air temperature, *Mus musculus*)	
Variable/s measured (e.g. daily min and max, annual population size)[2]	**Population Number and Identities.**
Units of measurement (e.g. °C, number of individuals /ha)	Number of Individuals / Photographic Catalogue / Indices.
Frequency of record taking[3]	Incidental recording (and photographing) of individuals/groups throughout every year, centred on October – January.
Locality/ies of record taking[3]	East coast beaches (Kildalkey – Good Hope Bay Peninsula), but primarily Sealer's Beaches – Archway Bay on north-east coast around Base.
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	Informal training sufficient for resighting killer whales, but additional expertise recommended.
Human-induced drivers of change in above variable (e.g. climate change)[3]	Climate Change; Biological Interactions with Fisheries; Whale watching? (Keith *et al.* 2001; Poncelet *et al.* 2002; Trites *et al.* 2002).
Currently available time series data[3]	1973 – 1979; 1983 - 2003.
Key publications outlining methods and/or historic records	KEITH, M., BESTER, M.N., BARTLETT, P.A. & BAKER, D. 2001. Killer whales (*Orcinus orca*) at Marion Island, Southern Ocean. *Afr. Zool.* 36: 163-175. PISTORIUS, P.A., TAYLOR, F.E., LOUW, C., HANISE, B., BESTER, M.N., DE WET, C., DU PLOOY, A., GREEN, N., KLASEN, S., PODILE, S. & SCHOEMAN, J. 2002. Distribution, movement, and estimated population size of killer whales (*Orcinus orca*) at Marion Island, December 2000. *S. Afr. J. Wildl. Res. 32*: 86-92. PONCELET, E., GUINET, C., MANGIN, S. & BARBRAUD, C. 2002. Life history and decline of killer whales in Crozet Archipelago, Southern Indian Ocean. In: *Fourth International Orca Symposium and Workshop*. CEBC-CNRS, Villiers en Bois, France. Pp121-125. TRITES, A.W., BAIN, D.E., WILLIAMS, R.M. & FORD, J.K.B. 2002. A review of short- and long-term effects of whale watching on killer whales in British Columbia. In: *Fourth International Orca Symposium and Workshop*. CEBC-CNRS, Villiers en Bois, France. Pp 165-167. VAN GINNEKEN, A.M. & BALCOMB III, K.C. 2002. Can routine data collection benefit killer whale research? In: *Fourth International Orca Symposium and Workshop*. CEBC-CNRS, Villiers en Bois, France. Pp 178-181.
Additional /related comments:	

APPENDIX 2. QUESTIONAIRRE

KEY INDICATORS FOR MONITORING ENVIRONMENTAL CHANGE IN AND AROUND THE PRINCE EDWARD ISLANDS

Objective: To establish a long-term monitoring programme for the Prince Edward Islands, principally to monitor human-induced environmental change. The basic idea is to motivate for the continuity of record taking of what are considered to be key indicators of change, i.e. continuity beyond funding cycles and the career spans of individual scientists.
Key indicators: **Including marine (oceanography, marine biology), terrestrial (geomorphology, taxon-specific: seals, birds, plants, invertebrates, invasive species) and meteorological parameters**

Compiled for and at the request of the Prince Edward Islands Management Committee[1]

Your views/opinions on such an initiative	
Biotic/Abiotic parameter to be measured (e.g. air temperature, *Mus musculus*)	
Variable/s measured (e.g. daily min and max, annual population size)[2]	
Units of measurement (e.g. °C, no.individuals /ha)	
Frequency of record taking[3]	
Locality/ies of record taking[3]	
Level of expertise required to take records/collect data (e.g. BSc, PhD, informal training sufficient)	
Human-induced	

drivers of change in above variable (e.g. climate change) [3]	
Currently available time series data[3]	
Key publications outlining methods and/or historic records	
Additional /related comments:	

[1]A copy of the draft report (including contributions on all proposed key indicators) will be sent to all participants for comment, as well as a copy of the final report submitted to the PEIMC.

[2] Please copy and complete additional forms if necessary. For example, if both indigenous and introduced species should be monitored and in different ways, or if any two or more parameters should be monitored and these conducted using different methods.

[3]You could give one or more references that describe these, rather than filling in the details here.

Doc 2.12

"DRAFT"

FILMING POLICY: PRINCE EDWARD ISLANDS

1. Introduction

In recent times, the Prince Edward Island Management Committee (PEIMC) and the Department of Environmental Affairs and Tourism (DEAT) received some requests for filming on Marion Island. While each request is dealt with separately and a decision taken on the merits of each case, a need was identified to develop a filming policy for the Prince Edward Islands, as it will facilitate and provide specific guidelines for the consideration of filming requests.

2. Policy

The Prince Edward Islands (PEI) were proclaimed as a Special Nature Reserve with the primary aim the conservation and sustained preservation of the unique ecosystem for all the people of South Africa and the scientific community at large. The PEI Management Plan further acknowledges that the public of South Africa must have an opportunity to experience the special attributes of the islands through a public awareness programme. The filming policy will therefore have to coincide with the aims of a special nature reserve and the management policies of the islands. Filming on the islands will therefore only be allowed under very specific conditions and must be well motivated according to the management objectives of the islands.

Filming groups that apply for visits to the islands will be accommodated within certain limits and guidelines. Furthermore, it is acknowledged that there are two main categories of film requests, i.e.:

- Requests from production companies that aim to develop a commercial product that can generate considerable amounts of money.
- Requests that will benefit DEAT and the general public of South Africa and are more of an educational nature.

The above requests differ in nature and need to be dealt with differently – DEAT might consider the introduction of a tariff system for commercial ventures, or at least a system to recover costs of voyage and accommodation fees on the Marion Island. This system needs to make provision for the waiver of fees in instances where the filming will be to the benefit of the islands and DEAT, and is aimed at the South African public for educational purposes.

2.1 Filming categories

Four broad filming categories are generally recognised, i.e.:

- Conservation related shoots – documentary type film and video productions.
- Productions by the national broadcaster for local public broadcast.
- Tourism/commercial related shoots – commercial filming/photographing for feature films and advertisements.
- Still photography (Advertising shoots, Wildlife photography & Magazines/newspapers).

Due to the limited opportunities available to visit the Prince Edward Islands for filming purposes, and the stipulations of the management plan, not all types of filming will be allowed on the islands. Only requests for productions by the national broadcaster for local public broadcast and scientific/conservation documentaries will be considered. Any requests for still photography must be well motivated, while tourism or commercial filming shoots will not be allowed at all.

2.2 Approval criteria and conditions

2.2.1 Filming restricted to Marion Island

Filming requests will only be considered for Marion Island. NO filming crews will be allowed on Prince Edward Island, as the limited access opportunities are reserved for scientific purposes only.

2.2.2 Availability of accommodation

Requests from filming crews to visit Marion Island will only be considered during voyages where space is available to accommodate crew members and their equipment. Due to limited space available and supervision on the island, only one film crew will be accommodated at any given time.

2.2.3 Filming requests restricted to take-over voyages

Filming requests will only be considered during the annual take-over voyages. No other voyages or visits to the islands will qualify, as these voyages are of a shorter duration that does not make them viable to accommodate film crews.

2.2.4 Filming requests must comply with objectives of PEI Management Plan

Filming application requests must be in line with the objectives of the Prince Edward Island Management Plan, i.e.:

- *Bona fide* scientific purposes
- Educational purposes
- Documentaries on the unique character and inherent ecological value of the islands.

2.2.5 Supervision on the island by a dedicated guide

Approval of a filming request may be on condition that a film crew is accompanied by a guide that is well conversant with the island and conditions on the islands. This condition will especially be considered during filming requests for documentaries and where the nature of the request makes it difficult for the filming crew to be under direct supervision of the Officer in charge of the take-over or the Conservation Officer. The costs for the guide will be for the account of the film crew.

2.2.6 Compliance with management zones

Film crews will only be allowed general access to Zones 1 and 2 of Marion Island. Any requests for filming in Zones 3 and 4 of the island must be well motivated and will be subject to serious scrutiny from PEIMC.

2.2.7 Exclusion and restriction conditions

- Certain shoots may not be appropriate due to ethical or safety reasons, or because of the ecological sensitivity of the area to be filmed in.
- The applicant must apply for approval timeously due to the necessary ratification by PEIMC who can only meet to review applications periodically.
- Many shoots will require the presence of DEAT staff and researchers. Such presence is supplementary to their core responsibility and cannot always be accommodated as and when the applicant desire.
- Applicants are urged not to make unreasonable requests. The location is a special nature reserve where conserving the biodiversity of South Africa comes first and foremost. PEIMC and DEAT reserve the right to reject any request.

- The availability of certain facilities, i.e. voyage helicopter are restricted and film crews will only be accommodated if there is space available in the helicopter during the normal take-over activities. Any needs to use the helicopter or ship outside the normal activities, must be approved in advance and will be for the costs of the film crew.

2.2.8 Logistical arrangements

Film crews must ensure that they know what the logistical problems are for visiting Marion island. The film crew will be responsible for their own logistical arrangements within the broader logistics of a take-over voyage. They need to ensure that their equipment are packaged in the correct way, be delivered at the holding facilities of DEAT in time and that the right equipment are available for conditions on the island.

2.2.9 Insurance

The onus lies with the production house to ensure that they are adequately insured. The use of areas under the control of DEAT will be entirely at their own risk. DEAT, as the land owner, cannot be held liable for any claims, accidents, injuries or loss, etc. arising from such use.

2.2.10 Indemnity

Members from film crews have to complete indemnity forms before visiting Marion Island. This indemnity will be applicable for voyages to and from the island, accommodation and traversing the island and for participating in activities on the ship and island, i.e. flying in the helicopter, immobilisation of animals, etc.

2.2.11 Compliance with rules & regulations

All film crews must comply with the acts and regulations that are applicable to the management of Marion Island, as well as the policies in the PEI Management Plan. Additional written directives might be issued by PEIMC that need to be complied to.

Rules might include:

- No manipulation of animals will be allowed.
- Prior and special approval is needed to erect hides for filming purposes and only temporary hides will be allowed. An Environmental Management Plan must be completed for the construction and rehabilitation of a hide.
- Restriction to certain areas, i.e. in line with the zonation of Marion Island. Filming in wilderness areas are only allowed in certain instances and then under strict conditions.
- Filming activities must not have a negative impact on other management activities.

2.2.12 Contact person

A contact person will be allocated to a film crew that requires the assistance from DEAT to supervise the filming and make the necessary arrangements needed for the duration of the stay of the particular film crew.

2.3 Film applications

All filming request must be submitted in the same format to ensure that all the relevant information is available to allow PEIMC to take a decision whether to allow a request or not.

Details required :

- Application date
- Applicant's name, address, telephone and fax numbers and e-mail address
- Company's name, address, telephone and fax numbers and e-mail address (if different from above)
- Type of production
- Name and subject of work to be undertaken (Detailed on all aspects)
- Purpose for which films or photographs are to be used – particulars as to when and where they are going to be shown, exhibited or published and in what context (Detailed)
- Duration of project (Commencement date/Conclusion date)
- Indication of area where the company wish to operate
- Assistance required – guide, filming after hours, etc.
- People to be interviewed and on what topic.
- Accommodation needs
- Number of people in crew
- Equipment needs and volumes

Applications will be reviewed by PEIMC and be approved accordingly (with conditions) or rejected.

2.4 Tariff structure

DEAT might take a decision to implement a tariff structure to recover costs for accommodating film crews and according to the type of production, i.e. commercial ventures. Should this be the case, the following will be applicable:

It will be expected from all film crews to pay for the voyage and accommodation on the island. Should PEIMC approve a request on condition that a guide must accompany the film crew, the costs will be for the film crew.

Waiving of film fees

The following parties qualify or will be considered for possible waiving of film fees:

- All direct news and media footage.
- Domestic South African public interest television programmes such as 50/50, Carte Blanche, Focus, etc.
  - Production houses producing documentaries for the above type programmes/sister organisations will only receive favour **if they produce written documentation from the programme/organisation concerned that they are commissioned by the relevant programme/organisation** to take the specified footage applied for.
  - Production houses taking footage in the hope that they will be able to sell their product to specific programmes will not be granted the waiver.
- There will be certain documentary type shoots that are geared towards exposing the merits of the Marion Island. Waiving fees in such instances must be reviewed with caution, as producers accrue much value from such shoots. PEIMC should exercise extreme discretion, taking into account impact on the environment.
- Special Interest requests of specific significance can also be considered for waiver, but under the same cautionary note as the previous point.

Doc 3.1

CONSERVATION REPORT: MARION ISLAND TAKE-OVER, MARCH-APRIL 2003

John Cooper & Marienne de Villiers

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Introduction

At its 15th meeting, held on 19 February 2003, the Prince Edward Islands Management Committee appointed John Cooper as Conservation Officer for the 2003 take-over at Marion Island. Subsequently Dr Marienne de Villiers was appointed as an Assistant Conservation Officer. We accompanied the take-over expedition over the period 25 March to 30 April, spending the whole period at Marion Island.

Prior to the voyage JC attended a voyage planning meeting in the Cape Town SANAP offices on 21 February.

A set of colour photos illustrating aspects of this report are available, but have been kept separate for ease of electronic transmission.

Environmental education issues and permits

1. A set of permits was received on the southward voyage and handed out to the respective group leaders, and the occasion taken to explain their contents. Three missing permits, a Special Entry Permit (Zone 4) for the take-over ornithologists, and Entry and Special Entry (Macaroni Bay Wandering Albatross Monitoring colony only) Permits for M. Henri Chorosz, the pilot of the downed plane, were requested from the Cape Town office. Approval was given to the ornithologists to enter Zone 4 areas prior to the arrival of their permit on the island. The three permits were faxed to the island on 2 April.

2. Three copies each of the islands' management plan and visitors' guide were placed in the ship's passenger lounge for consultation on the southward voyage.

3. During the southward voyage a short talk on conservation issues at the islands was given in the passenger lounge to attendees of the science talks. Unfortunately this meant that not all expedition members heard it. On future voyages, the conservation talk should be held separately and attendance for all persons going ashore (including ship-based scientists) should be compulsory. Topics covered included permit zoning, alien biota and quarantine measures, disturbance to biota, littering, "night bird strikes" and the need for drawing blinds at dusk, and "souveniring". It was specifically mentioned that the site of the downed plane was out of bounds to all without a permit allowing them to enter Zone 4 areas. Notice was given of the forthcoming "boot-

washing ceremony" and that attendance was compulsory for all those intending to go ashore.

Quarantine and alien introduction issues

1. The SANAP stores at Paarden Eiland were inspected on 14 March. The stores were generally tidy and clean, although two large (but old?) cobwebs with dead spiders visible were obvious above the changing rooms in the clothing facility and a few old bird droppings, probably from pigeons, were noticed. The Bromadiolone "Tomcat" bait stations were in place as were several Racumin bait boxes. The stations had last been inspected on 4 March (see attached certificate; most recent previous inspections 3 December, 3 September, 14 June and 22 March 2002). Open orange containers that could be checked were clean. Containers were labeled G, M or S (SANAE) to keep Marion and Gough boxes separate, as has been recommended by the PEIMC for some time. A used (but cleaned) rain jacket issued to JC had plant material in a pocket and was not accepted. **Note**: the cobwebs alluded to above were still present on 13 May when they were again pointed out to SANAP staff.

2. The NDPW stores in the Customs Building on the Foreshore were inspected on 17 March. Rodenticide boxes (active ingredient Racumin: Coumatetralyl 0.375g/kg in 10-g sachets) have apparently been in place since *c*. August 2002. About eight boxes were seen. The boxes had been renewed on 14 March by Eagle Services whose "rodent report" certified that the facilities were then rodent free (attached). However, 4-5 faecal pellets (presumed from house mice) were collected from next to one box. Apart from this the stores were reasonably clean and no cobwebs or plant material were seen. All containers had been recently cleaned with a high-pressure hose before filling. Full containers were being stored outside the stores in the open air (but under cover) prior to being sent to the ship.

3. The *SA Agulhas* was visited on 17 March. Rat guards were present on 11 of 13 hawsers. However, the design is not considered adequate to stop rodents and a cone design should be better than the flat disc currently in use. The guards were in place on the morning of sailing, but were removed around about midday, two hours before departure. A De-ratting Exemption Certificate certifying the ship as rodent-free (attached) shows that the ship had been inspected on 19 March, and again by Swat Pest Control on 23 March, when Racumin bait stations were renewed.

4. On 24 March the Paarden Eiland stores were revisited to observe the packing for Prince Edward Island. All food stuffs, camping and scientific equipment and issued clothing (brand-new) were carefully checked, removing as much unnecessary packaging and labels as was feasible prior to sealing materials in plastic containers. Seed Crunch Gilly Bars which contained whole seeds were not packed as a precautionary measure. Two of the four tents to be used had been fumigated with ?? by Prof V.R. Smith a few days previously. These had apparently only ever been used at Prince Edward Island. One had two *Acaena* seeds in a Velcro seam. The other two SANAP tents had apparently been irradiated (unknown dosage, no certificate available), but on inspection contained plant material, including moss, *Blechnum* and *Agrostis*, as identified by Dr N. Gremmen. It is uncertain at which of the two islands this tent had previously been used so it was cleaned thoroughly. It was believed that

the PEIMC required that brand-new equipment be obtained (as it had done for back packs and clothing) but this was not achieved for any of the four tents. All packed material was taken to the ship and placed in the balloon room.

5. The "Boot-washing Ceremony" was held on 28 March on the southward voyage. All shore-based personnel as well as ship-based passengers (oceanographers, helicopter crew, medical doctor and French pilot) attended with their outer clothing foot wear, packs and camera bags. Relatively small amounts of plant material were found, but this included some *Uncinia*, grass (possibly *Agrostis*) and lily-like and *Rumex* seeds. Most material was found in Velcro seams and pockets. It is clear that SANAP cleaning procedures are inadequate in this regard. It is recommended that over-trousers be made without Velcro on their cuffs, since this collected the most material, which conceivably could have come from Gough Island. Footwear was scrubbed in a bleach (sodium hypochlorite) solution. The ship's Captain agreed to make certain that any of his crew going ashore washed their boots on the day of departure. Helicopter skids were brushed clean on 29 March and washed prior to landing the Prince Edward Island party on 30 March.

6. Various live invertebrates were seen on the vessel on its southward voyage up to the last night (29 March) before going ashore. These included at least three house flies, a "bluebottle" fly, two kelp(?) flies, a moth and a praying mantis. The mantis and one house fly were collected. A dead fly was found in one of the helicopters on 29 March.

7. Offloading of cargo commenced on 31 March. Upon offloading, five live cockroaches *Blatella germanica* were found among packaged beer and cool drink cans in container S19. As a consequence, the unpacked beers were replaced in the container and flown back to the ship the same day, along with two other containers (S27 and S30) containing alcohol as a precautionary measure. Later that day, two of the containers were unpacked on the ship, all non-transparent packaging was removed and the cans inspected for more cockroaches. A total of 10 was found, including very small ones and an egg case(?) in container S19. The other container was apparently free of invertebrates. These two containers were sprayed with "Doom Super" insecticide (active ingredients various pyrethroids) before and after repacking, and then sent back to the island the same day, but left sealed overnight. The next day they were unpacked and each "six pack" was examined and then immersed in a strong solution of commercial bleach before storage. No further cockroaches were found. The remaining container was unpacked and then resealed on the ship in a similar manner on 2 April: *c.* 25 cockroaches were found in liquor cases. No further insects were found when the containers were opened after their return to the island. Overall, *c.* 40 cockroaches were found. It is to be noted that an alien moth was found in a drinks box shortly after the 2002 take-over. The suppliers clearly need to be informed of strict quarantine requirements.

8. During unpacking ashore on 31 March a live moth and fruit fly *Drosophil*a, as well as some seeds, were found in various containers. All were collected. The moth was found in a sealed box of rusks. All other rusk boxes were then unpacked indoors but no further invertebrates were found. A M60 member found a live fishmoth among his papers on 2 April. JC found a dead noctuid moth in a box file he had brought to the island on 12 April. The moth had a live psopterid (book louse) on it that was

collected. As a precaution, the box was then sprayed with insecticide and sealed in a plastic bag.

9. On 7 April a cockroach (same species as 7. above) was collected alive along with a dead moth in a cardboard box containing library books kept in the gymnasium. The cardboard was burnt and the books repacked in a plastic box after careful inspection in the closed room. The organophosphate Dichlorvos was sprayed around the inside of the door frame. The books had apparently been repacked hurriedly at the Paarden Eiland stores (following the break-in of the team's shipping container) and it seems likely that the source was the same as for the cockroaches found in the drinks containers. A dead moth was found in one book.

10. News of the cockroaches was passed to the Cape Town SANAP office, and as a consequence, the ship chandlers were written to on 8 April requesting that they treat their premises against pests.

11. A live noctuid moth was found in the emergency generator room on 18 April. It was collected for identification.

12. The M60 Conservation Officer, Mr G. Hofmeyer, was instructed in procedures for monitoring and treating the local infestations of the alien grass *Agrostis gigantea* and the isopod *Porcellio scaber* around the base by the M59 Conservation Officer, Ms M. du Toit. Additionally, Dr N. Gremmen identified and discussed alien plants during a tour of the base vicinity with a number of people, including the M60 Conservation Officer. He reported that the herbicide treatment with "Sting" (glyphosate) of the grass appeared to be working, with no signs of the plant spreading. Spraying of existing plants with glyphosate ("Sting") and the isopod infestation with Dichlorvos, should continue on a monthly basis. Dr Gremmen also recommended that the patch of alien *Rumex acetosella* at Gentoo Lake be sprayed with the same herbicide during its summer growing season. If this has a successful outcome then the two other known patches of *Rumex* on the island, near Sealer's Cave and Goney Plain, should also be so treated in the growing season. The former site was not found by Dr Gremmen, but the whole area was not searched due to the presence of seals. The M60 Conservation Officer should assess whether more herbicide needs to be sent to the island in August to achieve these goals.

13. The patch of the alien rush *Luzula* near Sealer's Cave (46° 56' 53.9'S, 39° 52' 08.9"E) was inspected by Dr Gremmen, who found the plants to be flowering and seeding. A specific identification by an expert is still awaited from flowering material previously collected. Signs of new growth in small patches adjacent to the main infestation were noticed.

14. No fresh fruit, vegetables or other plant material were observed to have been brought ashore from the ship. Frozen poultry waste and food bones were flown to the ship in well-sealed containers on 23 April. During the takeover sorting and disposal of food wastes was conducted adequately. However, dumping of food wastes other than poultry products and bones at sea as is still currently practiced remains in contravention of the management plan which requires them to be incinerated.

15. Based on reports from M59 team members, the numbers of mice seen and caught through their year was rather low, perhaps due to lower than usual winter survival. However, 30 mice were trapped in the Bird Lab during the takeover utilizing daily trapping and mouse sign was seen in most huts visited. Eradication of mice at Marion Island remains a priority for the future.

Hut inspections

1. JC flew to all the field huts and to the old hut site at Kampkoppie on 31 March. Except for Cape Davis, all the hut surrounds appeared tidy, without obvious signs of alien plants and were largely clean of litter (but see notes on Kildalkey Hut in Appendix One). At Cape Davis an amount of wood and metal needed to be removed, as well as two rusted drums containing burnt material near to the hut. This material was successfully removed as part of the hut restocking operation (see Appendix Two). The toilet drum at Katedraalrans was about two-thirds full and needs replacement. The steel hut base frame at Kampkoppie needed to be cut up by the NDPW before it could be loaded into a container (see below).

2. Later in the take-over we spent two nights at the Grey-headed Albatross Ridge Hut and one night at the Kildakey Bay Hut. JC inspected the Rook's Peninsula hut site during this overland trip. MdeV spent one night at the Repetto's Hill Hut. During these visits we inspected and cleared up any rubble found in the vicinity (see Appendix One).

3. Recommended procedures for keeping huts mite free are outlined in Appendix Two. It is recommended that waste food be kept to an absolute minimum as a consequence of the need to dispose of it in the toilet pits.

4. Based on the Kildalkey Hut experience (Appendix One) it is suggested that the Conservation Officer on the 2004 take-over undertake a round-island trip on foot so that sufficient time can be spent at each coastal hut site, including those of removed huts, to undertake thorough clean-ups of their environs.

Disturbance, littering, pollution and rubble issues

1. Black-out blinds were kept closed at nights at the base, with regular reminders being made by intercom and walkie-talkie radio. No bird strikes were observed or reported, including from meteorological equipment, during the take-over. Two bird strikes on met equipment were reported during the year, one on stays that resulted in an assumed mortality. A fledgling White-chinned Petrel was collected dead aboard the ship while off the island early during the take-over. A Sooty Albatross was found stunned aboard the ship on 24 April when it was at the island (and when a braai was held, which perhaps attracted the bird). It was released the next day.

2. Visitors (oceanographers, officers and crew) from the ship came ashore by helicopter on 23 and 24 April. Parties were led by team members in groups of up to

10 people to Ship's Cove and Trypot Beach (within Zone 2). No disturbance issues were reported as a consequence. A report of a person disturbing King Penguins on the beach at Ship's Cove was received. The person involved had been admonished at the time. Consideration should be given to changing the beach from Zone 2 to Zone 3, to reduce disturbance to the penguins and seals present and to the nearby historical site. However, guided visits for Zone 2 permit holders could still be allowed.

3. Detailed information on "country clean-ups" is given in Appendix One. In summary, nine container, three cargo net and two sling loads (perhaps eight tonnes in total) were flown to the ship with rubble collected from the Base vicinity and elsewhere on the island. The amount of rubble that could be loaded into a container was constrained more by helicopter lifting ability than container size. Further clean-ups are still required, especially at the hydroshack and dam sites.

4. A "chicken run" around the Base buildings was undertaken on 24 April. A large amount of wooden, metal and other material was collected, including from underneath buildings. A proper clear out of accumulated rubble from below the PWD and Wet Lab buildings and the old food store floor and its environs at Gunner's Point remains and much-needed task. Relatively little litter was deposited around the base during the takeover, although several cigarette butts were found below windows and near doors. Smokers were reminded by way of blackboard messages to be more careful in this regard.

5. The wooden catwalk to the hangar and the lower helicopter pad are "leaking" polystyrene fragments, most probably due to the actions of mice. Thought needs to be given as how to halt this, and how best to remove the catwalks and helipad as part of the new base construction activities.

6. It is once more recommended that the open-air incineration of wood be halted and that all waste wood be stored for return to South Africa.

7. Information (GPS positions, descriptions) on existing long-term study sites was obtained from project leaders (see Appendix Three).

8. Information on effects of helicopter over-flights is given in Appendix 4. Flights during breeding seasons (such as during construction take-overs) need to take special care.

Fuel pumping

A total of 128 700 l of fuel (polar diesel) was pumped ashore on 2 April. No leaks occurred.

Prince Edward Island visit

1. A party of five scientists was flown to Prince Edward Island from the ship on 30 March and removed in the early morning of 5 April. The longer than planned stay (four days) was caused by bad weather preventing an earlier pick-up. Two scientists were dropped on the slopes above NcNish Bay and three at Golden Gate. Helicopter wheels were reported to have been cleaned aboard the ship before flying in the party (since the helicopter had previously landed at Marion that day). The Prince Edward Island scientists left all their camping equipment and dedicated outer clothing aboard ship before being transferred to Marion Island. The party removed all their rubbish from the island. A black plastic bag was found near the Golden Gate camp site and removed.

2. A total of 48 white plastic poles was used to mark a previously studied botanical site near Golden Gate (see Appendix Three). The Management Committee needs to consider whether this is allowed in a Zone 4 area without a specific permit. We were not aware in advance that marker poles were to be left on the island.

New base issues

1. Meetings were held on site and on the return voyage that decided that a specific whale-watching platform for the new base was not required, since the 3-m high helicopter pad, which will have railings, was deemed sufficient for the purpose.

2. The dim corridor lights were tested at night outside the base. They produced less light than that leaking through blinds in the existing base, so it was decided that they should be used as planned, and the situation monitored once the base was occupied.

ACKNOWLEDGEMENTS

Grateful thanks are due to Greg Hofmeyr, Leonie Joubert and Dumile Tshingana for helping with "country clean-ups". Frans Hoffman was an effective co-ordinator of helicopter flights and the helicopter pilots flew rubble loads with elan. Adriaan Dreyer ran an efficient and pleasant take-over.

RECOMMENDATIONS

1. Clothing- and tent-cleaning procedures need to be amended so that propagules do not remain in pockets and on Velcro strips. It is strongly recommended that over-trousers be manufactured without Velcro on their ankle cuffs, and that in the interim no used over-trousers be issued.

2. There appears to be an increasing number of live invertebrates being found on the ship and reaching the island. Suitable fumigation procedures, including by suppliers, need to be investigated urgently and put into place before the next voyage to the island. Insecticides need to be kept on the ship and at the island to treat any

infestations discovered. New rat guards of a cone design should be tested and adopted if found suitable.

3. Regular spraying of the alien grass *Agrostis gigantea* and the alien isopod *Porcellio scaber* should continue and spraying of the alien rush *Rumex acetosella* at the Base should commence.

4. "Country clean-ups" will need to be continued during the 2004 relief voyage since a large number of sites still require attention. As for 2003, a team of two dedicated persons is considered the minimum for efficient operation. Special efforts should be made to remove the hydroshack superstructures and various embedded poles and anchor points in 2004, for which NPWD support is essential, and to instigate a clean-up underneath the buildings closest to the crane on Gunner's Point. Twelve containers need to be dedicated to clean-ups in 2004. However, if helicopter lifting power is substantially improved, a smaller number may suffice. It is strongly recommended that three containers be placed at the hydroshack site during the August construction visit and that the M60 Conservation Officer be asked to organise a small party of his team members to fill them with the material accumulated but left on site this take-over (estimated to be half a day's work).

5. The use of painted and wooden (including bamboo) field markers should be halted, to be replaced with inert materials, such as non-rusting metal (e.g. aluminium) rods (in hard ground) and plastic conduit piping (in soft ground). Wooden NDPW (and other) containers that have been painted must be kept in a condition so that paint fragments do not disperse into the environment.

6. The open-air incineration of wood should be halted and all wooden materials and waste stored for return to South Africa in 2004.

7. All new field study sites must be plotted and their GPS and site-marker information made available to the Management Committee and the island team's Conservation Officer. All non-registered field markers should thereafter be removed as found by Conservation Officers, commencing from the time of the 2004 take-over.

8. The next meeting of the Management Committee should be informed of, and then discuss and comment on, procedures planned for environmental management during the new base construction period in 2003 and thereafter. Specific matters to discuss should include briefing of the to-be-appointed environmental officer, the type of zoning permits to be issued to construction personnel, quarantine procedures to halt alien arrivals, and the minimisation of on-site trampling and littering. In this regard it is to be noted that the M60 Conservation Officer will be in the field for much of the 2003 construction period, and thus not always available for daily consultation. This discussion (if necessary by e-mail) needs to take place well in advance of the August construction voyage.

9. The construction of the new base will lead to helicopter over-flights in times of the year other than during the normal April take-overs. Since both birds and seals will then be in different life-cycle stages, there are possibilities that any disturbance caused may be more critical. This most especially applies to breeding giant petrels, which will be incubating eggs and brooding small chicks from August through to

October in areas within a few hundred metres of the Base. Care thus needs to be taken during construction take-overs in this regard (when larger, more noisy helicopters may be used) and a precautionary approach adopted, along with ground observations whenever possible by seal and bird biologists/field assistants and the conservation officer on the team to develop on-the-spot advice to reduce disturbance to the minimum.

10. It is now approaching a decade since SANAP reviewed by way of a workshop the effects and possibilities of eradication of the House Mouse on Marion Island. It is suggested that the next meeting of the Management Committee consider the issue and recommend that a SANAP-sponsored review be undertaken of developments since 1995. A starting reference is:

Veitch, C.R. & Clout, M.N. 2002. Turning the tide: the eradication of invasive species. Proceedings of the International Conference on Eradication of Island Invasives. *Occasional Paper of the IUCN Species Survival Commission* No. 27: 414 pp.

12. The health and safety issues brought up in the Conservation Officer's report for the 2003 take-over still largely remain and should be addressed by the Directorate.

Cape Town, 19 May 2003

APPENDIX ONE

COUNTRY CLEAN-UPS: REMOVAL OF RUBBLE IN 2003

ZONE 1 (BASE VICINITY)

PRION VALLEY (46° 52.616'S, 37° 51.543'E)

Large number of redundant aerial anchors (poles, shackles and concrete blocks in wooden plank frames). Some metal items and wood cladding removed by hand on 3-4 April to a container and flown to ship. NDPW support required. **Site partially cleared.**

E-BASE

Scattered material on burnt ground and in sink holes behind the building, including partially buried solidified cement bags, wood, nails, screws, broken glass, an old shoe and porcelain and battery fragments, plus wooden cladding, shackles and wire from nearby anchor points for dismantled aerials. Large amount of material collected together on 8 April and placed in container S42 on 10 April. More material placed in container on 21 April. Container flown to ship on 23 April. Site requires further attention in 2004 to remove newly exposed and still buried material. **Surface of sites cleared.**

BOLUG BUILDING AND LOWER HELICOPTER PAD

Two nearby old dump sites. Material (glass, metal, wood, batteries, etc.) visible on the surface removed on 13 and 21 April to adjacent container. Container flown to ship on 23 April. Sites require further attention in 2004 to remove newly exposed and still buried material. A NDPW container at the helicopter pad, to be left on the island, was noticed to be shedding paint fragments. It was then covered in plastic wrapping. It is recommended that it be painted in August. **Surface of sites cleared.**

BASE BUILDINGS

Assorted rubble underneath and surrounding buildings. Some material, mainly wood, removed from below Bird Lab, E-Base and old food store floor **Sites partially cleared.**

ZONE 2

OLD WATER PIPELINE (46° 52.768'S, 37° 49.468'E; 160 m)

Plastic water pipe (partially buried) cut up into sections and loaded into container S21 on 11 and 15 April. A few pieces of wood, wire mesh and a glass bottle found in the vicinity. Container flown to ship on 22 April. One *c.* 20-m buried section at above co-ordinates remains to be removed, perhaps by direct attachment to a helicopter. Two piles of long pieces of water pipe on surface of mire at 46° 52.765'S, 37°

49.805'E; 156 m and 46° 52.664'S, 37° 49.994'E; 144 m placed in slings and removed to the ship on 24 April. **Site partially cleared.**

VAN DEN BOOGAARD DAM (46° 52.536'S, 37° 49.755'E)

Water plastic pipe sections, old spade and two piles of stone chips and sand, some in plastic bags present. Overgrown electric cable from dam to base: the exposed end is at 46° 52'S, 37° 49.866'E; 101 m. Two containers were loaded on 9 April with sections of water pipe and stone chips, some in original plastic bags, wooden shuttering, three concrete lumps from below dam and a *c*. 30-m nearby section of the power cable. A third container was loaded with stone chips and concrete fragments on 15 April, when a further section of the power cable (*c*. 4 m) was taken to base. Bamboo canes marking old photo points around the top of the peat slip were removed on 15 April. Containers flown to ship on 22 April. Wire and metal strapping removed from dam waters on 24 April. A further five containers are required in 2004 to remove remaining stone chips and plastic piping and *c*. 10 concrete lumps from immediately below dam wall. **Site partially cleared.**

HYDRO-ELECTRIC BUILDINGS (46° 52.186'S, 37° 50.46'E)

Metal and wooden superstructures of two buildings, steel poles, wooden planked deck and steps, incineration site and partially buried concrete lumps. NDPW support required to remove superstructures. Plank removed from ridge above shacks by foot on 1 April. Redundant albatross nest markers from Goney Plain placed at container on 7 April. One container placed next to incineration site and loaded on 9 April. Incineration site fully dug up and burnt materials ready for loading on 10 April. Cladding in small shack removed, along with some wooden planks in large shack. About 25 stone chip and sand bags and a metal pole dug up at large shack on 10 and 13 April. Container flown to ship on 22 April. Accumulated material (three containers required) remains on site due to lack of available containers. **Site partially cleared.**

CABLE DRUM No. 1 (46° 52.309'E, 37° 50.759E; 62 m)

Rotten wood and metal rods of a collapsed and partially buried cable drum between hangar and hydroshacks next to path in a hollow. Two pack loads carried out on foot on 1 April, three each on 3 and 4 April, two on 6 April, one on 7 April, all to base. Last load (10th) carried to hydroshack container on 9 April. **Site fully cleared.**

CABLE DRUM No. 2 (46° 52.432'S, 37° 51.115'E; 42 m)

Partially burnt and buried cable drum (waterlogged wood and metal rods) between hangar and hydroshacks removed in five pack loads on foot on 21 April. Fuel smell and oil trace (probably diesel) noticeable. **Site fully cleared.**

HYDROSHACK POWER CABLE (46° 52.449'S, 37° 51.178'E; 36 m)

Power cable from hydroshack exposed at this point and intermittently towards base, where exposed near hangar at 46° 52.548'S, 37° 51.478'; 40 m. Needs to be dug out and cut up into sections. Lifting out by helicopter without cutting may be feasible.

Four cut sections found near site of cable drum #1 and taken to hydroshack, on 22 and 23 April, where they remain on site (see above). **Sites partially cleared.**

SHIP'S COVE (46° 51.248'E, 37° 49.468'E; 50 m)

Two embedded metal anchor poles on top of bluff at northern end of cove inspected. Cannot be removed by hand.

JUNIOR'S KOP (No GPS)

Several wooden markers reported present at summit. Not investigated.

ZONE 3 (EAST COAST)

THIRD SISTER (46° 51.548'S, 37° 48.816'E; 136 m)

Large roll of chicken wire mesh (cat exclosure from early 1980s). Metal fence poles and droppers in vicinity moved to this site on 14 April. Flown out in cargo net by helicopter along with material in plastic bags from Bill Brigg's Beacon and elsewhere (see below) on 24 April. **Site fully cleared.**

BILL BRIGG'S BEACON (46° 51.997'S, 37° 48.050'E; 395 m)

This partially cleared site was visited on 14 April and a pack load of rusted metal objects (angle iron, shackles, wire, eye bolts, pole, etc.) and some rotten canvas were removed in a plastic bag to the site of wire mesh near the Third Sister (see above). **Site fully cleared.**

FIRST RED HILL (No GPS)

Large piece of canvas material in right-hand gully near the top (JC knows the site). Not visited.

NEAR KATEDRAALKRANS HUT (hut at 46° 53.893'S, 37° 46.483; 754 m)

Small wire mesh structure with metal rod supports close to hut on inland side of ridge. Not seen on 31 March during a brief hut inspection. Removed by the hut-restocking party to Base on 23 April. The toilet was not replaced. **Site fully cleared.**

N.B. A defunct AWS tripod may exist somewhere near the hut (V.R. Smith pers. comm.).

NEAR ARCHWAY BAY (46° 54.086'S, 37° 54.227'E)

Eleven concrete blocks on the coastal slope south of the King Penguin colony. Carried by hand on 13 April using a steel pipe away from the colony to container S9 previously placed at a distance (*c.* 200 m) by helicopter to avoid disturbance to penguins. Steel anchor pole taken from King Penguin colony to container on 8 April. Container with six blocks flown to ship on 22 April. Five remaining blocks loaded into a cargo net dropped at the site on 23 April and flown out the next day. **Site fully cleared.**

N.B. A large amount of what is assumed to be mainly drift wood is present at the back of the King Penguin colony at Archway Bay, along with a number (12-20?) of disused concrete blocks within the colony, once used as quadrat markers. A decision needs to be made as how to treat these various objects.

<u>SEALERS' CAVE</u> (No GPS)

Two aluminium ladders next to the "sealer's lookout" (a historical site). Not inspected. Will need to be flown out by helicopter.

<u>KILDALKEY BAY (No GPS)</u>

Six to eight embedded steel anchor poles on Green Hill side of King Penguin colony. Not inspected during take-over. Will need to be carried on foot to the Kildalkey Hut prior to removal by helicopter. NDPW support required.

<u>KILDALKEY HUT</u> (46° 57.291'S, 37° 51.211'E; 81 m

Large amount of partially buried wet wooden planks, two rolls aerial wire, plastic bag fragments, steel poles, glass fragments, buried spade, etc. collected together at hut entrance from hut and toilet surrounds on 19 April. Needs to be flown out during next take-over. **Site partially cleared.**

ZONE 3 (WEST AND SOUTH COASTS)

<u>WATERTUNNEL STREAM HUT</u> (46° 57.44'S, 37° 44.56'E)

Whole hut to be replaced. Especial care needs to be taken with any exposed polystyrene material. Site inspected on 31 March (via helicopter) and again on 9 April (on foot).

<u>GREY-HEADED ALBATROSS RIDGE HUT</u> (No GPS)

Rusted fence pole and a koskassie box full of wood from several cat trap sites and the collapsed Santa Rosa Valley signpost on the "Golden Highway", and asbestos and glass fragments from Rook's Peninsula hut site (see below) collected together on 17 and 18 April. To be removed by helicopter during the next take-over. **Site partially cleared.**

<u>ROOK'S PENINSULA HUT SITE</u> (46° 57.997'S, 37° 40.976'E; 79 m)

Eight embedded anchor poles found on 18 April. All visible asbestos sheeting and glass was then collected and removed to Grey-headed Albatross Ridge Hut save one large piece, left on site with a *c.* 4-m steel anchor pole. NDPW support required. **Site partially cleared.**

<u>ROOK'S BAY HUT</u> (46° 58.021'S, 37° 39.597'E)

A few planks and a wooden catwalk to be removed when the new hut is positioned.

NEAR KAMPKOPPIE (46° 52.992'S, 37° 37.828'E; 67 m)

Old rondawel hut remains with metal base frame 75 m north. Site inspected on 31 March by helicopter. Material (steel base (cut up by NDPW), scattered and part-buried asbestos sheeting, wood and glass fragments, one anchor pole, etc.) collected and part-flown out to base in container M9 on 5 April. A pile of cut-up steel is still to be removed from the base frame site in a cargo net, along with nine embedded anchor poles and a part-buried metal frame and a 1-metre long asbestos sheet fragment. This removal, with NDPW assistance required, should be undertaken during hut restocking of the nearby Mixed Pickle Bay hut in 2004. **Site partially cleared.**

BETWEEN SWARTKOP AND MIXED PICKLE (No GPS)

Metal grids. Site not known. Is this the Kampkoppie site? If not reported by the next take-over, suggest it be deleted from this list.

LAEKOP HUT SITE (No GPS)

Vicinity inspected for presence of rubble from helicopter without landing on 31 March. No signs seen but site not exactly identified from the air. Requires a ground inspection in 2004.

CAPE DAVIS HUT (46° 49.703E, 37° 42.263E; 47 m)

A few planks and a metal pipe removed from old rondawel hut site to hut on 31 March. Two rusted drums containing burnt material close to hut along with a quantity of wet wood and metal pipes, etc. around hut removed by helicopter on 5 April. **Site reported as fully cleared.**

ZONE 4

THE FAULT (46° 52.741'S, 37° 50.137'E)

Three concrete blocks together with 'plane site material (see below). All material loaded into a cargo net on 23 April and flown to ship the next day. Rotten rope at the ladder removed on foot on 8 April. **Site fully cleared.**

ALBATROSS LAKES (46° 53.411'S, 37° 52.410'E; 55 m)

The crashed aeroplane in the Macaroni Bay Wandering Albatross Monitoring Colony south of the Fault was flown out by helicopter on 2 April and placed temporarily at the base. The nose wheel, battery, broken window and various loose pieces were removed by foot the same day. The poles, guy cables, plastic sheeting and a wooden plank were carried on foot to the blocks near the Fault (see above) on 8 April.

Displaced plant material was used to fill partially the scars made by the plane. The plane was flown to the ship on 23 April. **Site completely cleared.**

SCIENTIFIC FIELD MARKERS IN ZONES 2-4

Plastic 20-mm electrical conduit piping in soft ground and non-rusting metal rods in hard ground are recommended as environmentally inert and long-lasting field markers. Use of painted and wooden field markers should cease, to halt paint fragments and decomposed wood from entering the environment over time.

Scientific group leaders to identify with GPS positions and plot on map markers currently in use (see appendices) All others to be removed when found. Cat stone walls to be left in place for their historical interest. When visited, GPS positions should be collected.

APPENDIX TWO

RECOMMENDATIONS FOR MANAGEMENT OF THE MITE PROBLEM IN FIELD HUTS ON MARION ISLAND

Based on information from Dr D.J. Marshall (University of Durban Westville) and discussion with team members and the M59 Conservation Officer, Ms M. du Toit, I would recommend a prophylactic (rather than a symptomatic) approach to the management of the current mite problem. Dr Marshall has examined specimens of this mite species and is fairly certain that it is *Tyrophagus similes kerguelenensis* Fair 1976, associated with penguin colonies, indigenous to the island and generally harmless to humans (they do not bite). At present the problem appears to be largely confined to dustbins and food preparation surfaces in huts on Marion Island.

The most effective and environmentally sound approach to managing this species in the huts under these conditions is as follows:

1. Do not leave food (anything edible) or food waste (including food containers or wrapping, such as sweet papers) lying exposed in huts.
2. Dispose of all food waste down the toilet, and not in the hut dustbin.
3. Wash tins and food containers to remove all food remnants before throwing these away in the dustbin. Place food wrappers in separate, closed plastic bags and then into the main dustbin bag.
4. Keep all surfaces and dustbins clean and dustbins sealed closed.
5. Do not leave open food containers in the hut between visits (tins, boxes, bags). Either dispose of these, place them in clean, sealed (tupperware) containers, or return them to base.

If an area does become infested the following is recommended:

1. Remove the source of contamination (food item or food container). If this is food, dispose of it in the toilet, and if a food container then wash it in warm soapy water before throwing it in the dustbin. If the dustbin is infested, remove the bag, close it and if possible return it to base for disposal. If it is not possible to return the dustbin bag to base, then close the bag, wipe/spray its outer surface down as described below. Return it to the cleaned dustbin and use a new dustbin bag on top of it.
2. Wipe infested and surrounding surfaces down with a solution of bleach (Jik), ammonia (Handy Andy) or other disinfectant.

Infestations are likely to be controlled if these measures are followed stringently. However, should the situation deteriorate despite measures taken, then this management approach should be re-evaluated. Any decision to use a pesticide (this would be a registered miticide), must be considered by the Prince Edward Islands Management Committee.

M.A. McGeoch, University of Stellenbosch

APPENDIX THREE

LONG-TERM STUDY SITES WITH FIELD MARKERS, APRIL 2003

Biocomplexity and Change Project

Project leader: Prof M.A. McGeoch (mcgeoch@sun.ac.za)

Site markers: Four dowel sticks with red reflective tape at each site (marking each corner of the plot), and numbered metal tags in some *Azorella selago* cushions at these sites.

Mixed Pickle Cove

MP –	H	46º 53.83'S, 37º 39.266' E	@ 597 m asl
	M	46º 53.211'S, 37º 38.860' E	@ 375 m asl
	L	46º 52.574'S, 37º 38.548' E	@ 210 m asl

Swartkop Point

SK -	H	46º 56.203'S, 37º 37.52' E	@ 566 m asl
	M	46º 55.820'S, 37º 37.222' E	@ 415 m asl
	L	46º 55.795'S, 37º 36.481' E	@ 218 m asl

Tafelberg

TL -	H	46º 53.676'S, 37º 47.290' E	@ 576 m asl
	M	46º 53.267'S, 37º 48.116' E	@ 360 m asl
	L	46º 52.750'S, 37º 49.649' E	@ 176 m asl

Stony Ridge

SL -	H	46º 54.060'S, 37º 47.971' E	@ 593 m asl
	M	46º 54.607'S, 37º 49.054' E	@ 366 m asl
	L	46º 54.928'S, 37º 51.440' E	@ 163 m asl

Skua Ridge

46º 52.061'S, 37º 50.317'E @106 m a.s.l.

Ornithology Project

Project Leaders: Drs R.J.M. Crawford and P.G. Ryan (crawford@mcm.wcape.gov.za)

Long-term study colonies of Wandering Albatrosses

Boundary and nest markers: Numbered white plastic pipes. Boundary markers at Macaroni Bay and Sealer's Beach are set in concrete blocks.

Note: all positions are 46°S, 37°E; therefore only minutes in decimals are given, South, followed by East. Altitude by GPS in metres is available for most, but not for all. These co-ordinates also mark the boundaries of Zone 4 sites.

Macaroni Bay

1. 53.407	52.012
2. 53.467	52.025
3. 53.483	52.223
4. 53.515	52.246
5. 53.665	52.067
6. 53.836	52.266
7. 53.751	52.508
8. 53.703	52.633
9. 50.615	52.550
9A. 53.405	52.464
10. 53.315	52.381

Sealer's Beach

1. 51.106	50.373
2. 51.142	50.293
3. 51.118	50.159
4. 51.135	50.105
5. 51.163	49.962
6 51.257	49.764
7. 51.230	49.586
8. 51.192	49.444
8A. 50.934	49.506
9. 50.894	49.565
10. 50.898	49.667
11. 50.921	49.834
12. 50.968	50.051
13. 51.061	50.202
14. 51.079	50.328

Goney Plain

1. 50.638	48.385
2. 50.475	48.261
3. 50.369	48.180
3A. 50.325	48.058
4. 50.389	48.066
5. 50.440	48.049
6. 50.532	49.051
7. 50.601	48.074
8. 50.725	48.296

Long-term study of Grey-headed Albatrosses

At Grey-headed Albatross Ridge immediately to right of cliff path, visible from hut. Top of ridge immediately above study colony is at 46° 57.701'S, 37° 42.387'E; 146 m. Is a Zone 4 area. Numbered plastic pipes inserted into side of nests. No boundary markers in use.

Long-term studies of Macaroni Penguins

Bullard Beach and Kildalkey Bay colonies have boundary markers and 5-m quadrats demarcated by concrete blocks, some of which have plastic pipes or bamboo canes as risers. No GPS positions currently available, but surveyed maps exist for both colonies with boundary and quadrat markers trigonometrically surveyed in.

Macaroni Bay, Archway and Van den Boogaard River. Study colony at Macaroni Bay has boundary markers made of white-flagged bamboo poles. No GPS positions currently available.

Long-term study of burrowing petrels

Orange broom poles and bamboo canes at various localities at Macaroni Bay, Skua Ridge, van den Boogaard River/Skua Ridge valley and elsewhere inland. No GPS positions currently available.

Long-term study of White-chinned Petrel

Burrows in general vicinity of the Base, Nellie Humps and Prion Valley ("Kapua Bridge") are marked with numbered plastic pipes and with ice-cream carton observation "plugs". No GPS positions available, but a rough sketch map of sites exists on the island.

Long-term study of Northern Giant Petrel

No permanent markers are used but all occupied nests in an area encompassed by Skua Ridge, Junior's Kop, Tom, Dick & Harry and Archway Bay are marked (and removed) annually in summer with H-numbered white-flagged long bamboo canes. No GPS positions for boundaries or nest sites are currently available.

Vegetation Dynamics Project

Project Leader: Dr N. Gremmen (gremmen@wxs.nl)

Site markers: White plastic conduit pipes, and bamboo poles at NG3 only.

Sites NG1 and NG2

At base below Mammal Lab at 46° 52.43.3"S, 37° 51 30.8"E; 47 m. Blue ground-water pipes are present, flush with the ground.

Site NG3

North of Van den Boogaard River dam at 46° 52' 28.6"S, 37° 49' 48.8"E; 132 m

Golden Gate, Prince Edward Island

A total of 48 plastic pipes used in 2003 to replace bamboo poles placed in 1993. Remnants of bamboo poles removed in 2003.

Soil Respiration Project

Project Leader: Prof V.R. Smith (vr2@sun.ac.za)

Site markers: ?

Base vicinity

c. 500 m from hangar inland of path to hydroshack (No GPS)

Trypot Beach

100 m (?) inland (No GPS)

Geomorphology Project

Project Leaders: Dr P. Sumner (sumner@scientia.up.ac.za)

Site markers: Steel rods or bamboo canes

Tate's Hill

46° 54' 57.9"S, 37° 49' 20.9"E — Long-term ground movement

"Red Rocks"

46° 57' 30.5"S, 37° 46' 00.4"E — Long-term ground movement

Junior's Kop North

46° 52' 50.4"S, 37°49' 49.6"E; 202 m — Soil temperature logger

Junior's Kop North

46° 52' 41.3"S, 37° 50' 13.7"E — Soil temperature logger

Junior's Kop South

46° 53' 04.9"S, 37° 49' 47.2"E Long-term ground movement & soil temperature logger

Long Ridge North

46° 51' 10.9"S, 37° 48' 12.7"E; 161 m Long-term ground movement

Three Sisters

46° 51' 41"S, 37° 48' 40"E Long-term ground movement

"Cold Ridge"

46° 55' 07.7"S, 37° 37' 33.9"E Long-term ground movement & soil temperature logger

Repetto's Hill

47° 50' 44.5S, 37° 44' 27.4"E Long-term ground movement

Katedraalkrans

46° 53' 53.6"S, 37° 46' 28.0"E Micro-climate logger

Tafelberg

46° 53' 11.4"S, 37°48' 22.1"E Long-term ground movement

N.B.: Mammal projects (Prof MN Bester, University of Pretoria) do not currently utilize field markers.

APPENDIX FOUR

DISTURBANCE OF FAUNA BY HELICOPTER OVER-FLIGHTS AT MARION ISLAND

Over 300 helicopter flights were flown during the take-over period. Supply runs were flown at a maximum height of 300 foot, whereas cruising altitude was between 1000 and 1500 foot. Non-quantitative observations were made during as many flights as possible from the ground of the effects of such flights on both birds and seals.

Rockhopper Penguins

Roosting and/or moulting Rockhopper Penguins reacted to helicopter overflights by showing mild signs of panic, but no birds were observed to rush into the sea (the plumage of moulting birds is not waterproof). During normal takeover periods, when this species is not breeding, helicopter flights appear to have little negative effect.

King Penguins

King Penguins are known to panic in response to aircraft under certain circumstances. Unfortunately, no observations were made of reactions of helicopter flights during the take-over.

Wandering Albatrosses

None of 13 nests observed near base were deserted during takeover. Adults brooding chicks initially displayed some signs of unease and increased vigilance, but appeared to ignore the disturbance after several hours of flying had taken place. Interactions between courting birds close to the helipad were interrupted by flights and the associated disturbance by humans on foot, but by the end of takeover even these birds were displaying a remarkable level of site fidelity. At the beginning of takeover, most of the albatrosses observed were brooding small to medium-sized chicks. Albatrosses at this stage of breeding are likely to be quite tolerant of disturbance. Flights earlier in the year, when these birds may still be finding partners or incubating eggs, are likely to be more disruptive to breeding.

Southern Giant Petrels

Observations from the air indicated that this species is extremely sensitive to helicopter disturbance. Roosting groups of Southern Giant Petrels took to the air when the helicopter passed over at cruising altitude. Whereas this is of low importance when the birds are not breeding, it could have a potentially disastrous impact during the breeding season.

Southern Elephant Seals

Elephant seals near base initially reacted to helicopter overflights with increased awareness and by lumbering towards water, but soon (within a matter of hours) appeared to habituate to the disturbance, remaining prone and only slightly alert during flights.

Subantarctic Fur Seals

This species appeared to be most affected by helicopter flights. Near Base, fur seals up to 500 m from the flight path began to flee in response to supply flights. Fur seals on the western side of the island, less habituated to human disturbance, began to panic and flee when a helicopter flew over at cruising altitude. Adult males tended to hold their ground best, whereas sub-adult males, females and pups were more likely to panic. Increased vocalisations indicated distress. Several aggressive encounters were observed as fleeing males moved into the territories of other males. At least one such encounter involved biting, rather than just aggressive posturing. After two hours of flying on the first day of supply flights, most seals which remained on Boulders Beach near the Base remained prone during flights and those which did begin to flee soon halted their flight and relaxed again once the helicopter had landed. However, during the first four days of flying the number of seals using Boulders Beach and nearby areas decreased by about 25%. It should be noted that while the impact of flights on Fur Seals during current takeover periods may be minimal, flights earlier in the year could lead to the trampling of very young pups by fleeing adults.

Disturbance of fauna by removal of the crashed aircraft from Zone 4

The aircraft crashed on 24 November 2002 near Albatross Lakes and The Fault in a Zone 4 area, during which time no Wandering Albatrosses were breeding in the study area. The two albatrosses that were establishing nest sites in the area flew off during the aircraft's approach but returned at a later stage and subsequently bred near the site of the crash. The aeroplane was removed from the area on 2 April 2003 by a team of eight people, with helicopter assistance. The two nesting albatrosses closest to the crash site (50-80 m) reacted aggressively to the helicopter but continued to brood their chicks throughout the presence of the team, and these chicks still survived at the end of the take-over. The aircraft crash and its removal thus appeared to have minimal impact on the Wandering Albatross study colony in a Zone 4 area.

Recommendation

The construction of the new base will lead to helicopter over-flights in times of the year other than during the normal April take-overs. Since both birds and seals will then be in different life-cycle stages, there are possibilities that any disturbance caused may be more critical. This most especially applies to breeding giant petrels, which will be incubating eggs and brooding small chicks from August through to October in areas within a few hundred metres of the Base. Care thus needs to be taken during construction take-overs in this regard (when larger, more noisy helicopters may be used) and a precautionary approach adopted, along with ground observations whenever possible by seal and bird biologists/field assistants and the conservation officer on the team to develop on-the-spot advice to reduce disturbance to the minimum.

MS de Villiers

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Appendix 1

COMPARATIVE POPULATION ECOLOGY OF SOUTHERN ELEPHANT SEALS

Project Leader: M.N. Bester, Mammal Research Institute, Department of Zoology & Entomology, University of Pretoria, Pretoria 0002

Project Researchers: M.N. Bester, T. Mulaudzi, F. Munyai, P. Pistorius & C. McMahon

Date of Report: Third interim progress report, 01 July 2002 - 30 June 2003

Objectives: The aims of this study are: (a) to establish whether the Marion Island elephant seal population has finally stabilised after a period of rapid decline, (b) to estimate juvenile and adult survival for the 'stable' Marion Island population and the increasing Peninsula Valdés population, (c) to compare these vital rates between the two populations, as well as with those from the Marion Island and Macquarie Island populations while in a state of decline, and (d) to assess the change in juvenile and adult female survival associated with the presumed halt of a 5.8% intrinsic rate of population decline (Marion Island population) as well as a 3.6% intrinsic rate of increase (Peninsula Valdés population relative to 'stable' Marion Island population) in population size in elephant seals.

History of the Project:
The monitoring aspects of the pinniped populations at Marion Island were addressed in the period 1996 – 2001. The current project was designed to continue with the mark-recapture programme of southern elephant seals (1983 – 2001) and to make an in depth comparison amongst southern elephant seal populations in different stages of population growth/decline. The project requires close collaboration with the Australian Antarctic Division (AAD) and the Centro Nacional Patagonico, Puerto Madryn, Argentina. An updated workplan (Bester 2002a) and the updated volume of collated papers dealing with practical aspects of the research (Bester 2002b) were prepared. The debriefing of the 2001/02 field assistant (T. Mulaudzi) and training of the 2002/03 field assistant (T. Maswime) was completed. Pierre A. Pistorius completed his PhD (Pistorius 2001) and graduated in March 2002, while Clive R. McMahon travelled to Marion Island in March-April 2002 to assist with, amongst others, mark-recapture data manipulation. These PhD students dealt with the collaborative programmes to compare parameters of declining (Marion), stabilizing (Marion & Macquarie) and increasing (Valdés Peninsula) populations of southern elephant seals. To date, financial support amounting to R 435 090 has been allocated, apportioned as follows:

Year	*2001/2002*	*2002/2003*	*2003/2004*
Manpower	103 850	126 517	156 830
Running Expenses	12 300	11 593	18 800
Capital Equipment	-	5 200	-
Total	116 150	143 310	175 630

Scientific Progress:
An updated workplan (Bester 2003a) and the updated volume of collated papers dealing with practical aspects of the research (Bester 2003b) were prepared. The debriefing of the 2002/03 field

assistant (T. Maswime) and training of the 2003/04 field assistants (F Munyai & G. Hofmeyr, the latter funded out of the Satellite Tracking Project) was completed. Past PhD students, P.A. Pistorius (UP) and C.R. McMahon (AAD, Kingston, Tasmania), continued to compare parameters of declining (Marion), stabilizing (Marion & Macquarie) and increasing (Valdés Peninsula) populations of southern elephant seals.

1. *What is the rate of population change using pup numbers as an index of population size in elephant seals at the Prince Edward Islands?*

We found no change in population size at Marion Island from 1994 through 2002 suggesting that the population was stable during this period (Pistorius *et al.* Accepted). This contrasts markedly with the population data from 1986 to 1993 that showed that numbers had decreased continuously. Therefore, the Marion Island age-specific survival estimates before 1994 (taken from Pistorius *et al.* 1999b) were pooled to represent the declining population and all the estimates after 1993 (Pistorius *et al.* 1999b; Pistorius *et al.* Accepted) were pooled to represent the stable population (see Key Question 2 below).

2. *What is the change in population parameters of the southern elephant seal population (juvenile survival, age at sexual maturity, fecundity, breeding population size and composition) using direct counts and mark/recapture as a gauge of change in critical components of the environment?*

We continued to analyse mark-recapture data collected at Marion Island (using program MARK) since the termination of the long-term population decline and compared our survival estimates with similar data collected during the decline and with data collected from the Valdés population in southern Argentina, which has been increasing. Survival of prime-age adult females increased significantly by 5.6% during the latter part of the decline at Marion Island, and the survival of adult females at the colony in southern Argentina was about 5% greater than at Marion Island after the stabilisation. The future annual survival and breeding probabilities of females breeding at a young age, was similar to those from females primiparous at an older age. There was in addition no reduced survival in the year following first breeding in young or older first time breeders. Reproductive expenditure in young primiparous females therefore did not entail future fitness costs relative to older primiparous females, and we found no evidence supporting the existence of various life history strategies in terms of age of primiparity within a population of southern elephant seals (Pistorius *et al.* Accepted).

Comparing the Marion Island population with that of Macquarie Island over the period 1993 – 2001 showed that recapture probabilities were higher at Marion Island than at Macquarie Island. There are two possible reasons: (1) the population at Marion Island is smaller and less dense than at Macquarie Island and (2) seals hauled out along a smaller section of the coast at Marion Island than at Macquarie Island, which: (1) facilitates the detection and individual identification of seals and (2) increases access to hauled out seals. Age specific survival estimates (corrected for pre-weaning mortality and tag loss) differed significantly at the two islands and were consistently higher at Macquarie Island. The survival estimates for male and female seals were different at Macquarie Island and Marion Island. Female survival estimates were higher than male survival estimates. The combined survival estimates for juvenile seals (1-3 years) differed between islands and survival of older seals (4-6 years) did not. The inclusion of gender in the survival models did not improve model performance and hence male and female estimates were considered jointly (McMahon *et al.* 2003).

The mean age at first breeding was different ($p < 0.001$) at the two island populations. At Macquarie Island the mean age of first breeding was 4.68 years ± 0.38, and at Marion Island it was 3.95 years ± 1.03. More three-year-old females breed at Marion Island (28.7%) than at Macquarie Island (1.2%) and the proportion of seals that had bred at least once by age seven was greater at Marion Island than at Macquarie Island.

3. *Using direct body measurements, how does pup growth (as a function of energy transfer by their mothers) compare between years, sites and amongst different populations?*

The mean wean masses of male and female seals combined were not significantly different between islands ($T_{6837} = 1.169$, $p = 0.242$). At Macquarie Island the mean wean mass was 118.8 kg (SD = 27.2, n = 6504) while at Marion Island the mean wean mass was 120.6 kg (SD = 24.7, n = 335). Elephant seal wean masses during this study at Macquarie Island were similar ($p = 0.94$) to those collected earlier (1985-1991) (Burton *et al.* 1997), 118.8 kg (SD = 27.2, n = 6504) and 118.7kg (SD = 20.7, n = 463) respectively. However, the weaning masses at Marion Island were significantly different for these two periods ($p = 0.0001$) at 120.6kg (SD = 24.7, n=335) and 114.1kg (SD = 20.6, n = 411) respectively. It can be concluded that the increase in wean mass at Marion Island and the stability of the wean masses at Macquarie Island prior to 1992 and after 1993 is proof of (a) an increase in resources or (b) an increase in the mean age of females at Marion Island. The latter is unlikely because, for this to occur, juvenile survival rates would have to decrease relative to adult survival or adult survival would have to increase relative to juvenile survival over these two periods. Neither appears to have occurred at Marion Island (Pistorius *et al.* 1999b; Pistorius *et al.* 2001; McMahon *et al.* 2003). Wean mass influenced survival differently at the two island locations ($\chi^2_{16} = 38.664$, $p = 0.0012$). At Macquarie Island wean mass influenced first and second year survival, but only first year survival at Marion Island.

We conclude that the observed decreases in elephant seal numbers between the 1950s and 1990s in the Pacific and Indian Ocean sectors were driven principally by resource limitation in the Southern Ocean. A conglomerate of factors including local predation by killer whales (Pistorius *et al.* 2002) and intra-specific resource competition is postulated as a cause for the inter-island (regional) differences in population trends. It appears that more resources are available *per capita* to the Marion Island population than are available to the Macquarie Island population.

4. *What is the nature and incidence of entanglement of elephant seals in man-made debris?*

With the advent of formal (permitted) longline fishing in the EEZ of the PEI in 1996, data collection is essential to evaluate entanglements in the period 1996-2004 (Hofmeyr *et al.* 2002), as entanglement may severely impact on the population here and elsewhere within their foraging range, and can provide a baseline for evaluating some of the effects of commercial fishing in offshore waters. Data collection continues.

Continued data collection and analyses of the Marion Island elephant seal mark-recapture database permitted investigation into age- and sex-related temporal aspects of the annual haulout cycle (Kirkman *et al.* 2002), likely predatory impacts of killer whales (Pistorius *et al.* 2002; Bester *et al.* 2002) and age- and sex-related dispersion and dispersal which impacts on the basic assumptions of a mark-recapture study.

Data and Sample Storage:
All mark-recapture information collected (hard copy and computer files) is deposited at the Department of Zoology & Entomology, UP.

Acknowledgements:
The Department of Environmental Affairs & Tourism for financial and logistic support; the University of Pretoria Postgraduate Programme, Mirtha Lewis at CENPAT and Harry Burton at AAD, and the Marion and Macquarie Island expeditioners for their assistance with data collection.

Publications:

i) Publications:

BRADSHAW, C.J.A., McMAHON, C.R., HINDELL, M.A., PISTORIUS, P.A. & BESTER, M.N. 2002. Do southern elephant seals show density dependence in fecundity? *Polar Biol.* 25: 650-655.

McMAHON, C.R., BURTON, H.R. & BESTER, M.N. 2003. A demographic comparison of two southern elephant seal populations. *J. Anim. Ecol.* 72: 61-74.

McMAHON, C.R. 2002. A demographic comparison of two elephant seal populations. PhD Thesis, University of Pretoria, Pretoria. 160 pp.

PISTORIUS, P.A. & BESTER, M.N. 2002. Juvenile survival and population regulation in southern elephant seals at Marion Island. *Afr. Zool.* 37: 35-41.

PISTORIUS, P.A., KIRKMAN, S.P., BESTER, M.N. & TAYLOR, F.E. 2002. Implications of the winter haulout for future survival and resighting probability of southern elephant seals at Marion Island. *S. Afr. J. Wildl. Res.* 32: 59-63.

ii) Accepted:

PISTORIUS, P.A., LEWIS, M.N., BESTER, M.N., TAYLOR, F.E., CAMPAGNA, C. & KIRKMAN, S.P. Adult female survival, population trend, and the implications of early primiparity in a capital breeder, the southern elephant seal. *J. Zool., Lond.*

iii) Internal reports/manuals/abstracts:

BESTER MN 2003a. Marion Island Pinniped Monitoring Manual and Workplan for 2003/2004. Typescript, Department of Zoology & Entomology, University of Pretoria. 75 pp.

BESTER MN 2003b. A selection of scientific papers providing background and methodology in support of the Pinniped Monitoring Programme. Collated Papers, Department of Zoology & Entomology, University of Pretoria.

Signature:
Prof M N Bester
26 June 2003

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Appendix 1

SATELLITE-LINKED IDENTIFICATION AND CHARACTERIZATION OF SOUTHERN ELEPHANT SEAL FORAGING AREAS

Project Leaders:

1. M.N. Bester, Mammal Research Institute, Department of Zoology & Entomology, University of Pretoria, Pretoria 0002
2. J. Plötz, Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany.
3. B.S. Stewart, Hubbs-Sea World Research Institute, San Diego, USA.

Project Researchers: M.N. Bester, J. Plötz, B. Stewart, T. Mulaudzi, H. Bornemann, G. Hofmeyr & S. Ramdohr.

Date of Report: Third interim progress report, 01 July 2002 - 30 June 2003

Objectives: A comprehensive analysis and synthesis of biological and physical data obtained in two different regions of the Southern Ocean, i.e. the Antarctic Peninsula region and the Kerguelen Province, using data on foraging movements and diving behaviour of the southern elephant seal acquired by using satellite telemetry. A comprehensive analysis of the spatio-temporal behaviour of elephant seals at sea and relationships with physical and biological parameters will be achieved by using the information system PANGAEA – Network for Geological and Environmental Data, to further our understanding of the behaviour of the seals and the role they play in the Antarctic and Subantarctic marine ecosystems of the Southern Ocean.

History of the Project:

The preliminary bout of satellite tracking of elephant seal males from Marion Island took place from April 1999 (Stewart & Bester 2000). Our strategic goals were first, to identify foraging corridors and destinations of juvenile and adult male southern elephant seals from Marion Island during their post-molt and post-breeding season migrations to address hypotheses of prey limitations (and impacts of commercial fisheries vs. natural and anthropogenic environmental change) related to decline of the Marion Island colony. Secondly, we wanted to compare foraging migrations of southern elephant seals with those of northern elephant seals (*Mirounga angustirostris*) as a preliminary step in investigating the influences of environment on the evolutionary ecologies of these closely related species. The project was then formalised in its expanded current form, taking on board the AWI with their PANGAEA initiative. The project required close collaboration with the AWI, Germany and the HSWRI, USA. The outcome of the funding applications within the research co-operation between South Africa and Germany (the DFG/BMZ Programme) and to the 'Volkswagenstiftung' (www.Volkswagenstiftung.de) was not successful, and the German participation in the 2001 Marion takeover (when the HSWRI deployed six satellite-linked radio transmitters) had to be postponed to the 2002 Marion takeover when nine AWI sponsored satellite transmitters were deployed, together with additional ones (n = 4) from the HSWRI (Stewart, Bester, Plötz & Ramdohr 2002). The entire schedule for the current project was, however, eventually delayed by 2 years. The different envisaged phases, and its execution thus far, are as follow:

Phase	Personnel	Destination	Task	Duration [d]*	Execution
1. Starting	2	Germany	Introductory workshop	5	Not done
	1	South Africa	Installation of PANGAEA	5	Not done
2. Expedition	2	South Africa/Marion Is.	SDR deployment	35	Completed
3. Evaluation	#	Germany	Data evaluation		Partly done
4. Analysis	#	South Africa	Analysis		Not done
5. Synthesis	6	South Africa	Synthesis workshop	3	Not done

* days for departure and arrival are excluded # no additional exchange requested

To date, financial support amounting to R 266 592 has been allocated, apportioned as follows:

Year	*2001/2002*	*2002/2003*	*2003/2004*	*2004/2005*
Manpower	-	82 644	140 414	
Running Expenses	12 529	8 850	7 300	
Capital Equipment	14 855	-	-	
Total	27 384	91 494	147 714	

Scientific Progress:
The schedule for the current project as it pertains to the comprehensive analysis which will link the at-sea spatio-temporal behaviour of elephant seals with physical and biological parameters by using the information system PANGAEA – Network for Geological and Environmental Data - has been delayed pending procurement of a salary for Dr. Bornemann. However, that all-important cog in the 'PANGAEA' wheel, Dr. Horst Bornemann, has gained permanent employment within the AWI as from 1 July 2003, and he can now become fully involved in this project, and proceed with phases 1 (installation of Pangaea), 3 & 4 above.

The elephant seals instrumented in 1999 and 2001 ranged north of Marion Island to South Africa, (near Cape Town), south to and below the Antarctic Polar Front, and east to Îles Crozet and Îles Kerguelen (Stewart & Bester 2000, 2001; Stewart et al. 2001). Two adult males (4215, 4225) hauled out at Îles Kerguelen during the 1999/2000 breeding season and at least one of them returned to Marion Island to moult in 2000 (Fig. 1). During 2002 some males visited the ~ 1000 km distant Iles Crozet to the east, and others spent time over the Zulu Seamount in the west (Fig. 2). These and the other males oriented on, and several spent most of their time foraging over, the spreading ridges in the southern Indian Ocean and South Atlantic. The foraging areas of all overlapped substantially with those of adult females documented earlier (Jonker & Bester 1998), in contrast to patterns of sexual segregation reported for southern elephant seals in the South Atlantic (Bornemann *et al.* 2000). The elephant seals from Marion Island seem to be focusing their foraging effort on prey that occur in areas of upwelling that correlate with predominant currents or current boundaries near and over spreading ridges and sub-surface plateaus. This hypothesis can only be substantiated by using correlation analyses within the PANGAEA database and information system, which has become a World Data Center last year - a rare distinction that PANGAEA shares with less than 50 working groups world wide (www.wdc-mare.org). In July 2002, 7 of the 13 Argos satellite tags deployed in April 2002 were still transmitting, one of these continuing into January 2003 (Fig. 2). The tracks of some of the instrumented animals over the approximately 2 – 12 months of tracking time at various stages of the project are depicted in Fig. 1 & 2.

The HSWRI could not participate in the 2003 Marion Takeover, and will do so during the 2004 Takeover when 6 satellite transmitters will be deployed. A poster was presented at the 4th International Symposium on Physiology and Behaviour of Wild and Zoo Animals within this collaboration by our German colleagues (Ramdohr *et al.* 2002). The two Global Positioning Satellite (GPS) receivers which were also deployed in April 2002, sponsored by Africa Wildlife Tracking, both failed. However, a new version with upgraded software has been developed, and two more have been sponsored and are to be deployed during October/November on adult female elephant seals.

References to the Report:

BORNEMANN, H., KREYSCHER, M., RAMDOHR, S., MARTIN, T., CARLINI, A.R., SELLMAN, L. & PLöTZ, J. 2000. Southern elephant seal movements and Antarctic sea ice. *Antarct. Sci.* 12: 3-15.

JONKER, F.C. & BESTER, M.N. 1998. Seasonal movements and foraging areas of adult southern female elephant seals, *Mirounga leonina*, from Marion Island. *Antarct. Sci.* 10: 21-30.

STEWART, BS & BESTER, MN. 2000. Pelagic ecology of male southern elephant seals from Marion Island. Interim Expedition Report. Joint Technical Report HSWRI and MRI, UP. 13 pp.

STEWART, BS & BESTER, MN. 2001. Foraging ecology of southern elephant seals, *Mirounga leonina*, from Marion Island, 2001-2002. Interim Expedition Report. HSWRI Technical Report 2001-315. 25 pp.

STEWART, BS, BESTER, MN, PLÖTZ, J. & RAMDOHR, S. 2002. Foraging ecology of southern elephant seals (*Mirounga leonina*) from Marion Island. Joint Technical Report, HSWRI Tech. Rep. 2002-334. 19 pp.

Data and Sample Storage:

All satellite linked information collected (hard copy and computer files) is deposited at the HSWRI and AWI, with copies to the MRI, Department of Zoology & Entomology, UP.

Acknowledgements:

The Department of Environmental Affairs & Tourism for financial and logistic support; the NRF for running expenses; the HSWRI and AWI for travel funding and capital equipment (transmitters) and their continued support to get the PANGAEA component of the project up and running; Africa Wildlife Tracking for additional transmitters.

Publications:

i) Publications:

RAMDOHR, S., PLÖTZ, J., BORNEMANN, H., SELLMAN, L., NIEDERJASPER, F., HELLMER, H., MARTIN, T., CARLINI, A. & BESTER, M.N. 2002. Movements of adult male southern elephant seals from King George Island observed by satellite telemetry. *Advances in Ethology* Vol. 37:68, Supplements to Ethology. Dehnhard, Hofer (eds) 4th International Symposium on Physiology and Behaviour of Wild and Zoo Animals.

ii) In press: None

iii) Internal reports/manuals/abstracts:

BESTER, MN 2003. Marion Island Pinniped Monitoring Manual and Workplan for 2003/2004. Typescript, MRI, Department of Zoology & Entomology, University of Pretoria. 75 pp.

Signature:
Prof M N Bester
26 June 2003

Fig.1: **Southern Elephant Seal Tracklines**

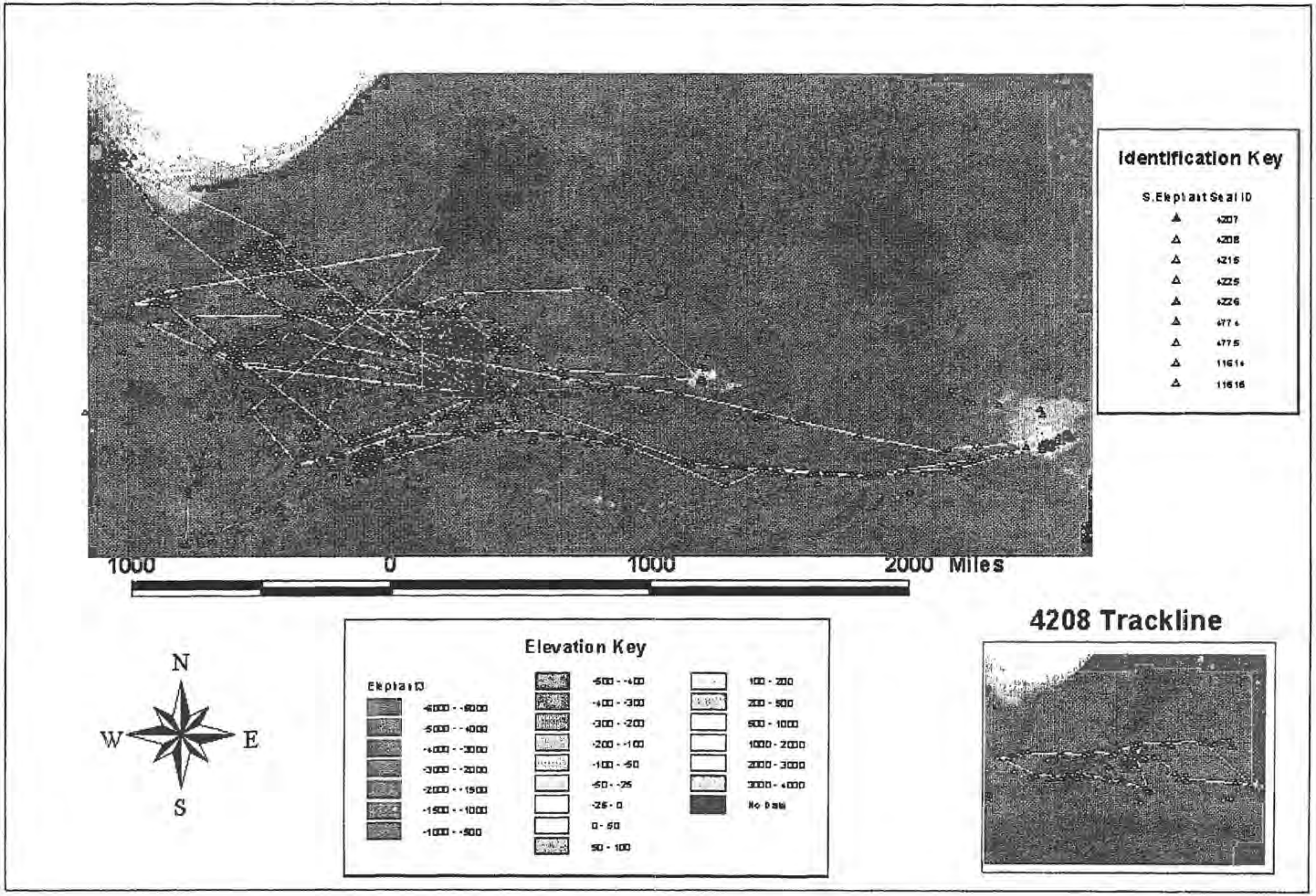
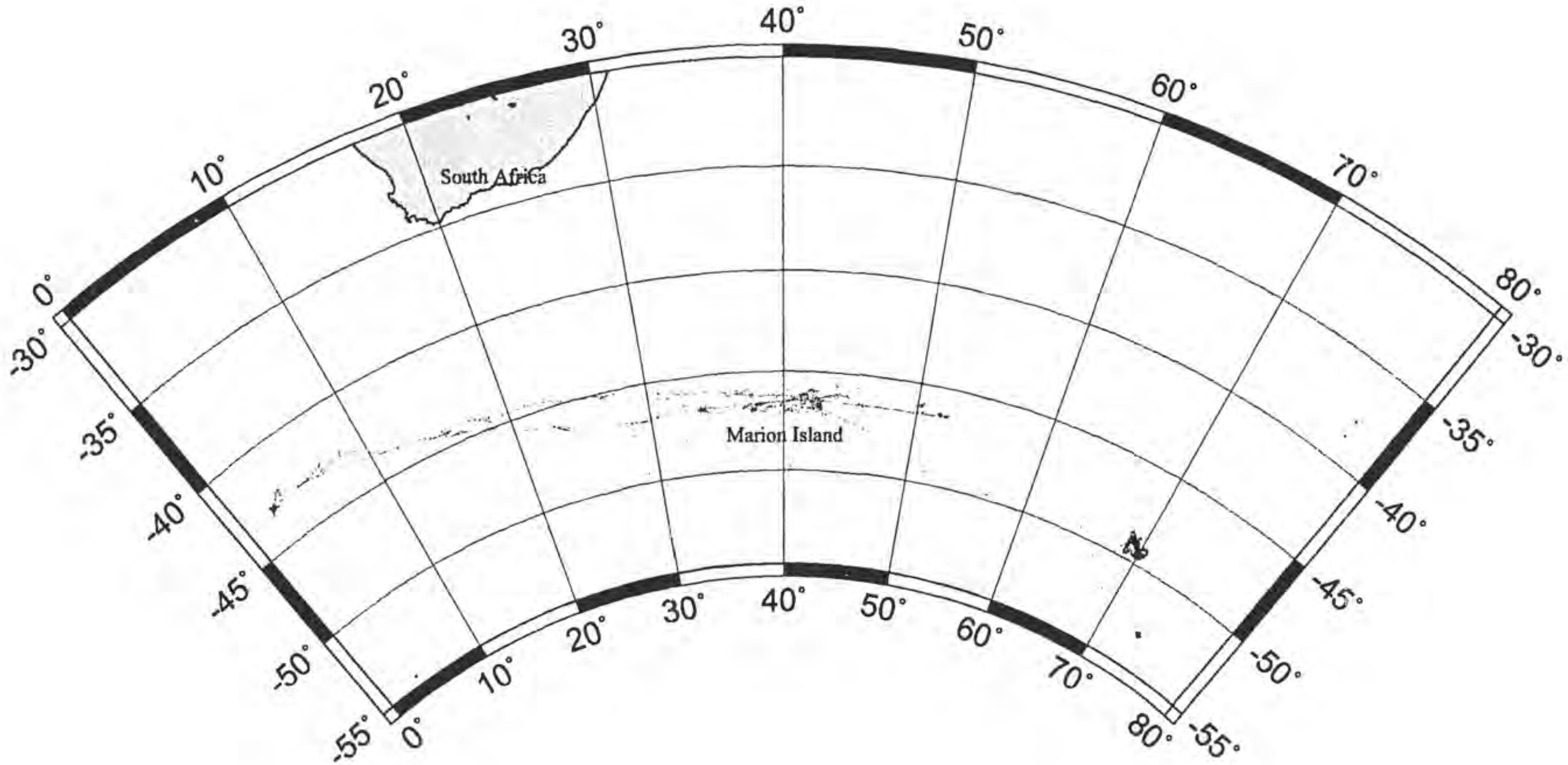


Fig 2: elephant seal tracks from April 02 - 24.Jan. 03



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SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)
DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM

INTERIM ANNUAL PROGRESS REPORT 2003

BIOCOMPLEXITY AND CHANGE: THE ROLE OF A LONG-LIVED KEYSTONE SPECIES, *A. SELAGO*

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1. TITLE OF PROJECT

BIOCOMPLEXITY AND CHANGE: THE ROLE OF A LONG-LIVED KEYSTONE SPECIES, *A. SELAGO*

1.1 DURATION OF PROJECT: 1 April 2001 TO 31 March 2004 (applied for extension to 2005)

2. RESPONSIBLE PROJECT LEADER (AND CO-LEADERS)

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4. **DATE OF REPORT:** Third Interim Progress Report, July 2002 – June 2003

(a) OBJECTIVES

The opportunities presented by Marion Island are being used to study the likely consequences of climate change on biocomplexity. Specifically, we aim to use a model, keystone plant species on the island, *A. selago* Hook f., to investigate these changes by using the altitudinal gradient over which it occurs as a climate change analogue. In addition, we aim to use manipulative experiments to alter the microclimate experienced by this plant species in accordance with climate change trends (refer to SACAR 1).

Thus, what we propose here is to examine spatial variability in the size, shape, morphology and phenology of cushions with altitude to determine how these parameters vary in response to changes in temperature and water availability. We will then use this information to show how changes in environmental conditions are likely to affect the structure of the arthropod and epiphyte communities that live in association with *A. selago*. We will also investigate the effect of environmental variation on the plant and animal communities directly (in the form of a manipulative experiment) so as to be able to apportion variance between spatial and environmental variables. Finally, we will record the size, shape and spatial arrangement of *A. selago* cushions at representative sites on the island as a start of a long-term biomonitoring programme (McGeoch 1998), to provide an indication of the effects of climate change on the terrestrial environment at Marion Island (a prerequisite of the Prince Edward Islands Management Plan, Anonymous (1996)). Our work will also provide information on mouse damage to *A. selago* cushions, a threat to this plant species in some areas that has become particularly evident over the last several years (V.R. Smith and S.L. Chown, personal observations). Finally, our work will address a key RiSCC component because *Azorella selago* has been identified as one of the focal species for this collaborative SCAR research project.
(see http://www.scar.org/).

Specific Objectives

Hypothesis 1. *Azorella selago* does not show morphological and physiological variation across the altitudinal gradient at Marion Island

Hypothesis 2. Spatial patterning of the size, shape and density of *A. selago* cushions is uniform within *A. selago* patches and across altitudes on Marion Island

Hypothesis 3. *Azorella selago* forms a sufficiently mild climate for epiphytic plants and invertebrates such that the density and community structure of the latter does not change with altitude

Hypothesis 4. Assemblage structure and species occupancy distributions are not influenced by the spatial patterns and characteristics of *A. selago* cushions

Hypothesis 5. *Azorella selago* morphology, growth rate and physiology, and the arthropod community associated with cushions, are not affected by experimental drying and shading.

(b) HISTORY OF PROJECT

This project began in January 2001 with the news from DEAT of the success of our application. During January and February 2001 the two manpower positions (one PhD and one MSc) were advertised widely in South Africa and telephonic and personal interviews were conducted with suitable candidates. A PhD candidate (Ms LA Hugo) was appointed. No suitable MSc candidate was found and the position was downgraded to field assistant because this project depends critically on having two persons concurrently in the field. Ms W. Wilkinson was appointed to the position. During March 2001 Mss Hugo and Wilkinson spent some time in the Department of Zoology and Entomology, University of Pretoria, discussing the project with the project leader, doing a literature search and receiving training on equipment usage. They also attended team training during this period. Ms C. Hanel was appointed on non-DEAT funds for the period March to May 2001 to assist with the purchase of project equipment and materials, preparation thereof for the year on the island and logistic support. M.A. McGeoch and C. Hanel participated in Marion Island voyage and takeover (3 April to 4 May 2001).

The second phase of the project began with advertising for one PhD (Marion based for 2002) and one MSc (home based) position. No suitable PhD applications were received, and Mr Nyakatya was appointed as an MSc in this position. Mr leRoux was appointed in the home-based position. Mr leRoux subsequently received an NRF prestigious scholarship and is thus not funded by SANAP, although his research project remains part of this SANAP project. The work on Marion Island by E. Hugo and W. Wilkinson continued until April 2002. MA McGeoch moved from Pretoria to Stellenbosch in October 2001, and Mr leRoux began working on his project (in preparation for the 2002 take-over) in Stellenbosch in January 2002. MA McGeoch, M. Nyakatya, P. leRoux and D. Marshall participated in the 2002 voyage to Marion Island, with Mr Nyakatya staying behind as part of the over-wintering team. Ms Wilkinson was re-appointed as field assistant on the project for the period October 2002-April 2003, and assisted Mr Nyakatya and conducted additional research for the project on the island during this period.

MA McGeoch, EA Hugo and PC leRoux took part in the 2003 voyage to Marion Island, and together with M. Nyakatya and W. Wilkinson completed the field work for this project during the takeover. PC leRoux, M.Nyakatya and EA Hugo are now registered and based at the University of Stellenbosch and in the process of completing their degrees. During the April 2003 takeover on Marion Island all data collection for hypotheses 1-5 above was completed. In May 2003 the opportunity to extend the current project by one year arose, and this opportunity was taken in the form of the application for extension accompanying this progress report (SACAR1).

Summary of financial support 2002-2003

Details	Grant amounts
Manpower	R 33 334.00
Running expenses	R 61 374.41
Capital equipment	R 22 493.36
TOTAL	R 117201.77

(c) SCIENTIFIC PROGRESS

i. Student training

Ms EA Hugo spent the last year in the first stages of preparing her PhD thesis, registering for this degree at the University of Stellenbosch in June 2002. Research for the period included identifying the arthropods in the samples taken while on the island, presenting her PhD proposal at the University, analyzing data and preparing the research results in the form of publications. She will present the first of these results at the July 2003 Conference of the Zoological Society of South Africa.

Mr PC leRoux spent this period working on his MSc thesis (registered January 2002). He presented his research at two separate conferences, submitted one research publication and published one popular article during the period (see publications and outputs). He will submit his thesis in December 2003.

Mr Nyakatya completed his year of field work on Marion Island in April 2003, and is currently in the process of developing his MSc research proposal to be presented to the University of Stellenbosch (official registration to be completed by July 2003).

ii. Establishment of field sites

Data on the 12 field sites selected during the April 2002 takeover was collected. These sites included patches of 50 *Azorella selago* cushions, chosen along altitudinal gradients at Stony Ridge, Tafelberg, Mixed Pickle and Swartkop (three patches at each locality, one in each of the following three altitudinal bands: 0-250; 250-500; 500-750 m a.s.l.). These sites have been marked and may now become **long-term ecological monitoring sites** for *A. selago* on Marion Island. The GPS localities were provided to Mr John Cooper as part of the record of permanent markers that is now being kept for the island (Appendix 1). The information available for these sites includes cushion shape, size, vitality, phenology and some microclimatic data. Arthropod community data is also now available for these sites.

The experiment to determine the effect of increased shading and decreased precipitation on *A. selago* was conducted on Skua Ridge. The experimental treatments were removed and the effects of these measured during the 2003 takeover. Data collected included the effects of treatments on temperature and moisture content of cushion plants, plant growth rate, phenology, leaf morphology and nutrient content, vitality and epiphyte load. Data on the effects of drying, warming and shading treatments on the arthropod community in cushion plants are also now available and being processed. Cushion markers have been left at this site because monitoring of the recovery of these cushions post treatment will provide vital additional information on the effects of environmental change on this species (see proposal for extension).

iii. Data collection

Primary data collection has been completed for the plant and arthropod components of the research project (all 5 hypotheses listed above). This includes the following information: GPS and theodolite locality and altitude measurements, cushion maximum and perpendicular diameters, cushion height, number of *Agrostis magellanica* grasses growing on each cushion, number and identity of other epiphytes on the cushion, % cushion with dead plant material, leaf size and trichome density. In addition to the above, more detailed phenological data, and additional morphological data (stomatal densities) have been collected. Data has also now been collected on the effects of experimental drying, warming and shading on cushion plant characteristics. Data collection on the arthropods that inhabit *A. selago* has also been completed, and includes data to examine the effect of cushion size and morphology on the invertebrate assemblage, altitudinal effects on arthropod communities as well as the effects of experimental drying, warming and shading.

iv. Preliminary results

Azorella selago

Plant species with individuals that can be aged using morphological features are potentially useful for understanding past environmental conditions. The size and growth rate of the cushion plant, *Azorella selago* Hook. (Apiaceae), were examined to determine if this species can be reliably and accurately aged using the phytometric model ('cushionometry') detailed by Frenot et al. (1993) (Fig. 1). Growth rate was found to be independent of cushion size, but was related to environmental factors and differed between sites (Figs 2, 3). As a result, the model's age estimates may be biased by habitat variables. The results of the cushionometric model, albeit in the absence of support for one assumption, estimated mean cushion age at 30 years, with some cushions estimated as older than 80 years (Table 1). Using a simulation model, the accuracy of age estimates was shown to vary with temporal variation in cushion growth rate and cushion size. Nonetheless, even a conservative approach suggested these estimates to be accurate to within 2-15 years. While further development of the cushionometric model would improve its reliability, the model remains a valuable tool for ageing plants in an environment where many related techniques cannot be applied (see Figs 1-3, Table 1).

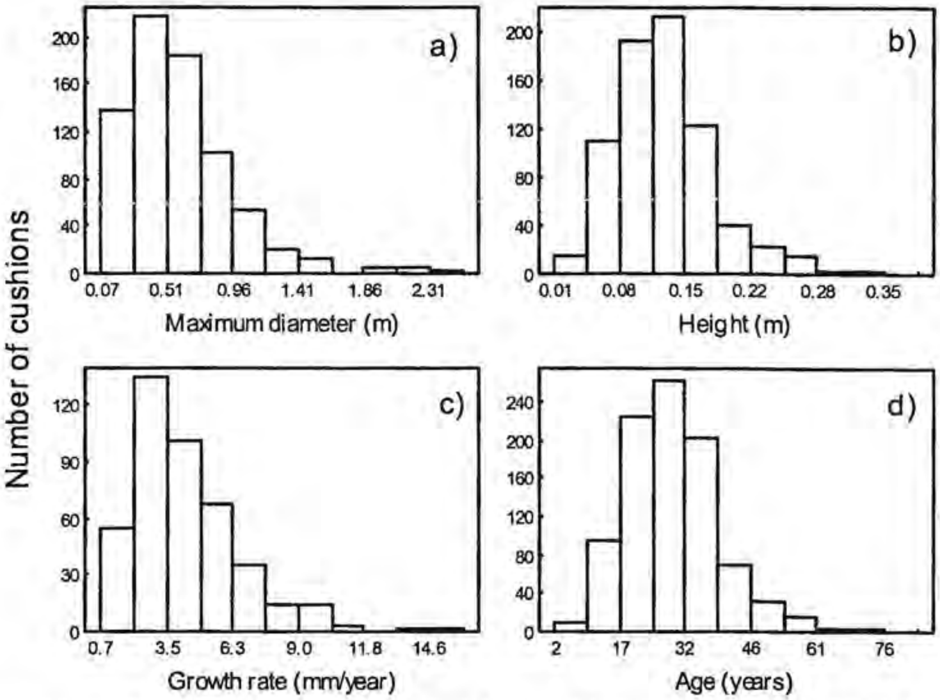

Fig. 1. Frequency distributions for *Azorella selago* cushions across all quadrats of a) maximum diameter (n = 738), b) height (n = 738), c) growth rate (n = 527), d) estimated cushion age (n = 738, using mean growth rate for each quadrat to estimate age).

Table 1. Simulated ages (mean simulated age and one standard deviation around that mean age, i.e. estimate of accuracy) for three idealised cushion heights using measured growth rate data from the six study sites.

Cushion height	Variable (years)	Quadrat SE	Quadrat NE	Quadrat W	Transect SE	Transect NE	Transect W
75 mm	Mean age	18.6	19.9	16.7	11.2	12.1	18.6
	1 S.D. around mean[1]	2.2	2.6	2.1	2.1	2.2	1.8
	2 S.D. around mean[2]	4.4	5.2	4.2	4.2	4.4	3.6
	Min. – Max.	10 - 27	11 - 30	9 - 24	4 - 18	6 - 23	11 - 27
300 mm	Mean age	72.6	77.6	64.9	42.7	45.6	72.3
	1 S.D. around mean	4.3	5.2	4.2	4.2	4.3	3.5
	2 S.D. around mean	8.6	10.4	8.4	8.4	8.6	7.0
	Min. – Max.	57 - 89	54 - 97	50 - 82	30 - 56	30 - 65	57 - 92
600 mm	Mean age	144.7	154.6	123.2	84.8	91.1	144.5
	1 S.D. around mean	6.2	7.3	6.0	6.0	6.0	4.9
	2 S.D. around mean	12.4	14.6	12.0	12.0	12.0	9.8
	Min. – Max.	121 - 172	129 - 182	106 - 150	65 - 104	70 - 116	124 – 168

[1] Approximately 68 % of simulated cushion ages fall within the mean age ± 1 S.D.
[2] Approximately 95 % of simulated cushion ages fall within the mean age ± 2 S.D.

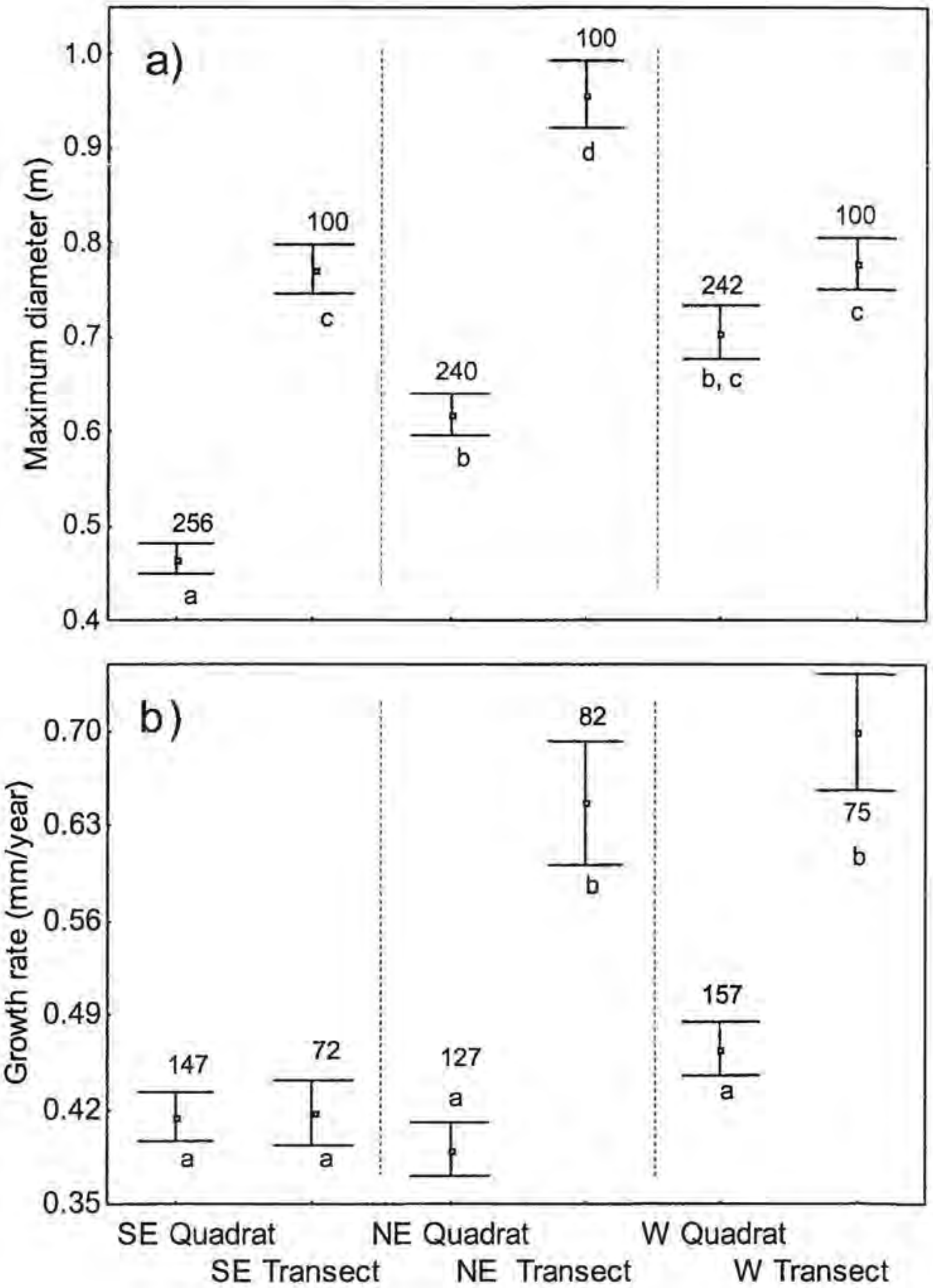

Fig. 2. Mean (± S.E.) a) maximum diameter and b) growth rate of *Azorella selago* cushions sampled at each site. Number above whiskers indicates sample size. Sites not sharing a letter (below whiskers) were significantly different at $p < 0.05$.

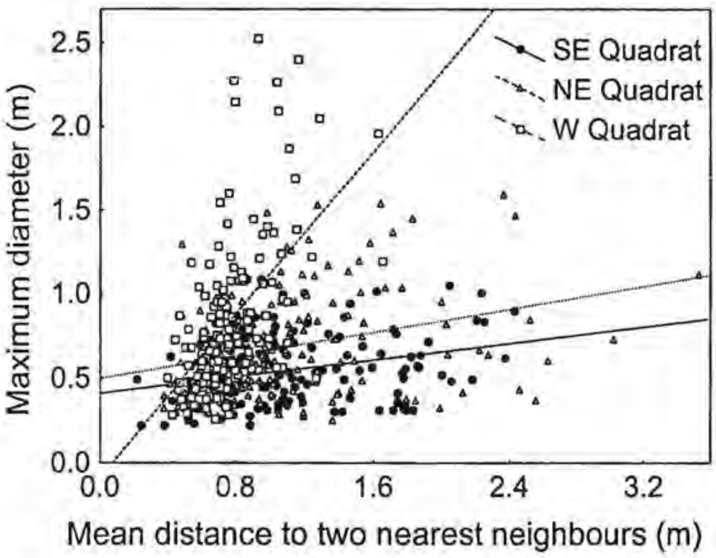

Fig. 3. Relationships between *Azorella selago* cushion maximum diameter and distance to its two nearest neighbours for each quadrat (simple linear regression lines fitted for illustration, see Table 2 for full model results).

Arthopods associated with *Azorella selago*

A. selago cushions have previously been shown to harbour 19 times the density of mites (Acari) and springtails (Collembola) than the surrounding fellfield, and may thus be considered favourable habitat for arthropods in the harsh fellfield environment. The effect of cushion characteristics on the structure of arthropod assemblage within them has, however, never been examined. The objectives of this study were thus (1) to determine if mite and springtail assemblage structure is affected by *A. selago* cushion size and density, (2) to examine patterns of within-plant variability in these assemblages, and (3) to assess the impact of epiphyte load (i.e. number of *Agrostis magellanica* (Poaceae) individuals growing epiphytically on the cushion) on arthropod assemblage structure. Within-cushion invertebrate distribution was assessed by taking multiple cores from individual cushions. Although there was no relationship between either cushion size or density and species richness and abundance, some individual species were more abundant in larger, less isolated cushions (Table 2). Within cushions, there was a general tendency for mite and springtail abundance to be higher on the leeward side of the cushion (Table 3). Total abundances were also higher in cushions covered by high densities of epiphytes (Fig. 4). These results suggest that mites and springtails actively disperse between *A. selago* cushions in fellfield, and that cushions provide not only nutrients but also act as a buffer against cold, windy fellfield conditions.

Table 2. Species richness (S) and abundance (N) of mesoarthropods (mean ± standard error) in different cushion size classes (small, medium, medium-large and large) on Skua Ridge and Stony Ridge (n = 10).

Site and cushion size	Mean S ± SE	Mean N ± SE
Skua Ridge		
Small	14.6 ± 0.65	213.6 ± 26.08
Medium	14.4 ± 0.69	253.0 ± 33.69
Medium large	16.2 ± 0.68	276.6 ± 29.77
Large	15.5 ± 0.70	199.5 ± 21.86
Stony Ridge		
Small	12.2 ± 0.61	132.4 ± 10.62
Medium	13.0 ± 0.72	159.4 ± 9.88
Medium large	12.2 ± 0.53	141.2 ± 11.85
Large	11.1 ± 0.62	149.8 ± 21.12

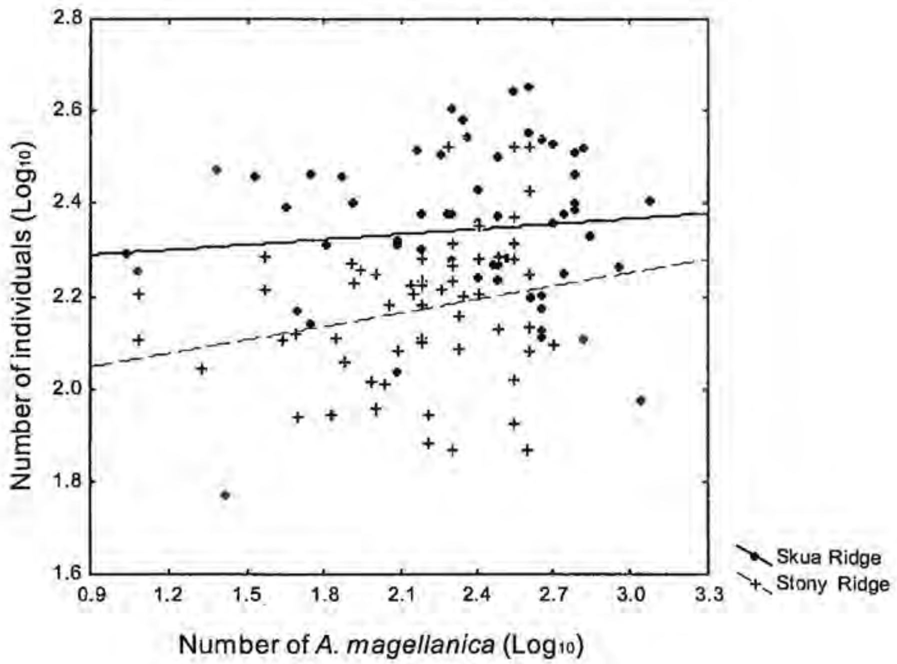

Fig. 4. Relationship between the number of *A. magellanica* individuals and total abundance of mesoarthropod on Skua and Stony Ridges.

Table 3. Species richness (S) and abundance (N) of mesoarthropods in different positions (directions) in cushions on Skua Ridge and Stony Ridge (mean ± standard error). Different letters (superscript) indicate a significance of $p<0.05$. ($n = 10$)

Site	Position/direction	Mean S ± SE	Mean N ± SE
Skua Ridge	East	15.20 ± 1.76^{a}	276.3 ± 36.53^{a}
	South	16.40 ± 1.25^{a}	275.2 ± 39.49^{ab}
	Centre	15.40 ± 0.60^{a}	236.3 ± 16.26^{b}
	North	14.50 ± 0.83^{a}	221.00 ± 24.52^{b}
	West	13.70 ± 1.86^{a}	179.50 ± 22.85^{b}
Stony Ridge	South	15.10 ± 0.48^{a}	247.10 ± 24.36^{a}
	West	14.00 ± 0.60^{a}	195.60 ± 20.54^{ab}
	East	14.00 ± 0.78^{a}	192.90 ± 25.79^{abc}
	Centre	13.75 ± 0.60^{a}	182.90 ± 17.22^{bc}
	North	13.80 ± 0.81^{a}	166.00 ± 19.66^{c}

(d) DATA AND SAMPLE STORAGE

i. Biological material

All biological material collected up until 01 May 2003 has been returned to South Africa, and resides in the Department of Conservation Ecology, University of Stellenbosch. The invertebrates sampled are stored in 90% ethanol in labelled glass vials (sample no. and locality). Some of this material will be used to supplement the permanent reference collection of Collembola and mites for Marion Island in the possession of S.L. Chown. The plant material is in the form of leaves pressed onto cards and is housed at the same address. Soil and leaf material for determining nutrient status were also returned from the Island and await processing and analysis. A reference collection of mite and collembola material collected from each site is being prepared and will be housed in the Department of Conservation Ecology, University of Stellenbosch. A reference collection of digital *Azorella selago* cushion plant and leaf photographic images is also being prepared in electronic format and will also be housed at the above address.

ii. Electronic data storage

GPS and Nikon 300DTM TotalStation locality records have been downloaded and stored electronically, as have all biological data collected to date. This data is stored in electronic and hard copy format in the Department of Conservation Ecology, University of Stellenbosch. All plant and arthropod data are available in electronic form with the exception of those still being processed in the laboratory.

(e) ACKNOWLEDGEMENTS

We thank Mr Joos Esterhuizen (Town and Regional Planning, University of Pretoria) for the loan of equipment for use on Marion Island.

(f) PUBLICATIONS and OUTPUTS TO DATE (*current reporting period)

Scientific

Publications

1. Chown, S.L., McGeoch, M.A. & Marshall, D.J. 2002. Diversity and conservation of invertebrates on the sub-Antarctic Prince Edward Islands. *African Entomology Special Issue: Arthropod Diversity and Conservation in Southern Africa* 10, 67-82.

*2. (submitted) leRoux, P.C. & McGeoch, M.A. Evaluation of the efficacy of *Azorella selago* (Apiaceae) for ageing landscapes. *Arctic, Alpine & Antarctic Research.*

Conference proceedings and invited lectures (national and international)

1. Chown, S.L., Marshall, D.J. & McGeoch, M.A. 2001. Diversity and conservation of invertebrates at the Prince Edward Islands. *Proceedings of the Thirteenth Congress of the Entomological Society of southern Africa*, 2-5 July 2001, Pietermaritzburg. P. 13.

2. McGeoch, M.A., Chown, S.L. & Hugo, E.A. 2001. Variability in the spatial distribution and morphology of *Azorella selago* (Apiaceae) patches on Marion Island. *VIII Scar International Biology Symposium, Antarctic Biology in a Global Context.* Vrije Universiteit Amsterdam, 27 August – 1 September 2001, S5P13.

*3. Le Roux, P.C. & McGeoch, M.A. 2003. Spatial variability in the size and growth rate of *Azorella selago* Hook. (Apiaceae) on sub-Antarctic Marion island: Phytometric implications. *Abstracts of the Joint Conference of South African Association of Botanists and International Society for Ethnopharmacology*, Pretoria 7-11 January, p. 49.

*4. Le Roux, P.C. & McGeoch, M.A. 2003. Spatial variation in the size and growth rate of *Azorella selago* Hook. (Apiaceae) across sub-Antarctic Marion Island. Handbook of the 2nd joint meeting of the Ecological Society of Australia and the New Zealand Ecological Society, Cairns, 1-6 December, p. 92.

*5. McGeoch, M.A. 2003. Invertebrates and climate change: is it possible to identify species predisposed to threat? IUCN Climate Change Workshop, Zoological Society of London, 15-17 January. (Invited Lecture)

Informal presentations

1. McGeoch, M.A. 2002. Biocomplexity and change: the role of a long-lived, keystone species, *Azorella selago*. Talk presented to Scientists on SA Agulhas on Voyage 101 to Marion Island, April 2002.
*2. McGeoch, M.A. 2002. Biocomplexity and change: the role of a long-lived, keystone species, *Azorella selago*. Talk presented to Scientists on SA Agulhas on Voyage 109 to Marion Island, April 2003.

Popular communications

1. Radio appearance: Participation as Project Leader in South African National Antarctic Programme and research on Prince Edward Islands. SAFm, PM Live, Friday 9 March 2001.
2. Nikon Worldwide Newsletter 11 June 2001: Marion Island Research Project.
3. Tukkievaria: University of Pretoria Staff Newsletter 18 (11) 18 June 2001: Young researchers do vital work in Antarctica, p. 3.
*4. McGeoch, M.A., Smith, V.R., le Roux, P.C. & Hänel, C. 2002. Cushion Islands of the sub-Antarctic: A plant at home in an inhospitable climate. *Veld & Flora* 88, 159-161.

Student award

*P. C. le Roux received the Hannes van Staden Prize for 2nd Best Oral Presentation by an M.Sc. student at the 2003 *Joint Conference of South African Association of Botanists and International Society for Ethnopharmacology*, Pretoria 7-11 January. This award was received for his paper on Spatial variability in the size and growth rate of *Azorella selago* Hook. (Apiaceae) on sub-Antarctic Marion Island: Phytometric implications.

(g) SIGNATURE

Melodie McGeoch

24 June 2003

Project leader: Prof. M. A. McGeoch | Date

Appendix 1. LONG-TERM STUDY SITES WITH FIELD MARKERS, APRIL 2003

Biocomplexity and Change Project

Project leader: Prof M.A. McGeoch (mcgeoch@sun.ac.za)

Site markers: Four dowel sticks with red reflective tape at each site (marking each corner of the plot), and numbered metal tags in some *Azorella selago* cushions at these sites.

Mixed Pickle Cove

MP –	H	46° 53.83'S, 37° 39.266' E	@ 597 m asl
	M	46° 53.211'S, 37° 38.860' E	@ 375 m asl
	L	46° 52.574'S, 37° 38.548' E	@ 210 m asl

Swartkop Point

SK -	H	46° 56.203'S, 37° 37.52' E	@ 566 m asl
	M	46° 55.820'S, 37° 37.222' E	@ 415 m asl
	L	46° 55.795'S, 37° 36.481' E	@ 218 m asl

Tafelberg

TL -	H	46° 53.676'S, 37° 47.290' E	@ 576 m asl
	M	46° 53.267'S, 37° 48.116' E	@ 360 m asl
	L	46° 52.750'S, 37° 49.649' E	@ 176 m asl

Stony Ridge

SL -	H	46° 54.060'S, 37° 47.971' E	@ 593 m asl
	M	46° 54.607'S, 37° 49.054' E	@ 366 m asl
	L	46° 54.928'S, 37° 51.440' E	@ 163 m asl

Skua Ridge

46° 52.061'S, 37° 50.317'E @106 m a.s.l.

Doc 4.4

INTERIM PROGRESS REPORT, JUNE 2003

Project Title

MONITORING SEABIRDS AT MARION ISLAND

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Project Researchers

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Date of Report

Interim progress report, July 2002 – June 2003

(a) Objectives

To monitor populations of seabirds at Marion Island in order to:

1) contribute to the CCAMLR Working Group on Ecosystem Monitoring and Management (WG-EMM);
2) contribute to the Agreement on the Conservation of Albatrosses and Petrels of the Southern Hemisphere (ACAP);
3) assess trends in the populations of selected species;
4) obtain selected demographic parameters for selected species.

(b) History of the Project

In 1994/95, a programme was implemented at Marion Island to monitor aspects of the biology of Gentoo Penguins and Macaroni Penguins, so as to contribute to the monitoring programme of CCAMLR (the Commission for the Conservation of Antarctic Marine Living Resources). Additionally, the population sizes of all surface-nesting seabirds breeding at Marion Island were established. Of the 29 seabird species that breed at the Prince Edward Islands (all except the Indian Yellow-nosed Albatross are thought to breed at Marion Island), 15 were subsequently listed in *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. Hence, monitoring of seabird populations at Marion Island is considered a high priority.

(c) Scientific Progress

Objective 1) contribute to the CCAMLR Working Group on Ecosystem Monitoring and Management (WG-EMM)

Information on the breeding chronology of Gentoo Penguins has been collected for eight seasons (1994 to 2001), of Macaroni Penguins for five seasons (1994/95 to 1996/97; 1998/99 to 1999/2000) and of Rockhopper Penguins for one season (1994/95). This includes data on dates of arrival of adults at colonies, laying of eggs, hatching, crèching and fledging of chicks. This information is important for planning and interpreting population counts. The timing of breeding may be influenced by environmental conditions and may influence breeding success, which can best be ascertained from a time series of information. For example, for Gentoo Penguins laying was about three weeks later in 1997, during the large ENSO event of 1997/98, than in any other season. This led to almost total reproductive failure because chicks were small at the time of return of Subantarctic Skuas.

Breeding success of Gentoo, Macaroni and Rockhopper Penguins was measured in each season from 1994/95 to 2002/03.

Mass at arrival at breeding colonies of male and female Macaroni and Rockhopper Penguins, and at fledging of chicks of these two penguin species and Gentoo Penguins were measured in each season from 1994/95 to 2002/03. Diet samples were obtained for Macaroni and Rockhopper Penguins in each of the eight breeding seasons from 1994/95 to 2001/02, for Macaroni Penguins additionally in 2002/03 and for Gentoo Penguins from 1994/95-1996/97.

Objective 2) contribute to the Agreement on the Conservation of Albatrosses and Petrels of the Southern Hemisphere (ACAP)

Albatrosses, giant petrels and various other species of petrel and shearwater are susceptible to mortality through interactions with fishing fleets operating both around and distant from their breeding localities. Wandering, Grey-headed, Dark-mantled Sooty and Light-mantled Sooty Albatrosses are counted annually to ascertain their populations. Light-mantled Albatrosses breed inland, as well as around the coast. In most years only the coastal population has been counted, but in 2001 and 2002 the entire population was counted. Wandering Albatross and Grey-headed Albatross are counted three times per year, once when on eggs, once when eggs have hatched and again when there are large chicks. Breeding success is monitored at three colonies of Wandering Albatross and at three sections of the colony of Grey-headed Albatross at Grey-headed Albatross Ridge. Adults and chicks are banded with unique colour bands.

Breeding success of White-chinned Petrels is monitored at 68 nest sites close to the Base. Adults and chicks are banded with unique colour bands.

Southern Giant Petrel colonies are counted annually while those for Northern Giant Petrel are counted every other year. This is so because Southern Giant Petrels breed colonially while the other breeds solitarily. Breeding success of Northern Giant Petrels is monitored in an area from Duiker's Point to East Cape and inland to Fred's Hill and Junior's Kop. Adults and chicks are banded with unique colour bands.

Nests of all species are checked for pollutants, more especially for debris associated with fisheries.

Objective 3) establish trends in the populations of species

Estimates have been made of the breeding populations, and trends in these, for all surface-breeding seabirds at the Prince Edward Islands (King Penguin, Gentoo Penguin, Macaroni Penguin, Eastern Rockhopper Penguin, Northern Giant Petrel, Southern Giant Petrel, Wandering Albatross, Grey-headed Albatross, Yellow-nosed Albatross, Dark-mantled Sooty Albatross, Light-mantled Sooty Albatross, Crozet Shag, Subantarctic Skua, Kelp Gull, Antarctic Tern and Kerguelen Tern). In addition, the adult population of Lesser Sheathbill is counted annually in winter at Marion Island. This species nests in cavities and therefore would result in an undercount if done when breeding.

Disconcertingly, populations of nine of the surface-breeding seabirds have decreased in the past decade; populations of two other species also may have decreased and that of Kerguelen Tern remains small (Table 1).

Measurements of densities of nests of burrowing seabirds have been undertaken at sites where measurements were also undertaken in 1979/80 (Schramm 1986, *Polar Biology* 6: 63-70). This has provided information on changes in abundance of Salvin's Prion and Blue Petrel (combined) and Great-winged Petrel. Indices of abundance for eight other species of seabird that nest in burrows at Marion Island are being obtained through making night-time observations of birds returning to the island. These observations started in 1995 and are continuing.

The burrowing bird seen most often during the eight years of observations was Salvin's Prion followed by Great-winged Petrel. In all 17 638 individuals representing 13 species of burrowing seabird were identified during a total of 407 hours of observations. Additionally, 19 701 birds that were not identified to species level were recorded during observations. Because many of the seabirds at Marion Island have distinct seasonal patterns of occurrence there, the indices will need to account for such seasonality.

Objective 4) identify life stages of species that are influencing population trends and where conservation action should be applied

Two approaches are useful to understanding the poor performance of seabird populations, and introducing remedial measures to rectify the situation. One is an expert systems approach. An informal application of this approach is to utilize the opinion of experts. An example relevant to Marion Island is the viewpoint that disturbance during the annual take-over is causing some Gentoo Penguins to delay breeding, and that this is reducing their breeding success. Attempts were made to investigate this viewpoint during the 1998 and 1999 take-overs, through conducting observations at colonies close to and remote from base. Observations were made of the times at which birds arrived at and departed from colonies, of their activities at colonies, and of their reaction to disturbance such as the presence of humans and flights of helicopters. Additionally, the modal dates of laying at colonies that are subject to varying degrees of disturbance during take-over were established.

A second approach is to establish demographic parameters for species that will enable models of seabird populations to be constructed. It then becomes possible to investigate the extent to which parameters must be altered to obtain desired population trends. For seabirds, important demographic parameters are reproductive success (usually number of chicks fledged per breeding pair per year), immature survival, adult survival, age at first breeding and breeding frequency. Estimating these parameters often involves monitoring over several years.

One of the easier parameters to obtain is breeding success. This has been measured for Gentoo Penguins, Macaroni Penguins, Rockhopper Penguins (see objective 1), Wandering Albatrosses, Grey-headed Albatrosses, Northern Giant Petrels, Southern Giant Petrels, White-chinned Petrels, Great-winged Petrels and Crozet Shags. Colour-banding of chicks of Crozet Shags has been undertaken to establish the age at first breeding of this species (three years). Age at first breeding has also been established (using banding) for Macaroni

Penguins (three years). Survival of Crozet Shag adults has been shown to be maximally 85% per annum.

Modelling, often incorporating parameters measured at other breeding localities, has shown that decreases of Gentoo Penguins, Macaroni Penguins, Rockhopper Penguins and Crozet Shags are largely driven by inadequate breeding success. This is most plausibly attributed to a reduced availability of prey and thought to have resulted from climate change. Increased surface air and sea temperatures at the island have been shown (SMITH, V. R. 2002 – Climate change in the sub-Antarctic: an illustration from Marion Island. *Climatic Change* **52**: 345-357; MÉLICE, J-L., LUTJEHARMS, J. R. E., ROUALT, M., GOOSSE, H., FICHEFET, T. and C. J. C. REASON in press – Evidence for the Antarctic Circumpolar Wave in the Subantarctic during the past 50 years. *Geophys. Res. Letters*).

(e) Publications

COOPER, J., BATTAM, H., LOVES, C. MILBURN, P. J. and L. E. SMITH 2003 – The oldest known banded wandering albatross *Diomedea exulans* at the Prince Edward Islands. *Afr. J. mar. Sci.* **25**:

COOPER, J. and H. WEIMERSKIRCH 2003 – Exchange of wandering albatrosses *Diomedea exulans* between the Prince Edward and Crozet islands: implications for conservation. *Afr. J. mar. Sci.* **25**:

CRAWFORD, R. J. M. and J. COOPER 2003 – Conserving surface-nesting seabirds at the Prince Edward Islands: the roles of research, monitoring and legislation. *Afr. J. mar. Sci.* **25**:

CRAWFORD, R. J. M., COOPER, J. and B. M. DYER 2003a – Population, breeding and diet of the macaroni penguin *Eudyptes chrysolophus* at Marion Island, 1994/95-2002/03. *Afr. J. mar. Sci.* **25**:

CRAWFORD, R. J. M., COOPER, J., DYER, B. M., GREYLING, M. D., KLAGES, N. T. W., NEL, D. C., NEL, J. L., PETERSEN, S. L. and A. C. WOLFAARDT 2003b – Decrease in numbers of the eastern rockhopper penguin *Eudyptes chrysocome filholi* at Marion Island, 1994/95-2002/03. *Afr. J. mar. Sci.* **25**:

CRAWFORD, R. J. M., COOPER, J., DYER, B. M., GREYLING, M. D., KLAGES, N. T. W., RYAN, P. G., PETERSEN, S. L., UNDERHILL, L. G., UPFOLD, L., WILKINSON, W., DE VILLIERS, M. S., DU PLESSIS, S., DU TOIT, M., LESHORO, T. M., MAKHADO, A. B., MASON, M., MERKLE, D., TSHINGANA, D., WARD, V. L. and P. A. WHITTINGTON 2003c – Populations of surface-nesting seabirds at Marion Island, 1994-2002. *Afr. J. mar. Sci.* **25**:

CRAWFORD, R. J. M., COOPER. J., DU TOIT, M., GREYLING, M. D., HANISE, B., HOLNESS, C. L., KEITH, D. G., NEL, J. L., PETERSEN, S. L., SPENCER, K., TSHINGANA, D. and A. C. WOLFAARDT 2003d - Population and breeding of the gentoo penguin *Pygoscelis papua* at Marion Island, 1994-2002. *Afr. J. mar. Sci.* **25**:

CRAWFORD, R. J. M., COOPER, J., DYER, B. M., WOLFAARDT, A. C., TSHINGANA, D., SPENCER, K., PETERSEN, S. L, NEL, J. L., KEITH, D. G., HOLNESS, C. L., HANISE, B., GREYLING, M. D. and M. DU TOIT 2003f - Population, breeding, diet and conservation of the Crozet shag *Phalacrocorax [atriceps] melanogenis* at Marion Island, 1994/95-2002/03. *Afr. J. mar. Sci.* **25**:

CRAWFORD, R. J. M., DUNCOMBE RAE, C. M., NEL, D. C. and J. COOPER 2003e – Unusual breeding by seabirds at Marion Island during 1997/98. *Afr. J. mar. Sci.* **25**:

SCHULTZ, A. and S. L. PETERSEN 2003 - Absence of haematozoa in breeding macaroni *Eudyptes chrysolophus* and rockhopper *E. chrysocome* penguins at Marion Island. *Afr. J. mar. Sci*. **25**:

UNDERHILL, L. G., PETERSEN, S. L. and J. COOPER 2003 – Nest densities of the Wandering Albatross *Diomedea exulans* at the Prince Edward Islands, estimated using GPS. *Afr. J. mar. Sci* **25**:

(f) Acknowledgements

Marine and Coastal Management provided funding for the project to continue in 2002/03. We are grateful to all who assisted with collection of information and subsequent analysis of data, especially J. Cooper.

(g) Signature(s)
R. J. M. Crawford

.... Date 22/07/2003

Table 1. Estimates of the population (pairs) of surface-nesting seabirds at Marion Island and Prince Edward Island in 2001/02 and their contributions to the world populations of these species. The International (BirdLife International 2000) and South African (Barnes 2000) classifications of conservation status are indicated, as well as the trend over the most recent decade (1992/93-2002/03): D – decreasing; I – increasing; S - stable

	Marion Island	Prince Edward Island	Combined annual breeding population	World annual breeding population	Source	Proportion of world population	Status Birdlife International	Status South Africa	Trend 1992/93 - 2002/03
King penguin	218000	3000	221000	1650000	a	0.13			S/I
Gentoo penguin	844	475	1319	317000	a	0.00	Near-threatened	Near-threatened	D
Macaroni penguin	363000	9000	372000	9000000	a	0.04	Vulnerable	Near-threatened	D
Eastern rockhopper penguin	67000	45000	112000	665000	a	0.17	Vulnerable	Near-threatened	D
Wandering albatross	1869	1850	3719	8500	b	0.44	Vulnerable	Vulnerable	S
Grey-headed albatross	6229	3000	9229	92300	b	0.10	Vulnerable	Vulnerable	S
Indian yellow-nosed albatross	0	7500	7500	36500	b	0.21	Vulnerable	Vulnerable	S
Dark-mantled sooty albatross	564	1000	1564	15655	b	0.10	Vulnerable	Near-threatened	D
Light-mantled sooty albatross	179	150	329	21600	b	0.02	Near-threatened	Near-threatened	D
Northern giant petrel	295	300	595	11500	c	0.05	Near-threatened	Near-threatened	S/D
Southern giant petrel	1430	1400	2830	31000	c	0.09	Vulnerable	Near-threatened	D
Crozet shag	344	50	394	1200	d	0.33		Vulnerable	D
Subantarctic skua	546	250	796	7500	e	0.11			D
Kelp gull	24	30	54	> 1000000	e	0.00			D
Antarctic tern	6	< 5	< 15	42000	e	0.00			S/D
Kerguelen tern	19	< 5	ca 60	2000	e	0.03	Near-threatened	Endangered	S

a Ellis *et al.* (1998) modified for Prince Edward Islands
b Gales (1998)
c BirdLife International (2000)
d Jouventin *et al.* (1984), Crawford *et al.* (in press)
e Higgins and Davies (1996), Delany and Scott (2002)

BARNES, K. N. (Ed.) 2000 – *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. Johannesburg; BirdLife South Africa.

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CRAWFORD, R. J. M., COOPER, J., DYER, B. M., WOLFAARDT, A. C., TSHINGANA, D., SPENCER, K., PETERSEN, S. L, NEL, J. L., KEITH, D. G., HOLNESS, C. L., HANISE, B., GREYLING, M. D. and M. DU TOIT in press - Population, breeding, diet and conservation of Crozet shags *Phalacrocorax melanogenis* at Marion Island, 1994-2002. *Afr. J. mar. Sci.* **25**:

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GALES, R. 1998 – Albatross populations: status and threats. In *Albatross Biology and Conservation*. Robertson, G. and R. Gales (Eds). Chipping Norton, Australia; Surrey Beatty: 20-45.

HIGGINS, P. J. and S. J. J. F. DAVIES 1996 – *Handbook of Australian, New Zealand and Antarctic Birds. Volume 3. Snipe to Pigeons*. Melbourne; Oxford University Press.

JOUVENTIN, P., STAHL, J-C., WEIMERSKIRCH, H. and J. L. MOUGIN 1984 – The seabirds of the French subantarctic islands & Adelie Land, their status and conservation. *ICBP Technical Publication* 2: 609-625.

Doc 4.5

SANAP INTERIM PROGRESS REPORT

PROJECT TITLE:

Threats to biodiversity and ecosystem functioning at the Prince Edward Islands: developing a conservation strategy for endemic and keystone insect species

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DATE OF REPORT

Third Interim Progress Report, June 2002 - June 2003 *viridis* from Heard Island will be genetically characterized so as to obtain reasonable indications of the evolutionary differences between populations. Material for the afore-mentioned species has already been made available. Phylogenetic analyses will be performed as described in hypothesis 1, the results of which will assist in future conservation management strategies.

Some of this material is already available and was collected by previous studies as part of the general collection procedures. The material is stored in the collection of S.L. Chown or at the National Collection of Insects, Pretoria.

Hypothesis 3. The populations of the two *Ectemnorhinus* species found on Marion Island and Prince Edward Island are not sufficiently distinct genetically for them to be managed independently.

This hypothesis is similar to the previous one. To complete the work here, the collections will have to be made on Prince Edward Island. Some of this material was collected as part of the qualitative invertebrate survey undertaken by A.G.A. Gabriel and J. Barendse in 2000 for the project run at that time by the co-project leader. Given the usefulness of CO I and CO II gene sequences for evolutionary studies from intraspecific phylogenies up to higher evolutionary levels, the molecular characterization and analyses will be performed in an identical manner to that outlined above. In this phase of the study, all of the information will be combined.

Hypothesis 4. There has been no consistent change in the population densities of the *Ectemnorhinus* species and the *Pringleophaga* species on Marion Island.

In 1975/6, 1983-1985, 1986-1988, 1991-1993, and from 1996-2000, numerous density estimates of these species were made in a variety of contexts. To date there has been no attempt to compile these data and analyze them in such a way as to determine just how significant the impact of mice has been on populations of these species. We intend to compile these data and to investigate whether there are significant differences in the densities of each species between years and whether there is any trend detectable. As part of a pilot study we have already secured the original invertebrate density data collected by Alan Burger in the mid-1970s. We intend to secure the original data of all of the other authors mentioned here. These data will then be subject to standard statistical analyses (mostly Generalized Linear Modelling) taking year, habitat and collector into account.

rates to provide a first approximation of the likely effects of such changes on ecosystem functioning.

(b) History of the Project

This project commenced in April 2001. The first 3 months, reported on in the first interim report detailed the insect sampling carried out during the 2001 relief period and the approaches that were to be followed with respect to the genetic and morphological analyses. The second progress report dealt with the development and application of molecular methods for characterising the six weevil species on Marion Island. Emphasis was placed on discerning the genetic relationships of the two *Ectemnorhinus* species previously distinguished on the basis of size and feeding preferences. Phylogenetic analysis of the COI gene sequences generated for weevils representative of the size and feeding diversity within this genus on the island indicated that there was no genetic support for the two species presently recognised. Instead a genetically diverse species-complex exists. The morphometric component of the study was aimed at reducing the number of measurements, without compromising on informational content. By economising on measurements, the sample size can be increased. A summary of the progress made in the 12 months since this 2nd report, is detailed below.

Project Funding to Date

Category	2001/2	2002/3	2003/4
Human resources costs	R80 000	R80 000	R80 000
Running expenses	R93 590	R100 900	R110 955
Capital equipment	-	-	-
TOTAL	**173 590**	**R180 900**	**R190 955**

Initially, the same 23 measurements were considered for the present study. However, it has been shown that after the assessment of linear dependence (redundancy) and colinearity, sets of many quantitative measurements can be reduced and still contain equivalent information (Chimimba & Dippenaar 1995). Consequently, the 23 linear measurements were subjected to a series of cluster analyses and ordination procedures in order partition redundant and colinear measurements. Various criteria developed by Chimimba & Dippenaar (1995) were used as guidelines for the subsequent removal of redundancy and the selection of a final set of 13 measurements. While reducing the number of measurements for subsequent recording, these analyses permitted an adequate representation of the phenotype, consistent with the concept of morphological integration. In addition, these analyses allowed the assessment of sexual dimorphism.

[3] Genetic analysis

This study represents the first attempt at genetic characterisation of PEI weevil and moth species. The taxonomy of the *Ectemnorhinus* genus within and between islands of the PEI archipelago is unclear but molecular markers are powerful tools, not only for clarifying taxonomic status but also for determining patterns of colonization of islands by beetles and for determining the relative ages of weevils and the islands they inhabit (Juan et al. 1995; Sequeira et al. 2000). The cytochrome oxidase I gene of the mitochondrial DNA (mtDNA genome) revealed the presence of a single *Ectemnorhinus* specie on Marion Island, but did not address the effects of predation (2nd interim report). Sampling from mice-free localities on Marion Island and altitudinal sampling from Prince Edward in 2003, makes it possible to address hypotheses 2 and 3.

3.1 Materials & Methods

3.1.1 Genetic characterisation of moths

Attempts to amplify the COI gene of *Pringleophaga* specimens with universal insect primers (Simon et al, 1994) proved unsuccessful. This is presumably due to primer-binding failure as the quality and integrity of the DNA extracted has been confirmed. The complete failure to amplify COI indicates that *Pringleophaga* probably differs markedly at its COI gene compared to other

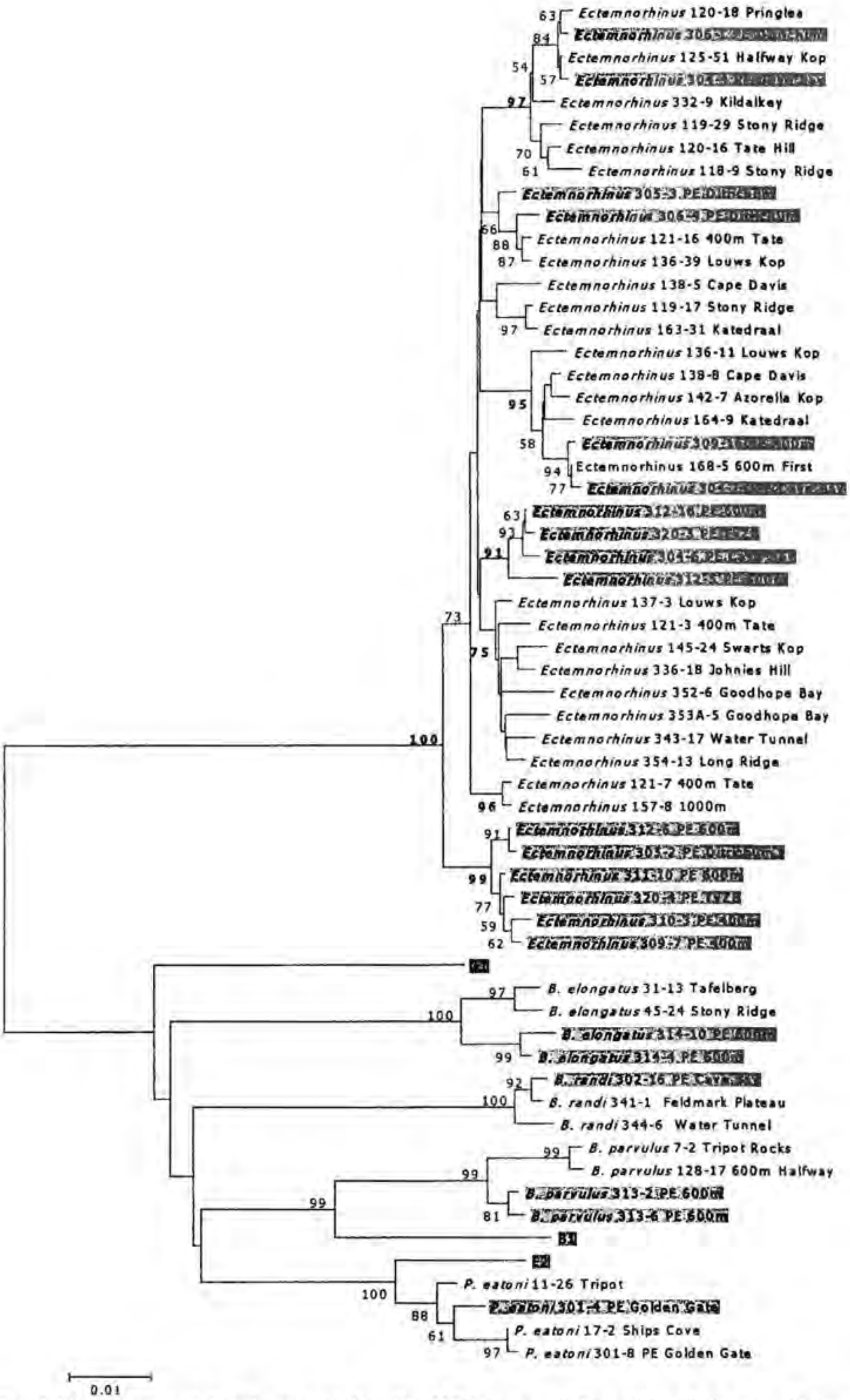

Fig. 1 Miminum evolution tree depicting the CO I gene relationships of six weevil species from Marion Island (indicated in yellow) and from Prince Edward Island (indicated in green). For each taxon, the species name is followed by the individual identity number and the sampling locality (vegetation type / altitude / name) is indicated last. Bootstrap values are based on 1000 pseudo-replications with only those values greater than 50 % being indicated.

a 'back-up' role. It is therefore recommended that genetic characterisation of weevil species on Marion Island be intensified in order to more accurately determine the potential loss in biodiversity.

Our efforts will be directed at concluding the following:

- **Hypothesis 2 & 3**: The molecular data generated for *Ectemnorhinus* component of the study will be subjected to further statistical analyses and two papers will be prepared for publication. The first will be a revision of the taxonomic status of this genus at PEI and will incorporate both morphometric and molecular evidence for the presence of a single species. The second will be a population level study addressing origin and spread of these weevils and suggesting management strategies.
- **Hypothesis 1**: Primers targeting more conserved genomic regions such as 16S have been ordered and alternative COI primers have been designed on the basis of sequences available in the Genbank database. Amplification and sequencing of representative samples will be conducted once suitable primers have been identified.
- **Hypothesis 4 & 5**: All weevil and moth measurements have been taken from specimens collected between 2001 and 2003 from PEI. In addition, 200 previously collected individuals in the National Collection of Insects and 300 individuals previously collected by S.L. Chown were also measured. These data will be complimented by that of approximately 5000 specimens collected primarily from Marion Island, by Prof. S.L. Chown over approximately 14 years. These additional specimens are mainly *Ectemnorhinus* species from Marion Island. Measurements will be recorded for all samples in order to address the question of population changes through time.

References

Chimimba, C.T. and Dippenaar, N.J. 1995. The selection of taxonomic characters for morphometric analysis: A case study based on Southern African *Aethomys* (Mammalia: Rodentia: Muridae). *Annals of Carnegie Museum* 64 (3): 197-217.

(d) Data and Sample Storage

Data and samples are currently housed in the Department of Zoology & Entomology, University of Pretoria, and the responsible project leader is A.D. Slager-Bastos.

(e) Acknowledgements

All personnel involved in logistic operations at the Prince Edward Islands are thanked for their assistance and the Department of Microscopy, UP is gratefully acknowledged for their assistance and for use of their facilities

(f) Publications (under review)

Janse van Rensburg, L., Chimimba, C.T., Bastos, A.D. & Chown, S.L. Morphometric measurement selection: An invertebrate case study based on weevils from Marion Island. *Polar Biology* (submitted)

(g) Scientific Presentations

L. Janse van Rensburg: Morphometric measurement selection: An invertebrate case study based on weevils from Marion Island, presented at the Annual General Meeting of the department of Zoology and Entomology at the University of Pretoria, November 2002 – Talk

Dr. A.D. Slager-Bastos
30 June 2003

Doc 4.6

SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)

PROJECT REPORT INTERIM ANNUAL PROGRESS REPORT 2003

Moss flora of Marion Island
Other botanical research on the island 2001-2003

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DURATION OF PROJECT: **1st April 1999 to 31st March 2004**

Date of report: **Third interim progress report, May 2003.**

1. Objectives

The Moss Flora project aims at identifying and describing the mosses of Marion and Prince Edward islands. During the time spent on the islands other botanical research was also carried out by VRS and NJMG and progress in that research is included in this report.

2. History of the Moss Flora project

The first stage of this project as carried out in April/May 1999, with funds provided by the Polish Academy of Sciences. The project recommenced in April 2001 and is cosponsored by SANAP and the Polish Academy of Sciences.

3. Key questions in the Moss Flora project

1. What mosses occur on Marion Island?

2. What mosses occur on Prince Edward Island?

3. How are the the various moss species distributed on the island and what are the main abiotic and biotic determinants of their distribution?

4. What are the biogeographical relationships of the mosses?

4. Scientific progress

4.1 Moss Flora

In April 2001 twenty days, and in April 2003 25 days were spent on the islands continuing the collecting efforts of 1999. 3200 specimens were collected, air-dried and sent to Poland for identification and description. Three publications have resulted (Publications 1, 2 and 11 listed below). A further five papers have been submited or are in press.

4.2 Other research carried out on the island

<u>4.2.1 Alien plants on Marion and Prince Edward Islands</u>

During the fieldwork of the Moss Flora project detailed inspections have been made of the occurrence and distribution of alien plant species on both islands. The results are in publication 3 and in a paper in press.

<u>4.2.2 Lichen flora of Marion and Prince Edward Islands</u>

During the fieldwork of the Moss Flora project the opportunity was taken to collect lichens. Herbarium work associated with this activity was financially supported by the Botanical Institute, Bergen (Norway) and the Netherlands Antarctic Programme. In total 100 lichen species were collected and described, six new to science. This work resulted in a monograph on the lichens of Marion And Prince Edward Islands (Publication 8).

4.2.3 Hepatic records from the islands

Several new hepatic (liverwort) species were discovered when collecting the mosses and are the described in publications 9 & 12.

4.2.4. Distribution and response of Marion Island terrestrial habitats to climate change

In a previous project ("Structural and functional classification of Marion Island habitat types") a formal classification of the main habitat types on Marion Island was drawn up, based on soil and vegetation information. The Biological Sciences Task Group urged that an avenue should be found for publishing the classification. In 2000 a further 67 sites were added to the data base and the classification analysis redone on the extended data set. A key to the 23 habitats in the final classification was constructed. The classification and key have been published (publication 4).

The original reason for producing the classification was to establish a framework against which to detect the effects of climatically-driven and human-induced changes at the island. In 2001 a data from 86 additional sites was added to the data base and an analysis made of the altitudinal distribution of habitats on the island and their response to climate change (publication 5).

4.2.5 Carbon exchange by Marion Island plants, soils and communities

In 2001 a proposal to examine the effects of abiotic and biotic factors on carbon exchange phenomena at Marion Island, from the level of individual plants to whole communities was not supported financially by SACAR but the proposer (VRS) was encouraged to find alternative support for the research. Financial support was obtained from the University of Stellenbosch to start the project on a limited scale. The photosynthetic response and carbon budget of a lichen species, and the abiotic and botic determinants of soil respiration rate, were investigated (publications 6, 7 and 13). The results of additional work on the response of soil respiration to moisture and inorganic and organic nutrients have been submitted for publication.

4.2.6 Climate change
The air temperature, sunshine and precipitation records from Marion Island between 1950 and 1999 were analysed and the trends reported in publication 10.

4.2.7 Trampling
The effect of human trampling on the vegetation of Marion Island was studied and the results are in press.

5. List of project publications.

1. Ochyra, R. And Halina Bednarek-Ochyra (1999) *Racomitrium valdon-smithii* (Musci, Grimmiaceae) sp. nov. from the Subantarctic Marion Island. Fragm. Flor. Geobot. 44(2): 209–217.

2. Ochyra, R. (1999) *Dicranella gremmenii* (Musci, Dicranaceae) sp. nov. from Subantarctic Marion Island. Fragm. Flor. Geobot. 44(2): 219–225.

3. Gremmen N.J.M. & V.R. Smith (1999) New records of alien vascular plants from Marion and Prince Edward Islands, sub-Antarctic. Polar Biology 21: 401-409.

4. Smith V.R., Steenkamp M. (2001) Classification of the terrestrial habitats on sub-Antarctic Marion Island based on vegetation and soil chemistry. Journal of Vegetation Science 12: 181-198. *The results in this paper were derived mainly in a previous project. Additional field and laboratory work was carried out in 2000 and 2001 and the final classification published in 2001 at the request of SACAR.*

5. Smith V.R., Steenkamp M. & Gremmen N.J.M. (2001) Terrestrial habitats on sub-Antarctic Marion Island: Their vegetation, edaphic attributes, distribution and response to climate change. South African Journal of Botany 67: 641-654

6. Smith, V.R. & N.J.M. Gremmen (2001) Photosynthesis in a sub-Antarctic shore-zone lichen. New Phytologist 149: 291-299.

7. Smith V.R., Gremmen N.J.M. (2001) *Turgidosculum complicatulum* on sub-Antarctic Marion Island: carbon acquisition response to climate change. Polar Biology 24: 455-459

8. Øvstedal D.O. & Gremmen N.J.M. (2001) The lichens of Marion and Prince Edward Islands. South African Journal of Botany 67: 552-572.

9. Grolle R. (2002) The Hepaticae and Anthocerotae of the subantarctic and temperate islands in the eastern Southern Hemisphere (90°E to 0°): an annotated catalogue. Journal of Bryology 24: 57-80.

10. Smith V.R. (2002) Climate change in the sub-Antarctic: An illustration from Marion Island. Climatic Change 52: 345-357.

11. Ochyra, R. (1999) *Ptychomnion ringianum* Broth. & Kaal., synonymous with *P. densifolium* (Brid) A.Jaeger (Ptychomniaceae). Journal of Bryology 24: 87-88.

12. Schuster, R.M. (2002) Austral Hepaticae. Part II. *Nova Hedwigia Beiheft* 119: i-viii + 1-606.

13. Smith V.R. (2003) Soil respiration and its determinants on a sub-Antarctic island. Soil Biology and Biochemistry 35: 77-91

Papers accepted and in press

1.. Ochyra, R. (1999) Antipodal mosses: VIII. Valdonia gen. nov. (Seligeriaceae) from the Kerguelen Province in the Subantarctic.*Cryptogamie, Bryol. 2003, 24 (x) : xxx–xxx*

2. Ochyra, R. & Smith V.R.. *Entosthodon productus* Mitt. (Funariaceae) on Marion Island – the first record in the Subantarctic. Cryptogamie, Bryologie

3. Ochyra, R. Smith V.R.. & Gremmen N.J.M. *Thuidium delicatulum* (Hedw.) Schimp. (Thuidiaceae) – another bipolar moss disjunct from Subantarctic Marion Island. Cryptogamie, Bryologie

4. Ochyra, R. & Smith V.R.. *Anisothecium cardotii* (R. Br. bis) Ochyra. Marion Island. – In: T. L. BLOCKEEL (ed.), New national and regional bryophyte records, 8. Journal of Bryology 25.

5 Ochyra, R. & Smith V.R. *Syntrichia anderssonii* (Ångstr.) R. H. Zander. Marion Island. – In: T. L. BLOCKEEL (ed.), New national and regional bryophyte records, 8. Journal of Bryology 25.

6. Ryan P. G. , Smith V. R. and Gremmen N. J. M. The distribution and spread of alien vascular plants on Prince Edward Island. Ournal of south African Marine Science

7.Gremmen N.J.M., Smith, V.R. and van Tongeren, O.F.R. Impact of trampling on the vegeation of sub-Antarctic Marion Island. Arctic, Antarctic and Alpine Research.

Date: 6 May 2003

Signed: V. R Smith
Project leader

Doc A.7

SOUTH AFRICAN NATIONAL ANTARCTIC RESEARCH PROGRAMME
2nd INTERIM PROGRESS REPORT

Short Project title: STRUCTURE AND TROPHIC ECOLOGY OF FISH COMMUNITY

Project Leader:	Prof EA Pakhomov Department of Zoology University of Fort Hare, P/Bag X1314 Alice 5700
Project researchers:	Prof EA Pakhomov Miss T. Bushula
Date of report:	Second interim progress report, 1 July 2002 – 30 June 2003

Objectives

To provide information on structure, distribution and trophic interactions of the demersal fish community in the vicinity of the Prince Edward Islands. To obtain information on general biology of selected, commercially valuable fish species in the South African Exclusive Economic Zone around the Prince Edward Islands.

History of the project

This project was initiated in April 2002. The project is based on the solid foundation laid down during previous 5-year programme conducted in the vicinity of the Prince Edward Islands (MIOS, 1996-2001). The current project is designed to obtain the scientific information for a thrust: "Populations and their Management" (Prince Edward Islands and Exclusive Economic Zone).

Scientific progress

This report covers the period 1 July 2002 – 30 June 2003. During this period, Miss Bushula completed literature review on the topic, prepared and started analysing fish community data collected during April/May 2001 bottom survey. In addition, some information on fish biology and feeding ecology were collected and analysed for six species of fish, including Patagonian toothfish (*Dissostichus eleginoides*) and Grey notothenia (*Lepidonotothen squamifrons*). Finally, more than 110 tissue samples of *ca* 20 species of fish were analysed for carbon and nitrogen stable isotopes.

During March and April 2003, Prof EA Pakhomov (Ship-based Chief Scientist) and Miss

T Bushula participated in the annual relief voyage to Marion Island onboard mv *SA Agulhas* (Voyage 110). The detailed preliminary report on the cruise activities is enclosed (see attached paper by Pakhomov et al.) and has been submitted for publication to *South African Journal of Science*. During this cruise, Miss Bushula has collected 150 specimens of two demersal species of fish, *Lepidonotothen larseni* and *Gobionotothen marionensis*. The analysis of the collection to obtain information on their biology and feeding habits is currently in progress. Additional 50 fish tissue samples, including mesopelagic, demersal and coastal fish, for stable isotopes were collected during voyage 110 and are currently prepared for analyses. Lastly, in June 2003 Miss Bushula has attended a two weeks course on "Stable Light Isotope Ecology" at the University of Cape Town.

Other activities

Prof EA Pakhomov has presented an invited key note entitled "**Ecological consequences of the tunicate *Salpa thompsoni* high Antarctic expansion: implications for krill/salp interactions in the Southern Ocean**" at the Second International GLOBEC Open Science Meeting held in Qingdao, China, 15-18 October 2002. In addition, a poster entitled "**Life-support systems of sub-Antarctic archipelago and seamounts: physical and biological coupling mechanisms**" was presented on the Eleventh Annual Meeting of the North Pacific Marine Science Organization (PICES) during 18-26 October 2003 in Qingdao, China.

Prof EA Pakhomov attended a strategic International Open Science Conference "***OCEANS: Ocean Biochemistry and Ecosystem Analysis***" held on 7-10 January 2003 in Paris, France, where he co-chaired a session '**Physical forcing of biochemical cycling and marine food webs**' and presented a poster entitled "**Feeding dynamics of the tunicate *Salpa thompsoni* in the Southern Ocean: low to high latitude comparison**". Prof EA Pakhomov was also a co-author of a poster entitled "**ICCED: Integrated analyses of Circumpolar Climate Interactions and Ecosystem Dynamics in the Southern Ocean – A Southern Ocean Initiative for the OCEANS Programme**" presented by Prof U Bathmann, Alfred-Wegener Research Institute, Germany. It was decided by the group of contributors that the same poster will be presented by Dr E Murphy (British Antarctic Survey, UK) at the Final Open Science Conference: ***A Sea of Change: JGOFS Accomplishments and the Future of Ocean*** on May 5-8, 2003 in Washington DC, USA and at the 23rd General Assembly of the International Union of Geodesy and Geophysics (IUGG): ***State of the Planet: Frontiers and Challengers***. To be held June 30-July 11, 2003 in Sapporo, Japan. Prof EA Pakhomov has been invited to deliver a key talk to the latter conference but rejected the invitation due to luck of time and other commitments.

Prof EA Pakhomov participated in the South African/German Workshop on Research Activities in the Southern Ocean held at the University of Cape Town on 22 November 2002, where he delivered a paper entitled "**Antarctic research component at the University of Fort Hare: Current status and future perspectives**".

Prof EA Pakhomov intended but could not attend, due to lecturing responsibilities, the 3rd International Zooplankton Production Symposium held on May 20-23, 2003 in Gijon, Spain. However, one of his co-authors, Dr A Atkinson (British Antarctic Survey, UK) delivered a paper and a poster entitled "**The evidence for changes in the abundance and distribution of krill and salps in the Southern Ocean during the last century**" and "**Trophodynamics of the pelagic tunicate *Salpa thompsoni* in the Southern Ocean**", respectively.

Lastly, Prof EA Pakhomov, together with Prof CD McQuaid (Rhodes University) co-supervises Masters project of Mr L Vumazonke dealing with biology and demography of the swimming prawn *Nauricaris marionis* at the Prince Edward Islands.

Data and sample storage

Unprocessed data are kept in the office of Prof Pakhomov and in the MCM (Cape Town). Biological samples are stored and curated in the South African Museum, MCM, Zoology Department at the University of Fort Hare and South African Institute for Aquatic Biodiversity (SAIAB).

Future activities

At the beginning of September 2003, Prof EA Pakhomov will leave overseas to accept the position in Biological/Fisheries Oceanography at the Department of Earth and Ocean Sciences of the University of British Columbia, Canada. It is anticipated that by this time Miss Bushula will be at an advanced stage of her Masters studies. In fact, it is anticipated that drafts of two papers (two chapters of Masters Project) will be completed. It is also anticipated that Miss Bushula will submit her thesis by the end of 2003.

Prof EA Pakhomov

11 June 2003

Doc 4.8

SANAP Interim Progress Report

Project Title: ENVIRONMENTAL RESPONSES TO CLIMATE CHANGE ON MARION ISLAND

Project Leaders: Dr Paul Sumner
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Project Researcher: As above, and
Dr Dmitri Mauquoy
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Date of Report: Second Interim Progress Report
July 2002 to June 2003

1. Objectives

1.1 To assess responses of geomorphic processes to climate changes. (Based on field-monitoring of geomorphological processes, the rates at which they operate, and interactions with biotic components, in combination with ground climate monitoring.)

1.2 Analysis and description of the Holocene sedimentological palaeoenvironmental records at the study sites.

To explore and generate proxy-climate data and to integrate the mire-based data with data and modeling from researchers in palaeolimnology and climate modeling.

To examine possible Northern and Southern Hemisphere teleconnections/ interhemispheric relationships between climate change.

Compare the peat-based proxy-climate data with ice-core, pollen, dendrochronological and dendroclimatological databases.

1.3 Detailed morphological and sedimentological analysis of key landforms (e.g. patterned ground, slope failures, blockfields) in order to assess palaeoenvironmental implications of these landforms.

2. History of the Project

As indicated in the First Interim Progress Report (submitted by Dr S. Holness) the project had been running from April to June 2002. On the resignation of Dr Holness from University of the Western Cape , Paul Sumner was approved by SANAP as RSA project leader, co-led with Professor Jan Boelhouwers (Uppsala, Sweden) for the 2003/4 period. The Aims and Objectives from the original SACAR1 remained largely unchanged. Paul Sumner and three assistants from the University of Pretoria participated in the April-May 2003 takeover. Budget limitations prevented participation by a representative from Sweden, although analysis on core samples from the 2002 takeover continued during this period.

Financial support: Allocation 2003/04: R50 000 made up as follows:

Manpower:	R30 000 (MSc bursary for home-based representative student)
Running expenses	R20 000

(No MSc bursary candidate was forthcoming and these funds will not be utilised.)

3. Scientific Progress

3.1 Objective 1

3.1.1 *General*

Activities continue with ground microclimatic monitoring to establish base line information on environmental boundary constraints for geomorphic processes. This includes the role of aspect on micro-, slope, and island scale. Data analysis is ongoing but a complete data set has not yet been obtained (see specific comments under 3.1.2). In addition, sensitivity to climate change is being evaluated in terms of oceanicity and continentality indices, highlighting the distinve attributes of the sub-Antarctic periglacial environment (Boelhouwers *et al,* 2003; Boelhouwers, 2003). This work is ongoing.

The work undertaken on process activity increasingly focuses on fundamental mechanisms of ice segregation and soil displacement associated with freeze-thaw cycles in soils. Field tests were undertaken during the Marion 2002 takeover on soil electric potential and heat and moisture fluxes related to freeze-thaw cycles and need further development. Laboratory tests are under development to study the role of wind on needle-ice development and soil heave. This needs field testing and monitoring during forthcoming field seasons.

3.1.2 *Ground microclimatic monitoring*

During April 2003 takeover, field climate monitoring stations were visited at Red Rocks, Cold Ridge, Repetto's and Juniors Kop on the island. Unfortunately, few data were retrieved owing either to recorder failure or loss of micro-loggers, probably due to wind. Ground-climate monitoring was discontinued at Red Rocks, Cold Ridge and Repetto's while the logging on Juniors Kop was intensified by the re-installation of loggers on the northern aspect.

3.1.3 *Rock weathering-related investigations*

Weathering related monitoring was undertaken at base during takeover 2003. This included detailed rock surface temperature automated recording in association with two weeks of detailed rock moisture content manual recording.

Bedrock samples from the northern and southern aspects of outcrops at Long Ridge South and Katedraalkrans were taken for chemical analysis. Professor Kevin Hall (University of Northern British Columbia is assisting in the analysis).

Scree traps from the southern slope of Katedraalkrans were removed.

3.2 Objective 2: Organic sedimentary record analysis (Dmitri Mauquoy)

3.2.1 *General*

Analysis of organic records of Holocene environmental change were started during the 2002 takeover on a pilot study basis. The lengthy procedures of the various analyses are mostly completed and each is reported on below. The pilot study is proposed to continue with additional sampling and types of analysis.

3.2.2 *Testate amoebae analyses*

A minimum of 150 testate amoebae tests have been counted from 13 surface samples taken from a small peat bog located at S 46°52.6766', E 37°51.0785. The bog is relatively small and measures 135 metres in length and 79 metres in width. Samples were boiled in 50 ml of distilled water for ten minutes, and then sieved through a 250 µm mesh to remove larger macroscopic material which may obscure some tests. Each sample was then centrifuged at 3000 rpm for three minutes, decanted, and mounted on slides for analysis. The pH of the surface samples ranged from 4.56 to 6.09, and the samples were taken at water table depths of 0 cm (x2), 4, 6, 7, 9, 10, 18, 39, 64, 71, 79 and 95 cm.

Analyses of fossil tests to reconstruct mire surface wetness as a proxy for possible changes in climate was unsuccessful, as the concentration of testate amoebae tests was too low. This palaeoenvironmental technique was therefore abandoned.

3.2.3 *Peat humification analyses*

A modified version of the Bahnson colorimetric method (Blackford and Chambers, 1993) was used to measure peat humification. Professor Keith Barber, Palaeoecology Laboratory, University of Southampton, UK, conducted analyses of 136 subsamples taken from the entire 287 cm peat sequence recovered during fieldwork on 03-04-2002. The data and phases of low transmission indicate possible warmer/wetter conditions) may serve to show potential late-Holocene climatic changes.

3.2.4 *Plant macrofossil analyses*

The peat matrices contain macrofossils of *Agrostis magellanica* only, and therefore this palaeoenvironmental reconstruction technique was also abandoned.

3.2.5 *Radiocarbon dating*

A radiocarbon chronology will be established for the peat core based on ^{14}C AMS assays of 6 samples, which are currently being processed by the NERC Radiocarbon Laboratory, UK. The samples for the radiocarbon dating were taken from 185, 183, 125, 118, 90 and 50 cm depth in the core.

3.2.6 *Diatom analyses*

Fossil diatoms in the peat core are abundant, and Dr. Charlotte Sjunneskog, Dept. of Geology and Environmental Geosciences, Northern Illinois University, USA, is currently processing these. These may prove to have great palaeoenvironmental reconstruction value.

3.2.7 *Tephra analyses*

Shards of volcanic glass (tephra) have been sent to Dr. Chris Turney, School of Archaeology and Palaeoecology, Queen's University, Belfast, UK. The geochemistry of these shards will be determined using electron microprobe analyses.

3.2.8 *Anticipated outputs*

One or possibly two manuscripts submitted to one of the Quaternary Science journals, for example (The Holocene, Journal of Quaternary Science, Quaternary Science Reviews).

3.3 Objective 3: Detailed analysis of key landforms

3.3.1 *General*

This component of the work is limited to available field time during takeover and progresses slowly. Morphological and sedimentological data were collected from the active pronival rampart in the interior (near Beta peak). New data on the physical attributes, including relative-age dating, of blockfieds were collected from sites at Fred's, Long Ridge South and Tafelberg.

Observations were made on the degradation of permafrost and ice bodies in the interior.

3.4. Other objectives

3.4.1 *Site maintenance*

Reference points for all know long-term ground movement and logger monitoring sites were taken and the information provided to Dr Cooper. Sites were cleaned up where necessary; excess markers were removed. These sites are to remain for additional long-term data.

3.4.2 *Radon monitoring*

Jay le Roux (takeover assistant) assisted NESCA by installing their Radon Monitor at base during takeover. This will be reported on separately by NECSA.

3.4 Discussion

The project is developing from a descriptive analytical stage to more fundamental science on slope dynamics in maritime periglacial environments. A high sensitivity to climate change can now be shown but underlying mechanics and micro-climatic interactions between various heat and moisture fluxes need careful laboratory and field analysis using radiation, soil electric conductivity, soil moisture and hot-film anemometer sensors.

The same is true for the weathering studies. Moisture and temperature data are now showing the potential for wetting and drying and thermals stress to be important factors other than assumed freeze-thaw shattering (Boelhouwers *et al*, 2003). These conceptually very new insights into mechanical weathering in cold regions (cf Hall *et al*, 2002) need field testing by direct measurement of strain using strain gauges and acoustic emission sensors. The research is now at the point of becoming world-leading, but requires the equipment investment to make it happen. While descriptive and field-based analysis has been acceptable in geomorphological research, this is no longer the case. Numerical analytical approaches focused on physical process understanding are now technologically possible. Without such technology future geomorphological research is not possible and it will become increasingly difficult to publish results without having applied such technology. Increased funding for equipment items is essential.

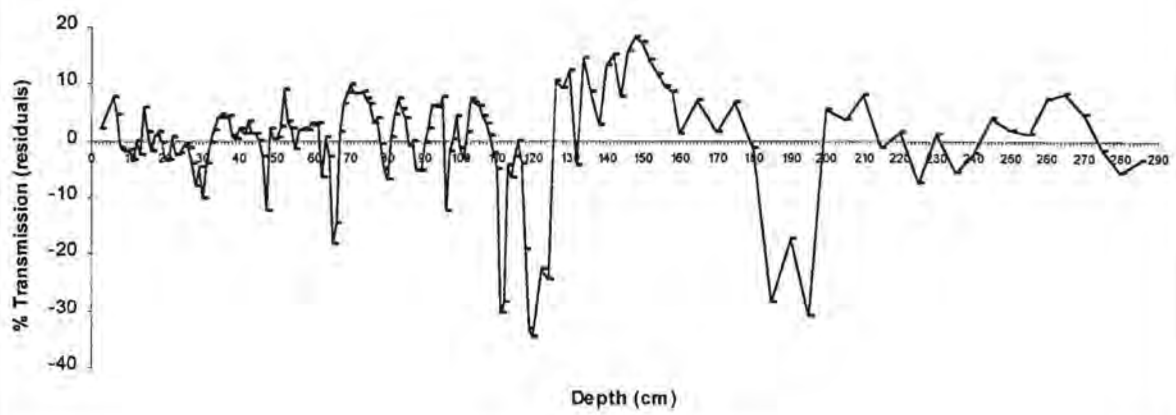
Field based study of landforms – the end-product of the soil/rock mechanical processes and creating the link between form and climate reconstruction – are time intensive. Following the field campaign by Steve Holness the field analytical component of the project has falling behind. Increased access to longer field periods on the island are particularly important for a field-oriented discipline such as geomorphology.

The pilot studies on organic records of environmental change have shown variable results as reported above. However, diatoms and peat humification analysis have offered promising results. It is proposed that this work be continued on a pilot study basis, allowing for additional sampling during the 2004 takeover. Meaningful climate reconstruction is however only possible with C14 dating of the material. Some funding for this purpose will need to be made available. Based on the preliminary humification results presented in Figure 1 this seems a high-yield investment with meaningful results for many disciplines represented on the island.

References

Blackford, J. J. and Chambers, F. M. 1993. Determining the degree of peat decomposition for peat based palaeoclimatic studies. International Peat Journal, 5, 7-24.

Figure 1 - Marion Peat Core (Mari1) - %Transmission, corrected for LOI & detrended



4. Data and Sample Storage

Organic sedimentary records are held at Uppsala University.

Logger records from 2003 takeover are held at University of Pretoria.

Rock samples retained at the University of Pretoria (sub-samples have been forwarded to University of Northern British Columbia for analysis).

5. Publications

Boelhouwers, J. (2003) Sensitivity and responses to climate change in the subantarctic periglacial environment. 8th International Permafrost Association Refereed Conference Proceedings (in press).

Boelhouwers, J., Holness, S. and Sumner, P.D. (2003). The Subantarctic: A distinct periglacial environment. Geomorphology, 52, 39-55.

Holness, S.D. (2003). The periglacial record of Holocene environmental change, subantarctic Marion Island. Permafrost and Periglacial Processes, 14, 69-74.

Nel, W., Holness, S. and Meiklejohn, K.I. (2003): Observations on rapid movement on Sub-Antarctic Marion Island, South African Journal of Science, 99 (in press)

Sumner, P.D., Nel, W., Holness, S. and Boelhouwers, J. (2002). Rock weathering characteristics as relative-age indicators for glacial and post-glacial landforms on Marion Island. South African Geographical Journal, 84, 153-157.

Signature

Dr Paul Sumner
17 June 2003

Doc 4.9

SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME
3RD INTERIM PROGRESS REPORT

Project title: Marion Offshore Variability Ecosystem Study (MOVES)

Project leader: Prof. CD McQuaid
Southern Ocean Group
Department of Zoology
Rhodes University PO Box 94, Grahamstown
6140

Project researchers: Dr PW Froneman, Miss KS Bernard and Mr V Vumazonke

Date of report: 3rd interim progress report 1 July 2002 to 30 June 2003

Objectives

To provide scientifically-based information to the management structure of the Prince Edward island ecosystem with particular focus on the upstream region of the islands; to investigate the living resources potential of selected crustaceans and nekton for South Africa in the Exclusive Economic Zone surrounding the islands and; to examine the feeding ecophysiology and inter-specific relationships between major Antarctic metazoans with particular emphasis on pelagic tunicates.

History of project

This project was initiated on 1 April 2001. The project is based on the solid foundations established during two previous 5 year programmes (MOES 1986-1991 and MIOS 1996-2001) carried out in the vicinity of the Prince Edward islands. The current project was designed to obtain scientific information for two thrusts: " Populations and their management" (Prince Edward Island and Exclusive Zone) and "Resources and management". Funding for the project commenced on the 1 April 2001 during voyage 99 of the *SA Agulhas*.

Scientific progress

This report covers the period 1 July 2002 to 30 June 2003. During this time members (Mr Vumazonke and Dr S. Kaehler) of the Southern Ocean Group (SOG), Rhodes University in collaboration with members of the Oceanography Department of the University of Cape Town and Department of Zoology at the University of Fort Hare, participated in a research cruise to the islands during relief voyage 110 of the mv *SA Agulhas*.

The research addressed two main objectives: the use of stable isotope analysis to elucidate food web structure and the effects of upstream anomalies on the biota. There were four main components to the work:

1. Underway transects to and from the Prince Edward Islands. Underway samples were collected for analysis of phytoplankton community structure (250ml samples preserved in formalin) and for Particulate Organic Matter (POM) isotope signatures (2-10L samples filtered through GFF filters and frozen) POM samples were collected every half degree of latitude and phytoplankton samples every degree. A total of approximately 200 POM samples and 70 phytoplankton samples were collected.

2. Inter-island surveys. POM and phytoplankton samples were collected in the inter-island region on two occasions; shortly after arrival at the islands and following the upstream survey when conditions were quite different. During the second survey, grab and dredge samples were used to collect sediments, as well as specimens of brachiopods and *Nauticaris marionis*. Samples were collected along a transect from the nearshore region to the middle of the inter-island region.

3. An oceanographic survey was carried out in the upstream region in an attempt to identify anomalies. Again POM and phytoplankton samples were collected, as well as 10 RMT8 samples used to characterise the nektonic communities inside and outside the anomalies. Community composition varied strongly, including Antarctic fish species,

sub-tropical species and salps. It is not yet clear how closely the variability in plankton community correlates with eddy structure.

4. A detailed kelp survey was attempted using a launch to sample oxygen, nitrates, POM, phytoplankton and zooplankton at two depths along transects of six stations. Unfortunately this was disrupted by bad weather.

Data and sample storage

Unprocessed data together with logbooks are kept in the offices of the Southern Ocean Group. The bulk of the processed data is on disk at Rhodes University Southern Ocean Group computer facilities. All biological samples are stored and curated in the Southern Ocean group's storeroom in the Department of Zoology at Rhodes University.

Future activities

During the next year, members of the research group will continue to analyse data collected during the previous research cruises to Marion Island. Results of the studies will be submitted to international peer review journals for publication. Members of the Southern Ocean Group will continue to conduct collaborative research with Prof Pakhomov from the University of Fort Hare.

McQuaid

C.D. McQUAID 26/06/2003

Publications 1 July 2002 to 28 June 2003

Published

Bernard K, Froneman PW (2002). Mesozooplankton community structure in the Southern Ocean upstream of the Prince Edward Islands. *Polar Biology* 25: 597-604.

Bernard K, Froneman PW (2003) Mesozooplankton community structure and grazing impact in the Polar Frontal Zone during austral autumn 2002. ***Polar Biology*** 26: 268-275.

Froneman P.W., Ansorge I.J., Vumazonke L., Gulekana K., Webb A.M., Leukes W., Risien C.M., Thomalla S., Bernard K., Hermes J., Knott M., Anderson D., Hargey N., Jennings M., Veitch. Lutjeharms J.R.E., McQuaid C.D. (2002) Physical and biological variability in the Antarctic Polar Frontal Zone: Report on the research cruise 104 of the ***M.V. S.A. Agulhas. South African Journal of Science*** 98: 534-536.

Vumazonke LU, Pakhomov EA, Froneman PW, McQuaid CD (2003) Diet and daily ration of male and female *Nauticaris marionis* at the Prince Edward Archipelago. ***Polar Biology*** 26: 420-422. Short note.

In press

Froneman PW (in press). Protozooplankton community structure and grazing impact in the high Antarctic during austral summer 1998. *Deep-Sea Research II.*

Abrahamsson K, Bertilsson S, Chierici M, David R, Fransson A, Froneman PW, Loren A, Pakhomov EA (in press). Variations of biochemical parameters along a transect in the Southern Ocean with special emphasis on volatile halogenated organic compounds. *Deep-Sea Research II.*

Chierici M, Fransson A, Turner DR, Pakhomov EA, Froneman PW (in press). Variability in the oceanic carbonate system and CO_2 fluxes in the surface waters along a transect in the Atlantic sector of the Southern Ocean. *Deep-Sea Research II*.

Pakhomov EA, Froneman PW (in press). Mesozooplankton dynamics in the Atlantic sector of the Southern Ocean (south of 49°S along 6°E) during austral summer 1997-1998. *Deep-Sea Research II*.

Pakhomov EA, Froneman PW (in press). Mesozooplankton grazing impact in the Atlantic sector of the Southern Ocean (south of 49°S along 6°E) during austral summer 1997-1998. *Deep-Sea Research II*.

Froneman PW, Balarin M, Pakhomov EA (in press). Size fractionated primary production and biogenic carbon flux in the eastern Atlantic sector of the Southern Ocean in austral summer 1997-1998. *Deep-Sea Research II*.

Doc 4.10

SACAR 1 ADDENDUM

INTERIM PROGRESS REPORT: *DEIMEC, Dynamics of Eddy Impacts on Marion's Ecosystem*

The DEIMEC project commenced in 2002. This observational programme has been carried out with one funded MSc student, a non-funded postdoctoral student (Dr I.J. Ansorge) and a group of non-funded Honours students. This dangerously under-funded and under-equipped group has shown enormous dedication and scientifically has achieved a great deal in the period of only two years. This is evident in the number and quality of the publications produced during this period. In order fully to reach the aims of the initial proposal, it is intended that the project be continued for a further year to the end of March 2005 (See SANAP 1, Appendix 3).

The DEIMEC builds firmly on previous SANAP projects, such as the MOES and the MIOS, during which it was discovered that the oceanic environment of the Prince Edward Islands is a very variable one, usually consisting of a collection of eddies (Ansorge and Lutjeharms, 2002). These eddies may be both cyclonic as well as anti-cyclonic. It has furthermore been demonstrated that these eddies have their origin at the Bains fracture zone in the South-West Indian Ridge south-west of the Prince Edward Islands (Ansorge and Lutjeharms, 2003). It has also been shown that these eddies are the preferred feeding features in the ocean for some birds on Marion Island (Nel *et al.*, 2001), thus affecting the whole ecosystem of the islands. It was therefore considered imperative that the origin and the characteristics of these eddies be better understood. To this end the DEIMEC was designed and a number of cruises carried out.

The DEIMEC has thus far consisted of two major ocean cruises, the DEIMEC I (March-April 2002) and the DEIMEC II (March-April 2003). Both were carried out in close and productive cooperation with the Southern Ocean Group of Rhodes University, a prerequisite if the interaction of the physical features of the ocean and the biological response is to be understood. The aims of the DEIMEC I had been to investigate some eddies streaming from the South-West Indian Ridge towards the Prince Edward Islands. Due to some equipment failure on board ship this was not possible and instead the flow through the fracture zone in the ridge was studied for the first time (Froneman *et al.*, 2002). Illustrations on what was achieved are given in the attached SACAR 1 form. The DEIMEC II in 2002 was to have been carried out by first identifying some eddies – both cyclonic and anti-cyclonic – in satellite altimetric data and then to steer the vessel through them to do a preliminary survey with XBTs (expendable bathythermograph units) before the islands were reached. This was not permitted and the cruise had to leave the Prince Edward Islands to search for the eddies with only the altimetric data as a guide. Nevertheless, two anti-cyclonic eddies were surveyed in detail, also biologically, and the thermal detail of one cyclonic eddy was established in the short period allowed for these observations (Pakhomov *et al.*, 2003). In order to achieve the aims set out for this project, a more detailed study of the hydrography of some of the cyclonic eddies that have an impact on the Prince Edward Islands is required and this is intended for the extension to the project proposed for 2004-2005. Nevertheless a great deal has already been achieved with the DEIMEC I and II.

First, a solid concept on the flow through the Bains fracture zone has been gained. It has been shown that the Antarctic Polar Front tends to lie farther equatorward here than elsewhere, whereas the Subantarctic Front lies farther poleward. This constriction causes the Antarctic Circumpolar Current to flow through this gap at a greater speed than up- or downstream, thus conceivably leading to greater current shear and the possibility of enhanced potential for mesoscale turbulence. The hydrographic characteristics of the water masses in this important region have also been established in detail for the first time.

Second, some detail of the hydrographic characteristics of the anti-cyclonic eddies that approach the Prince Edward Islands has been determined for the first time. It has been shown that they consist of different water masses, with different origins. It has furthermore been confirmed that the eddies are well-represented as sea surface height anomalies in the altimetric data. It has also been established that there is an increase in organisms such as squid at the edges of the eddies (Pakhomov *et al.*, 2003).

Third, a detailed study has been undertaken of the records of sea surface temperature taken at Marion Island on a daily basis over the past 50 years. The aim of this exercise was to establish if the passage of eddies could be determined for a long period in this record. The sophisticated statistical analysis of this data was carried out by Dr Jean-Luc Mélice of the French IRD in collaboration with the local team. It has thus been established (Mélice *et al.*, 2003a, b) that the temperatures at both Marion and Gough Island have been rising over the past 50 years, more so at Marion than at Gough Island. It has also been demonstrated that the sea surface temperatures at both islands are influenced by the Antarctic Circumpolar Wave with a period between 8-10 years. The extent of the pack ice to the south of the island acts in harmony with this trend (Mélice *et al.*, 2003a).

Apart from the scientific results, considerable training and education has also been achieved. Mr Gulekana is making good progress with his MSc, based largely on the results of the DEIMEC I. He has taken an active part in both the DEIMEC I and the DEIMEC II cruises, thus gaining invaluable hands-on experience. Two classes of Honours students have acted as scientific crew on these cruises (DEIMEC I; L. Vumazonke, K. Gulekana, A. M. Webb, W. Leukes, C. M. Resien, S. Thomalla, K. Bernard, J. Hermes, M. Knott, D. Anderson, N. Hargey, M. Jennings, J. Veitch, DEIMEC II; S. Kaehler, L. U. Vumazonke, G. Gulekana, T. Bushula, N. Hargey, H. Stewart, N. Chang, L. Furno, S. Mkatshwa, D. Paul, C. Balt, C. Visser) and have contributed to the papers that have been published as cruise reports (Froneman *et al.*, 2002; Pakhomov *et al.*, 2003). This has given them some of the only sea-going training available in South Africa and is helping to form a next cohort of ocean scientists for the country. Dr Ansorge has ably lead the physical oceanographic component of both cruises. She has published a number of papers in the international literature (e.g. Ansorge and Lutjeharms, 2002, 2003), contributed to international scientific conferences and even been invited to act as session chair at the IUGG Conference held in Sapporo, Japan in 2003. She has received the prestigious Claude Leon Harris Foundation award for 2002-2003.

SANAP publications stemming from or published during the DEIMEC

(In all these papers the SANAP has been acknowledged for its financial support.)

Rau, A. J., J. Rogers, J. R. E. Lutjeharms, J. Giraudeau, J. A. Lee-Thorp, M.-T. Chen and C. Waelbroeck 2002
A 450 kyr record of surface water conditions on the Agulhas Bank slope, South Africa.
Marine Geology, **180**(1-4): 183-201.

Lutjeharms, J. R. E., S. Jamaloodien and I. J. Ansorge 2002
The temporal displacement of ocean fronts south-east of Africa.
South African Journal of Science, **98**(5/6): 304-306.

Ansorge, I. J. and J. R. E. Lutjeharms 2002
The hydrography and dynamics of the ocean environment of the Prince Edward Islands (Southern Ocean).
Journal of Marine Systems, **37**(1-3): 107-127.

Froneman, P. W., I. J. Ansorge, L. Vumazonke, K. Gulekana, A. M. Webb, W. Leukes, C. M. Resien, S. Thomalla, K. Bernard, J. Hermes, M. Knott, D. Anderson, N. Hargey, M. Jennings, J. Veitch, J. R. E. Lutjeharms and C. D. McQuaid 2002
Physical and biological variability in the Antarctic Polar Frontal Zone: Report on the research cruise 104 of the M. V. *S. A. Agulhas*.
South African Journal of Science, **98**(11/12): 534-536.

Reason, C. J. C., J. R. E. Lutjeharms, J. Hermes, A. Biastoch and R. E. Roman 2003
Inter-ocean fluxes south of Africa in an eddy-permitting model.
Deep-Sea Research II, **50**(1): 281-298.

Boebel, O., T. Rossby, J. R. E. Lutjeharms, W. Zenk and A. Baron 2003
Path and variability of the Agulhas Return Current.
Deep-Sea Research II, **50**(1): 35-56.

You, Y., J. R. E. Lutjeharms, O. Boebel and W. P. M. de Ruijter 2003
Quantification of the interocean exchange of intermediate water masses around southern of Africa.
Deep-Sea Research II, **50**(1): 197-228.

Ansorge, I. J. and J. R. E. Lutjeharms 2003
Eddies originating from the South-West Indian Ridge.
Journal of Marine Systems, **39**(1-2): 1-18.

Lutjeharms, J. R. E. and C. S. Fillis 2003
Intrusion of sub-Antarctic water across the Subtropical Convergence south of Africa.
South African Journal of Science, **99**(3/4): 173-176.

Lutjeharms, J. R. E. and G. Kortum 2003
On the influence of German marine research on South African physical oceanography since 1890.
Historisch-meereskundliches Jahrbuch, **9**: 81-100.

Lutjeharms, J. R. E. and G. Kortum (2003)
On the German influence in South African physical oceanography since 1890.
Proceedings of the Sixth International Conference on the History of Oceanography, Qingdao, *IOC*, in press.

Luschi, P., A. Sale, R. Mencacci, G. R. Hughes, J. R. E. Lutjeharms and F. Papi (2003)
Current transport in leatherback sea turtles (Dermochelys coriacea) wandering in the ocean.
Proceedings of the Royal Society of London, accepted.

Ansorge, I. J., P. W. Froneman, J. R. E. Lutjeharms and C. D. McQuaid (2003)
Topographical influence of the South-west Indian Ridge on the flow of the Antarctic Circumpolar Current.
Geophysical Research Letters, submitted.

Mélice, J.-L., J. R. E. Lutjeharms, M. Rouault, C. Reason, H. Goosse and T. Fichefet (2003a)
Evidence for the Antarctic Circumpolar Wave in the Subantarctic during the past 50 years.
Geophysical Research Letters, submitted.

Pakhomov, E. A., I. J. Ansorge, S. Kaehler, L. U. Vumazonke, G. Gulekana, T. Bushula, N. Hargey, H. Stewart, N. Chang, L. Furno, S. Mkatshwa, D. Paul, C. Balt, C. Visser, J. R. E. Lutjeharms and P. Hayes-Foley (2003)
Studying the impact of ocean eddies on the ecosystem of the Prince Edward Islands; DEIMEC II.
South African Journal of Science, submitted.

Mélice, J.-L., J. Lutjeharms, M. Rouault and I. Ansorge (2003b)
Sea surface temperatures at the sub-Antarctic islands of Marion and Gough during the past 50 years.
South African Journal of Science, in preparation.

Ansorge, I. J., J. R. E. Lutjeharms and I. Belkin (2003)
Frontal systems along the Madagascar Ridge.
Deep-Sea Research I, in preparation.

Prof. Johann R. E. Lutjeharms FRSSAf
2003-06-28

Doc 4.11

SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME

First Interim Progress Report
April 2003 to June 2003

MEASUREMENTS AND REGIONAL MODEL STUDIES OF OCEAN-ATMOSPHERE INTERACTION IN THE SOUTHERN OCEAN IN ORDER TO IMPROVE OUR UNDERSTANDING OF THE OCEAN BOUNDARY LAYER'S CONTRIBUTION TO SUB-TROPICAL CLIMATE AND WEATHER SYSTEMS

Dr C.J.deW. (Hannes) Rautenbach
Department of Geography, Geoinformatics and Meteorology
Faculty of Natural and Agricultural Sciences
University of Pretoria

MEASUREMENTS AND REGIONAL MODEL STUDIES OF OCEAN-ATMOSPHERE INTERACTION IN THE SOUTHERN OCEAN IN ORDER TO IMPROVE OUR UNDERSTANDING OF THE OCEAN BOUNDARY LAYER'S CONTRIBUTION TO SUB-TROPICAL CLIMATE AND WEATHER SYSTEMS

First Interim Progress Report
April 2003 to June 2003

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OBJECTIVES

The objectives of the project focus on two principles namely *measurements* and *modelling*:

MEASUREMENTS

To measure surface atmospheric variables and ocean surface fluxes such as the turbulent fluxes of momentum (wind stress), sensible heat and latent heat over the Southern Ocean

MODELLING

To determine how these fluxes contribute to local and remote forcing in regional and large-scale weather systems that sweep over the ocean surface on a frequent basis

The objectives will be achieved by making use of different instruments to measure different atmospheric variables such as winds, temperature, mean sea-level pressure (MSLP), radiation and the moisture content of the atmosphere. Line measurements will be made on ship cruises, and point measurements by automatic weather stations (land stations on the islands and weather buoys in the Southern Ocean). Mesoscale modeling of atmospheric responses to boundary fields (including measured data) will contribute to a better understanding of atmosphere-ocean processes. The objectives have not changed from the original SACAR 1 proposal.

PROJECT HISTORY

The project commenced on 1 April 2003 meaning that the report outlines what have been achieved over a relative short period of time (three months). Although it will happen soon, no project funds have yet been paid to the University of Pretoria. Despite of this the project team already achieved a lot in terms of obtaining and establishing an atmospheric modelling facility. Over the past three months the Honours-level student that was identified for the project has familiarise himself with the structure of the atmospheric model. Up to now no suitable candidate could be identified for the MSc bursary that was made available (MSc students that will participate in the project are employed and do not qualify for the bursary).

SCIENTIFIC PROGRESS

Since no ship cruise took place since the project started, and since the project team decided to perform the first line measurements on a cruise in February 2004, no ship measurements have yet been collected.

MEASUREMENTS

The project team decided to include atmospheric recordings from weather buoys in the project analysis. This was not mentioned in the original SACAR 1 proposal, but additional measurements will be of great benefit to the project. Consultation with NETSYS International (the company that developed and provides software for the data exchange system of the South African Weather Service) led to an agreement in May 2003 between NETSYS and the University of Pretoria. According to the agreement NETSYS will install software at the university that will allow for the direct downloading of Southern Ocean weather buoy data on a regular basis to a local computer at the university. The project leader also consulted with the South African Weather Service, and it has been agreed that weather buoy (and other) data will be made available for SANAP research purposes. The observed weather buoy data will be used to:

- Verify atmospheric reanalysis fields from the National Centre for Environmental Prediction (NCEP). NCEP data are commonly regarded as the best global observation data set, although systematic errors might occur over the "remote" Southern Ocean. If NCEP and buoy data compare well, NCEP fields will also be used to investigate vertical atmospheric circulation profiles over the Southern Ocean atmosphere. In June 2003 the project team started to download NCEP data for this purpose.
- Investigate atmospheric flow patterns in the marine atmosphere boundary layer during the propagation of different synoptic scale weather systems.

MODELLING

The project team decided to rather use a global variable resolution model for Southern Ocean atmospheric simulations. There are many good reasons to motivate why this approach is superior to the use of a nested limited area model (DARLAM developed by the CSIRO Atmospheric Research in Australia) for Southern Ocean modelling studies. In the original SACAR 1 proposal it was suggested that DARLAM be used for this purpose. However, the more advanced Conformal Cubic Atmospheric Model (CCAM) was acquired from the CSIRO Atmospheric Research in April 2003, and subsequently installed on a computer at the University of Pretoria. The CCAM was obtained by means of an official licence agreement between the two institutions. Since no manuals were available for model installation, the project leader spent almost two months to successfully compile and run the model. A test simulation was completed in June 2003, and the project team were convinced that model simulations produced realistic atmospheric flow patterns over the Southern Ocean. The model was therefore successfully installed and is ready for use as a tool to investigate the complex ocean-atmosphere interactions over the Southern Ocean.

INSTRUMENTATION

Although funding for equipment is not yet available, the project team made good progress in preparing software for measuring atmospheric variables on small time intervals. A data logger (similar to the CAMBEL CR10 logger that we intend to use during cruises) was obtained for a limited period. Available instruments were mounted (wind speed and direction, temperature, relative humidity, atmospheric pressure) and software was prepared to measure and download data to a computer located in a research laboratory (Laboratory for Research and Training in Atmospheric Modelling (LRAM) at the University of Pretoria). Students involved in the project learned more about the operation and maintenance of automatic weather stations and obviously benefited significantly from the exercise.

SHIP LINE MEASUREMENTS

I was decided to undertake the first ship ocean-atmosphere line measurements on a cruise planned for February 2004.

PUBLICATIONS

As the project has only been running for three months, no published outputs are available yet. Researchers of the Universities of Pretoria and Cape Town identified themes for a number of suitable research publications, some of which will be completed during the first project year.

Rautenbach

Dr C.J.deW. Rautenbach
29 June 2003

Doc 5.1

SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)

PROJECT PROPOSAL - APPLICATION FOR FUNDING AND LOGISTIC SUPPORT

1. SUBMISSION OF THIS APPLICATION

Please submit this application to:

SANAP PROJECT PROPOSAL
c/o Department of Environmental Affairs and Tourism
Directorate: Antarctica and Islands
Private Bag X 447
PRETORIA
0001

ATTENTION: Carol Jacobs (Rm 831)

Applications must be submitted by no later than 30 June 2003.

All applications must be signed by the Applicant, Project Leader, Head of Department and the Head of the Organisation, before forwarding to the Department of Environmental Affairs and Tourism (DEAT). All proposals will be treated as tenders and will be opened together soon after the closing date of 30 June 2003.

We regret that late or incomplete applications will not be considered.

14. MAJOR DISCIPLINE IN WHICH THE RESEARCH/STUDY WILL BE UNDERTAKEN

BIOLOGICAL SCIENCES

15. TITLE OF PROJECT

(The title must be short and specific and should be used for the duration of the project)

Physiology of extreme fasting in subantarctic fur seal (*Arctocephalus tropicalis*) pups

3.1 DURATION OF PROJECT: April 2004 TO September 2004 (field component)

4. CATEGORY OF PROJECT PROPOSAL

(a) First proposal (Please attach a summary of the literature).

~~(b)~~ Follow-up proposal (Please submit a full progress report with this application)

~~(c)~~ Application for additional funds (A full progress report and a motivation by the project leader should be submitted with this application)

5. **KEYWORDS BY MEANS OF WHICH THE PROJECT CAN BE IDENTIFIED**

fur seals

fasting physiology

Marion Island

6. **RESPONSIBLE PROJECT LEADER (AND CO-LEADERS)**

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7. PARTICULARS OF APPLICANTS

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Date of birth	26 August 1949

Citizenship

Are you a South African citizen?	Yes
If not, a permanent resident?	N/A
Country of citizenship	Republic of South Africa
Occupation	Professor
Employer	University of Pretoria
Department/Institution	Department of Zoology & Entomology

8. QUALIFICATIONS

Highest qualification	DSc Zoology
Where obtained	University of Pretoria
Date obtained	April 1978
Research to obtain a degree?	No
Which degree	N/A

8.1 Please provide details of previous experience in Antarctica.

Research activities

1974 - 1977	Ecology of Subantarctic fur seals *Arctocephalus tropicalis* at Gough Island, South Atlantic Ocean.
1977 - 1983	Population dynamics and reproductive physiology of *A. tropicalis* at Gough Island.
1976,1981/82 1986 - 1993	Control programme with a view to exterminating feral house cats *Felis catus* on Marion Island.
1979-1985	Population ecology of southern elephant seals *Mirounga leonina* at Iles Kerguelen in collaboration with French scientists of Terres Australes et Antarctiques Francaises (TAAF).
1981-present	Population ecology of elephant seals and fur seals (*Arctocephalus* spp.) at Marion Island.
1981 - 1983	Spatial and temporal distribution of Pinnipedia. This represents the overall title of projects b, d, & e during the aforementioned period.
1983-present	Migration of southern elephant seals *Mirounga leonina* from Marion Island.
1991 - 1995	Distributional ecology of Ross seals, *Ommatophoca rossii*, off Western Dronning Maud Land, Antarctica.
2000	Dallmann-Jubany Station, King George Island. Satellite telemetry studies on the migratory behaviour of Southern elephant seals.

Experience of research within the pack ice specifically was obtained during shipboard seal surveys from M.V. SA Agulhas southwest of Bouvet in August 1979, the M.V. Nella Dan southeast of Heard Island in October 1985, the M.V. Icebird off Enderby and MacRobertson Land and Prydz Bay, Antarctica during November/December 1985, the MV S.A. Agulhas off Western Dronning Maud Land in 1991/92 and 1992/93, and the RV Polarstern in the Weddell Sea in 1998.

9. SCIENTIFIC PUBLICATIONS (1998 – 2003)

BESTER, M.N., ODENDAAL, P.N. & FERGUSON, J.W.H. 1998. Abundance and distribution of Antarctic pack ice seals in the Weddell Sea during an anomalous year. *N. Z. Nat. Sci.* 23 Supplement: 13.

JONKER, F.C. & **BESTER, M.N.** 1998. Seasonal movements and foraging areas of adult southern female elephant seals, *Mirounga leonina*, from Marion Island. *Antarct. Sci.* 10: 21-30.

KLAGES, N.T.W. & **BESTER, M.N.** 1998. The fish prey of fur seals *Arctocephalus* spp. at subantarctic Marion Island. *Marine Biol.*131: 559-566.

OOSTHUIZEN, W.H., GREYLING, F.J. & **BESTER, M.N.** 1998. Estimation of age from stained sections of canine teeth in the Cape fur seal (*Arctocephalus pusillus pusillus*). *J. Dent. Assoc. S.A.* 53: 47-51.

PISTORIUS, P.A. & **BESTER, M.N.** 1998. Status of the southern elephant seal population on Marion Island. *N. Z. Nat. Sci.* 23 Supplement: 151.

STEWARDSON, C. L., **BESTER, M.N.** & OOSTHUIZEN, W.H. 1998. Reproduction in the male Cape fur seal *Arctocephalus pusillus pusillus*: age at puberty and annual cycle of the testis. *J. Zool., Lond.* 246: 63-74.

BESTER, M.N. & ODENDAAL, P.N. 1999. Abundance and distribution of Antarctic pack ice seals in the Weddell Sea. In: The Expedition ANTARKTIS XV/3 (EASIZ II) of "Polarstern" in 1998. (Eds) W.E. Arntz & J. Gutt. Alfred-Wegener-Institut für Polar- und Meeresforschung. *Ber. Polarforsch.* 301: 102-107.

FERREIRA, S.M. & **BESTER, M.N.** 1999. Chemical immobilisation, physical restraint, and stomach lavaging of fur seals (*Arctocephalus* spp.) at Marion Island. *S. Afr. J. Wildl. Res.* 29: 55-61.

JOHNSON, R., OOSTHUIZEN, W.H. & **BESTER, M.N.** 1999. The effects of the shark cage diving industry on the ecology of Dyer Island. In: Impact assessment as related to poverty and development issues in Southern Africa. International Association for Impact Assessment, SA Branch, Conference Proceedings, Bloemfontein, September 1999. pp 148-154.

McMAHON, C.R., BURTON, H.R. & **BESTER, M.N.** 1999. First-year survival of southern elephant seals, *Mirounga leonina,* at sub-Antarctic Macquarie Island. *Polar Biol.* 21: 279-284.

PISTORIUS, P.A., **BESTER, M.N.** & KIRKMAN, S.P. 1999. Survivorship of a declining population of southern elephant seals, *Mirounga leonina*, in relation to age, sex and cohort. *Oecologia* 121: 201-211.

PISTORIUS, P.A., **BESTER, M.N.** & KIRKMAN, S.P. 1999. Dynamic age-distributions in a declining population of southern elephant seals. *Antarct. Sci.* 11: 446-451.

THOM, A., VAN DER MERWE, M. & **BESTER, M.N.** 1999. Seasonal and age-related changes in the micro-anatomy of the prostate gland of the Subantarctic fur seal, *Arctocephalus tropicalis*. *S. Afr. J. Zool.* 34: 197-200.

BESTER, M.N., BLOOMER, J.P., MULLER, D.D., VAN ROOYEN, M. & BÜCHNER, H. 2000. Final eradication of feral house cats *Felis catus* from Marion Island. *S. Afr. J. Wildl. Res.* 30: 53-57.

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7. PARTICULARS OF APPLICANTS

Title	Dr
Surname	Arnould
First names	John
Business address	Department of Zoology University of Melbourne VIC 3010 Australia
Telephone	+61 3 8344 7986
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Citizenship	
Are you a South African citizen?	No
If not, a permanent resident?	No
Country of citizenship	Australia
Occupation	Research Officer
Employer	University of Melbourne
Department/Institution	Department of Zoology

9. QUALIFICATIONS

Highest qualification	PhD Zoology
Where obtained	University of Aberdeen, UK.
Date obtained	October 1995
Research to obtain a degree?	No
Which degree	N/A

8.1 Please provide details of previous experience in Antarctica.

Field research

JPYA

Macquarie Island 1986/87 (Australian Antarctic Division)

Prydz Bay and Davis Station, Larseman Hill 1987/88 (Australian Antarctic Division)

Bird Island, South Georgia 1990-93 (British Antarctic Survey)

Bird Island, South Georgia 1998/99 (British Antarctic Survey/Macquarie University)

Possession Island, Crozet Archipelago 2001/02 (CNRS, IPEV, University of Melbourne)

Delphine Verrier

Possession Island, Crozet Archipelago 2000-02 (IPEV, CNRS)

9. **SCIENTIFIC PUBLICATIONS** (Please attach a list of your publications during the past 5 years)

Refereed journals:

Arnould, J.P.Y., Boyd, I.L. and Warneke, R.M. (in press). The historical dynamics of a fur seal population: evidence of regulation by man. Can. J. Zool.

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Book Chapters:

Arnould, J.P.Y. (2001). The southern fur seals (*Arctocephalus* spp.). In Encyclopaedia of marine mammals. Eds Perrin, W.F., Würsig, B. and Thewissen, H.G.M. Academic Press, California. Pp 1146-1151.

10. SUMMARY OF FINANCIAL REQUIREMENTS

	Received for current year 2003	This Application 2004/05	Future Application/s 20___ 20___
Manpower costs	-	-	-
Running expenses	-	R 5 000	
Capital equipment	-	-	
TOTAL	-	R 5 000	

10.1 Which organization will be responsible for the administration of the funds?

UNIVERSITY OF PRETORIA

11. OBJECTIVES AND RATIONALE (NEED AND PURPOSE).

(Please state the objectives of the project, the need for it and how it will contribute to SANAP. In follow-up proposals, please indicate and explain any changes from the previous proposal.)

Objectives

The overall aim of this project is to investigate the physiological responses of subantarctic fur seal (*Arctocephalus tropicalis*) pups to the extreme fasts they endure repeatedly throughout the period of maternal dependence.

Rationale

This project will provide the first thorough study of the physiological mechanisms associated with long-term fasting in otariid seals. Reproducibility and plasticity of these mechanisms will be emphasized to explain how the organism responds to a repetitive fasting pattern. Dealing with the eco-physiology of natural fasting in fur seal pups, this study will go beyond documenting the extreme physiological capacity of the model to understanding the relative importance of this trait to the animal's life history. This will contribute to a better understanding of how these animals may adapt to environmental changes, either natural or human induced (e.g. habitat destruction and overexploitation of food resources; global climatic changes). In addition, this study could provide a new model for biomedical research leading to clinical applications for more efficient treatments of human obesity, diabetes and pathological hypercatabolism.

Background to proposal

For obvious medical reasons, feeding biology and starvation in humans have been widely studied (Cahill 1976). Fasting has been modelled extensively with laboratory animals, as laboratory rats *Rattus norvegicus* (Goodman *et al.* 1980). Although long-term fasting is not a routine part of natural history in both species, data in the literature show that they are able to withstand prolonged fasting to a certain extent, through different metabolic and physiological adjustments occurring in three consecutive phases. Phase I is a rapid period of adaptation, characterized by increasing mobilisation of fat stores and a lowering in protein utilisation. This is following by Phase II, a relatively long period characterized by a high level of lipid utilisation providing the majority of energy expenditure, a decreasing metabolic rate and a partial sparing of proteins. In these non-fasting adapted species, protein catabolism decreases but doesn't reach a very low level and, thus, protein stores may become limited (with cardiac muscle being the first depleted). Finally, Phase III occurs at an advanced stage of fasting, when 30-50% of the body protein has been used; lipid utilisation falls and protein catabolism increases, with serious risk of irreversible starvation leading to death (review in Castellini and Rea 1992). Hence, consequences of prolonged fast can be very dangerous in humans, even under medical care (Le Maho *et al.* 1988). Currently, our understanding of the mechanisms controlling metabolic and physiological responses to long-tem fasting in non-fasting adapted species prevent clinical application of fasting to treat obesity and fight against pathological situations of excessive protein catabolism (Le Maho and Groscolas 1990).

In contrast to humans and other non-fasting adapted species, a wide range of vertebrate species naturally undergo periods of prolonged food restriction or deprivation throughout their life history and are very well adapted for extremely long periods of fasting, mostly in relation to migrations, hibernation, breeding cycles and moulting periods. These fasting-adapted species show a common physiological response to extended fasts, also occurring in the three phases described in non-fasting adapted species, with a similar biochemical pattern (Castellini and Rea 1992). However, the protein sparing process they carry out during Phase II is extremely efficient; conservation of lean tissue is insured through a great reduction of protein catabolism and/or urea recycling (Nelson *et al.* 1975; Groscolas 1986; Le Maho *et al.* 1988; Chérel *et al.* 1992). As a whole, their Phase II is a real stage of economy, characterized by a steady-state (Chérel and Groscolas 1999), which enables them to safely undertake long periods with no food and no water, as an integral part of their natural life-history. The essential factors for adaptation to extended fasting, therefore, are preferential mobilisation of body lipid reserves and efficient sparing of body protein. The mechanisms controlling these, however, are little understood (Le Maho and Groscolas 1990). Furthermore, whereas lot of studies have focused on the shift from Phase II to Phase III (Robin *et al.* 1988; Robin *et al.* 1998; Groscolas *et al.* 2000; Bernard *et al.* 2002), little is known about the transition from Phase I to Phase II during the fast. Studying this transition in animals adapted to long-term fasting could help us to understand the mechanisms that trigger the onset of protein-sparing metabolic pathways with obvious benefits to clinical applications.

The growth and development of infants rely on adequate energy supply. Because of the nutritional and energetic costs of growth added to maintenance requirements, periods of severe food restrictions are often lethal in infants (see Arnould *et al.* 2001). Nevertheless, remarkable exceptions have been already documented in infants who are able to undergo prolonged fasts, employing the same strategies of preferential lipid mobilisation and efficient protein sparing as adults. For example, King penguin (*Aptenodytes patagonica*) chicks withstand 5 months of fasting during the austral winter (Chérel and Le Maho 1985) and phocid seal pups undertake 2 to 12 weeks of post-weaning fast ashore before their departure to sea (Costa 1991). However, infants in these species generally experience just one extended period of fasting during their development. In addition, postweaned phocid seal pups have a relatively large size and massive body fat reserves that prepare them well for this single fast (Carlini *et al* 2001). In contrast, because during lactation female otariid seals (fur seals and sea lions) alternate between long foraging trips to sea (leaving the pup on land) and short nursing periods ashore, otariid pups must fast regularly throughout their early period of development (Gentry and Kooyman 1986; Costa 1991; Guinet and Georges 2000). Furthermore, otariid pups are much smaller than weaned phocids and have significantly lower body fat levels (Arnould *et al.* 2001; Beauplet *et al.* in press).

At Marion Island (Southern Indian Ocean), lactating subantarctic fur seals undertake the longest maternal foraging trips (an average of up to 25 days in winter) of any otariid seal. Thus, pups of this species face the longest inter-suckling interval of any mammalian infant and must endure repeated extreme fasting durations several times during their 10 months of maternal dependence (Guinet & Georges 2000).

How can these fur seal pups withstand such long-term and repeated fasts as an integral part of their natural life-history? Substantial information exists for the mechanisms controlling the physiological responses to extreme fasting in birds (Le Maho 1977; Chérel *et al.* 1987; Chérel *et al.* 1988; Groscolas 1986, 1990), whereas comparatively little is known for free-ranging mammals and, in particular, those enduring repeated, extreme fasts during development.

Hence, due to:

- their remarkable ability to endure repeating prolonged fasting periods continuously throughout lactation,
- the fact that very little is known about their physiological adaptations for these frequent long fasts (Rea *et al.* 2000; Arnould *at al.* 2001; Lea *et al.* 2002),
- the easy handling of these animals, gathered ashore into rookeries, without any disturbance of the mother-infant interactions

the subantarctic fur seal is an ideal model species for the study of fasting physiology in free-ranging mammals.

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Bernard S.F., Thil M.A., Groscolas R. (2003) : Lipolytic and metabolic response to glucagon in fasting king penguin : phase II *vs* phase III. *Am. J. Physiol. Regul. Integr. Comp. Physiol.* 284: R444-R454

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Robin J.-P., Frain M., Sardet C., Groscolas R., Le Maho Y. (1988): Protein and lipid utilization during long-term fasting in emperor penguins. *Am. J. Physiol. 254:* R61-R68.

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12. PARTICULARS OF A PILOT OR FEASIBILITY STUDY THAT HAS BEEN UNDERTAKEN.

(Please give a short description of any pilot/feasibility study which may have been undertaken.)

This research builds on the studies of fasting metabolism in Antarctic fur seals (Arnould *et al.* 2001), a species in which pups endure fasts of only moderate duration, and a preliminary study of subantarctic fur seals at Amsterdam Island (Beauplet *et al.*, in press). The techniques to be used in the present study have all previously been successfully tested and the interpretation of the results will benefit from the extensive experience in research on extreme fasting in king and emperor penguins by members of the collaborative team.

13. KEY QUESTIONS AND RESEARCH APPROACH

(Please provide a list of specific questions to be answered or hypotheses that will be tested and indicate how each is to be approached. In follow-up proposals, indicate and explain any changes from the previous proposal.)

The specific aims of this study are to:

1) describe the changes in metabolic rate, metabolic fuel use, blood chemistry, and behaviour which occur during these fasting periods,

2) determine the factors that induce these changes,

3) elucidate how these factors are hormonally regulated.

Experimental protocol outline

Field work will be conducted from April to September when the at-sea foraging trips of mothers are longest (an average of up to 26 days) and pup must endure the longest fasts (Kirkman *et al.* 2002).

In April 2004, a cohort of 4 months old pups will be selected for the study. Sixty pups (30 male, 30 female) will be selected at random on the rookery, weighed, measured and tagged in the fore-flipper. The study colony will then be checked daily to detect visits of mothers to their pup. Study periods will commence at the end of a maternal attendance period ashore as the mother departs the colony on a foraging trip and continue until she returns to nurse again. Pups will be free-ranging throughout the fasting period. Each pup will be studied for only one fasting period.

The following variables will be measured regularly the fasting period:

Body mass:

Body mass will be measured daily throughout fasting periods.

Body composition and water fluxes:

Body composition changes and water flux during the fasting periods will be measured in each pup using hydrogen isotope dilution (Costa 1987, Arnould *et al.* 2001).

Metabolic rates:

Oxygen consumption and resting metabolic rates (RMR) will be measured every 3 days in each pup using an open circuit respirometry system (Arnould *et al.* 2001).

Field metabolic rate (FMR) over the fasting periods will be measured in each pup using the doubly-labelled water method (Nagy and Costa 1980).

Body fuel metabolism, blood parameters and hormonal status:

During fasting periods, a blood sample will be collected every 3 days from each pup to determine:

- the concentration of blood metabolites as indicators for metabolic status such as urea, creatinine, glucose, β-hydroxybutyrate, cholesterol and NEFA,
- the concentration of hormones involved in fasting such as plasma leptin, insulin, glucagon, thyroid hormones and cortisol,
- the level of blood parameters: haematocrit, blood volume, haemoglobin concentration and muscular myoglobin concentration.

Behaviour:

Behaviour will be assessed through time-budget measurements and electronic data loggers attached to the dorsal fur using quick-setting epoxy that will record the amount of time individuals spend in water.

The above parameters will be investigated in relation to the age, initial body composition, sex of the pups and the duration of the fasting period endured.

13.1 Please provide an indication of the <u>unique multi-disciplinary nature of the research</u>.

This research brings together the expertise of researchers in Zoology and Veterinary Sciences from both the University of Pretoria and the University of Melbourne, Australia, and the CNRS in France, to address a unique physiological response of fasting fur seals (Subantarctic fur seals) that occur only in the Subantarctic at a few localities. The immediate proximity of fur seal colonies to the Base station at Marion Island facilitiates this research.

14. PROPOSED WORK PLAN

(Please describe the tasks to be undertaken during the whole project. Describe the methods to be used, indicate the persons and institutions involved and provide target dates for the start and completion of each task. In follow-up proposals, indicate and explain any changes from the previous proposal.)

Field procedures (see above) will be undertaken by Delphine Verrier DVM (PhD candidate at the University of Melbourne, Australia) during the winter of 2004 (April-September) in collaboration with field technicians of the MRI, UP. All blood samples will be transported back to Australia and analysed at the University of Melbourne laboratories by Delphine Verrier, with the assistance and supervision of Dr John Arnould (PhD Supervisor), during 2004/05. Data analysis and interpretation will be assisted by Dr Rene Groscola (co-supervisor, CNRS, France).

14.1 Is this project a co-operative/collaborative project. Please provide summary information on the associated projects and discuss the role of this project in the total programme.

This project ties in with the CCAMLR monitoring of fur seals at the Prince Eward Island, i.e. recording of pup growth rates and female attendance patterns with the overall Pinniped Monitoring Programme. As top predators in the marine ecosystem, changes in seal abundance, behaviour and health can serve as important indicators of change. This research supports the proposed establishment of Marion Island (Prince Edward Islands) as a national long term ecological research (LTER) site which would provide a national ecological research tool (through a network of sites) capable of delivering improved ecological understanding through fundamental research and monitoring into ecosystem structure, function and composition, and provide a framework for improved ecological trend detection.

15. WILL THE PROJECT LEADER BE AWAY FOR ANY SIGNIFICANT PERIODS WHILE THE PROJECT IS IN PROGRESS?

No

15.1 If yes, describe the arrangements made for leadership and supervision during his/her absence.

16. END PRODUCT OF THE PROJECT

(Describe the planned final products that will result from the project (i.e. the nature of the final report, maps, etc.) and state when they will be submitted. All DEAT funded projects should include the text for a popular publication which will be used to bring the results of the research to the general public or to a specific user group.)

The research results will be published in high quality peer-reviewed international journals. In addition, the study will form part of a PhD thesis dissertation.

17. DISCUSS ANY POTENTIAL IMPACT YOUR STUDY WILL HAVE ON THE ENVIRONMENT AND DESCRIBE MITIGATING ACTIONS WHICH YOU PROPOSE TO MINIMIZE OR ELIMINATE THE IMPACT

The following guidelines are provided to assist applicants with questions relating to the potential environmental impact of a proposal.

(i) Proposals for the continuation of ongoing projects should state clearly if any changes are proposed in field methods, work programmes, camp sites, and timing from those documented in the original proposal, or subsequent modifications to it.

(ii) The proposer should list aspects of the proposed activity, that have not been noted, that might

cause impacts on the Antarctic environment (e.g. visual impact or other forms of disturbance).

(iii) In making all these assessments of impact, the proposer should briefly consider the nature, duration and intensity of the likely environmental effects, including the following;

a. the existing environment, its variability or dynamic nature, resilience to change, sensitivity to disturbance, previous disturbance, protected status etc;

b. cumulative and possible indirect impacts;

c. the probability of accidents and their environmental consequences;

d. the adequacy of existing information and knowledge.

(iv) A map of the area should be included (sketch if necessary) to assist the interpretation of this section of the research application.

Proposers are expected to provide sufficient information in their answers to allow the DEA & T to make a thorough, complete and accurate evaluation of the environmental impact of the project. Insufficient information will require follow-up action and/or may prejudice the environmental acceptability of the project.

Preliminary Environmental Evaluation

Details of Activities
Answer all questions only if work is to be carried out in Antarctica or Marion Island during 2004_./ 2005

If you answer "Yes" to any of these questions, a full description of proposed activity, including proposals for mitigating and monitoring these impacts, is required.

It is important that you provide maps detailing the proposed research areas (hand drawn sketches are acceptable).

Will your objective:
a. Use a radionuclide? Yes X No☐

If Yes, complete the following:

Radionuclide	Chemical form	Quantity (Curies)	Half Life (Years)
Tritium	Tritiated water	0.02	11

Detail procedures you will take to ensure that no radiation will enter the Antarctic or sub-Antarctic environment from use or spillage.

All radio-isotopes will be taken into the field in pre-weighed sealed vials and administered to the animals by injection. All needles, syringes and waste will be placed in sealed "sharps" bins and transported back to South Africa for disposal. The radio-isotopes will be administered to seal pups in 1 mL doses of 200µCi. At these levels, the isotopes have no detrimental physiological effect and are diluted through time by metabolic processes. The excretion of these isotopes from the animals (via urine, faeces) is extremely small.

b. Take any chemical to Antarctica or Marion Island?

Yes ☐ No X

c. Release any chemical to the Antarctic or sub-Antarctic Environment?

Yes ☐ No X

d. Require the use of explosives? Yes ☐ No X

e. Collect, capture, kill, restrain, tag or band any terrestrial, freshwater or marine plants or animals?

Yes X No ☐

If Yes, complete the following:

For each species (apart from those taken using plankton nets or trawl), estimate the proportion of the local population you will be collecting, capturing, killing, tagging or banding. If restraining, include period of restraint:

Species	Method	Number	Proportion of population (%)
Subantarctic fur seal pups (*Arctocephalus tropicalis*)	Capture by hand and manual restrained	60	0.1%

For each species, indicate the proportion of the local population you will be disturbing while carrying out the above activities.

Only 0.48% of the entire population will be disturbed as the study will be confined to the Rockhopper Bay area

f. Enter any Protected Area? Yes ☐ No X

g. Take to Antarctica or Marion Island any animal, plant (includes seeds), micro-organism or soil?

Yes ☐ No X

h. Significantly disturb by flooding, sampling, trampling, camp operations or any other means any ice-free area (bare ground)?

Yes ☐ No X

i. Take or remove any physical specimens eg. rocks, fossils etc?

Yes ☐ No X

j. Cumulative Impacts.

Occupy new or existing camp sites?

☐ New

☒ Old

☐ Both old and new sites

Will you track previously untracked ground?

Yes ☐ No ☒

Will you install equipment, markers, stakes, cairns etc. that will be left in the field?

Yes ☐ No ☒

k. Do you expect your activities to have an environmental impact not covered in the above?

Yes ☐ No X

l. Is the proposed activity likely to have more than a minor or transitory impact?

Yes ☐ No X

18. FINANCIAL REQUIREMENTS

18.1 MANPOWER

(Please provide details of all persons involved and/or employed and/or applied for including ad hoc help on a part-time basis.)

No Antarctic Officers and/or technical/administrative personnel will be funded - the management and administration of the specific project will be the responsibility of the project leader. The Department will only fund home-based researchers appointed on bursaries, and no allowances will be made for the payment of service benefits, such as housing subsidies, medical aids, pensions, etc.

In follow-up proposals explain any changes from the projection given in the previous proposal.

Name, qualifications, past experience and function in this Project	Time available for this project (% of full-time man-year)	Nature and Source of non- SANAP funding	Amount requested from SANAP
Prof M.N. Bester (D.Sc. Zoology), facilitator & co-ordinator, 29 years ecperience of Antarctic Research (1974 – 2003), Antarctic Research Officer (1982 – 1996) SANAP Project Leader (1996 – 2003).	5%	Salary University of Pretoria	0
Delphine Verrier (DVM) -Veterinarian and PhD candidate -18 months field experience studying fasting physiology of king penguins on Possession Is. (Crozet). -will be conducting all field research as part of PhD project	100%	International Postgraduate Research Scholarship (Australia) – fee remission $48,000 AUD Melbourne University International Research Scholarship – stipend $54,000 AUD	0
John P.Y. Arnould (PhD) -15 years experience studying marine mammals, in particular the energetics of fur seals on subantarctic islands -co-supervisor of PhD project and assisting with sample and data analysis.	5%	University of Melbourne $59,000 +26% on costs pro-rata	0
Total		$113,151 AUD	0

18.2 RUNNING EXPENSES

(Please complete all sections. Indicate non-SANAP funds available. That, if a University decides to suggest a research proposal, the University itself must render the necessary support services, such as photocopies, telephone calls, postage, etc. If a research project requires technical support services, the time required must be budgeted for instead of a designated appointment.)

In follow-up proposals explain any changes from the projections given in the previous proposal.

Items	Nature and source of non-SANAP funding	Funds requested From SANAP
Transport (sea, air and land with distances and rates)		
Melbourne-Johannesburg return airfare	$2,300 AUD International Postgraduate Research Scholarship (Australia) - research support grant	0
Johannesburg – Cape Town return airfare		R 1 900
Car hire – Cape Town		R 1 250
Subsistence (nature and rates)		
3 Days Pretoria & 4 days Cape Town @ R 250 per day.		R 1 750
Supplies and services (please specify)		
Total	$2,300	R 5 000

18.3 CAPITAL EQUIPMENT
(Please describe the items required.)
Items paid for in full by SANAP remain the property of DEAT. Items to which the participating organization contribute 50% or more of the cost, become the property of the organization.

In follow-up proposals, please explain any changes from the projections given in the previous proposal.

Description of item and total cost	Non-SANAP Funding	Non-SANAP application	Amount requested from SANAP
Open circuit respirometry system (O_2 and CO_2 gas analysers, flow meters, pumps, chamber)	$26,000 AUD	Laboratory of Dr John Arnould	0
Notebook computer (to run above system)	$2,600 AUD	Laboratory of Dr John Arnould	0
Tritiated water 0.02 Ci	$1,000 AUD	Laboratory of Dr John Arnould	0
^{18}O labelled water	$8000 AUD	Laboratory of Dr John Arnould	0
Biochemical assays (ß-hydroxybutyrate, NEFA, cholesterol, glucose, urea)	$3,000 AUD	Laboratory of Dr John Arnould	0
Commercial kits for hormonal assays (leptin, cortisol, insulin, glucagon, T_3, T_4)	$8,000 AUD	Laboratory of Dr John Arnould	0
Consumables (liquid scintillation fluid, needles, syringes, vials, etc.)	$1500 AUD	Laboratory of Dr John Arnould	0
Spring scales, flipper tags, weighing sacks	$500 AUD	Laboratory of Dr John Arnould Note: All the required equipment is already available in the laboratory of Dr John Arnould or will be purchased with existing funding derived from numerous granting agencies	0
Total	$50,600		0

A short motivation must be provided for each item requested. Please supply a quotation for all items requested.

18.4 LOGISTIC SUPPORT

(Please assess your support requirements carefully. The details provided will be used to develop the support for your project, as well as the total integrated support for all programmes. *You will be required to complete this section for each voyage undertaken.*)

Volume and mass of cargo 1.5 m^3 100 kg

Description of cargo

Boxes containing analytical equipment (O2 and CO_2 gas analysers, respirometry chamber, flow meters, pumps), consumables (syringes, needles, etc.) portable generator, centrifuge, notebook computer.

Destination where cargo is required Marion Island base

Radio-active and other hazardous cargo.
Please provide details of materials and how they will be used. State special precautions to be undertaken.

Tritiated water (0.02 Ci) pre-packaged as 200µ·mL^{-1} in 1 ml doses in septum-sealed vials and stored in metal cases lined with vermiculite for transport.

Accommodation requirements

Ship:

Number of persons: 1 person (in transit)

Period April 2004 ; September 2004

Base:

Number of persons: 1 person

Period April 2004 to September 2004

Ship's time required: None

Sampling locations at sea (please attach a detailed map):

Laboratory requirements (ship): None

Laboratory requirements (base):

Bench space (3 m^2), access to freezer space (-20°C), enclosure for temporary holding of seal pups, access to electricity power points – Mammal Laboratory.

Type of equipment requiring deployment from ship: None
Small boat needs (locality and time): None
Surface vehicle needs: None

Helicopter support (describe fully e.g. time, locality, special requirements):

Camping equipment

No of persons / teams

Special equipment:

Protective clothing - None

No of persons – None

List any special requirements:

Please list any special needs:

19. PARTICULARS OF RESEARCH/STUDY ABROAD

19.1 Reasons why it is necessary to undertake the research/study abroad.

19.2 What arrangements have been made for overseas research/study?

19.3 Period that will be spent abroad

Date of departure: ______________

Date of return: ________________

19.4 Subsistence and transport
(Calculations should be made at the current public service rates.)

19.5 Travel costs

Type of Transport	Destination	Distance	Costs
Total			

20. **STATEMENT BY APPLICANT**

I declare that the foregoing information is correct.

Signature [signature] Date 27-06-2003

21. **RECOMMENDATION BY THE RESEARCH OR EQUIVALENT COMMITTEE OF THE APPLICANT'S ORGANIZATION**

Chair [signature] Date 27/06/03

I certify that the information contained in this application is correct and that if SANAP financial support is provided, it will be utilised in accordance with the conditions as laid down by the DEAT.

Project Leader [signature] Date 27-06-2003

Head of Department [signature] Date 27.6.03

Head of Organization [signature] Date

UNIVERSITY OF PRETORIA
3 0 JUN 2003
RESEARCH SUPPORT

22. **COMMENT AND RECOMMENDATION BY SANAP**

Chair ________________ Date ________________

Appendix 1

SUBMISSION TO THE ETHICS COMMITTEE, FACULTY OF BIOLOGICAL AND AGRICULTURAL SCIENCES, UNIVERSITY OF PRETORIA

1. **Project Title:** PHYSIOLOGY OF EXTREME FASTING IN SUBANTARCTIC FUR SEAL PUPS
2. **Date handed in:** 7 JUNE 2003
3. **Staff:**

3.1	Title	Prof
	Surname	Bester
	First names	Marthán N.
	Business address	Mammal Research Institute University of Pretoria, 0002 Pretoria.
	Telephone	(012) 420-2067
	Fax	(012) 420-2534
	E-mail	mnbester@zoology.up.ac.za
3.2	Title	Dr
	Surname	Arnould
	First names	John
	Business address	Department of Zoology University of Melbourne, VIC 3010 Australia
	Telephone	+61 3 8344 7986
	Fax	+61 3 8344 7909
	E-mail	j.arnould@zoology.unimelb.edu.au

4. **Status of Project:** PhD research project (University of Melbourne, Australia) in collaboration with the MRI, DOZ&E, UP.
5. **Funding:** University of Melbourne; Department of Environmental Affairs & Tourism.
6. **Aims of Project:**
   1) To describe the changes in metabolic rate, metabolic fuel use, blood chemistry, and behaviour which occur during fasting periods of Subantarctic fur seal pups,
   2) To determine the factors that induce these changes,
   3) Top elucidate how these factors are hormonally regulated.
7. **Motivation:**

The growth and development of infants rely on adequate energy supply. Because of the nutritional and energetic costs of growth added to maintenance requirements, periods of severe food restrictions are often lethal in infants. Remarkable exceptions have been already documented, particularly in phocid seal pups which undertake 2 to 12 weeks of post-weaning fast ashore before their departure to sea. Infants in these species, however, generally experience just one extended period of fasting during their development. In addition, their relatively large size and massive body fat reserves prepare them well for this single fast. In contrast, because during lactation female otariid seals (fur seals and sea lions) alternate between long foraging trips to sea (leaving the pup on land) and short nursing periods ashore, otariid pups must fast regularly throughout their early period of development. Furthermore, otariid pups are much smaller than weaned phocids and have significantly lower body fat levels.

At Marion Island (Southern Indian Ocean), lactating Subantarctic fur seals undertake the longest maternal foraging trips (an average of up to 28 days in winter) of any otariid seal (Kirkman *et al.* 2002). Thus, on one hand, pups of this species face the longest inter-suckling interval of any mammalian infant, and on the other hand, they have to repeat these extreme fasting durations several times during their 10 months of maternal dependence. How can these fur seal pups withstand such long-term and repeated fasts as an integral part of their natural life-history? Substantial information exists for the mechanisms controlling the physiological responses to extreme fasting in birds whereas comparatively little is known for free-ranging mammals and, in particular, those enduring repeated, extreme fasts during development.

This project will provide the first thorough study of the physiological mechanisms associated with long-term fasting in otariid seals. Reproducibility and plasticity of these mechanisms will be emphasized to explain how the organism responds to a repetitive fasting pattern. Dealing with the eco-physiology of natural fasting in fur seal pups, this study will go beyond documenting the extreme physiological capacity of the model to understanding the relative importance of this trait to the animal's life history. This will contribute to a better understanding of how these animals may adapt to environmental changes, either natural or human induced (e.g. habitat destruction and overexploitation of food resources; global climatic changes).

In addition, this study could provide a new model for biomedical research leading to clinical applications for more efficient treatments of human obesity, diabetes and pathological hypercatabolism.

8. Materials and Methods:

8.1 *Animals:* (a) *A. tropicalis*: 60 pups (30 male, 30 female) (<0.05% of pup production) will be used in the study. Each pup will be sampled for the duration of a single natural fasting period.

8.3 *Treatments:*

Pups monitoring and captures

In April 2004, a cohort of 4 months old pups will be selected for the study. Sixty pups (30 male, 30 female) will be selected at random on the rookery, weighed, measured and tagged in the fore-flipper with individually numbered plastic tags (Dalton Supertags). The study colony will then be checked daily to detect visits of mothers to their pup. Study periods will commence at the end of a maternal attendance period ashore as the mother departs the colony on a foraging trip and continue until she returns to nurse again.

The following variables will be measured regularly during the study period:

Body mass:

Body mass will be measured daily throughout fasting periods by placing the pup in a sack and weighed using a spring balance.

Body composition and water fluxes:

Body composition changes and water flux during the fasting periods will be measured in each pup using hydrogen isotope dilution (Costa 1987; Arnould *et al.* 2001). Upon initial capture, the study pup will be given an intra-muscular injection of tritiated water (1 mL of 200 μCi/mL) and then kept in a shaded enclosure for 3 hours before an equilibration blood sample (5 mL) is collected into a heparinised syringe by venipuncture of an inter-digital vein in a hind-flipper to determine total body water space (and, hence, body composition) The animal will then be released onto the colony and left to behave normally.

The animal will be recaptured every 3-5 days, weighed and blood sampled, to determine water flux rates. Upon the last recapture (just prior to expected arrival of the mother from her foraging trip – as determined by analysis of previous patterns) and after blood sampling, a second injection of tritiated water will be administered and a final blood sample will be collected after 3 hours (as previously) to determine body composition changes throughout the fast.

Metabolic rates:

Oxygen consumption and resting metabolic rates (RMR) will be measured every 3 days in each pup using an open circuit respirometry system (Arnould *et al.* 2001). Each pup will be placed in a respirometry chamber (60 x 60 x 50 cm) fitted with a mixing fan, and inlet and outlet hoses. Air will be drawn through the chamber at 100 L/min and sub-samples of the inlet and outlet air will be analysed continuously for oxygen and carbon dioxide concentrations to determine the oxygen consumption of the pup. Minimum RMR measurement will be taken over 5 min after the animal has acclimatised to the chamber (usually <15 min). No animal will be kept in the chamber for >60 min.

Field metabolic rate (FMR) over the fasting periods will be measured in each pup using the doubly-labelled water method (Nagy & Costa 1980). Upon injection of the tritiated water (see above), an intramuscular injection (3 ml) of ^{18}O-labelled water (99%) will be administered and the animal will be blood sampled as previously for water flux measurements. Analysis of the samples for ^{18}O concentration, in conjunction with the tritiated water, will provide estimates of carbon dioxide production.

Body fuel metabolism, blood parameters and hormonal status:

During fasting periods, a blood sample will be collected every 3 days form each pup to determine:

- the concentration of blood metabolites as indicators for metabolic status such as urea, creatinine, glucose, β-hydroxybutyrate, cholesterol and NEFA,
- the concentration of hormones involved in fasting such as plasma leptin, insulin, glucagon, thyroid hormones and cortisol,
- the level of blood parameters: haematocrit, blood volume, haemoglobin concentration and muscular myoglobin concentration.

Behaviour:

Behaviour will be assessed through time-budget measurements and electronic data loggers (attached to the dorsal fur using quick-setting epoxy) that will record the amount of time individuals spend in water.

8.4 **Biohazards**: None

8.5 **Locality**: Marion Island

8.6 **Potential Impact**: Slight wound (tag/injection site) infection. Tagging and injections/blood sampling do not cause any obvious problems, even with more invasive (biopsy sampling) techniques (e.g. Wynen *et al.* 2000), coupled with the cleansing effect of seawater. Veterinary practices will be maintained throughout the suggested procedures.

8.7 **Conduct at End:** Tags (semi-permanent) will remain in place as per common practice in mark-recapture studies of otariids (Erickson *et al.* 2003) and data loggers will be removed from pups by snipping off the guard hairs of the pelt (Bengtson 1993).

9. **Outside Parties**: Department of Environmental Affairs & Tourism (DEA&T), Pretoria; University of Melbourne, Australia.
10. **Announcement of Results**: Project Report to SACAR, DEA&T; Publication in Scientific Journal (to be selected).
11. **Assurance**: The overall project on 'Monitoring of Pinniped Populations at the Prince Edward Islands' is ongoing, and the Ethics Committee had already approved all actions to be carried out within this project as it pertains to handling and tagging of pups, and deployment & recovery of instrumentation, on previous occasions (Ref. No. EC990112-002). The techiques for marking fur seals (Erickson & Bester 1993) and the methods used to study the bioenergetics of seals, are well established (Anderson *et al.* 2003), have been applied to fur seals by the proposers of this study (Arnould *et al.* 2001), and requires the blessing of the ethics committee. The fieldwork will be carried out by a qualified veterinarian Dr Delphine Verrier (d.verrier@pgrad.unimelb.edu.au). She will be assisted by experienced South African fieldworkers.
12. **Time schedule**: i) Field work April – September 2004,
    ii) Sampling of individuals for a single fast (20-25 days each) as described above,

iii) Analysis of samples and data analysis October 2004 – December 2005.

13. **References:**

ANDERSON, S.S., COSTA, D. & FEDAK, M.A. 1993. Bioenergetics. In: Antarctic Seals: Research Methods and Techniques. R.M. Laws (ed.), Cambridge University Press, Cambridge, England. Pp. 291-315.

ARNOULD, J.P.Y., GREEN, J.A. & RAWLINS, D.R. 2001. Fasting metabolism in Antarctic fur seal (*Arctocephalus gazella*) pups. *Comp. Bioch. Physiol.* A 129: 829-841.

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WYNEN, L.P., GOLDSWORTHY, S.D., GUINET, C., BESTER, M.N., BOYD, I.L., GJERTZ, I., HOFMEYR, G.J.G., WHITE, R.W.G. & SLADE, R. 2000. Post-sealing genetic variation and population structure of two species of fur seal (*Arctocephalus gazella* and *A. tropicalis*). *Molecular Ecol.* 9: 299-314.

DELIVERABLES

(SANAP-RELATED ONLY)

A. CURRENT SANAP RESEARCH CYCLE: 1 April 2001 – 31 March 2005

Kindly indicate what the expected deliverables of your project will be for the duration of the current research cycle, including the one year extension, with respect to the following:

- Number of Honours, MSc and PhD students expected to be trained/obtained *(if in progress, please list name, degree and year of completion – add further lines if necessary)*

Honours → 0

MSc → 0

PhD → 1

NAME	DEGREE	YEAR
Delphine Verrier	PhD Zoology	2006

- Estimated number of scientific publications to be published in accredited scientific journals

3

- Estimated number of scientific papers to be presented at local and international conferences

LOCAL → 0

INTERNATIONAL → 1

- How and to what level you intend enhancing transformation/capacity building/representivity levels in your project

If all go well, and this and other projects dealing with pinnipeds at Marion Island are funded in 2004/2005, three students will benefit immensely through involvement with this project that brings new expertise into SANAP, which can be used to good effect to develop cutting edge projects post-2004/05 on Marion Island. Representivity within my current & envisaged projects is well established – Mariëtte Brause (a *Cum Laude* student which I intend appointing to the Elephant Seal Population Ecology project), Fhatu Munyai & Tambu Mulaudzi (future & current SANAP bursars) will be exposed to international researchers of excellent standing, and the envisaged appointment of another B.Sc. graduate from UNIVEN to the Phocid Tracking project will facilitate his/her exposure to field techniques within the proposed project.

- The project's contribution to the public understanding of Science and Technology

We are involved with the 'UP with Science' venture, and have given talks to Secondary School students visiting the Department with a view to further their Tertiary education in Science at UP. The co-leader is involved with the development of the "Tsebo Ribola" Integrated Science, Engineering and Technology Discovery Centre on the UP Campus. This affords opportunities to draw the attention of visitors to the Centre to the proposed, and other, projects on marine mammals. During the UP open day (17 May 2003) the Department of Zoology & Entomology's exhibit and information stall overwhelmingly featured our involvement in SANAP, in particular satellite tracking of elephant seals, and in 2004 will also emphasize the proposed project.

B. PREVIOUS SANAP RESEARCH CYCLES: All previous cycles up until 31 March 2001

If you have previously received SANAP funding, please indicate the following for ALL previous SANAP research cycles:

- Number of scientific papers published in accredited journals from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please attach complete list)*

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- Number of completed Honours, MSc and PhD degrees from members of your group from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please list name, degree and year of completion – add further lines if necessary)*

Honours	→	3
MSc	→	6
PhD	→	1

NAME	DEGREE	YEAR
M. ST CLAIR HILL (F)	B.Sc. Honours	1996
M. KEITH (M)	B.Sc. Honours	1997
J.E. THOM (F)	B.Sc. Honours	1997

C.R. McMAHON (M)	M.Sc.	1998
F.C. JONKER (M)	M.Sc.	1998
J. MALHERBE (M)	M.Sc.	1998
P.A. PISTORIUS (M)	M.Sc.	1999
S.P. KIRKMAN (M)	M.Sc.	2000
G.J.G. HOFMEYR (M)	M.Sc.	2001
P.A. PISTORIUS (M)	PhD.	2001

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Doc 5.2

SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)

PROJECT PROPOSAL - APPLICATION FOR FUNDING AND LOGISTIC SUPPORT

1. SUBMISSION OF THIS APPLICATION

Please submit this application to:

SANAP PROJECT PROPOSAL
c/o Department of Environmental Affairs and Tourism
Directorate: Antarctica and Islands
Private Bag X 447
PRETORIA
0001

ATTENTION: **Carol Jacobs (Rm 831)**

Applications must be submitted by no later than 30 June 2003.

All applications must be signed by the Applicant, Project Leader, Head of Department and the Head of the Organisation, before forwarding to the Department of Environmental Affairs and Tourism (DEAT). All proposals will be treated as tenders and will be opened together soon after the closing date of 30 June 2003.

We regret that late or incomplete applications will not be considered.

2. MAJOR DISCIPLINE IN WHICH THE RESEARCH/STUDY WILL BE UNDERTAKEN

BIOLOGICAL SCIENCES

3. TITLE OF PROJECT

(The title must be short and specific and should be used for the duration of the project)

BIODIVERSITY AT THE PRINCE EDWARD ISLANDS: EXTENT, THREATS AND MANAGEMENT

3.1 Duration of Project: 01 APRIL 2004 to 31 MARCH 2005

4. CATEGORY OF PROJECT PROPOSAL

(a) **First proposal (Please attach a summary of the literature).***

See Objectives & Rationale and:
http://www.sun.ac.za/zoology/space/Marionbibliography.pdf

(b) Follow-up proposal (Please submit a full progress report with this application)

(c) Application for additional funds (A full progress report and a motivation by the project leader should be submitted with this application)

5. **KEYWORDS BY MEANS OF WHICH THE PROJECT CAN BE IDENTIFIED**

INVASIVE SPECIES	ENDEMIC SPECIES
BIODIVERSITY	INVERTEBRATES
MONITORING	PLANTS
CLIMATE CHANGE	INDICATORS
VERTEBRATES	POPULATION TRENDS

6. **RESPONSIBLE PROJECT LEADER (AND CO-LEADERS)**

Title	PROFESSOR
Surname	CHOWN
First name/s	STEVEN LOUDON
Business address	DEPARTMENT OF ZOOLOGY UNIVERSITY OF STELLENBOSCH PRIVATE BAG X1 MATIELAND, 7602
Telephone	(021) 808 2385
Fax	(021) 808 2405
E-mail	slchown@sun.ac.za

Title	PROFESSOR
Surname	MCGEOCH
First name/s	MELODIE ALYCE
Business address	DEPARTMENT OF CONSERVATION ECOLOGY UNIVERSITY OF STELLENBOSCH PRIVATE BAG X1 MATIELAND, 7602
Telephone	(021) 808 3309
Fax	(021) 808 3304
E-mail	mcgeoch@sun.ac.za

Title	MR
Surname	MERCER
First name/s	RICHARD DENNIS
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Telephone	(021) 808 2571
Fax	(021) 808 2405
E-mail	mercer@sun.ac.za

7. **PARTICULARS OF APPLICANTS**

Title	PROFESSOR
Surname	CHOWN
First name/s	STEVEN LOUDON
Business address	DEPARTMENT OF ZOOLOGY

UNIVERSITY OF STELLENBOSCH
PRIVATE BAG X1
MATIELAND, 7602

Telephone	(021) 808 2385
Fax	(021) 808 2405
E-mail	slchown@sun.ac.za
Date of birth	1964/06/27

Citizenship

Are you a South African citizen?	YES
If not, are you a permanent resident?	N/A
Country of citizenship	SOUTH AFRICA
Occupation	ACADEMIC
Employer	UNIVERSITY OF STELLENBOSCH
Department/Institution	DEPARTMENT OF ZOOLOGY

8. **QUALIFICATIONS *(S.L. CHOWN)***

Highest qualification	PHD
Where obtained	UNIVERSITY OF PRETORIA
Date obtained	1989/12/07
Will the research be used to obtain a degree	NO
Which degree	N/A

8.1 Please attach details of previous experience in Antarctica, Marion and Gough Islands and the Southern Ocean.

The project leaders have many years experience on sub-Antarctic islands, have been actively involved in the management of the Prince Edward Islands and are representatives on a number of international Antarctic committees (e.g. SCAR).

S.L. Chown has extensive experience on sub-Antarctic Islands, having spent three summers and a winter at Marion Island (1983/4, 1986/7, 1987/8), a summer at South Georgia Island (1993/4), a summer at Heard Island (2000/1), and numerous relief voyages to the Prince Edward Islands and Gough Island. He has concentrated on entomological research but has published in a broad range of disciplines applicable to the islands (see Appendix I). He has been actively involved in the management of the Prince Edward Islands, serving on the PEIMC, and is currently the Chief Officer of the Life Sciences Standing Scientific Group (SCAR).

M.A. McGeoch has undertaken research on Marion Island on three occasions, in 2000, 2001, and 2002, and she is supervising several research students who are working on aspects of the island's vegetation and invertebrates. Since 2003 she has been a member of the Prince Edward Islands Management Committee. Her work has focused on the spatial ecology of both plants and insects and she is an authority on bioindicators.

R.D. Mercer has field experience on Marion Island, having spent a summer and winter on the island (1997/8) and two relief voyages (1999 & 2003) collecting data and as group leader for the CBP-CCR team. His MSc thesis focused on acarological and entomological research on the islands. He is currently the research coordinator for the USAID funded Capacity Building Programme for Climate Change Research and is thus in a position to facilitate the running of this project.

9. **SCIENTIFIC PUBLICATIONS** (Please attach a list of your publications during the past 5 years)

SEE APPENDIX 1

10. **SUMMARY OF FINANCIAL REQUIREMENTS**

	Received for the current year 2003/4	This Application 2004/05	Future Application/s 2005/06
Human Resources	0	100 000	0
Running expenses	0	75 000	0
Capital equipment	0	0	0
TOTAL	**0**	**175 000**	**0**

10.1 Which organization will be responsible for the administration of the funds?

UNIVERSITY OF STELLENBOSCH

11. **OBJECTIVES AND RATIONALE (NEED AND PURPOSE).**
(Please state the objectives of the project, the need for it and how it will contribute to SANAP. In follow-up proposals, please indicate and explain any changes from the previous proposal.)

Two of the main aims of the Prince Edward Islands Management Plan are "to maintain biological diversity, including genetic diversity, species diversity and the diversity of ecological processes" and "to minimize interference with natural processes and the destruction or degradation of natural features resulting from human interference" (Anonymous 1996). The Management Plan recognizes that to achieve these aims information on the biodiversity of the islands is required, both in the context of the current situation, and with reference to likely future scenarios. Indeed, research support by the South African National Antarctic Programme at the islands is geared towards providing such information, and has this has been stated as an explicit condition for research support for at least the past six years, and implicitly for at least a decade before that. In consequence, there is now much information available that could potentially be used for management of the island's biodiversity (for explicit examples see Beckley & Branch 1992; Gremmen & Smith 1999; Pakhomov & Froneman 1999; Huyser et al. 2001; Gabriel et al. 2001; Nel et al. 2002; and for review of the literature up to 1999 see Hänel & Chown 1999a).

Despite the abundance of this information, it remains widely scattered in the primary literature, and is relatively inaccessible to the Prince Edward Island Management Committee (PEIMC), the body responsible for overseeing the management of the islands and their biological resources (Anonymous 1996). Indeed, the only synthetic source of information on the islands is the Van Zinderen Bakker et al. (1971) volume, and the popular book by Hänel & Chown (1999b), neither of which are appropriate for taking management decisions. Moreover, no sets of indicators (see McGeoch 1998 for a general review) have been developed that the PEIMC could use to understand the state of the environment of Marion Island. Indeed, there is no annual reporting regarding the environment of the Prince Edward Islands in a way that would indicate whether the environment as a whole or particular species are enjoying adequate conservation, or are in need of some form of conservation action, either by way of direct intervention or lobbying for international agreements. This situation is particularly concerning for two major reasons:

- Several seabird species breeding at the islands are showing declines in abundance (e.g. Rockhopper Penguin; Crozet Shag; Southern Giant Petrel) (Woehler et al. 2001; Nel et al. 2002). These trends may be aggravated by both climate change and long-line fishing (Nel et al. 2002). There are clear relationships between seabird breeding success, the distribution of resources at sea and changes in major fronts owing to global climate change (Ansorge & Lutjeharms 2000; Pakhomov et al. 2000; Nel et al. 2001). However, the conservation management implications of these changes are poorly understood.

- Invasive species are having major direct and indirect influences on terrestrial ecosystems at the island (Chown & Smith 1993; Gremmen et al. 1998; Hänel & Chown 1998; Gabriel et al. 2001; Huyser et al. 2001). Approximately 40% of the vascular plant species on Marion Island are exotic and are found in 21 out of the 23 plant communities on the island (Gremmen et al. 1998). In those plant communities where introduced plants have reached dominance there is a 50% reduction in indigenous plant biodiversity (Gremmen et al. 1998). Similarly high percentages of species richness and occurrence are found for introduced invertebrate (see Chown et al. 2002) and terrestrial vertebrate taxa. Both climate change (Smith 2002) and increasing human activities (associated especially with the construction of a new station) mean that the impacts of invasive species are likely to increase (Smith & Steenkamp 1990; Chown et al. 1998; Bergstrom & Chown 1999; Chown & Gaston 2000). Moreover, the composition of local communities is also likely to change, although what this means for conservation is not clear.

- Despite the implementation of the Prince Edward Islands Management Plan, there is on-going invasion by new species. These have included, in recent years, the grass *Agrostis gigantea* (Gremmen & Smith 1999), and the porcellionid isopod *Porcellio scaber* (Slabber & Chown 2002). Whilst both of these species are the subject of eradication programmes, they are both proving difficult to remove, illustrating the importance of prevention. In the context of the very large building programme commencing at Marion Island in 2003, the risk of new invasions is particularly concerning.

- It has now been shown at several other sites that both fouling assemblages and ballast-dwelling organisms might be a significant source of marine invasives to sub-Antarctic island systems (see Lewis et al. 2003 for information on potential threats in the Southern Ocean region, and Bax et al. 2001 for a general review of marine invaders). Moreover, it seems likely that the threat of invasion will increase as climate continue to warm (Stachowicz et al. 2002), as they are doing at Marion Island (Smith 2002). To date there has been known attempt to ascertain threats to the diverse marine communities at Marion Island, nor has there been any formulation of sensible preventative measures.

Clearly, the conservation of both species and ecosystems at the Prince Edward Islands faces considerable challenges in the future. Moreover, it seems unlikely that these challenges can be met without readily accessible, sound baseline information on the status of the biodiversity of the islands, and without a system of indicators that can be used to assess the status of these biological resources and the outcomes of decisions made by the PEIMC on them. Indeed the need for both accessible baseline information and a set of indicators has been widely recognized, both globally (see http://www.grida.no/soeno98/index.htm), and within the context of conservation of the Antarctic Treaty Area. Two major initiatives in the Antarctic have recently addressed these requirements. New Zealand has undertaken a state of the environment report for the Ross Sea Region (Waterhouse 2001), and Australia has developed a State of the Environment System for Indicator Management and Reporting (SIMR) (http://www-aadc.aad.gov.au/soe/default.asp).

Moreover, the National Biodiversity Bill (*http://www.nbi.co.za/whatsnew/biodiversitybillmay03.PDF*) requires that for each bioregion of South Africa, a bioregional plan must be drafted and reviewed at five-yearly intervals. Clearly, the Prince Edward Islands are sufficiently different in the their climate, geology and biotas, to areas in South Africa, to warrant the development of a specific bioregional plan. According to the Biodiversity Bill these bioregional plans must:

(a) contain measures for the effective management of biodiversity in the region in which the plan applies;
(b) provide for monitoring of the plan; and
(c) be consistent with –
  (i) this Act;
  (ii) the national environmental principles;
  (iii) the national biodiversity framework;
  (iv) the directive principles set out in any legislation regulating land use management, land development and spatial planning administered by the Cabinet member responsible for land affairs; and
  (v) any relevant international agreements binding on the Republic."

Clearly, for (a) to be addressed, modern information on the status of biodiversity in a region, and information on biodiversity trends will be required. The Bill further sets out requirements for monitoring, control of alien or invasive species, and various other actions that will require modern biodiversity information and a system of indicators for assessing trends and management impacts on them.

The main objectives of this project are therefore to provide a synthetic source of information on the current status (and trends) of the biodiversity of the Prince Edward Islands, to adapt the Australian SIMR for use at the Prince Edward Islands, and to assess the likely extent and threats of marine invasive species associated with shipping activities at the islands. These aims will be achieved via four major activities:

1. A workshop will be held to bring together information on the status and trends of species and ecosystems at the Prince Edward Islands in the context of the broader Antarctic region. All participants will be required to arrive at the meeting with the completed text of a chapter on their group or system of interest. At the meeting a synthetic report of recommendations for management actions will be prepared and consensus will be reached on the indicators to be used. The meeting will be hosted at the University of Stellenbosch and will be co-funded by the USAID Capacity Building programme for Climate Change Research. Dr Lee Belbin, who developed the Australian SIMR, will be invited to attend the workshop. Several other sources of funds will also be sought. The final product will be an edited volume describing the state of the environment at the Prince Edward Islands.

2. The Australian SIMR will be modified, over the period of one year, and in collaboration with its developer (Dr. Lee Belbin, Australian Antarctic Division), for application to the Prince Edward Island situation. This activity would require the employment of a full-time person for one year (contractual position at R 100 000 per year) to see to the development and implementation of the system.

3. A survey will be undertaken of the research and supply vessel, the S.A. Agulhas, for ballast and for fouling assemblages on at least three occasions, i.e. prior to its departure for Marion Island, at Marion Island, and on its return to Cape Town.

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Lewis, P.N., Hewitt, C.L., Riddle, M. & McMinn, A. 2003. Marine introductions in the Southern Ocean: an unrecognized hazard to biodiversity. *Marine Pollution Bulletin* **46**, 213-223.

McGeoch, M.A. 1998. The selection, testing and application of terrestrial insects as bioindicators. *Biological Reviews* **73**, 181-201.

Nel, D.C., Lutjeharms, J.R.E., Pakhomov, E.A., Ansorge, I.J., Ryan, P.G. & Klages, N.T.W. 2001. Exploitation of mesoscale oceanographic features by grey-headed albatross *Thalassarche chrysostoma* in the southern Indian ocean. *Marine Ecology Progress Series* **217**, 15-26.

Nel, D.C., Ryan, P.G., Crawford, R.J.M., Cooper, J. & Huyser, A.W. 2002. Population trends of albatrosses and petrels at sub-Antarctic Marion Island. *Polar Biology* **25**, 81-89.

Ochyra, R. 1999. *Dicranella gremminii* (Musci, Dicranaceae) sp. nov. from Subantarctic Marion Island. *Fragmenta Floristica et Geobotanica* **44**, 219-225.

Ochyra, R. & Bednarek - Ochyra, H. 1999. *Racomitrium valdon-smithii* (Musci, Grimmiaceae) sp.

nov. from Subantarctic Marion Island. *Fragmenta Floristica et Geobotanica* **44**, 209-217.
Øvstedal, D.O. & Gremmen, N.J.M. 2001. The lichen flora of Marion and Prince Edward islands. *South African Journal of Botany* **67**, 552-572.
Pakhomov, E.A. & Froneman, P.W. 1999. The Prince Edwards Islands pelagic ecosystem, south Indian Ocean: a review of achievements, 1976-1990. *Journal of Marine Systems* **18**, 355-367.
Pakhomov, E.A., Froneman, P.W., Ansorge, I.J. & Lutjeharms, J.R.E. 2000. Temporal variability in the physico-biological environment of the Prince Edward Islands. *Journal of Marine Systems* **26**, 75-95.
Staochowicz, J.J., Teriwn, J.R. Whitlatch, R.B. & Osman, R.W. Linking climate change and biological invasions: Ocean warming facilitates nonindigenous species invasions. *Proceedings of the National Academy of Sciences of the U.S.A.* **99**, 15497-15500.
Slabber, S. & Chown, S.L. 2002. The first record of a terrestrial crustacean, *Porcellio scaber* (Isopoda, Porcellionidae), from sub-Antarctic Marion Island. *Polar Biology* **25**, 855-858.
Smith, V.R. 2002. Climate change in the sub-Antarctic: An illustration from Marion Island. *Climatic Change* **52**, 345-357.
Waterhouse, E.J. 2001. *A State of the Environment Report for the Ross Sea Region of Antarctica.* New Zealand Antarctic Institute, Christchurch.
Woehler, E.J., Cooper, J., Croxall, J.P., Fraser, W.R., Kooyman, G.L., Miller, G.D., Nel, D.C., Patterson, D.L., Peter, H.U., Ribic, C.A., Salwicka, K., Trivelpiece, W.Z. & Weimerskirch, H. 2001. *A Statistical Assessment of the Status and Trends of Antarctic and Subantarctic Seabirds.* Scientific Committee on Antarctic Research, Cambridge.

12. PARTICULARS OF A PILOT OR FEASIBILITY STUDY THAT HAS BEEN UNDERTAKEN.

(Please give a short description of any pilot/feasibility study which may have been undertaken.)

This project will rely on the experience and information available to several researchers who have spent many years working either on or around the Prince Edward Islands. The Principal Investigator has much experience both coordinating projects of this kind and of producing high quality scientific outputs. Moreover, reviews of this kind have been undertaken for both the Prince Edward Islands invertebrates and for other islands (e.g. Chown et al. 2002; Jones et al. 2002). The marine survey work will be undertaken in collaboration with Dr. Martin Riddle of the Australian Antarctic Division Human Impacts programme and his collaborator Patrick Lewis, both of whom have considerable experience assessing marine impacts of human activities.

13. KEY QUESTIONS AND RESEARCH APPROACH

(Please provide a list of specific questions to be answered or hypotheses that will be tested and indicate how each is to be approached. In follow-up proposals, indicate and explain any changes from the previous proposal.)

K.1. What is the status of the species and ecosystems on the Prince Edward Islands, what trends can be seen, if any, in the populations of species of conservation concern, and what alien species are likely to constitute the largest present and future threats to the ecosystems at the islands?

A.1. Experts in their field (e.g. plants – N.J.M. Gremmen, V.R. Smith; birds – P.G. Ryan, D.C. Nel; marine systems – W. Froneman, I. Ansorge; marine mammals – M.N. Bester) will be invited to attend a workshop with a completed manuscript indicating the status of the species or systems they have worked or are working on. This will include an inventory of taxa present at the islands. The information will be synthesized to provide recommendations for the PEIMC. Dr L. Belbin (the developer of the Australian SIMR) will also be invited to attend the workshop.

K.2. What is the likelihood of invasion of marine communities at the Prince Edward Islands by non-indigenous marine species, and what taxa are likely to be of major concern.

A.2. Using standardized methods that have already been tested on vessels moored in Tasmania, assessments will be made of the marine communities adhering to both the research vessel and its associated infrastructure (anchor chains, tenders, nets, etc.) (see Lewis et al. 2003). Assessments of the ballast biota will be undertaken using methods developed by this group in Australia. These findings will be compared with species lists of the relatively well-known inshore marine biota at the islands (see Hänel & Chown 1999 for a bibliography), with the inshore marine biota of southern Africa, and with a list of the globally most significant marine invaders (http://www.invasivespecies.gov/databases/aadb.shtml).

K.3.Undertake the modification of the Australian SIMR system for use on the Prince Edward Islands.

A3. This task will be based on the outcomes of questions 1 and 2. The indicators developed by the Australians, and the system for monitoring and assessing them, will be modified for use on the Prince Edward Islands. This task will also allow a system of bioindicators to be developed that will require regular monitoring at the islands to assess the state of both the terrestrial ecosystem, and the surrounding marine ecosystems which are reflected in the population status and trends of the pelagic seabirds ad mammals breeding at the island.

This part of the work should be considered separate to the former questions especially because it is the application of a monitoring tool developed elsewhere. As such it also has higher cost implications (human resources costs). Arguably, questions 1 and 2 could be answered without carrying the information through to this application stage, but then much of the value of the information gathered answering these questions would be lost.

13.1 Please provide an indication of the unique multi-disciplinary nature of the research.

This project is intensely interdisciplinary and its products will be unique. In the first instance, the outcome of the workshop will be an integrated, multi-disciplinary volume, which outlines the current state of knowledge of both marine and terrestrial systems at the islands, and provides guidelines for further management of the region. Such a goal is not only in keeping with the Prince Edward Islands Management Plan, but also conforms to the requirement of the National Biodiversity Bill for the development of bioregional plans to allow the better management of a biodiversity assets. Second, the development of a State of the Environment System for Indicator Management and Reporting (SIMR) for a sub-Antarctic island will be a first for any country, and will make interdisciplinary assessments of the state of the environment of the Prince Edward islands a more straightforward and better informed task than it has been to date.

14. PROPOSED WORK PLAN

(Please describe the tasks to be undertaken during the whole project. Describe the methods to be used, indicate the persons and institutions involved and provide target dates for the start and completion of each task. In follow-up proposals, indicate and explain any changes from the previous proposal.)

Workshop *(Research Approach 1)*

The workshop, to be hosted by the University of Stellenbosch, will be held towards the middle of 2004. Experts in different fields (e.g. plants – N.J.M. Gremmen, V.R. Smith; birds – P.G. Ryan, D.C. Nel; marine systems – W. Froneman, I. Ansorge; invertebrates – S.L. Chown, M.A. McGeoch, D.J. Marshall; marine mammals – M.N. Bester; Geomorphology: J. Boelhouers, K. Hall) will be invited to attend the three-day workshop together with a manuscript indicating the status of the species or the systems on which they have worked or on which they are working. The final, published product, to be submitted to the PEIMC in December 2005 at earliest, will be an edited volume describing the state of the environment at the Prince Edward Islands. The workshop will be facilitated and coordinated by S.L. Chown, M.A. McGeoch and R.D. Mercer.

Marine invasions (*Research Approach 2*)

The research approach adopted here will be based on the methods of Lewis et al. (2003). The direction, quantity and duration of ballasting procedures during the last voyage before the winter layover of the S.A. Agulhas will be determined from the ballast logbook. Ballast-water will be sampled from the ballast tanks to determine the biological composition of the ballast water from the Southern Ocean. Samples will be obtained by "pressing up" the targeted tanks in a process whereby seawater is drawn into tanks to facilitate a flow of ballast-water through sounding pipes located on the deck, or on the sides of the vessel. The resulting outflow will be strained through a 20 µm mesh plankton net for 5 min. Plankton samples will be identified with a light microscope within two days of collection. Two sub-samples of each ballast water sample will be introduced to two separate GSe culture preparations. One of each pair of cultures will be maintained at 5°C (representative of Southern Ocean water temperatures) whilst the other will be maintained at 17°C (representative of South African temperatures). Biological regeneration will be monitored with an inverted microscope at 4-day intervals for a three month period after culturing commences. Scanning electron microscopy will be used to assist identification of cultured organisms at the end of the culture period. Fouling assemblages on the S.A. Agulhas will be examined by divers using SCUBA whilst the vessel is moored at Cape Town and anchored at Marion Island. Fouling communities will be photographed *in situ* and samples from the hull of the vessel will be collected and sealed in plastic bags underwater for identification.

The species will be compared with lists available for southern Africa and the Prince Edward Islands, and with lists of known invaders (http://www.invasivespecies.gov/databases/aadb.shtml).

Modification of the Australian SIMR system for use on the Prince Edward Islands *(Research Approach 3)*

This section of the proposed work plan is subject to the availability of the necessary human resources. The duration of this section of the project will involve the appointment of a full-time SIMR Coordinator for a full year. The SIMR Coordinator will either need to spend a period of time (no longer than 8 weeks) visiting Dr Lee Belbin (Australian Antarctic Division) in order to gain experience with the Australian SIMR system, and to develop it for use on the Prince Edward Islands, or Dr Belbin would have to spend the time here in South Africa. The SIMR Coordinator would modify the SIMR system based on the outcomes of the workshop and the species/indicators identified as critical at that meeting. Much of this work will be driven by M.A. McGeoch.

14.1 Is this project a co-operative/collaborative project. Please provide summary information on the associated projects and discuss the role of this project in the total programme.

This project is intensely collaborative and will involve both the entire local community of researchers who are active at the Prince Edward Islands and those members of the international community that have an interest in this system (e.g. R. Ochyra, & N.J.M. Gremmen). It will also be linked directly to the following programmes:

- Regional Sensitivity to Climate Change in Antarctic Terrestrial Systems (RiSCC)
- Australian Antarctic Division (AAD) (Dr Lee Belbin – Australian SIMR; Dr. Martin Riddle, Human Impacts Programme)

15. WILL THE PROJECT LEADER BE AWAY FOR ANY SIGNIFICANT PERIODS WHILE THE PROJECT IS IN PROGRESS?

NO

15.1 If yes, describe the arrangements made for leadership and supervision during his/her absence.

N/A

16. END PRODUCT OF THE PROJECT

(Describe the planned final products that will result from the project (i.e. the nature of the final report, maps, etc.) and state when they will be submitted. All DEAT funded projects should include the text for a popular publication which will be used to bring the results of the research to the general public or to a specific user group.)

1. An edited volume describing the state of the environment at the Prince Edward Islands, the identification of suitable indicators and a report of recommendations for the PEIMC. This document will be synthesis of the workshop.
2. Updated species lists.
3. The publication of research results regarding marine invaders in international, peer-reviewed scientific journals.
4. The publication of a popular article on the project.
5. The development and implementation of a State of the Environment System for Indicator Management and Reporting (SIMR).

17. DISCUSS ANY POTENTIAL IMPACT YOUR STUDY WILL HAVE ON THE ENVIRONMENT AND DESCRIBE MITIGATING ACTIONS WHICH YOU PROPOSE TO MINIMIZE OR ELIMINATE THE IMPACT

The following guidelines are provided to assist applicants with questions relating to the potential environmental impact of a proposal.

(i) Proposals for the continuation of ongoing projects should state clearly if any changes are proposed in field methods, work programmes, camp sites, and timing from those documented in the original proposal, or subsequent modifications to it.

(ii) The proposer should list aspects of the proposed activity, that have not been noted, that might

cause impacts on the Antarctic environment (e.g. visual impact or other forms of disturbance).

(iii) In making all these assessments of impact, the proposer should briefly consider the nature, duration and intensity of the likely environmental effects, including the following;

a. the existing environment, its variability or dynamic nature, resilience to change, sensitivity to disturbance, previous disturbance, protected status etc;

b. cumulative and possible indirect impacts;

c. the probability of accidents and their environmental consequences;

d. the adequacy of existing information and knowledge.

(iv) A map of the area should be included (sketch if necessary) to assist the interpretation of this section of the research application.

Proposers are expected to provide sufficient information in their answers to allow the DEA & T to make a thorough, complete and accurate evaluation of the environmental impact of the project. Insufficient information will require follow-up action and/or may prejudice the environmental acceptability of the project.

Preliminary Environmental Evaluation

Details of Activities
Answer all questions only if work is to be carried out in Antarctica or Marion Island during 2004./ 2005

If you answer "Yes" to any of these questions, a full description of proposed activity, including proposals for mitigating and monitoring these impacts, is required.

It is important that you provide maps detailing the proposed research areas (hand drawn sketches are acceptable).

Will your objective:
a. Use a radionuclide? Yes [ ] No [X]

If Yes, complete the following:

Radionuclide	Chemical form	Quantity (Curies)	Half Life (Years)
N/A	N/A	N/A	N/A

Detail procedures you will take to ensure that no radiation will enter the Antarctic or sub-Antarctic environment from use or spillage.

N/A

b. Take any chemical to Antarctica or Marion Island?

Yes [ ] No [X]

If Yes, complete the following:

Chemical	Formula	Quantity	Use
N/A	N/A	N/A	N/A

Unused chemicals will be: [ ] Left at SANAE Base

[ ] Returned to South Africa

[ ] Other

If Other, detail disposal procedure:

____

c. Release any chemical to the Antarctic or sub-Antarctic Environment?

Yes [ ] No [X]

If Yes, detail the need to release, the chemical, the amounts involved and the location.

____

d. Require the use of explosives? Yes [ ] No [X]
If Yes, complete the following:

How will the explosives be used?

____

____

Detail any precautions taken to minimise disturbance to any wildlife or plants:

Explosive Type	Number of detonations	Charges per detonation (kg)	Total weight (kg)
N/A	N/A	N/A	N/A

e. Collect, capture, kill, restrain, tag or band any terrestrial, freshwater or marine plants or animals?

Yes [X] No [ ]

If Yes, complete the following:

For each species (apart from those taken using plankton nets or trawl), estimate the proportion of the local population you will be collecting, capturing, killing, tagging or banding. If restraining, include period of restraint:

Species	Method	Number	Proportion of population (%)
Not known in advance	Hand collecting and by plankton net	Not known in advance	Ship fouling and ballast organisms only

For each species, indicate the proportion of the local population you will be disturbing while carrying out the above activities.

f. Enter any Protected Area? Yes [X] No [ ]

If Yes, complete the following:

Name of Protected Area	Duration of Visit	Total person-days
Marion Island Zones I-II	Relief 2004	60

Detail why the work must be carried out within the Protected Area:

g. Take to Antarctica or Marion Island any animal, plant (includes seeds), micro-organism or soil?

Yes [ ] No [X]

If Yes, complete the following:

Species	Quantity
N/A	N/A

Detail why these materials need to be taken to Antarctica:

____

____

Detail the quarantine procedures you will undertake to ensure that there is no release to the Antarctic environment:

____

____

h. Significantly disturb by flooding, sampling, trampling, camp operations or any other means any ice-free area (bare ground)?

Yes [ ] No [X]

If Yes, complete the following:

Briefly describe any such significant disturbance:

____

____

Detail any steps you will take to minimise such disturbance:

____

____

i. Take or remove any physical specimens eg. rocks, fossils etc?

Yes [ ] No [X]

If Yes, detail the general area and types of specimens to be collected:

Location	Specimen	Type	Total Number of Weight
N/A	N/A	N/A	N/A

j. Cumulative Impacts.

Occupy new or existing camp sites?

☐ New

☐ Old

☐ Both old and new sites

If new, list these sites and indicate why a previously impacted site cannot be used.

____

____

Will you track previously untracked ground?

Yes ☐ No ☒

If Yes, state why this is necessary:

____

____

Will you install equipment, markers, stakes, cairns etc. that will be left in the field?

Yes ☐ No ☒

If Yes, detail location and type of marker, stake etc:

Location	Type
N/A	N/A

k. Do you expect your activities to have an environmental impact not covered in the above?

Yes ☐ No ☒

If Yes, fully detail impacts:

____

____

l. Is the proposed activity likely to have more than a minor or transitory impact?

Yes ☐ No ☒

If Yes, a CEE will be required:

18. **FINANCIAL REQUIREMENTS**

18.1 MANPOWER

(Please provide details of all persons involved and/or employed and/or applied for including ad hoc help on a part-time basis.)

No Antarctic Officers and/or technical/administrative personnel will be funded - the management and administration of the specific project will be the responsibility of the project leader. The Department will only fund home-based researchers appointed on bursaries, and no allowances will be made for the payment of service benefits, such as housing subsidies, medical aids, pensions, etc.

In follow-up proposals explain any changes from the projection given in the previous proposal.

Name, qualifications, past experience and function in this Project	**Time available for this project (% of full-time man-year)**	**Nature and Source of non-SANAP funding**	**Amount requested from SANAP**
Prof SL Chown, PhD +18 years experience, project leader	5%	Salary, Univ. Stellenbosch	0
Prof MA McGeoch, PhD +8 years experience	5%	Salary, Univ. Stellenbosch	0
Mr RD Mercer, MSc + 2 years experience, research coordinator	15%	Salary, USAID	0
SIMR Developer	100%	NONE	100 000
Total			**100 000**

18.2 RUNNING EXPENSES

(Please complete all sections. Indicate non-SANAP funds available. That, if a University decides to suggest a research proposal, the University itself must render the necessary support services, such as photocopies, telephone calls, postage, etc. If a research project requires technical support services, the time required must be budgeted for instead of a designated appointment.)

In follow-up proposals explain any changes from the projections given in the previous proposal.

Items	Nature and source of non-SANAP funding	Funds requested From SANAP
Transport (sea, air and land with distances and rates) Airfares for workshop attendees within South Africa	10 000	10 000
Subsistence (nature and rates) Subsistence for workshop attendees (20 attendees for three days @ R 500 per day)	15 000	15 000
Supplies and services (please specify) Publishing costs - DTP services, typesetting etc.		50 000
Total	**25 000**	**75 000**

18.3 CAPITAL EQUIPMENT

(Please describe the items required.)

Items paid for in full by SANAP remain the property of DEAT. Items to which the participating organization contribute 50% or more of the cost, become the property of the organization.

In follow-up proposals, please explain any changes from the projections given in the previous proposal.

Description of item and total cost	Non-SANAP Funding	Non-SANAP application	Amount requested from SANAP
NONE	N/A	N/A	N/A
Total			

A short motivation must be provided for each item requested. Please supply a quotation for all items requested.

18.4 LOGISTIC SUPPORT

(Please assess your support requirements carefully. The details provided will be used to develop the support for your project, as well as the total integrated support for all programmes. *You will be required to complete this section for each voyage undertaken.*)

Volume and mass of cargo 3 m^3 250 kg

Description of cargo DIVING GEAR

Destination where cargo is required MARION ISLAND

Radio-active and other hazardous cargo.
Please provide details of materials and how they will be used. State special precautions to be undertaken.

NO RADIO ACTIVE MATERIALS WILL BE USED

Accommodation requirements

Ship:

Number of persons 2

Period RELIEF 2004

Base:

Number of persons NONE

Period N/A

Ship's time required:

DAYS FOR FOULING INSPECTIONS, 2 IN CAPE TOWN, 2 AT MARION ISLAND (CAN BE COORDINATED WITH OTHER ACTIVITIES), 2 IN CAPE TOWN AGAIN

Sampling locations at sea (please attach a detailed map):

AT MARION ISLAND, OFF THE SHIP

Laboratory requirements (ship): WET LABORATORY FOR SORTING SPECIMENS

Laboratory requirements (base): NONE

Type of equipment requiring deployment from ship: NONE

Small boat needs (locality and time):

INFLATABLE RUBBER BOAT OR TENDER FOR SCUBA WORK.

Surface vehicle needs: NONE

Helicopter support (describe fully e.g. time, locality, special requirements): NONE

Camping equipment NONE

No of persons / teams N/A

Special equipment: N/A

Protective clothing STANDARD PROTECTIVE CLOTHING

No of persons 2

List any special requirements: NONE

Please list any special needs: NONE

19. **PARTICULARS OF RESEARCH/STUDY ABROAD**

NONE

19.1 Reasons why it is necessary to undertake the research/study abroad.

N/A

19.2 What arrangements have been made for overseas research/study?

N/A

19.3 Period that will be spent abroad

Date of departure: N/A

Date of return: N/A

19.4 Subsistence and transport
(Calculations should be made at the current public service rates.)

N/A

19.5 Travel costs

N/A

20. **STATEMENT BY APPLICANT**

I declare that the foregoing information is correct.

Signature ______________ Date 30/6/2003

21. **RECOMMENDATION BY THE RESEARCH OR EQUIVALENT COMMITTEE OF THE APPLICANT'S ORGANIZATION**

~~Chair~~ Director Research ______________ Date 30/6/2003

I certify that the information contained in this application is correct and that if SANAP financial support is provided, it will be utilised in accordance with the conditions as laid down by the DEAT.

Project Leader ______________ Date 30/6/2003

Head of Department ______________ Date ______________

Head of Organization Act. H Groenewald Date 30/6/2003

22. **COMMENT AND RECOMMENDATION BY SANAP**

Chair ______________ Date ______________

APPENDIX 1: 9. SELECTED PUBLICATIONS: LEADER & CO-LEADERS

SCIENTIFIC PUBLICATIONS: SL CHOWN (1997 – 2003)

PRIMARY

1997

Chown, S.L. 1997. Thermal sensitivity of oxygen uptake of Diptera from sub-Antarctic South Georgia and Marion Islands. *Polar Biology* **17**, 81-86.

Chown, S.L. & Block, W. 1997. Comparative nutritional ecology of grass-feeding in a sub-Antarctic beetle: the impact of introduced species on *Hydromedion sparsutum* from South Georgia. *Oecologia* **111**, 216-224.

Chown, S.L. & Gaston, K.J. 1997. The species-body size distribution: energy, fitness and optimality. *Functional Ecology* **11**, 365-375.

Chown, S.L., Van Der Merwe, M. & Smith, V.R. 1997. The influence of habitat and altitude on oxygen uptake in sub-Antarctic weevils. *Physiological Zoology* **70**, 116-124.

Frears, S.L., **Chown, S.L.** & Webb, P.I. 1997. Behavioural thermoregulation by mopane worms (Lepidoptera). *Journal of Thermal Biology* **22**, 325-330.

Gaston, K.J., **Chown, S.L.** & Styles, C.V. 1997. Changing size and changing enemies: the case of the mopane worm. *Acta Oecologica* **18**, 21-26.

Klok, C.J. & **Chown, S.L.** 1997. Critical thermal limits, temperature tolerance and water balance of a sub-Antarctic caterpillar, *Pringleophaga marioni* Viette (Lepidoptera: Tineidae). *Journal of Insect Physiology* **43**, 685-694.

McGeoch, M.A. & **Chown, S.L.** 1997. Evidence of competition in a herbivorous, gall-inhabiting moth (Lepidoptera) community. *Oikos* **78**, 107-115.

McGeoch, M.A. & **Chown, S.L.** 1997. The spatial variability of rare and common species in a gall-inhabiting Lepidoptera community. *Ecography* **20**, 123-131.

McGeoch, M.A. & **Chown, S.L.** 1997. Impact of urbanization on a gall-inhabiting Lepidoptera assemblage: the importance of reserves in urban areas. *Biodiversity and Conservation* **6**, 979-993.

Van Der Merwe, M., **Chown, S.L.** & Smith, V.R. 1997. Thermal tolerance limits in six weevil species from sub-Antarctic Marion Island. *Polar Biology* **18**, 331-336.

1998

Chown, S.L., Gaston, K.J. & Williams, P.H. 1998. Global patterns in species richness of pelagic seabirds: the Procellariiformes. *Ecography* **21**, 342-350.

Chown, S.L., Gremmen, N.J.M. & K.J. Gaston, K.J. 1998. Ecological biogeography of southern ocean islands: Species-area relationships, human impacts, and conservation. *American Naturalist* **152**, 562-575.

Chown, S.L., Pistorius, P. & Scholtz, C.H. 1998. Morphological correlates of flightlessness in southern African Scarabaeinae (Coleoptera: Scarabaeidae): Testing a condition of the water conservation hypothesis. *Canadian Journal of Zoology* **76**, 1123-1133.

Gremmen, N.J.M., **Chown, S.L.** & D.J. Marshall, D.J. 1998. Impact of the introduced grass *Agrostis stolonifera* on vegetation and soil fauna communities at Marion Island, sub-Antarctic. *Biological Conservation* **85**, 223-231.

Hänel, C. & **Chown, S.L.** 1998. The impact of a small, alien macro-invertebrate on a sub-Antarctic terrestrial ecosystem: *Limnophyes minimus* Meigen (Diptera, Chironomidae) at Marion Island. *Polar Biology* **20**, 99-106.

Hänel, C., **Chown, S.L.** & Davies, L. 1998. Records of alien insect species from sub-Antarctic Marion and South Georgia Islands. *African Entomology* **6**, 366-369.

Hull, H.E., Freitag, S., **Chown, S.L.** & Bellamy, C.L. 1998. Identification and evaluation of priority conservation areas for Buprestidae (Coleoptera) in South Africa, Lesotho, Swaziland and Namibia. *African Entomology* **6**, 265-274.

Klok, C.J. & **Chown, S.L.** 1998. Field thermal ecology and water relations of *gregaria* phase african armyworm caterpillars, *Spodoptera exempta* (Lepidoptera: Noctuidae). *Journal of Thermal Biology* **23**, 131-142.

Klok, C.J. & **Chown, S.L.** 1998. Interactions between desiccation resistance, host-plant contact and the thermal biology of a leaf-dwelling sub-Antarctic caterpillar, *Embryonopsis halticella* (Lepidoptera: Yponomeutidae). *Journal of Insect Physiology* **44**, 615-628.

Le Lagadec, M.D., **Chown, S.L.** & Scholtz, C.H. 1998. Desiccation resistance and water balance in southern African keratin beetles (Coleoptera, Trogidae): the influence of body size, habitat and phylogeny. *Journal of Comparative Physiology B* **168**, 112-122.

McGeoch, M.A. & **Chown, S.L.** 1998. Scaling up the value of bioindicators. *Trends in Ecology & Evolution* **13**, 46-47.

Van Jaarsveld, A.S., Freitag, S., **Chown, S.L.**, Muller, C., Koch, S., Hull, H., Bellamy, C., Krüger, M., Endrödy-Younga, S., Mansell, M.W. & Scholtz, C.H. 1998. Biodiversity assessment and conservation strategies. *Science* **279**, 2106-2108.

Van Jaarsveld, A.S., Gaston, K.J., **Chown, S.L.** & Freitag, S. 1998. Throwing biodiversity out with the binary data? *South African Journal of Science* **94**, 210-214.

1999

Bergstrom, D. & **Chown, S.L.** 1999. Life at the front: history, ecology and change on southern ocean islands. *Trends in Ecology & Evolution* **14**, 472-477.

Chown, S.L. & Gaston, K.J. 1999. Patterns in procellariiform diversity as a test of species-energy theory in marine systems. *Evolutionary Ecology Research* **1**, 365-373.

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Appendix 1
ETHICAL REQUIREMENTS FOR RESEARCH ON THE PRINCE EDWARD ISLANDS
Questionnaire to be completed by reviewing ethical committee

SOUTH AFRICAN LAW STATES THAT INVERTEBRATE RESEARCH DOES NOT REQUIRE ETHICS CLEARANCE. MOREOVER, THE REST OF THE WORK WILL BE A PAPER-BASED EXERCISE.

This questionnnaire represents the minimum ethical requirements for research on the Prince Edward Islands. It is not intended as an alternative to the reviewing ethical committee's review process and guidelines, but as a supplement to it and as such represents a standardised format whereby the Department of Environmental Affairs and Tourism can ensure that research conducted on the Prince Edward Islands is of a high ethical standard.

The questionnaire is based on the National Code for the handling and Use of Animals in Research, Education, Diagnosis and Testing of Drugs and Related Substances in South Africa (1990) and expects of the reviewing committee to indicate whether certain aspects of the proposed projects have been reviewed by it or not. Please note that these questions are applicable only if the proposed project affects vertebrate animals. Where a question is not relevant, please indicate either *no comment, not enough information*, or *not applicable*. Space is provided below for comments on any of the questions. Please refer to the question number when commenting.

QUESTION	REVIEWED **Indicate either Yes / No / No comment / Not enough information / Not applicable**
Part 1. Professional detail regarding applicant and co-workers	
I Applicant name and affiliation	
II Whether the following information about persons responsible for applying proposed research techniques has been provided:	
i. names	
ii. qualifications (academic or technical)	
iii. description of each person's experience in proposed techniques	
III Whether the following information about other co-workers has been provided:	
i. names	
ii. qualifications	
iii. affiliation	

QUESTION	REVIEWED **Indicate either Yes / No / No comment / Not enough information / Not applicable**
Part 2. Ethical aspects with regard to proposed research project	
i. whether the project's contribution to the relevant scientific field justifies any possible pain or discomfort caused to animals during the course of research	
ii. whether alternatives to animal models are necessary or available	
iii. whether proposed methods/techniques are acceptable in terms of the level of risk to the animal subject's life or well-being	
iv. whether techniques to be applied in the project has been refined through planning and pilot studies	
v. whether the trial/survey is statistically valid (i.e. not wasteful of its animal subjects)	
vi. whether treatments and/or clinical procedures applied and/or surgery done to animals are justifiable and humane	
vii. whether vertebrate animal capture techniques (including drugs used where applicable) is appropriate and humane	
viii. whether systems and techniques for the handling of animals during research is appropriate and humane	
ix. whether facilities for the handling and housing of restrained/captive animals are appropriate, adequate and humane	
x. whether there is adequate planning in the event of emergencies or in the case of unexpected results which may cause unnecessary and excessive pain and suffering to the animals	
xi. whether methods proposed to handle carcases of animals that die during the period they are in the care of the applicant are adequate and appropriate	
xii. whether proposed methods of euthanisation (including any proposed pest extermination methods) are justifiable and humane	
xiii. whether the experience and qualifications of the researcher and his/her assistants is adequate and appropriate for the proposed techniques (including the administration of any drugs)	
xiv. whether all drugs that are to be used in the proposed techniques are accompanied by the appropriate prescription forms	
xv. whether veterinary supervision/consultation is necessary and if so, adequate	
xvi. whether the applicant and his/her co-workers and assistants are familiar with standard guidelines for the ethical manipulation and care of experimental animals and the laws governing these	

Author: TD Wassenaar, CERU, Dept Zoology & Entomology, University of Pretoria, Pretoria, 0002

COMMENTS:

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HEAD OF ETHICS COMMITTEE

DATE

Appendix 2

DELIVERABLES
(SANAP-RELATED ONLY)

A. CURRENT SANAP RESEARCH CYCLE: 1 April 2001 – 31 March 2005

Kindly indicate what the expected deliverables of your project will be for the duration of the current research cycle, including the one year extension, with respect to the following:

- Number of Honours, MSc and PhD students expected to be trained/obtained *(if in progress, please list name, degree and year of completion – add further lines if necessary)*

Honours → 8

MSc → 5

PhD → 3

NAME	DEGREE	YEAR
S. Nevhutalu	B.Sc. (Hons)	2002
N. Nondula	B.Sc. (Hons)	2003
S. Abraham	B.Sc. (Hons)	2003
N. Makwabasa	B.Sc. (Hons)	2003
P.C. le Roux	M.Sc.	2003
N. Gasant	M.Sc.	2004
J. Deere	M.Sc.	2004
M. Nyakatya	M.Sc.	2004
S. Slabber	Ph.D.	2004
A.E. Hugo	Ph.D.	2005

The unnamed students form part of the USAID-funded Capacity Building Programme for Climate-Change Research.

- Estimated number of scientific publications to be published in accredited scientific journals

15

- Estimated number of scientific papers to be presented at local and international conferences

LOCAL → 10

INTERNATIONAL → 2

- How and to what level you intend enhancing transformation/capacity building/representivity levels in your project?

For the current project we hope to involve all HDIs in the workshop. The Capacity Building Programme for Climate Change Research at Marion Island has an active capacity building component – indeed, it is one of the major goals of the programme.

- The project's contribution to the public understanding of Science and Technology

The book publication will contribute substantially to public understanding because it will be the first synthesis of information on Marion Island for many years. However, this book will only be accessible to a small sector of the public and therefore it will be summarized in a popular article. It is also planned to follow this up with an update to the Hänel & Chown (1999) popular volume.

B. PREVIOUS SANAP RESEARCH CYCLES: All previous cycles up until 31 March 2001

If you have previously received SANAP funding, please indicate the following for ALL previous SANAP research cycles:

N.B. PLEASE NOTE THAT THE PAPERS LISTED BELOW INCLUDE THOSE PRODUCED UNDER THE AUSPICES OF THE CAPACITY BUILDING PROGRAMME FOR CLIMATE CHANGE RESEARCH, A SANAP/DEAT/USAID/U. STELLENBOSCH COOPERATIVE PROJECT, AND UNDER THE AUSPICES OF THE DARWIN INITIATIVE/DEAT COLLABORATION. MOREOVER, THEY DO NOT INCLUDE WORKS BY D.J. MARSHALL WHO COLLABORATED ON A PREVIOUS PROJECT, BUT WHO IS NOT A CO-INVESTIGATOR HERE.

- Number of scientific papers published in accredited journals from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please attach complete list)*

82

- Number of completed Honours, MSc and PhD degrees from members of your group from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please list name, degree and year of completion – add further lines if necessary)*

Honours → 0

MSc → 4

PhD → 1

NAME	DEGREE	YEAR
A.G.A Gabriel	M.Sc.	1998
J. Barendse	M.Sc.	1999
C. Haenel	M.Sc.	1999
R. D. Mercer	M.Sc.	2000
C.J. Klok	Ph.D.	1998

SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP) Doc 5.3

PROJECT PROPOSAL - APPLICATION FOR FUNDING AND LOGISTIC SUPPORT

1. **SUBMISSION OF THIS APPLICATION**

Please submit this application to:

SANAP PROJECT PROPOSAL
c/o Department of Environmental Affairs and Tourism
Directorate: Antarctica and Islands
Private Bag X 447
PRETORIA
0001

ATTENTION: Carol Jacobs (Rm 831)

Applications must be submitted by no later than 30 June 2003.

All applications must be signed by the Applicant, Project Leader, Head of Department and the Head of the Organisation, before forwarding to the Department of Environmental Affairs and Tourism (DEAT). All proposals will be treated as tenders and will be opened together soon after the closing date of 30 June 2003.

We regret that late or incomplete applications will not be considered.

2. **MAJOR DISCIPLINE IN WHICH THE RESEARCH/STUDY WILL BE UNDERTAKEN**
Biological sciences

3. **TITLE OF PROJECT**
(The title must be short and specific and should be used for the duration of the project)

Cumulative impacts of environmental stress on indigenous and introduced species

3.1 DURATION OF PROJECT: 1 April 2004 TO 31 March 2005

4. **CATEGORY OF PROJECT PROPOSAL**

(a) First proposal (Please attach a summary of the literature).
Appendix A

(b) Follow-up proposal (Please submit a full progress report with this application)

(c) Application for additional funds (A full progress report and a motivation by the project leader should be submitted with this application)

5. KEYWORDS BY MEANS OF WHICH THE PROJECT CAN BE IDENTIFIED

Cold Tolerance

Water Balance

Invasive and Indigenous Arthropods

Climate Change

6. RESPONSIBLE PROJECT LEADER (AND CO-LEADERS)

Title	Prof.
Surname	Chown
First name/s	Steven Loudon
Business address	S.P.A.C.E. Group
	Department of Zoology
	University of Stellenbosch
	Private Bag X1
	Matieland 7602
	South Africa
Telephone	(021) 808-2385
Fax	(021) 808-2995
E-mail	slchown@sun.ac.za

Title	Dr
Surname	Sinclair
First name/s	Brent John
Business address	S.P.A.C.E. Group
	Department of Zoology
	University of Stellenbosch
	Private Bag X1
	Matieland 7602
	South Africa

Telephone	(021) 808 3585
Fax	(021) 808 2405
E-mail	bjs@sun.ac.za

Title	Dr
Surname	Convey
First name/s	Peter
Business address	British Antarctic Survey NERC, High Cross Madingley Road Cambridge CB3 0ET United Kingdom
Telephone	+ 44 (0) 1223 221 588
Fax	+ 44 (0) 1223 262 616 / 221 259
E-mail	p.convey@bas.ac.uk

7. PARTICULARS OF APPLICANTS

Title	Prof.
Surname	Chown
First name/s	Steven Loudon
Business address	Department of Zoology University of Stellenbosch Private Bag X1 Matieland 7602 South Africa
Telephone	(021) 808-2385
Fax	(021) 808-2995
E-mail	slchown@sun.ac.za
Date of birth	1964 /06 /27
Citizenship	

Are you a South African citizen? Yes If not, are you a permanent resident?

_Country of citizenship ________________Occupation Academic

Employer University of Stellenbosch ________Department/Institution Zoology

8. **QUALIFICATIONS**

Highest qualification Ph.D.______Where obtained Pretoria ____________________Date obtained 1989-12-07 _____Will the research be used to obtain a degree No _____Which degree.

8.1 Please attach details of previous experience in Antarctica, Marion and Gough Islands and the Southern Ocean.

Prof. Chown has considerable and wide-ranging experience of the southern ocean islands. He first worked on Marion Island in 1983, and has spent two summers (1983/4; 1987/8) and a full year (1986/7) on the island as an expedition member. He has visited the island on relief voyages in 1991, 1992, 1993, 1996, 1997, 1999, 2001 and 2002. He was elected Chief Terrestrial Scientist and/or relief Conservation Officer for five of these relief voyages. Prof. Chown has also spent a field summer at South Georgia (1993/4), a summer at Heard Island (2000/01) and a relief on Gough Island. These visits have all been scientifically productive and resulted in either one, but more usually several, research outputs. On the basis of his experience, Prof. Chown was elected first Chair of the Prince Edward Islands Management Committee, served for six years as Secretary to the SCAR Working Group on Biology, and is now Chief Officer of the SCAR Standing Scientific Group for the Life Sciences.

Dr Sinclair has experience conducting physiological and ecological research in a variety of alpine and polar environments. As part of his PhD research he worked at Cape Bird on Ross Island (77°S) for three summers (1997/98, 1998/99 and 1999/2000), during which period he was also field leader of Antarctica New Zealand Event K067 (Ecology of Terrestrial Antarctic Fauna). He participated in the 2002 Marion Island Relief Voyage and was the Event Leader and Principal Investigator of Antarctica New Zealand Event K140 (Biology of Antarctic Springtails) at Cape Hallett, North Victoria Land on the Antarctic Continent (co-supported by SANAP). Dr Sinclair's work at Cape Bird resulted in five scientific publications, as well as contributions to the IPCC Third Assessment Report on climate change and the award-winning Ross Sea Region State of the Environment Report. Two papers have been published from work conducted during the 2002 relief voyage, with a third in preparation, and the first publication from the Hallett expedition has been submitted for publication.

Dr Convey is the project leader of the Biological Responses to Environmental Stress in Antarctica Core Project at the British Antarctic Survey. He spent sixteen months on Signy Island in 1989-91, a summer on South Georgia (1992/93), as well as four seasons at Rothera Station, Antarctica (1997/98, 1998/99, 2000/2001), and several trips to the South Orkney, Falkland and South Sandwich Islands (1996/97, 2002/03). In addition, Dr Convey has a season's Arctic experience (Ny Ålesund, Svalbard, 2002). Dr Convey sits on the Steering Committee of the SCAR RiSCC Programme, and is the acting head of the British Antarctic Survey's Evolutionary Biology group. Dr Convey has published more than fifty scientific papers as a result of his Antarctic and Southern Ocean investigations.

9. **SCIENTIFIC PUBLICATIONS** (Please attach a list of your publications during the past 5 years)
See Appendix B

10. **SUMMARY OF FINANCIAL REQUIREMENTS**

	Received for current year 20__	This Application 2004	Future Application/s 20__ 20__
Manpower costs	0		
Running expenses	0	43 400	
Capital equipment	0		
TOTAL	0	43 400	

10.1 Which organization will be responsible for the administration of the funds?

University of Stellenbosch

11. **OBJECTIVES AND RATIONALE (NEED AND PURPOSE).**
(Please state the objectives of the project, the need for it and how it will contribute to SANAP. In follow-up proposals, please indicate and explain any changes from the previous proposal.)

Climate change is a scientific certainty, and its effects are already being recorded on Marion Island (Smith and Steenkamp 1990, Bergstrom and Chown 1999). A critical aspect of understanding the effects of climate change on Marion Island lies in predicting shifts in the physiology and ecology of indigenous and alien invertebrates, which are essential for ecosystem functioning on the island (Bergstrom and Chown 1999, Chown et al. 2002b). To date, a creditable database of the ecophysiological characteristics of Marion Island Invertebrates has been established (Chown and van Drimmelen 1992, Chown 1993, Chown et al. 1997, Klok and Chown 1997, van der Merwe et al. 1997, Klok and Chown 1998, 2000, Mercer et al. 2000, Barendse and Chown 2001, Gaston et al. 2001a, Klok and Chown 2001, Sinclair and Chown 2002, Klok and Chown 2003, Sinclair and Chown 2003), and ongoing work will enlarge this considerably in the next few years (currently three students –two

MSc, one PhD– see http://www.sun.ac.za/zoology/space/climate/index.htm for details of the Capacity-Building Programme for Climate Change Research and its objectives). However, although this style of descriptive physiology is a powerful tool for understanding the ecology (Convey and Block 1996, Convey and Arnold 2000, Chown and Klok 2001, Gabriel et al. 2001, Gaston et al. 2001b, Chown et al. 2002a), evolution (Chown and van Drimmelen 1992, Chown 1993, Bale 2002, Klok and Chown 2003) and interactions (Convey and Block 1996, Klok and Chown 1997, 1998, Bergstrom and Chown 1999, Bale et al. 2000, Bale et al. 2001, Bale 2002, Sinclair and Chown 2003) of stress tolerances by sub-Antarctic invertebrates, its predictive power is limited by the 'single-measurement' approach that does not allow for dynamic and cumulative impacts, and the consequences are overly-simplified models of organismal responses to climate change. For example, Bale et al. (2001) show that repeated freezing events result in significant changes in observed cold hardiness strategy of perimylopid beetles; while Sinclair (2001) predicts that climate change will result in an increase in both frequency and intensity of freeze-thaw events in the New Zealand Alpine Zone. Surprisingly, there is little data globally on the cumulative effects of repeated environmental stresses on subsequent survival of those stresses in invertebrates.

Cumulative effects of environmental stress on invertebrate physiological responses have a far-reaching impact on their ecology and distribution, their responses to climate change and differential effects have the potential to reduce or accentuate interactions between indigenous and alien species. We propose to quantify the cumulative effects of repeated low temperature and desiccation stress in several species of indigenous and alien invertebrates on Marion Island. We will then integrate these data with ecological and microclimate data gathered from Marion Island, as well as current predictions of the effects of climate change, with a view to a better understanding of the likely effects of change in frequency and intensity of cold and drought events on the physiology and ecology of the Marion Island terrestrial Invertebrate Community.

This project will contribute substantially to all three of the SANAP Biological Sciences Research Directives (Annexure A), and will also be a contribution to the SCAR RiSCC programme.

References:

Bale, J. S. 2002. Insects and low temperatures: from molecular biology to distributions and abundance. Philosophical Transactions of the Royal Society of London Series B-Biological Sciences 357: 849-861.

Bale, J. S., W. Block, and M. R. Worland. 2000. Thermal tolerance and acclimation response of larvae of the sub-Antarctic beetle *Hydromedion sparsutum* (Coleoptera: Perimylopidae). Polar Biology 23: 77-84.

Bale, J. S., M. R. Worland, and W. Block. 2001. Effects of summer frost exposures on the cold tolerance strategy of a sub-Antarctic beetle. Journal of Insect Physiology 47: 1161-1167.

Barendse, J., and S. L. Chown. 2001. Abundance and seasonality of mid-altitude fellfield arthropods from Marion Island. Polar Biology 24: 73-82.

Bergstrom, D. M., and S. L. Chown. 1999. Life at the front: history, ecology and change on southern ocean islands. Trends in Ecology and Evolution 14: 472-477.

Chown, S. L. 1993. Desiccation resistance in six sub-Antarctic weevils (Coleoptera: Curculionidae): humidity as an abiotic factor influencing assemblage structure. Functional Ecology 7: 318-325.

Chown, S. L., and M. van Drimmelen. 1992. Water balance and osmoregulation in weevil larvae (Coleoptera: Curculionidae: Brachycerinae) from three different habitats on Sub-Antarctic Maion Island. Polar Biology 12: 527-532.

Chown, S. L., and C. J. Klok. 2001. Habitat use, diet and body size of Heard Island weevils. Polar Biology 24: 706-712.

Chown, S. L., M. van der Merwe, and V. R. Smith. 1997. The influence of habitat and altitude on

oxygen uptake in Sub-Antarctic weevils. Physiological Zoology 70: 116-124.
Chown, S. L., M. A. McGeoch, and D. J. Marshall. 2002a. Diversity and conservation of invertebrates on the sub-Antarctic Prince Edward Islands. African Entomology 10: 67-82.
Chown, S. L., M. A. McGeoch, and D. J. Marshall. 2002b. Diversity and conservation of invertebrates on the sub- Antarctic Prince Edward Islands. African Entomology 10: 67-82.
Convey, P., and W. Block. 1996. Antarctic Diptera: Ecology, physiology and distribution. European Journal of Entomology 93: 1-13.
Convey, P., and R. J. Arnold. 2000. A potential invertebrate indicator of climate change on sub-Antarctic South Georgia. Cryo-Letters 21: 69.
Gabriel, A. G. A., S. L. Chown, J. Barendse, D. J. Marshall, R. D. Mercer, P. J. A. Pugh, and V. R. Smith. 2001. Biological invasions of Southern Ocean islands: the Collembola of Marion Island as a test of generalities. Ecography 24: 421-430.
Gaston, K. J., S. L. Chown, and R. D. Mercer. 2001a. The animal species-body size distribution of Marion Island. Proceedings of the National Academy of Sciences 98: 14493-14496.
Gaston, K. J., S. L. Chown, and R. D. Mercer. 2001b. The animal species-body size distribution of Marion Island. Proceedings of the National Academy of Sciences of the United States of America 98: 14493-14496.
Klok, C. J., and S. L. Chown. 1997. Critical thermal limits, temperature tolerance and water balance of a sub-Antarctic caterpillar, *Pringleophaga marioni* (Lepidoptera: Tineidae). Journal of Insect Physiology 43: 685-694.
Klok, C. J., and S. L. Chown. 1998. Interactions between desiccation resistance, host-plant contact and the thermal biology of a leaf-dwelling sub-antarctic caterpillar, *Embryonopsis halticella* (Lepidoptera: Yponomeutidae). Journal of Insect Physiology 44: 615-628.
Klok, C. J., and S. L. Chown. 2000. Lack of cold tolerance in a small, brachypterous sub-Antarctic fly, *Apetaenus litoralis* Eaton (Diptera: Tethinidae), from Marion Island. African Entomology 8: 305-308.
Klok, C. J., and S. L. Chown. 2001. Critical thermal limits, temperature tolerance and water balance of a sub-Antarctic kelp fly, *Paractora dreuxi* (Diptera: Helcomyzidae). Journal of Insect Physiology 47: 95-109.
Klok, C. J., and S. L. Chown. 2003. Resistance to temperature extremes in sub-Antarctic weevils: interspecific variation, population differentiation and acclimation. Biological Journal of the Linnean Society 78: 401-414.
Mercer, R. D., S. L. Chown, and D. J. Marshall. 2000. Mite and insect zonation on a Marion Island rocky shore: a quantitative approach. Polar Biology 23: 775-784.
Sinclair, B. J. 2001. Field ecology of freeze tolerance: interannual variation in cooling rates, freeze-thaw and thermal stress in the microhabitat of the alpine cockroach *Celatoblatta quinquemaculata*. Oikos 93: 286-293.
Sinclair, B. J., and S. L. Chown. 2002. Haemolymph osmolality and thermal hysteresis activity in 17 species of arthropods from sub-Antarctic Marion Island. Polar Biology 25: 928-933.
Sinclair, B. J., and S. L. Chown. 2003. Rapid responses to high temperature and desiccation but not to low temperature in the freeze tolerant sub-Antarctic caterpillar *Pringleophaga marioni* (Lepidoptera, Tineidae). Journal of Insect Physiology 49: 45-52.
Smith, V. R., and M. Steenkamp. 1990. Climate change and its ecological implications at a subantarctic island. Oecologia 85: 14-24.
van der Merwe, M., S. L. Chown, and V. R. Smith. 1997. Thermal tolerance limits in six weevil species (Coleoptera, Curculionidae) from sub-Antarctic Marion Island. Polar Biology 18: 331-336.

12. **PARTICULARS OF A PILOT OR FEASIBILITY STUDY THAT HAS BEEN UNDERTAKEN.**

(Please give a short description of any pilot/feasibility study which may have been undertaken.)

This project will build on many years of experience conducting ecophysiological research in the sub-Antarctic and Antarctic, and we will therefore be using tried and tested methods. In addition, S.L. Chown has twenty years' experience of invertebrate research on Marion Island, and is thus familiar with the feasibility of the objectives with regard to the species we intend to study.

13. KEY QUESTIONS AND RESEARCH APPROACH

(Please provide a list of specific questions to be answered or hypotheses that will be tested and indicate how each is to be approached. In follow-up proposals, indicate and explain any changes from the previous proposal.)

1. What are some ecologically relevant stressful thresholds for Marion Island Invertebrates?

Using the approach of Sinclair (Sinclair 2001), we will use field-relevant cooling and desiccation rates to determine the upper limit of the Injury Zone (ULIZ – the temperature or water loss that first results in mortality, cf. Nedved et al. (1998)), the LT_{50} or $Lloss_{50}$ (the temperature/water loss that results in 50% mortality) and the LLT (lower lethal temperature) and Maximum survivable water loss. We will then use ecologically-relevant, sub-lethal stresses to address the remainder of the questions.

References:

Nedved, O., D. Lavy, and H. A. Verhoef. 1998. Modelling the time-temperature relationship in cold injury and effect of high-temperature interruptions on survival in a chill-sensitive collembolan. Functional Ecology 12: 816-824.

Sinclair, B. J. 2001. Field ecology of freeze tolerance: interannual variation in cooling rates, freeze-thaw and thermal stress in the microhabitat of the alpine cockroach *Celatoblatta quinquemaculata*. Oikos 93: 286-293.

2. What are the consequences of repeated exposure by Marion Island invertebrates to cold or desiccation stress?

We will use water baths, desiccation chambers, climate-control cabinets and appropriate monitoring equipment to expose a group of insects repeatedly to low temperature or desiccation stress (Klok and Chown 1997, Sinclair 1997, Worland et al. 1997, Klok and Chown 1998, Bale et al. 2000, Convey and Worland 2000, Klok and Chown 2000, Worland 2000, Hayward et al. 2001, Klok and Chown 2001, Sinclair 2001, Worland and Convey 2001, Klok and Chown 2003, Sinclair and Chown 2003). After each exposure, the insects will be allowed to recover, and a sub-sample will be removed for determination of body mass and composition (water, protein, carbohydrate and lipid content, and, for *Pringleophaga marioni* only, gut content composition). By this method, we will be able to plot the cumulative impacts of repeated exposure on aspects of body composition that have consequences for reproductive fitness. For freeze avoiding species, we will also periodically measure the (lethal) supercooling point using conventional techniques (Sjursen and Sinclair 2002) and Differential Scanning Calorimetry (see Block 1994). Changes in supercooling point (and therefore of cold tolerance strategy) will be monitored for freeze tolerant species exposed to low temperatures.

References:

Bale, J. S., W. Block, and M. R. Worland. 2000. Thermal tolerance and acclimation response of larvae of the sub-Antarctic beetle *Hydromedion sparsutum* (Coleoptera: Perimylopidae). Polar Biology 23: 77-84.

Block, W. 1994. Differential scanning calorimetry in ecophysiological research. Acta Oecologica 15: 13-22.

Convey, P., and M. R. Worland. 2000. Refining the risk of freezing mortality for Antarctic terrestrial microarthropods. CryoLetters 21: 333-338.

Hayward, S. A. L., J. S. Bale, M. R. Worland, and P. Convey. 2001. Influence of temperature on the hygropreference of the Collembolan, *Cryptopygus antarcticus*, and the mite, *Alaskozetes antarcticus* from maritime Antarctic. Journal of Insect Physiology 47: 11-18.

Klok, C. J., and S. L. Chown. 1997. Critical thermal limits, temperature tolerance and water balance of a sub-Antarctic caterpillar, *Pringleophaga marioni* (Lepidoptera: Tineidae). Journal of Insect Physiology 43: 685-694.

Klok, C. J., and S. L. Chown. 1998. Interactions between desiccation resistance, host-plant contact and the thermal biology of a leaf-dwelling sub-antarctic caterpillar, *Embryonopsis halticella* (Lepidoptera: Yponomeutidae). Journal of Insect Physiology 44: 615-628.

Klok, C. J., and S. L. Chown. 2000. Lack of cold tolerance in a small, brachypterous sub-Antarctic fly, *Apetaenus litoralis* Eaton (Diptera: Tethinidae), from Marion Island. African Entomology 8: 305-308.

Klok, C. J., and S. L. Chown. 2001. Critical thermal limits, temperature tolerance and water balance of a sub-Antarctic kelp fly, *Paractora dreuxi* (Diptera: Helcomyzidae). Journal of Insect Physiology 47: 95-109.

Klok, C. J., and S. L. Chown. 2003. Resistance to temperature extremes in sub-Antarctic weevils: interspecific variation, population differentiation and acclimation. Biological Journal of the Linnean Society 78: 401-414.

Sinclair, B. J. 1997. Seasonal variation in freezing tolerance of the New Zealand alpine cockroach *Celatoblatta quinquemaculata*. Ecological Entomology 22: 462-467.

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Sinclair, B. J., and S. L. Chown. 2003. Rapid responses to high temperature and desiccation but not to low temperature in the freeze tolerant sub-Antarctic caterpillar *Pringleophaga marioni* (Lepidoptera, Tineidae). Journal of Insect Physiology 49: 45-52.

Sjursen, H., and B. J. Sinclair. 2002. On the cold hardiness of *Stereotydeus mollis* (Acari: Prostigmata) from Ross Island, Antarctica. Pedobiologia 46: 188-195.

Worland, M. R. 2000. Temperature gradients in intact/undisturbed soil cores - an experimental system for use in freeze-thaw studies. Cryo-Letters 21: 71-72.

Worland, M. R., and P. Convey. 2001. Rapid cold hardening in Antarctic microarthropods. Functional Ecology 15: 515-524.

Worland, M. R., B. J. Sinclair, and D. A. Wharton. 1997. Ice nucleator activity in a New Zealand alpine cockroach *Celatoblatta quinquemaculata* (Dictyoptera: Blattidae). Cryo-Letters 18: 327-334.

3. Is there a difference in the cumulative effects of cold and desiccation stress between indigenous and alien species on Marion Island?

We will use the data from Key Question 2 to explicitly address this question by comparing appropriately (taxon- and size-) matched pairs of indigenous and alien Collembola.

4. To what extent are Marion Island invertebrates exposed to repeated environmental stresses, and how does this differ among habitats on the Island?

In collaboration with the Capacity-Building Programme for climate Change Research, we have been gathering microclimate data from an altitudinal transect on Marion Island since 2002. We will use these data, as well as other microclimate data gathered in the past for other purposes (Crafford and

Chown 1992, Blake 1996, M. A. McGeoch & P. Le Roux, in preparation) to determine the frequency and intensity of environmental stresses (as defined in Key Question 1) on Marion Island. Within the limits of the data, we will also attempt to determine how these stresses are likely to differ between habitats and altitudes.

References:

Blake, B. 1996. Microclimate and prediction of photosynthesis at Marion Island, Department of Botany and Genetics. University of the Free State, Bloemfontein.

Crafford, J. E., and S. L. Chown. 1992. Microhabitat temperatures at Marion Island. South African Journal of Antarctic Research 22: 51-58.

5. Given current climate change scenaria and information about cumulative responses by invertebrates to repeated environmental stresses, what are the likely physiological consequences of climatic change on Marion Island for the terrestrial invertebrates?

The ultimate goal of this research is to achieve two basic types of data: (1) a model allowing us to predict microhabitat temperatures from meteorological data and (2) a model allowing us to predict the physiological consequences of microclimate for a range of indigenous and non-indigenous invertebrates on Marion Island. We will then use detailed ecological and habitat knowledge available elsewhere (eg: references in Objectives and Rationale and Key Question 2), and current global circulation models (GCM) of climate change to make an initial attempt to draw conclusions about the environmental stress 'landscape' likely to be faced by Marion Island Invertebrates under a variety of climate change scenaria. It is likely that this will act as an hypothesis generation exercise, and will highlight profitable directions for future research to address the effects of climate change on terrestrial sub-Antarctic arthropods.

13.1 Please provide an indication of the unique multi-disciplinary nature of the research.

This project involves the combination of Insect Physiology, Ecology, Micrometeorology and Climate Change Modelling to address questions that are unable to be answered using a strictly unidisciplinary approach.

14. PROPOSED WORK PLAN

(Please describe the tasks to be undertaken during the whole project. Describe the methods to be used, indicate the persons and institutions involved and provide target dates for the start and completion of each task. In follow-up proposals, indicate and explain any changes from the previous proposal.)

Ecophysiology of Marion Island Arthropods (Key Questions 1-3)

Personnel:
Prof. Steven L. Chown, University of Stellenbosch
Dr Brent J. Sinclair, University of Stellenbosch
Dr Peter Convey, British Antarctic Survey
Dr M. Roger Worland, British Antarctic Survey

Time Frame:
Field Laboratory Work during 2004 Marion Island Relief Voyage
Further laboratory analyses (carbohydrates etc) in South Africa and the United Kingdom to be

completed by September 30 2004.

Methods:
Selected Arthropods (including *Pringleophaga marioni, Embryonopsis halticella*, several indigenous and alien Collembola species, and *Antaractipsocus jeanneli*)will be collected from appropriate field sites on Marion Island, and returned to the base for acclimation and physiological studies. Initially (1 week), we will determine their responses to cooling and desiccation under field-relevant conditions, and use these as the basis for further research.

We will then expose (pre-weighed and identified) groups of animals to repeated cold or desiccation stress (likely at 12, 24 and 48 hour frequency), allowing recovery between, and removing groups of individuals for determination of Mass, Water content, Lipid content, and samples will be extracted and frozen for further laboratory analysis in South Africa and the United Kingdom. We will also frequently measure supercooling point (SCP) and Critical Thermal minimum (CTmin) to detect any changes in these parameters with repeated freezing and thawing. We will aim for 5 repeats of each stress at each frequency (requiring a maximum of ten days for the longest frequency).

Frequency of Stressful conditions experienced by Marion Island Arthropods (Key Question 4)

Personnel:
Dr B.J. Sinclair
Prof. S.L. Chown

Time Frame:
Begin May 2004, end September 2004.

Methods:
We will compile microclimate data from a variety of published (see references for Key Question 4) and unpublished sources (S. L. Chown, V.R. Smith & B. Blake, M.A. McGeoch) and use threshold-based analyses (Sinclair 2001a, b) to determine the frequency and intensity of thermally stressful episodes, as defined by thresholds defined in preliminary work in Key Question 1 and 2. We will then compare the overall 'stress landscape' for introduced and indigenous arthropods. This analytical work will be conducted at the University of Stellenbosch.

References:
Sinclair, B. J. 2001a. Field ecology of freeze tolerance: interannual variation in cooling rates, freeze-thaw and thermal stress in the microhabitat of the alpine cockroach *Celatoblatta quinquemaculata*. Oikos 93: 286-293.

Sinclair, B. J. 2001b. Biologically relevant environmental data: Macros to make the most of microclimate recordings. Cryo-Letters 22: 125-134.

Physiological Consequences of climate Change for Marion Island Invertebrates

Personnel:
Prof. S.L. Chown
Dr B.J. Sinclair
Dr P. Convey
Dr M.R. Worland
Mr. T. Lado (Ph.D. student)
Consultant GIS Specialist

Time Frame:
Begin May 2004, conclusion December 2005

Methods:
We will use conventional and Neural-Network modelling techniques to develop a model that allows us to predict microclimate temperatures from meteorological data gathered on Marion Island. We will then use similar techniques, in combination with the data from Key Questions 1-4, and previously published data on the ecophysiology of Marion Island arthropods to create a model of potential consequences of environmental conditions for the arhropods. These two models will then be combined into a supermodel allowing us to predict the physiological consequences of invertebrates from meteorological data. We will then create a synthetic meteorological dataset by applying GCM predictions of climate change to a five-year meteorological dataset and run the supermodel to derive predictions of potential physiological consequences of climate change on Marion Island invertebrates. While this will not by any means represent a final model, it is widely recognised that such modelling activities serve an important purpose as hypothesis-generation and strategic management tools.

14.1 Is this project a co-operative/collaborative project. Please provide summary information on the associated projects and discuss the role of this project in the total programme.

- This project will address Research Focus 2 ('How do organisms and communities respond to abiotic variables along the Antarctic Environmental Gradient and how will climate change affect these responses?') of SCAR's Regional Sensitivity to Climate Change (RiSCC) Research Programme (www.riscc.aq).
- Through interactions in the Laboratory and at the University of Stellenbosch, we will work closely with the USAID-funded Capacity Building Programme for Climate Change Research (http://www.sun.ac.za/zoology/space/climate/index.htm), contributing to the realisation of its scientific, outreach and capacity-building goals by sharing information and experience.
- B.J. Sinclair is supported by a New Zealand Foundation for Research, Science and Technology Research Fellowship to investigate 'The ecophysiology of arthropods living in extreme environments', and this work will contribute indirectly to the realisation of the goals of that project.
- This project involves collaboration with two senior researchers from the British Antarctic Survey, largely under the auspices of RiSCC.
- Our goals of integrating physiological information with micro- and macro-climate data and models is also being pursued in three locations in Southern Africa, in projects funded by the National Geographic Society ('Cold Tolerance of Southern African Insects', PI: B.J. Sinclair) and the National Research Foundation (Species Responses to Climate, PI: S.L. Chown). The present proposal would provide a complementary dataset from the sub-Antarctic that will allow comparison with continental data, and we anticipate significant sharing of intellectual resources between these three projects.

15. **WILL THE PROJECT LEADER BE AWAY FOR ANY SIGNIFICANT PERIODS WHILE THE PROJECT IS IN PROGRESS?**

No

15.1 If yes, describe the arrangements made for leadership and supervision during his/her absence.

16. **END PRODUCT OF THE PROJECT**

(Describe the planned final products that will result from the project (i.e. the nature of the final report, maps, etc.) and state when they will be submitted. All DEAT funded projects should include the text for a popular publication which will be used to bring the results of the research to the general public or to a specific user group.)

The primary goal of this project is to produce peer-reviewed scientific papers. We aim to begin submitting these papers to Journals by September 2004. In addition, it will contribute to the completion of a PhD thesis by T. Lado at the end of 2006. We anticipate presenting some of the results of this project at the SCAR IX Biology Symposium and the International Congress of Entomology in 2004.

17. **DISCUSS ANY POTENTIAL IMPACT YOUR STUDY WILL HAVE ON THE ENVIRONMENT AND DESCRIBE MITIGATING ACTIONS WHICH YOU PROPOSE TO MINIMIZE OR ELIMINATE THE IMPACT**

The following guidelines are provided to assist applicants with questions relating to the potential environmental impact of a proposal.

(i) Proposals for the continuation of ongoing projects should state clearly if any changes are proposed in field methods, work programmes, camp sites, and timing from those documented in the original proposal, or subsequent modifications to it.

(ii) The proposer should list aspects of the proposed activity, that have not been noted, that might cause impacts on the Antarctic environment (e.g. visual impact or other forms of disturbance).

(iii) In making all these assessments of impact, the proposer should briefly consider the nature, duration and intensity of the likely environmental effects, including the following;

a. the existing environment, its variability or dynamic nature, resilience to change, sensitivity to disturbance, previous disturbance, protected status etc;

b. cumulative and possible indirect impacts;

c. the probability of accidents and their environmental consequences;

d. the adequacy of existing information and knowledge.

(iv) A map of the area should be included (sketch if necessary) to assist the interpretation of this section of the research application.

Proposers are expected to provide sufficient information in their answers to allow the DEA & T to make a thorough, complete and accurate evaluation of the environmental impact of the project. Insufficient information will require follow-up action and/or may prejudice the environmental acceptability of the project.

Preliminary Environmental Evaluation

Details of Activities
Answer all questions only if work is to be carried out in Antarctica or Marion Island during 20____/ 20____

If you answer "Yes" to any of these questions, a full description of proposed activity, including proposals for mitigating and monitoring these impacts, is required.

It is important that you provide maps detailing the proposed research areas (hand drawn sketches are acceptable).

Will your objective:
a. Use a radionuclide? Yes [ ] No [X]

If Yes, complete the following:

Radionuclide	Chemical form	Quantity (Curies)	Half Life (Years)

Detail procedures you will take to ensure that no radiation will enter the Antarctic or sub-Antarctic environment from use or spillage.

b. Take any chemical to Antarctica or Marion Island?

Yes [X] No [ ]

If Yes, complete the following:

Chemical	Formula	Quantity	Use
Chloroform	CH_4	2 l	Lipid extraction
Ethanol	C_2H_7OH	10 l	Preservation of insects and extraction of Carbohydrates
Silica Gel		5 kg	Desiccant

Unused chemicals will be: [ ] Left at SANAE Base

[X] Returned to South Africa

[ ] Other

If Other, detail disposal procedure:

c. Release any chemical to the Antarctic or sub-Antarctic Environment?

Yes [ ] No [X]

If Yes, detail the need to release, the chemical, the amounts involved and the location.

d. Require the use of explosives? Yes [ ] No [X]
If Yes, complete the following:

How will the explosives be used?

Detail any precautions taken to minimise disturbance to any wildlife or plants:

Explosive Type	Number of detonations	Charges per detonation (kg)	Total weight (kg)

e. Collect, capture, kill, restrain, tag or band any terrestrial, freshwater or marine plants or animals?

Yes [X] No [ ]

If Yes, complete the following:
For each species (apart from those taken using plankton nets or trawl), estimate the proportion of the local population you will be collecting, capturing, killing, tagging or banding. If restraining, include period of restraint:

Species	**Method**	**Number**	**Proportion of Population (%)***
Pringleophaga marioni	Hand collection from abandoned Albatross Nests	Not more than 1000	c. 0.1% of local population
Embryonopsis halticella	Collection from *Poa cookie* tussocks	Not more than 1000	<0.1% of population
Pogonognathellus flavescens	Hand collection	Not more than 10000	<0.001% of population
Isotomurus cf. palustris	Hand collection	Not more than 10000	<0.001% of population
Cryptopygus	Hand collection	Not more than 10000	<0.001% of population

antarcticus			
Antarctopsocus jeanneli	Hand collection	Not more than 10000	<0.001% of population
Paractora dreuxi	Hand collection	Not more than 4000	<0.01% of population
Hypogastrura viatica	Hand collection	Not more than 10000	<0.001% of population

*Population impacts estimated from data provided in Gabriel et al. 2001. Ecography 24, 421-430, and Haenel. 1999. M.Sc. Thesis, University of Pretoria.

For each species, indicate the proportion of the local population you will be disturbing while carrying out the above activities.

____

____

f. Enter any Protected Area? Yes [x] No [ ]

If Yes, complete the following:

Name of Protected Area	Duration of Visit	Total person-days
Marion Island Zones 1,2 & 3	Relief Voyages 2004 and 2005	120

Detail why the work must be carried out within the Protected Area:
Many of the species we intend to investigate do not occur abundantly in Zones 1-2. Moreover, altitudinal variation in microclimate can only be examined across a gradient that extends outside the limits of Zone 2.

g. Take to Antarctica or Marion Island any animal, plant (includes seeds), micro-organism or soil?

Yes [ ] No [X]

If Yes, complete the following:

Species	Quantity

Detail why these materials need to be taken to Antarctica:

____

Detail the quarantine procedures you will undertake to ensure that there is no release to the Antarctic environment:

h. Significantly disturb by flooding, sampling, trampling, camp operations or any other means any ice-free area (bare ground)?

Yes [ ] No [X]

If Yes, complete the following:

Briefly describe any such significant disturbance:

Detail any steps you will take to minimise such disturbance:

i. Take or remove any physical specimens eg. rocks, fossils etc?

Yes [ ] No [X]

If Yes, detail the general area and types of specimens to be collected:

Location	Specimen	Type	Total Number of Weight

j. Cumulative Impacts.

Occupy new or existing camp sites? [ ] New

[X] Old

[ ] Both old and new sites

If new, list these sites and indicate why a previously impacted site cannot be used.

____

____

Will you track previously untracked ground?

Yes [ ] No [X]

If Yes, state why this is necessary:

____

____

Will you install equipment, markers, stakes, cairns etc. that will be left in the field?

Yes [ ] No [X]

If Yes, detail location and type of marker, stake etc:

Location	Type

k. Do you expect your activities to have an environmental impact not covered in the above?

Yes [ ] No [X]

If Yes, fully detail impacts:

____

____

____

l. Is the proposed activity likely to have more than a minor or transitory impact?

Yes [ ] No [X]

If Yes, a CEE will be required:

18. FINANCIAL REQUIREMENTS

18.1 MANPOWER

(Please provide details of all persons involved and/or employed and/or applied for including <u>ad hoc</u> help on a part-time basis.)

No Antarctic Officers and/or technical/administrative personnel will be funded - the management and administration of the specific project will be the responsibility of the project leader. The Department will only fund home-based researchers appointed on bursaries, and no allowances will be made for the payment of service benefits, such as housing subsidies, medical aids, pensions, etc.

In follow-up proposals explain any changes from the projection given in the previous proposal.

Name, qualifications, past experience and function in this Project	Time available for this project (% of full-time man-year)	Nature and Source of non-SANAP funding	Amount requested from SANAP
Prof. S.L. Chown	10%	Salary from University of Stellenbosch	Nil
Dr B.J. Sinclair	30%	Support from FRST	Nil
Dr P. Convey	10%	Support from BAS	Nil
Dr M.R. Worland	10%	Support from BAS	Nil
Total			

18.2 RUNNING EXPENSES

(Please complete all sections. Indicate non-SANAP funds available. That, if a University decides to suggest a research proposal, the University itself must render the necessary support services, such as photocopies, telephone calls, postage, etc. If a research project requires technical support services, the time required must be budgeted for instead of a designated appointment.)

In follow-up proposals explain any changes from the projections given in the previous proposal.

Items	Nature and source of non-SANAP funding	Funds requested From SANAP
Transport (sea, air and land with distances and rates) Air Travel UK-South Africa (Convey and Worland) Local Travel (To Airport, Stores and Dock from Stellenbosch)	 Requested from BAS	 Nil 1 400
Subsistence (nature and rates) Accommodation and Subsistence (Convey and Worland) in Stellenbosch (5 nights x 2 people x R400/night)		 4 000
Supplies and services (please specify) Gas Chromatography Consumables (Silation reagent, Extraction reagents, Standard Solutions, Gas, Vials, Caps, Use of Freeze-Drier) Laboratory chemicals (non-Gas Chromatography; includes analytical grade solvents, desiccants and internal standards) Field and Laboratory consumables (Plastic containers, tubing, circulating fluids for water baths, plastic bags, storage boxes and labelling equipment) Data analysis by GIS modelling, consultation at R 500 per hour x 20 h		 20 000 4 000 4 000 10 000
Total		43 400

18.3 CAPITAL EQUIPMENT

(Please describe the items required.)

Items paid for in full by SANAP remain the property of DEAT. Items to which the participating organization contribute 50% or more of the cost, become the property of the organization.

In follow-up proposals, please explain any changes from the projections given in the previous proposal.

Description of item and total cost	Non-SANAP Funding (R)	Non-SANAP application	Amount requested from SANAP
Campbell CR10 datalogger c. R 30 000 (US)	30000		
Grant Squirrel SQ-800 data logger R 18 971 (US)	18971		
Grant LTD20 waterbath c. 50 000 (SANAP)			Owned by SANAP
Pico Technology TC-08 datalogger R 4 731 (US)	4731		
FreezWilly 1 Peltier cooling device c. R 30 000 (US)	30000		
Grant LTC12 waterbath c. R 70 000 (US)	70000		
Sable Systems PTC-1 peltier-effect temperature cabinet R 20 000 (US)	20000		
Incubators and refrigerators (Marion Island) c. R 100 000 (SANAP)			Owned by SANAP
Agilent Technologies 6850 Gas Chromatograph R 240 000 (US)	240000		
Mettler-Toledo UMX-2 microbalance R 109 159 (US)	109159		
Mettler-Toledo 4 d. p. balance c. R 40 000(SANAP)			Owned by SANAP
Mettler-Toledo TA8000 Differential Scanning Calorimeter c. £ 100 000 (BAS)	1324626		
Total	1 847 487		Nil

A short motivation must be provided for each item requested. Please supply a quotation for all items requested.

18.4 LOGISTIC SUPPORT

(Please assess your support requirements carefully. The details provided will be used to develop the support for your project, as well as the total integrated support for all programmes. *You will be required to complete this section for each voyage undertaken.*)

Volume and mass of cargo ___8___ m^3 ___800___ kg

Description of cargo
Scientific equipment and consumables

Destination where cargo is required

Marion Island

Radio-active and other hazardous cargo.
Please provide details of materials and how they will be used. State special precautions to be undertaken.

Ethanol and Chloroform need to be stored in a flammable store. Ethanol is used for insect preservation, Chloroform will be used for lipid extraction in the fume cupboard in the lab on Marion Island.

Accommodation requirements

Ship: S.A. Agulhas or Marion Relief Vessel

Number of persons: 4

Period Relief Voyages in 2004 and 2005

Base: Marion Island

Number of persons: 4

Period: Relief periods in 2004 and 2005

Ship's time required: None

Sampling locations at sea (please attach a detailed map):
None

Laboratory requirements (ship):
None

Laboratory requirements (base):

Access to microbiology laboratory for 4 people at Marion Island

Type of equipment requiring deployment from ship:

Fragile scientific equipment as indicated above. Helicopter deployment preferable.

Small boat needs (locality and time):
None

Surface vehicle needs:
None

Helicopter support (describe fully e.g. time, locality, special requirements):

Helicopter support to Katedraalkrans and to and from West Coast, once during each relief

Camping equipment
None

No of persons / teams

Special equipment:
None

Protective clothing
Proper rain gear.

No of persons
4

List any special requirements:

Please list any special needs:

19. **PARTICULARS OF RESEARCH/STUDY ABROAD**

19.1 Reasons why it is necessary to undertake the research/study abroad.

N/A

19.2 What arrangements have been made for overseas research/study?

N/A

19.3 Period that will be spent abroad

Date of departure: ______________

Date of return: __________________

19.4 Subsistence and transport
(Calculations should be made at the current public service rates.)

Place	Type of accommodation	No of days	Costs
Total			

19.5 Travel costs

Type of Transport	Destination	Distance	Costs
Total			

20. **STATEMENT BY APPLICANT**

I declare that the foregoing information is correct.

Signature ______________ Date 24/6/2003

21. **RECOMMENDATION BY THE RESEARCH OR EQUIVALENT COMMITTEE OF THE APPLICANT'S ORGANIZATION**

DIE UNIVERSITEIT VAN STELLENBOSCH ADMINISTRASIEGEBOU
24 JUN 2003
THE UNIVERSITY OF STELLENBOSCH ADMINISTRATION BUILDING

~~Chair~~ Director: Research ______________ Date ______________

I certify that the information contained in this application is correct and that if SANAP financial support is provided, it will be utilised in accordance with the conditions as laid down by the DEAT.

Project Leader ______________ Date 24/06/2003

Head of (~~Department~~ Organization) ______________ Date 24/6/2003

Head of (~~Organization~~ Department) ______________ Date 24/6/2003

22. **COMMENT AND RECOMMENDATION BY SANAP**

Chair ______________ Date ______________

Appendix 1

ETHICAL REQUIREMENTS FOR RESEARCH ON THE PRINCE EDWARD ISLANDS
Questionnaire to be completed by reviewing ethical committee

Kindly take note that according to National Regulations, research on invertebrates does not require ethics clearance.

This questionnnaire represents the minimum ethical requirements for research on the Prince Edward Islands. It is not intended as an alternative to the reviewing ethical committee's review process and guidelines, but as a supplement to it and as such represents a standardised format whereby the Department of Environmental Affairs and Tourism can ensure that research conducted on the Prince Edward Islands is of a high ethical standard.

The questionnaire is based on the National Code for the handling and Use of Animals in Research, Education, Diagnosis and Testing of Drugs and Related Substances in South Africa (1990) and expects of the reviewing committee to indicate whether certain aspects of the proposed projects have been reviewed by it or not. Please note that these questions are applicable only if the proposed project affects vertebrate animals. Where a question is not relevant, please indicate either *no comment*, *not enough information*, or *not applicable*. Space is provided below for comments on any of the questions. Please refer to the question number when commenting.

QUESTION	REVIEWED Indicate either Yes / No / No comment / Not enough information / Not applicable
Part 1. Professional detail regarding applicant and co-workers	
I Applicant name and affiliation	
II Whether the following information about persons responsible for applying proposed research techniques has been provided:	
i. names	
ii. qualifications (academic or technical)	
iii. description of each person's experience in proposed techniques	

III Whether the following information about other co-workers has been provided:	
i. names	
ii. qualifications	
iii. affiliation	

QUESTION	REVIEWED Indicate either Yes / No / No comment / Not enough information / Not applicable
Part 2. Ethical aspects with regard to proposed research project	
i. whether the project's contribution to the relevant scientific field justifies any possible pain or discomfort caused to animals during the course of research	
ii. whether alternatives to animal models are necessary or available	
iii. whether proposed methods/techniques are acceptable in terms of the level of risk to the animal subject's life or well-being	
iv. whether techniques to be applied in the project has been refined through planning and pilot studies	
v. whether the trial/survey is statistically valid (i.e. not wasteful of its animal subjects)	
vi. whether treatments and/or clinical procedures applied and/or surgery done to animals are justifiable and humane	
vii. whether vertebrate animal capture techniques (including drugs used where applicable) is appropriate and humane	
viii. whether systems and techniques for the handling of animals during research is appropriate and humane	
ix. whether facilities for the handling and housing of restrained/captive animals are appropriate, adequate and humane	
x. whether there is adequate planning in the event of emergencies or in the case of unexpected results which may cause unnecessary and excessive pain and suffering to the animals	
xi. whether methods proposed to handle carcases of animals that die during the period they are in the care of the applicant are adequate and appropriate	
xii. whether proposed methods of euthanisation (including any proposed pest extermination methods) are justifiable and humane	
xiii. whether the experience and qualifications of the researcher and his/her assistants is adequate and appropriate for the proposed techniques (including the admninistration of any drugs)	
xiv. whether all drugs that are to be used in the proposed techniques are accompanied by the appropriate prescription forms	
xv. whether veterinary supervision/consultation is necessary and if so, adequate	
xvi. whether the applicant and his/her co-workers and assistants are familiar with standard guidelines for the ethical manipulation and	

care of experimental animals and the laws governing these	

Author: TD Wassenaar, CERU, Dept Zoology & Entomology, University of Pretoria, Pretoria, 0002

COMMENTS:

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HEAD OF ETHICS COMMITTEE

DATE

Appendix 2

DELIVERABLES

(SANAP-RELATED ONLY)

A. CURRENT SANAP RESEARCH CYCLE: 1 April 2001 – 31 March 2005

Kindly indicate what the expected deliverables of your project will be for the duration of the current research cycle, including the one year extension, with respect to the following:

- Number of Honours, MSc and PhD students expected to be trained/obtained *(if in progress, please list name, degree and year of completion – add further lines if necessary)*

Honours → [ ]

MSc → [ ]

PhD → [ ]

NAME	DEGREE	YEAR

- Estimated number of scientific publications to be published in accredited scientific journals

[5]

- Estimated number of scientific papers to be presented at local and international conferences

LOCAL → [3]

INTERNATIONAL → [3]

- How and to what level you intend enhancing transformation/capacity building/representivity levels in your project

We will work closely with the USAID-funded Capacity-Building Programme for Climate Change Research (CBP-CCR), which will have students on Marion Island during the Relief Voyages we have applied for. It is anticipated that the researchers from this project will interact closely with the CBP-CCR students, both scientifically and socially, before, during and after the relief voyages. Thus the students will be exposed to high-quality experienced scientific input beyond the level already provided by the CBP-CCR, enhancing the goals of that (explicitly capacity-building) programme.

- The project's contribution to the public understanding of Science and Technology

All of the project's scientists have a background in public dissemination of their Science, and it is anticipated that (again, in collaboration with the CBP-CCR), we will make several press releases highlighting the international nature of the collaboration, and any results of general interest from the project.

B. <u>PREVIOUS SANAP RESEARCH CYCLES: All previous cycles up until 31 March 2001</u>

If you have previously received SANAP funding, please indicate the following for <u>ALL previous SANAP research cycles</u>:

N.B. PLEASE NOTE THAT THE PAPERS LISTED BELOW INCLUDE THOSE PRODUCED UNDER THE AUSPICES OF THE CAPACITY BUILDING PROGRAMME FOR CLIMATE CHANGE RESEARCH, A SANAP/DEAT/USAID/U. STELLENBOSCH COOPERATIVE PROJECT, AND UNDER THE AUSPICES OF THE DARWIN INITIATIVE/DEAT COLLABORATION. MOREOVER, THEY DO NOT INCLUDE WORKS BY D.J. MARSHALL AND P.G. RYAN, WHO COLLABORATED ON PREVIOUS PROJECTS, BUT WHO ARE NOT CO-INVESTIGATORS HERE.

- Number of scientific papers published in accredited journals from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *<u>(please attach complete list)</u>*

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- Number of completed Honours, MSc and PhD degrees from members of your group from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please <u>list name, degree and year of completion – add further lines if necessary)</u>*

  Honours → 0

MSc → 4

PhD → 1

NAME	DEGREE	YEAR
J. Barendse	M.Sc.	1999
A.G.A Gabriel	M.Sc.	1998
C. Haenel	M.Sc.	1999
R. D. Mercer	M.Sc.	2000
C.J. Klok	Ph.D.	1998

PUBLICATIONS LISTING

A. SCIENTIFIC PUBLICATIONS IN PEER-REVIEWED JOURNALS

I. PRIMARY RESEARCH

1986

Crafford, J.E., Scholtz, C.H. & **Chown, S.L.** 1986. The insects of sub-Antarctic Marion and Prince Edward Islands; with a bibliography of entomology of the Kerguelen Biogeographical Province. *South African Journal of Antarctic Research* **16**, 42-84.

1987

Crafford, J.E. & **Chown, S.L.** 1987. *Plutella xylostella* L. (Lepidoptera: Plutellidae) on Marion Island. *Journal of the Entomological Society of Southern Africa* **50**, 259-260.

1989

Chown, S.L. 1989. Habitat use and diet as biogeographic indicators for subantarctic Ectemnorhinini (Coleoptera: Curculionidae). *Antarctic Science* **1**, 23-30.

Chown, S.L. & Scholtz, C.H. 1989. Biology and ecology of the *Dusmoecetes* Jeannel (Col. Curculionidae) species complex on Marion Island. *Oecologia* **80**, 93-99.

Chown, S.L. & Scholtz, C.H. 1989. Cryptogam herbivory in Curculionidae from the sub-Antarctic Prince Edward Islands. *The Coleopterists Bulletin* **43**, 165-169.

Chown, S.L. & Scholtz, C.H. 1989. Immature stages of Curculionidae (Coleoptera) from the sub-Antarctic Prince Edward Islands. *Journal of the Entomological Society of Southern Africa* **52**, 253-275.

1990

Chown, S.L. 1990. Speciation in the sub-Antarctic weevil genus *Dusmoecetes* Jeannel (Coleoptera: Curculionidae). *Systematic Entomology* **15**, 283-296.

Chown, S.L. 1990. Possible effects of Quaternary climatic change on the composition of insect communities of the South Indian Ocean Province Islands. *South African Journal of Science* **86**, 386-391.

Chown, S.L. & Scholtz, C.H. 1990. Description of the larva of *Christensenia antarctica* Brinck with implications for the phylogeny of Ectemnorhinini (Curculionidae). *The Coleopterists Bulletin* **44**, 255-264.

1991

Crafford, J.E. & **Chown, S.L.** 1991. Comparative nutritional ecology of bryophyte and angiosperm feeders in a sub-Antarctic weevil species complex (Coleoptera: Curculionidae). *Ecological Entomology* **16**, 323-329.

1992

Chown, S.L. 1992. A preliminary analysis of sub-Antarctic weevil assemblages: Local and regional patterns. *Journal of Biogeography* **19**, 87-98.

Chown, S.L. & Avenant, N. 1992. Status of *Plutella xylostella* at Marion Island six years after its colonization. *South African Journal of Antarctic Research* **22**, 37-40.

Chown, S.L. & Crafford, J.E. 1992. Microhabitat temperatures at Marion Island (46°54'S 37°45'E). *South African Journal of Antarctic Research* **22**, 51-58.

Chown, S.L. & Van Drimmelen, M. 1992. Water balance and osmoregulation in weevil larvae (Coleoptera: Curculionidae: Brachycerinae) from three different habitats on Subantarctic Marion Island. *Polar Biology* **12**, 527-532.

Theodorides, J. & **Chown, S.L.** 1992. On the occurrence of *Gregarina munieri* (A. Schneider) (Apicomplexa, Eugregarina, Gregarinidae) in weevils (Coleoptera, Curculionidae) from Marion Island. *Bulletin de la Société Française de Parasitologique* **10**, 27-29.

1993

Chown, S.L. 1993. Instar number and mass of *Palirhoeus eatoni* (C.O. Waterhouse) and *Bothrometopus randi* Jeannel (Coleoptera: Curculionidae) from Subantarctic Marion Island. *The Coleopterists Bulletin* **47**, 69-73.

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II. SCIENCE POLICY & IMPLICATIONS

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B. PEER-REVIEWED CONTRIBUTIONS TO BOOKS

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Appendix A: Literature summary

Note: there are over 5000 published papers on insect cold tolerance alone. This summary is merely to serve as an introduction to the recent literature, and makes use of review articles as much as possible.

Cumulative Effects of Temperature and desiccation Stress on Arthropods.

Environmental stressors, including desiccation and cold, are (together with biogeography and isolation) the major factors limiting arthropod distribution, colonization and invasion in the Southern Ocean and South Polar regions (Kennedy 1995, Bergstrom and Chown 1999, Kennedy 1999, Chown et al. 2002b). Climate change will result in changes in the variables driving these stressors (eg: insolation, precipitation and temperature), leading to an alteration of the environmental stress landscape for arthropods living in the region (Smith and Steenkamp 1990, Kennedy 1995, Chown et al. 1998, Bergstrom and Chown 1999, Doran et al. 2002, Sinclair 2002). We propose to address the effects of repeated exposure to environmental stress, and to put this into the context of predicted effects of climate change on Marion Island and elsewhere.

Desiccation resistance (see (Hadley 1994, Sømme 1995, Addo-Bediako et al. 2001) for a summary of the main features of arthropod water balance and the associated literature) and cold tolerance (see (Convey 2000, Ramløv 2000, Bale 2002, Sinclair et al. 2003) for summaries of the main features of insect cold tolerance physiology) are extremely useful physiological parameters because they are essential to survival in cold environments, plastic at multiple scales, from short-term to evolutionary (Lee et al. 1987, Lee 1991, Gibbs et al. 1997, Kelty and Lee 1999, Addo-Bediako et al. 2001, David and Vannier 2001, Hoffmann et al. 2001b, Sjursen et al. 2001, Holmstrup et al. 2002, Watanabe et al. 2002, Sinclair and Chown 2003, Sinclair et al. 2003), and because there are readily quantifiable measures of tolerances to both stresses available (eg: (Edney 1977, Cannon and Block 1988, Ring 1990, Hadley 1994, Hoffmann et al. 2001a, Hoffmann et al. 2001b, Holmstrup et al. 2001, Naidu 2001, Sinclair and Sjursen 2001, Stark and Gothe 2001, Vernon and Vannier 2001, Worland and Convey 2001, Chown 2002, Holmstrup et al. 2002, Juliano et al. 2002, Sinclair and Chown 2003). Because changes in habitat temperature and water availability are likely as a consequence of climate change (IPCC 2001), the responses of arthropods to these factors have received some attention as indicators and as consequences of this change (eg: (Block and Harrisson 1995, Coulson et al. 1995, Kennedy 1996, Virtanen et al. 1998, Convey and Arnold 2000, Coulson et al. 2000, Sinclair 2001, Doran et al. 2002, Irwin and Lee 2003). However, these models and predictions are based around static laboratory treatments, and are almost always conducted under the assumption that there are few cumulative effects of exposure to the stresses in question, in spite of both speculation (Sinclair 2001, Sinclair et al. 2003) and evidence (Bale et al. 2001) that there are significant cumulative effects, which may take the form of either acclimatory responses (increasing the likelihood of survival) or deleterious effects (resulting in cumulative damage). Indeed, Bale et al. (2001) found that repeated exposure actually resulted in a switch in the strategy of cold tolerance in sub-Antarctic beetles. In addition, the rapid cold hardening (RCH) response (Lee et al. 1987, Kelty and Lee 1999, Rinehart et al. 2000, Kelty and Lee 2001, Worland and Convey 2001) and cross tolerances with desiccation, anoxia and other stressors (Coulson and Bale 1991, Yocum et al. 1991, Chen and Denlinger 1992, Tammariello et al. 1999, Bayley et al. 2001, Sinclair and Chown 2003) and acclimation effects on desiccation tolerance (eg: (Bayley et al. 2001)) all suggest that there may be significant cumulative responses that are currently unaccounted for in models of insect responses to environmental stress.

Although modeling of species responses to environmental change is considerably advanced at a broad scale (eg: (Virtanen et al. 1998, Erasmus et al. 2002)), at the scale of the microhabitat significantly less is known, although it is apparent that the interactions between macroclimate (that usually modeled in Global

Circulation Models of climate change) and microclimate (that experienced by the animal) is often complex and counterintuitive (eg: (Irwin and Lee 2000, Sinclair 2001, Helmuth et al. 2002)). However, species-specific modeling has been accomplished for some plant communities (e.g. Gottfried et al. 1999, Callaway et al. 2002) and species (e.g. Dole et al. 2003). Extreme environment systems like the sub-Antarctic promise to be an important proving ground for the extension of such models to arthropods because they are relatively simple communities in which population dynamics and interspecific interactions are likely driven or regulated by the abiotic environment (Block 1994, Bergstrom and Chown 1999, Virginia and Wall 1999, Chown et al. 2002a). In addition, the extent and rate of change in climate in these systems will (from an academic perspective) the testing of the models within the lifetime of the modeler, and (from the management perspective) an important tool for maintaining biodiversity.

Cold and desiccation resistance have been well-studied in the Arthropods on Marion Island (eg: (Crafford and Chown 1992, Klok and Chown 1997, van der Merwe et al. 1997, Klok and Chown 2000, Barendse and Chown 2001, Klok and Chown 2001, Chown et al. 2002b, Sinclair and Chown 2002, 2003)), providing an excellent platform from which to address these issues on the island.

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Sinclair, B. J., and S. L. Chown. 2003. Rapid responses to high temperature and desiccation but not to low temperature in the freeze tolerant sub-Antarctic caterpillar *Pringleophaga marioni* (Lepidoptera, Tineidae). Journal of Insect Physiology 49: 45-52.

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Virginia, R. A., and D. H. Wall. 1999. How soils structure communities in the Antarctic Dry Valleys. BioScience 49: 973-983.

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Appendix B: Publications

S.L. Chown

I. Mainstream peer-reviewed literature

1998

Chown, S.L., Gaston, K.J. & Williams, P.H. 1998. Global patterns in species richness of pelagic seabirds: the Procellariiformes. *Ecography* **21**, 342-350.

Chown, S.L., Gremmen, N.J.M. & K.J. Gaston, K.J. 1998. Ecological biogeography of southern ocean islands: Species-area relationships, human impacts, and conservation. *American Naturalist* **152**, 562-575.

Chown, S.L., Pistorius, P. & Scholtz, C.H. 1998. Morphological correlates of flightlessness in southern African Scarabaeinae (Coleoptera: Scarabaeidae): Testing a condition of the water conservation hypothesis. *Canadian Journal of Zoology* **76**, 1123-1133.

Gremmen, N.J.M., **Chown, S.L.** & D.J. Marshall, D.J. 1998. Impact of the introduced grass *Agrostis stolonifera* on vegetation and soil fauna communities at Marion Island, sub-Antarctic. *Biological Conservation* **85**, 223-231.

Hänel, C. & **Chown, S.L.** 1998. The impact of a small, alien macro-invertebrate on a sub-Antarctic terrestrial ecosystem: *Limnophyes minimus* Meigen (Diptera, Chironomidae) at Marion Island. *Polar Biology* **20**, 99-106.

Hänel, C., **Chown, S.L.** & Davies, L. 1998. Records of alien insect species from sub-Antarctic Marion and South Georgia Islands. *African Entomology* **6**, 366-369.

Hull, H.E., Freitag, S., **Chown, S.L.** & Bellamy, C.L. 1998. Identification and evaluation of priority conservation areas for Buprestidae (Coleoptera) in South Africa, Lesotho, Swaziland and Namibia. *African Entomology* **6**, 265-274.

Klok, C.J. & **Chown, S.L.** 1998. Field thermal ecology and water relations of *gregaria* phase african armyworm caterpillars, *Spodoptera exempta* (Lepidoptera: Noctuidae). *Journal of Thermal Biology* **23**, 131-142.

Klok, C.J. & **Chown, S.L.** 1998. Interactions between desiccation resistance, host-plant contact and the thermal biology of a leaf-dwelling sub-Antarctic caterpillar, *Embryonopsis halticella* (Lepidoptera: Yponomeutidae). *Journal of Insect Physiology* **44**, 615-628.

Le Lagadec, M.D., **Chown, S.L.** & Scholtz, C.H. 1998. Desiccation resistance and water balance in southern African keratin beetles (Coleoptera, Trogidae): the influence of body size, habitat and phylogeny. *Journal of Comparative Physiology B* **168**, 112-122.

McGeoch, M.A. & **Chown, S.L.** 1998. Scaling up the value of bioindicators. *Trends in Ecology & Evolution* **13**, 46-47.

Van Jaarsveld, A.S., Freitag, S., **Chown, S.L.**, Muller, C., Koch, S., Hull, H., Bellamy, C., Krüger, M., Endrödy-Younga, S., Mansell, M.W. & Scholtz, C.H. 1998. Biodiversity assessment and conservation strategies. *Science* **279**, 2106-2108.

Van Jaarsveld, A.S., Gaston, K.J., **Chown, S.L.** & Freitag, S. 1998. Throwing biodiversity out with the binary data? *South African Journal of Science* **94**, 210-214.

1999

Bergstrom, D. & **Chown, S.L.** 1999. Life at the front: history, ecology and change on southern ocean islands. *Trends in Ecology & Evolution* **14**, 472-477.

Chown, S.L. & Gaston, K.J. 1999. Patterns in procellariiform diversity as a test of species-energy theory in marine systems. *Evolutionary Ecology Research* **1**, 365-373.

Chown, S.L. & Gaston, K.J. 1999. Exploring links between physiology and ecology at macro-scales: the role of respiratory metabolism in insects. *Biological Reviews* **74**, 87-120.

Chown, S.L., Le Lagadec, M.D. & Scholtz, C.H. 1999. Partitioning variance in a physiological trait: desiccation resistance in keratin beetles (Coleoptera, Trogidae). *Functional Ecology* **13**, 838-844.

Davis, A.L.V., **Chown, S.L.** & Scholtz, C.H. 1999. Discontinuous gas- exchange cycles in *Scarabaeus* dung beetles (Coleoptera: Scarabaeidae): Mass-scaling and temperature dependence. *Physiological and Biochemical Zoology* **72**, 555-565.

Davis, A.L.V., Scholtz, C.H. & **Chown, S.L.** 1999. Species turnover, community boundaries and biogeographical composition of dung beetle assemblages across an altitudinal gradient in South Africa. *Journal of Biogeography* **26**, 1039-1056.

Frears, S.L., **Chown, S.L.** & Webb, P.I. 1999. Temperature dependence of feeding behaviour in the mopane worm (Lepidoptera). *Journal of Thermal Biology* **24**, 241-244.

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Gaston, K.J. & **Chown, S.L.** 1999. Elevation and climatic tolerance: a test using dung beetles. *Oikos* **86**, 584-590.

Hänel, C. & **S.L. Chown, S.L.** 1999. Fifty years at the Prince Edward Islands: A bibliography of scientific and popular literature concerning Marion and Prince Edward Islands. *South African Journal of Science* **95**, 87-112.

Klok, C.J. & **Chown, S.L.** 1999. Assessing the benefits of aggregation: thermal biology and water relations of anomalous emperor moth caterpillars. *Functional Ecology* **13**, 417-427.

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2000

Addo-Bediako, A., **Chown, S.L.** & Gaston, K.J. 2000. Thermal tolerance, climatic variability and latitude. *Proceedings of the Royal Society of London B* **267**, 739-746.

Barendse, J. & **Chown, S.L.** 2000. The biology of *Bothrometopus elongatus* (Coleoptera, Curculionidae) in a mid-altitude fellfield on sub-Antarctic Marion Island. *Polar Biology* **23**, 346-351.

Bosch, M., **Chown, S.L.** & Scholtz, C.H. 2000. Discontinuous gas exchange and water loss in the keratin beetle *Omorgus radula*: further evidence against the water loss hypothesis. *Physiological Entomology* **25**, 309-314.

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Chown, S.L. & Gaston, K.J. 2000. Rapoport effect and speciation/extinction rates in the tropics - Reply. *Trends in Ecology & Evolution* **15**, 514-515.

Chown, S.L. & Holter, P. 2000. Discontinuous gas exchange cycles in *Aphodius fossor* (Scarabaeidae): a test of hypotheses concerning origins and mechanisms. *Journal of Experimental Biology* **203**, 397-403.

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Erasmus, B.F.N., Kshatriya, M., Mansell, M.W., **Chown, S.L.** & van Jaarsveld, A.S. 2000. A modelling approach to antlion (Neuroptera: Myrmeleontidae) distribution patterns. *African Entomology* **8**, 157-168.

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Koch, S.O., **Chown, S.L.**, Davis, A.L.V., Endrödy-Younga, S. & Van Jaarsveld, A.S. 2000. Conservation strategies for poorly surveyed taxa: a dung beetle (Coleoptera, Scarabaeidae) case study from southern Africa. *Journal of Insect Conservation* **4**, 45-56.

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Mercer, R.D., **Chown, S.L.** & Marshall, D.J. 2000. Mite and insect zonation on a Marion Island rocky shore: a quantitative approach. *Polar Biology* **23**, 775-784.

Van Rensburg, B.J., **Chown, S.L.**, Van Jaarsveld, A.S. & McGeoch, M.A. 2000. Spatial variation and biogeography of sand forest avian assemblages in South Africa. *Journal of Biogeography* **27**, 1385-1401.

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Chown, S.L. & Klok, C.J. 2001. Habitat use, diet and body size of Heard Island weevils. *Polar Biology* **24**, 706-712.

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Gaston, K.J., **Chown, S.L.** & Mercer, R.D. 2001. The animal species-body size distribution of Marion Island. *Proceedings of the National Academy of Sciences of the U.S.A.* **98**, 14493-14496.

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McInnes, S.J., **Chown, S.L.**, Dartnall, H.J.G. & Pugh, P.J.A. 2001. *Milnesium* cfr. *tardigradum* (Milnesiidae, Apochela, Tardigrada): A monitor of high altitude meiofauna on sub-Antarctic Marion Island. *Zoologischer Anzeiger* **240**, 461-465.

Mercer, R.D., Gabriel, A.G.A. Barendse, J. Marshall, D.J. & **Chown, S.L.** 2001. Invertebrate body sizes from Marion Island. *Antarctic Science* **13**, 135-143.

Parr, C.L. & **Chown, S.L.** 2001. Inventory and bioindicator sampling: testing pitfall and Winkler methods with ants in a South African savanna. *Journal of Insect Conservation* **5**, 27-36.

Rösch, M., **Chown, S.L.** & McGeoch, M.A. 2001. Testing a bioindicator assemblage: gall inhabiting moths and urbanisation. *African Entomology* **9**, 85-94.

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Addo-Bediako, A., **Chown, S.L.** & Gaston, K.J. 2002. Metabolic cold adaptation in insects: a large scale perspective. *Functional Ecology* **16**, 332-338.

Barendse, J., Mercer, R.D., Marshall, D.J. & **Chown, S.L.** 2002. Habitat specificity of mites on sub-Antarctic Marion Island. *Environmental Entomology* **31**, 612-625.

Chown, S.L. 2002. Respiratory water loss in insects. *Comparative Biochemistry and Physiology A* **133**, 791-804.

Chown, S.L., Addo-Bediako, A. & Gaston, K.J. 2002. Physiological variation in insects: large-scale patterns and their implications. *Comparative Biochemistry and Physiology B* **131**, 587-602.

Chown, S.L. & Freitag-Ronaldson, S. 2002. Survey site selection for data deficient arthropod taxa: from R.A.G.S. to richness. *African Entomology* **10**, 345-349.

Chown, S.L., McGeoch, M.A. & Marshall, D.J. 2002. Diversity and conservation of invertebrates on the sub-Antarctic Prince Edward Islands. *African Entomology* **10**, 67-82.

Erasmus, B.F.N., van Jaarsveld, A.S., **Chown, S.L.**, Kshatriya, M. & Wessels, K.J. 2002. Vulnerability of South African animal taxa to climate change. *Global Change Biology* **8**, 679-693.

Jones, A.G., **Chown, S.L.** & Gaston, K.J. 2002. Terrestrial invertebrates of Gough Island: an assemblage under threat? *African Entomology* **10**, 83-91.

Klok, C.J., Mercer, R.D. & **Chown, S.L.** 2002. Discontinuous gas exchange in centipedes and its convergent evolution in tracheated arthropods. *Journal of Experimental Biology* **205**, 1031-1036.

Marshall, D.J. & **Chown, S.L.** 2002. The acarine fauna of Heard Island. *Polar Biology* **25**, 688-695.

Reynolds, J.W., Jones, A.G., Gaston, K.J. & **Chown, S.L.** 2002. The earthworms (Oligochaeta, Lumbricidae) of Gough Island, South Atlantic. *Megadrilogica* **9**, 6-15.

Sinclair, B.J. & **Chown, S.L.** 2002. Haemolymph osmolality and thermal hysteresis activity in 17 species of arthropods from sub-Antarctic Marion Island. *Polar Biology* **25**, 928-933.

Slabber, S. & **Chown, S.L.** 2002. The first record of a terrestrial crustacean, *Porcellio scaber* (Isopoda, Porcellionidae), from sub-Antarctic Marion Island. *Polar Biology* 25, 855-858.

Smith, V.R., Avenant, N.L. & **Chown, S.L.** 2002. The diet of house mice on a sub-Antarctic island. *Polar Biology* **25**, 703-715.

Van Rensburg, B.J., **Chown, S.L.** & Gaston, K.J. 2002. Species richness, environmental correlates, and spatial scale: a test using South African birds. *American Naturalist* **159**, 566-577.

2003

Delettre, Y., Frenot, Y., Vernon, P. & **Chown, S.L.** 2003. First record of *Telmatogeton* sp. (Diptera: Chironomidae) at Heard Island. *Polar Biology* **26**, 423-426.

Gaston, K.J., Jones, A.G., Hänel, C. & **Chown, S.L.** 2003. Rates of species introduction to a remote oceanic island. *Proceedings of the Royal Society of London B* **270**, 1091-1098.

Harrison, J. du G., Scholtz, C.H. & **Chown, S.L.** 2003. A revision of the endemic south-western African dung beetle subgenus *Scarabaeus* (*Pachysoma*) MacLeay, including notes on other flightless Scarabaeini (Scarabaeidae: Scarabaeinae). *Journal of Natural History* **37**, 305-355.

Jones, A.G., **Chown, S.L.** Ryan, P.G., Gremmen, N.J.M. & Gaston, K.J. 2003. Conservation threats on Gough Island: a case study for terrestrial conservation in the Southern Oceans. *Biological Conservation* **113**, 75-87.

Klok, C.J. & **Chown, S.L.** 2003. Resistance to temperature extremes in sub-Antarctic weevils: interspecific variation, population differentiation and acclimation. *Biological Journal of the Linnean Society* **78**, 401-414.

Parr, C.L., Robertson, H.G. & **Chown, S.L.** 2003. Apomyrminae and Aenictogitoninae: Two new subfamilies of ant (Hymenoptera: Formicidae) for southern Africa. *African Entomology* **11**, 128-129.

Sinclair, B.J. & **Chown, S.L.** 2003. Rapid responses to high temperature and desiccation but not to low temperature in the freeze tolerant sub-Antarctic caterpillar *Pringleophaga marioni* (Lepidoptera, Tineidae). *Journal of Insect Physiology* **49**, 45-52.

Sinclair, B.J., Vernon, P., Klok, C.J. & **Chown, S.L.** 2003. Insects at low temperatures: an ecological perspective. *Trends in Ecology & Evolution* **18**, 257-262.

Warren, M., McGeoch, M.A. & **Chown, S.L.** 2003. Predicting abundance from occupancy: a test for an aggregated insect assemblage. *Journal of Animal Ecology* **72**, 468-477.

In press

Chown, S.L., Addo-Bediako, A. & Gaston, K.J. 2003. Physiological diversity: listening to the large-scale signal. *Functional Ecology*, in press.

Chown, S.L. & Klok, C.J. 2003. Altitudinal body size clines: latitudinal effects associated with changing seasonality. *Ecography*, in press.

Chown, S.L. & Klok, C.J. 2003. Water balance characteristics respond to changes in body size in sub-Antarctic weevils. *Physiological and Biochemical Zoology*, in press.

Chown, S.L., van Rensburg, B.J., Gaston, K.J., Rodrigues, A.S.L. & van Jaarsveld, A.S. 2003. Energy, species richness, and human population size: conservation implications at a national scale. *Ecological Applications*, in press.

Jones, A.G., **Chown, S.L.** & Gaston, K.J. 2003. The free-living pterygote insects of Gough Island. *Systematics and Biodiversity*, in press.

Jones, A.G., **Chown, S.L.** & Gaston, K.J. 2003. Introduced house mice as a conservation concern on Gough Island. *Biodiversity and Conservation*, in press.

Marshall, D.J. & **Chown, S.L.** 2003. Marine hyadesiid mites from Gough Island. *Hydrobiologia*, in press.

Pakhomov, E. & **Chown, S.L.** 2003. The Prince Edward Islands: Southern Ocean oasis. *Ocean Yearbook* **17**, in press.

Parr, C.L. & **Chown, S.L.** 2003. Burning issues for conservation: A critique of faunal fire research in Southern Africa. *Austral Ecology*, in press.

Parr, Z.J.E. Parr, C.L. & **Chown, S.L.** 2003. The size-grain hypothesis: a phylogenetic and field test. *Ecological Entomology*, in press.

Sinclair, B.J., Addo-Bediako, A. & **Chown, S.L.** 2003. Climatic variability and the evolution of insect freeze tolerance. *Biological Reviews*, in press.

Zapata, F.A., Gaston, K.J. & **Chown, S.L.** 2003. Mid-domain models of species richness gradients: assumptions, methods and evidence. *Journal of Animal Ecology*, in press.

II. SCIENCE POLICY & IMPLICATIONS

2000

Chown, S.L. & Gaston, K.J. 2000. Island-hopping invaders hitch a ride with tourists in the Southern Ocean. *Nature* **408**, 637.

Chown, S.L., Gaston, K.J. & Hänel, C. 2000. Gough Island biodiversity study goes ahead. *South African Journal of Science* **96**, 7-8.

2001

Van Jaarsveld, A.S. and **Chown, S.L.** 2001. Climate change and its impacts in South Africa. *Trends in Ecology & Evolution* **16**, 13-14.

2002

Chown, S.L. & Mercer, R.D. 2002. Biocomplexity and climate change: a new research programme at Marion Island. *South African Journal of Science* **98**, 217-218.

B. PEER-REVIEWED CONTRIBUTIONS TO BOOKS

1999

Gaston, K.J. & **Chown, S.L.** 1999. Geographic range size and speciation. In: *Evolution of Biological Diversity*. A.E. Magurran & R.M. May, eds. Oxford University Press, Oxford, pp. 236-259.

2000

Chown, S.L. & Clarke, A. 2000. Stress and the geographic distribution of marine and terrestrial animals. In: *Cell and Molecular Responses to Stress*. K.B. Storey & J. Storey, eds. Elsevier, Amsterdam, pp. 41-54.

Chown, S.L., Gaston, K.J. & Gremmen, N.J.M. 2000. Including the Antarctic: Insights for ecologists everywhere. In: *Antarctic Ecosystems: Models for Wider Ecological Understanding*. W. Davison, C. Howard-Williams & P. Broady, eds. New Zealand Natural Sciences, Christchurch N.Z, pp. 1-15.

2003

Chown, S.L., Greenslade, P. & Marshall, D.J. 2003. Terrestrial invertebrates of Heard Island. In: *Heard Island: A Biogeographic Isolate*. K. Green & E.J. Woehler, eds. Surrey & Beatty, Chipping Norton.

B.J. Sinclair

Peer-reviewed Journal Publications

2003

Sinclair, B. J., Vernon, P., Klok, C. J. & Chown, S. L. (2003). Insects at Low Temperatures: An Ecological Perspective. *Trends in Ecology and Evolution* **18:** 257-262.

Sinclair, B. J., Addo-Bediako, A. & Chown, S. L. (2003). Climatic variability and the evolution of insect freeze tolerance. *Biological Reviews* **78:** 181-195.

Sinclair, B. J. & Chown, S. L. (2003). Rapid cold hardening responses to high temperature and desiccation, but not to low temperature in the freeze tolerant sub-Antarctic caterpillar *Pringleophaga marioni* (Lepidoptera, Tineidae). *Journal of Insect Physiology* **49:** 45-52.

2002

Sinclair, B. J. & Chown, S. L. (2002). Haemolymph osmolality and thermal hysteresis activity in 17 species of arthropods from sub-Antarctic Marion Island. *Polar Biology* **25:** 928-933.

Sinclair, B. J. (2002). Effects of increased temperatures simulating climate change on terrestrial invertebrates on Ross Island, Antarctica. *Pedobiologia* **46:** 150-160.

Sjursen, H. & **Sinclair, B. J.** (2002). On the cold hardiness of *Stereotydeus mollis* (Acari: Prostigmata) from Ross Island, Antarctica. *Pedobiologia* **46:** 188-195.

2001

Sinclair, B. J. (2001). Biologically relevant environmental data: Macros to make the most of microclimate recordings. *CryoLetters* **22:** 125-134.

Sinclair, B. J. (2001) Field Ecology of Freeze-Tolerance: Interannual variation in cooling rates, freeze-thaw and thermal stress in the microhabitat of the alpine cockroach *Celatoblatta quinquemaculata* *Oikos* **93:** 286-293.

Sinclair, B. J. (2001). On the distribution of Terrestrial invertebrates at Cape Bird, Ross Island, Antarctica. *Polar Biology* **24:** 394-400.

Sinclair, B. J., Lord, J. M. & Thompson, C. M. (2001). Microhabitat selection and seasonality of alpine invertebrates. *Pedobiologia* **45:** 107-120.

Sinclair, B. J. & Sjursen, H. (2001) Cold tolerance of the Antarctic springtail *Gomphiocephalus hodgsoni* (Collembola: Hypogastruridae). *Antarctic Science* **13:** 271-279.

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Sinclair, B. J. (2000). Water relations of the freeze-tolerant New Zealand alpine cockroach *Celatoblatta quinquemaculata* (Dictyoptera: Blattidae). *Journal of Insect Physiology* **46:** 869-876.

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Sinclair, B. J. (1999). Insect cold tolerance: How many kinds of frozen? *European Journal of Entomology* **96:** 157-164.

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Block, W., Wharton, D. A. & **Sinclair, B. J.** (1998). Cold tolerance of a New Zealand alpine cockroach, *Celatoblatta quinquemaculata* (Dictyoptera: Blattidae). *Physiological Entomology* **23** 1-6.

Report Contributions

McCarthy, J. J., Canziani, O. F., Leary, N. A., Dokken, D. J. & White, K. S. (eds). (2001). *Climate Change 2001: Impacts, Adaptations and Vulnerability.* Intergovernmental Panel on Climate Change (IPCC), Geneva. (Contributor to Chapter 16: Polar Regions (Arctic and Antarctic),

edited by O. Anisimov & B. Fitzharris.

Waterhouse, E. J. (ed.) (2001). *Ross Sea Region 2001: A State of the Environment Report for the Ross Sea Region of Antarctica.* Antarctica New Zealand, Christchurch. (Contributor to Terrestrial Biology Chapter).

Book review

Sinclair, B. J. (2002). Insect Giants – Out of the Grey. Review of: Field, L. (ed) 2001. *The Biology of Wetas, King Crickets and their Allies,* CABI, Oxford. *New Zealand Journal of Ecology* **26:** 91-92.

P. Convey

Significant internal and unpublished reports, general interest articles, grey literature

1998 **Convey, P.** & Morton, A. Beach debris surveys, South Sandwich islands. *CCAMLR Scientific Abstracts, 1997,* pp. 1-2. (CCAMLR-XVI/BG/10) Commission for the Conservation of Antarctic Marine Living Resources, Hobart, Australia.

Convey, P. Terrestrial invertebrate ecophysiology. *BAS Field Report* R/1997/NT5, 24 pp.

1999 **Convey, P.** Poles apart. Book review of AThe biology of polar habitats, by G.E. Fogg. *Trends in Ecology and Evolution* **14**, 160-161.

Convey, P. Sky Blu Environmental Assessment. *BAS Report* R/1998/EV2, 12 pp.

Convey, P. Terrestrial Invertebrate Ecology. *BAS Field Report* R/1998/NT5, 16 pp.

2000. Block, W. & **Convey, P.** Antarctic collembolan response to climate: a sensitive bioindicator of change. *Cryo-Letters* **21**, 68 (extended abstract).

Convey, P. & Arnold, R.J. A potential indicator of climate change on sub-Antarctic South Georgia. *Cryo-Letters* **21**, 69 (extended abstract).

2001. **Convey, P.** Invertebrate Ecology and Biogeography. *BAS Field Report* R/2000/NT4, 19 pp.

Convey, P. Book review of "Stratospheric ozone depletion: the effects of enhanced UV-B radiation on terrestrial ecosystems", by J. Rozema. *Plant Ecology.*

2002 **Convey**, P. Book review of "Life at the limits – organisms in extreme environments" by D.A. Wharton. *Antarctic Science.*

Bergstrom, D., Chown, S.L., **Convey, P.**, Frenot, Y. & Whinam, J. Biological invasions of Southern Ocean islands: risk assessment and policy implications. *SCAR Shanghai.*

Hughes, K.A & **Convey, P.** Bipolar investigations of physiological stress susceptibility and responses in microbes and arthropods. EU LSF field report. *BAS Report* Gen/2001/NT2, 6 pp.

Maslen, R & ***Convey, P.*** *Southern maritime Antarctic nematodes. BAS Internal Report AD6/2/2002/NT1*

Convey, P.*, Barnes, D, Geissler, P., Pearce, D., Pond, D. & Reid, K. BSD Health & Safety CAT Report and Recommendations, 18 pp.*

2003 **Convey, P.** & Worland, M.R. Invertebrate ecophysiology, biogeography and environmental description. *BAS Field Report* R/2002/NT1, 15 pp.

Peer-reviewed Publications

1998

1) Arnold, R.J. & **Convey, P.** The life history of the world's most southerly diving beetle, *Lancetes angusticollis* (Curtis) (Coleoptera: Dytiscidae), on sub-Antarctic South Georgia. *Polar Biol.* **20**, 153-160.
2) **Convey, P.** Latitudinal variation in allocation to reproduction by the Antarctic oribatid mite, *Alaskozetes antarcticus. Appl. Soil Ecol.* **9**, 93-99.

1999

3) **Convey, P.**, Morton, A. & Poncet, J. Survey of marine birds and mammals of the South Sandwich Islands. *Polar Record* **35 (193)**, 107-124.
4) Marshall, D.J. & **Convey, P.** Compact aggregation and life history strategy in a continental Antarctic mite. In: *Evolution and Ecology of Acari* (J. Bruin, L.P.S. van der Geest and M.W. Sabelis, editors), Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 557-567.
5) **Convey, P.**, Greenslade, P., Arnold, R.J. & Block, W. Collembola of sub-Antarctic South Georgia. *Polar Biol.* **22**, 1-6.

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6) **Convey, P.** How does cold constrain life cycles of terrestrial plants and animals? *Cryo-Lett.* **21**, 73-82.
7) **Convey, P.**, Greenslade, P. & Pugh, P.J.A. Terrestrial fauna of the South Sandwich Islands. *J. Nat. Hist.* **34**, 597-609.
8) Downie, R.H., **Convey, P.**, McInnes, S.J. & Pugh, P.J.A. The non-marine invertebrate fauna of Deception Island (Maritime Antarctic): a baseline for a comprehensive biodiversity database. *Polar Record* **36 (199)**, 297-304.
9) Hayward, S.A.L., Worland, M.R., Bale, J.S. & **Convey, P.** Temperature and the hygropreference of the Arctic collembolan *Onychiurus arcticus* and mite *Lauroppia translamellata*. *Physiol. Entomol.* **25**, 266-272.
10) **Convey, P.**, Smith, R.I.L., Peat, H.J. & Pugh, P.J.A. The terrestrial biota of Charcot Island, eastern Bellingshausen Sea, Antarctica an example of extreme isolation. *Antarct. Sci.* **12**, 406-413.
11) Worland, M.R., **Convey, P.** & Lukešová, A. Rapid cold hardening: a gut feeling. *Cryo-Lett.* **21**, 315-324.
12) Pugh, P.J.A. & **Convey, P.** Scotia Arc Acari: antiquity and origin. *Zool. J. Linn. Soc.* **130**, 309-328.
13) **Convey, P.** & Worland, M.R. Refining the risk of freezing mortality for Antarctic terrestrial microarthropods. *Cryo-Lett.* **21**, 333-338.
14) **Convey, P.** & Worland, M.R. Survival of freezing by free-living Antarctic soil nematodes. *Cryo-Lett.* **21**, 327-332
15) **Convey, P.** Environmental change and Antarctic terrestrial life histories: fact and prediction. In: *Antarctic ecosystems: models for wider ecological understanding* (ed. W. Davison, C. Howard-Williams, P. Broady), pp. 243-251. New Zealand Natural Sciences, Christchurch.
16) **Convey, P.**, Smith, R.I.L., Hodgson, D.A & Peat, H.J. The flora of the South Sandwich Islands, with particular reference to the influence of geothermal heating. *J. Biogeog.* **27**, 1279-1295.

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17) Hayward, S.A.L., Bale, J.S., Worland, M.R. & **Convey, P.** Influence of temperature on the hygropreference of the collembolan *Cryptopygus antarcticus* and the mite *Alaskozetes antarcticus* from the maritimeAntarctic. *J. Insect Physiol.* **47**, 11-18.
18) **Convey, P.** Antarctic Ecosystems. In: *Encyclopedia of Biodiversity*, ed. S.A. Levin. Academic Press, San Diego, Vol. 1, pp. 171-184.
19) Worland, M.R. & **Convey, P.** Rapid cold hardening in Antarctic microarthropods. *Funct. Ecol.* **15**, 515-525.
20) **Convey, P.** Terrestrial ecosystem response to climate changes in the Antarctic. In: *"Fingerprints" of climate change - adapted behaviour and shifting species ranges*, G.-R. Walther, C.A. Burga & P.J. Edwards (eds.), Kluwer, New York, pp 17-42.

21) Block, W. & **Convey, P.** Seasonal and long-term variation in body water content of an Antarctic springtail - a response to climate change? *Polar Biol.* **24**, 764-770.

22) Rozema, J., Noordijk, A.S.J., Broekman, R.A., van Beem, A., Meijkamp, B.M., de Bakker, N.V., van de Staaij, J.W.M., Stroetenga, M., Bohncke, S.J.P., Konert, M., Kars, S., Peat, H.J., Smith, R.I.L. & **Convey, P.** (Poly)phenolic compounds in pollen and spores of Antarctic plants as indicators of solar UV-B: a new proxy for the reconstruction of past solar UV-B? *Plant Ecol.* **154**, 9-25.

2002

23) Walther, G.-R., Post, E., **Convey, P.**, Parmesan, C., Menzel, M., Beebee, T.J.C., Fromentin, J.-M., Hoegh-Guldberg, O. & Bairlein, F. Ecological responses to recent climate change. *Nature* **416**, 389-395.

24) Smith, R.I.L. & **Convey, P.** Enhanced sexual reproduction in bryophytes at high latitudes in the maritime Antarctic. *J. Bryol.* **24**, 107-117.

25) **Convey, P.**, Barnes, D.K.A. & Morton, A. Artefact accumulation on Antarctic oceanic island shores. *Polar Biol.* **25**, 612-617.

26) **Convey, P.** & Wynn-Williams, D.D. Antarctic soil nematode response to artificial environmental manipulation. *Eur. J. Soil Biol.* **38**, 255-259

27) **Convey, P.**, Pugh, P.J.A., Jackson, C., Murray, A.W., Ruhland, C.T., Xiong, F.S. & Day, T.A. Response of Antarctic terrestrial arthropods to long-term climate manipulations. *Ecology* **83**, 3130-3140.

2003

28) Coulson, S.J., Hodkinson, I.D. Webb, N.R. & **Convey, P.** A high Arctic population of *Pyla fusca* (Lepidoptera, Pyralidae) on Svalbard? *Polar Biol.* **26**, 283-285.

29) **Convey, P.** Soil faunal community response to environmental manipulation on Alexander Island, southern maritime Antarctic. *VIII SCAR International Biology Symposium: Antarctic Biology in a Global Context*, ed. A.H.L. Huiskes, W.W.C. Gieskes, J. Rozema, R.M.L. Schorno, S. van der Vies & W.J. Wolff, pp. 74-78 Backhuys, Leiden.

In press

30) **Convey, P.** Maritime Antarctic climate change: signals from terrestrial biology. In: *Antarctic Peninsula Climate Variability: a Historical and Palaeoenvironmental Perspective*, eds. E. Domack, A. Burnett, A. Leventer, **P. Convey**, M. Kirby & R. Bindschadler. *Antarctic Research Series*, American Geophysical Union.

31) **Convey, P.**, Scott, D. & Fraser, W.R. Multi-faceted Regional Change: Arctic and Antarctic. In: Climate Change and Biodiversity: Synergistic Impacts, eds. T.E. Lovejoy & L. Hannah, Yale University Press.

32) Quayle, W.C, **Convey, P.**, Peck, L.S., Ellis-Evans, J.C., Butler, H.G. & Peat, H.J. Ecological responses of maritime Antarctic lakes to regional climate change. In: *Antarctic Peninsula Climate Variability: a Historical and Palaeoenvironmental Perspective*, eds. E. Domack, A. Burnett, A. Leventer, **P. Convey**, M. Kirby & R. Bindschadler. *Antarctic Research Series*, American Geophysical Union.

33) Arnold, R.J., **Convey, P.**, Hughes, K.A. & Wynn-Williams, D.D. Seasonal periodicity of physical and edaphic factors, and microalgae in Antarctic fellfields. *Polar Biol.*

34) Hayward, S.A.L., Worland, M.R., **Convey, P.** & Bale, J.S. Temperature preference of the mite, *Alaskozetes antarcticus* (Michael), and collembolan, *Cryptopygus antarcticus* (Willem) from the maritime Antarctic. *Phys. Entomol.*

Doc 5.4

SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP)

PROJECT PROPOSAL - APPLICATION FOR FUNDING AND LOGISTIC SUPPORT

1. **SUBMISSION OF THIS APPLICATION**

Please submit this application to:

SANAP PROJECT PROPOSAL
c/o Department of Environmental Affairs and Tourism
Directorate: Antarctica and Islands
Private Bag X 447
PRETORIA
0001

ATTENTION: Carol Jacobs (Rm 831)

Applications must be submitted by no later than 30 June 2003.

All applications must be signed by the Applicant, Project Leader, Head of Department and the Head of the Organisation, before forwarding to the Department of Environmental Affairs and Tourism (DEAT). All proposals will be treated as tenders and will be opened together soon after the closing date of 30 June 2003.

We regret that late or incomplete applications will not be considered.

2. **MAJOR DISCIPLINE IN WHICH THE RESEARCH/STUDY WILL BE UNDERTAKEN**

Biology

3. **TITLE OF PROJECT**
(The title must be short and specific and should be used for the duration of the project)

Microbiology of Marion Island soils

3.1 DURATION OF PROJECT: __01 March_ 2004_ TO __28 February__2006

4. **CATEGORY OF PROJECT PROPOSAL**

(a) First proposal (Please attach a summary of the literature).

(b) Follow-up proposal (Please submit a full progress report with this application)

(c) Application for additional funds (A full progress report and a motivation by the project leader should be submitted with this application)

5. **KEYWORDS BY MEANS OF WHICH THE PROJECT CAN BE IDENTIFIED**

Microbiology

Cold-active

Psychrotrophic

Phylogenetics

6. **RESPONSIBLE PROJECT LEADER (AND CO-LEADERS)**

Title Professor

Surname Cowan

First name/s Donald Arthur

Business address Department of Biotechnology, University of the Western Cape, Bellville 7535, Cape Town

Telephone (021) 959 2083

Fax (021) 959 3505

E-mail dcowan@uwc.ac.za

7. **PARTICULARS OF APPLICANTS**

Title Professor

Surname Cowan

First name/s Donald Arthur

Business address Department of Biotechnology, University of the Western Cape, Bellville 7535, Cape Town

Telephone (021) 959 2083

Fax (021) 959 3505

E-mail dcowan@uwc.ac.za

Date of birth 1954 /07 /07

Citizenship

Are you a South African citizen? No If not, are you a permanent resident? Application pending

Country of citizenship New Zealand Occupation Professor Employer University of the Western Cape Department/Institution Department of Biotechnology

8. **QUALIFICATIONS**

Highest qualification PhD Where obtained New Zealand Date obtained 1980 Will the research be used to obtain a degree No Which degree

8.1 Please attach details of previous experience in Antarctica, Marion and Gough Islands and the Southern Ocean.

I first visited Antarctica in the 1977/78 austral summer season as a field assistant with the Waikato University Antarctic Research Program. The 8-week program, working out of Scott Base, was sited in the Dry Valley regions of the Ross Dependency (Taylor Valley, Wright Valley) and involved a 6-week field program surveying the lichen distributions of the lower and upper Taylor Valley regions.

In 1988, I established a collaborative relationship with Dr Ellis-Evans of BAS, UK, leading to a successful 3-year funding program in which a post-doctoral researcher spent a summer season with the Chilaean Antarctic Research Program.

In 1997, I was invited by Professor TGA Green, leader of the Waikato University Antarctic Terrestrial Biology program, to contribute to their 4-year research program. This has led to my leading 3 field expeditions to the Ross Dependency (1999, 2000, 2002), each focussing on the microbiology of the Dry Valley desert gravels. Field experimentation was carried out at a number of sites including Cape Royds, Cape Bird and Cape Crozier (Ross Island) and Miers Valley, Granite Harbour, Taylor Valley and Upper Wright Valley (Dry Valleys) and Bratina Island. A number of publications have resulted from these field studies (see below).

9. **SCIENTIFIC PUBLICATIONS** (Please attach a list of your publications during the past 5 years)

1. Fleming, T., Jones, C., Piper, P.W., Cowan, D.A., Isupov, M. and Littlechild, J.A. (1998) Characterisation and crystallisation of glyceraldehyde phosphate dehydrogenase from the hyperthermophilic Archaeon *Sulfolobus solfataricus*. **Acta Cryst**. D54, 671-674.

2. Egas, M.C. V., da Costa, M.S., Cowan, D.A. and Vieira Pires, E.M. (1998) Purification and characterisation of an extracellular α-amylase from *Thermus filiformis* OrkA2. **Extremophiles** 2, 23-32.

3. Pereira, R., Graham, D. & Cowan, D.A. (1998) A novel thermostable nitrile hydratase. **Extremophiles** 2, 347-358.

4. Cowan, D.A., Cramp, R.A., Pereira, R.A. and Almatawah, Q. (1998) Biochemistry and biotechnology of nitrile-metabolising enzymes. **Extremophiles** 2, 207-216.

5. Ali, S., Fernandez-Lafuente, R. and Cowan, D.A. (1998) Meta-pathway degradation of phenolics by thermophilic Bacilli. **Enzyme Microb. Technol**. 23, 462-468.

6. Thompson, D., Fernandez-Lafuente, R., Matao, S., Cowan, D.A., Guisan, J. and Daniel, R.M. (1998) Degradation and denaturation of stable enzymes. in **Stability and Stabilisation of Biocatalysts** (A. Ballesteros, F.J. Plou, J.L. Iborra and P. Halling, eds.), Progress in Biotechnology Series, Elsevier, Amsterdam, pp. 349-352.

7. Cramp, R.A& Cowan, D.A. (1999) Molecular characterisation of a novel thermophilic nitrile hydratase. **Biochim. Biophys. Acta** 1431, 249-260.

8. Cowan, D.A. (1999) Life in Extreme Thermal Environments: Implications for exobiology. Ch 6 in **Life on Mars** British Interplanet. Soc Special Publ. Pp. 37-48.

9. Huneke, F-U. and Cowan, D.A. (1999) Effect of water-miscible organic solvents on the kinetics of a thermostable β-glucosidase. **Biocatal. Biotrans.**, 17, 251-267

10. Almatawah, Q., Cramp, R.A. and Cowan, D.A. (1999) Characterisation of an inducible nitrilase from a thermophilic bacillus. **Extremophiles** 3, 283-291

11. Almatawah, Q. and Cowan, D.A. (1999) Thermostable nitrilase catalysed production of nicotinic acid from 3-cyanopyridine. **Enzyme Microbial Technol**. 25, 718-724

12. Fernandez-Lafuente, R., Guisan, J.M., Ali, S. and Cowan, D.A. (2000) Immobilization of functionally unstable catechol-2,3-dioxygenase greatly improves operational stability. **Enzyme Microb. Technol**. 26, 26, 268-573.

13. Cowan, D.A. (2000) Microbial genomes-the untapped resource. **Trends Biotechnol**. 18, 14-16.

14. Graham, D., Barfield, D., Pereira, R.A. and Cowan, D.A. (2000) Nitrile transformation studies using free and immobilised cells of a thermophilic *Bacillus sp*. **Enzyme Microb. Technol**. 26, 368-373.

15. Daniel, R.M. and Cowan, D.A. (2000) Biomolecular stability and life at high temperatures. **Cell. Mol. Life Sci.** 57,:250-64

16. Huneke, F-U., Bailey, D., Nucci, R. and Cowan, D.A. (2000) *Sulfolobus solfataricus* β-glucosidase catalysed synthesis of alkyl glycosides in organic solvents. **Biocatal. Biotrans**. 18, 291-299.

17. Sjoling, S. and Cowan, D.A. (2000) Presence of human-specific enteric micro-organisms in current and historic field camp sites. **Polar Biology,** 23, 644-650.

18. Cowan, D.A. (2000) Using your neighbours genome! **Nature**, 407, 466-467.

19. Atkinson, T., Cairns, S., Cowan, D.A., Danson, M.J. Hough, D.W., Johnson, D.B., Norris, P., Raven, N., Robson, R., Robinson, C. and Sharp, R.J. (2000) A microbiological survey of Montserrat Island hydrothermal biotopes, **Extremophiles,** 4, 305-314.

20. Baker, GC, Gaffar, S, Cowan, DA & Suharto, AR. (2001) Microbial community analysis of Indonesian hot-springs. **FEMS Microbiol. Lett.**, 200, 103-109

21. Cowan, DA and Burton, SB (2002) Archaea in Biotechnology. **Encyclopaedia of Environmental Microbiology**. Wiley, Publ. pp 259-276

22. Burton, S., Cowan, D.A. and Woodley, J.M. (2002) The search for the ideal biocatalyst. **Nature Biotechnology.** 30, 35-46

23. Bustard, MT, Whiting, S., Cowan, DA and Wright, PC (2002) Biodegradation of high concentration solvents by a solvent tolerant thermophile, *Bacillus pallidus*. **Extremophiles**, 6: 319-323.

24. Wilkinson, D., Jaenicke, T. and Cowan, D.A. (2002) Efficient cloning of DNA from environmental sources. **Biotechnol. Lett.** 24, 155-161.

25. Cowan, D.A., Mamais, A. Sheppard, D. and Russell, N. (2002) Antarctic Dry Valley mineral soils contain unexpectedly high levels of microbial biomass. **Extremophiles,** 6, 431-436.

26. Daniel, RM, Holden, JF, van Eckert, R. and Cowan, DA (2003) The stability of biomolecules and the implications for life at high temperatures. ACU Monograph Series, **in press**

27. Cameron, R and Cowan, DA (2003) Comparative biology of thermophilic and mesophilic nitrile hydratases, **Adv. Appl. Microbiol.**, in press

28. Baker, G, Ah Tow, L, Cowan, DA (2003) Detection of non-indigenous micro-organisms in 'pristine' environments. **J. Microbiol. Methods**, 53, 157-164

29. Sjoling, S and Cowan, DA (2003) High 16S rDNA bacterial diversity in maritime lake sediment, Bratina Island, Antarctic, **Extremophiles**, in press.

30. Ah Tow, L and Cowan, DA (2003) Non-specificity of Staphylococcus specific primers. **Microbiology**, in press.

10. SUMMARY OF FINANCIAL REQUIREMENTS

	Received for current year 20___	This Application 2004	Future Application/s 2005 to 2007
Manpower costs	0	95,000	250,000
Running expenses	0	48,000	120,000
Capital equipment	0	0	25,000
TOTAL	0	143,000	395,000

10.1 Which organization will be responsible for the administration of the funds?
University of the Western Cape

11. OBJECTIVES AND RATIONALE (NEED AND PURPOSE).

(Please state the objectives of the project, the need for it and how it will contribute to SANAP. In follow-up proposals, please indicate and explain any changes from the previous proposal.)

Although there is a long history of classical microbiology in Antarctic continental and island localities (particularly the Dry Valleys and Signey Island: see Cameron et al., 1970; Vincent, 1988; Wynn-Williams, 1990; Friedmann, 1993) only limited studies using modern molecular phylogenetic methods have been applied (Cowan et al., unpublished results; Franzmann et al., 1993). The extent of microbial analysis of Marion Island is restricted to a limited number of culture-based studies (Smith & Ashton, 1981; Smith & Hillmer, 1984), only two of which have focussed on the soil biotopes (French & Smith, 1986; Grossler et al., 1987). Given the current recognition that less than 1% of extant microbial species are accessed by culture-based enumeration (Amann, 1995), these studies have gone little distance in resolving some of the fundamental questions relating to the microbiology of the Marion Island soil biotopes, including;

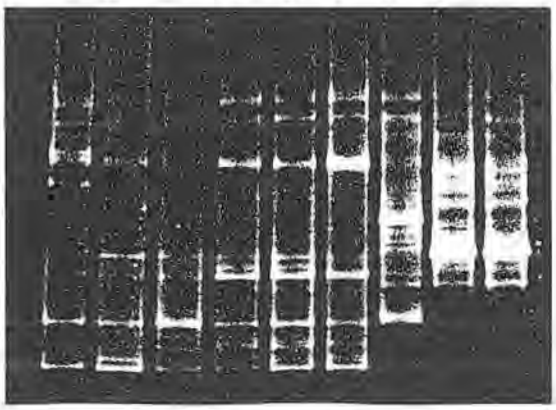
- What is the quantitative and qualitative distribution of micro-organisms
- What are the key factors dictating the distribution of micro-organisms across altitudinal transects?
- Can new metagenomic strategies be used to access genes and gene products in the "uncultured' complement of soil micro-organisms.

We have successfully introduced *in situ* DNA extraction and *ex situ* DGGE analysis to initiate a study of the microbial diversity in the Miers Valley of Eastern Antarctica (Figure 1). This project aims to employ modern molecular phylogenetics approaches, in conjunction with novel environmental transect designs, to address these questions.

In addition, and unlike classical isolation-based enumeration methods, molecular phylogenetics can provide an essential 'baseline' dataset for longer term studies of the effects of climate change on microbial distribution.

Figure 1. DGGE pattern (16S rDNA universal bacterial primers) of samples taken from Miers Valley vertical transect [Lanes 1-9, samples from valley floor (200m) to summit (600m) in approx. 50m altitude increments).]

Lanes **1 2 3 4 5 6 7 8 9**



12. **PARTICULARS OF A PILOT OR FEASIBILITY STUDY THAT HAS BEEN UNDERTAKEN.**
(Please give a short description of any pilot/feasibility study which may have been undertaken.)

We have undertaken related studies as part of the Dry Valley microbiology research program, in collaboration with the University of Waikato. While this study has not been completed, it is interesting to note that we observe substantial changes in microbial content in relation to soil water content (altitude and locality related) and nutrient content. In the moister and more eutrophic sites, free living cyanobacteria dominate. In the desiccated Dry Valley gravels, cyanobacteria are largely replaced by bacterial heterotrophs (such as Actinomycetes, *Planococcus* etc).

13. **KEY QUESTIONS AND RESEARCH APPROACH**
(Please provide a list of specific questions to be answered or hypotheses that will be tested and indicate how each is to be approached. In follow-up proposals, indicate and explain any changes from the previous proposal.)

Specific questions:

1. What is the quantitative distribution of micro-organisms in Marion Island soils
2. What is the qualitative distribution of micro-organisms in Marion Island soils
3. What are the key factors dictating the distribution of micro-organisms across altitudinal transects and trophic gradients?
4. Can new metagenomic strategies be used to access genes and gene products in the "uncultured' complement of soil micro-organisms.
5. What is the extent of soil contamination by non-indigenous organisms as the result of hiuman activities.

General Experimental Approach

1. Investigations of microbial biomass will employ the *in situ* ATP analysis methods that have previously proved to be highly effective (Cowan et al. 2002). The correlation of extractable DNA and lipid (*ex situ*) with ATP titres gives a high level of confidence to these data.
2. Phylogenetic diversity will be assessed by combining the methods of ssu rRNA sequence and DGGE (denaturing gradient gel electrophoresis) analysis. The latter has particular advantages in that it provides a simple and rapid comparative assessment of microbial diversity, potentially usable in the field, where the fine detail of the DGGE pattern can be deconvoluted using the more time-consuming laboratory-based ssu rRNA sequence.
3. Evidence for the importance of environmental factors (temperature/soil water availability/nutrient availability/salinity/radiation impact) in dictating microbial biomass/distribution can be obtained by careful choice and exploitation of environmental gradients. Altitudinal gradients provide measurable variations in surface water availability (Cowan, Carey et al. unpublished results) and heterotrophic/oligotrophic status.
4. We have already made substantial progress in developing and using metagenomic methods for

'mining' genes from extreme environment samples (Wilkinson et al. 2002). Multigenomic libraries prepared from Dry Valley soils (Ah Tow et al., unpublished results) have yielded a number of novel enzyme genes, which are currently under investigation. We are further extending metagenomic gene mining methods by developing several highly novel approaches, including semi-random PCR (Meyer et al. unpublished results) and integron-specific cloning (Whiting & Cowan, unpublished results).

5. We already have experience of using PCR to detect human commensal microorgaanisms in impacted Antarctic sites, as a measure of the distribution of non-indigenous organisms (Sjoling & Cowan, 2000; Ah Tow & Cowan, 2003). We will use similar methods (*Staphylococcus epidermidis*-specific PCR detection) in this study. In a further study, we will broaden this investigation to a range of other microbial species.

13.1 Please provide an indication of the <u>unique multi-disciplinary nature of the research</u>.

This research project requires input from a range of disciplines, including chemistry, microbiology and molecular genetics. The design of the field program requires input from climatologists and soil scientists. The results of the study will impact on other fields, such as plant biology and applied enzymology.

14. **PROPOSED WORK PLAN**

(Please describe the tasks to be undertaken during the whole project. Describe the methods to be used, indicate the persons and institutions involved and provide target dates for the start and completion of each task. In follow-up proposals, indicate and explain any changes from the previous proposal.)

Field Program [minimum 1- month]

The field program requires access to exposed (i.e., not snow/ice covered) soils, preferably across altitudinal transects of at least 500m. The field program will undertake the following:

1. Sampling of soils from a suitable altitudinal transect and other relevant sites.
2. *In situ* (i.e. at the research station) measurement of water content, ATP and extractable DNA. Preservation of samples for total and organic C/N.
3. Preliminary analysis of microbial distribution using genus- or species-specific PCR amplification (primers based on known and projected species data).

Laboratory Program

Samples returned to the UWC laboratories will be fully assessed using ssu rDNA and DGGE techniques. Microbial diversity will focus on the three primary kingdoms (bacteria, archaea and lower eukaryotes) using appropriate 16S/18S primers. Individual phyla (e.g., methanogenic archaea), genera (e.g., Nostoc) or species (e.g., *S. epidermidis, E. coli*) can be probed using more specific ssu rRNA gene primer sequences.

Samples will also be used as part of the wider gene discovery program, including elements of:

1. Gene specific PCR amplification (esterase/lipase and nitrile hydratase groups are initial targets).
2. Semi-random PCR to obtain full-length ORFs from metagenomic DNA
3. Preparation of metagenomic (multiplex) expression libraries

14.1 Is this project a co-operative/collaborative project. Please provide summary information on the associated projects and discuss the role of this project in the total programme.

This project stands alone. However, the methods to be used, and expertise in DACs laboratory on related projects will provide strong cross-fertilisation from other projects, many of which are nationally and internationally collaborative.

15. WILL THE PROJECT LEADER BE AWAY FOR ANY SIGNIFICANT PERIODS WHILE THE PROJECT IS IN PROGRESS?

No. Professor Cowan expects to be absent for only short periods (e.g., 1-2 week international conference visits) during the period of the project.

15.1 If yes, describe the arrangements made for leadership and supervision during his/her absence.

16. END PRODUCT OF THE PROJECT

(Describe the planned final products that will result from the project (i.e. the nature of the final report, maps, etc.) and state when they will be submitted. All DEAT funded projects should include the text for a popular publication which will be used to bring the results of the research to the general public or to a specific user group.)

The following constitute projected end products of the study.

1. Final scientific report (for submission to SANAP ad DEAT)
2. Presentation of results at national meetings (e.g., SAMS 2004) and international meetings (e.g, Extremophiles 2004)
3. Publication of experimental results in international peer-reviewed journals
4. Preparation of article for popular publication
5. Preparation of audio-visual presentation for popular presentation.

17. DISCUSS ANY POTENTIAL IMPACT YOUR STUDY WILL HAVE ON THE ENVIRONMENT AND DESCRIBE MITIGATING ACTIONS WHICH YOU PROPOSE TO MINIMIZE OR ELIMINATE THE IMPACT

The following guidelines are provided to assist applicants with questions relating to the potential environmental impact of a proposal.

(i) Proposals for the continuation of ongoing projects should state clearly if any changes are proposed in field methods, work programmes, camp sites, and timing from those documented in the original proposal, or subsequent modifications to it.

(ii) The proposer should list aspects of the proposed activity, that have not been noted, that might

cause impacts on the Antarctic environment (e.g. visual impact or other forms of disturbance).

(iii) In making all these assessments of impact, the proposer should briefly consider the nature, duration and intensity of the likely environmental effects, including the following;

a. the existing environment, its variability or dynamic nature, resilience to change, sensitivity to disturbance, previous disturbance, protected status etc;

b. cumulative and possible indirect impacts;

c. the probability of accidents and their environmental consequences;

d. the adequacy of existing information and knowledge.

(iv) A map of the area should be included (sketch if necessary) to assist the interpretation of this section of the research application.

Proposers are expected to provide sufficient information in their answers to allow the DEA & T to make a thorough, complete and accurate evaluation of the environmental impact of the project. Insufficient information will require follow-up action and/or may prejudice the environmental acceptability of the project.

Preliminary Environmental Evaluation

Details of Activities
Answer all questions only if work is to be carried out in Antarctica or Marion Island during 2004 / 2005

If you answer "Yes" to any of these questions, a full description of proposed activity, including proposals for mitigating and monitoring these impacts, is required.

It is important that you provide maps detailing the proposed research areas (hand drawn sketches are acceptable).

Will your objective:
a. Use a radionuclide? No [X]

---

b. Take any chemical to Antarctica or Marion Island?

Yes [X]

If Yes, complete the following:

Chemical	Formula	Quantity	Use
ATP detection kits	Luciferase, substrate	Ca 500 assays	Microbial quantitation
DNA extraction/ purification reagents	Lysozyme, SDS, buffers, silica columbs,	Est. 100mL	DNA extraction

reagents PCR reagents Agarose gel PCR reagents	PVPP Na DNA polymerase, dNTPs	Est 100g Est. 5mL	DNA separation PCR reactions

Unused chemicals will be: ☐ Left at SANAE Base

☒ Returned to South Africa

☐ Other

If Other, detail disposal procedure:

---

c. Release any chemical to the Antarctic or sub-Antarctic Environment?

No ☒

---

d. Require the use of explosives? No ☒

e. Collect, capture, kill, restrain, tag or band any terrestrial, freshwater or marine plants or animals?

No ☒

---

f. Enter any Protected Area? Yes ☐ No ☐ Advice required

If Yes, complete the following:

Name of Protected Area	Duration of Visit	Total person-days
Advice required		

Detail why the work must be carried out within the Protected Area:

---

g. Take to Antarctica or Marion Island any animal, plant (includes seeds), micro-organism or soil?

No ☐

h. Significantly disturb by flooding, sampling, trampling, camp operations or any other means any ice-free area (bare ground)?

Yes ☐

If Yes, complete the following:

Briefly describe any such significant disturbance:

The field program requires the sampling of soils. Samples in the range of 10g – 500g are typically recovered from individual sites. Our experience from the Dry Valleys indicates that these samples can be recovered without significant visual modification or disturbance to the site.

Detail any steps you will take to minimise such disturbance:

1. Recover sample sites from neighbouring surface soil.
2. Re-fill any sampling holes (typically 20 cm sq x 30 cm d.) with material removed, and recover as above.

i. Take or remove any physical specimens eg. rocks, fossils etc?

No ☐

If Yes, detail the general area and types of specimens to be collected:

Location	Specimen	Type	Total Number of Weight

j. Cumulative Impacts.

Occupy new or existing camp sites? ☐ New

☒ Old

☐ Both old and new sites

If new, list these sites and indicate why a previously impacted site cannot be used.

____Existing field sites will be used.

Will you track previously untracked ground?

Yes ☒

If Yes, state why this is necessary:

Sampling altitudinal transects will probably require movement across untracked ground. Tracked areas will be avoided for all but past [5] of the project, so as to avoid contamination by non-indigenous organisms.

Will you install equipment, markers, stakes, cairns etc. that will be left in the field?

No ☒

k. Do you expect your activities to have an environmental impact not covered in the above?

No ☒

l. Is the proposed activity likely to have more than a minor or transitory impact?

No ☒

18. FINANCIAL REQUIREMENTS

18.1 MANPOWER

(Please provide details of all persons involved and/or employed and/or applied for including ad hoc help on a part-time basis.)

No Antarctic Officers and/or technical/administrative personnel will be funded - the management and administration of the specific project will be the responsibility of the project leader. The Department will only fund home-based researchers appointed on bursaries, and no allowances will be made for the payment of service benefits, such as housing subsidies, medical aids, pensions, etc.

In follow-up proposals explain any changes from the projection given in the previous proposal.

Name, qualifications, past experience and function in this Project	Time available for this project (% of full-time man-year)	Nature and Source of non-SANAP funding	Amount requested from SANAP
Professor DA Cowan	10	Salaries by UWC; Reseach funding from NRF, DST, Industry	0

Post-Doctoral researcher (to be appointed) Honours researcher (to be appointed)	100 50	Equipment and lab facilities fully supported by DAC/UWC.	75,000 20,000
Total			95,000

18.2 RUNNING EXPENSES

(Please complete all sections. Indicate non-SANAP funds available. That, if a University decides to suggest a research proposal, the University itself must render the necessary support services, such as photocopies, telephone calls, postage, etc. If a research project requires technical support services, the time required must be budgeted for instead of a designated appointment.)

In follow-up proposals explain any changes from the projections given in the previous proposal.

Items	Nature and source of non-SANAP funding	Funds requested From SANAP
Transport (sea, air and land with distances and rates)		1 x Pax (amount unknown)
Subsistence (nature and rates)		For 1 Pax, for period of 1-2 month field program (amount unknown)
Supplies and services (please specify) Molecular biological reagents Cloning kit DNA separation Disposibles ATP detection kits General chemical items Glassware and general lab items Sequencing costs		 15,000 12,000 4,500 3,500 5,000 5,000 3,000 10,000
Total		48,000

18.3 CAPITAL EQUIPMENT

(Please describe the items required.)

Items paid for in full by SANAP remain the property of DEAT. Items to which the participating organization contribute 50% or more of the cost, become the property of the organization.

In follow-up proposals, please explain any changes from the projections given in the previous proposal.

Description of item and total cost	Non-SANAP Funding	Non-SANAP application	Amount requested from SANAP
Total			

A short motivation must be provided for each item requested. Please supply a quotation for all items requested.

18.4 LOGISTIC SUPPORT

(Please assess your support requirements carefully. The details provided will be used to develop the support for your project, as well as the total integrated support for all programmes. *You will be required to complete this section for each voyage undertaken.*)

Volume and mass of cargo approx 1 m³ <100 kg

Description of cargo

Laboratory equipment , including electronic items (microcentrifuge, PCR machine). General laboratory reagents (molecular biological reagents requiring frozen storage); Plastic ware. Sampling equipment.

Destination where cargo is required Marion Is. (detail to be advised)

Radio-active and other hazardous cargo. None required

Please provide details of materials and how they will be used. State special precautions to be undertaken.

Accommodation requirements

Ship:

Number of persons 1

Period ________ to ________ For early 2004 1-2 month field program: Detail to be advised

Base:

Number of persons ____1

Period _________ to _________ as above

Ship's time required: ____________________None

Sampling locations at sea (please attach a detailed map):

Laboratory requirements (ship):

Laboratory requirements (base):
Laboratory space for basic molecular biology. Minimum requirements: Benching, running water, 240V power supply, Refrigeration (4°C and –18°C), Gas supply for Bunsen.
Additional preferred items; Temperature controlled incubators (4-40°C); microcentriguge, PCR machine, Electrophoresis tank and power pack; -70°C freezer;

Type of equipment requiring deployment from ship: None

Small boat needs (locality and time): None

Surface vehicle needs: Uncertain (advice required)

Helicopter support (describe fully e.g. time, locality, special requirements): Uncertain (advice required)

Camping equipment (uncertain, advice required)

No of persons / teams _________ 1 person

Special equipment: None

Protective clothing; Advice required

No of persons

List any special requirements:

Please list any special needs:

19. PARTICULARS OF RESEARCH/STUDY ABROAD

19.1 Reasons why it is necessary to undertake the research/study abroad.

19.2 What arrangements have been made for overseas research/study?

19.3 Period that will be spent abroad

Date of departure: ______________

Date of return: ______________

19.4 Subsistence and transport
(Calculations should be made at the current public service rates.)

Place	Type of accommodation	No of days	Costs
Total			

19.5 Travel costs

Type of Transport	Destination	Distance	Costs
Total			

20. **STATEMENT BY APPLICANT**

I declare that the foregoing information is correct.

Signature ______________ Date 26.06.03

21. **RECOMMENDATION BY THE RESEARCH OR EQUIVALENT COMMITTEE OF THE APPLICANT'S ORGANIZATION**

Chair Renfrew Christie Date 27 June 2003

I certify that the information contained in this application is correct and that if SANAP financial support is provided, it will be utilised in accordance with the conditions as laid down by the DEAT.

Project Leader [signature] Date 26.06.03

Head of Department [signature] Date 26.03.03
HoD, Biotechnology.

Head of Organization Renfrew Christie Date 27 June 2003
Dean of Research

22. **COMMENT AND RECOMMENDATION BY SANAP**

Chair ______________ Date ______________

Appendix 1

ETHICAL REQUIREMENTS FOR RESEARCH ON THE PRINCE EDWARD ISLANDS

Questionnaire to be completed by reviewing ethical committee

This questionnaire represents the minimum ethical requirements for research on the Prince Edward

Islands. It is not intended as an alternative to the reviewing ethical committee's review process and guidelines, but as a supplement to it and as such represents a standardised format whereby the Department of Environmental Affairs and Tourism can ensure that research conducted on the Prince Edward Islands is of a high ethical standard.

The questionnaire is based on the National Code for the handling and Use of Animals in Research, Education, Diagnosis and Testing of Drugs and Related Substances in South Africa (1990) and expects of the reviewing committee to indicate whether certain aspects of the proposed projects have been reviewed by it or not. Please note that these questions are applicable only if the proposed project affects vertebrate animals. Where a question is not relevant, please indicate either *no comment, not enough information*, or *not applicable*. Space is provided below for comments on any of the questions. Please refer to the question number when commenting.

QUESTION	**REVIEWED** **Indicate either Yes / No / No comment / Not enough information / Not applicable**
Part 1. Professional detail regarding applicant and co-workers	
I Applicant name and affiliation	N/A.
II Whether the following information about persons responsible for applying proposed research techniques has been provided:	
i. names	N/A.
ii. qualifications (academic or technical)	
iii. description of each person's experience in proposed techniques	
III Whether the following information about other co-workers has been provided:	
i. names	N/A
ii. qualifications	
iii. affiliation	

QUESTION	**REVIEWED** **Indicate either Yes / No / No comment / Not enough information / Not applicable**
Part 2. Ethical aspects with regard to proposed research project	
i. whether the project's contribution to the relevant scientific field	N/A

justifies any possible pain or discomfort caused to animals during the course of research	
ii. whether alternatives to animal models are necessary or available	
iii. whether proposed methods/techniques are acceptable in terms of the level of risk to the animal subject's life or well-being	
iv. whether techniques to be applied in the project has been refined through planning and pilot studies	
v. whether the trial/survey is statistically valid (i.e. not wasteful of its animal subjects)	
vi. whether treatments and/or clinical procedures applied and/or surgery done to animals are justifiable and humane	
vii. whether vertebrate animal capture techniques (including drugs used where applicable) is appropriate and humane	
viii. whether systems and techniques for the handling of animals during research is appropriate and humane	
ix. whether facilities for the handling and housing of restrained/captive animals are appropriate, adequate and humane	N/A
x. whether there is adequate planning in the event of emergencies or in the case of unexpected results which may cause unnecessary and excessive pain and suffering to the animals	
xi. whether methods proposed to handle carcases of animals that die during the period they are in the care of the applicant are adequate and appropriate	
xii. whether proposed methods of euthanisation (including any proposed pest extermination methods) are justifiable and humane	
xiii. whether the experience and qualifications of the researcher and his/her assistants is adequate and appropriate for the proposed techniques (including the admninistration of any drugs)	
xiv. whether all drugs that are to be used in the proposed techniques are accompanied by the appropriate prescription forms	
xv. whether veterinary supervision/consultation is necessary and if so, adequate	
xvi. whether the applicant and his/her co-workers and assistants are familiar with standard guidelines for the ethical manipulation and care of experimental animals and the laws governing these	

Author: TD Wassenaar, CERU, Dept Zoology & Entomology, University of Pretoria, Pretoria, 0002
Not to be cited or altered without permission from author.

COMMENTS:

-
-
-
-
-

This project only involves soil sampling. No non-human vertebrate animals are involved.

Renfrew Christie

Chairperson
Ethics Committee.

Renfrew Christie
27 June 2003

HEAD OF ETHICS COMMITTEE DATE

Appendix 2

DELIVERABLES

(SANAP-RELATED ONLY)

A. <u>CURRENT SANAP RESEARCH CYCLE: 1 April 2001 – 31 March 2005</u>

Kindly indicate what the <u>expected deliverables</u> of your project will be for the duration of the current research cycle, including the one year extension, with respect to the following:

- Number of Honours, MSc and PhD students expected to be trained/obtained *(if in progress, please* *list name, degree and year of completion – add further lines if necessary)*

PLEASE NOTE THAT FOR A 1-YEAR CYCLE ONLY, IT DOES NOT SEEM TO BE APPROPRIATE TO OFFER 2- AND 3-YEAR DEGREE PROGRAMS.

Honours	→	1
MSc	→	
PhD	→	

NAME	DEGREE	YEAR
to be recruited		(2004)

- Estimated number of scientific publications to be published in accredited scientific journals

1-2

- Estimated number of scientific papers to be presented at local and international conferences

LOCAL	→	2-4
INTERNATIONAL	→	2

- How and to what level you intend enhancing transformation/capacity building/representivity levels in your project

UWC is South Africa's leading Historically Disadvantaged University. As such, a very high proportion of its students (approx. 97%) come form Historically Disadvantaged Groups. Most of the students in Professors Cowan's laboratory (current staffing 6 Post-Doc, 6 PhD, 1 Masters, 3 Honours, 2 Research Assistant) come from this group. Professor Cowan's program therefore makes a significant contribution to the training of individuals from HDGs in 'scarce skills', in the context of an international-quality research environment. The SANAP project will contribute to this on-going and active process of transformation and capacity building.

- The project's contribution to the public understanding of Science and Technology
  Antarctic research is, by its nature, of considerable public interest. My previous work in the Dry Valleys has led to a substantial number of PUST interventions, in the form of public lectures/presentations, press releases and public articles. It is anticipated that this project will contribute to PUST objectives in a similar manner.

B. PREVIOUS SANAP RESEARCH CYCLES: All previous cycles up until 31 March 2001

If you have previously received SANAP funding, please indicate the following for ALL previous SANAP research cycles:

- Number of scientific papers published in accredited journals from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please attach complete list)*

- Number of completed Honours, MSc and PhD degrees from members of your group from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please list name, degree and year of completion – add further lines if necessary)*

Honours →

MSc →

PhD →

NAME	DEGREE	YEAR

SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP) Doc 5.5

PROJECT PROPOSAL - APPLICATION FOR FUNDING AND LOGISTIC SUPPORT

1. SUBMISSION OF THIS APPLICATION

Please submit this application to:

SANAP PROJECT PROPOSAL
c/o Department of Environmental Affairs and Tourism
Directorate: Antarctica and Islands
Private Bag X 447
PRETORIA
0001

ATTENTION: Carol Jacobs (Rm 831)

Applications must be submitted by no later than 30 June 2003.

All applications must be signed by the Applicant, Project Leader, Head of Department and the Head of the Organisation, before forwarding to the Department of Environmental Affairs and Tourism (DEAT). All proposals will be treated as tenders and will be opened together soon after the closing date of 30 June 2003.

We regret that late or incomplete applications will not be considered.

2. MAJOR DISCIPLINE IN WHICH THE RESEARCH/STUDY WILL BE UNDERTAKEN

Biological Sciences

3. TITLE OF PROJECT

Genetic profiling of pinniped populations at the Prince Edward Islands

3.1 DURATION OF PROJECT: 1 April 2004 TO 31 March 2005

4. CATEGORY OF PROJECT PROPOSAL

(a) First proposal (Please attach a summary of the literature).

FIRST PROPOSAL

(b) Follow-up proposal (Please submit a full progress report with this application)

(c) Application for additional funds (A full progress report and a motivation by the project leader should be submitted with this application)

5. KEYWORDS BY MEANS OF WHICH THE PROJECT CAN BE IDENTIFIED

Elephant seals

Fur seals

Genetic profiling

6. RESPONSIBLE PROJECT LEADER (AND CO-LEADERS)

Title	Dr.
Surname	Slager-Bastos
First name/s	Armanda Duarte
Business address	Mammal Research Institute Department of Zoology and Entomology University of Pretoria Pretoria, 0002
Telephone	(012) 420-4612
Fax	(012) 362-5141
E-mail	ADBastos@zoology.up.ac.za

Title	Prof.
Surname	Bester
First name/s	Marthán Nieuwoudt
Business address	Mammal Research Institute Department of Zoology and Entomology University of Pretoria Pretoria, 0002
Telephone	(012) 420-2067
Fax	(012) 420-2634
E-mail	MNBester@zoology.up.ac.za

7. PARTICULARS OF APPLICANTS

Title	Dr
Surname	Slager-Bastos
First names	Armanda Duarte
Business address	Mammal Research Institute Department of Zoology & Entomology University of Pretoria 0002 Pretoria
Telephone	(012) 420-4612
Fax	(012) 362-5242
E-mail	adbastos@zoology.up.ac.za
Date of birth	25 March 1969

Citizenship

Are you a South African citizen?	Yes
If not, a permanent resident?	N/A
Country of citizenship	Republic of South Africa
Occupation	Senior Lecturer
Employer	University of Pretoria
Department/Institution	Department of Zoology & Entomology

Title	Prof
Surname	Bester
First names	Marthán Nieuwoudt
Business address	Mammal Research Institute Department of Zoology & Entomology University of Pretoria 0002 Pretoria
Telephone	(012) 420-2067
Fax	(012) 420-2534
E-mail	mnbester@zoology.up.ac.za
Date of birth	26 August 1949

Citizenship

Are you a South African citizen?	Yes
If not, a permanent resident?	N/A
Country of citizenship	Republic of South Africa
Occupation	Professor
Employer	University of Pretoria
Department/Institution	Department of Zoology & Entomology

8. QUALIFICATIONS

Dr. A.D. Bastos

Highest qualification	PhD
Where obtained	University of Pretoria
Date obtained	September 2001

Research to obtain a degree?	No
Which degree	N/A

Prof. M.N. Bester

Highest qualification	DSc Zoology
Where obtained	University of Pretoria
Date obtained	April 1978
Research to obtain a degree?	No
Which degree	N/A

8.1 Please provide details of previous experience in Antarctica.

Research activities – Dr. A.D. Bastos

2001-2004 Threats to biodiversity and ecosystem functioning at the Prince Edward Islands: Developing a conservation strategy for endemic and keystone insect species with Prof. C.T. Chimimba (University of Pretoria) and Prof. S.L. Chown (University of Stellenbosch)

Dr. Bastos has supervised two PhD research projects, but has never been to the southern ocean islands or to Antarctica.

Research activities – Prof. M.N. Bester

1974 - 1977	Ecology of Subantarctic fur seals *Arctocephalus tropicalis* at Gough Island, South Atlantic Ocean.
1977 - 1983	Population dynamics and reproductive physiology of *A. tropicalis* at Gough Island.
1976,1981/82 1986 - 1993	Control programme with a view to exterminating feral house cats *Felis catus* on Marion Island.
1979-1985	Population ecology of southern elephant seals *Mirounga leonina* at Iles Kerguelen in collaboration with French scientists of Terres Australes et Antarctiques Francaises (TAAF).
1981-present	Population ecology of elephant seals and fur seals (*Arctocephalus* spp.) at Marion Island.
1981 - 1983	Spatial and temporal distribution of Pinnipedia. This represents the overall title of projects b, d, & e during the aforementioned period.
1983-present	Migration of southern elephant seals *Mirounga leonina* from Marion Island.
1991 - 1995	Distributional ecology of Ross seals, *Ommatophoca rossii*, off Western Dronning Maud Land, Antarctica.
2000	Dallmann-Jubany Station, King George Island. Satellite telemetry studies on the migratory behaviour of Southern elephant seals.

Experience of research within the pack ice specifically was obtained during shipboard seal surveys from M.V. SA Agulhas southwest of Bouvet in August 1979, the M.V. Nella Dan southeast of Heard Island in October 1985, the M.V. Icebird off Enderby and MacRobertson Land and Prydz Bay, Antarctica during November/December 1985, the MV S.A. Agulhas off Western Dronning Maud Land in 1991/92 and 1992/93, and the RV Polarstern in the Weddell Sea in 1998.

9. **SCIENTIFIC PUBLICATIONS** (Please attach a list of your publications during the past 5 years)

Attached as appendix 4

10. SUMMARY OF FINANCIAL REQUIREMENTS

	Received for current year 20___	This Application 2004/05	Future Application/s 20___ 20___
Manpower costs		R 16 000	
Running expenses		R 96 316	
Capital equipment		0	
TOTAL		R 112 316	

10.1 Which organization will be responsible for the administration of the funds?

University of Pretoria

11. OBJECTIVES AND RATIONALE (NEED AND PURPOSE).

(Please state the objectives of the project, the need for it and how it will contribute to SANAP. In follow-up proposals, please indicate and explain any changes from the previous proposal.)

One of the main management objectives of the Prince Edward Island Management Plan is 'to maintain biological diversity, including genetic diversity, species diversity and the diversity of ecological processes'. Genetic diversity is intrinsically linked to species diversity and can only be maintained once appropriate management units have been identified. This study aims to address this management objective by preliminary investigation into the genetic structure of the three seal species occurring at the Prince Edward Islands.

Hybrids between the Antarctic fur seal (*Arctocephalus gazella*) and Subantarctic fur seal (*A. tropicalis*) have been reported from two of the three islands where these species breed sympatrically (Goldsworthy *et al.* 1999). This hybridization is proven for Macquarie Island where a third species, the New Zealand fur seal, also occur in sympatry (Shaughnessy *et al.* 1988; Goldsworthy *et al.* 1999). However, hybridization has only been inferred for the Prince Edward Islands from individuals with intermediate external characteristics (Condy 1978; Kerley & Robinson 1987) and vocal repertoire (St Clair Hill *et al.* 2001). Species-specific genotypes were identified for Marion Island (Wynen *et al.* 2000), and it now remains to identify hybrid pups on particular beaches where mixed harems usually occur during the breeding season (Kerley 1983). This would be a first step in investigating the nature and extent of hybridization between the two species at the Prince Edward Islands.

Southern elephant seals (*Mirounga leonina*) breed on Subantarctic islands and have a circumpolar distribution. Mitochondrial DNA (mtDNA) and nuclear DNA (nDNA) variation in the three main populations in the south Atlantic, south Indian, and south Pacific oceans, and a smaller continental population in South America, has been established. It was found that population structure of mtDNA and nDNA was strong and not consistent with isolation by distance and that geographic structure appears to be dominated by historical processes, not contemporary gene flow (Slade *et al.* 1998). Subsequently, all major and seven minor colonies were characterized and evidence was gathered for male-mediated genetic dispersal over a geographic range of about 8000 km between Macquarie Island and the Falkland Islands (Fabiani *et al.* 2003). Although excursions from breeding grounds of up to 5200 km have previously been documented for the southern elephant seal (Jonker & Bester 1998; Hindell & McMahon 2000), this is the only record of long-distance genetic dispersal (Fabiani *et al.* 2003). The Marion Island population of southern elephant seals has never been genotyped, and this project aims to do so not only for comparison with other populations, but as a first step towards determining kinship relationships of this marked (at birth) population of elephant seals.

12. PARTICULARS OF A PILOT OR FEASIBILITY STUDY THAT HAS BEEN UNDERTAKEN.

(Please give a short description of any pilot/feasibility study which may have been undertaken.)

The mtDNA genetic characterisation methods detailed in this proposal have been successfully employed in other population studies directed at the same species. We therefore do not envisage any technical difficulties. Optimisation of the methods to our laboratory conditions will have to be performed, but be achieved within the first month of commencing with the laboratory work.
Although microsatellite primers are available for fur seals, reports from the literature indicate that they have only been successfully applied to one *A. gazella* population (Gemmell et al. 2001). The suitability of these primers for *A. tropicalis* will have to be established and primer conditions will have to be optimised before the samples can be genotypes. This microsatellite primer feasibility component will take between 1 and 3 months to conclude, depending on the technical difficulties encountered.

13. KEY QUESTIONS AND RESEARCH APPROACH

(Please provide a list of specific questions to be answered or hypotheses that will be tested and indicate how each is to be approached. In follow-up proposals, indicate and explain any changes from the previous proposal.)

(i) To show through genetic means that hybridisation takes place between sympatrically breeding Subantarctic fur seals and Antarctic fur seals at the Prince Edward Islands

A total of 60 fur seal pups (30 Subantarctic fur seal pups and 30 Antarctic fur seal pups) will be biopsied for the purposes of extracting genomic DNA. Fur seal pups will be physically restrained by hand (Erickson & Bester 1993), a 16 mm^2 piece of fleshy extension of a hindflipper removed using a standard biopsy technique (Shaughnessy *et al.* 1993; Wynen *et al.* 2000). Pups will be released within 1 min after capture and the skin biopsy sample will be stored in absolute ethanol. Pup phenotypes will be recorded using species-typical characteristics summarised by Goldsworthy *et al.* 1999. The mtDNA control region will be targeted with primers described by Wynen and co-workers (2000), for genetic characterisation of *A. gazella* and *A.tropicalis*. Comparison of mtDNA species designation with phenotype will allow for identification of conflict between phenotype and maternal genotype. In order to assess conflict between phenotype and paternally inherited DNA, nuclear DNA will have to be targeted. Microsatellite primers that have been used to successfully screen the *A. gazella* Bird Island population (Gemmell *et al.* 2001) will be used for this purpose.

(ii) To assess genetic variation and population structure in the southern elephant seal population at Marion Island

Moulted skin will be collected (non-invasively) from southern elephant seals (50 females and 50 males) using methods that have been successfully carried out at Marion Island during previously funded projects (Salwicka 2000). A 444 bp amplicon corresponding to the HVR1 segment of the control region of the mitochondrial genome will be targeted with the THR and TDKD primers (Slade *et al.* 1993) that have been successfully used to characterise diverse elephant seal populations (Slade *et al.* 1993, Slade *et al.* 1994, Fabiani *et al.* 2003). Following genomic amplification, the PCR products will be purified and the nucleotide sequence determined using an automated cycle sequencing approach. The nucleotide sequences will be used to investigate within-population haplotype diversity, whilst data similarly obtained for diverse sub-Antarctic populations will be accessed from the Genbank database and used to assess inter-population diversity and structure.

13.1 Please provide an indication of the unique multi-disciplinary nature of the research.

This project brings together population ecologists and molecular biologists to assess the identity and integrity of the two fur seal populations, and the identity and kinship relationships of the elephant seal population that had initially recovered from exploitation, and has recently stabilized after a population decline of some 30 years.

14. PROPOSED WORK PLAN

(Please describe the tasks to be undertaken during the whole project. Describe the methods to be used, indicate the persons and institutions involved and provide target dates for the start and completion of each task. In follow-up proposals, indicate and explain any changes from the previous proposal.)

No fieldwork will be done during the project as the material would have been collected before its official start. The two prospective students, L. Cahuke & T. Maswime will enrol for the B.Sc. (Hon) Zoology course in January 2004.

February 2004: The students will commence with an intensive course in 'research methods', and they will write and defend their project proposals

March 2004: The students will receive training in basic molecular biology techniques

April-June 2004: The students will optimise methods and determine the feasibility of the microsatellite component of the fur seal study

May-September 2004: Genetic profiling of seal samples

October 2004: Data analysis (One of the students will travel to the UK to do his analyses with Prof. Hoelzel)

November 2004: Writing of the research reports

December 2004-March 2005: Preparation and submission of manuscripts for publication

14.1 Is this project a co-operative/collaborative project. Please provide summary information on the associated projects and discuss the role of this project in the total programme.

This project will contribute to the Status of Stocks Report to CCAS and CCAMLR, has a bearing on the mark-recapture programme of elephant seals as samples (non-invasive) will be taken primarily from marked animals (born on Marion Island) as well as from unidentified individuals so as to establish the prevalence of possible long range genetic dispersal. This project therefore links with the SANAP project on Satellite Linked Identification and Characterization of Southern Elephant Seal Foraging Areas, an initiative supported by the German Alfred-Wegener-Institute for Polar and Marine Research (AWI) and the Hubbs-Sea World Research Institute, San Diego, USA. It collaborates with the School of Biological and Biomedical Sciences, University of Durham, UK, and provides input into local studies on top predators (birds & mammals) within the Prince Edward Islands Management Plan.

15. **WILL THE PROJECT LEADER BE AWAY FOR ANY SIGNIFICANT PERIODS WHILE THE PROJECT IS IN PROGRESS?**
No

15.1 If yes, describe the arrangements made for leadership and supervision during his/her absence.

N/A

16. **END PRODUCT OF THE PROJECT**
(Describe the planned final products that will result from the project (i.e. the nature of the final report, maps, etc.) and state when they will be submitted. All DEAT funded projects should include the text for a popular publication which will be used to bring the results of the research to the general public or to a specific user group.)

Two papers will be published in appropriate scientific journals, one for on each of the seal genera under study.

17. **DISCUSS ANY POTENTIAL IMPACT YOUR STUDY WILL HAVE ON THE ENVIRONMENT AND DESCRIBE MITIGATING ACTIONS WHICH YOU PROPOSE TO MINIMIZE OR ELIMINATE THE IMPACT**

Proposers are expected to provide sufficient information in their answers to allow the DEA & T to make a thorough, complete and accurate evaluation of the environmental impact of the project. Insufficient information will require follow-up action and/or may prejudice the environmental acceptability of the project.

Preliminary Environmental Evaluation

Details of Activities
Answer all questions only if work is to be carried out in Antarctica or Marion Island during 2004./ 2005

If you answer "Yes" to any of these questions, a full description of proposed activity, including proposals for mitigating and monitoring these impacts, is required.

It is important that you provide maps detailing the proposed research areas (hand drawn sketches are acceptable).

Will your objective:

a. Use a radionuclide? Yes [ ] No [v]

b. Take any chemical to Antarctica or Marion Island?

Yes [ ] No [v]

c. Release any chemical to the Antarctic or sub-Antarctic Environment?

Yes ☐ No ☑

d. Require the use of explosives? Yes ☐ No ☑

e. Collect, capture, kill, restrain, tag or band any terrestrial, freshwater or marine plants or animals?

Yes ☑ No ☐

If Yes, complete the following:

For each species (apart from those taken using plankton nets or trawl), estimate the proportion of the local population you will be collecting, capturing, killing, tagging or banding. If restraining, include period of restraint:

Species	**Method**	**Number**	**Proportion of population (%)**
A. tropicalis	Restrain by hand	30 pups	0.05%
A. gazella	Restrain by hand	30 pups	1.50%

For each species, indicate the proportion of the local population you will be disturbing while carrying out the above activities.

A. tropicalis = 0.48% *A. gazella* = 3.5%

f. Enter any Protected Area? Yes ☐ No ☑

g. Take to Antarctica or Marion Island any animal, plant (includes seeds), micro-organism or soil?

Yes ☐ No ☑

h. Significantly disturb by flooding, sampling, trampling, camp operations or any other means any ice-free area (bare ground)?

Yes ☐ No ☑

i. Take or remove any physical specimens eg. rocks, fossils etc?

Yes ☐ No ☑

j. Cumulative Impacts.

Occupy new or existing camp sites? ☐ New

[v] Old

[ ] Both old and new sites

Will you track previously untracked ground?

Yes [ ] No [v]

Will you install equipment, markers, stakes, cairns etc. that will be left in the field?

Yes [ ] No [v]

k. Do you expect your activities to have an environmental impact not covered in the above?

Yes [ ] No [v]

l. Is the proposed activity likely to have more than a minor or transitory impact?

Yes [ ] No [v]

18. FINANCIAL REQUIREMENTS

18.1 MANPOWER

(Please provide details of all persons involved and/or employed and/or applied for including ad hoc help on a part-time basis.)

In follow-up proposals explain any changes from the projection given in the previous proposal.

Name, qualifications, past experience and function in this Project	Time available for this project (% of full-time man-year)	Nature and Source of non-SANAP funding	Amount requested from SANAP
A.D.S. Bastos	10%	Salary, UP	0
M.N. Bester	10%	Salary, UP	0
BSc (Hons) Zoology student bursary for L. F. Chauke (B.Sc. Microbiology & Zoology)	100%	Office space, stationary, lab facilities	R 8 000
BSc (Hons) Zoology student bursary for T.A.M. Maswime (B.Sc. Microbiology & Zoology)	100%	Office space, stationary, lab facilities	R 8 000
Total			R 16 000

18.2 RUNNING EXPENSES

(Please complete all sections. Indicate non-SANAP funds available. That, if a University decides to suggest a research proposal, the University itself must render the necessary support services, such as photocopies, telephone calls, postage, etc. If a research project requires technical support services, the time required must be budgeted for instead of a designated appointment.)

ITEMS	NATURE AND SOURCE OF NON-SACAR FUNDING	FUNDS REQUESTED FROM SACAR
Transport (sea, air and land with distances and rates)		
		R 0
Subsistence (nature and rates)		
		R 0
Supplies and services (please specify)		
MtDNA control region analysis of elephant seals 100 specimens @ R 320 per specimen (see Methods)	0	R 32 000
MtDNA control region analysis of fur seals 60 specimens @ R 320 per specimen (see Methods)	0	R 19 200
Nuclear DNA analysis – pilot study, optimisation and screening of 60 fur seals specimens @ R210 per specimen (see Methods)	0	R 12 600
Purchase of labelled primers for nuclear DNA characterisation (8 primer pairs) and 2 unlabelled primer pairs for the mtDNA characterisation	0	R 11 300
5 L Ethanol @ R 398 for 2,5 L, for sample collection	0	R 796
5 ml cyotubes, R 1 620 per 500	0	R 1 620
Telephone costs, R 100 per month x 12 months	R 1 200, U.P.	
Facsimile costs, R 50 per month x 12 months	R 600, U.P.	
Internet costs, R 50 per month x 12 x 2 students	R 1 200, UP	
Postage costs, R 50 per month x 12 x 3	R 1 800, U.P.	
Stationery costs, R 200 per month x 12 x 2 students	R 4 800, U.P.	
Facility costs	R 20 000, U.P.	
Total	**R29 600, UP**	**R77 516**

18.3 CAPITAL EQUIPMENT
(Please describe the items required.)
Items paid for in full by SANAP remain the property of DEAT. Items to which the participating organization contribute 50% or more of the cost, become the property of the organization.

In follow-up proposals, please explain any changes from the projections given in the previous proposal.

Description of item and total cost	**Non-SACAR Funding**	**Non-SACAR application**	**Amount requested from SACAR**
Themal cyclers	R 52 000		0
Agarose gel electrophoresis equipment	R 7 500		0
Gel documentation system	R 55 000		
Fume hood	R 20 000		0
Laminar flow	R 22 000		0
Centrifuges	R 32 000		0
Heating blocks	R 9 500		0
UV transilluminator	R 12 000		0
Computers and analysis software	R 32 000		0
Micropipettes	R 16 200		0
Total	**R 236 200**		

A short motivation must be provided for each item requested. Please supply a quotation for all items requested.

18.4 LOGISTIC SUPPORT

NONE – samples are at hand (elephant seals & fur seals) and additional samples will be collected during routine research by field technicians currently at Marion Island (in August 2003 & March 2004). We have gone through the process of submitting our proposal to the appropriate Ethics Committee to ensure that such collections will not be hampered during the current (2003/2004) financial year.

19. PARTICULARS OF RESEARCH/STUDY ABROAD

19.1 Reasons why it is necessary to undertake the research/study abroad.

To allow Capacity Building, and to "Empower", one of the two students that show most promise, will be funded to visit Prof A.R. Hoelzel, a world authority on pinniped genetics, at his Laboratory in the School of Biological and Biomedical Sciences, University of Durham, South Road, Durham, UK.

19.2 What arrangements have been made for overseas research/study?

We have successfully made our overtures to Prof Hoelzel with regards to collaborating on the population genetics of elephant seals; we are now in the process of arranging the visit subject to this project being funded.

19.3 Period that will be spent abroad

Date of departure: Unknown Date of return: Unknown

19.4 Subsistence and transport
(Calculations should be made at the current public service rates.)

Place	Type of accommodation	No of days	Costs
Durham, England	Accommodation and subsistence 60 BP per day (calculated using an exchange rate of R14=1BP)	15 days	R 12 600
Total			R 12 600

19.5 Travel costs

Type of Transport	Destination	Distance	Costs
Return airfare	Durham, England	-	R 6 200
Total			R 6 200

20. **STATEMENT BY APPLICANT**

I declare that the foregoing information is correct.

Signature ____________ Date 27/6/2003

21. **RECOMMENDATION BY THE RESEARCH OR EQUIVALENT COMMITTEE OF THE APPLICANT'S ORGANIZATION**

Chair ____________ Date 27/06/03

I certify that the information contained in this application is correct and that if SANAP financial support is provided, it will be utilised in accordance with the conditions as laid down by the DEAT.

Project Leader ____________ Date 27/6/2003

Head of Department ____________ Date 27.6.03

Head of Organization ____________ Date ____________

22. COMMENT AND RECOMMENDATION BY SANAP

Chair ________________ Date ________________

17 Jun. 03

Prof MN Bester
Department of Zoology and entomology
University of Pretoria

Appendix 1

University of Pretoria

Faculty of Natural- and Agricultural Sciences
Ethics Committee
Tel : 012-420 3270
Fax: 012-420 3290
E-mail: ethics@postino.up.ac.za

Dear Prof Bester

Re: EC 030602-016: Genetic profiling of Pinniped populations at the Prince Edward Islands

The project conforms to the requirements of the Ethics Committee.

Prof NH Casey
CHAIRMAN: ETHICS COMMITTEE
(FACULTY OF NATURAL AND AGRICULTURAL SCIENCES)

Appendix 1

ETHICAL REQUIREMENTS FOR RESEARCH ON THE PRINCE EDWARD ISLANDS

Questionnaire to be completed by reviewing ethical committee

This questionnnaire represents the minimum ethical requirements for research on the Prince Edward Islands. It is not intended as an alternative to the reviewing ethical committee's review process and guidelines, but as a supplement to it and as such represents a standardised format whereby the Department of Environmental Affairs and Tourism can ensure that research conducted on the Prince Edward Islands is of a high ethical standard.

The questionnaire is based on the National Code for the handling and Use of Animals in Research, Education, Diagnosis and Testing of Drugs and Related Substances in South Africa (1990) and expects of the reviewing committee to indicate whether certain aspects of the proposed projects have been reviewed by it or not. Please note that these questions are applicable only if the proposed project affects vertebrate animals. Where a question is not relevant, please indicate either *no comment, not enough information,* or *not applicable*. Space is provided below for comments on any of the questions. Please refer to the question number when commenting.

QUESTION	**REVIEWED** Indicate either Yes / No / No comment / Not enough information / Not applicable
Part 1. Professional detail regarding applicant and co-workers	
I Applicant name and affiliation	Yes
II Whether the following information about persons responsible for applying proposed research techniques has been provided:	
i. names	Yes
ii. qualifications (academic or technical)	Yes
iii. description of each person's experience in proposed techniques	Yes
III Whether the following information about other co-workers has been provided:	
i. names	Yes
ii. qualifications	Yes
iii. affiliation	Yes

QUESTION	**REVIEWED** Indicate either Yes / No / No comment / Not enough information / Not applicable
Part 2. Ethical aspects with regard to proposed research project	
i. whether the project's contribution to the relevant scientific field justifies any possible pain or discomfort caused to animals during the course of research	Yes
ii. whether alternatives to animal models are necessary or available	N/A
iii. whether proposed methods/techniques are acceptable in terms of the level of risk	Yes

- to the animal subject's life or well-being		
iv. whether techniques to be applied in the project has been refined through planning and pilot studies	Yes	
v. whether the trial/survey is statistically valid (i.e. not wasteful of its animal subjects)	Yes	
vi. whether treatments and/or clinical procedures applied and/or surgery done to animals are justifiable and humane	Yes	
vii. whether vertebrate animal capture techniques (including drugs used where applicable) is appropriate and humane	Yes	
viii. whether systems and techniques for the handling of animals during research is appropriate and humane	Yes	
ix. whether facilities for the handling and housing of restrained/captive animals are appropriate, adequate and humane	N/A	
x. whether there is adequate planning in the event of emergencies or in the case of unexpected results which may cause unnecessary and excessive pain and suffering to the animals	N/A	
xi. whether methods proposed to handle carcases of animals that die during the period they are in the care of the applicant are adequate and appropriate	N/A	
xii. whether proposed methods of euthanisation (including any proposed pest extermination methods) are justifiable and humane	N/A	
xiii. whether the experience and qualifications of the researcher and his/her assistants is adequate and appropriate for the proposed techniques (including the administration of any drugs)	N/A	
xiv. whether all drugs that are to be used in the proposed techniques are accompanied by the appropriate prescription forms	N/A	
xv. whether veterinary supervision/consultation is necessary and if so, adequate	No	
xvi. whether the applicant and his/her co-workers and assistants are familiar with standard guidelines for the ethical manipulation and care of experimental animals and the laws governing these	N/A	

Author: TD Wassenaar, CERU, Dept Zoology & Entomology, University of Pretoria, Pretoria, 0002
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COMMENTS:

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HEAD OF ETHICS COMMITTEE

17/6/03.
DATE

Appendix 2

DELIVERABLES

(SANAP-RELATED ONLY)

A. CURRENT SANAP RESEARCH CYCLE: 1 April 2001 – 31 March 2005

Kindly indicate what the expected deliverables of your project will be for the duration of the current research cycle, including the one year extension, with respect to the following:

- Number of Honours, MSc and PhD students expected to be trained/obtained *(if in progress, please list name, degree and year of completion – add further lines if necessary)*

Honours → 2

MSc → 0

PhD → 0

NAME	DEGREE	YEAR
L. F CHAUKE*	B.Sc. Honours	2004
T.A.M. MASWIME*	B.Sc. Honours	2004

* Registering as students in January 2004

- Estimated number of scientific publications to be published in accredited scientific journals

2

- Estimated number of scientific papers to be presented at local and international conferences

LOCAL → 2

INTERNATIONAL → 0

- How and to what level you intend enhancing transformation/capacity building/representivity levels in your project

Currently we have appointed 2 prospective (for 2004) B.Sc. Honours students [B.Sc Zoology graduates from UNIVEN in 2001] as student assistants within a NRF supported research project. Both Mr L.F. Chauke and Mr T.A.M. Maswime have recently returned from Marion Island where they served with distinction as field assistants in salaried positions within two of our SANAP projects in 2002/2003.

- The project's contribution to the public understanding of Science and Technology

We are involved with the 'UP with Science' venture, and have given talks to Secondary School students visiting the Department with a view to further their Tertiary education in Science at UP. The co-leader is involved with the development of the "Tsebo Ribola" Integrated Science, Engineering and Technology Discovery Centre on the UP Campus. This affords opportunities to draw the attention of visitors to the Centre to the proposed, and other, projects on marine mammals. During the UP open day (17 May 2003) the Department of Zoology & Entomology's exhibit and information stall overwhelmingly featured our involvement in SANAP, in particular satellite tracking of elephant seals, and in 2004 will also emphasize the proposed project.

B. PREVIOUS SANAP RESEARCH CYCLES: All previous cycles up until 31 March 2001

If you have previously received SANAP funding, please indicate the following for ALL previous SANAP research cycles:

- Number of scientific papers published in accredited journals from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please attach complete list)*

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- Number of completed Honours, MSc and PhD degrees from members of your group from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please list name, degree and year of completion – add further lines if necessary)*

Honours → 3

MSc → 6

PhD → 1

NAME	DEGREE	YEAR

M. ST CLAIR HILL (F)	B.Sc. Honours	1996
M. KEITH (M)	B.Sc. Honours	1997
J.E. THOM (F)	B.Sc. Honours	1997
C.R. McMAHON (M)	M.Sc.	1998
F.C. JONKER (M)	M.Sc.	1998
J. MALHERBE (M)	M.Sc.	1998
P.A. PISTORIUS (M)	M.Sc.	1999
S.P. KIRKMAN (M)	M.Sc.	2000
G.J.G. HOFMEYR (M)	M.Sc.	2001
P.A. PISTORIUS (M)	PhD.	2001

LIST OF SCIENTIFIC PAPERS GENERATED WHILE RECEIVING FUNDING AS PROJECT LEADERS WITHIN SANAP

1. BESTER, M.N. & VAN JAARSVELD, A.S. 1997. Growth in Subantarctic fur seal pups as a possible indicator of offshore food availability. In: *Marine Mammal Research in the Southern Hemisphere*. Vol 1: pp 88-91. Eds Hindell, M & Kemper, C.S. Surrey Beatty & Sons, Chipping Norton.
2. BURTON, H.R., ARNBOM, T., BOYD, I.L., BESTER, M., VERGANI, D. & WILKINSON, I. 1997. Significant differences in weaning mass of southern elephant seals from five sub-Antarctic islands in relation to population declines. In: *Antarctic Communities: Species, Structure and Survival*. Pp 335-338. Eds Battaglia, B., Valencia, J. & Walton, D.W.H. Springer, Berlin.
3. HOFMEYR, G.J.G., BESTER, M.N. & JONKER, F.C. 1997. Changes in population sizes and distribution of fur seals at Marion Island. *Polar Biol.* 17: 150 – 158.
4. WILKINSON, I.S. & BESTER, M.N. 1997. Tag-loss estimates for southern elephant seals, *Mirounga leonina*, at Marion Island. *Antarct. Sci.* 9: 162-167.
5. JONKER, F.C. & BESTER, M.N. 1998. Seasonal movements and foraging areas of adult southern female elephant seals, *Mirounga leonina*, from Marion Island. *Antarct. Sci.* 10: 21-30.
6. KLAGES, N.T.W. & BESTER, M.N. 1998. The fish prey of fur seals *Arctocephalus* spp. at subantarctic Marion Island. *Marine Biol.*131: 559-566.
7. McMAHON, C.R., BURTON, H.R. & BESTER, M.N. 1999. First-year survival of southern elephant seals *Mirounga leonina* at sub-Antarctic Macquarie Island. *Polar Biol.* 21: 279-284.
8. FERREIRA, S.M. & BESTER, M.N. 1999. Chemical immobilisation, physical restraint, and stomach lavaging of fur seals (*Arctocephalus* spp.) at Marion Island. *S. Afr. J. Wildl. Res.* 29: 55-61.
9. PISTORIUS, P.A., BESTER, M.N. & KIRKMAN, S.P. 1999. Survivorship of a declining population of southern elephant seals, *Mirounga leonina*, in relation to age, sex and cohort. *Oecologia* 121: 201-211.
10. PISTORIUS, P.A., BESTER, M.N. & KIRKMAN, S.P. 1999. Dynamic age-distributions in a declining population of southern elephant seals. *Antarct. Sci.* 11: 446-451.
11. THOM, A., VAN DER MERWE, M. & BESTER, M.N. 1999. Seasonal and age-related changes in the

micro-anatomy of the prostate gland of the Subantarctic fur seal, *Arctocephalus tropicalis*. *S. Afr. J. Zool.* 34: 197-200.

12. BESTER, M.N. & ODENDAAL, P.N. 2000. Abundance and distribution of Antarctic pack ice seals in the Weddell Sea. In: Antarctic Ecosystems: Models for Wider Ecological Understanding. W. Davison, C. Howard-Williams & P. Broady (eds), Caxton Press, Christchurch, New Zealand. Pp. 59-63.
13. BESTER, M.N., BLOOMER, J.P., MULLER, D.D., VAN ROOYEN, M. & BüCHNER, H. 2000. Final eradication of feral house cats *Felis catus* from Marion Island. *S. Afr. J. Wildl. Res.* 30: 53-57.
14. McMAHON, C.R., BURTON, H., McLEAN, S., SLIP, D. & BESTER, M. 2000. Field immobilisation of southern elephant seals with intravenous tiletamine and zolazepam. *Vet. Rec.* 146: 251-254.
15. PISTORIUS, P.A., BESTER, M.N., KIRKMAN, S.P. & BOVENG, P.L. 2000. Evaluation of age- and sex-dependent rates of tag loss in southern elephant seals. *J. Wildl. Manage.* 64: 373-380.
16. PLÖTZ, J., BORNEMANN, H., KNUST, R., SCHRÖDER, A. & BESTER, M. 2002. Foraging behaviour of Weddell seals, and its ecological implications. In: *Ecological Studies in the Antarctic Sea Ice Zone*. W.E. Arntz & A. Clarke (eds), Springer, Berlin. Pp. 148-156.
17. KERLEY, G.I.H, ALLEN, B.R. & BESTER, M.N. 2000. Comparison of skull morphometrics of male Subantarctic fur seals (*Arctocephalus tropicalis*) from Marion and Gough islands. *Afr. Zool.* 35: 165-171.
18. KIRKMAN, S.P., WILSON, W., KLAGES, N.T.W., BESTER, M.N. & ISAKSEN, K. 2000. Diet and estimated food consumption of Antarctic fur seals at Bouvetoya during summer. *Polar Biol.* 23: 745-752.
19. McMAHON, C.R., BURTON, H.R. & BESTER, M.N. 2000. Weaning mass and the future survival of juvenile southern elephant seals, *Mirounga leonina*, at Macquarie Island. *Antarct. Sci.* 12: 149-153.
20. WYNEN, L.P., GOLDSWORTHY, S.D., GUINET, C., BESTER, M.N., BOYD, I.L., GJERTZ, I., HOFMEYR, G.J.G., WHITE, R.W.G. & SLADE, R. 2000. Post-sealing genetic variation and population structure of two species of fur seal (*Arctocephalus gazella* and *A. tropicalis*). *Molecular Ecol.* 9: 299-314.
21. KIRKMAN, S.P., HOFMEYR, G.J.G., BESTER, M.N. & ISAKSEN, K. 2001. Counts of southern elephant seals, *Mirounga leonina*, at Bouvet Island. *Polar Biol.* 24: 62-65.
22. BESTER, M.N., MÖLLER, H., WIUM, J. & ENSLIN, B. 2001. An update on the status of southern elephant seals at Gough Island. *S. Afr. J. Wildl. Res.* 31 (1&2): 68-71.
23. ST. CLAIR HILL M, FERGUSON, J.W.H., BESTER, M.N. & KERLEY, G.I.H. 2001. Preliminary comparision of calls of the hybridising fur seals, *Arctocephalus tropicalis* and *A. gazella*. *Afr. Zool.* 36: 45-53.
24. KEITH, M., BESTER, M.N., BARTLETT, P.A. & BAKER, D. 2001. Killer whales (*Orcinus orca*) at Marion Island, Southern Ocean. *Afr. Zool.* 36: 163-175.
25. KIRKMAN, S.P., BESTER, M.N., PISTORIUS, P.A., HOFMEYR, G.J.G., OWEN, R. & MECENERO, S. 2001. Participation in the winter haulout by southern elephant seals, *Mirounga leonina*. *Antarct. Sci.* 13: 380-384.
26. PISTORIUS, P.A., BESTER, M.N., KIRKMAN, S.P. & TAYLOR, F.E. 2001. Temporal changes in

fecundity and age at sexual maturity of southern elephant seals at Marion Island. *Polar Biol.* 24: 343-348.

27. PISTORIUS, P.A., BESTER, M.N., KIRKMAN, S.P. & TAYLOR, F.E. 2001. Pup mortality in southern elephant seals at Marion Island. *Polar Biol.* 24: 828-831.
28. PLÖTZ, J., BORNEMANN, H., KNUST, R., SCHRÖDER, A. & BESTER, M. 2001. Foraging behaviour of Weddell seals, and its ecological implications. *Polar Biol.* 24: 901-909.
29. RAMDOHR, S., BORNEMANN, H., PLÖTZ, J. & BESTER, M. 2001. Immobilization of free-ranging adult male southern elephant seals with Immobilon™ (etorphine/acepromacine) and ketamine. *S. Afr. J. Wildl. Res.* 31 (3&4): 135-140.
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Appendix 4

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2. MAJOR DISCIPLINE IN WHICH THE RESEARCH/STUDY WILL BE UNDERTAKEN

Biological Sciences

3. TITLE OF PROJECT
(The title must be short and specific and should be used for the duration of the project)

Moisture and nutrients as determinants of soil respiration rate on Marion Island

3.1 DURATION OF PROJECT: **_1st April 2004 to 31st March 2005**

4. CATEGORY OF PROJECT PROPOSAL

(a) **First proposal** (summary of literature –**see Annexure A**).

5. KEYWORDS BY MEANS OF WHICH THE PROJECT CAN BE IDENTIFIED

Sub-Antarctic **Marion Island** **Soil respiration**
Ecosystem carbon exchange

6. RESPONSIBLE PROJECT LEADER (AND CO-LEADERS)

Title	**Professor**
Surname	**Smith**
First name/s:	**Valdon Redvers**
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7. **PARTICULARS OF APPLICANTS**

Title: **Professor**

Surname: **Smith**

First name/s: **Valdon Redvers**

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e-mail: **vs2@land.sun.ac.za**

Date of birth: **11 December 1948**

Citizenship: **South African**

Are you a South African citizen? **Yes** If not, are you a permanent resident?

Country of citizenship: **South Africa** Occupation: **Lecturer/researcher**

Employer: **University of Stellenbosch** Department/Institution: **Botany**

8. **QUALIFICATIONS**

Highest qualification: **Ph. D.** Where obtained: **University of the Free State**

Date obtained: **1984** Will the research be used to obtain a degree? **Yes (for project researcher)**

Which degree: **M.Sc. or B.Sc. Hons**

8.1 Please attach details of previous experience in Antarctica, Marion and Gough Islands and the Southern Ocean. **- Annexure B**

9. **SCIENTIFIC PUBLICATIONS** (Please attach a list of your publications during the past 5 years) **- Annexure C**

10. SUMMARY OF FINANCIAL REQUIREMENTS

	Received for current year 2003	This Application 2004/05	Future Application/s
Manpower costs	**Nil**	**R30 000**	**Nil**
Running expenses	**Nil**	**R26 450**	**Nil**
Capital equipment	**Nil**	**R0**	**Nil**
TOTAL	**R0**	**R56 450**	

10.1 Which organization will be responsible for the administration of the funds?

University of Stellenbosch

11. OBJECTIVES AND RATIONALE (NEED AND PURPOSE).

(Please state the objectives of the project, the need for it and how it will contribute to SANAP. In follow-up proposals, please indicate and explain any changes from the previous proposal.)

(See Annexure A for supporting information)

Ecosystem carbon exchange is receiving considerable attention in the polar and subpolar regions of the northern hemisphere; few studies are addressing this in the Antarctic and none in the sub-Antarctic. The main objective of the northern hemisphere subpolar carbon exchange studies is to establish whether Arctic and sub-Arctic tundras are contributing to, or ameliorating, the increasing global concentrations of greenhouse gases such as CO_2 and methane. Sub-Antarctic islands are a miniscule part of the southern hemisphere subpolar region so their role in increasing or decreasing greenhouse gas concentrations at a global scale is likewise miniscule. Rather, the incentive for researching carbon exchange on Marion Island is that it is an easily-measured emergent property that can be used as a convenient tool to assess the island ecosystem's response to climate change. Temperature has increased, and precipitation (also soil moisture) decreased, very markedly at the island since 1969 (reference 9 in annexure C).

A proposal to SACAR in 1999 to undertake a project entitled "Carbon Balance of the Marion Island Terrestrial Ecosystem" from 2000 to 2004 did not succeed in obtaining financial support, due to shortage of funding within SACAR. I was invited to carry out all or any of proposed studies using non-SACAR funding. Accordingly, between 2001 and 2003 a modest start was made toward understanding some components of carbon exchange at the island. A study of lichen photosynthetic physiology (reference 3 in Annexure C) enabled construction of a carbon budget model to predict net carbon balance for stands of the lichen under different climate change scenarios (ref. 5). Using laboratory incubations, the effect of temperature on soil respiration at field moisture holding capacity was assessed for 100 sites representing 21 habitats on the island. Across-habitat variation in respiration rate was related to soil chemistry, soil microrganism counts and site botanical characteristics. That study (ref. 12) showed that the soil respiration rate responds positively to temperature between 5 °C and 20°C and that there are no between-habitat differences in respiratory Q_{10}. Manuring by seals and seabirds was shown to be the main determinant of CO_2 flux from the island's soils. However, since rates were measured only at 100% water holding capacity the influence of soil moisture content could not be assessed. It could also not be shown whether the stimulation of soil respiration by manuring is due to enhanced soil inorganic N and P status, to an increased availability of labile organic C substrates, or both.

In a previous SACAR project (1987-1992) it was shown that soil macroinvertebrates markedly stimulate mineralization of inorganic nutrients in plant litter or peat contained in microcosms. At that time I carried out a small pilot study that showed that a similar microcosm technique can be used to monitor carbon mineralization. The island's terrestrial macroinvertebrates are heavily predated on by mice, excepting for the introduced slug, which the mice do not eat (ref 10). The slug also enhances inorganic nutrient mineralization but the pilot study suggested that the ratio of N to C, and of N to P released might be different than in the case of indigenous macroinvertebrate species. If this is the case, and slug densities are increasing at the expense of native species, then this has implications for ecosystem functioning on the island.

This proposal is for field and laboratory investigations of the responses of soil CO_2 flux to moisture content and to inorganic and organic nutrient amendments The across-habitat patterns of variation in soil respiration suggested by the laboratory incubations will also be tested using field measurements. Rates of release of C, N and P from litter fed to slugs will be compared with those from litter fed to larvae of the flightless moth, which are about the same size as the slugs.

12. PARTICULARS OF A PILOT OR FEASIBILITY STUDY THAT HAS BEEN UNDERTAKEN.

(Please give a short description of any pilot/feasibility study which may have been undertaken.)

I have been involved with atmospheric CO_2 measurements and plant CO_2 assimilation studies at Marion Island since 1980. I participated in an ecosystem carbon exchange study in the Arctic in 1994. More pertinently, the soil respiration study mentioned in section 11 and described in reference 12 in annexure C demonstrate the feasibility of making the types of measurements needed in this study.

13. KEY QUESTIONS AND RESEARCH APPROACH

(Please provide a list of specific questions to be answered or hypotheses that will be tested and indicate how each is to be approached. In follow-up proposals, indicate and explain any changes from the previous proposal.)

1. How does soil respiration respond to moisture content at different temperatures?

Laboratory measurement of respiration rate of soils under different moisture contents and temperatures.

2. How does soil respiration respond to inorganic nutrient amendent and an enhanced supply of high energy substrate?
Laboratory and field measurements of respiration rate of soils fortified with N, P, N plus P, and glucose.

3. How does soil respiration rate vary across habitats?
Closed-system CO_2 exchange measurements in the field.

4. What are the rates of C, N and P mineralization in litter fed to slugs and to a native macroinvertebrate species?
Microcosm measurements of CO_2 exchange and of inorganic N and P release from litter in the presence and absence of slugs or the native species.

13.1 Please provide an indication of the unique multi-disciplinary nature of the research.

I am not sure whether this research is "uniquely" multi-disciplinary. At the taxonomical level it considers soil organisms and macroinvertebrates. It deals with physiological ecology, specifically respiratory responses to climatic factors such as moisture and temperature. At the ecosystem functional level it considers the role of climate, nutrients and energy supply in determining the rate of soil carbon emissions and will give results that can be used to predict ecosystem functional responses to climate change and to alien organisms. I suppose all my work to date on the island could be considered as multidisciplinary since it has encompassed aspects such as plant–animal–microbial interactions, production and nutrient cycling, plant ecophysiology, plant ecology, atmospheric chemistry, atmospheric CO_2 levels, soil biology, climate analysis and climate change, house mouse ecology and reproductive biology, the impact of alien plants, animals and fungal pathogens, etc. This project is a logical extension of those studies and is designed to further our knowledge of the functioning of sub-Antarctic ecosystems and biota.

14. **PROPOSED WORK PLAN**
(Please describe the tasks to be undertaken during the whole project. Describe the methods to be used, indicate the persons and institutions involved and provide target dates for the start and completion of each task. In follow-up proposals, indicate and explain any changes from the previous proposal.)

April 2004:
Appointment of student in project. On island (VRS and student): Field measurements of CO_2 exchange at 100 sites characterized according to the habitat classification scheme of Smith and Steenkamp 2001 (ref. 4 in appendix). Field measurement of CO_2 exchange at sites fertilized with N, P or glucose. Collection of slugs and one native macroinvertebrate species.

May to December 2004:
Laboratory studies (student): Establishment of moisture/temperature treatments, also nutrient treatments. Measurements of respiration rate on the treatments. Microcosm measurements of CO_2 and N and P release from litter fed to macroinvertebrates.

January -March 2005:
Data analysis and write-up.

14.1 Is this project a co-operative/collaborative project. Please provide summary information on the associated projects and discuss the role of this project in the total programme.

I do not know what projects will be carried out at Marion Island from 2004. This will probably depend on what is decided at the Stellenbosch workshop in July 2003. However, the project will fulfil a cardinal role in the overall SANAP program by addressing one of the stated objectives: "Differential responses to environmental change". It also addresses the role of introduced species on the island. Internationally, the project falls squarely into the focusof the "Regional Sensitivity to Climate Change in Antarctic Ecosystems" (RiSCC) program of the Scientific Committee on Antarctic Research (SCAR). It also addresses objectives of the "Global Change and Terrestrial Ecosystems" (GCTE) core project of the International Geosphere Biosphere Programme.

15. **WILL THE PROJECT LEADER BE AWAY FOR ANY SIGNIFICANT PERIODS WHILE THE PROJECT IS IN PROGRESS?**

No

16. **END PRODUCT OF THE PROJECT**
(Describe the planned final products that will result from the project (i.e. the nature of the final report, maps, etc.) and state when they will be submitted. All DEAT funded projects should include the text for a popular publication which will be used to bring the results of the research to the general public or to a specific user group.)

The final project report will be submitted in March 2005. The information will be published in scientific journals and will form the basis the project researcher's MSc or Honours thesis.

17. **DISCUSS ANY POTENTIAL IMPACT YOUR STUDY WILL HAVE ON THE ENVIRONMENT AND DESCRIBE MITIGATING ACTIONS WHICH YOU PROPOSE TO MINIMIZE OR ELIMINATE THE IMPACT**

The following guidelines are provided to assist applicants with questions relating to the potential environmental impact of a proposal.

(i) Proposals for the continuation of ongoing projects should state clearly if any changes are proposed in field methods, work programmes, camp sites, and timing from those documented in the original proposal, or subsequent modifications to it.

(ii) The proposer should list aspects of the proposed activity, that have not been noted, that might cause impacts on the Antarctic environment (e.g. visual impact or other forms of disturbance).

(iii) In making all these assessments of impact, the proposer should briefly consider the nature, duration and intensity of the likely environmental effects, including the following;

a. the existing environment, its variability or dynamic nature, resilience to change, sensitivity to disturbance, previous disturbance, protected status etc;

b. cumulative and possible indirect impacts;

c. the probability of accidents and their environmental consequences;

d. the adequacy of existing information and knowledge.

(iv) A map of the area should be included (sketch if necessary) to assist the interpretation of this section of the research application.

Proposers are expected to provide sufficient information in their answers to allow the DEA & T to make a thorough, complete and accurate evaluation of the environmental impact of the project. Insufficient information will require follow-up action and/or may prejudice the environmental acceptability of the project.

Preliminary Environmental Evaluation

Details of Activities

Answer all questions only if work is to be carried out in Antarctica or Marion Island during 2004./ 2005

Will your objective:

a. Use a radionuclide? Yes [ ] No [X]

b. Take any chemical to Antarctica or Marion Island?

Yes [X] No [ ]

If Yes, complete the following:

Chemical	Formula	Quantity	Use
Soda lime	NaOH/CaOH	20kg	CO_2 absorber
Drierite	$CaSO_4$	10kg	H_2O absorber
Silica gel	H_2SiO_3	2kg	H_2O absorber

Unused chemicals will be: [ ] Left at SANAE Base

[X] Returned to South Africa X

[ ] Other

c. Release any chemical to the Antarctic or sub-Antarctic Environment?

Yes [ ] No [X]

d. Require the use of explosives? Yes [ ] No [X]
If Yes, complete the following:

e. Collect, capture, kill, restrain, tag or band any terrestrial, freshwater or marine plants or animals?

Yes [X] No [ ]

If Yes, complete the following:

For each species (apart from those taken using plankton nets or trawl), estimate the proportion of the local population you will be collecting, capturing, killing, tagging or banding. If restraining, include period of restraint:

Species	**Method**	**Number**	**Proportion of population (%)**
Deroceras caruanae (slug)	Hand collect	50	? - certainly < 0.0001%
Pringleophaga marioni larvae (flightless moth)	Hand collect	30	? - previous studies show that there are up to 200 individuals per sq metre depending on habitat
Plant litter	Hand collect	100 g	There is from 2 to 13 tons of plant litter per hectare in the lowland vegetation types

For each species, indicate the proportion of the local population you will be disturbing while carrying out the above activities. **None other than the individuals collected**

f. Enter any Protected Area? Yes [ ] No [X]

g. Take to Antarctica or Marion Island any animal, plant (includes seeds), micro-organism or soil?

Yes [ ] No [X]

h. Significantly disturb by flooding, sampling, trampling, camp operations or any other means any ice-free area (bare ground)?

Yes [ ] No [X]

i. Take or remove any physical specimens eg. rocks, fossils etc?

Yes [X] No [ ]

If Yes, detail the general area and types of specimens to be collected:

Location	Specimen	Type	Total Number of Weight
Various, all in zone 1	Soil	Peat and mineral	2 kg wet mass (about 2 litres)

j. Cumulative Impacts.

Occupy new or existing camp sites? **No**

Will you track previously untracked ground?

Yes [ ] No [X]

Will you install equipment, markers, stakes, cairns etc. that will be left in the field?

Yes [X] No [ ]

If Yes, detail location and type of marker, stake etc:

Location	Type
Markers are already out in longterm study plots and in three sites* where the soil respiration studies will be undertaken	Plastic pipes staked into peat * will be removed in March 2005

k. Do you expect your activities to have an environmental impact not covered in the above?

Yes [ ] No [X]

l. Is the proposed activity likely to have more than a minor or transitory impact?

Yes [ ] No [X]

18. FINANCIAL REQUIREMENTS

18.1 MANPOWER

In follow-up proposals explain any changes from the projection given in the previous proposal.

Name, qualifications, past experience and function in this Project	Time available for this project (% of full-time man-year)	Nature and Source of non-SANAP funding	Amount requested from SANAP
V.R. Smith, Ph.D., 30 years sub-Antarctic Research experience, project leader Student/ Project researcher	40 100	Salary and benefits Univ. Stellenbosch	Nil Bursary R30 000
Total			R30 000

18.2 RUNNING EXPENSES

(Please complete all sections. Indicate non-SANAP funds available. That, if a University decides to suggest a research proposal, the University itself must render the necessary support services, such as photocopies, telephone calls, postage, etc. If a research project requires technical support services, the time required must be budgeted for instead of a designated appointment.)

In follow-up proposals explain any changes from the projections given in the previous proposal.

Items	Nature and source of non-SANAP funding	Funds requested From SANAP
<u>Transport (sea, air and land with distances and rates)</u> Traveland freight between Stellenbosch and Cape Town, 400 km @ R1.92 per km	 Nil	 R768
Subsistence (nature and rates)	Nil	Nil
<u>Supplies and services (please specify)</u> Soda lime 2kg @ R900 per kg Drierite 2kg @ R950 per kg Silica gel 6 kg @ R160 per kg N,P, Glucose fortification Soil C, N, P analysis x 100	 Nil Nil Nil Nil Nil	 R1 800 R1 900 R960 R274 R8 100

Microcosm filtrate N,P analysis x 160 Plant litter C, N, P analysis x 8 Construction of 24 microcosms Use of EGM and soil respiration chamber on island, 30 days (includes compulsory all risks insurance)	Nil Nil Nil Nil	R4 000 R648 R3 000 R3 000
Use of gas exchange apparatus, 160 days	R16 000	Nil
Sundry collection and field equipment, sample vials, plastic bags, tags, string, pruning shears etc	Nil	R2 000
Office equipment, stationery, postage, photostats, computer support, email, telephone etc	R10 000	Nil
Total	R26 000	R26 450

18.3 CAPITAL EQUIPMENT

(Please describe the items required.)

Items paid for in full by SANAP remain the property of DEAT. Items to which the participating organization contribute 50% or more of the cost, become the property of the organization.

In follow-up proposals, please explain any changes from the projections given in the previous proposal.

Description of item and total cost	Non-SANAP Funding	Non-SANAP application	Amount requested from SANAP
Multiplexor for sampling microcosm atmospheres	U.S. R67 000		Nil
Laptop computer	U.S. R15 000		Nil
Data logger	U.S. R 12 400		Nil
Temperature sensors	U.S. R1 295		Nil
300g balance	U.S. R28 000		Nil
Total	R123 695		Nil

A short motivation must be provided for each item requested. Please supply a quotation for all items requested.

18.4 LOGISTIC SUPPORT

(Please assess your support requirements carefully. The details provided will be used to develop the support for your project, as well as the total integrated support for all programmes. *You will be required to complete this section for each voyage undertaken.*)

Volume and mass of cargo 2 m^3 600 kg

Description of cargo Scientific equipment, Collectingequipment

Destination where cargo is required: Marion Island

Radio-active and other hazardous cargo.
Nil

Accommodation requirements
Ship: .

Number of persons : 2

Period: Marion Island relief voyage 2004

Base
Number of persons: 2

Period: Marion Island relief period 2004

Ship's time required: Nil

Sampling locations at sea (please attach a detailed map):
Nil

Laboratory requirements (base): Use of Microbiology/chemical analysis laboratory

Helicopter support (describe fully e.g. time, locality, special requirements):

Helicopter support to get personnel and equipment to field sites, especially the high altitude ones

Camping equipment: Nil

Special equipment: Nil

Protective clothing
No of persons: 2

List any special requirements: Nil

Please list any special needs: Nil

19. **PARTICULARS OF RESEARCH/STUDY ABROAD**

Nil

20. **STATEMENT BY APPLICANT**

I declare that the foregoing information is correct.

Signature ____________ Date 17/6/03

21. **RECOMMENDATION BY THE RESEARCH OR EQUIVALENT COMMITTEE OF THE APPLICANT'S ORGANIZATION**

DIE UNIVERSITEIT VAN STELLENBOSCH ADMINISTRASIEGEBOU
19 JUN 2003
THE UNIVERSITY OF STELLENBOSCH ADMINISTRATION BUILDING

Chair ____________ Date 18/6/03
Director: Research

I certify that the information contained in this application is correct and that if SANAP financial support is provided, it will be utilised in accordance with the conditions as laid down by the DEAT.

Project Leader ____________ Date 17/6/03

Head of Department ____________ Date 17/6/03

Head of Organization ____________ Date 17/6/03

22. **COMMENT AND RECOMMENDATION BY SANAP**

Chair ____________ Date ____________

ETHICAL REQUIREMENTS FOR RESEARCH ON THE PRINCE EDWARD ISLANDS

Questionnaire to be completed by reviewing ethical committee

Not required, no work will be done on vertebrates

Appendix 2

DELIVERABLES

(SANAP-RELATED ONLY)

A. CURRENT SANAP RESEARCH CYCLE: 1 April 2001 – 31 March 2005

Kindly indicate what the expected deliverables of your project will be for the duration of the current research cycle, including the one year extension, with respect to the following:

- Number of Honours, MSc and PhD students expected to be trained/obtained *(if in progress, please list name, degree and year of completion – add further lines if necessary)*

Honours → 1

OR

MSc → 1

PhD →

NAME	DEGREE	YEAR
Unknown	MSc or BSc Hons	2005

- Estimated number of scientific publications to be published in accredited scientific journals

3

- Estimated number of scientific papers to be presented at local and international conferences

LOCAL → 1
INTERNATIONAL → 0

- How and to what level you intend enhancing transformation/capacity building/representivity levels in your project

Every attempt will be made to appoint a student from a representative group in this project

- The project's contribution to the public understanding of Science and Technology

I give regular talks (19 in 2002 and 2003so far) on the Prince Edward Islands to public fora and institutions. I also gave 4 talks to high schools in the same period. I published one popular article on the Prince Edward Islands in 2002. There is no reason to believe that this type of activity wiii not continue during the duration of the project.

B. PREVIOUS SANAP RESEARCH CYCLES: All previous cycles up until 31 March 2001

If you have previously received SANAP funding, please indicate the following for ALL previous SANAP research cycles:

- Number of scientific papers published in accredited journals from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please attach complete list)*

146 **See Annexure D**

- Number of completed Honours, MSc and PhD degrees from members of your group from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please list name, degree and year of completion – add further lines if necessary)*

Honours → 2

MSc → 2

PhD → 3

Name	Degree	Year
D. Haines	BSc Hons	1979
B Blake	BSc Hons	1991
V Smith	MSc	1976
B Blake	MSc	1996
V Smith	PhD	1984
M Steenkamp	PhD	1991
N Avenant	PhD	1999

Annexure A

Motivation and literature review for proposal:

"Moisture and nutrients as determinants of soil respiration rate on Marion Island"

Proposer: V.R. Smith

Sub-Antarctic islands are characterised by limitations of space, restricted habitats and impoverished floras and faunas that show modified ecological behaviour and morphological, reproductive and physiological traits. All these have consequences for the islands' ecosystems (Jenkin, 1975; Lewis Smith and Walton, 1975; French and Smith, 1985). Crucially, important ecological functional groups such as mammalian herbivores and vertebrate and invertebrate predators are poorly represented in, and often absent from, the indigenous biotas of sub-Antarctic islands. Another feature of sub-Antarctic island ecosystems is that they are heavily influenced by the manuring and trampling of seals and seabirds. (following terminology commonly used in the island's ecological literature - e.g. Huntley, 1971, Gremmen, 1981, Smith and Steenkamp, 2001 - the term *biotic* is used when referring to sites, vegetations or habitats influenced by seals and seabirds). The sub-Antarctic climate is oceanic and in many respects cool temperate rather than polar, so that bitterly cold or dry periods are short (for some islands absent) and the vegetation growing season is long. Annual primary production is therefore high (Jenkin and Ashton, 1970; Lewis Smith, 1984; Smith, 1987a,b). The paucity of grazers and predators results in most of the energy and nutrients incorporated in primary production going through a detritus-, rather than a grazing-, chain. The consistently cool climate, high cloud cover and very high rainfall result in the soils experiencing low temperatures and excessive moisture, both of which restrict microbial activity (Wynn-Williams,1980; Smith et al., 1993) On Marion Island (47°S, 38°'E) it has been shown that decomposition, with the concomitant release of nutrients, is overwhelmingly the main bottleneck in nutrient cycling and primary production for most plant communities (Smith, 1988, Smith and Steenkamp 1992). Consequently, much research on that island has been directed toward understanding the decomposition subsystem.

Smith and Steyn (1982) showed that a high proportion (48%) of the variation in plate-count numbers of soil aerobic bacteria across 21 sites (representing 10 of the 41 plant communities recognized in the island's vegetation) was explained by differences in soil inorganic N content related to the manuring influence of seabirds or seals. Soil pH and inorganic N together explained 52% of the variation in plate-count numbers of soil fungi. French and Smith (1986) showed that direct (epifluorescence microscopy) counts of soil bacteria at six of these plant communities (12 sites in total), were significantly negatively related to climatic severity (decreasing temperature, increasing aridity) and positively related to soil fertility (inorganic N and P, organic C and N concentrations). Total bacterial cell volume was not related to climatic severity - the main division was simply between edaphically rich and poor sites, associated with manuring. From the combinations of bacterial cell numbers, types (shapes and sizes), and total volumes, French and Smith (1986) formulated some hypotheses regarding the growth and metabolic activities of soil bacteria in relation to site conditions and suggested that these could be tested by measuring microbial activities.

Grobler et al. (1987) measured heterotrophic bacterial activity using a ^{14}C-glucose kinetic assay and a dehydrogenase assay in soils of four of the main vegetation formations on the island (fellfield, mire/bog, fernbrake and a biotic vegetation formation). Specific activity (activity per bacterial cell) measured by both methods varied between formations in the manner predicted by French and Smith (1986); the biotic vegetation showed the highest soil bacterial activity, followed by fernbrake, mire and fellfield, in that order. Within vegetation formation there was a clear effect of altitude (taken to indicate an effect of climatic severity). Smith et al. (1993) showed that variation in TSL (tensile strength loss of buried cotton strips; a measure of soil decomposition potential) on the island could be ascribed mainly to a non-linear relationship between TSL and soil moisture content and soil inorganic N. Across the 10 plant communities studied, TSL was only weakly related to soil temperature since very wet sites with low decomposition potential tended to be as warm (or even warmer) than more mesic, but more biotically-influenced, sites. The pattern of TSL across the plant communities was similar to that shown by the heterotrophic activity data of Grobler et al. (1987).

These earlier studies encompassed only a small proportion of the island's terrestrial habitats; indeed, when they were carried out the range of habitats and the patterns of variation in the various vegetation and soil properties across it were not fully understood. This recently changed. To provide a framework against which to detect and evaluate the biological and ecological responses to climate change, Smith and Steenkamp (2001) produced a quantitative classification of the island's terrestrial habitats. The classification, based on canonical correspondence analyses of patterns of variation in vegetation and soil chemistry, closely reflects the between-habitat differences in the relative magnitudes of the main ecological forcing variables on the island. This implies that the classification should also reflect between-habitat differences in ecosystem functional properties, of which decomposition phenomena are particularly pertinent considering the peculiarities of the island's ecosystem described above. Recently, Smith (2003) tested that implication by relating soil respiration rates measured under controlled conditions in the laboratory to soil chemistry, soil microrganism counts and botanical characteristics. The effect of temperature on soil respiration rate was also assessed. The across-habitat pattern of differences in soil respiration rate was shown to be clearly related to the magnitude of one forcing variable - manuring by animals.

An important limitation to the conclusions of Smith (2003) is that they were derived from measurements made in the laboratory, rather than *in vivo*. It cannot be assumed that the across-habitat patterns of differences in soil respiration rate *in vivo* will be the same as that shown in laboratory incubations; in fact, experience elsewhere shows that that is rarely the case. Also, Smith (2003) could not assess the influence of moisture (shown to be the prime determinant of habitat structure), since rates were measured only at 100% water holding capacity. It was also not shown whether the stimulation of soil respiration, or the enhancement of microbial growth and activity found in previous studies, by manuring could be ascribed to enhanced soil inorganic N and P status or to an increased availability of high energy labile organic C substrates, or both. There is much controversy about the role of inorganic nutrients in determining soil respiration rate in subpolar regions. In tundra and subpolar areas of the Northern Hemisphere, low rates of soil respiration are generally associated with low organic matter quality (low total N inorganic N or P, high C-to-N ratio), low temperature and often shortage or excess of moisture, but the importance of inorganic nutrients such as N and P has not been unequivocally established. In field incubations of taiga soils respiration response to added N was greatest when endogenous labile C was abundant, and adding labile C (sucrose) with or without inorganic N greatly stimulated respiration rate, leading Vance and Chapin III (2001) to conclude that field soil respiration rate responded primarily to labile C in the short term and to N in the longer term. Those authors also carried out laboratory incubations that showed that addition of inorganic N did not elevate (and in one case depressed) respiration rate, unless accompanied by addition of high amounts of organic C (cellulose or cellobiose), supporting the concept that microbial activity responds to a balanced supply of C and N. N, P and K fertilisation in paper birch and quaking aspen taiga communities was associated with a significant reduction in soil respiration (Van Cleve, 1974); later this was ascribed by Van Cleve and Moore (1978) to the inhibiting effect of KCl addition on soil biological activity. From long-term field studies those authors showed that the main effect of improved N and P supply in an aspen-dominated taiga was a 30 to 40% increase in 0_2 uptake by the soil. However, highly variable results were obtained from a subsequent study on the same taiga communities (J.C. Brunberg, unpub. M. Sc. thesis University of Alaska, 1983; reported in Van Cleve and Yarie, 1986) aimed at separating the effect of inorganic nutrient and labile C addition from primary substrate quality (low quality substrate was compared with high quality substrate), and at controlling for the effect on biological activity of variable temperature and moisture regimes (incubations were carried out at 10 °C and field moisture holding capacity). The tendency was an increasing respiration rate with energy (labile C) addition and no effect or depressed respiration with inorganic nutrient addition.

In the Southern Hemisphere polar region too, there is no consensus regarding the role of inorganic nutrients in determining soil respiration rate. For instance, Cocks et al. (1998) showed that respiration rate of soils influenced by the manuring of snow petrels was an order of magnitude higher than for nearby uninfluenced soils. The uninfluenced soils all showed much lower inorganic N and P contents than, but some had as favourable moisture and temperature regimes as, the manured ones, leading those authors to conclude that the main effect of manuring on respiration rate was through an enhanced nutrient status. In contrast, Harris and Tibbles (1997) ascribed enhanced soil heterotrophic activity (incorporation of ^{3}H-thymine and ^{3}H-leucine) at snow petrel-influenced sites on the same nunataks as being primarily due to more favourable moisture and temperature regimes than at the uninfluenced sites, rather than to differences in nutrient status.

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Van Cleve, K., Moore, T.A., 1978. Cumulative effects of nitrogen, phosphorus and potassium fertilizer additions on soil respiration, pH and organic matter content. Soil Science Society of America Journal 42, 121-124.

Van Cleve, K., Yarie, J., 1986. Interaction of temperature, moisture and soil chemistry in controlloing nutrient cycling and ecosystem development in the taiga of alaska. In: Van Cleve, K., Chapin III, F.S., Flanagan, P.W., Viereck, L.A., Dytness, C.T. (Eds.). Forest Ecosystems in the Alaskan Taiga. Springer, New York, pp. 160-189.

Vance, E.D., Chapin, F.S., III., 2001. Substrate limitations to microbial activity in taiga forest floors. Soil Biology & Biochemistry 33, 173-188.

Wynn-Williams, D.D., 1980. Seasonal fluctuations in microbial activity in Antarctic moss peat. Biological Journal of the Linnean Society 14, 11-28.

Annexure B

Sub-Antarcic research experience, V.R. Smith

I have been involved in sub-Antarctic researcgh since December 1971. Since then I have visited Marion Island about 45 times and Prince Edward 9 times. I have also carried out research on Heard Island, as part of an Australian research expedition. My research has involved collaboration with 19 Antarctic/sub-Antarctic researchers from other countries and many South African researchers.

This research has yielded 146 scientific papers, 120 of which arose from projects in which I was either the project leader or the main project researcher.

In 1996 I was awarded the BP ANtarctic Medal for my sub-Antarctic research

Annexure C

Publications last 5 years, V.R. Smith

1. Gremmen N.J.M. & V.R. Smith (1999) New records of alien vascular plants from Marion and Prince Edward Islands, sub-Antarctic. Polar Biology 21: 401-409.

2. Ripley, B.S., N.W. Pammenter & V.R. Smith (1999) Function of leaf hairs revisited: The hair layer on leaves *Arctotheca populifolia* shows reduces photoinhibition but leads to higher leaf temperatures caused by lower transpiration rates. J. Plant Physiology 155: 78-85.

3. Smith, V.R. & N.J.M. Gremmen (2001) Photosynthesis in a sub-Antarctic shore-zone lichen. New Phytologist 149: 291-299.

4. Smith V.R., Steenkamp M. (2001) Classification of the terrestrial habitats on sub-Antarctic Marion Island based on vegetation and soil chemistry. Journal of Vegetation Science 12: 181-198

5. Smith V.R., Gremmen N.J.M. (2001) *Turgidosculum complicatulum* on sub-Antarctic Marion Island: carbon acquisition response to climate change. Polar Biology 24: 455-459

6. Gabriel A.G.A., Chown S.L., Barendse J., Marshall D.J., Mercer R.D., Pugh P.J.A. & Smith V.R. (2001) Biological invasions of Southern Ocean islands: the Collembola of Marion Island as a test of generalities. Ecography 24: 421-430

7. Smith V.R., Steenkamp M. & Gremmen N.J.M. (2001) Terrestrial habitats on sub-Antarctic Marion Island: Their vegetation, edaphic attributes, distribution and response to climate change. South African Journal of Botany 67: 641-654

8. Mierowska A., Keutgen N, Huyshamer M. & Smith V.R. (2002) Photosynthetic acclimation of apple spur leaves to summer pruning. Scientia Horticulturae 92: 9-27

9. Smith V.R. (2002) Climate change in the sub-Antarctic: An illustration from Marion Island. Climatic Change 52: 345-357

10. Smith V.R., Avenant N.L. & Chown S.L. (2002) The diet and impact of house mice on a sub-Antarctic island. Polar Biology 25: 703-715

11. Avenant N.L & Smith V.R. (2003) The microenvironment of house mice on Marion Island (sub-Antarctic). Polar Biology 26: 129-141

12. Smith V.R. (2003) Soil respiration and its determinants on a sub-Antarctic island. Soil Biology and Biochemistry 35: 77-91

13. Ochyra R. & Smith V.R. (in press) *Entosthodon productus* Mitt. (Funariaceae) on Marion Island – the first record in the Subantarctic. Cryptogamie, Bryologie

14. Ochyra R., Smith V.R, & Gremmen N.J. M. (in press) *Thuidium delicatulum* (Hedw.) Schimp. (Thuidiaceae) – another bipolar moss disjunct from Subantarctic Marion Island. Cryptogamie, Bryologie

15. Ochyra R. & Smith V.R. (in press) *Anisothecium cardotii* (R. Br. bis) Ochyra. Marion Island. In: T. L. Blockeel (ed.), New national and regional bryophyte records, 8. Journal of Bryology 25.

16. Ochyra R. & Smith V.R.(in press) *Syntrichia anderssonii* (Ångstr.) R. H. Zander. Marion Island. In: T. L. Blockeel (ed.), New national and regional bryophyte records, 8. Journal of Bryology 25.

17. Gremmen N.J.M., Smith, V.R. & van Tongeren, O.F.R. (in press) Impact of trampling on the vegetation of sub-Antarctic Marion Island. Arctic, Antarctic and Alpine Research.

18. Ryan P. G. , Smith V. R. & Gremmen N. J. M. (in press) The distribution and spread of alien vascular plants on Prince Edward Island. Journal of South African Marine Science

Annexure D

Deliverables: Scientific publications from SANAP-funded projects

1. Publications authored or co-authored by myself, that resulted from SANAP projects in which I was leader or principal researcher

1. Smith, V.R. (1976) Standing crop and nutrient status of Marion Island (sub-Antarctic) vegetation. Jl. S. Afr. Bot. 42, 231-263.

2. Smith, V.R. (1976) The effect of burrowing species of Procellariidae on the nutrient status of inland tussock grasslands on Marion Island. Jl. S. Afr. Bot. 42, 265-272.

3. Smith, V.R. (1977) A qualitative description of energy flow and nutrient cycling in the Marion Island terrestrial ecosystem. Polar Record 18, 361-370

4. Smith, V.R. (1977) Vegetation standing crop of the grey lava flows and of the eastern coastal plain on Marion Island. Jl. S. Afr. Bot. 43, 105-114.

5. Smith, V.R. (1977) Notes on the feeding of Ectemnorrhinus similis Waterhouse (Curculionidae) adults on Marion Island. Oecologia (Berl.) 29, 269-273.

6. Smith, V.R. (1977) The chemical composition of Marion Island soils, plants and vegetation. S. Afr. J. Antarct. Res. 7, 28-39.

7. Smith, V.R. (1978) Soil chemistry of Marion Island (sub-Antarctic). S. Afr. J. Sci. 74, 174-175.

8. Smith, V.R. (1978) Animal-plant-soil nutrient relationships on Marion Island (sub-Antarctic). Oecologia 32, 239-253.

9. Smith, V.R. (1978) Plant ecology of Marion Island - A review. S. Afr. J. Antarct. Res. 8, 21-30.

10. Smith, V.R. (1978) Plant responses to osmotic stress in the coastal zone of Marion Island. S. Afr. J. Antarct. Res. 8, 106-113.

11. Smith, V.R. (1978) Standing crop and production estimates of selected Marion Island plant communities. S. Afr. J. Antarct. Res. 8, 103-105.

12. Smith, V.R. (1979) A comparison between the H2SO4-H2O2-Li2SO4-Se oxidation method and alternative digestion procedures for plant nutrient analysis. Communications in Soil Science and Plant Analysis 10, 1067-1077.

13. Smith, V.R. (1979) The influence of seabird manuring on the phosphorus status of Marion Island (sub-Antarctic) soils. Oecologia (Berl.) 41, 123-126.

14. Smith, V.R. (1979) Evaluation of a resin-bag procedure for determining plant available P in organic, volcanic soils. Plant and Soil 53, 245-249.

15. Smith, V.R. (1980) A phenol-hypochlorite manual determination of ammonium-nitrogen in Kjeldahl digests of plant tissue. Communications in Soil Science and Plant Analysis 11, 709-722.

16. Gremmen, N.J.M. and V.R. Smith (1981) Agrostis stolonifera L. on Marion Island (sub-Antarctic). S. Afr. J. Antarct. Res. 10/11, 33-34.

17. Smith, V.R., G.C. Bate and M.M. Oosthuizen (1981) Andat: An interactive, computerized manual for the chemical analysis of plants, soils and freshwaters. S. Afr. J. Sci. 77, 103.

18. Smith, V.R. and P.J. Ashton (1981) Bryophyte-Cyanobacteria associations on sub-Antarctic Marion Island: Are they important in nitrogen fixation? S. Afr. J. Antarct. Res. 10/11, 24-26.

19. Steyn, M.G. and V.R. Smith (1981) Microbial populations in Marion Island soils. S. Afr. J. Antarct. Res. 10/11, 14-18.

20. Smith, V.R. and S. Russell (1982) Acetylene reduction by Bryophyte-Cyanobacteria associations on a sub-Antarctic Island. Polar Biology 1, 153-157.

21. Smith, V.R. and M.G. Steyn (1982) Soil microbial counts in relation to site characteristics at a sub-Antarctic Island. Microbial Ecology 8, 253-266

22. Pammenter, N.W. and V.R. Smith (1983) The effect of salinity on leaf water relations and chemical composition in the sub-Antarctic tussock grass Poa cookii Hook f. New Phytologist 94, 585-594.

23. Bate, G.C. and V.R. Smith (1983) Photosynthesis and respiration in the sub-Antarctic tussock grass Poa cookii. New Phytologist 95, 533-543.

24. French, D.D. and V.R. Smith (1983) A note on the feeding of Pringleophaga marioni larvae at Marion Island. S. Afr. J. Antarct. Res. 13, 45-46.

25. Smith, V.R. (1984) Effects of abiotic factors on acetylene reduction by cyanobacteria epiphytic on moss at a sub-Antarctic Island. Applied and Environmental Microbiology 48, 594-600.

26. Smith, V.R. and T. Hilmer (1984) Bacterial numbers in the freshwater bodies of a sub-Antarctic island. S. Afr. J. Antarct. Res. 14, 23-26.

27. Smith, V.R. (1984) The effect of glucose, P. Co and Mo on heterotrophic acetylene reduction in a sub-Antarctic peat. S. Afr. J. Antarct. Res. 14, 27-28

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29. Pammenter, N.W., P. Drennan and V.R. Smith (1985) Photosynthesis in two Agrostis species in the sub-Antarctic. Plant Physiol. 77 (Suppl.), 99.

30. French, D.D. and V.R. Smith (1985) A comparison between Northern and Southern Hemisphere tundras and related ecosystems. Polar Biol. 5, 5-21.

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33. Smith, V.R., N.W. Pammenter and P.M. Drennan (1986) A case study of an alien vascular plant (Agrostis stolonifera) introduced on Marion Island. S. Afr. J. Antarct. Res. 16, 128.

34. French, D.D. and V.R. Smith (1986) Bacterial populations in soils of a sub-Antarctic Island. Polar Biol. 6, 75-82.

35. Pammenter, N.W., P.M. Drennan and V.R. Smith (1986) Physiological and anatomical aspects of photosynthesis of two Agrostis species at a sub-Antarctic Island. New Phytol. 102, 143-160.

36. Smith, V.R. and I. Newton (1986) Vesicular-Arbuscular mycorrhizae at Marion Island. Soil Biol. Biochem. 18, 547-549.

37. Smith, V.R. and R.I. Lewis Smith (1987) The biota and conservation status of sub-Antarctic Islands. Environment International 13, 95-104.

38. Smith, V.R. (1987) A computerized bibliography of Antarctic and sub-Antarctic research. S. A. J. Sci. 83,

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39. Smith, V.R. (1987) The environment and biota of Marion Island. S. A. J. Sci. 83, 211-220.

40. Grobler, D.C., D.F. Toerien and V.R. Smith (1987) Bacterial activity in soils of a sub-Antarctic Island. Soil. Biol. Biochem. 19, 485-490.

41. Smith, V.R. (1987) Chemical composition of precipitation at Marion Island (sub-Antarctic). Atm. Environ. 21, 1159-1165.

42. Smith, V.R. (1987) Seasonal changes in plant and soil chemical composition at Marion Island (sub-Antarctic): I - Mire grasslands. S. Afr. J. Antarct. Res. 17, 117-132.

43. Smith, V.R. (1987) Seasonal changes in plant and soil chemical composition at Marion Island (sub-Antarctic): II - Fjaeldmark and fernbrakes. S. Afr. J. Antarct. Res. 17, 133-154.

44. Smith, V.R. (1987) Production and nutrient dynamics of plant communities on a sub-Antarctic Island. 1. Standing crop and primary production of mire-grasslands. Polar Biol. 7, 57-75.

45. Smith, V.R. (1987) Production and nutrient dynamics of plant communities on a sub-Antarctic Island. 2. Standing crop and primary production of fjaeldmark and fernbrakes. Polar Biol. 7, 125-144.

46. Smith, V.R. (1987) Production and nutrient dynamics of plant communities on a sub-Antarctic Island. 3. Standing stocks, uptake and loss of nutrients in mire-grasslands. Polar Biol. 8, 135-153.

47. Smith, V.R. (1988) Production and nutrient dynamics of plant communities on a sub-Antarctic Island. 4. Standing stocks, uptake and loss of nutrients in fjaeldmark and fernbrakes. Polar Biol. 8, 191-211.

48. Smith, V.R. (1988) Production and nutrient dynamics of plant communities on a sub-Antarctic Island. 5. Nutrient budgets and turnover times for mire-grasslands, fjaeldmark and fernbrakes. Polar Biol. 8, 255-269.

49. Smith, V.R. and D.D. French (1988) Patterns of variation in the climates, soils and vegetation of some sub-Antarctic and Antarctic Islands. S. Afr. J. Bot. 54, 35-46.

50. Smith, V.R. (1988) Ecophysiology of carbon assimilation and nitrogen fixation in a sub-Antarctic lichen. Polarforschung 58, 155-170.

51. Pammenter, N.W. and V.R. Smith (1990) Intercepted irradiance limits carbon assimilation on a coastal dune plant. Current Research in Photosynthesis 4, 919-922. Ed. by M. Baltcheffski. Kluwer Academic Publishers, Dortrecht, Netherlands.

52. Bergstrom, D.M. and V.R. Smith (1990) Alien vascular plant flora of Marion and Prince Edward Islands: New species, present distribution and status. Antarctic Science 2, 301-308.

53. Smith, V.R. and M. Steenkamp (1990) Climatic change and its ecological implications at a sub-Antarctic Island. Oecologia 85, 14-24.

54. Smith, V.R. (1991) Atmospheric carbon dioxide levels at Marion Island. S. Afr. J. Sci. 87, 535-536.

55. Smith, V.R. (1991) Climate change and its ecological consequences at Marion and Prince Edward Islands. S. Afr. J. Antarct. Res. 21, 223-224.

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57. Smith, V.R. (1992) Terrestrial slug recorded from sub-Antarctic Marion Island. J. Molluscan Studies 58, 80-81.

58. Smith, V.R. and Steenkamp, M (1992) Soil nitrogen transformations on a sub-Antarctic island. Antarctic Science 4, 41-50.

59. Smith, V.R. and Steenkamp, M. (1992) Macroinvertebrates and litter nutrient release on a sub-Antarctic island. S. Afr. J. Bot. 58, 105-116.

60. Smith, V.R. (1992) Project information: Biological implications of climate change at Marion and Prince Edward Islands. Bull. -S. Afr. Inst. Ecol. 11 (1), 22-24.

61. Smith, V.R. and Steenkamp, M. (1992) Soil macrofauna and nitrogen on a sub-Antarctic island. Oecologia 92, 201-206.

62. Smith, V.R (1992) Surface air temperatures at Marion Island. S. Afr. J. Sci. 88, 575-578.

63. Smith, V.R. (1992) South Africa's Climate Change research project at Marion and Prince Edward Islands. Biotas Newsletter 7, 11-13.

64. Smith, V.R. and Steenkamp, M. (1993) Macroinvertebrates and peat nutrient mineralization on a sub-Antarctic island. S. Afr. J. Bot. 59, 106-108.

65. Smith, V.R. (1993) Climate change and ecosystem functioning: A focus for sub-Antarctic research in the 1990s. S. Afr. J. Sci. 89, 69-71.

66. Smith, V.R. (1993) Effect of nutrients on CO2 assimilation by mosses on a sub-Antarctic island. New Phytologist 123, 693-697.

67. Smith, V.R., M. Steenkamp and D.D. French (1993) Soil decomposition potential in relation to environmental factors on Marion Island (sub-Antarctic). Soil Biology and Biochemistry 25, 1619-1633.

68. Chown, S.L. and Smith, V.R. (1993) Climate change and the short-term impact of feral house mice at the sub-Antarctic Prince Edward Islands. Oecologia 96, 508-516.

71. Kloppers F.J. & V.R. Smith 1998. First report of Botryotinia fuckeliana on Kerguelen Cabbage on the sub-Antactic Marion Island. Plant Disease Vol 82 (6) : 710 (On-line Publication Number D-1998-0325-02N)

72. Gremmen N.J.M. & V.R. Smith (1999) New records of alien vascular plants from Marion and Prince Edward Islands, sub-Antarctic. Polar Biology 21: 401-409.

74. Smith, V.R. & N.J.M. Gremmen (2001) Photosynthesis in a sub-Antarctic shore-zone lichen. New Phytologist 149: 291-299.

75. Smith V.R., Steenkamp M. (2001) Classification of the terrestrial habitats on sub-Antarctic Marion Island based on vegetation and soil chemistry. Journal of Vegetation Science 12: 181-198

76. Smith V.R., Gremmen N.J.M. (2001) Turgidosculum complicatulum on sub-Antarctic Marion Island: carbon acquisition response to climate change. Polar Biology 24: 455-459

78. Smith V.R., Steenkamp M. & Gremmen N.J.M. (2001) Terrestrial habitats on sub-Antarctic Marion Island: Their vegetation, edaphic attributes, distribution and response to climate change. South African Journal of Botany 67: 641-654

80. Smith V.R. (2002) Climate change in the sub-Antarctic: An illustration from Marion Island. Climatic Change 52: 345-357

81. Smith V.R., Avenant N.L. & Chown S.L. (2002) The diet and impact of house mice on a sub-Antarctic island. Polar Biology 25: 703-715

82. Avenant N.L & Smith V.R. (2003) The microenvironment of house mice on Marion Island (sub-Antarctic). Polar Biology 26: 129-141

83. Smith V.R. (2003) Soil respiration and its determinants on a sub-Antarctic island. Soil Biology and Biochemistry 35: 77-91

84. Ochyra R. & Smith V.R. (in press) Entosthodon productus Mitt. (Funariaceae) on Marion Island – the first record in the Subantarctic. Cryptogamie, Bryologie

85. Ochyra R., Smith V.R, & Gremmen N.J. M. (in press) Thuidium delicatulum (Hedw.) Schimp. (Thuidiaceae) – another bipolar moss disjunct from Subantarctic Marion Island. Cryptogamie, Bryologie

86. Ochyra R. & Smith V.R. (in press) Anisothecium cardotii (R. Br. bis) Ochyra. Marion Island. In: T. L. Blockeel (ed.), New national and regional bryophyte records, 8. Journal of Bryology 25.

87. Ochyra R. & Smith V.R.(in press) Syntrichia anderssonii (Ångstr.) R. H. Zander. Marion Island. In: T. L. Blockeel (ed.), New national and regional bryophyte records, 8. Journal of Bryology 25.

88. Gremmen N.J.M., Smith, V.R. & van Tongeren, O.F.R. (in press) Impact of trampling on the vegetation of sub-Antarctic Marion Island. Arctic, Antarctic and Alpine Research.

2. Publications by other authors that resulted from SANAP projects in which I was project leader

1. Grolle R. (2002) The Hepaticae and Anthocerotae of the subantarctic and temperate islands in the eastern Southern Hemisphere (90°E to 0°): an annotated catalogue. Journal of Bryology 24: 57-80.

2. Ochyra, R. (1999) *Ptychomnion ringianum* Broth. & Kaal., synonymous with *P. densifolium* (Brid) A.Jaeger (Ptychomniaceae). Journal of Bryology 24: 87-88.

3. Ochyra, R. (1999) *Dicranella gremmenii* (Musci, Dicranaceae) sp. nov. from Subantarctic Marion Island. Fragm. Flor. Geobot. 44(2): 219–225.

4. Ochyra, R. (in press) Antipodal mosses: VIII. Valdonia gen. nov. (Seligeriaceae) from the Kerguelen Province in the Subantarctic.Cryptogamie, Bryol. 2003, 24

5. Ochyra, R. And Halina Bednarek-Ochyra (1999) *Racomitrium valdon-smithii* (Musci, Grimmiaceae) sp. nov. from the Subantarctic Marion Island. Fragm. Flor. Geobot. 44(2): 209–217.

6. Øvstedal D.O. & Gremmen N.J.M. (2001) The lichens of Marion and Prince Edward Islands. South African Journal of Botany 67: 552-572.

7. Schuster, R.M. (2002) Austral Hepaticae. Part II. Nova Hedwigia Beiheft 119: i-viii + 1-606.

8. Berjak P. (1979). The Marion Island flora –leaf structure in *Poa cookii* (F. Hook). Proceedings of the Electron Microscopy Society of South Africa 9, 67–68.

9. Berjak P. (1979). The Marion Island flora – *Tillaea moschata* DC from fresh and salt water situations. Proceedings of the Electron Microscopy Society of South Africa 9, 69–70.

10. Gremmen N.J.M. (1982). Alien vascular plants on Marion Island. Comité National Français des Recherches Antarctiques 51, 315–323.

11. Gremmen N.J.M. (1996). Vegetation changes at Marion Island, sub-Antarctic. Circumpolar Journal 11, 52–55.

12. Gremmen N.J.M. (1997). Changes in the vegetation of sub-Antarctic Marion Island resulting from introduced vascular plants. In: Battaglia B., Valencia J. and Walton D.W.H. (eds) Antarctic Communities: Species, Structure and Survival. CambridgeUniversity Press, Cambridge, pp. 417–423.

13. Gremmen N.J.M. and Van der Meijden R. (1995). Introduced Agrostis species at sub-Antarctic Marion Island. South African Journal of Antarctic Research 25, 85–86.

14. Grobbelaar J.U., Jarvis A.C., Robarts R.D., Sephton L.M., Steenkamp M. and Cawood M.E. (1987). A diet

study of carbon flow in the pelagic zone of a small lava-lakelet on Marion Island (sub-Antarctic). Polar Biology 7, 115–124.

15. Henssen A. (1983). A new Zahlbrucknerella species from the sub-Antarctic. Lichenologist 15, 307–308.

16. Henssen A. (1985). Hertella, a new lichen genus in the peltigerales from the southern hemisphere. Mycotaxon 22, 81–397.

17. Henssen A. (1986). Edwardiella mirabilis, a holocarpous lichen from Marion Island. Lichenologist 18, 51–56.

18. Henssen A.G., Boves G. and Renner B. (1982). New species of Roccellinastrum with an emendation of the genus. Nordic Journal of Botany 2, 587–599.

19. Henssen A. and Budel B. (1984). Phyllisciella, a new genus of the Lichinaceae. Ex: Beiheft 79 zur Nova Hedwigia, Zeitschrift für Kryptogramenkunde, Festschrift J. Poelt, pp. 381–397.

20. Henssen A. and Lumbsch T. (1985). A new Gyalideopsis species from the sub-Antarctic (Lichens). International Journal of Mycology and Lichenology 2, 1–12.

21. Henssen A.G. and Renner B. (1981). Studies in the lichen genus Psoroma 1: Psoroma tenue and Psoroma cinnamoneum. Mycotaxon 13, 433–449.
Ochyra R. and Hertel H. (1990). Contribution to the moss flora of the sub-Antarctic island Marion. Polish Botanical Studies 1, 19–34.

22. Rheeder J.P., Van Wyk P.S. and Marasas W.F.O. (1990). Fusarium species from Marion and Prince Edward Islands: sub-Antarctic. South African Journal of Botany 56, 482–486.

23. Russell S. (1984). Growth measurements in bryophytes: a case study. Journal of the Hattori Botanical Laboratory 56, 147–157.

24. Russell S. (1985). Bryophyte production at Marion Island. In: Siegfried W.R., Condy P.R. and Law R.M. (eds) Antarctic Nutrient Cycles and Food Webs. Springer, Berlin, pp. 200–203.

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27.Schuster R.M. (1989). Studies on the hepatic flora of the Prince Edward Islands. I. Aneuracae. Journal of the Hattori Botanical Laboratory 67, 59–108.

28. Scott L. (1985). Palynological indications of the Quaternary vegetation history of Marion Island (sub-Antarctic). Journal of Biogeography 12, 413–431.

29. Scott L. (1990). Environmental changes reflected by pollen in some Holocene sediments from Transvaal, South Africa and Marion Island, Southern Ocean. South African Journal of Science 86, 464–466.

30. Scott L. and Hall K.J. (1983). Palynological evidence for interglacial vegetation cover on Marion Island, sub-Antarctic. Palaeogeography, Palaeogeography, Palaeoclimatology and Palaeoecology 41, 35–43.

31. Scott L. and Van Zinderen Bakker E.M. (1984). Exotic pollen and long-distance wind dispersal at a sub-Antarctic island. Grana 24, 45–54.

32. Seppelt R.D. and Russell S. (1986). Fissidens bryoides Hedw., new to the moss flora of sub-Antarctic Prince Edward Island. Lindbergia 12, 57–59.

3. Publications from SANAP projects for which I did not receive the funding, but with which I was associated (eg. as expedition leader, participation in fieldwork, write-up etc)

1. Chown, S.L., van der Merwe, M and V.R. Smith (1997) The influence of habitat and altitude on oxygen uptake in sub-Antarctic weevils. Physiological Zoology 70, 116-124.

2. Gabriel A.G.A., Chown S.L., Barendse J., Marshall D.J., Mercer R.D., Pugh P.J.A. & Smith V.R. (2001) Biological invasions of Southern Ocean islands: the Collembola of Marion Island as a test of generalities. Ecography 24: 421-430

3. Ryan P. G. , Smith V. R. & Gremmen N. J. M. (in press)The distribution and spread of alien vascular plants on Prince Edward Island. Journal of South African Marine Science

4. Van der Merwe, M., S.L. Chown & V.R. Smith. 1997. Thermal tolerance limits in six weevil species (Coleoptera, Curculionidae) from sub-Antarctic Marion Island. Polar Biology 18, 331-336.

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SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP) Doc 5.7

PROJECT PROPOSAL - APPLICATION FOR FUNDING AND LOGISTIC SUPPORT

1. SUBMISSION OF THIS APPLICATION

Please submit this application to:

SANAP PROJECT PROPOSAL
c/o Department of Environmental Affairs and Tourism
Directorate: Antarctica and Islands
Private Bag X 447
PRETORIA
0001

ATTENTION: **Carol Jacobs (Rm 831)**

Applications must be submitted by no later than 30 June 2003.

All applications must be signed by the Applicant, Project Leader, Head of Department and the Head of the Organisation, before forwarding to the Department of Environmental Affairs and Tourism (DEAT). All proposals will be treated as tenders and will be opened together soon after the closing date of 30 June 2003.

We regret that late or incomplete applications will not be considered.

2. MAJOR DISCIPLINE IN WHICH THE RESEARCH/STUDY WILL BE UNDERTAKEN

Biological Sciences

3. TITLE OF PROJECT

(The title must be short and specific and should be used for the duration of the project) A preliminary investigation into the effects of research activities and guided parties of ship-based personnel on the behaviour of breeding and roosting birds at Marion Island

The effects of human disturbance on the behaviour and physiology of breeding seabirds and seals at Marion Island

3.1 DURATION OF PROJECT: 1 April 2004 to 31 March 2005

4. CATEGORY OF PROJECT PROPOSAL

(a) **First proposal**

See Attachment 1, DisturbAttach1.doc

(b) Follow-up proposal (Please submit a full progress report with this application)

(c) Application for additional funds (A full progress report and a motivation by the project leader should be submitted with this application)

5. KEYWORDS BY MEANS OF WHICH THE PROJECT CAN BE IDENTIFIED

Disturbance Seabirds

Seals Behaviour

Heart rate

6. RESPONSIBLE PROJECT LEADER (AND CO-LEADERS)

Title	Dr
Surname	de Villiers
First name/s	Marienne Sonja
Business address	Avian Demography Unit Department of Statistical Sciences University of Cape Town Rondebosch, 7701
Telephone	(021) 650 4548
Fax	(021) 650 3434
E-mail	mdevill@adu.uct.ac.za

Title	Prof
Surname	Bester
First names	Marthán Nieuwoudt
Business address	Mammal Research Institute Dept of Zoology & Entomology University of Pretoria 0002 Pretoria
Telephone	(012) 420-2067
Fax	(012) 420-2534
E-mail	mnbester@zoology.up.ac.za

Title	Mr
Surname	Cooper
First name/s	John
Business address	Avian Demography Unit Department of Statistical Sciences University of Cape Town Rondebosch, 7701
Telephone	(021) 650 3426
Fax	(021) 650 3434
E-mail	jcooper@adu.uct.ac.za

7. PARTICULARS OF APPLICANTS

MS de Villiers

Are you a South African citizen?	Yes
If not, a permanent resident?	N/A
Country of citizenship	Republic of South Africa
Occupation	Post-Doctoral Fellow
Employer	Avian Demography Unit
Department/Institution	University of Cape Town

MN Bester

Are you a South African citizen?	Yes
If not, a permanent resident?	N/A
Country of citizenship	Republic of South Africa
Occupation	Professor
Employer	University of Pretoria
Department/Institution	Department of Zoology & Entomology

J Cooper

Are you a South African citizen?	No
If not, a permanent resident?	Yes
Country of citizenship	United Kingdom
Occupation	Biologist
Employer	University of Cape Town
Department/Institution	Avian Demography Unit, Dept Statistical Sciences

8. QUALIFICATIONS

MS de Villiers

Highest qualification	PhD
Where obtained	University of Pretoria
Date obtained	1995
Research to obtain a degree?	No
Which degree	N/A

MN Bester

Highest qualification	DSc Zoology
Where obtained	University of Pretoria
Date obtained	April 1978
Research to obtain a degree?	No
Which degree	N/A

J Cooper

Highest qualification	BSc (Honours)
Where obtained	University of London
Date obtained	1967
Research to obtain a degree?	No
Which degree	N/A

8.1 Please attach details of previous experience in Antarctica, Marion and Gough Islands and the Southern Ocean.

See Attachment 2, DisturbAttach2.doc

9. **SCIENTIFIC PUBLICATIONS** (Please attach a list of your publications during the past 5 years)

See Attachment 3, DisturbAttach3.doc

10. **SUMMARY OF FINANCIAL REQUIREMENTS**

	Received for current year 2003	This Application 2004	Future Application/s 20___ 20___
Manpower costs	N.A.	R60 000 (or according to DEA&T salary scale)	
Running expenses	N.A.	R4 450	
Capital equipment	N.A.	R61 999	
TOTAL	N.A.	R126 449	

10.1 Which organization will be responsible for the administration of the funds?

University of Cape Town

11. **OBJECTIVES AND RATIONALE (NEED AND PURPOSE).**
(Please state the objectives of the project, the need for it and how it will contribute to SANAP. In follow-up proposals, please indicate and explain any changes from the previous proposal.)

Objective: To investigate the effects of various forms of human disturbance on key seal and surface-nesting seabird species on Marion Island, and to compare these effects during different stages of their breeding cycles.

Human disturbance to fauna can have numerous negative effects. It may induce stress, disrupt social bonds and be energetically disadvantageous. It may deter potential new recruits to a colony, all or part of a disturbed breeding population may abandon breeding attempts and/or a colony site, or breeding animals may be forced to select sub-optimal breeding sites. Disturbance may also lead to the destruction or predation of vulnerable offspring. These consequences, when added to other pressures already faced by threatened and /or declining populations, may significantly affect the conservation status of species.

Several species of fauna on Marion Island have previously been identified as especially vulnerable to disturbance and some broad guidelines are in place for their approach. However, these recommendations are based purely on *ad hoc* observations by field workers and not on the results of dedicated studies. They thus do not take into account subtleties such as the stage of the breeding cycle or the previous history of disturbance of a particular individual or colony. A more complete understanding of the impacts of human disturbance on these species will contribute to the aims of the Prince Edward Islands' management plan and to future revisions of the current management plan. The results of this study will also potentially contribute to the management plans of other sub-Antarctic islands, and ultimately towards the conservation of the species under consideration.

12. PARTICULARS OF A PILOT OR FEASIBILITY STUDY THAT HAS BEEN UNDERTAKEN.

(Please give a short description of any pilot/feasibility study which may have been undertaken.)

During March/April 2003, a preliminary study was made of the effects of disturbance by helicopter on the behaviour of seals and seabirds at Marion Island. These observations form part of the Conservation Report for the 2003 take-over. Rockhopper Penguins and Wandering Albatrosses showed minor signs of distress during flights, but no moulting Rockhoppers were observed to head for the sea to escape the disturbance, and no incubating or breeding Wanderers deserted their nests. Southern Giant Petrels, on the other hand, panicked and took to the air even when helicopters were passing over at a height of 1000 feet. Sub-Antarctic Fur Seals were also noticeably affected by helicopter flights, tending to panic and flee long before helicopters flew over the general area. The number of seals using the beach closest to base decreased by 25% in the first four days of flying. Few species (apart from Wandering Albatrosses) were breeding during the take-over period but later in the year, the consequences of helicopter disturbance on the breeding success of certain summer-breeding species could be severe and should be monitored. This is of special relevance during the construction of the new base, beginning in 2004.

A pilot study was also conducted to determine what variables predict the severity of reaction of breeding Wandering Albatrosses to a human approaching on foot. Over 350 incubating or brooding adults and 73 solitary chicks were approached. Key reactions and the distance at which these took place were recorded. Analysis of the data is still in progress, but initial indications are that stage of breeding, previous breeding success and history of disturbance are more important factors in determining intensity of reaction than the age and sex of birds.

The feasibility of the research approach outlined below (point 13) was assessed.

13. KEY QUESTIONS AND RESEARCH APPROACH

(Please provide a list of specific questions to be answered or hypotheses that will be tested and indicate how each is to be approached. In follow-up proposals, indicate and explain any changes from the previous proposal.)

Key Questions and approaches

Refer to end of Section 13 for details of references used in this section.

A. *What are the behavioural responses of key seabird and seal species to approach by a human on foot, and what are the minimum recommended approach distances for each species?*

The sequence of key behaviours (see Section 14 - Attachment DisturbAttach4.doc) in response to a human approach, and the distances at which these behaviours are observed, will be recorded using a digital video camera. The approach protocol (see Section 14) is an adaptation of methods currently being used to assess the effects of disturbance on southern African seabird species (Post-Doctoral research project, MS de Villiers). A similar protocol has been used successfully to study Adélie Penguins in the Antarctic and is currently being used on a range of species on Macquarie Island in the sub-Antarctic (Dr Melissa Giese, Australian Antarctic Division, pers. comm.).

B. *How do the behavioural responses in A. above vary with stage of the breeding cycle?*

Breeding animals may be especially sensitive to disturbance at particular stages of the life cycle, e.g. brooding birds may be more tolerant than incubating ones (Kury & Gochfeld 1975). The procedures outlined in A. above will be repeated at the following stages of the breeding cycles of each of the study species:- Courtship and nest construction, early incubation, late incubation, and early and late stages of brooding (seabirds), and territory establishment, pregnancy, and early and late stages of pup care (seals).

C. What are the effects of key variables (group size, group cohesion and speed of approach) on the behaviour of King Penguins and Wandering Albatrosses?
While following the approach protocol outlined in *A.* above for King Penguins and Wandering Albatrosses, approach characteristics will also be varied. The effects of different approach characteristics will then be assessed through a comparison of the average distances at which key responses are elicited.

D. Does human disturbance interfere with incubation by King Penguins and Sub-Antarctic Skuas?
Disturbance may cause incubating birds to stand up off their eggs or to desert their nests, temporarily or permanently. Not only does this open up predation opportunities for other species, but it may cause the affected eggs to become unviable. The effect of such occurrences on egg temperature may be assessed by temporarily replacing eggs with artificial eggs containing temperature loggers. Preliminary trials with egg temperature loggers have been successfully conducted on African Penguins (de Villiers, pers. obs.) and are to be used this year to determine the effect of helicopter flights on incubation by this species on Dassen Island, Western Cape (Dr PG Ryan, Percy FitzPatrick Institute, University of Cape Town, pers. comm.). We propose investigating the effects of controlled single-person approaches and helicopter over-flights, on egg temperatures. See Section 14 for further detail.

E. How is the heart rate of study species affected by human disturbance?
Heart rate responses of seabirds to human approach have been measured by placing artificial eggs containing heart rate monitors in the nests of incubating birds (Nimon *et al.* 1996; Giese 1998). It is proposed that this approach be used to monitor the heart rate responses of Wandering Albatrosses, King Penguins and Southern Giant Petrels to the following disturbances:

- controlled single-person approaches
- researcher disturbance
- helicopter over-flights (see *F.* below)

Wandering Albatrosses and Southern Giant Petrels differ greatly in their tolerance of disturbance and would thus provide useful comparative information. King Penguins and Southern Giant Petrels have been identified as species especially vulnerable to helicopter disturbance (Rounsevell & Binns 1991; Cooper et al. 1994). See Section 14 for further details.

Changes in the heart rate of seals relative to disturbance will be estimated visually, following Salwicka, K. & Stonehouse, B. (2000).

F. What is the effect of helicopter supply flights on study species?
The number of King Penguins at Archway Bay, Sub-Antarctic Fur Seals and Southern Elephant Seals on Boulder Beach, and Gentoo Penguins and Wandering Albatrosses nesting in the vicinity of base, will be counted daily at set times during periods of intense helicopter activity. *Ad lib* observations of the behaviour of these species relative to flights will be made and the behaviour of sub-sets of individuals within colonies will be filmed and analysed later. All predation events will be recorded.

Artificial eggs with heart rate monitors will be used to measure the heart rate responses of Wandering Albatrosses, King Penguins and Southern Giant Petrels to helicopter flights. Eggs containing temperature loggers will be used to determine the effect of helicopter-related disturbance on the incubation temperature of King Penguin and Sub-Antarctic Skua eggs. See Section 14 for further details.

G. Does pup weaning mass / chick fledging mass differ between colonies exposed to high versus low levels of human disturbance?

A pup's body mass at weaning, or chick's body mass at fledging, directly reflects its chances of survival during the first year (Engelhard *et al.* 2002, Arnbom *et al.* 1997, Hall *et al.* 2001). For seals, stressful environments have been associated with a shorter lactation period and pups with lower body mass at weaning (Arnborn *et al.* 1997). We propose a comparison of the masses of seal pups and seabird fledglings in colonies with high and low levels of disturbance (i.e. close to, and far from, base). Photogrammetric techniques will be used to estimate mass at weaning of Southern Elephant and Sub-Antarctic Fur Seal pups (McFadden *et al.* 1999). See Section 14 for further detail.

Study species

Proposed study species are King Penguins, Rockhopper Penguins, Gentoo Penguins, Wandering Albatrosses, Crozet Shags, Southern Giant Petrels, Sub-Antarctic Skuas, Sub-Antarctic Fur Seals and Elephant Seals. This selection includes two species which are abundant (King Penguin and Sub-Antarctic Skua), four species with globally declining populations (Gentoo Penguin, Southern Giant Petrel, Rockhopper Penguin and Southern Elephant Seal) and one species of which Marion Island supports a significant percentage (44%) of the world's population (Crozet Shag). Also included are a non-colonial bird species which is relatively tolerant of disturbance (Wandering Albatross) and three species which are intolerant of disturbance (Gentoo Penguin, Southern Giant Petrel and Sub-Antarctic Fur Seal).

References for Section 13

Arnbom, T., Fedak, M.A. & Boyd, I.L. 1997. Factors affecting maternal expenditure in Southern elephant seals during lactation. *Ecology* **78**: 471-483.

Cooper, J., Avenant, N.L. & Lafite, P.W. 1994. Airdrops and King Penguins: a potential conservation problem at sub-Antarctic Marion Island. *Polar Record* **30**: 277-282.

Hall, A. J., McConnel, B.J. & Barker, R.J., 2001. Factors affecting first-year survival in grey seals and their implications for life history strategy. *Journal of Animal Ecology* 70: 138-149.

Kury, C.R. & Gochfeld, M. 1975. Human interference and gull predation in cormorant colonies. *Biol. Conserv.* **8**: 23-34.

McFadden, K.W., Worthy, G.A.J., Lacher, T.E., 1999. Photogrammetry as a tool for estimating size and condition in the Hawaiian monk seal (*Monachus schauinslandi*), the harbor seal (*Phoca vitulina*), and the Northern elephant seal (*Mirounga anguistirosis*)." M.S. thesis defense, August 1999. University of California, Santa Cruz.

Rounsevell, D. & Binns, D. 1991. Mass deaths of King Penguins (*Aptenodytes patagonica*) at Lusitania Bay, Macquarie Island. Aurora **10**: 8-10.

Salwicka, K. & Stonehouse, B. 2000. Visual monitoring of heartbeat and respiration in Antarctic seals. *Polish Polar Research* **21**:189-197.

13.1 Please provide an indication of the unique multi-disciplinary nature of the research.

The research will focus on both birds and seals, and include a behavioural and physiological approach to the investigation of disturbance effects. Both at Marion Island specifically, and elsewhere in the world generally, ornithologists and mammalogists have tended to work apart. Considerable synergy is expected with this project, which will combine the knowledge and methodology of the two fields of study. This project will also provide information useful in the management of Marion and other sub-Antarctic islands. There is either very little information (Wandering Albatrosses, Southern Giant Petrels, Sub-Antarctic Skuas, Gentoo Penguins, Southern Elephant Seals) or no information (Rockhopper

Penguins, Crozet Shags, Sub-Antarctic Fur Seals) available on the effects of disturbance on most of the species proposed for inclusion in this study. This study proposes to collect data on the effects of disturbance in the absence of tourism, whereas existing studies have generally been collected from populations already exposed to tourism. The study will contribute to the small database of information on the effect of aircraft on breeding seabirds and seals.

14. **PROPOSED WORK PLAN**

(Please describe the tasks to be undertaken during the whole project. Describe the methods to be used, indicate the persons and institutions involved and provide target dates for the start and completion of each task. In follow-up proposals, indicate and explain any changes from the previous proposal.)

See Attachment 4, DisturbAttach4.doc.

14.1 Is this project a co-operative/collaborative project. Please provide summary information on the associated projects and discuss the role of this project in the total programme.

Yes, this is a collaborative project. Associated projects:-

1. Population ecology of elephant seals and fur seals (*Arctocephalus* spp.) at Marion Island. Prof. MN Bester, University of Pretoria.

2. Monitoring seabird populations at the Prince Edward Islands. Dr. RJM Crawford, Marine and Coastal Management.

15. **WILL THE PROJECT LEADER BE AWAY FOR ANY SIGNIFICANT PERIODS WHILE THE PROJECT IS IN PROGRESS?**

At least one of the three project co-leaders will be present at any one time. All three leaders are expected to be on the island during the 2004 and 2005 take-overs. If possible, at least one project co-leader should be on the island for at least a week in winter. This could be accomplished by taking advantage of one of the planned construction voyages (e.g. in August). The opportunity would be of enormous benefit to both the appointed Field Biologist and to the project itself, in terms of the additional supervision and methodological and data quality checks which could be accomplished.

15.1 If yes, describe the arrangements made for leadership and supervision during his/her absence.

N.A.

16. **END PRODUCT OF THE PROJECT**

(Describe the planned final products that will result from the project (i.e. the nature of the final report, maps, etc.) and state when they will be submitted. All DEAT funded projects should include the text for a popular publication which will be used to bring the results of the research to the general public or to a specific user group.)

Video material will be analysed on the island and a database compiled by the end of the 2005 take-over. From May to December 2005, the data will be analysed and papers written. We foresee the publication of the results in the form of 5 scientific and 5 popular papers. A report will be submitted to SANAP and the

Prince Edward Islands Management Committee, detailing recommendations possible inclusion in future revisions of the Islands' Management Plan. A short video will be compiled and will contain information such as recommended approach protocols, minimum approach distances and pre-flight behavioural cues of different species. This video would be the property of the SANAP program and could be used during team training and screened on take-over and other voyages to the island. It would also be of relevance to Gough Island team members.

17. DISCUSS ANY POTENTIAL IMPACT YOUR STUDY WILL HAVE ON THE ENVIRONMENT AND DESCRIBE MITIGATING ACTIONS WHICH YOU PROPOSE TO MINIMIZE OR ELIMINATE THE IMPACT

The following guidelines are provided to assist applicants with questions relating to the potential environmental impact of a proposal.

(i) Proposals for the continuation of ongoing projects should state clearly if any changes are proposed in field methods, work programmes, camp sites, and timing from those documented in the original proposal, or subsequent modifications to it.

(ii) The proposer should list aspects of the proposed activity, that have not been noted, that might cause impacts on the Antarctic environment (e.g. visual impact or other forms of disturbance).

(iii) In making all these assessments of impact, the proposer should briefly consider the nature, duration and intensity of the likely environmental effects, including the following;

a. the existing environment, its variability or dynamic nature, resilience to change, sensitivity to disturbance, previous disturbance, protected status etc;

b. cumulative and possible indirect impacts;

c. the probability of accidents and their environmental consequences;

d. the adequacy of existing information and knowledge.

(iv) A map of the area should be included (sketch if necessary) to assist the interpretation of this section of the research application.

See Attachment 5, Map.

Proposers are expected to provide sufficient information in their answers to allow the DEA & T to make a thorough, complete and accurate evaluation of the environmental impact of the project. Insufficient information will require follow-up action and/or may prejudice the environmental acceptability of the project.

Preliminary Environmental Evaluation

Details of Activities

Answer all questions only if work is to be carried out in Antarctica or Marion Island during 2004./ 2005

If you answer "Yes" to any of these questions, a full description of proposed activity, including proposals for mitigating and monitoring these impacts, is required.

It is important that you provide maps detailing the proposed research areas (hand drawn sketches are acceptable).

See Attachment 5, Map.

Will your objective:

a. Use a radionuclide? Yes No X

b. Take any chemical to Antarctica or Marion Island?

Yes No X

c. Release any chemical to the Antarctic or sub-Antarctic Environment?

Yes No X

d. Require the use of explosives? Yes No X

e. Collect, capture, kill, restrain, tag or band any terrestrial, freshwater or marine plants or animals?

Yes X No

Some individuals of all study species except Gentoo Penguins will be manually restrained for periods of no more than 5-10 minutes. Culmen measurements will be taken, for the purpose of sexing seabird individuals. Some individuals may be permanently banded to aid with later identification. A number of seal pups and seabird chicks will be weighed.

The eggs some seabird species will be temporarily replaced with artificial eggs, to measure heart rate and/or egg temperature. Removed eggs will be kept at incubation temperature until they are replaced under the brooding adult. Should this egg substitution fail more than twice for King Penguins, or once for any of the other species, then this part of the project will be abandoned. See Section 14 (Attachment 4, DisturbAttach4), for further detail.

Species	Method	Number	Total Marion Population	Percentage Pop restrained	Percentage Pop disturbed
Wandering Albatrosses	Measurements Banding Artificial eggs	200 30 20	~1 500 pairs	6.7	13
King Penguins	Artificial eggs	60	~200 000 pairs	0.02	0.75%
Sub-Antarctic Skuas	Measurements Banding Artificial eggs	20 20 20	~500 pairs	2	4
Southern Giant Petrels	Measurements Banding Artificial eggs	40 40 20	~1 700 pairs	1.2	12
Sub-Antarctic Fur Seals	Measurements Tagging	50 50	~50 000	0.1	5
Southern Elephant Seals	Measurements Tagging	50 50	~2 000	2.5	10

f. Enter any Protected Area? Yes X No

If Yes, complete the following:

Name of Protected Area	Duration of Visit	Total person-days
Zone 3 and 4 bird and seal colonies	Ongoing throughout the year, and co-ordinated so that visits do not interfere with or deleteriously affect work of UP and MCM field workers	200

Detail why the work must be carried out within the Protected Area:

This is necessary in order to compare the behaviour of study and non-study colony individuals, and of colonies exposed to varying levels of non-research related disturbance, i.e. at different distances from Base

g. Take to Antarctica or Marion Island any animal, plant (includes seeds), micro-organism or soil?

Yes No X

h. Significantly disturb by flooding, sampling, trampling, camp operations or any other means any ice-free area (bare ground)?

Yes No X

i. Take or remove any physical specimens eg. rocks, fossils etc?

Yes X No

If Yes, detail the general area and types of specimens to be collected: To be collected for the construction of artificial eggs

Location	Specimen	Type	Total Number of Weight
Goney Plain King Penguin Bay East Cape	Wandering Albatross eggs King Penguin eggs S. Giant Petrel eggs	Non-viable / broken eggs for all species	3 for each species, in order to create moulds of eggs for heart rate monitors

j. Cumulative Impacts.

Occupy new or existing camp sites? New

X Old

Both old and new sites

Field work will be conducted from base or from existing field huts only.

Will you track previously untracked ground?

Yes No X

Note: Field work will mainly take place in the low-lying areas of the island where there is practically no "untracked ground" remaining. Journeys to study sits will mainly take place along established paths and/or routes.

Will you install equipment, markers, stakes, cairns etc. that will be left in the field?

Yes X No

If Yes, detail location and type of marker, stake etc:

Temporary nest and colony markers as detailed below, will be placed in the field for the duration of the project. All field markers will be removed during April 2005.

Location	Type
Relevant bird and seal colonies in the protected areas described in (f) above Relevant bird and seal colonies in the area between Sealers Beach and East Cape	Unpainted plastic conduit piping: 1. Temporary distance markers at 5-m intervals from 30-m to the edge of study colonies (seals and seabirds) 2. Nest markers at some colonies

k. Do you expect your activities to have an environmental impact not covered in the above?

Yes No X

l. Is the proposed activity likely to have more than a minor or transitory impact?

Yes No X

18. FINANCIAL REQUIREMENTS

18.1 MANPOWER

(Please provide details of all persons involved and/or employed and/or applied for including ad hoc help on a part-time basis.)

No Antarctic Officers and/or technical/administrative personnel will be funded - the management and administration of the specific project will be the responsibility of the project leader. The Department will only fund home-based researchers appointed on bursaries, and no allowances will be made for the payment of service benefits, such as housing subsidies, medical aids, pensions, etc.

Name, qualifications, past experience and function in this Project	Time available for this project (% of full-time man-year)	Nature and Source of non- SANAP funding	Amount requested from SANAP
Marienne de Villiers Project co-leader	25%	Avian Demography Unit, UCT	None
Marthan Bester Project co-leader	10%	University of Pretoria	None
John Cooper Project co-leader	10%	Avian Demography Unit, UCT	None
Robert Crawford Collaborative Researcher	<5%	Marine & Coastal Mgmt	None
Field Biologist, to be appointed Minimum qualification BSc (Hons)	100%		R60 000, or following SANAP salary scale
Total			~R60 000

18.2 RUNNING EXPENSES

Items	Nature and source of non-SANAP funding	Funds requested From SANAP
Transport (land: 300km @ R1.50/km)	N.A.	R450
Subsistence (nature and rates)	N.A.	None
Supplies and services (Stationary; video camera tapes; tape measure; computer accessories e.g. printer cartridge and disks; batteries; materials for constructing artificial eggs; plastic nest markers)	N.A.	R4000
Total		R4450

18.3 CAPITAL EQUIPMENT

(Please describe the items required.)

Items paid for in full by SANAP remain the property of DEAT. Items to which the participating organization contribute 50% or more of the cost, become the property of the organization.

Description of item and total cost	Motivation	Non-SANAP Funding	Non-SANAP application	Amount requested from SANAP
Handheld GPS	To map positions of study colonies / nests, and huts.			R3 899
Digital video camera with 2-times converter	To capture behavioural responses of colonial breeders, to compile educational video, and for identification photos of Wandering Albatrosses			R14 100
Camera splashpack	To protect video camera			R5 000
Dictaphone with waterproof bag	To record behavioural observations in the field			R 800 R 200
Earphones	To play back dictaphone recordings			R 200
Waterproof binoculars	To make behavioural observations in the field			R3 550
Tripod	For binoculars and video camera, essential for observations made in windy conditions			R3 150
Desktop PC	For data entry and analysis, and project admin			R7 400
Laserjet printer	For data entry and project admin			R3 600
Television set	For analysis of video material			R2 700
Heart rate monitors and associated recording equipment	To measure and capture heart rate data			R12 600 (6 @ R2 100 each)
Egg temperature loggers	To measure changes in egg temperatures relative to disturbances			R2 800 (40 @ R70 each)
Field incubator	To maintain replaced eggs at incubation temperature			R2 000
Total				R61 999

A short motivation must be provided for each item requested. Please supply a quotation for all items requested.

<u>See Attachment 6, Quotations. Note that figures for heart rate monitors, egg temperature loggers and field incubator are based on estimates supplied by email, from Dr M. Giese, Australian Wildlife Services</u>

18.4 LOGISTIC SUPPORT

(Please assess your support requirements carefully. The details provided will be used to develop the support for your project, as well as the total integrated support for all programmes. *You will be required to complete this section for each voyage undertaken.*)

Volume and mass of cargo: 2 m^3 ; 150 kg

Description of cargo: Equipment as listed in 18.3 above
Destination where cargo is required: Marion Island
Radio-active and other hazardous cargo. *Please provide details of materials and how they will be used. State special precautions to be undertaken.* N.A.

Accommodation requirements

Ship:
Number of persons: 3
Period: Mar/Apr 2004 (3 persons), Aug 2004 (1 person), Mar/Apr 2005 (3 persons)

Base:
Number of persons: 3
Period: Mar/Apr 2004 (3 persons), Aug 2004 (1 person), Mar/Apr 2005 (3 persons), rest of 2004/2005 (1 person)

Ship's time required: N/A
Sampling locations at sea (please attach a detailed map): N.A.
Laboratory requirements (ship): None

Laboratory requirements (base): Mar/Apr 2004 and 2005: Desk-space for 3 persons
Remainder of year: Desk-space (for PC and Television) and work-bench space for one person

Type of equipment requiring deployment from ship: Container with equipment listed in 18.4 above

Small boat needs (locality and time): None

Surface vehicle needs: None

Helicopter support (describe fully e.g. time, locality, special requirements): Prior notification, where possible, of flying times and routes. If possible, 2 hours dedicated flying time during take-over 2005. In assessing the effects of helicopter disturbance, it will be of enormous advantage to be able to pre-plan some fly-overs for specific times and locations

Camping equipment: Backpacks, daypacks and sleeping bags
No of persons / teams 3 persons during take-overs and one person year-round
Special equipment: None

Protective clothing:
No of persons: Three persons for take-overs, one person for a full year
List any special requirements: Best possible quality waterproof jacket and pants, as field work will require many hours of observations outdoors, often in extremely unpleasant weather conditions. Hypothermia a real danger

Please list any special needs: Use of field huts, for teams of up to 3 persons during 2004 and 2005 take-overs, for two persons during August 2004, and for Field Biologist for the rest of 2004/2005

20. STATEMENT BY APPLICANT

I declare that the foregoing information is correct.

Signature ______ Date 23/06/03

21. RECOMMENDATION BY THE RESEARCH OR EQUIVALENT COMMITTEE OF THE APPLICANT'S ORGANIZATION

Chair ______ Date 25/06/03

I certify that the information contained in this application is correct and that if SANAP financial support is provided, it will be utilised in accordance with the conditions as laid down by the DEAT.

Project Leader ______ Date 23/06/03

Head of Department ______ Date 23-June-03

Head of Organization ______ Date 23 June 2003

22. COMMENT AND RECOMMENDATION BY SANAP

Chair ______ Date ______

PROJECT TITLE : THE EFFECTS OF HUMAN DISTURBANCE ON THE BEHAVIOUR AND PHYSIOLOGY OF BREEDING SEABIRDS AND SEALS AT MARION ISLAND

Appendix 1

ETHICAL REQUIREMENTS FOR RESEARCH ON THE PRINCE EDWARD ISLANDS
Questionnaire to be completed by reviewing ethical committee

This questionnaire represents the minimum ethical requirements for research on the Prince Edward Islands. It is not intended as an alternative to the reviewing ethical committee's review process and guidelines, but as a supplement to it and as such represents a standardised format whereby the Department of Environmental Affairs and Tourism can ensure that research conducted on the Prince Edward Islands is of a high ethical standard.

The questionnaire is based on the National Code for the handling and Use of Animals in Research, Education, Diagnosis and Testing of Drugs and Related Substances in South Africa (1990) and expects of the reviewing committee to indicate whether certain aspects of the proposed projects have been reviewed by it or not. Please note that these questions are applicable only if the proposed project affects vertebrate animals. Where a question is not relevant, please indicate either *no comment*, *not enough information*, or *not applicable*. Space is provided below for comments on any of the questions. Please refer to the question number when commenting.

QUESTION	REVIEWED Indicate either Yes / No / No comment / Not enough information / Not applicable
Part 1. Professional detail regarding applicant and co-workers	
I Applicant name and affiliation	✓
II Whether the following information about persons responsible for applying proposed research techniques has been provided:	
i. names	✓
ii. qualifications (academic or technical)	✓
iii. description of each person's experience in proposed techniques	✓
III Whether the following information about other co-workers has been provided:	
i. names	✓
ii. qualifications	✓
iii. affiliation	✓

QUESTION	REVIEWED Indicate either Yes / No / No comment / Not enough information / Not applicable
Part 2. Ethical aspects with regard to proposed research project	
i. whether the project's contribution to the relevant scientific field justifies any possible pain or discomfort caused to animals during the course of research	YES
ii. whether alternatives to animal models are necessary or available	N/A
iii. whether proposed methods/techniques are acceptable in terms of the level of risk to the animal subject's life or well-being	YES
iv. whether techniques to be applied in the project has been refined through planning and pilot studies	YES
v. whether the trial/survey is statistically valid (i.e. not wasteful of its animal subjects)	YES
vi. whether treatments and/or clinical procedures applied and/or surgery done to animals are justifiable and humane	YES
vii. whether vertebrate animal capture techniques (including drugs used where applicable) is appropriate and humane	YES
viii. whether systems and techniques for the handling of animals during research is appropriate and humane	YES
ix. whether facilities for the handling and housing of restrained/captive animals are appropriate, adequate and humane	YES
x. whether there is adequate planning in the event of emergencies or in the case of unexpected results which may cause unnecessary and excessive pain and suffering to the animals	N/A
xi. whether methods proposed to handle carcases of animals that die during the period they are in the care of the applicant are adequate and appropriate	N/A
xii. whether proposed methods of euthanisation (including any proposed pest extermination methods) are justifiable and humane	N/A
xiii. whether the experience and qualifications of the researcher and his/her assistants is adequate and appropriate for the proposed techniques (including the admninistration of any drugs)	YES
xiv. whether all drugs that are to be used in the proposed techniques are accompanied by the appropriate prescription forms	N/A
xv. whether veterinary supervision/consultation is necessary and if so, adequate	NO
xvi. whether the applicant and his/her co-workers and assistants are familiar with standard guidelines for the ethical manipulation and care of experimental animals and the laws governing these	YES

COMMENTS:

The project is a useful & non-invasive investigation which in the long term will be of benefit to seabird & seal conservation.

The approach & techniques to be used will not harm the animals or disrupt their breeding.

M. D. Picker

M. D. PICKER

Acting HEAD OF ETHICS COMMITTEE

(UCT ANIMAL EXPERIMENTATION COMMITTEE)

25 JUNE 2003

DATE

Tel. (021) 650 3630

Appendix 2

DELIVERABLES

(SANAP-RELATED ONLY)

A. CURRENT SANAP RESEARCH CYCLE: 1 April 2001 – 31 March 2005

Kindly indicate what the expected deliverables of your project will be for the duration of the current research cycle, including the one year extension, with respect to the following:

- Number of Honours, MSc and PhD students expected to be trained/obtained *(if in progress, please list name, degree and year of completion – add further lines if necessary)*

Honours →

MSc → 1

PhD →

NAME	DEGREE	YEAR
Field Biologist to be appointed	MSc Zoology	2005

- Estimated number of scientific publications to be published in accredited scientific journals

5

- Estimated number of scientific papers to be presented at local and international conferences

LOCAL → 2

INTERNATIONAL → 1

- How and to what level you intend enhancing transformation/capacity building/representivity levels in your project

Applicants for the post of field worker will be given preference if they belong to previously disadvantaged / under-represented groups..

- The project's contribution to the public understanding of Science and Technology

Results of the project will be presented in the form of at least two popular articles and local television stations will be informed of the project's progress and able to broadcast this publicly, should they wish to do so. Project updates will be posted to the Avian Demography Unit's website, which is widely accessed by members of the public with an interest in birding. A description of conservation activities and preliminary disturbance research during Take-over 2003 is already on this site http://www.uct.ac.za/depts/stats/adu/. Seminars will also be presented at local bird clubs and wildlife societies.

MN Bester is involved with the 'UP with Science' venture, and has given talks to Secondary School students visiting the Department with a view to further their Tertiary education in Science at UP. A similar practice will be followed by MS de Villiers at UC. MN Bester is also involved with the development of the "Tsebo Ribola" Integrated Science, Engineering and Technology Discovery Centre on the UP Campus. This affords opportunities to draw the attention of visitors to the Centre to the proposed, and other, projects on marine mammals.

B. PREVIOUS SANAP RESEARCH CYCLES: All previous cycles up until 31 March 2001

If you have previously received SANAP funding, please indicate the following for ALL previous SANAP research cycles:

PART 1: MN BESTER

- Number of scientific papers published in accredited journals from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please attach complete list)*

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- Number of completed Honours, MSc and PhD degrees from members of your group from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please list name, degree and year of completion – add further lines if necessary)*

  Honours → 3

  MSc → 6

  PhD → 1

NAME	DEGREE	YEAR
M. ST CLAIR HILL (F)	B.Sc. Honours	1996
M. KEITH (M)	B.Sc. Honours	1997
J.E. THOM (F)	B.Sc. Honours	1997

C.R. McMAHON (M)	M.Sc.	1998
F.C. JONKER (M)	M.Sc.	1998
J. MALHERBE (M)	M.Sc.	1998
P.A. PISTORIUS (M)	M.Sc.	1999
S.P. KIRKMAN (M)	M.Sc.	2000
G.J.G. HOFMEYR (M)	M.Sc.	2001
P.A. PISTORIUS (M)	PhD.	2001

LIST OF SCIENTIFIC PAPERS GENERATED WHILE RECEIVING FUNDING AS PROJECT LEADERS WITHIN SANAP

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C. Howard-Williams & P. Broady (eds), Caxton Press, Christchurch, New Zealand. Pp. 59-63.

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mar. Sci. 25: In press.

PART 2: J COOPER

- Number of scientific papers published in accredited journals from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please attach complete list)*

  A total of 252 scientific papers has been published in the primary literature emanating from research conducted with SANAP support during the period that I was a SANAP Antarctic Officer employed at the FitzPatrick Institute, University of Cape Town from the mid 1980s to the mid 1990s. A complete list is not readily available (but see South African National Reports to SCAR for the period).

- Number of completed Honours, MSc and PhD degrees from members of your group from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please list name, degree and year of completion – add further lines if necessary)*

  Honours 0

  MSc 4

  PhD 5

NAME	DEGREE	YEAR
Andrew M. Griffiths	MSc	1982
Michael Schramm	MSc	1984
Ron W. Abrams	PhD	1985
Peter G. Ryan	MSc	1986
Christopher R. Brown	PhD	1987
Nigel J. Adams	PhD	1990
Susan Jackson	PhD	1990
Peter G. Ryan	PhD	1992
Louise Coetzee	MSc	1996

ATTACHMENT 1

Summary of Literature

Islands are fragile ecosystems and the breeding success of animals inhabiting them can be negatively impacted by human disturbance (Anderson & Keith 1980). To be taken into account are the timing, frequency and severity of the disturbance, and the sensitivity, existing level of habituation and physical location of the affected species. Disturbance may cause the disruption of courtship, pair-bond formation and the establishment of territories. It may deter potential new recruits from settling in a colony or cause the abandonment of nests or colonies, with an associated loss of eggs and/or chicks. It may also interrupt incubation, brooding, or the feeding of chicks or seal pups (reviewed in WBM Oceanics 1997). Seals fleeing from disturbance in a breeding colony may cause mortality to their own young and the young of other species (including seabirds) through trampling (Boren *et al.* 2002; Heydenrych & Jackson 2000). Perhaps the most extreme example of the potentially disastrous effects of disturbance is that of the death of 7000 King Penguins on Macquarie Island, resulting from mass panic of the birds following the passage of an aircraft near the colony (Rounsevell & Binns 1991; Cooper *et al.* 1994). Helicopters may also cause severe disturbance to seals (Born *et al.* 1999, Cooper & de Villiers 2003).

Apart from the aforementioned overt reactions, disturbance may also cause potentially detrimental physiological changes indicated by, for example, increased heart rate or stress hormone concentrations, and may be energetically disadvantageous (e.g. Nimon *et al.* 1996; Born *et al.* 1999; Vleck *et al.* 2000).

Research and tourism in the sub-Antarctic have been increasing since the 1960s. In 1997, New Zealand's sub-Antarctic islands received 1500 tourists and for the first time tourists were allowed to visit some of the French sub-Antarctic islands (Heydenrych & Jackson 2000). Eco-tourism is a growing industry, both in South Africa and world-wide. Tour companies compete to offer new and unusual destinations to their clients. Islands, because of their relative inaccessibility and often unique flora and fauna, attract special interest. The vast aggregations of breeding seabirds and seals that may inhabit islands add to the appeal (Yorio *et al.* 2001). Even islands to which no tourism takes place may be subject to pressures imposed by research and associated support activities, e.g. Weidinger 1998.

For seabirds, numerous investigations have been conducted into the effects of human disturbance on wildlife on the Antarctic Continent (e.g. Harris 1991; Woehler *et al.* 1994; Giese 1998; Weidinger 1998; Crosbie 1999; Hofman & Jatko 2000 and Giese & van Polanen Petel 2001). Surprisingly few studies have investigated the disturbance of seabirds on sub-Antarctic islands. A few seal disturbance studies have been conducted in New Zealand, but these have mostly been on small, non-breeding, mainland populations of Hooker's Sea Lions (Boren *et al.* 2002). Furthermore, little is known on the effect of human activities on (sub-) Antarctic pinnipeds (Engelhard *et al.* 2002).

During 1996 and 1997, the Department of Environmental Affairs & Tourism, South Africa, received three proposals for tourism to sub-Antarctic Marion Island. In November 2002 the first cruise ship visited the island's inshore waters, although tourists were not permitted to disembark. An Environmental Impact Assessment (Heydenrych & Jackson 2000) outlines the potential positive and negative effects of tourism to the island, and provides a list of recommendations should tourism be allowed. While recommendations regarding the disturbance of seals and seabirds are based on the valuable field experience of researchers on the island over a number of decades, there has never been a dedicated research programme on this subject. Only two publications have been produced that deal specifically with disturbance of the island's fauna (Wilkinson & Bester 1988; Cooper *et al.* 1994). Tourism on this island may take place at some future date. In such an event, it would be useful to have specific guidelines for approaching species in place. Such guidelines can also be applied to all the current (scientific and logistic) Field Workers at the Prince Edward Islands. These guidelines should be based on dedicated research into the effects of human disturbance on sub-Antarctic vertebrate fauna at Marion Island. Even if tourism to Marion Island never takes place, such guidelines would be useful to scientists and support personnel on Marion and other sub-Antarctic islands for which tourism is still a possibility.

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ATTACHMENT 2

MS de Villiers

Dec 2001	Biologist, Marion Island. Member of on one of four teams counting surface-nesting seabirds during Summer Survey of the Prince Edward Islands
Apr 2003	Assistant Conservation Officer, Marion Island. Assisted Conservation Officer with inspections and country clean-ups. Conducted pilot study on the effects of human disturbance (helicopters and humans on foot) on seals and seabirds.

MN Bester

1974 - 1977	Ecology of Subantarctic fur seals *Arctocephalus tropicalis* at Gough Island, South Atlantic Ocean.
1977 - 1983	Population dynamics and reproductive physiology of *A. tropicalis* at Gough Island.
1976,1981/82 1986 - 1993	Control programme with a view to exterminating feral house cats *Felis catus* on Marion Island.
1979-1985	Population ecology of southern elephant seals *Mirounga leonina* at Iles Kerguelen in collaboration with French scientists of Terres Australes et Antarctiques Francaises (TAAF).
1981-present	Population ecology of elephant seals and fur seals (*Arctocephalus* spp.) at Marion Island.
1981 - 1983	Spatial and temporal distribution of Pinnipedia. This represents the overall title of projects b, d, & e during the aforementioned period.
1983-present	Migration of southern elephant seals *Mirounga leonina* from Marion Island.
1991 - 1995	Distributional ecology of Ross seals, *Ommatophoca rossii*, off Western Dronning Maud Land, Antarctica.
2000	Dallmann-Jubany Station, King George Island. Satellite telemetry studies on the migratory behaviour of Southern elephant seals.

Experience of research within the pack ice specifically was obtained during shipboard seal surveys from M.V. SA Agulhas southwest of Bouvet in August 1979, the M.V. Nella Dan southeast of Heard Island in October 1985, the M.V. Icebird off Enderby and MacRobertson Land and Prydz Bay, Antarctica during November/December 1985, the MV S.A. Agulhas off Western Dronning Maud Land in 1991/92 and 1992/93, and the RV Polarstern in the Weddell Sea in 1998.

J Cooper

Conducted and directed avian research during many relief voyages at Marion and Gough Islands since 1978

Made one visit to Antarctica during SIBEX II oceanographic cruise to Prydz Bay

Visited three Australian and New Zealand sub-Antarctic islands conducting environmental research in 1994

Antarctic Officer managing SANAP's avian research programme for 10 years in the 1980s-1990s

Conservation Officer, Prince Edward Islands Millennium Expedition, December 2001 and Marion Island 2002 and 2003 takeovers

Contributing author, Prince Edward Islands Management Plan

Member, Prince Edward Islands Management Committee (PEIMC) and Gough Island Nature Reserve Advisory Committee

Member, Marion Island Tourism Subcommittee

Conservation Officer, Tristan da Cunha Government

Member (and past Chair of its predecessor), SCAR Group of Experts on Birds

Member (and past Chair) IUCN Antarctic Advisory Committee.

ATTACHMENT 3

PUBLICATION LISTS

A. MS DE VILLIERS (1998-2003)

FRANTZEN, M.A.J., FERGUSON, J.W.H. & **DE VILLIERS, M.S.** 2001. The African wild dog (*Lycaon pictus*) in captivity. A prolific captive breeding program does not necessarily imply a successful conservation program. *Biol. Conserv.* 100: 253-260.

DE VILLIERS, M.S. 2002. Islands of the Wild West. *Promerops* 252: 14-15.

DE VILLIERS, M.S. 2002. Effects of a storm on breeding African Penguins *Spheniscus demersus* at Foxy Beach, Boulders Penguin Colony, Simon's Town. *Bird Numbers* 11(2): 7-9.

DU TOIT, M., BOERE, G.C., COOPER, J., **DE VILLIERS, M.S.**, KEMPER, J., LENTEN, B., PETERSEN, S.L., SIMMONS, R.E., WHITTINGTON, P.A. & BYERS, O.P. (eds). 2003. *Conservation Assessment and Management Plan for Southern African Seabirds.* Cape Town: Avian Demography Unit & Apple Valley: Conservation Breeding Specialist Group. pp 194.

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DE VILLIERS, M.S., RICHARDSON, P.R.K. & VAN JAARSVELD, A.S. In press. Patterns of coalition formation and spatial association in a social carnivore, the African wild dog *Lycaon pictus*. *J. Zool., Lond.*

B. MN BESTER (1998-2003)

BESTER, M.N., ODENDAAL, P.N. & FERGUSON, J.W.H. 1998. Abundance and distribution of Antarctic pack ice seals in the Weddell Sea during an anomalous year. *N. Z. Nat. Sci.* 23 Supplement: 13.

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KLAGES, N.T.W. & **BESTER, M.N.** 1998. The fish prey of fur seals *Arctocephalus* spp. at subantarctic Marion Island. *Marine Biol.*131: 559-566.

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PISTORIUS, P.A. & **BESTER, M.N.** 1998. Status of the southern elephant seal population on Marion Island. *N. Z. Nat. Sci.* 23 Supplement: 151.

STEWARDSON, C. L., **BESTER, M.N.** & OOSTHUIZEN, W.H. 1998. Reproduction in the male Cape fur seal *Arctocephalus pusillus pusillus*: age at puberty and annual cycle of the testis. J. Zool., Lond. 246: 63-74.

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PISTORIUS, P.A., TAYLOR, F.E., LOUW, C., HANISE, B., **BESTER, M.N.**, DE WET, C., DU PLOOY, A., GREEN, N., KLASEN, S., PODILE, S. & SCHOEMAN, J. 2002. Distribution, movement, and estimated population size of killer whales (*Orcinus orca*) at Marion Island, December 2000. *S. Afr. J. Wildl. Res.* 32: 86-92.

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KIRKMAN, S.P., **BESTER, M.N.**, MAKHADO, A.B. & PISTORIUS, P.A. 2003. Female attendance behaviour of Antarctic fur seals at Marion Island. *Afr. Zool.* 38: In press.

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C. J COOPER (1998-2003)

In press

CALF, K.M., **COOPER, J.** & UNDERHILL, L.G. in press. First breeding records of the Kelp *Gull Larus dominicanus vetula* at Robben Island, Western Cape, South Africa. *African Journal of Marine Science*

COOPER, J. (Ed.). 2003. Scientific papers of the Prince Edward Islands Millennium Expedition, December 2001. *African Journal of Marine Science* 25.

COOPER, J., BACCETTI, N., BELDA, E.J., BORG, J.J., ORO, D., PAPACONSTANTINOU, C & SÁNCHEZ, A. 2003. Seabird mortality from longline fishing in the Mediterranean and Macaronesian waters: a review and a way forward. *Scientia Marina* 67, Suppl. 2.

COOPER, J., BAKER, B., BOERE, G.C., DU TOIT, M., LENTEN, B., MONTGOMERY, N. & MÜLLER-HELMBRECHT, A. in press. Improving the conservation status of the world's seabirds through the Bonn Convention on Migratory Species (abstract). *Pacific Seabirds.*

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CRAWFORD, R.J.M., **COOPER, J.** & DYER, B.M. 2003. Population, breeding and diet of the Macaroni Penguin *Eudyptes chrysolophus* at Marion Island, 1994/95-2002/03. *African Journal of Marine Science* 25.

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2003

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2001

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ATTACHMENT 4

14. PROPOSED WORK PLAN

(Please describe the tasks to be undertaken during the whole project. Describe the methods to be used, indicate the persons and institutions involved and provide target dates for the start and completion of each task. In follow-up proposals, indicate and explain any changes from the previous proposal.)

The proposed work plan is summarised in Table 2 below, according to the breeding cycles of the seal and seabird species included in the study. Collection of all data will be by the appointed Field Biologist, although data on the effects of helicopter disturbance will rely on additional *ad lib* observations by University of Pretoria and Marine & Coastal Management Field Biologists. Collection of data on the effects of researcher disturbance will be in collaboration with these same Field Biologists. Additionally, during the 2004 and 2005 annual take-overs, Project co-leaders will collect field data in conjunction with the Field Biologist.

A. Approach Protocol

The sequence of key behaviours (postural changes and comfort and agonistic/defence behaviours) in response to a human approach, and the distances at which these behaviours are observed, will be recorded using a waterproof digital video camera. All instances of predation or attempted predation will also be noted. The approach protocol is an adaptation of methods currently being used to assess the effects of disturbance on southern African seabird species. A similar protocol has been used successfully to study Adélie Penguins in the Antarctic and is currently being used on a range of species on Macquarie Island in the sub-Antarctic (Dr Melissa Giese, Australian Antarctic Division, pers. comm.). A single observer stationed at a maximum distance of 100-m from the colony under investigation, and will record pre- and post-disturbance behaviours by means of scan sampling. The disturbance consists of a controlled approach by a human / humans on foot towards the colony. The approacher advances at slow speed until observing the first signs of unacceptable levels of agitation on the part of the species under investigation, e.g. adult birds or chicks moving off nests, or predators harassing breeding birds. (Note that extreme caution will be taken when approaching Gentoo Penguins, as this species is known to be sensitive to disturbance.) The approacher then kneels for one minute (simulating the taking of photographs) and finally retreats to the maximum distance. Behaviour of focal animals is video-recorded for 5 minutes before, during and after the disturbance. Video-recordings are used to compile a description of the sequence of behaviours accompanying the approach, and to determine the distances at which key reactions are exhibited by focal animals.

For each species, approaches at each stage of the breeding cycle will be duplicated for two colonies regularly exposed to disturbance (e.g. near base) and two colonies seldom exposed to disturbance (e.g. far from base). For King Penguins and Wandering Albatrosses, additional approaches will be made during the late incubation and early brooding stages, while varying each of the following variables in turn: group size, group cohesion and speed of approach.

After approaches, un-banded Wandering Albatrosses, Southern Giant Petrels and Sub-Antarctic Skuas will be temporarily restrained (for no more than 5-10 minutes) to obtain culmen measurements for the purpose of sexing individuals. Some birds may also be banded to aid with later identification, if this is of use to the existing Marine and Coastal Management seabird research project. Approaches to previously banded birds / seals with known history will allow an investigation of what variables predict severity of reaction to a human approaching on foot. Potential variables include age, sex, previous breeding success, and previous history of disturbance. We propose following the protocol used for Wandering Albatrosses in the pilot study conducted during take-over 2003 (see DisturbProposal.doc, Section 13). Key reactions and the distance from an individual at which these take place will be recorded.

B. Experiments using artificial eggs

Table 1: Number of individuals per species experimented on for each procedure

	Temperature loggers	Heart Rate monitors
Wandering Albatross		20
Southern Giant Petrel		20
King Penguin	20	40
Sub-Antarctic Skua	20	

1. Artificial eggs containing temperature loggers

Preliminary trials with egg temperature loggers have been successfully conducted on African Penguins and are to be used this year to determine the effect of helicopter flights on incubation by this species on Dassen Island, Western Cape (Dr P.G. Ryan, Percy FitzPatrick Institute, University of Cape Town, pers. comm.) We propose the temporary replacement (for no more than three hours) of the eggs of 20 King Penguins with artificial eggs containing temperature loggers, and the temporary placement of artificial eggs in the nests of 20 Sub-Antarctic Skuas (no removal of real eggs, placement of artificial eggs for no more than 5 hours). This will allow the assessment of the effects of approach by a human on foot, and of helicopter disturbance, on egg temperature. Real King Penguin eggs will be kept at incubation temperature during experimentation with artificial eggs, and returned to parent birds upon conclusion. Preliminary trials will test these procedures and if it more than two eggs of either species are lost, then these experiments will be terminated.

2. Artificial eggs containing heart rate monitors

Heart rate responses of seabirds to human approach have been measured by placing artificial eggs containing heart rate monitors in the nests of incubating birds. We propose that the heart rate responses of 20 Wandering Albatrosses, 40 King Penguins and 20 Southern Giant Petrels to the following disturbances be monitored:

- controlled single-person approaches
- researcher disturbance
- helicopter over-flights

The study bird's egg will be temporarily (for no more than 3 hours) removed and kept at a suitable incubation temperature, while it is replaced with the artificial egg. Basal heart rate, the magnitude and duration of heart rate changes due to external stimuli (such as the presence of natural predators, or the occurrence of a disturbance) will be monitored. Preliminary trials will test this procedure and if it more than two King Penguin eggs or a single Southern Giant Petrel or Wandering Albatross egg is lost, then these experiments will be terminated.

C. Weighing of seal pups and seabird fledglings

We propose a comparison of the masses of seal pups and seabird fledglings in colonies with high and low levels of disturbance (i.e. close to, and far from, base). Photogrammetric techniques will be used to estimate mass at weaning of Southern Elephant and Sub-Antarctic Fur Seal pups (McFadden *et al.* 1999). Mass data for seal pups would be obtained in the course of field procedures currently being practised by University of Pretoria Field Biologists, and these data would be used to ground-truth photogrammetric data collected simultaneously. This would not require any additional handling of pups and would allow for the comparison of estimated masses of offspring from colonies exposed to high and low levels of human disturbance. The mass at fledging of chicks in seabird colonies with high and low levels of disturbance could also be compared, although this would be dependent on co-operation with Dr Robert Crawford of Marine and Coastal Management, in order to minimise the disturbance associated with the weighing procedure.

It may be necessary to weigh some additional pups and fledglings, beyond those already weighed by University of Pretoria or MCM Field Biologists. Weighing protocols will follow those already in place.

See following page for Table 2

Months	Helicopter disturbance	Researcher disturbance	Species courtship or nest / territory establishment approaches	Species early incubation / pregnancy (seals) approaches	Species late incubation approaches	Early brooding / pup approaches	Late brooding / pup approaches	Moulting
Apr '04	PK SGP WA ES FS	FS ES KP	WA			WA	WA PK	ES
May '04		FS ES KP					WA PK	ES
Jun '04			CS PG				WA PK	
Jul '04		PG WA	CS PG	CS PG			WA PK	
Aug '04	PK SGP WA ES	PG WA	SGP CS ES	CS	CS PG	PG	WA PK	
Sep '04		PG SGP	SGP CS ES	SGP CS ES	CS	CS PG	WA PK	
Oct '04		FS ES KP WA SGP	PK FS	SGP CS SAS ES	SGP CS	CS ES	WA PG CS	PK
Nov '04		ES KP WA SGP	WA PK FS	CS PK CS FS	SGP CS SAS	SGP CS ES SAS	PG CS ES	PK ES
Dec '04		WA SGP	WA	WA PK FS	CS	SGP CS FS SAS	PG CS SAS	PK ES PG
Jan '05		WA FS KP		WA PK FS	PK	SGP CS FS	SGP CS SAS	PK ES PG
Feb '05		WA			WA PK	PK	PK SGP CS FS	PK ES PG
Mar '05		WA			WA PK	WA PK	SGP CS PK FS	FS ES PG
Apr '05	PK SGP WA PR ES FS	FS ES KP				WA PK	WA PK FS	FS ES

Key: CS - Crozet Shag; ES - Southern Elephant Seal; FS - Sub-Antarctic Fur Seal; PG Gentoo Penguin; PK - King Penguin; SAS - Sub-Antarctic Skua; SGP - Southern Giant Petrel; WA - Wandering Albatross

ATTACHMENT 5

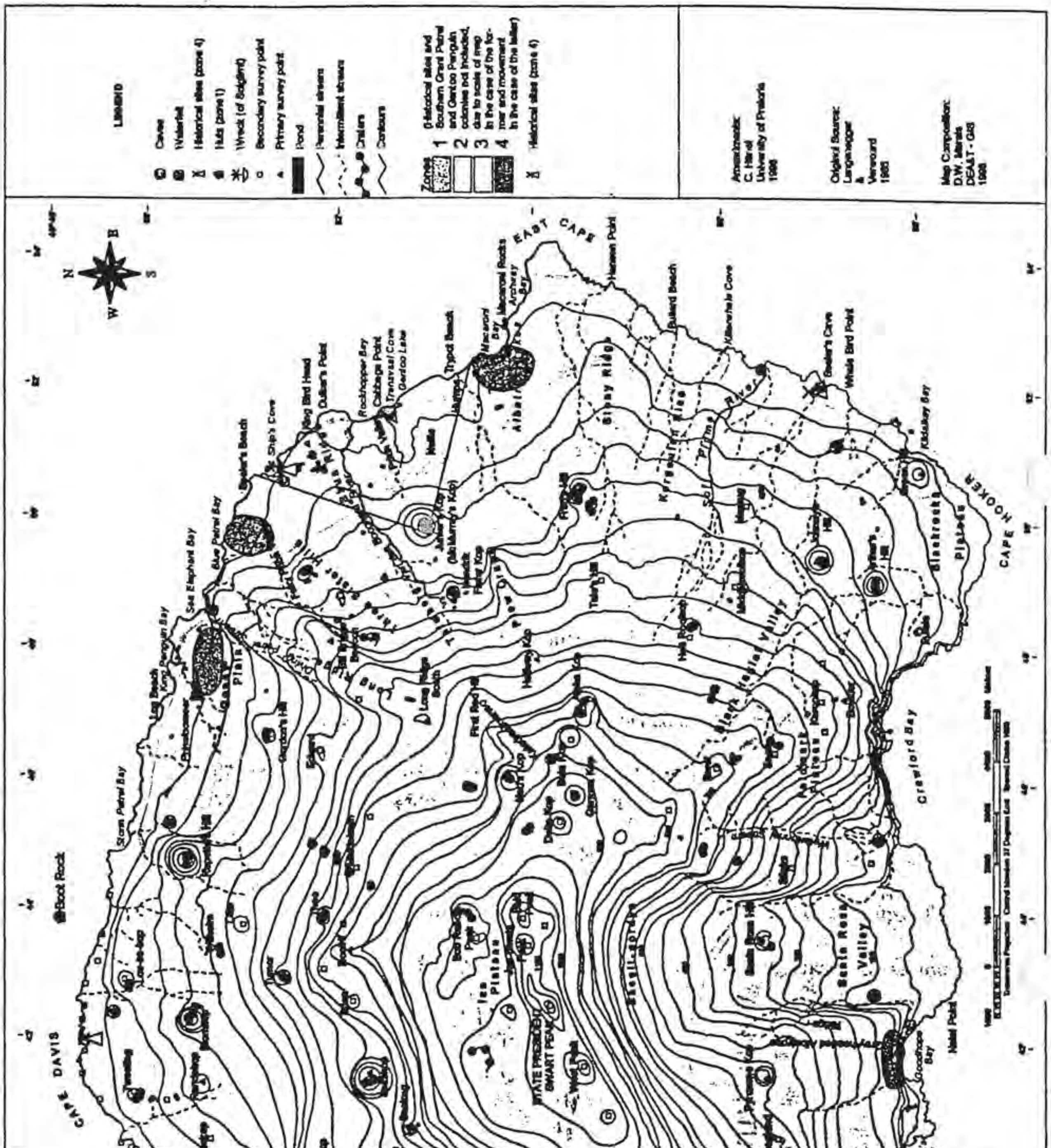

Fig. 2. Map of Marion Island

ATTACHMENT 6: QUOTATIONS

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Facsimile:	6503434

Date:	23 Jun 2003
Sales Rep.:	Reza Jaffer
Cel.:	083 727 6990
Quote No.:	

QTY	SKU	DESCRIPTION	UNIT PRICE	TOTAL
1		Mecer Pentium IV 2.4Ghz	7,350.00	7,350.00
		Pentium IV 2.4Ghz		-
		40Gb Hd		-
		256Mb Ram		-
		52X Mecer CDRW Drive,16X DVD		-
		56K Modem,10/100		-
		Keyboard,mouse & speakers		-
		17" Mecer monitor		-
		2 Year warranty		-
				-
1		HP 1150 Laser printer	3,599.95	3,599.95
				-
1		USB Printer cable	49.99	49.99
		Please bring this quote in when collecting		-
		goods and ask to speak to the relevant		-
		salesperson		-
		SUB TOTAL EXCLUDING VAT		R 9,649.07
		VAT AT 14%		R 1,350.87
		TOTAL	R	R 10,999.94

1. All prices shown are inclusive of VAT unless otherwise indicated.
2. This quotation is valid for a period of 48 hours or while stocks last.
3. Prices are subject to change without notice.
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CASH, CREDIT CARDS, BANK GUARANTEED CHEQUES DURING BANKING HOURS ONLY

QUOTATION 225177

	QTY.	DESCRIPTION	UNIT PRICE INCL VAT.	TOTAL
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4				
5	1	GRUNDIG 54CM TV		2699.99
6				
7	1	STANTON PRO 50 S		
8				199.99
			GRAND TOTAL	

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YOURS FAITHFULLY

GPS

Most manufacturers have various ranges, from bottom to top of the range, each to suit a variety of needs. We took a look at Garmin's eTrex range of GPS's to illustrate this point.

1. eTrex Personal Navigator

R1 925 excluding CD

This unit combines the best features of a 12 parallel channel GPS receiver into a lightweight package 10cm high and 5cm wide. The result is a GPS that will literally fit in the palm of your hand. The diminutive size is complemented by a sleek design featuring all buttons positioned on either side of the unit, thus allowing for simple, one-handed operation without obstructing the display. In fact, the eTrex features only five operator buttons for the ultimate in user-friendly design. It is completely waterproof, can run for a generous 18 hours on two AA batteries, stores 500 user waypoints together with a range of graphic icons and boasts Garmin's exclusive TracBack feature that will reverse your track log and help you navigate your way back home. In addition, the eTrex uses animated graphics that will help you identify your marked waypoints quickly and easily. Best of all, there is no need to worry about dense tree canopy with this unit; the eTrex will continue to maintain a [illegible]tellite lock even while operating in forest-like conditions.

2. eTrex Summit

R2 750 excluding CD

The eTrex Summit follows on the heels of the extremely popular eTrex Personal Navigator and will work equally well both within marine and recreational applications. Outdoor enthusiasts will appreciate this all-in-one navigational device combining GPS, altimeter and an electronic compass. The electronic compass provides bearing information when you're stationary, while the altimeter determines precise altitude, thus calculating how high you've climbed and your rate of ascent. Like its predecessor, the eTrex Summit boasts a powerful 12 parallel channel GPS receiver packaged within a small, sleek case with operating buttons located on either side of the unit. The case is completely waterproof and can withstand immersion in one meter of water for up to 30 minutes, making it the perfect tool for the outdoor tribe.

3. eTrex Legend

R3 899 excluding CD

The eTrex Legend comes packaged with a full base map of North and South An[illegible], but this does not mean anything if you're off to ride the Harkerville trail. However, an advantage of the unit is the improved GPS precision afforded through the use of correction data obtained from the Wide Area Augmentation System (WAAS). This product will provide positional accuracy to less than three meters when receiving WAAS corrections, while additional memory pushes its capacity up to 8 megabytes. This allows it to accept downloaded map data from Garmin's entire line of MapSource® CD-ROMs or off their web sites.

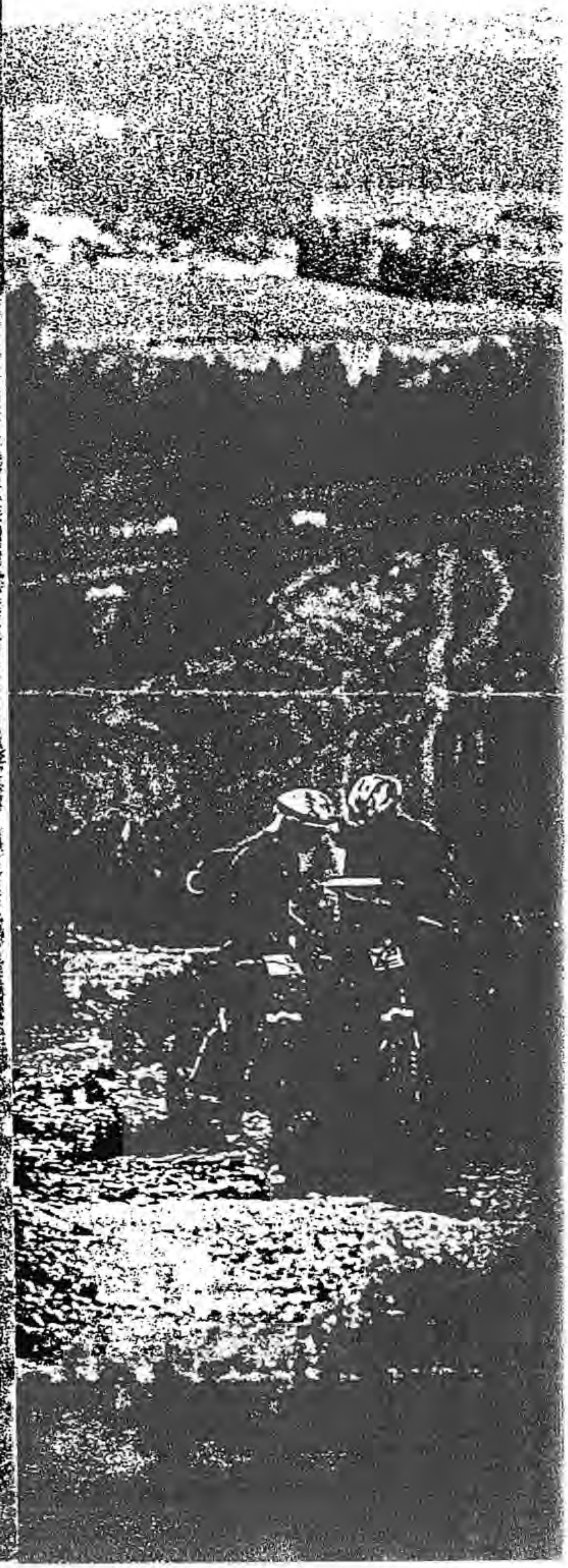
4. Garmin GPS V

R6 499 excluding CD

The GPS V is a top-of-the-range navigational tool and this versatile navigator delivers automatic routing, detailed mapping and WAAS capability. It comes bundled with the MapSource City Select CD, giving you access to detailed street-level maps indicating the locations of restaurants, hotels and other services - again in the US, so of little value to us Saffies except if you're off to spend dollars you don't have. Theoretically you will be able to use the GPS V to look up a location and it will automatically calculate a route and guide you to your destination with turn-by-turn directions and audible beeps that alert you to upcoming turns. Another feature is that you are able to switch the display from horizontal (for mounting on a bike or a vehicle dash) to vertical for handheld use.

The featured GPS units are available from national outdoor retailers and selected Cape Union Mart stores.

Stock [illegible] overleaf



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Attention: MARIENNE DE VILLIERS

Tel. No.: 021 - 8528396

Fax No.: 021 - 650 3434

Date: 23 - 06 - 2003

Quotation as requested

Quan-	Item	Unit Price	Total
1x	Sony DCR - PC 105		11120-00
1x	Sony DCR - TRV 38E		10250-00
1x	KAMAKURA 10 x 42		3050-00
1x	MANFROTTO 055 + 501 HEAD + BAG		3150-00
1x	PANASONIC NV - GX 70 (3 CCD VIDEO)		14100-00
1x	2x convertor		350-00
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		Tax	14%
		Shipping	
		Total	41670-00
	For further information, please do not hesitate in contacting me.		

Price: INCLUDING VAT

Payment: COD

Availability: STOCK

Guarantee: 12 MONTHS

Quotation valid for: 14 days. Subject to change without notice.

Quotation prepared by: CORALI DE WIT.

SOUTH AFRICAN NATIONAL ANTARCTIC PROGRAMME (SANAP) **Doc 5.8**

PROJECT PROPOSAL - APPLICATION FOR FUNDING AND LOGISTIC SUPPORT

1. SUBMISSION OF THIS APPLICATION

Please submit this application to:

The Chair: SACAR
SANAP PROJECT PROPOSAL
c/o Department of Environmental Affairs and Tourism
Directorate: Antarctica and Islands
Private Bag X 447
PRETORIA
0001

Applications must be submitted by 12:00 on Friday 28 June 2003.

All applications must be signed by the Applicant, Project Leader, Head of Department and the Head of the Organisation, before forwarding to the Department of Environmental Affairs and Tourism (DEA&T). All proposals will be treated as tenders and will be opened together soon after the closing time of 12:00 on 28 June 2002.

We regret that late or incomplete applications will not be considered.

2. MAJOR DISCIPLINE IN WHICH THE RESEARCH/STUDY WILL BE UNDERTAKEN

ENVIRONMENTAL MANAGEMENT

3. TITLE OF PROJECT

(The title must be short and specific and should be used for the duration of the project)

REVISION OF THE PRINCE EDWARD ISLANDS MANAGEMENT PLAN (PHASE TWO)

3.1 DURATION OF PROJECT

1 AUGUST 2003 - 31 MARCH 2004 (PHASE ONE)
1 APRIL 2004 - 31 MARCH 2005 (PHASE TWO)

4 CATEGORY OF PROJECT PROPOSAL

(a) First proposal (Please attach a summary of the literature). YES

(b) Follow-up proposal (Please submit a full progress report with this application)

(c) Application for additional funds (A full progress report and a motivation by the project leader should be submitted with this application)

5. KEYWORDS BY MEANS OF WHICH THE PROJECT CAN BE IDENTIFIED

Prince Edward Islands

Management Plan

6. RESPONSIBLE PROJECT LEADER (AND CO-LEADERS)

Title	Mr
Surname	Cooper
First name/s	John
Business address	Avian Demography Unit
	University of Cape Town
	Rondebosch 7701
	South Africa
Telephone	(021) 650-3426
Fax	(021) 650-3434
E-mail	jcooper@adu.uct.ac.za

Title	
Surname	
First name/s	
Business address	
Telephone	( )
Fax	( )
E-mail	

Title

Surname

First name/s

Business address

Telephone ( )

Fax ( )

E-mail

7. **PARTICULARS OF APPLICANTS**

Title as above

Surname

First name/s

Business address

Telephone ( )

Fax ( )

E-mail

Date of birth 1947/01/31

Citizenship

Are you a South African citizen? No if not, are you a permanent resident? Yes

Country of citizenship United Kingdom Occupation Biologist Employer University of Cape Town Department/Institution Avian Demography Unit, Department of Statistical Sciences

8. **QUALIFICATIONS**

Highest qualification BSc (Hons) Where obtained University of London

Date obtained 1967 Will the research be used to obtain a degree NO

Which degree N/A

8.1 Please attach details of previous experience in Antarctica, Marion and Gough Islands and the Southern Ocean.

Conducted and directed avian research during many relief voyages at Marion and Gough Islands since 1978; made one visit to Antarctica during SIBEX II oceanographic cruise to Prydz Bay; visited three Australian and New Zealand sub-Antarctic islands conducting environmental research in 1994; Antarctic Officer managing SANAP's avian research programme for 10 years in the 1980s-1990s; Tristan da Cunha Environmental Officer, Gough Island Relief Voyage, 1992; Conservation Officer, Prince Edward Islands Millennium Expedition, December 2001 and Marion Island 2002 and 2003 takeovers; contributing author, Prince Edward Islands Management Plan; co-author, Gough Island Wildlife Reserve Management Plan; Member, Prince Edward Islands Management Committee (PEIMC); Member Gough Island Nature Reserve Advisory Committee; Member, Marion Island Tourism Subcommittee; Conservation Officer, Tristan da Cunha Government; Member (and past Chair of its predecessor), SCAR Group of Experts on Birds; Member (and past Chair) IUCN Antarctic Advisory Committee.

9. **SCIENTIFIC PUBLICATIONS** (Please attach a list of your publications during the past 5 years)

See attached list

10. **SUMMARY OF FINANCIAL REQUIREMENTS**

	Received for Current year 2003/04___	This Application 2004/05___	Future Application/s 20___ 20___
Manpower costs	R 63 000 (requested)	R 66 000	Nil
Running expenses	Nil	R 30 650	Nil
Capital equipment	Nil	Nil	Nil
TOTAL	R 63 000 (requested)	R 96 650	Nil

10.1 Which organization will be responsible for the administration of the funds?

UNIVERSITY OF CAPE TOWN

11. OBJECTIVES AND RATIONALE (NEED AND PURPOSE).

(Please state the objectives of the project, the need for it and how it will contribute to SANAP. In follow-up proposals, please indicate and explain any changes from the previous proposal.)

The current management plan for the Prince Edward Islands (PEIMP) came into force in 1996. Section 3, Part 22 of the plan "Monitoring and revision of management plan" states that "A comprehensive review of the plan will be undertaken at five-year intervals". This required review is thus overdue.

A revised PEIMP will take account of a number of developments pertaining to the management of the islands over the last seven years and will place environmental management at the islands on a firm and up-to-date footing for the next five-year period.

It is envisaged that a further revision of the PEIMP will become necessary soon after the new base at Marion Island has come into operation to take the islands into the second decade of the century/millennium.

12. PARTICULARS OF A PILOT OR FEASIBILITY STUDY THAT HAS BEEN UNDERTAKEN.

(Please give a short description of any pilot/feasibility study which may have been undertaken.)

Not applicable

13. KEY QUESTIONS AND RESEARCH APPROACH

(Please provide a list of specific questions to be answered or hypotheses that will be tested and indicate how each is to be approached. In follow-up proposals, indicate and explain any changes from the previous proposal.)

No "key questions" exist as such. The aim is to produce a substantially updated PEIMP that takes account of past and ongoing developments at the islands and in their management since 1996.

Inter alia, matters to be revised/covered in the revision include: management zoning; approach distances to birds and seals, quarantine procedures; eradication of alien plants and animals (especially the house mouse); removal of accumulated rubble and existing base; rehabilitation of existing base site after removal of structures building of the new base; submission of the World Heritage nomination; proposals for Ramsar International Wetland status and expansion of the Special Nature Reserve to 12 nautical miles (territorial waters); new and planned South African environmental legislation (e.g. NEMPA, NEMB, National Plan of Action – Seabirds); international conventions to which South Africa is a Contracting Party (e.g. CCAMLR, Convention on Migratory Species, Agreement on the Conservation of Albatrosses and Petrels); development and status of the Patagonian Toothfish longline fishery (both legal and illegal); capacity for enhanced at-sea patrolling of territorial and EEZ waters; effects of climatic change; new research findings since 1996; monitoring requirements; new topographical map; etc.

14. **PROPOSED WORK PLAN**

(Please describe the tasks to be undertaken during the whole project. Describe the methods to be used, indicate the persons and institutions involved and provide target dates for the start and completion of each task. In follow-up proposals, indicate and explain any changes from the previous proposal.)

Phase One (1 August 2003 – 31 March 2004)

1. The existing PEIMP will be revised (see #13 above) section by section. New text will be drafted as required. Drafts will be circulated for comment and criticism to past and present members/staff of the PEIMC; Directorate: Antarctica & Islands and Branch: Marine & Coastal Management, Department of Environmental Affairs & Tourism; South African Weather Services; National Department of Public Works; past and present project leaders and researchers at the Prince Edward Islands and surrounding waters; experts in the fields of environmental and marine legislation and management in South Africa; Patagonian Toothfish longline fishery rights holders; South African Environmental NGOs; and selected experts in countries (Australia, Chile, Falkland Islands, France, New Zealand, United Kingdom) that manage sub-Antarctic and cool temperate oceanic islands in the Southern Ocean. Comments received will be taken into account in producing a first revised text of the management plan, to be completed by 31 March 2004.

Phase Two (1 April 2004 – 31 March 2005)

1. The first revised text prepared during Phase One of the Project will be "tested" in the field during the April 2004 takeover voyage to the Prince Edward Islands , so as to "iron out" any difficulties or problems that come to light. The Project Leader (J. Cooper) should be appointed Conservation Officer for this voyage to facilitate the in-field assessment of the text.

2. Following the field test at the Prince Edward Islands a second revised text will be produced for consideration by the PEIMC and invited experts at a one-day workshop, preferably to be held back-to-back with a meeting of the PEIMC, in Cape Town. It is recommended that the workshop be held during July 2004. The Project Leader (J. Cooper) will arrange and facilitate the workshop, acting as *rapporteur*, which might best be chaired by the Chair of the PEIMC.

3. Based on the outcomes and recommendations of the workshop, a third revision will be produced and submitted to the Directorate: Antarctica & Islands by 30 September 2004. A public review process will then be followed, facilitated by placing the draft management plan onto DEAT's web site and by sending the text to selected experts and interested and affected parties.

4. A final (fourth) revision will be prepared to take account of any comments received, before the management plan is formally submitted to the Director-General of DEAT for approval by 31 December 2004.

5. Production of final copy (as a bound A4-sized booklet with ISBN number, colour cover, etc.) including illustrative material (figures, maps, photographs) by desk-top-publishing methods and arranging for printing will be undertaken within the Avian Demography Unit, University of Cape Town during the period January-March 2005.

6. The approved version of the management plan will then be published as a publicly-available document by DEAT, both as hard-copy and on the DEAT web site, by 31 March 2005. The provisions of the

revised PEIMP will then apply to activities at the Prince Edward Islands as from that date.

14.1 Is this project a co-operative/collaborative project. Please provide summary information on the associated projects and discuss the role of this project in the total programme.

The project is a collaborative one in the sense that members of the PEIMC will be expected to contribute fully to the revision of the PEIMP by reviewing draft texts, by attending the workshop, and by adopting the final version.

15. WILL THE PROJECT LEADER BE AWAY FOR ANY SIGNIFICANT PERIODS WHILE THE PROJECT IS IN PROGRESS?

September 2003 will be spent at the South African weather station on Gough Island as the UK Environmental Officer and April 2004 spent as the PEIMC Conservation Officer at Marion Island. Both these activities will contribute to the project by allowing existing and new environmental practices and procedures to be evaluated and tested in the field.

15.1 If yes, describe the arrangements made for leadership and supervision during his/her absence.

Not necessary, as the Project will continue during the above two field trips.

16. END PRODUCT OF THE PROJECT

(Describe the planned final products that will result from the project (i.e. the nature of the final report, maps, etc.) and state when they will be submitted. All DEA&T funded projects should include the text for a popular publication which will be used to bring the results of the research to the general public or to a specific user group.)

1. A revised Prince Edward Islands Management Plan formally adopted by the Director-General, Department of Environmental Affairs & Tourism (DEAT), published in paper copy and on DEAT's web site, and brought into effect by the Directorate: Antarctica & Islands by 31 March 2005.
2. The revised management plan will be made available for submission by South Africa to international fora, including meetings of relevant bodies of ACAP, CCAMLR and the Scientific Committee on Antarctic Research (SCAR).
3. An article summarising the major requirements of the management plan, emphasising revised and new practices and the reasons for them, will be submitted to the *South African Journal of Science* for its "News and Views" section during the first three months of 2005.
4. Popular article(s) will be written to advertise the revision, the necessity for a new management plan and the process followed during the course of the Project for South African environmental magazines (e.g. *Africa Geographic*, *African Wildlife*).

17. **DISCUSS ANY POTENTIAL IMPACT YOUR STUDY WILL HAVE ON THE ENVIRONMENT AND DESCRIBE MITIGATING ACTIONS WHICH YOU PROPOSE TO MINIMIZE OR ELIMINATE THE IMPACT**

The following guidelines are provided to assist applicants with questions relating to the potential environmental impact of a proposal.

(i) Proposals for the continuation of ongoing projects should state clearly if any changes are proposed in field methods, work programmes, camp sites, and timing from those documented in the original proposal, or subsequent modifications to it.

(ii) The proposer should list aspects of the proposed activity, that have not been noted, that might cause impacts on the Antarctic environment (e.g. visual impact or other forms of disturbance).

(iii) In making all these assessments of impact, the proposer should briefly consider the nature, duration and intensity of the likely environmental effects, including the following;

a. the existing environment, its variability or dynamic nature, resilience to change, sensitivity to disturbance, previous disturbance, protected status etc;

b. cumulative and possible indirect impacts;

c. the probability of accidents and their environmental consequences;

d. the adequacy of existing information and knowledge.

(iv) A map of the area should be included (sketch if necessary) to assist the interpretation of this section of the research application.

Proposers are expected to provide sufficient information in their answers to allow the DEA & T to make a thorough, complete and accurate evaluation of the environmental impact of the project. Insufficient information will require follow-up action and/or may prejudice the environmental acceptability of the project.

Since the project is essentially a "desk-top" one, no environmental impacts are envisaged. During the Marion Island 2004 takeover efforts commenced in 2001 will continue to remove accumulated litter and rubble from the surrounds of the base and field huts and from farther afield.

Preliminary Environmental Evaluation

Details of Activities

Answer all questions only if work is to be carried out in Antarctica or Marion Island during 2003___to 2005___

If you answer "Yes" to any of these questions, a full description of proposed activity, including proposals for mitigating and monitoring these impacts, is required.

It is important that you provide maps detailing the proposed research areas (hand drawn sketches are acceptable).

Will your objective:

a. Use a radionuclide? Yes [ ] No X

If Yes, complete the following:

Radionuclide	Chemical form	Quantity (Curies)	Half Life (Years)

Detail procedures you will take to ensure that no radiation will enter the Antarctic or sub-Antarctic environment from use or spillage.

b. Take any chemical to Antarctica or Marion Island?

Yes [ ] No X

If Yes, complete the following:

Chemical	Formula	Quantity	Use

Unused chemicals will be: [ ] Left at SANAE Base

[ ] Returned to South Africa

[ ] Other

If Other, detail disposal procedure:

c. Release any chemical to the Antarctic or sub-Antarctic Environment?

Yes [ ] No X

If Yes, detail the need to release, the chemical, the amounts involved and the location.

d. Require the use of explosives? Yes No X

If Yes, complete the following:

How will the explosives be used?

Detail any precautions taken to minimise disturbance to any wildlife or plants:

Explosive Type	Number of detonations	Charges per detonation (kg)	Total weight (kg)

e. Collect, capture, kill, restrain, tag or band any terrestrial, freshwater or marine plants or animals?

Yes ☐ No X

If Yes, complete the following:

For each species (apart from those taken using plankton nets or trawl), estimate the proportion of the local population you will be collecting, capturing, killing, tagging or banding. If restraining, include period of restraint:

Species	Method	Number	Proportion of population (%)

For each species, indicate the proportion of the local population you will be disturbing while carrying out the above activities.

---

f. Enter any Protected Area? Yes X No ☐

If Yes, complete the following:

Name of Protected Area	Duration of Visit	Total person-days
Zones 2-4, Marion Island	April 2004 takeover	*c.* 40 person-days

Detail why the work must be carried out within the Protected Area:

Environmental inspections, *inter alia*, for presence and spread of alien plants, assessing path erosion, presence of litter and rubble, effects of scientific studies, condition of historical sites and exposed artefacts, condition of field huts and toilets, etc.

g. Take to Antarctica or Marion Island any animal, plant (includes seeds), micro-organism or soil?

Yes ☐ No X

If Yes, complete the following:

Species	Quantity

Detail why these materials need to be taken to Antarctica:

Detail the quarantine procedures you will undertake to ensure that there is no release to the Antarctic environment:

h. Significantly disturb by flooding, sampling, trampling, camp operations or any other means any ice-free area (bare ground)?

☐

Yes No X

If Yes, complete the following:

Briefly describe any such significant disturbance:

Detail any steps you will take to minimise such disturbance:

i. Take or remove any physical specimens eg. rocks, fossils etc?

Yes ☐ No X

If Yes, detail the general area and types of specimens to be collected:

Location	Specimen	Type	Total Number of Weight

j Cumulative Impacts.

Occupy new or existing camp sites? ☐ New

☐ Old

☐ Both old and new sites

If New, list these sites and indicate why a previously impacted site can not be used.

Will you track previously untracked ground?

Yes ☐ No X

If Yes, state why this is necessary:

Field trips at Marion Island will in the main follow established paths between field huts and existing study sites, but deviations will occur to assess environmental conditions. No adverse effects are envisaged.

Will you install equipment, markers, stakes, cairns etc. that will be left in the field?

Yes ☐ No X

If Yes, detail location and type of marker, stake etc:

Location	Type

k Do you expect your activities to have an environmental impact not covered in the above?

Yes No X

If Yes, fully detail impacts:

l. Is the proposed activity likely to have more than a minor or transitory impact?

Yes ☐ No ☐

If Yes, a CEE will be required:

18 FINANCIAL REQUIREMENTS

18.1 MANPOWER

(Please provide details of all persons involved and/or employed and/or applied for including ad hoc help on a part-time basis.)

No Antarctic Officers and/or technical/administrative personnel will be funded - the management and administration of the specific project will be the responsibility of the project leader. The Department and SACAR will only fund home-based researchers appointed on bursaries, and no allowances will be made for the payment of service benefits, such as housing subsidies, medical aids, pensions, etc.

In follow-up proposals explain any changes from the projection given in the previous proposal.

Name, qualifications, past experience and function in this Project	Time available for this project (% of full-time man-year)	Nature and Source of non-SACAR funding	Amount Requested from SACAR
J. Cooper, Chief Research Officer, (BSc Hons), 30 years' experience as a biologist and environmental conservationist (see also Section 8.1 above), Project Leader	33% (costed as equivalent to three months' salary package, 2004 UCT's C.R.O. scale)	UCT	R 66 000
PEIMC member or AN Other, Assistant Conservation Officer, Marion takeover 2004	One month	N/A	Nil
Total			R 66 000

18.2 RUNNING EXPENSES

(Please complete all sections. Indicate non-SACAR funds available. That, if a University decides to suggest a research proposal, the University itself must render the necessary support services, such as photocopies, telephone calls, postage, etc. If a research project requires technical support services, the time required must be budgeted for instead of a designated appointment.)

In follow-up proposals explain any changes from the projections given in the previous proposal.

Items	Nature and source of Non-SACAR funding	Funds requested From SACAR
Transport (sea, air and land with distances and rates) (Local transport, 200 km at R1.50/km)	Nil	R 350

Subsistence (nature and rates)	Nil	Nil
Supplies and services (please specify) Medical examinations x2 Costs associated with the one-day workshop in July 2004 (air (three persons, JBG/CT), local transport, subsistence, accommodation (BxB, one night x3), teas, lunches, workshop materials, etc. for 12 persons) Costs associated with revising the PEIMP (postage, phones, faxes, stationary, photocopying, binding, computer consumables, etc. Costs associated with publishing the revised PEIMP (DTP: *c.* 80 pages at R100/page; printing 250 copies)	Nil Use of venue and audio-visual aids (UCT or MCM) (costed at R 2500) UCT (estimated to be of the order of R 5 000) Nil	R 300 R 10 000 Nil R 20 000
Total	*c.* R 7500	R 30 650

18.3 CAPITAL EQUIPMENT
(Please describe the items required.)
Items paid for in full by the SACAR remain the property of the DEA&T. Items to which the participating organization contribute 50% or more of the cost, become the property of the organization.

In follow-up proposals, please explain any changes from the projections given in the previous proposal.

Description of item and total cost	Non-SACAR Funding	Non-SACAR Application	Amount requested from SACAR
	Nil	Nil	Nil
	Nil	Nil	

Total			Nil

A short motivation must be provided for each item requested. Please supply a quotation for all items requested.

18.4 LOGISTIC SUPPORT

(Please assess your support requirements carefully. The details provided will be used to develop the support for your project, as well as the total integrated support for all programmes. *You will be required to complete this section for each voyage undertaken.*)

Volume and mass of cargo NIL________ m^2 _______ kg

Description of cargo

N/A

Destination where cargo is required ________N/A

Radio-active and other hazardous cargo.
Please provide details of materials and how they will be used. State special precautions to be undertaken.

Accommodation requirements

Ship:

Number of persons 2

Period: Voyage to and from Marion Island, April 2004

Base:

Number of persons 2

Period 2004 Takeover

Ship's time required: _______Nil_____________

Sampling locations at sea (please attach a detailed map):

N/A

Laboratory requirements (ship):

Nil

Laboratory requirements (base):

Use of desk space in the Lower General Purpose (Bird) Laboratory by two persons

Type of equipment requiring deployment from ship:

N/A

Small boat needs (locality and time):

Nil

Surface vehicle needs:

N/A

Helicopter support (describe fully e.g. time, locality, special requirements):

Support to place and retrieve containers for "country clean-ups" of rubble at the hydroshacks, dam site, Kildalkey Hut, old hut site near Kampkoppie, etc. Containers should be placed as early as possible during the takeover, and retrieved once full.

Camping equipment

No of persons / teams ______2

Special equipment:

Back and day packs and sleeping bags

Protective clothing

No of persons ____2

List any special requirements:

Nil

Please list any special needs:

Nil

19 PARTICULARS OF RESEARCH/STUDY ABROAD

19.1 Reasons why it is necessary to undertake the research/study abroad.

Not applicable

19.2 What arrangements have been made for overseas research/study?

Not applicable

19.3 Period that will be spent abroad

Date of departure: ________________

Date of return. ____________________

19.4 Subsistence and transport
(Calculations should be made at the current public service rates.)

Place	Type of accommodation	No of days	Costs
Total			

19.5 Travel costs

Type of Transport	Destination	Distance	Costs
Total			

20. STATEMENT BY APPLICANT

I declare that the foregoing information is correct.

Signature John Cooper Date 23 June 2003

21. RECOMMENDATION BY THE RESEARCH OR EQUIVALENT COMMITTEE OF THE APPLICANT'S ORGANIZATION

Chair [signature] Date 25 June 2003

I certify that the information contained in this application is correct and that if SACAR financial support is provided, it will be utilised in accordance with the conditions as laid down by the DEA&T.

Project Leader John Cooper Date 23 June 2003

Head of Department [signature] Date 23 June 2003

Head of Organization B D Reddy Date 23 June 2003

22. COMMENT AND RECOMMENDATION BY SACAR

Chair ______________ Date ______________

Appendix 1

ETHICAL REQUIREMENTS FOR RESEARCH ON THE PRINCE EDWARD ISLANDS

Questionnaire to be completed by reviewing ethical committee

This questionnaire represents the minimum ethical requirements for research on the Prince Edward Islands. It is not intended as an alternative to the reviewing ethical committee's review process and guidelines, but as a supplement to it and as such represents a standardised format whereby the Department of Environmental Affairs and Tourism can ensure that research conducted on the Prince Edward Islands is of a high ethical standard.

The questionnaire is based on the National Code for the handling and Use of Animals in Research, Education, Diagnosis and Testing of Drugs and Related Substances in South Africa (1990) and expects of the reviewing committee to indicate whether certain aspects of the proposed projects have been reviewed by it or not. Please note that these questions are applicable only if the proposed project affects vertebrate animals. Where a question is not relevant, please indicate either *no comment*, *not enough information*, or *not applicable*. Space is provided below for comments on any of the questions. Please refer to the question number when commenting.

Note: not applicable as no field research component envisaged that will involve study or disturbance of indigenous biota at the Prince Edward Islands

QUESTION	REVIEWED **Indicate either Yes / No / No comment / Not enough information / Not applicable**
Part 1. Professional detail regarding applicant and co-workers	
I Applicant name and affiliation	
II Whether the following information about persons responsible for applying proposed research techniques has been provided:	
i. names	
ii. qualifications (academic or technical)	
iii. description of each person's experience in proposed techniques	
III Whether the following information about other co-workers has been provided:	
i. names	
ii. qualifications	
iii. affiliation	

QUESTION	REVIEWED **Indicate either Yes / No / No comment / Not enough information / Not applicable**
Part 2. Ethical aspects with regard to proposed research project	
i. whether the project's contribution to the relevant scientific field justifies any possible pain or discomfort caused to animals during the course of research	
ii. whether alternatives to animal models are necessary or available	
iii. whether proposed methods/techniques are acceptable in terms of the level of risk to the animal subject's life or well-being	
iv. whether techniques to be applied in the project has been refined through planning and pilot studies	

v. whether the trial/survey is statistically valid (i.e. not wasteful of its animal subjects)	
vi. whether treatments and/or clinical procedures applied and/or surgery done to animals are justifiable and humane	
vii. whether vertebrate animal capture techniques (including drugs used where applicable) is appropriate and humane	
viii. whether systems and techniques for the handling of animals during research is appropriate and humane	
ix. whether facilities for the handling and housing of restrained/captive animals are appropriate, adequate and humane	
x. whether there is adequate planning in the event of emergencies or in the case of unexpected results which may cause unnecessary and excessive pain and suffering to the animals	
xi. whether methods proposed to handle carcases of animals that die during the period they are in the care of the applicant are adequate and appropriate	
xii. whether proposed methods of euthanisation (including any proposed pest extermination methods) are justifiable and humane	
xiii. whether the experience and qualifications of the researcher and his/her assistants is adequate and appropriate for the proposed techniques (including the administration of any drugs)	
xiv. whether all drugs that are to be used in the proposed techniques are accompanied by the appropriate prescription forms	
xv. whether veterinary supervision/consultation is necessary and if so, adequate	
xvi. whether the applicant and his/her co-workers and assistants are familiar with standard guidelines for the ethical manipulation and care of experimental animals and the laws governing these	

Author: TD Wassenaar, CERU, Dept Zoology & Entomology, University of Pretoria, Pretoria, 0002

COMMENTS:

____________________________ __________________________

HEAD OF ETHICS COMMITTEE DATE

Appendix 2

DELIVERABLES

(SANAP-RELATED ONLY)

A. CURRENT SANAP RESEARCH CYCLE: 1 April 2001 – 31 March 2005

Kindly indicate what the expected deliverables of your project will be for the duration of the current research cycle, including the one year extension, with respect to the following:

- Number of Honours, MSc and PhD students expected to be trained/obtained *(if in progress, please list name, degree and year of completion – add further lines if necessary)*

Honours 0

MSc 0

PhD 0

NAME	DEGREE	YEAR

- Estimated number of scientific publications to be published in accredited scientific journals

1

- Estimated number of scientific papers to be presented at local and international conferences

LOCAL 1
INTERNATIONAL 1

- How and to what level you intend enhancing transformation/capacity building/representivity levels in your project

Revision of the Prince Edward Islands Management Plan is essentially a desk-top exercise, with relatively little scope for capacity building, etc. However, it is intended to attempt to involve all members of the Prince Edward Islands Management Committee in the revision, by commenting on drafts and by attending the planned workshop. Several of the current PEIMC members have not as yet visited the Prince Edward Islands and their involvement will thus be a learning process for them.. Approaches will also be made to past and current field researchers (both biologists and field assistants) from Marion Island for their input.

- The project's contribution to the public understanding of Science and Technology

A management plan is a readily understandable document to the layperson which synthesises and interprets a large amount of ecological information. By writing popular articles, undertaking media (press) interviews and "writing for the web" the revision of the plan will be brought to the attention of the public in a way that it will see the conservation value of its tax Rand that is spent on research at the Prince Edward Islands.

B. <u>PREVIOUS SANAP RESEARCH CYCLES: All previous cycles up until 31 March 2001</u>

If you have previously received SANAP funding, please indicate the following for <u>ALL previous SANAP research cycles</u>:

- Number of scientific papers published in accredited journals from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please attach complete list)*

A total of 252 scientific papers has been published in the primary literature emanating from research conducted with SANAP support during the period that I was a SANAP Antarctic Officer employed at the FitzPatrick Institute, University of Cape Town from the mid 1980s to the mid 1990s. A complete list is not readily available (but see South African National Reports to SCAR for the period).

- Number of completed Honours, MSc and PhD degrees from members of your group from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please list name, degree and year of completion – add further lines if necessary)*

Honours 0

MSc 4

PhD 5

NAME	DEGREE	YEAR
Andrew M. Griffiths	MSc	1982
Michael Schramm	MSc	1984
Ron W. Abrams	PhD	1985
Peter G. Ryan	MSc	1986
Christopher R. Brown	PhD	1987
Nigel J. Adams	PhD	1990
Susan Jackson	PhD	1990
Peter G. Ryan	PhD	1992
Louise Coetzee	MSc	1996

REVISION OF THE PRINCE EDWARD ISLANDS MANAGEMENT PLAN (PHASES ONE AND TWO)

Literature summary

AUSTRALIAN ANTARCTIC DIVISION 1995. *Heard Island Wilderness Reserve Management Plan.* Kingston: Australian Antarctic Division. 72 pp.

AUSTRALIAN FISHERIES MANAGEMENT AUTHORITY 1998. *Heard Island and McDonald Islands Fishery Management Policy 1988-2000.* [Canberra]: Australian Fisheries Management Authority. 64 pp. +14 attachments.

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BOSHOFF, J.J., HART, D. & LOOCK, J. 1997. *Survey of historical sites on Marion Island.* [No publication details]. 44 pp.

CHOWN, S.L. & COOPER, J. 1995. *The impact of feral House Mice at Marion Island and the desirability of eradication: report on a workshop held at the University of Pretoria 16-17 February 1995.* Pretoria: Directorate: Antarctica & Islands, Department of Environmental Affairs and Tourism. 18 pp.

CHOWN, S.L., McGEOCH, M.A. & MARSHALL, D.J. 2002. Diversity and conservation of invertebrates on the sub-Antarctic Prince Edward Islands. *African Entomology* 10: 67-82.

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DEPARTMENT OF CONSERVATION 1997. *Subantarctic Islands Heritage. Nomination of the New Zealand Subantarctic islands by the Government of New*

Zealand for inclusion in the World Heritage List. Wellington: Department of Conservation. 76 pp.

DEPARTMENT OF CONSERVATION 1998. Conservation management strategy. Subantarctic islands 1998-2008. *Southland Conservancy Conservation Management Planning Series* No. 10. 113 pp.

DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM 2001. *Prince Edward Islands World Heritage nomination*. Pretoria: Department of Environmental Affairs and Tourism. 88 pp. + 8 appendices.

DEPARTMENT OF PARKS, WILDLIFE AND HERITAGE 1991. *Macquarie Island Nature Reserve Management Plan 1991*. Hobart: Department of Parks, Wildlife and Heritage. 57 pp.

DEPARTMENT OF THE ENVIRONMENT, SPORT AND TERRITORIES 1996. *Nomination of Macquarie Island by the Government of Australia for inscription on the World Heritage List 1996*. [Canberra]: Department of the Environment, Sport and Territories. 95 pp. + inserts and video.

DEPARTMENT OF THE ENVIRONMENT, SPORT AND TERRITORIES 1996. *Nomination of Heard Island and McDonald Islands by the Government of Australia for inscription on the World Heritage List 1996*. [Canberra: Department of the Environment, Sport and Territories]. 78 pp. + inserts and video.

DE VILLIERS, C.C. Year? *An evaluation of management measures to control invasive organisms during annual takeovers at sub-Antarctic Marion Island*. M. Phil. thesis, University of Cape Town. 55 pp.

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JOHN COOPER

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PROJECT PROPOSAL - APPLICATION FOR FUNDING AND LOGISTIC SUPPORT Doc 5.9

1. SUBMISSION OF THIS APPLICATION

Please submit this application to:

SANAP PROJECT PROPOSAL
c/o Department of Environmental Affairs and Tourism
Directorate: Antarctica and Islands
Private Bag X 447
PRETORIA
0001

ATTENTION: Carol Jacobs (Rm 831)

Applications must be submitted by no later than 30 June 2003.

All applications must be signed by the Applicant, Project Leader, Head of Department and the Head of the Organisation, before forwarding to the Department of Environmental Affairs and Tourism (DEAT). All proposals will be treated as tenders and will be opened together soon after the closing date of 30 June 2003.

We regret that late or incomplete applications will not be considered.

2. MAJOR DISCIPLINE IN WHICH THE RESEARCH/STUDY WILL BE UNDERTAKEN

Space Geodesy, Oceanography, Meteorology, Mapping

3. TITLE OF PROJECT

SADC GPS and Earth Monitoring Network: Marion Island Node

3.1 DURATION OF PROJECT: 2004 TO 2024

4. CATEGORY OF PROJECT PROPOSAL

(a) First proposal

Summary of the literature:
The South African network of dual-frequency GPS receivers is described as a national asset with many applications and research opportunities (Cilliers et al., 2003). The proposed installation at Marion Island is part of a project (SADC GPS and Earth Monitoring Network) which is an extension and enhancement of the South African network to the SADC region and will allow the SADC region, inclusive of its mapping authorities and universities to participate and benefit from modern Space Geodetic techniques (Combrinck et al. 2003). GPS as a scientific tool is used in global networks for a multitude of applications, amongst which navigation, precise positioning, timing

applications, plate tectonics and crustal deformation, total electron content and integrated water vapour monitoring, orbit enhancement, earth orientation parameters, mapping, land management, and calibration of tide gauge sites are but some examples (Bevis et al., 1992, Soler et al., 1992, Chen et al., 2001, Jakowski et al., 2001).

Although there is an existing global network, the stations show a geometrical bias towards the northern hemisphere and the more affluent countries. Installation of such a system at Marion Island collocated with a tide gauge will greatly improve network geometry in the southern hemisphere, with benefits extending to the SADC region and the international scientific community. (Combrinck, 2002)

For a review on the status of tide gauges in Africa, see for instance Aarup et al., 2002. (http://unesdoc.unesco.org/images/0012/001251/125140e.pdf).

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5. KEYWORDS BY MEANS OF WHICH THE PROJECT CAN BE IDENTIFIED

geodesy
tide gauge
GPS
meteorology
sea level

6. RESPONSIBLE PROJECT LEADER (AND CO-LEADERS)

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7. PARTICULARS OF APPLICANTS

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Date of birth	1960/09/05
Citizenship	RSA
Are you a South African citizen?	Yes
Occupation	Research Scientist
Employer	National Research Foundation
Department/Institution	Hartebeesthoek Radio Astronomy Observatory

8. QUALIFICATIONS

Highest qualification	Ph.D.
Where obtained	University of Cape Town
Date obtained	2000

Will the research be used to obtain a degree No

8.1 Please attach details of previous experience in Antarctica, Marion and Gough Islands and the Southern Ocean.

None.

9. SCIENTIFIC PUBLICATIONS

As this project is an international effort with a large number of participants, which includes local government departments and foreign institutions, we attach a list of selected publications of only one applicant (the project leader).

SELECTED REFEREED JOURNAL PUBLICATIONS:

1. Combrinck, W.L. and Merry, C. 1997. Very Long Baseline Interferometry Antenna Axis Offset and Intersection Determination Using GPS. *JGR, Vol. 102, No. B11, pp 24,741-24,743.*
2. Combrinck, W.L. and Chin, M. 2001. IGS Stations: Station and Regional Issues, *Phys. Chem. Earth (A), Vol. 26, No. 6-8, pp.539-544.* Proceedings of the first COST Action 716 Workshop "Towards operational GPS meteorology" and the second Network workshop of the International GPS Service (IGS), Oslo, Norway, July 2000, guest editors H.-P. Plag, S. Barlag, M.Caissey, L.Combrinck, G. Elgered, A.Moore, H van der Marel.
3. Cilliers P. J., Gouws D., Opperman B., Wonnacott R.T. and Combrinck, L. (2003). The South African network of dual-frequency global positioning system satellite receiver base stations: a national asset with many applications and research opportunities. *SA. J. Science.* **99**, 12, pp. 51-55.

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1. Combrinck, W.L. and Schmidt, M. 1998. Physical Site Specifications: Geodetic Site Monumentation. *IGS Network Systems Workshop*, proceedings, November 2-5, 1998, Annapolis, USA.
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2. Combrinck, L. 2001. Hartebeesthoek Radio Astronomy Observatory (HartRAO), *in International VLBI Service for Geodesy and Astrometry 2000 Annual Report*, edited by N. R. Vandenberg and
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3. Combrinck, L. 2001. HartRAO. IGS Regional/Operational Center Report, *International GPS Service 2000 Technical Report*, edited by K Gowey, R. Neilan, A.Moore, 2001.
4. Combrinck L, and Haupt W.2002. HartRAO MOBLAS-6 station report, in *International Laser Ranging Service 2001 Annual Report.*, 2002.
5. Combrinck, L. 2002. Hartebeesthoek Radio Astronomy Observatory, in *International VLBI Service for Geodesy and Astrometry 2001 Annual Report*, edited by N. R. Vandenberg and K. D. Baver, NASA/TP-2002-21001, 2002.

10. SUMMARY OF FINANCIAL REQUIREMENTS

	Received for current year 20___	This Application 2004	Future Application/s 20___ 20___
Manpower costs		R 0.00	
Running expenses		R 0.00	
Capital equipment		R 0.00	
TOTAL		R 0.00	

This project is funded by HartRAO and its collaborators. We do not need additional funding for personnel or equipment, only logistical support.

10.1 Which organization will be responsible for the administration of the funds?

Hartebeesthoek Radio Astronomy Observatory

11. OBJECTIVES AND RATIONALE (NEED AND PURPOSE).

Objectives:

- Establishment of a permanent Global Positioning System (GPS) station as part of the IGS (International GPS Service) and SADC GPS and Earth Monitoring Network.
- Collocation of GPS system and tide gauge.
- Installation of radar tide gauge on cliff as part of Global Sea Level Observing System (GLOSS). This station's data will be used for applications to climate, oceanographic and ocean level research.
- Installation of meteorological unit.
- Geodetic footprint.

Rationale:

- The GPS system will dramatically improve the global GPS network geometry by occupying a site in a remote region which currently represents a major gap in the global distribution of sites. A similar rationale applies to the tide gauge and real-time met unit.
- This tide gauge will form part of the Global Core Network to provide an approximately evenly distributed sampling of global coastal sea level variations. Long-term trends and acceleration in global sea level will be monitored, and long term climate changes will be studied.
- This integrated system, consisting of GPS, meteorological unit and tide gauge, will provide near real-time data for monitoring earth and ocean tides, local meteorological parameters and total electron content.
- Determination of vertical and horizontal motion of Marion Island in the International Terrestrial Reference Frame (ITRF)
- Calibration of ocean level changes and separation of vertical signal due to crustal motion or long-term ocean level changes.
- Results from this station will be incorporated into numerical weather prediction models in collaboration with the South African Weather Services (SAWS), to enhance weather prediction capability in the SADC region.
- The geodetic footprint will provide three dimensional baselines between the previous CDSM surveying benchmarks, the French DORIS system (existing), the tide gauge and new GPS. This will provide a first order network for Marion Island crustal stability studies on a local scale.

12. PARTICULARS OF A PILOT OR FEASIBILITY STUDY THAT HAS BEEN UNDERTAKEN.

A pilot study has been done (at HartRAO) to determine precipitable water vapour in near real-time using the existing SADC GPS Network, which will be extended to include Marion Island's data. An example preliminary result of the pilot study can be seen on the front page of the January/February 2003 issue of the SA Journal of Science. The results of the pilot study are very encouraging, however it clearly demonstrates the need to increase the spatial coverage. A GPS installation on Marion Island would greatly improve the usefulness (and eventual implementation for weather prediction enhancement) of the water vapour project.

Global ionospheric maps are determined on a near real-time basis by the University of Bern and JPL (in collaboration with HartRAO) using data from about 150 GPS sites of the IGS and other institutions. Five of these stations have been installed by HartRAO. From Figure 1 it is quite apparent that a large gap exists between Africa and Antarctica, Gough and Kerguelen, which will be filled if a GPS station is installed at Marion Island. Currently the vertical total electron content (TEC) is modelled in a solar-geomagnetic reference frame using a spherical harmonics expansion up to degree and order 15. In order to convert line-of-sight TEC as derived from GPS measurements into vertical TEC, a modified single-layer model mapping function approximating the JPL extended slab model mapping function is introduced.

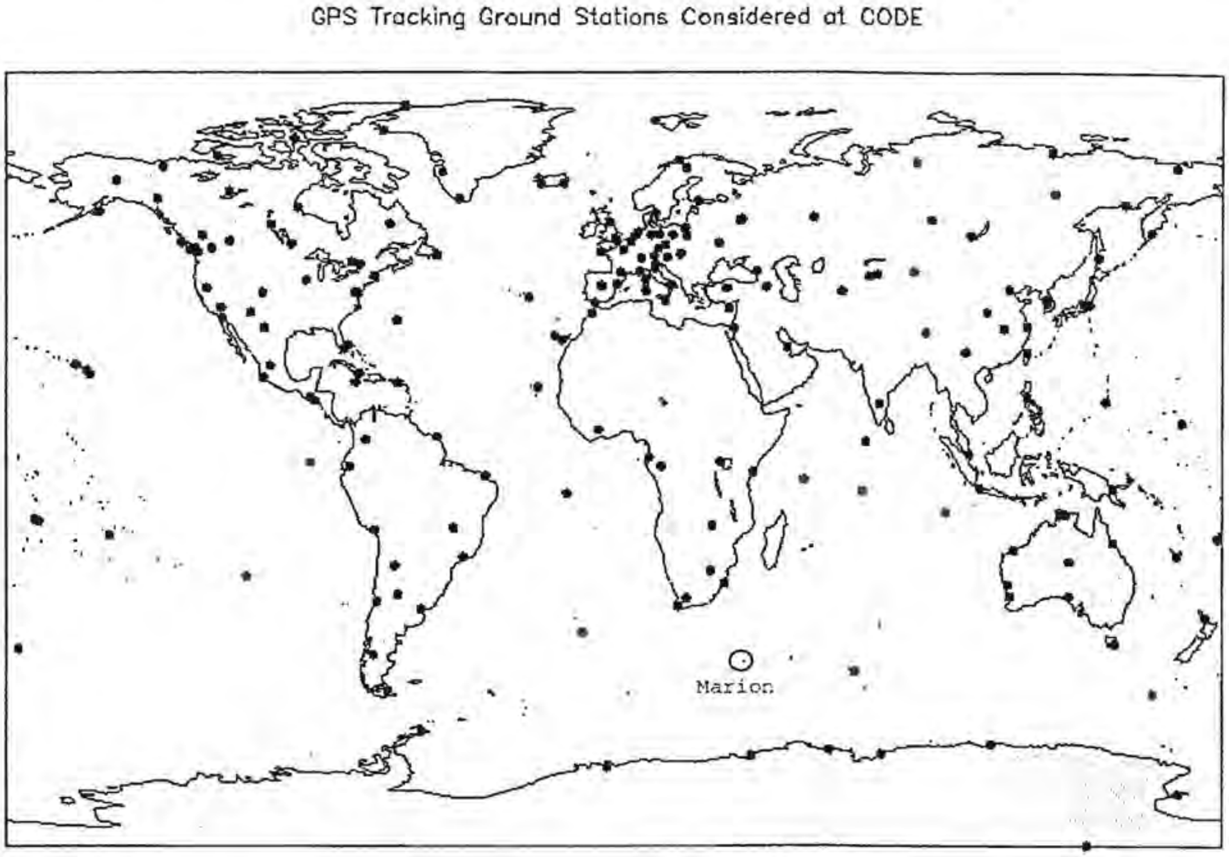

Fig 1. GPS stations used for TEC maps. HartRAO has installed stations at Simonstown, Sutherland, Richardsbay, Lusaka and Hartebeesthoek. A GPS station at Marion Island will provide much needed data for TEC monitoring over the Southern Ocean. The same network is being used for near real-time precipitable water vapour monitoring.

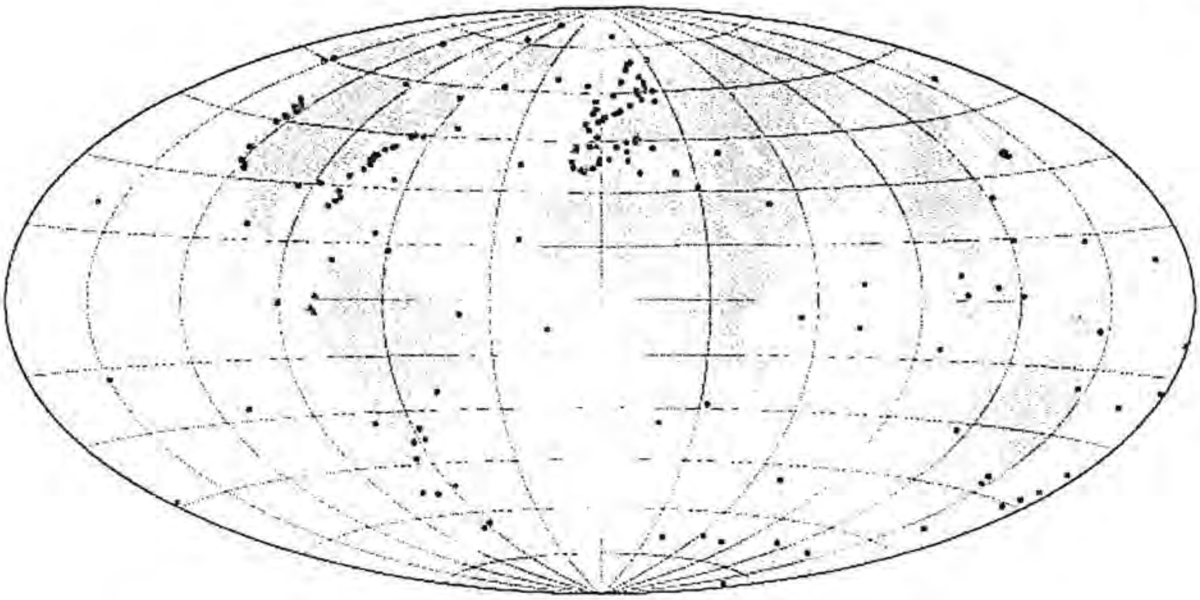

Fig. 2. A similar map, but for the case of GPS systems collocated with tide gauges. Again, note the open spaces in the Southern Oceans, indicating the need for a tide gauge at Marion Island.

A pilot study "Tide gauge at GPS" (TIGA) under the auspices of the International GPS Service (IGS) is currently underway and has several international collaborators. HartRAO is a TIGA Associate Analysis and Data Centre, see for instance http://www.hartrao.ac.za/geodesy/web_TIGA/index.html. The objective of TIGA is to establish a global network of long term tide gauge plus GPS installations which will be used to correct the ocean level time series for crustal vertical motion. The routine computation, establishment and maintenance of these new geodetic ties to tide gauge systems will be an important contribution to climate change studies (global warming, polar cap size reduction etc.).

13. KEY QUESTIONS AND RESEARCH APPROACH

- Is the tectonic motion of Marion Island tied to the African plate or the Antarctic plate? This will be determined by processing GPS data in a global network of International GPS Service (IGS) GPS stations, including IGS stations installed throughout the SADC region.
- Is the east African rift expanding and extending into the southern ocean region? Rift expansion will indicate active splitting of the African plate into the Nubian and Somalian plates. Having a GPS station at Marion Island will provide additional information on constraining parameters, which will facilitate these measurements.
- Can the effects of global warming be seen in the southern oceans? In the context of global networks of GPS systems and tide gauges, and in particular the TIGA (Tide gauge at GPS) network, accurate determination of a global increase in ocean level can only be obtained by collocation of GPS and tide gauges. This proposed station at Marion Island will provide the local and international research community with data that up to present, has not been available.
- Can weather predictions over the southern part of Africa and the southern oceans be improved by the assimilation of total integrated water vapour content into numerical

weather prediction models? The combination of real-time GPS and meteorological data can be used to determine the water vapour content of the atmosphere at Marion Island on a near real-time basis for inclusion into numerical weather prediction models.

- Can the total electron content of the ionosphere over the southern oceans be represented adequately by the combination of GPS data from Gough, Marion and Kerguelen Islands? Using dual frequency data from GPS stations and advanced processing software, total electron content can be calculated. The TEC data will be utilised by international working groups for producing near real-time TEC maps, a very useful product for HF communications predictions and research.

13.1 Please provide an indication of the unique multi-disciplinary nature of the research.

The combination of GPS, tide gauge and meteorological data allows one to apply these data to many different fields of research, not only in a local context, but in a global context.

- GPS data is used for:
  - International Earth Rotation Service (IERS) parameters, e.g. instantaneous orientation of the earth axis, polar motion and the rapid variations of universal time.
  - GPS data will provide an independent measurement of space geodetic parameters, which can be used to verify results obtained from satellite laser ranging and very long baseline Interferometry (VLBI).
  - Detection of crustal motion, which aids understanding of geophysical and geological models as well as the development of new geodynamic models.
  - Determination of earth tide, which, in turn, provides information of the parameters of the earth's crust such as elasticity and rheological properties.
  - Atmospheric studies of the variation of the total tropospheric delay of radio waves and the integrated water vapour content.
  - GPS is the most cost-effective method of densifying the international terrestrial reference frame (ITRF).
  - This GPS station located at Marion Island will provide an ITRF reference point for Marion Island and all future mapping and GIS projects will use it as the main reference point. It will provide data for other projects on the island, which utilises GPS data for precise point positioning.
- Tide gauge data have many scientific and practical applications, see for example http://www.pol.ac.uk/psmsl/training/gloss.pub.html:
  - Long term ocean level monitoring.
  - Short-term storm surge and ocean current effects.
  - Monitoring the effects of global warming due to ocean water expansion and ice cap melting on ocean levels.
  - In turn, this data provides parameters for angular momentum exchange between the solid earth and the oceans.
  - Of great concern to Africa is the El Niño-Southern oscillation phenomenon which causes sea level changes in the Pacific and Indian Ocean and which is correlated with fluctuations in global weather patterns.
  - Long-term changes in global sea level have potential environmental, social and economic consequences for coastal zones.
- Meteorological unit in collocation with GPS station will provide data to be used for:
  - Long-term climatological studies.
  - Near real-time weather predictions, see for instance http://kreiz.unice.fr/magic/.

14. PROPOSED WORK PLAN

Installation of the equipment will be done by a team of three staff members of HartRAO, each member having an area of expertise required for successful installation and to ensure operational success. Three people are necessary as apart from advanced technical and software issues, the physical requirements of these installations, especially the tide gauge, will require sufficient manpower for reasons of safety and practicability.

1. **Installation of the GPS system and meteorological unit:** The GPS system must be located in close proximity to the tide gauge. The GPS system consists of a choke ring antenna, which must preferably be located on bedrock. If exposed bedrock is available, this will entail drilling three holes into the rock to enable fixing of a stainless steel self-centring monument for mounting the antenna. This installation has minimal environmental impact. The antenna can be situated up to 50 metres away from the receiver. In practice, to minimise maintenance problems and accessibility issues, it is more convenient to use a wireless modem to transmit data from the GPS receiver to a PC located in a suitable building. Therefore in order to minimise environmental impact and visibility we would install the GPS receiver in a hermetically sealed box, self-contained with adequate battery back-up and solar/wind charger, next to the antenna and wireless modem equipment. Installation of the PC (LINUX operating system) is straightforward. The PC will be provided with a UPS, wireless modem master unit, and a small antenna, which will provide data communications with the GPS equipment. The PC will be connected to an existing VSAT link at the base.

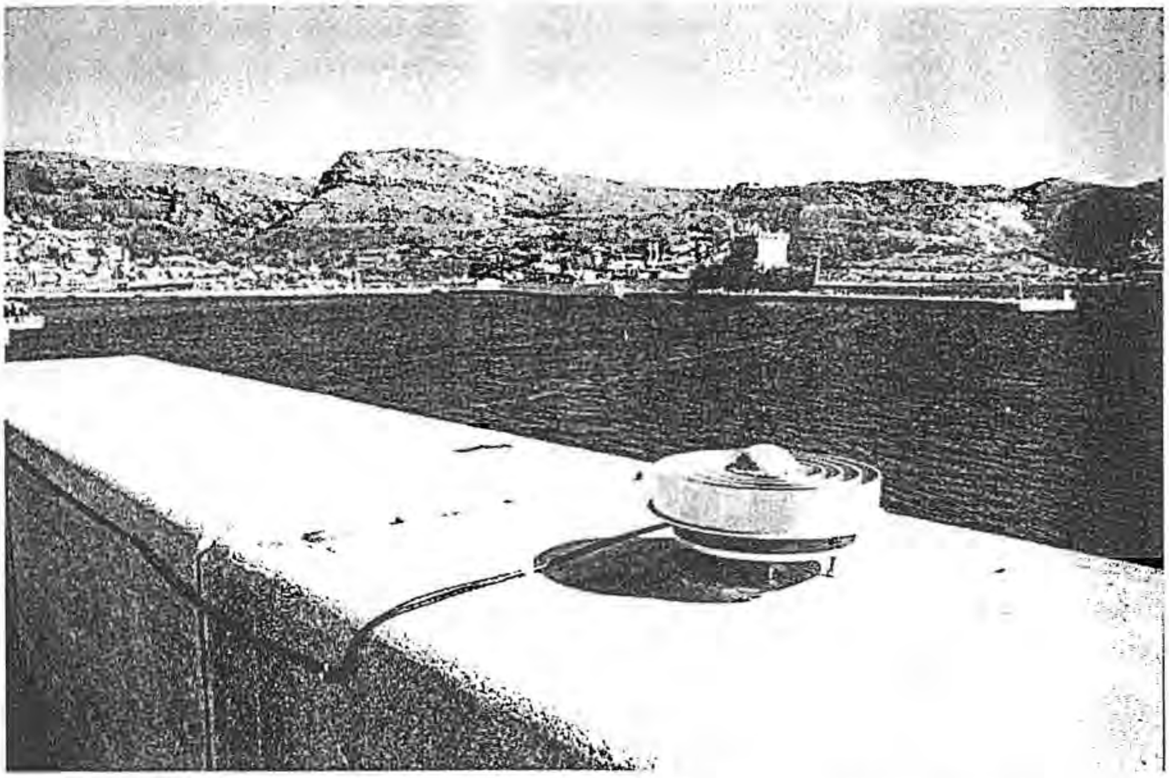

Fig. 3. The choke ring GPS antenna at Simon's Town. The installation at Marion Island will require the antenna to be mounted on a short stainless steel pole, bolted to rock. This antenna will be located as close as possible to the tide gauge and meteorological unit for collocation purposes.

2. **Installation of the tide gauge:** An Ott radar tide gauge will be installed. This will allow the tide gauge to be installed out of the water and waves; waves resulted in the destruction of a previous tide gauge installation on Marion Island. A stainless steel extendable boom will have to be bolted down on suitable rock, which will allow clear access to the ocean. The design of this extendable boom will be such that it can be adjusted to suit local requirements. A suitable site will only be located once we are on the island. The tide gauge will be connected to the GPS and wireless modem to transmit data to the remote PC located in a building.
3. **Geodetic tie between existing DORIS and Trig reference points:** Accurate baseline measurements between the existing French DORIS system, the new GPS system, tide gauge benchmark and existing trig beacon benchmarks will be done to determine a first-order "footprint" which will facilitate crustal stability studies on Marion Island. Reoccupation of these points during subsequent years will provide information on the crustal dynamics of the island, e.g. whether any slow tilting is present.
4. **Upload of data:** Data will be uploaded from the PC to the Hartebeesthoek Radio Astronomy Observatory on a near real-time basis. It will be stored on an archive system, which will allow immediate access to the data by the local and international scientific community.
5. **Processing of data:** Data will be processed at HartRAO, and at global processing centres at JPL (NASA's Jet Propulsion Laboratory), University of Bern (Germany), GFZ Potsdam (Germany), University La Rochelle (France), Indonesian National Coordination Agency for Surveys and Mapping, Finnish Geodetic Institute, European Reference Frame Subcommission, Australian Surveying and Land Information Group, South African Chief Directorate: Surveys and Mapping, Deutches Geodätisches Forschungsinstitut (Germany), Natural Resources Canada and several other university and research institutions. Processing of data will occur continuously and indefinitely as the nature of the installation is for long-term measurements (several decades or longer).

14.1 Is this project a co-operative/collaborative project. Please provide summary information on the associated projects and discuss the role of this project in the total programme.

This project is a collaborative project between HartRAO, Chief Directorate: Surveys & Mapping (South Africa), GFZ Potsdam (Germany), The Hydrographer: SA Navy, University of Cape Town, Southern Ocean Sea Level Centre (Flinders University of South Australia), and the Jet Propulsion Laboratory (NASA). A multitude of international institutes and universities will participate in the data reduction. The data will be useful to other projects within SANAP. We would encourage assimilation of the data as additional parameters wherever possible. The data will be particularly useful for meteorological studies, oceanography and geodynamics, geology, geophysics, as well as the existing upper atmospheric projects within SANAP.

It is clear that this project will contribute to the following existing research directives of SANAP:

- Earth Sciences: Geomorphology of Marion Island
- Physical Sciences: Atmospheric Physics

15. **WILL THE PROJECT LEADER BE AWAY FOR ANY SIGNIFICANT PERIODS WHILE THE PROJECT IS IN PROGRESS?**

No.

16. END PRODUCT OF THE PROJECT

There will be more than one product resulting from this installation. Furthermore, some of the products will be produced continuously, e.g. precise GPS orbits, global velocity rates, earth rotation parameters, global total electron content maps, global integrated water vapour maps and earth tide maps. Longer term products will include scientific papers on Marion Island specifically, including tectonic motion in a global reference frame, tectonic motion relative to the Nubian/Somalian differential movement, local crustal stability of Marion Island, seasonal and secular integrated water vapour content over Marion Island, the impact of Marion Island GPS data on global TEC maps, calibrated ocean level monitoring at Marion Island using GPS and radar tide gauge technology. Popular publications will be produced from the installation phase throughout the scientific and applications phase, suitable for general public consumption and science awareness.

17. DISCUSS ANY POTENTIAL IMPACT YOUR STUDY WILL HAVE ON THE ENVIRONMENT AND DESCRIBE MITIGATING ACTIONS WHICH YOU PROPOSE TO MINIMIZE OR ELIMINATE THE IMPACT

The following guidelines are provided to assist applicants with questions relating to the potential environmental impact of a proposal.

(i) Proposals for the continuation of ongoing projects should state clearly if any changes are proposed in field methods, work programmes, camp sites, and timing from those documented in the original proposal, or subsequent modifications to it.

(ii) The proposer should list aspects of the proposed activity, that have not been noted, that might cause impacts on the Antarctic environment (e.g. visual impact or other forms of disturbance).

(iii) In making all these assessments of impact, the proposer should briefly consider the nature, duration and intensity of the likely environmental effects, including the following;

a. the existing environment, its variability or dynamic nature, resilience to change, sensitivity to disturbance, previous disturbance, protected status etc;

b. cumulative and possible indirect impacts;

c. the probability of accidents and their environmental consequences;

d. the adequacy of existing information and knowledge.

(iv) A map of the area should be included (sketch if necessary) to assist the interpretation of this section of the research application.

Proposers are expected to provide sufficient information in their answers to allow the DEA & T to make a thorough, complete and accurate evaluation of the environmental impact of the project. Insufficient information will require follow-up action and/or may prejudice the environmental acceptability of the project.

Preliminary Environmental Evaluation

Details of Activities

Answer all questions only if work is to be carried out in Antarctica or Marion Island during 2004.

If you answer "Yes" to any of these questions, a full description of proposed activity, including proposals for mitigating and monitoring these impacts, is required.

It is important that you provide maps detailing the proposed research areas (hand drawn sketches are acceptable).

As we do not yet know exactly where a suitable location for the installation will be, we cannot provide map type of details. The installation will have to be on a cliff face or edge, so that the radar tide gauge can access the water. The radar needs a 30 degree cone of clear visibility to the water, therefore the boom carrying the tide gauge will extend from the cliff for a couple of meters, depending on the height above the water. A suitable location will have to be found by on-site inspection. This site will have to be practical, minimise impact on the environment, but be safe for installation and future maintenance.

Will your objective:

a. Use a radionuclide? Yes [ ] No [X]

If Yes, complete the following:

Radionuclide	Chemical form	Quantity (Curies)	Half Life (Years)

Detail procedures you will take to ensure that no radiation will enter the Antarctic or sub-Antarctic environment from use or spillage.

____

____

b. Take any chemical to Antarctica or Marion Island?

Yes [ ] No [X]

If Yes, complete the following:

Chemical	Formula	Quantity	Use

Unused chemicals will be: [ ] Left at SANAE Base

☐ Returned to South Africa

☐ Other

If Other, detail disposal procedure:

c. Release any chemical to the Antarctic or sub-Antarctic Environment?

Yes ☐ No ☒

If Yes, detail the need to release, the chemical, the amounts involved and the location.

d. Require the use of explosives? Yes ☐ No ☒
If Yes, complete the following:

How will the explosives be used?

Detail any precautions taken to minimise disturbance to any wildlife or plants:

Explosive Type	**Number of detonations**	**Charges per detonation (kg)**	**Total weight (kg)**

e. Collect, capture, kill, restrain, tag or band any terrestrial, freshwater or marine plants or animals?

Yes ☐ No ☒

If Yes, complete the following:

For each species (apart from those taken using plankton nets or trawl), estimate the proportion of the local population you will be collecting, capturing, killing, tagging or banding. If restraining, include period of restraint:

Species	**Method**	**Number**	**Proportion of population (%)**

For each species, indicate the proportion of the local population you will be disturbing while carrying out the above activities.

f. Enter any Protected Area? Yes [ ] No [X]

If Yes, complete the following:

Name of Protected Area	Duration of Visit	Total person-days

Detail why the work must be carried out within the Protected Area:

g. Take to Antarctica or Marion Island any animal, plant (includes seeds), micro-organism or soil?

Yes [ ] No [X]

If Yes, complete the following:

Species	Quantity

Detail why these materials need to be taken to Antarctica:

Detail the quarantine procedures you will undertake to ensure that there is no release to the Antarctic environment:

h. Significantly disturb by flooding, sampling, trampling, camp operations or any other means any ice-free area (bare ground)?

Yes [ ] No [X]

If Yes, complete the following:

Briefly describe any such significant disturbance:

____

____

Detail any steps you will take to minimise such disturbance:

____

____

i. Take or remove any physical specimens eg. rocks, fossils etc?

Yes [ ] No [X]

If Yes, detail the general area and types of specimens to be collected:

Location	Specimen	Type	Total Number of Weight

j. Cumulative Impacts.

Occupy new or existing camp sites? [ ] New

[X] Old

[ ] Both old and new sites

If new, list these sites and indicate why a previously impacted site cannot be used.

____

____

Will you track previously untracked ground?

Yes [ ] No [X]

If Yes, state why this is necessary:

Will you install equipment, markers, stakes, cairns etc. that will be left in the field?

Yes [X] No [ ]

If Yes, detail location and type of marker, stake etc:

Location	Type
Selected site on cliff close to new base	As discussed above, a GPS antenna, GPS receiver, tide gauge and meteorological unit will be installed. These will all be bolted to rock and will be elevated one and a half metres above gound level. The antenna is about thirty centimetres in diameter, so visual impact will be small. The mounting for the tide gauge will be made of tubular stainless steel and could be painted black for minimal visual impact.

k. Do you expect your activities to have an environmental impact not covered in the above?

Yes [ ] No [X]

If Yes, fully detail impacts:

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l. Is the proposed activity likely to have more than a minor or transitory impact?

Yes [ ] No [X]

If Yes, a CEE will be required:

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18. FINANCIAL REQUIREMENTS

18.1 MANPOWER

Name, qualifications, past experience and function in this Project	Time available for this project (% of full-time man-year)	Nature and Source of non-SANAP funding	Amount requested from SANAP
Dr. L Combrinck (Ph.D) Has been involved in Space Geodesy since 1989 Project Leader	20%	NRF / JPL / GFZ	R 0.00
Mr. A Combrink (B.Sc. Hons) M.Sc. researcher in GPS applications Data reduction and scientific interpretation	20%	NRF / JPL / GFZ	R 0.00
Mr. P Stronkhorst (qualified mechanical technician) Has previous experience of installing GPS stations in the SADC region Hardware and mechanical support	20%	NRF / JPL / GFZ	R 0.00
Total			R 0.00

18.2 RUNNING EXPENSES

Items	Nature and source of non-SANAP funding	Funds requested From SANAP
Transport (sea, air and land with distances and rates)	NRF	R 0.00
Subsistence (nature and rates)	NRF	R 0.00

Supplies and services (please specify)	NRF / JPL / GFZ / CDSM	R 0.00
Total		R 0.00

18.3 CAPITAL EQUIPMENT

Description of item and total cost	Non-SANAP Funding	Non-SANAP application	Amount requested from SANAP
GPS receiver & ancillaries Tide gauge Meteorological unit Wireless modem	R 300 000.00 R 60 000.00 R 30 000.00 R 20 000.00	R 0.00 R 0.00 R 0.00 R 0.00	R 0.00 R 0.00 R 0.00 R 0.00
Total	R 410 000.000	R 0.00	R 0.00

18.4 LOGISTIC SUPPORT

Volume and mass of cargo: 6 m^3 and 400 kg

Description of cargo:
Crated PC, GPS receiver and antenna, wireless modem and antennas, radio communication equipment, meteorological unit, tide gauge, monumentation, tools for installation purposes, stainless steel tubular sections for GPS and tide gauge monumentation and boom, portable generator, jerry can for generator fuel. The tubular sections will be 3 metre lengths.

Destination where cargo is required:
Marion Island.

Radio-active and other hazardous cargo:
Petrol for generator (jerry can).

Accommodation requirements
Ship:
Number of persons 3
Period 3 March 2004 to 5 May 2002

Base: (it would be essential to stay at the base)
Number of persons 3
Period March 2004 to May 2004

Ship's time required:
Sampling locations at sea:
None.

Laboratory requirements (ship):
None.

Laboratory requirements (base):
Permanent location for PC and wireless modem base station, close to LAN connecting point.

Type of equipment requiring deployment from ship:
Small boat needs (locality and time):
For reconnaissance of coastline close to base, availability of a rubberduck will be useful, shortly after arrival.

Surface vehicle needs:
None.

Helicopter support (describe fully e.g. time, locality, special requirements):
None.

Camping equipment
None

Special equipment:
None

Protective clothing
None

List any special requirements:
None.

Please list any special needs:
None.

19. PARTICULARS OF RESEARCH/STUDY ABROAD

Not applicable.

19.1 Reasons why it is necessary to undertake the research/study abroad.

19.2 What arrangements have been made for overseas research/study?

19.3 Period that will be spent abroad

Date of departure: ______________

Date of return: ________________

19.4 Subsistence and transport
(Calculations should be made at the current public service rates.)

Place	Type of accommodation	No of days	Costs
Total			

19.5 Travel costs

Type of Transport	Destination	Distance	Costs
Total			

20. **STATEMENT BY APPLICANT**

I declare that the foregoing information is correct.

Signature ____________ Date 18 June 2003

21. **RECOMMENDATION BY THE RESEARCH OR EQUIVALENT COMMITTEE OF THE APPLICANT'S ORGANIZATION**

Chair ____________ Date ____________

I certify that the information contained in this application is correct and that if SANAP financial support is provided, it will be utilised in accordance with the conditions as laid down by the DEAT.

Project Leader ____________ Date 18 June 2003

Head of Department ____________ Date ____________

Head of Organization ____________ Date 18/6/2003
DIRECTOR
HARTRAO
J.L. JONAS

22. **COMMENT AND RECOMMENDATION BY SANAP**

Chair ____________ Date ____________

Appendix 1

ETHICAL REQUIREMENTS FOR RESEARCH ON THE PRINCE EDWARD ISLANDS
Questionnaire to be completed by reviewing ethical committee

This questionnnaire represents the minimum ethical requirements for research on the Prince Edward Islands. It is not intended as an alternative to the reviewing ethical committee's review process and guidelines, but as a supplement to it and as such represents a standardised format whereby the Department of Environmental Affairs and Tourism can ensure that research conducted on the Prince Edward Islands is of a high ethical standard.

The questionnaire is based on the National Code for the handling and Use of Animals in Research, Education, Diagnosis and Testing of Drugs and Related Substances in South Africa (1990) and expects of the reviewing committee to indicate whether certain aspects of the proposed projects have been reviewed by it or not. Please note that these questions are applicable only if the proposed project affects vertebrate animals. Where a question is not relevant, please indicate either *no comment, not enough information*, or *not applicable*. Space is provided below for comments on any of the questions. Please refer to the question number when commenting.

QUESTION	**REVIEWED** Indicate either Yes / No / No comment / Not enough information / Not applicable
Part 1. Professional detail regarding applicant and co-workers	
I Applicant name and affiliation	

II Whether the following information about persons responsible for applying proposed research techniques has been provided:	
i. names	
ii. qualifications (academic or technical)	
iii. description of each person's experience in proposed techniques	
III Whether the following information about other co-workers has been provided:	
i. names	
ii. qualifications	
iii. affiliation	

QUESTION	**REVIEWED** **Indicate either Yes / No / No comment / Not enough information / Not applicable**
Part 2. Ethical aspects with regard to proposed research project	
i. whether the project's contribution to the relevant scientific field justifies any possible pain or discomfort caused to animals during the course of research	
ii. whether alternatives to animal models are necessary or available	
iii. whether proposed methods/techniques are acceptable in terms of the level of risk to the animal subject's life or well-being	
iv. whether techniques to be applied in the project has been refined through planning and pilot studies	
v. whether the trial/survey is statistically valid (i.e. not wasteful of its animal subjects)	
vi. whether treatments and/or clinical procedures applied and/or surgery done to animals are justifiable and humane	
vii. whether vertebrate animal capture techniques (including drugs used where applicable) is appropriate and humane	
viii. whether systems and techniques for the handling of animals during research is appropriate and humane	
ix. whether facilities for the handling and housing of restrained/captive animals are appropriate, adequate and humane	
x. whether there is adequate planning in the event of emergencies or in the case of unexpected results which may cause unnecessary and excessive pain and suffering to the animals	
xi. whether methods proposed to handle carcases of animals that die during the period they are in the care of the applicant are adequate and appropriate	
xii. whether proposed methods of euthanisation (including any proposed pest extermination methods) are justifiable and humane	
xiii. whether the experience and qualifications of the researcher and his/her assistants is adequate and appropriate for the proposed	

techniques (including the admninistration of any drugs)	
xiv. whether all drugs that are to be used in the proposed techniques are accompanied by the appropriate prescription forms	
xv. whether veterinary supervision/consultation is necessary and if so, adequate	
xvi. whether the applicant and his/her co-workers and assistants are familiar with standard guidelines for the ethical manipulation and care of experimental animals and the laws governing these	

Author: TD Wassenaar, CERU, Dept Zoology & Entomology, University of Pretoria, Pretoria, 0002

COMMENTS:

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HEAD OF ETHICS COMMITTEE ______________ DATE ______________

Appendix 2

DELIVERABLES

(SANAP-RELATED ONLY)

A. CURRENT SANAP RESEARCH CYCLE: 1 April 2001 – 31 March 2005

Kindly indicate what the expected deliverables of your project will be for the duration of the current research cycle, including the one year extension, with respect to the following:

- Number of Honours, MSc and PhD students expected to be trained/obtained *(if in progress, please list name, degree and year of completion – add further lines if necessary)*

Honours → [ ]

MSc → [10]

PhD → [5]

NAME	DEGREE	YEAR
A Combrink	M.Sc.	2004
R Wonnacott	M.Sc.	2005
R Farr	M.Sc.	2005

- Estimated number of scientific publications to be published in accredited scientific journals

[10]

- Estimated number of scientific papers to be presented at local and international conferences

[ ]

LOCAL → 10

INTERNATIONAL → $\boxed{5}$

- How and to what level you intend enhancing transformation/capacity building/representivity levels in your project:

This station forms part of the SADC GPS network, which has as one of its objectives, training and empowerment through local expertise development throughout the SADC region. It is envisaged that SADC country universities and SADC surveyor generals (or delegates) will be involved in specialised training to allow processing of these data for research purposes and conversion of their countries' geodetic datums to the modern ITRF datum. This will allow development of reliable geospatial information frameworks in these countries, which are essential for the effective and economical spatial planning and execution of land-related projects (e.g. water supply, agriculture, land reform programs, infrastructure development etc.). Representivity is not only based on local (SA) or project team demographics, but on SADC demographics. See attached NRF/GFZ project description (SADC Earth and Ocean Monitoring Network).

- The project's contribution to the public understanding of Science and Technology:

Special effort will be made to publicise science and technology by utilising the installation period on Marion Island to operate a special event radio amateur station as two of the proposed team members are licensed radio amateurs. This special event station will be publicised in advance and an appropriate QSL card with pertinent information on the project and its scientific applications and benefits to society will be printed and distributed to radio amateurs worldwide who make contact with Marion Island. Furthermore, several popular articles on the event will be published before and after the station installation.

B. PREVIOUS SANAP RESEARCH CYCLES: All previous cycles up until 31 March 2001

If you have previously received SANAP funding, please indicate the following for ALL previous SANAP research cycles:

- Number of scientific papers published in accredited journals from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please attach complete list)*

  [ ]

- Number of completed Honours, MSc and PhD degrees from members of your group from your Antarctic/sub-Antarctic/Southern Ocean-funded research data *(please list name, degree and year of completion – add further lines if necessary)*

Honours → [ ]

MSc → [ ]

PhD → [ ]

NAME	DEGREE	YEAR
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____________	__________	______
____________	__________	______
____________	__________	______

Doc 6.2

-------- Original Message --------
Subject: PEI mgmt Plan
Date: Fri, 01 Aug 2003 09:22:20 +0200
From: "Rob Crawford" <Crawford@mcm.wcape.gov.za>
To: <jcooper@adu.uct.ac.za>

Dear John

As mentioned briefly, I believe it would be beneficial if the PEI Management Plan were adapted to allow (perhaps even mandate) a comprehensive survey of seabirds and seals at Prince Edward Island at least once every five years. The specified provision (section 9.2) for up to six persons for a maximum of six days is inadequate for this purpose. We were not able to conduct a comprehensive survey of all surface-breeding seabirds in six days and paid only cursory attention to the burrowing seabirds. Addiotionally, it would be useful to have two persons working on seals together. I suggest that every five years provision be made for a team of up to 10 people for up to 10 days to conduct a rigorous survey of the seals and seabirds at PEI. There should also be provision for a smaller ornithological survey every five years in July or August (for those species that do not breed in summer). In addition to counts, the surveys should aim to obtain other information of use to management (interchange of animals between islands, foraging ranges of species).

The considerably more frequent visits to PEI for non seal/seabird purposes calls into question whether it is really wished to restrict access to this island. Although I accept that occasional assessment of the status of flora and other fauna may also be important, perhaps other research should be conducted at Marion Island. I.e. perhaps research at PEI should be restricted to that needed to assess conservation status or for conservation management.

Sincerely

Rob