



SCAR Scientific Research Programme



External Performance Review

## State of the Antarctic Ecosystem



[www.scar.org/srp/anteco](http://www.scar.org/srp/anteco)

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## Introduction

The SCAR Scientific Research Programme - State of the Antarctic Ecosystem (AntEco) is designed to focus on past and present patterns of biodiversity across all environments within the Antarctic, sub-Antarctic and Southern Ocean regions. The broad objectives of the programme are to increase the scientific knowledge of biodiversity, from genes to ecosystems that, coupled with increased knowledge of species biology, can be used for the conservation and management of Antarctic ecosystems.

Through the development and maintenance of an international research network, AntEco aims to inform our understanding of current biodiversity and patterns therein, to distinguish the impact of present processes from historical signals, and to use this knowledge to develop scenarios of its future state through interdisciplinary approaches. While the scope of research activities supported are broad, research priorities are directed towards science that is policy relevant and assists in guiding management and conservation in the region.

AntEco is structured into five research sectors, each with a sector leader:

1. Spatial Ecology (Huw Griffiths, British Antarctic Survey, UK)
2. Molecular Ecology and Evolution (Jan Strugnell, La Trobe University, Australia)
3. Ecoinformatics and Systems Biology (Alison Murray, DRI, USA)
4. Paleoecology (Dominic Hodgson, British Antarctic Survey, UK)
5. Impacts, Trends and Conservation (Annick Wilmotte, University Liège, Belgium).

The AntEco Executive is comprised of the joint Chief Officers (Jan Strugnell and Huw Griffiths), joint Deputy Chief Officers (Don Cowan and Pete Convey), Secretary (Anton Van de Putte) and the research sector leaders (Alison Murray, Dominic Hodgson and Annick Wilmotte). The remainder of the Steering Group is comprised of leading researchers that, together, represent a broad range of countries and disciplines (Appendix 1).

## Deliverables and Milestones

### I. Up to five key achievements

#### 1) Scientific Outputs:

Ant-Eco members contributed to hundreds of peer reviewed publications over the last 3 years. Many of these are listed in Appendix II. Notable highlights include:

- Chown S.L., Clarke A., Fraser C.I., Cary S.C., Moon K.L., & McGeoch M.A. (2015) The changing form of Antarctic biodiversity. *Nature* 522(7557), 431-438. doi:10.1038/nature14505
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- Barnes D.K.A. (2015) Antarctic sea ice losses drive gains in benthic carbon drawdown. *Current Biology*, 25. R789-R790. 10.1016/j.cub.2015.07.042
- Constable, A.J., Melbourne-Thomas, J., Corney, S.P., Arrigo, K.R., Barbraud, C., et al. (2014): Climate change and Southern Ocean ecosystems I: How changes in physical habitats directly affect marine biota. *Global Change Biology*, 1-22, doi: 10.1111/gcb.12623.
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#### 2) The Biogeographic Atlas of the Southern Ocean:

The Biogeographic Atlas of the Southern Ocean (De Broyer C., et al [eds.] 2014. Biogeographic Atlas of the Southern Ocean. Scientific Committee on Antarctic Research, Cambridge, XII 498 pp) is a key resource for all scientists studying life in the Southern Ocean. It represents an unprecedented effort by AntEco and SCAR scientists to collate and interpret the largest database of Antarctic marine life

ever compiled. It is a collection of 66 syntheses describing the distribution patterns and processes of a significant and representative proportion of Southern Ocean organisms, illustrated by more than 800 distribution maps and 200 pictures and graphs. The Atlas is an important legacy of the International Polar Year 2007-2008 and a key output of the Census of Marine Life and SCAR-Marine Biodiversity Information Network. The Atlas was launched at the SCAR Meeting and Open Science Conference (Auckland, New Zealand August 25-28th 2014).

### 3) Support for the AntEco community:

AntEco has nurtured new collaborations through facilitating and funding workshops and meetings (see section V for details). It also seeks to encourage early career scientists (see section VI) through actions such as providing letters of support, travel funding and the provision of berths on an AntEco-led expedition to the Southern Ocean. AntEco regularly communicates with the community via the email list, website and the SCAR Biology Facebook page, providing information about funding opportunities, new scientific discoveries, upcoming meetings and deadlines (see section VII).

### 4) The Monaco Assessment:

A meeting of global biodiversity and specifically Antarctic experts, entitled 'Antarctica and the Strategic Plan for Biodiversity 2011-2020: The Monaco Assessment', was convened for three days in Monaco in May 2015, with the support of the Monaco government, the Centre Scientifique de Monaco, SCAR, and Monash University. Aleks Terauds and Pete Convey from the AntEco Steering Group attended this meeting. The purpose of the meeting was to examine the extent to which conservation of the biodiversity of Antarctica and the Southern Ocean is realizing the set of ambitions agreed for the world as part of the Strategic Plan for Biodiversity 2011-2020. The meeting aimed to develop guidance for action that can effectively help deliver further conservation successes for Antarctica and the Southern Ocean. One outcome was a statement on Antarctic and Southern Ocean conservation in the context of the Strategic Plan for Biodiversity 2011-2020 entitled 'The Monaco Assessment' ([www.scar.org/monaco-assessment](http://www.scar.org/monaco-assessment)). Findings were that the biodiversity outlook for Antarctica and the Southern Ocean appears to be no better than that for the rest of the globe, and while some areas are tracking well (e.g. non-native species management), other direct pressures on Antarctic biodiversity remain significant and require urgent attention. The assessment noted that prospects for effective action over the next five years to improve the outlook are exceptional.

## II. Primary publications in peer-reviewed journals

See Highlight 1 and Appendix II.

## III. Major reports, including linkages to major SCAR activities (e.g. advice to the Treaty or IPCC)

AntEco Steering Committee members are authors on chapters of the latest Intergovernmental Panel on Climate Change reports and also the United Nations World Ocean Assessment – a landmark publication resulting in, on the 23rd of December 2015, the General Assembly adopting resolution 70/235 on "Oceans and the law of the sea".

AntEco members have contributed to a range of content on the Antarctic Environments Portal (AEP) including non-native species, conservation and biodiversity. They also were invited to the Climate Change Content Development Workshop that drafted topic scoping summaries for the AEP (Cambridge 17-18 March 2015).

## IV. Other reports and grey literature

AntEco members contributed to the scientific background document in support of the development of a CCAMLR MPA in the Weddell Sea (Antarctica) – Version 2014. This report has been compiled by members of the German Weddell Sea MPA project team and by experts from other CCAMLR member states and acceding states. AntEco members contributed to the 1<sup>st</sup> SCAR Antarctic and Southern Ocean Horizon Scan published in *Antarctic Science* and highlighted in *Nature*.

## V. Workshops and other key meetings

AntEco convened five sessions at the SCAR–OSC in Auckland: i) Diversity and Distribution of life in Antarctica; ii) Impact of Past Glaciation and Climate; iii) Scientific Advice for Policymakers and Evidence-based Conservation; iv) Microbes Diversity and Ecological Roles; v) Diversity and Connectivity in Antarctica & Spatial Analysis of Antarctic Biodiversity. These sessions represent each of the research sectors in the AntEco implementation plan and were extremely well subscribed and attended. The sessions included over 70 oral presentations covering all aspects of AntEco work from the marine, lacustrine and terrestrial realms. The link between scientific research and design of management and conservation strategies by environmental managers and policymakers was also emphasized. In addition, AntEco also convened three well-attended and successful workshops during the OSC:

Workshop 1: Physical drivers of biodiversity at multiple spatial scales. Significant progress in the collation of biodiversity has been made since the meeting, with both marine and terrestrial datasets being consolidated. Analyses have begun on some specific marine taxa and terrestrial models are currently under development.

Workshop 2: Antarctic Aerobiology. A subsequent perspective article, led by David Pearce and entitled 'Aerobiology over Antarctica – a new initiative for a pan-continental sampling approach', has recently been published in *Frontiers in Microbiology*

Workshop 3: Eradication in Antarctica: Management and ecological considerations to inform conservation decision-making. A manuscript detailing the workshop findings is nearing completion.

AntEco convened an Antarctic Symposium at the joint Ecological Society of Australia and New Zealand Conference in Auckland (August 2013). Antarctic ecology was presented to a broad cross-section of the ecological research community.

AntEco supported a workshop in Dartington, England (2014): 'Moss-Dominated Ecosystems in Antarctica and surrounding regions: Past, Present and Future.' A manuscript detailing findings is in preparation.

AntEco supported and convened a session at the 2015 ISAES meeting in Goa, India, 'Key drivers of Antarctic biodiversity through the Cenozoic: the influence of climate, oceanography and tectonics'.

AntEco supported the 'Antarctic Near-Shore and Terrestrial Observation System' (ANTOS) workshop held in Hamilton, NZ, 18-19 August, 2015. A videoconference was organised each evening to inform and discuss with participants who could not travel to NZ.

AntEco also supported and co-convened the Interdisciplinary SCAR Cross-Program Workshop on Interactions between Biological and Environmental Processes in the Antarctic", Barcelona, Spain September 2015, along with AnT-ERA, ACCE and AntClim21 (see IX below)

AntEco supported a session at the VIII Southern Connection Congress 2016 in Chile.

AntEco members (Convey, Cowan) contributed to the SCAR Sub-Antarctic region Action Group meeting in Punta Arenas, 15-17 January 2016

## VI. Capacity building and education outreach activities; detail any difficulties encountered

The SO-AntEco expedition is providing spaces for 8 early career scientists to gain vital experience of Antarctic fieldwork. They will be included as authors of the official reports and summary publications of the cruise. The expedition will also use social media and the SCAR website to engage with the public and the wider scientific community. This cruise has a website (<https://www.bas.ac.uk/project/so-anteco/>), blog and Twitter feed (#SOAntEco). This expedition will also conduct live telephone conversations with schools and museums as well as answering questions sent in over Twitter.

The Biogeographic Atlas had a significant media impact, with over 60 media articles published online following the press release including ABC News (Australia) and the BBC news website. Radio interviews

included voice of Russia, RTE (Ireland) and the BBC World Service. Printed media included The Irish Times, El Mundo and the Independent (UK).

Several AntEco activities have had active outreach components including the ANDEEP SYSTCO expedition and its blog and the Scotia Arc Expeditions through the Australian Museum ([www.australianmuseum.net.au/scotia-arc-expedition](http://www.australianmuseum.net.au/scotia-arc-expedition)). The data from the Scotia Arc expeditions was subsequently used to create lesson plans for increasing participation in STEM disciplines for high school students (<https://ucsdcreate.wordpress.com/2013/12/20/doing-a-deep-dive-biology-teachers-explore-antarctic-invertebrates-at-sio/>).

## **VII. New data and/or meta-data (including plans for archiving)**

New data and/or meta-data associated with AntEco includes:

- The complete expert-validated database that was used to create the Atlas, including records from the continent to latitude 40°S, represents 1.07 million occurrence records for 9,064 validated species from about 434,000 distinct sampling locations. The database is publicly available on the SCAR-MarBIN/ANTABIF portal ([www.biodiversity.aq](http://www.biodiversity.aq)).
- New geomorphic interpretation of the Ross Sea region, based on the IBCSO bathymetry compilation. Analysis of benthic communities from seafloor communities on the Sabrina Shelf (120E).
- Metagenomic DNA from 20 soil samples has been sequenced (HiSeq). Metagenome sequence datasets (to be submitted to Biodiversity.aq) will provide information on total soil biodiversity (viruses/phage, prokaryotes, lower eukaryotes, invertebrates).
- datasets continue to be made available on mARS (Microbial Antarctic Resource System) [http://mars.biodiversity.aq/site\\_pages/datasets](http://mars.biodiversity.aq/site_pages/datasets)

## **VIII. Communication activities (eg website contents, social media, brochures, speaking engagements) and how these contribute to the promotion of SCAR and its mission.**

AntEco news is highlighted on our website (<http://www.scar.org/anteco/anteco-news>). We have documented activities that AntEco has supported over the last few years including conferences, workshops and future events such as the South Orkneys – AntEco cruise.

AntEco steering committee members set up and manage the “SCAR Biology” Facebook account on behalf of the Life Sciences SSG, <https://www.facebook.com/SCARBiology/>, this is a vital communication tool for reaching a wider audience, especially for early career researchers. It is currently followed by 280 people and this number continues to grow.

## **IX. Linkages to other SCAR groups, international programmes and other activities**

A SCAR cross-program workshop was held in Barcelona, Spain, 16-18<sup>th</sup> of September 2015. This workshop brought together participants from several SCAR and other related programs including AntEco, AnT-ERA, AntClim21, ICED, BEPSII, PAIS, EGBAMM, ICED, and IPCC and aimed to provide a forum for biologists and physicists to discuss the development of cross-disciplinary research to answer pressing questions in Antarctic science.

Jan Strugnell, the co-Chair of Ant-Eco, was invited to present a keynote lecture, titled ‘Evolutionary Patterns and Processes in Antarctica (and the Arctic) at the Gordon Research Conference (GRC) on Polar Marine Science held in Tuscany, Italy from 15-20 March, 2015. The theme of the conference was ‘Polar Shelves and Shelf Break Exchange in Times of Rapid Climate Warming’. The conference included 172 delegates from 23 countries.

Don Cowan was an invited participant to the SCAR/COMNAP Antarctic Roadmap Challenge meeting, Tromsø, Norway, August 2015. Pete Convey gave invited plenary lectures to the Southern Connections meeting in Chile in January 2016 and also to the 12<sup>th</sup> workshop on Systems Biology 2015 ‘From Big Data to Bioeconomy’ in Melbourne 18 May- 5 June, 2015.

## X. Expenditure on project activities and plans for unspent funds

Activity	Expenditure (USD)
Cross Program Workshop, Accommodation, Spain	\$3,371.88
Cross Program Workshop, Long Haul Travel, Spain	\$6,375.90
ANTOS Workshop, New Zealand	\$2,000
XVI COLACMAR-XVI Senalmar Meeting D. Deregibus	\$1,490.19
XII International Symposium on Antarctic Earth Science C. Gonzalez-Wevar	\$1,100
VIII Southern Connection Congress	\$5,000

All 2015 funds have been spent.

Future funds will be directed towards value adding to existing conferences (e.g. SCAR OSC, SCAR Biology) by supporting meetings and workshops that seek to build new collaborations and aim to address AntEco's objectives. We will continue to encourage and support early career scientists.

### Future Plans

AntEco will continue to build upon its achievements and support scientific collaboration and capacity building. The three overarching inter-disciplinary questions (outlined in our terms of reference) remain as important as when they were first written and align well with the themes of the 1<sup>st</sup> SCAR Antarctic and Southern Ocean Horizon Scan. We plan on continuing to use AntEco funding to facilitate scientific meetings and workshops and to encourage participation by early career scientists and those from regions with less well-developed Antarctic programmes.

SO-AntEco is a British Antarctic Survey (BAS) led expedition undertaken in conjunction with an international team of scientists from the Scientific Committee for Antarctic Research (SCAR) AntEco research programme. The team includes participants from 9 different countries and 16 institutes. The expedition will take place on board the BAS research ship the RRS James Clark Ross in early 2016. The SO-AntEco expedition will investigate the diversity of life both inside and outside of the SOISS MPA region in order to better understand the distribution and composition of the seafloor communities around islands. This work will lead to a series of scientific publications, public outreach and scientific advice to policy makers through written reports and presentations.

AntEco will play a very active role in activities associated with the Open Science Conference in Malaysia. AntEco members are playing a lead role in organising the following Mini Symposia:

*MS2. Connecting the biological and the physical: Environmental drivers of biodiversity in Antarctica. MS3. Linking Antarctic science with environmental protection: Celebrating the 25<sup>th</sup> anniversary of the Madrid Protocol.* In addition, several symposia at the OSC will be chaired by AntEco members including S22, S25, S28, S29, & S30.

In addition two side meetings supported by AntEco will take place at the OSC, "Spatial analyses of Antarctic biodiversity: sampling bias, environmental variables and statistical issues" (organized by Stefano Schiaparelli) and Harmonising Molecular and Functional Analyses of Antarctic Microbiomes: Toward A Methodological Framework for Understanding Ecosystem Functional Resilience (organised by Charles Lee).

In addition two AntEco members (Annick Willmotte, Anton Van de Putte) will directly participate in the organisation of the next SCAR Biology meeting to be held in Belgium in 2017.

## Appendix I - Membership

### Steering Committee

Last Name, First Name	Affiliation	Country	Email	Gender	Term	Position
Griffiths, Huw	British Antarctic Survey	UK	hjc@bas.ac.uk	M	2012 -	Chief Officer & Research Sector leader
Strugnell, Jan	La Trobe University	Australia	J.Strugnell@latrobe.edu.au	F	2012 -	Chief Officer & Research Sector leader
Convey, Pete	British Antarctic Survey	UK	pcon@bas.ac.uk	M	2012 -	Deputy Chief Officer
Cowan, Don	U. Pretoria	South Africa	don.cowan@up.ac.za	M	2012 -	Deputy Chief Officer
Terauds, Aleks	Australian Antarctic Division	Australia	aleks.terauds@gmail.com	M	2012 -	Chief Officer (2012-14)
Murray, Alison	Desert Research Institute	US	Alison.Murray@dri.edu	F	2012 -	Research Sector leader
Hodgson, Dominic	British Antarctic Survey	UK	daho@bas.ac.uk	M	2012 -	Research Sector leader
Van de Putte, Anton	University of Leuven	Belgium	antonarctica@gmail.com	M	2012 -	Secretary
Wilmotte, Annick	University Liège	Belgium	awilmotte@ulg.ac.be	F	2012 -	Research Sector leader
Lea, Mary-Ann	IMAS, U Tas	Australia	MaryAnne.Lea@utas.edu.au	F	2012 -	Steering Group member
Brandt, Angelika	U. Hamburg	Germany	Abrandt@zoologie.uni-hamburg.de	F	2012 -	Steering Group member
Cary, Craig	U. Waikato	New Zealand	caryc@waikato.ac.nz	M	2012 -	Steering Group member
di Prisco, Guido	U. Naples	Italy	g.diprisco@ibp.cnr.it	M	2012 -	Steering Group member
Gonzales-Wevar, Claudio	U. Chile	Chile	omeuno01@hotmail.com	M	2012 -	Steering Group member
Gutt, Julian	AWI	Germany	julian.gutt@awi.de	M	2012 -	Linkage with Ant-ERA
Avila, Conxita	U. Barcelona	Spain	conxita.avila@ub.edu	F	2012 -	Steering Group member
Schiaparelli, Stefano	U. Genoa	Italy	stefano.schiaparelli@unige.it	M	2012 -	Steering Group member

### Members

AntEco is open to any interested scientists. It has no official membership. The AntEco mailing list comprising a 'community' of 278 members.

## Appendix II - References

### 2013

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SCAR Scientific Research Programme  
External Performance Review



**Evaluation Form**  
  
**for**  
  
**SCAR Scientific Research Programmes (SRPs)**

**Note to reviewers:**

*When reviewing an SRP's capabilities, activities and outputs, please keep in mind that SRPs are managed by volunteers from the SCAR community and that they receive between 20,000 to 25,000 USD per year to facilitate/coordinate the activities that will allow them to fulfil their goals. Please also be aware that your reviews will be shared with the SRP chairs and the SCAR Delegates, and be made public on the SCAR website after September 2016. Your name will be kept confidential, unless you specify otherwise.*

*Reviewers should complete this page, expanding the text boxes where necessary, but should be kept to 3 A4 pages max. Reviews will be made public.*

## **Name of SRP: AntEco – State of the Antarctic Ecosystem**

Name of Reviewer (optional):

**Science quality.** Recognising that the national/international science on which the research was based has already been peer-reviewed, do the scientific highlights and published papers indicate that the internationally collaborative research stimulated by the programme has produced science that is excellent, good, or fair? (please provide a brief justification for your choice).

There is absolutely no doubt that the science produced by the AntEco actors is **excellent**, some of the outputs being outstanding. It is also demonstrated that most of the work is done by international teams. It is interesting to note that there is a good balance (as suggested by the list of publications) between terrestrial and marine work, demonstrating that AntEco provides a very good overview of the whole Antarctic ecosystem.

Comment on the list of publications attached to the Report (Appendix II): It would be helpful to produce some statistics with this list (e.g. % terrestrial / marine publications, main disciplines such as microbes, plants, invertebrates, vertebrates, etc.). I note that this list is mainly built from the publications produced by the Steering Committee Members. Even if these colleagues are representative, we may assume, taking into account the 278 scientists in the mailing list of AntEco that the production of the whole AntEco community is much more important. This point should be emphasized in the report in order to not suggest that all the AntEco activities are reduced to the SC Members activities. I would also suggest to the SC to think about a way to better collect the outputs of the AntEco community (but the issue is likely similar in all the SRP).

Among the 320 publications listed in Annex II, about 15 are obviously not relevant of AntEco because related to other locations (Spitsbergen, Tasmania, New Zealand, Arctic ocean, Arctic soils, Malaysia) or topics (rock weathering, biopsy technique).

**Science importance/relevance/timeliness.** Has the work advanced scientific understanding and been in accordance with the SCAR Strategic Plan (<http://www.scar.org/about/futureplans/>)? (Yes or no; please provide a brief explanation for your choice). Are there important gaps currently not considered by the SRP? (If yes, please provide a brief description)

Has the work advanced scientific understanding? **Yes.**

First of all, the three main terms of reference for AntEco are crucial for understanding the current and future states of the Antarctic ecosystems in response to environmental changes. I am less convinced by the structure in the 5 research sectors (or at least this structure is not well explained and justified in the Report). But it is a minor remark which does not affect the global appreciation of the SRP.

There is no doubt that several scientific outputs are of major importance and help to better understand the Antarctic ecosystems. I specifically mention the Atlas of the Southern Ocean, which is an outstanding publication, amazing in its format (and weight!) and in the amount of data. The number of publications on microbiology is increasing. It is excellent news since this field was not fully explored in the past. In addition, the very high number (and not surprising) of works related to biodiversity and climate change is the demonstration that AntEco is perfectly in line with the current highest environmental priorities, not only in Antarctica but at the global level.

Accordance with the SCAR Strategic Plan? **Yes.** We can mention 1) the participation to the Horizon scan exercise, 2) the role in providing advices to the AT (but see my remark below) and the participation to the ARC Challenge meeting organized by COMNAP, 3) influence on global issues through the participation in the "Monaco Assessment", 4) organization of several workshops facilitating exchanges of scientific findings and cross- and interdisciplinary communication (e.g. aerobiology, environmental management) etc...

Are there important gaps currently not considered by the SRP? **No**, I don't think so

**Data archival and access.** Is the programme adequately addressing the issues of data

archiving and data access, and are its data accessible to the wider community? (Yes or no; please provide a brief explanation of your choice).

**Yes.** One of the most important outputs in this domain is the database used for the Biogeographic Atlas of the Southern Ocean (SCAR-MarBIN/ANTABIF. I know that the AntEco community contributes also significantly to the terrestrial data.

**Communication activities.** Are the communication activities of the SRP contributing to the promotion of SCAR and its mission? (Yes or no; please provide a brief explanation of your choice).

It is likely one of the weaknesses of AntEco, even if the Biogeographic Atlas had a significant media impact (but I do not think that it is a real problem, taking into account the main objectives of a SRP). I know and appreciate the AntEco website but I am obviously not a good target for Facebook or other social medias! So I have no comment on that.

The contribution of several AntEco members to the Antarctic Environments Portal, as tool for the CEP, must be emphasized. It is perfectly in line with the SCAR role of adviser to CEP/ATCM.

I suggest to the Steering Committee (and perhaps to SCAR as a whole) to think about a real communication strategy, in particular in terms of international press releases when major publications or scientific outputs are produced. At the moment, this type of communication comes from the scientists themselves (authors of publications), their national organisations, or the journals (Natures, Science...). It would be good to expand this practice collectively through the SRP or directly through SCAR.

Another suggestion to SCAR (not to AntEco): at the moment, each SRP is free to organise its own webpage as it wants. It is comfortable for the SRP, but I think that SCAR is penalised by this approach because it suggests a lack of consistency. For example, AntEco publishes on its page its own Terms of Reference, whereas other SRP like AnT-ERA seem to have no specific ToR. Again, it is not a criticism to AntEco, just a suggestion for SCAR.

**Education.** Is the work contributing to education about Antarctic science? (Yes or no; please provide a brief explanation of your choice).

**Yes and No:** in fact, we learn very few things about that in the Report. The SO-AntEco expedition providing spaces for 8 early career scientists is cited but without details. I understand that it is a BAS led expedition but we don't really know how it supports education and outreach activities.

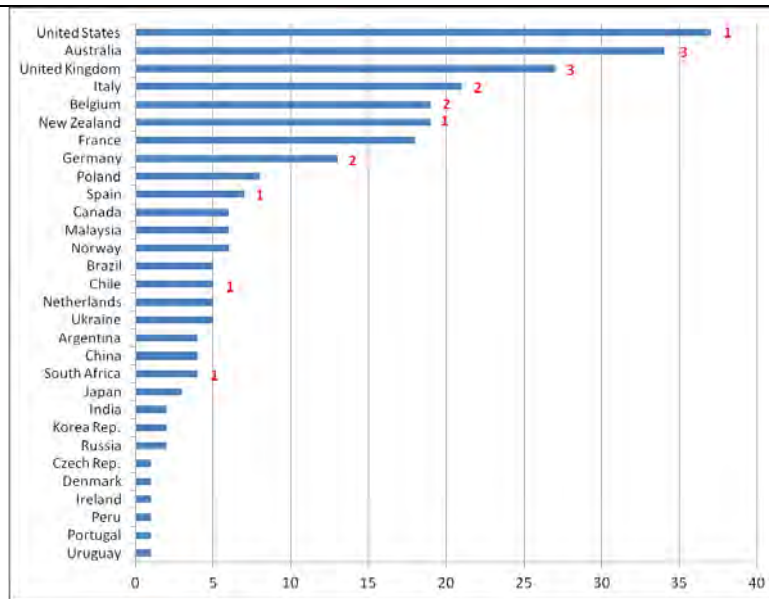
I know that many project under the AntEco umbrella have their own outreach and education activities, but this is not well reflected in the report, likely because it is mainly based on the Steering Committee activity (see my comment above on the publications).

**Building capacity across all SCAR Member countries.** Has the programme contributed to building the capacity of countries with less well developed Antarctic programmes and/or early career scientists a lot, modestly, little, or not at all? Keeping in mind that there are various difficulties in this area, e.g. depending on the current interest of science topics in certain countries, please provide a brief explanation of your choice.

This issue is clearly not well demonstrated in the Report and I cannot answer to this question.

However, the SCAR Secretariat provided to me, on my request, the e-mail addresses of the 278 "Members of AntEco. Using these addresses, it is possible to reconstruct the **geographical distribution pattern of the Members** (see figure below).

We note that in term of Members (or at least "interested" scientists), the geographical range of AntEco is very good. I have reported on the figure the number of SC Members from each country (in red). All the continents are represented except Asia. We note that Anglo-Saxon countries are dominant (US+Au+UK+NZ=8 SC Members). It is interesting to see that the US have only one representative whereas this country has the highest number of AntEco Members; by contrast, France which is at the 7<sup>th</sup> position, has no representative.



I recommend that the SC thinks about this kind of rough analysis in order to answer to the question above (building capacity...) and in term of representativeness in the SC.

**Value for Money.** Considering that SCAR is only able to invest ~20,000-25,000 USD per year in each SRP, do the results indicate excellent/good/fair/poor value for money (please provide a brief justification for your choice)?

**Good.** I note that the 2015 budget (19 338 \$) was entirely used for different meetings. It would be interesting to know who the beneficiaries of these supports were. The SC Members? Early career scientists? AntEco Members outside the SC?

It would be good also to discriminate the meeting for exchange of scientific outputs and those dedicated to the development of collaboration and construction of new projects. It would be interesting to know how the money of the previous budgets was used. For similar meeting support or other type of actions?

**Terms of Reference.** To what extent do you feel the SRP has met the Terms of Reference (provided on the following page).

I consider that AntEco generally has met the ToR. In detail:

- to oversee and guide the development and execution of the programme's implementation activities..., **Yes**
- to actively seek support of the programme's implementation..., **Yes**
- to ensure the delivery of agreed/approved scientific outcomes... **Yes (e.g. Biogeographic Atlas)**
- to respond to requests for expert advice/support from the SCAR Executive Committee in a timely and effective manner, **I cannot answer to this question** because it is not clear in the report how AntEco interacts with the SCAR EC, in particular how it provides information (if any) to SCAR in its essential role of advisor to CEP and ATCM. From my point of View, AntEco, together with AnT-ERA, should be the SRP providing the most important elements to the SCATS (with other Expert-Groups). This role of AntEco is not well described in the Report.
- to ensure appropriate exchange and archiving of data..., **Yes**
- to establish scientific liaison and logistical cooperation..., **Yes (e.g. COMNAP, Environments Portal...)**
- to advise the SCAR Executive Committee and Delegates onto help SCAR to play its essential role of adviser progress and on the use of funds. **I cannot answer to this question**

*Reviewers should complete this page, expanding the text boxes where necessary, but should be kept to 3 A4 pages max. Reviews will be made public.*

**Name of SRP:** State of the Antarctic Ecosystem (AntEco)

**Name of Reviewer (optional):** Hans M Verheye (DEA, SA)

**Science quality.** Recognising that the national/international science on which the research was based has already been peer-reviewed, do the scientific highlights and published papers indicate that the internationally collaborative research stimulated by the programme has produced science that is excellent, good, or fair? (please provide a brief justification for your choice).

In my view, this programme was, within its first 3+ years, very successful in producing excellent science, with over 300 peer-reviewed papers (although a few were duplicated in the Appendix II References list!) published in a broad spectrum of reputable scientific journals, several of them in *Nature*, and also as books and book chapters. Most of these publications are multi-authored and often stem from multi-institutional, multi-national and multi-disciplinary collaborations during international expeditions. Added to that is the publication, in 2014, of the most valuable, comprehensive, voluminous Biogeographic Atlas of the Southern Ocean, a joint effort by AntEco and SCAR conducted under the auspices of the global Census of Marine Life and SCAR-MarBIN.

This impressive scientific output documents demonstrated changes – at different temporal scales ranging from palaeo- to more recent – in the state (structure and trophic functioning) of the ecosystem as a whole and of the very diverse habitats it comprises. Does the AntEco Steering Committee have an idea at this stage which indicators need to be developed and/or used to monitor this change, as part of a management plan?

The programme has also made good progress with the assessment of impacts (both natural and human-induced) of such changes and shifts on Southern Ocean and Antarctic biodiversity, spanning a broad size spectrum – from viruses, bacteria and Archaea through to whales – and across a plethora of flora and fauna from marine benthic and pelagic, lacustrine, terrestrial, freshwater and aerial habitats.

In addition, a fair number of new discoveries have been publicized, including records of species new for the Antarctic/SO ecosystem, introduced and colonising non-native, invasive and alien species, many taxa new to science including diatoms and various invertebrate phyla, and the isolation and characterization of ‘natural drugs’ or derivatives with potential biomedical/pharmaceutical and biotechnological applications.

Finally, members of the AntEco Steering Committee have been actively involved in the drafting of reports for the IPCC, the AEP, the CCAMLR Weddell Sea MPA, and SCAR’s Antarctic and SO Horizon Scan.

**Science importance/relevance/timeliness.** Has the work advanced scientific understanding and been in accordance with the SCAR Strategic Plan (<http://www.scar.org/about/futureplans/>)? (Yes or no; please provide a brief explanation for your choice). Are there important gaps currently not considered by the SRP? (If yes, please provide a brief description)

The conservation and management of Antarctic, Sub-Antarctic and Southern Ocean ecosystems must be based on science and sound knowledge of the ecosystems. Comprehensive data and information are indispensable to provide this strong scientific basis, in a way that is site specific and considers the entirety of the ecosystem. The data and information that is emanating from this SRP and the increased research capacity that is being developed will not only find applications in conservation of biodiversity, climate change mitigations, as well as biotechnological and biomedical applications, but should also help provide guidelines to policy makers for the necessary sustainable biodiversity conservation and management measures and to create wide awareness of the major importance of marine biodiversity in this region.

Although I have currently no access to SCAR's Strategic Plan, I have little doubt that, based on my aforementioned perception of the progress made during the first term of AntEco, the research – or at least an appreciable portion of it – so far achieved, has significantly advanced our scientific understanding of the state of biodiversity of these ecosystems and how it has changed – and is likely to change – over time. Therefore, AntEco should be able to assist putting plans and policies in place towards effective biodiversity conservation and management. The latter does, unfortunately, not fall within my field of expertise to enable me to assess the existence of important gaps in the SRP. However, unless this did not form an integral part of the SRP, I would have liked to see evidence of, or reference to, some prior gap analysis to identify 'critical' areas of the ecosystem where the paucity of data and information (i.e. composition and status of biodiversity) would pose an obstacle to the development of a sustainable conservation management plan.

**Data archival and access.** Is the programme adequately addressing the issues of data archiving and data access, and are its data accessible to the wider community? (Yes or no; please provide a brief explanation of your choice).

Yes, data archiving and accessibility have thus far been addressed adequately. Digital availability of data and information resulting from AntEco are ensured through the use of open access databases, publishing in open-access journals and the use of information systems (digital libraries) available at institutions taking part in this SRP. A superb example is the Biogeographic Atlas of the SO, whose expert-validated, geo-referenced database (comprising >1 million records of >9,000 species from >400,000 locations south of 40°S) is publicly available on the SCAR-MarBIN/ANTABIF portal. Other examples are given in the mid-term report, including an ongoing effort at making microbial datasets accessible on mARS and future plans to submit a comprehensive metagenomic sequence dataset of soil biodiversity to the aforementioned biodiversity portal. In addition, 2 of AntEco's publications in *Nature* highlight the need and importance of archiving.

**Communication activities.** Are the communication activities of the SRP contributing to the promotion of SCAR and its mission? (Yes or no; please provide a brief explanation of your choice).

In addition to the reported efforts of dissemination and publication of research results (see above and below), which no doubt will be maintained beyond this mid-term review, I believe there are indeed a number of other, adequate communication channels in place and active, targeting not only the scientific community but also a broader audience. Reported examples include AntEco's active website, its Facebook page with a growing number of followers, and the appreciable number of conferences and workshops in which participants of this SRP have been directly and actively involved communicating their/AntEco's research findings during the past 3+ years of its life. These channels are also being used to make important communications regarding the upcoming South Orkneys-AntEco expedition, which in addition has its own, SCAR-independent website as well as a blog and Twitter feed (see also Education below). In addition, the launch of the Biogeographic Atlas of the SO received multiple international audio-visual and printed media coverage. Furthermore, AntEco Steering Committee members shared expert knowledge and scientific information during meetings and workshops in Spain, Italy, Norway and Melbourne (all held in 2015) and in Chile (in 2016).

**Education.** Is the work contributing to education about Antarctic science? (Yes or no; please provide a brief explanation of your choice).

Yes, the SRP accommodates several educational and outreach elements, including the equivalent of the Ocean Teacher Global Academy, which is a platform that supports classroom training, blended training, on-line tutoring and on-line self-learning; such approach was applied during 2 past Antarctic expeditions, but could, e.g., also be used by AntEco during workshops and to archive manuals and protocols developed for workshops and research cruises. There is also an opportunity for 8 early-career scientists to experience various aspects (*in situ* data collection, analysis and report writing) during and following the South Orkneys-AntEco expedition, and for the general public and scholars to interact with on-board expedition members.

It may not form part of AntEco or it may not have been reported explicitly in their mid-term report (or I may have missed it...), but it is my view that there is room for (i) information sessions directed

towards promoting not only public awareness but also science-based policy making; after all, policy makers must continually be informed of the research results, the importance of Antarctic biodiversity, and the importance of biodiversity research for the sustainable management of the ecosystem; and (ii) reference collection facilities that should be set up at some of the participating institutions or museums to act as national and regional reference centres.

**Building capacity across all SCAR Member countries.** Has the programme contributed to building the capacity of countries with less well developed Antarctic programmes and/or early career scientists a lot, modestly, little, or not at all? Keeping in mind that there are various difficulties in this area, e.g. depending on the current interest of science topics in certain countries, please provide a brief explanation of your choice.

Unless one has ‘grown up’ within the AntEco community, therefore having access to more detailed information in respect of past capacity building efforts and their successful outcomes, it is not an easy task for me to make an informed assessment here in this regard, also given the rather limited reporting in the External Performance review report. Limited in the sense that there is only one explicit example reported, namely the participation of 8 early-career scientists in the (at the time of report writing) forthcoming BAS-led South Orkneys-AntEco Expedition in early 2016. It is not clear from the report whether the 2 past AntEco expeditions (e.g. ANDEEP SYSTCO and Scotia Arc) had similar, if any, capacitation elements – I cannot presently access that information.

However, the SO-AntEco expedition is an international, multi-institutional expedition (16 institutions from 9 countries), so I prudently assume that it thus “contributes to building of capacity in countries with less well-developed Antarctic programmes”, while the number of early-career scientists participating is indeed appreciable. Their capacitation (through technical, fundamental and applied biodiversity research, education and infrastructure capacity building efforts) will be such that it stretches beyond the use of modern sampling techniques during the fieldwork, and will also include the use of modern/novel methods of post-cruise sample and data analyses, report writing and the publication of scientific articles. In addition, the nature of capacitation of young-career scientists should not only ensure sustainability of the research conducted during the expedition in their respective country of origin but also advance translation of gathered information into policy- informing briefs and outreach. All too often, post-expedition retention of trained young scientists at their universities as researchers and/or lecturers poses a challenge, as the release of this built capacity will ultimately cause an erosion of the improved quality of research and education in biodiversity sciences.

**Value for Money.** Considering that SCAR is only able to invest ~20,000-25,000 USD per year in each SRP, do the results indicate excellent/good/fair/poor value for money (please provide a brief justification for your choice)?

I have no hesitation stating that the results thus far obtained collectively in terms of scientific output, data sharing and communication of information, promotion of Antarctic research through education and outreach, and capacitation efforts are undoubtedly excellent value for money, especially considering the very modest investment of US\$20k (reported for 2015 only!), which I believe is by far outweighed by its returns, as exemplified by outcomes of AntEco’s participation in The Monaco Assessment, their convening of 5 sessions and 3 workshops at the SCAR-OSC in Auckland, and their support and contributions to, and (co-)convening of, the other 7 workshops, symposia, congress sessions and meetings listed in the AntEco mid-term report.

**Terms of Reference.** To what extent do you feel the SRP has met the Terms of Reference (provided on the following page).

Notwithstanding abovementioned challenges and perceived ‘shortcomings’ (underlined in previous sections herein – but there may be more – it is my belief that, over the period of review (i.e., at the half-way mark) and given the content of the mid-term report provided for external review, the ToRs of this SRP have been met adequately.

*Reviewers should complete this page, expanding the text boxes where necessary, but should be kept to 3 A4 pages max. Reviews will be made public.*

## **Name of SRP: AntEco**

Name of Reviewer (optional): Dirk Welsford

**Science quality.** Recognising that the national/international science on which the research was based has already been peer-reviewed, do the scientific highlights and published papers indicate that the internationally collaborative research stimulated by the programme has produced science that is excellent, good, or fair? (please provide a brief justification for your choice).

The science highlights are excellent, with high impact papers listed that have gone on to be used in conservation and management at regional and global scales.

The publications appended also indicates a very good level of output by the programme across a range of journals.

Assessing impact of research is not straightforward process, however having some additional summary statistics, such as paper citations after 5 years, or impact factors of the journals where publications have been accepted could be a useful metric to assess science quality in future reviews.

It would also be useful to clarify the process whereby a publication is listed as an output of the programme. For example, highlighting how papers advance the objectives of the programme, or listing them under the objectives to which they are targeted may also be useful for tracking progress.

**Science importance/relevance/timeliness.** Has the work advanced scientific understanding and been in accordance with the SCAR Strategic Plan (<http://www.scar.org/about/futureplans/>)? (Yes or no; please provide a brief explanation for your choice). Are there important gaps currently not considered by the SRP? (If yes, please provide a brief description)

The programme has advanced scientific knowledge and is in accordance with the SCAR strategic plan. In particular, examples where outputs from the programme have been influential in IPCC and CEP, and the assembly of the Biogeographic atlas are important milestones.

However, in my opinion, simply 'advancing scientific knowledge' is a fairly weak measure of success. Some more meaningful measures would be useful to include in future performance reviews, e.g. case studies showing how the community was coordinated through the programme and is consequently substantially better able to address the strategic objectives for which the programme was commissioned, or examples of management outcomes that were based on work arising from the SRP.

Although not a gap *per se*, an emphasis on synthesis of the information collected by the programme should be a priority over the next review period. Given that SRPs are intended to be finite in duration, it would be useful to identify some key outputs that can be put forward to say "We now have sufficient information on x to support robust conservation and management of this component of the Antarctic ecosystem. Document y assembles all the relevant information. SCAR can now focus on other priorities". Being able to make such statements in the next review would be among the ultimate measures of importance and relevance for this SRP in my opinion.

**Data archival and access.** Is the programme adequately addressing the issues of data archiving and data access, and are its data accessible to the wider community? (Yes or no; please provide a brief explanation of your choice).

Yes. Providing access to the datasets underlying the Biogeographic Atlas is a key milestone in this respect. I also note the website provides links to open access versions of many of the papers listed in Appendix II, which is also to the programme's credit.

**Communication activities.** Are the communication activities of the SRP contributing to the promotion of SCAR and its mission? (Yes or no; please provide a brief explanation of your choice).

Yes, the workshops and outreach around the Atlas for example are to the programmes credit. However explanations of the relationship with other SRPs in SCAR, such as AnTERA could be made clearer. It might also be useful to request that programme members note in the acknowledgments of their papers that they are contributions to this SRP (I note some do, but others in Appendix II do not appear to).

**Education.** Is the work contributing to education about Antarctic science? (Yes or no; please provide a brief explanation of your choice).

Yes. The outreach activities through social media to the public, schools and early career scientists is to the SRPs credit, especially given they are done with such a modest budget.

**Building capacity across all SCAR Member countries.** Has the programme contributed to building the capacity of countries with less well developed Antarctic programmes and/or early career scientists a lot, modestly, little, or not at all? Keeping in mind that there are various difficulties in this area, e.g. depending on the current interest of science topics in certain countries, please provide a brief explanation of your choice.

The contribution made is good, in particular the SO-AntEco. Also to the SRPs credit are involvement of non-English speaking/non-western hemisphere countries in hosting workshops.

**Value for Money.** Considering that SCAR is only able to invest ~20,000-25,000 USD per year in each SRP, do the results indicate excellent/good/fair/poor value for money (please provide a brief justification for your choice)?

The results of the SRP represent excellent value for money. It is to the SRPs credit that it has maintained engagement across a global community with such a small quantum of funds.

**Terms of Reference.** To what extent do you feel the SRP has met the Terms of Reference (provided on the following page).

Noting all of the comments above, I feel the SRP is definitely meeting its terms of reference.

*Reviewers should complete this page, expanding the text boxes where necessary, but should be kept to 3 A4 pages max. Reviews will be made public.*

## **Name of SRP: State of the Antarctic Ecosystem**

Name of Reviewer (optional): \_\_\_\_\_

**Science quality.** Recognising that the national/international science on which the research was based has already been peer-reviewed, do the scientific highlights and published papers indicate that the internationally collaborative research stimulated by the programme has produced science that is excellent, good, or fair? (please provide a brief justification for your choice).

The State of the Antarctic Ecosystem (AntEco) SRP has generated a highly impressive publication list, with many papers in high ranking journals. Key outputs listed touch on biodiversity, habitat, ecosystem function, and ecosystem and organismal response to climate change.

In addition this SRP has contributed to the Biogeographic Atlas of the Southern Ocean, and significant contribution to the Antarctic community.

All of the published outputs are inherently collaborative in nature, spanning a broad spectrum of the Antarctic Community. As such these outputs have contributed significantly to international partnerships, as well as building a substantial body of knowledge of Antarctic Ecosystems.

**Science importance/relevance/timeliness.** Has the work advanced scientific understanding and been in accordance with the SCAR Strategic Plan (<http://www.scar.org/about/futureplans/>)? (Yes or no; please provide a brief explanation for your choice). Are there important gaps currently not considered by the SRP? (If yes, please provide a brief description)

Yes. The work of the AntEco SRP has contributed significantly to advancing knowledge of Antarctic Ecosystems in accordance with the SCAR Strategic plan. The research focus has been on biodiversity and biogeography. Evidence of the knowledge contribution is seen in the publication list of the SRP members. The Biogeographic Atlas of the Southern Ocean represents an additional significant contribution in this vein, providing a timely, highly relevant, and important compilation of biodiversity data for the Southern Ocean. The timeliness of the Atlas and other outputs lies in their coming during a period of rapid climate change. As such, these outputs represent important tools for documenting and measuring ecosystem response to change.

Perhaps the only drawback with the atlas is the price which may make it inaccessible to many Antarctic research scientists, educators, and other potential users.

**Data archival and access.** Is the programme adequately addressing the issues of data archiving and data access, and are its data accessible to the wider community? (Yes or no; please provide a brief explanation of your choice).

Yes. A major contribution is the database used to compile The Biogeographic Atlas of the Southern Ocean, to which members of this SRP were significant contributors.

Additional data outlets have been pursued, including the mARS portal.

**Communication activities.** Are the communication activities of the SRP contributing to the promotion of SCAR and its mission? (Yes or no; please provide a brief explanation of your choice).

Yes. A wide range of communications activities have been employed. These include contributions to conferences (AntEco convened five sessions and three workshops at the SCAR–OSC in Auckland; sessions at other conferences); Jan Strugnell, the co-Chair of Ant-Eco, was invited to present a keynote lecture at the Gordon Research Conference; additional communication is provided through webpage and facebook page; voyage blogs.

Overall, well rounded communications activities, with perhaps room to develop further non-traditional approaches outside the research community.

**Education.** Is the work contributing to education about Antarctic science? (Yes or no; please provide a brief explanation of your choice).

Yes. The Biogeographic Atlas of the Southern Ocean represents a significant educational tool, however, relatively few Education outreach activities have been undertaken but AntEco. As highlighted above, perhaps the only drawback of the atlas is the price which may make it inaccessible to educators and learners.

A significant contribution will be made in 2016 on the SO-AntEco voyage. Eight early career scientists will be given opportunity to participate on the voyage. It is this type of activity that will inspire the next generation of Antarctic Scientists.

Keeping in mind that the researchers involved in the SRP are volunteers with substantial other commitments, seeking avenues to reach high school students could make a significant impact in educating about Antarctic science and ecosystems, and climate change impacts.

**Building capacity across all SCAR Member countries.** Has the programme contributed to building the capacity of countries with less well developed Antarctic programmes and/or early career scientists a lot, modestly, little, or not at all? Keeping in mind that there are various difficulties in this area, e.g. depending on the current interest of science topics in certain countries, please provide a brief explanation of your choice.

Yes. AntEco has supported conference sessions in countries with less well developed Antarctic Programs, stimulating interaction between AntEco SRP members and researchers from these nations  
AntEco is providing opportunity for eight early career scientists to participate on a research voyage in 2016, a significant contribution to the development of future Antarctic research scientists.

**Value for Money.** Considering that SCAR is only able to invest ~20,000-25,000 USD per year in each SRP, do the results indicate excellent/good/fair/poor value for money (please provide a brief justification for your choice)?

Excellent. It is the opinion of this reviewer that the AntEco SRP has been exceptional value for money. The level of output in terms of science and communications shows great commitment from the members. They appear to have formed a highly connected group that shows substantial collaboration and partnership, promising significant future contributions to this important area of Antarctic Research – Ecosystems.

**Terms of Reference.** To what extent do you feel the SRP has met the Terms of Reference (provided on the following page).

The AntEco SRP has very successfully met the terms of reference. Relevant activities are largely covered in the questions and responses outlined above. One TOR not yet touched on in this review is:

- to respond to requests for expert advice/support from the SCAR Executive Committee in a timely and effective manner,

In this regard the AntEco SRP contributed to 'The Monaco Assessment', the Strategic Plan for Biodiversity 2011-2020, through assessment of the biodiversity outlook for Antarctica and the Southern Ocean,



## State of the Antarctic Ecosystem (AntEco)

The State of the Antarctic Ecosystem (AntEco) SRP has generated a highly impressive publication list, with many papers in high ranking journals with international teams of multi-disciplinary researchers. Key outputs listed touch on biodiversity, habitat, ecosystem function, and ecosystem and organismal response to climate change. The science highlights are excellent, with high impact papers listed that have gone on to be used in conservation and management at regional and global scales.

The Biogeographic Atlas of the Southern Ocean is an outstanding contribution to Antarctic science and conservation! Perhaps the only drawback with the atlas is the price which may make it inaccessible to many Antarctic research scientists, educators, and other potential users. Outreach efforts for this product should be further developed.

The programme has also made good progress with the assessment of impacts (both natural and human-induced) of changes and shifts on Southern Ocean and Antarctic biodiversity, spanning a broad size spectrum – from viruses, bacteria and Archaea through to whales – and across a plethora of flora and fauna from marine benthic and pelagic, lacustrine, terrestrial, freshwater and aerial habitats.

The data and information that is emanating from this SRP and the increased research capacity that is being developed will find applications in conservation of biodiversity, climate change mitigations, as well as biotechnological and biomedical applications, but should also help provide guidelines to policy makers for the necessary sustainable biodiversity conservation and management measures and to create wide awareness of the major importance of marine biodiversity in this region.

Communication activities have been good, however there may be room to develop further non-traditional approaches outside the research community or perhaps they could have been better defined - particularly further spreading information about the activities engaging with the Antarctic Environments Portal and the Ocean Teacher Global Academy. More work could also be done to spread the word about the huge efforts put into the Biogeographic Atlas.

It is commendable that members of the AntEco Steering Committee have been actively involved in the drafting of reports for the IPCC, the AEP, the CCAMLR Weddell Sea MPA, and SCAR's Antarctic and Southern Ocean Horizon Scan - and that many of the publications listed are open access.

The AntEco SRP has been exceptional value for money. The level of output in terms of science and communications shows great commitment from the members. They appear to have formed a highly connected group that shows substantial collaboration and partnership, promising significant future contributions to this important area of Antarctic Research – Ecosystems.

### AntEco Recommendations:

- A brief summary of how the publications can be attributed to this program may be helpful, particularly as some are from non-Antarctic locations. You may also want to check for duplicates in the list.
- It should be recommended to members to mention in their publications that the paper is a contribution to the SCAR AntEco SRP.

- Contributions to the Antarctic Environments Portal should be profiled more, as well as wider distribution of the Biogeographic Atlas.
- A more detailed explanation how ANT-Eco provided support for education and early career scientists should be given (eg. during the SO-AntEco Expedition).
- Outreach efforts should be either better reported, or better defined.
- Even though AntEco has supported conference sessions in countries with less well developed Antarctic Programs, stimulating interaction between AntEco SRP members and researchers from these nations, with a review of the international involvement, particularly the lack of Asian participants, should be improved.
- The full years of budgets should be reported and detailed, including a more defined breakdown to showcase which person(s) received funding - SC members, early career scientists, developing countries, etc.
- Scientifically, if it does not exist, it might be good to give an idea of which indicators need to be developed and/or used to monitor changes in the ecosystem, perhaps as part of a conservation management plan.
- The SRP might consider providing evidence of, or reference to, some prior gap analysis to identify 'critical' areas of the ecosystem where the paucity of data and information (i.e. composition and status of biodiversity) would pose an obstacle to the development of a sustainable conservation management plan.
- AntECO should lead an effort within SCAR to archive education materials, such as the Ocean Teacher Global Academy produced as part of this SRP.
- It would be advisable to provide clearer explanations of the relationship with other SRPs in SCAR, such as AnT-ERA, as overlap seems likely.
- An emphasis on synthesis of the information collected by the SRP should be a priority over the next review period.



## External Performance Review Summary and Recommendations

### Recommendations for all SRPs and/or SCAR

The following are recommendations arising from the 2016 SRP External Review Process that apply to all SRPs and/or SCAR as a whole:

- Given that SRPs are intended to be finite in duration, it would be useful to identify some key outputs that can be put forward to summarize progress achieved, for example “We now have sufficient information on x to support robust conservation and management of this component of the Antarctic ecosystem. Document y assembles all the relevant information. SCAR can now focus on other priorities”. Along this line, all SRPs should consider putting an emphasis on synthesis of the information collected thus far and have such a paper/product result in the completion of their programme.
- All SRPs should consider assessing the impact of their research by having some additional summary statistics, such as a list of paper citations, or impact factors of the journals where publications have been accepted which could be a useful metric to assess science quality in future reviews.
- All the SRPs should recommend to their members to mention in their publications that the paper is a contribution to the SCAR xxxxx SRP.
- All SRPs should somehow document which of their achievements are directly resulting from the SRP and would not have happened otherwise.
- All SRPs should improve their engagement with scientists from less well-developed Antarctic programmes. Collaborations in Asia, Scandinavia, Africa and South American are particularly important to increase. To help assess current engagement, SRPs should create a graph of the distribution of people involved from various SCAR member countries.
- It is recognized that the SRPs establishment was prior to the SCAR Science Horizon Scan. However, SRPs might want to consider mapping their activities to Horizon Scan questions and including this information on their websites and make sure it is included in all Horizon Scan follow-ups/accomplishment reports.
- Support for early career scientists should involve some kind of ‘feed-back’ to their home countries, the larger early career and science community and/or other ‘outreach’ efforts. This could include a presentation to their home department when they return, a report to their National Committee, a webinar, or another activity to share their experience with the wider community
- The SRPs are encouraged to contribute to reinforce the linkages of SCAR with the IPCC and the future Special Reports.
- The SCAR Social Sciences groups could potentially consider doing case studies detailing how the science community was coordinated through the SRPs, if goals were met, what lessons might be learned, and detail examples of management/policy outcomes that were based on work arising from the SRP.
- SCAR should do better at showcasing the results of the SRPs and recognizing the amazing voluntary efforts of their many participants and the amount of in-kind contributions from participating institutions.
- SCAR as a whole, should have a real communication strategy for major publications and scientific outputs, including the outputs of the SRPs. This includes a more standardized format for the SRPs

that meet the needs of the programmes and help to showcase their efforts. Including metrics of hits for various programmes on webpages and social media channels would be useful to assessing reach of content.

- All SCAR groups, including the SRPs, should be reminded that acknowledging SCAR in publications is important. SCAR may wish to develop a standard statement that groups could use to help showcase publications that would not be possible without SCAR support. In a similar vein, when groups report publications they should highlight how papers advance the objectives of the programme, or listing them under the objectives to which they are targeted may also be useful for tracking progress.
- SCAR needs to define how publications can be attributed to a SCAR SRP, and which publications would have not been possible without SCAR involvement/endorsement. In the same vein, SCAR should set up a reference collection 'facility' to showcase all publications attributed to SCAR activities. This should also include non-technical publications.
- SCAR may wish to have a more detailed list of where all its data are stored and a contingency plan for maintaining the data in case current funding decisions are reversed.
- There is great value in SCAR's small contribution to these SRPs, which can often provide incentive funds to bring scientists together and it is essential that this be continued. SCAR Members are asked to continue to advocate for the support of SCAR efforts, particularly because few national funding sources allow for international collaborations such as those offered through SCAR activities.

# Scientific Research Programmes

## Antarctic data management evaluation

### General comments

The Antarctic Treaty System offers a clear statement on data. "*Scientific observations and results from Antarctica shall be exchanged and made freely available (Art. III).*"

Even at the level of ICSU the need for free and open access is becoming increasingly recognized. See "[Open data in a big Data world](#)". SCAR through the Standing Committee on Antarctic Data management has developed the SCAR Data and Information Management Strategy (DIMS). A principal component of this is the Antarctic Data Management System (ADMS) which is composed of The Antarctic Master Directory (AMD) and The National Antarctic Data Centres (NADCs). The Antarctic Master Directory is part of NASA's GCMD.

While overall the different research programs show good intent on making data and metadata available (through the AMD), this is not achieved in a consistent manner. Showing ample room from improvement.

It is clear all SRP's could be more aware of the SCADM and the ADMS. In regards to the overall reporting on data activities It would be good to have a more detailed description of how data feeds into the AMD as well as an overview of the records that belong to a specific SRP. This is a task that needs to be addressed by the SRP's and SCADM in collaboration.

For this purpose it would be good if all SRP could interact with SCADM during the upcoming SCAR OSC conference in Kuala Lumpur.

The SCADM joint meeting takes place on the 19<sup>th</sup> and 20<sup>th</sup> August. SRP's are invited to participate in this meeting (the 20<sup>th</sup> is probably of most interest). The meeting is open but notification of who will participate is mandatory. For this the SCADM Chief Officer can be contacted ([avandeputte@naturalsciences.be](mailto:avandeputte@naturalsciences.be) or [antonarctica@gmail.com](mailto:antonarctica@gmail.com)). We believe that participation to this meeting would help SRP's better understand SCAR DIMS and how to use it for improving the visibility of the research and data of their SRP.

### Evaluation of the individual reports.

#### **SERCE (score: B)**

No section on data management, no mention of the AMD. Nevertheless Data archiving & exchange is mentioned for instance in a 2015 workshop.

**PAIS (score: A)**

PAIS has a section on data management and they provide an overview of a number of domain specific data repositories. Metadata is not always put into the AMD directly by these repositories (Pangaea, IODP). But for instance IPEV IMAGES is part of GCMD and will as such feed into the GCMD. No concrete overview of which metadata was made available and national repositories are just briefly mentioned.

***AntarcticClimate21* (score: A)**

AntClim21 has a section on data management. It seems metadata and data is not yet made available but would be in future. No Mention of the AMD specifically but they would be using SOCCOM. SOCCOM contributes to SOOS (which is a SCAR data product), and as such this also to the AMD.

**AntEco (score: A)**

AntEco has a section on data and metadata, no mention of the AMD specifically, but data is fed into the biodiversity.aq, a SCAR data product that feeds into the AMD. However there is no outlined protocol. Some specific contributions are listed.

**AnT-ERA (score: A)**

AnT-ERA has a section on data management and they provide an overview of a number of domain specific data repositories. Not all of these feed into the AMD though.

Kind Regards

Dr Anton P. Van de Putte On behalf of SCADM

## Response to AntEco recommendations

The AntEco chairs and steering committee would like to express their thanks to the external and SCAR reviewers for their time and effort in reviewing the programme. Their comments were very constructive and will be useful in shaping AntEco into the future. We do, however, feel that some of the points raised in the performance summary and recommendations demonstrate that the SCAR Executive Committee has expectations that may be beyond the scope of a programme with such a small budget that is run by volunteers. In particular we believe that activities such as media and outreach, educational resources and attracting wider interest from less active SCAR members, should be centralized and run by the central SCAR office, especially in light of the transient nature of SRPs. That being said, we do emphasize the importance of attempting to use AntEco outcomes in outreach and education activities, in particular through engaging with the established media etc routes that are part of the structure of several of the leading national Antarctic operators. The Co-Chairs of AntEco also believe that a great deal of the time they dedicate to the programme is spent on repetitive and lengthy reporting procedures and leaves only limited time to actually run the programme. We feel that volunteers' time would be better spent keeping the content of the website up to date, thinking of innovative activities which will help AntEco address its key objectives, communicating with the AntEco members and coordinating scientific endeavors.

### **1. A brief summary of how the publications can be attributed to this program may be helpful, particularly as some are from non-Antarctic locations. You may also want to check for duplicates in the list.**

Much of the publication list came from the outputs of the steering committee and responses sent in by members in response to an email sent to the mailing list. This will have led to some less directly relevant manuscripts being included. The full publication list is likely to be even larger but would require a response from all those involved with AntEco (including the several hundred on the mailing list). Attributing papers to AntEco is at the discretion of the lead authors, and generally speaking, reflect either direct or indirect support from AntEco. It should be noted that most authors who acknowledge SCAR programmes in their papers do so through goodwill and a positive sense of developing community – while clearly some central and widely collaborative papers derive directly from SCAR-supported activities such as workshops and conferences, many and in reality the majority, derive entirely from national sources of funding and support, and acknowledgement of SCAR is a recognition of the intangible value of being part of a wider international community.

We have checked for duplicates in our publication list and removed all that we have detected.

### **2. It should be recommended to members to mention in their publications that the paper is a contribution to the SCAR AntEco SRP.**

AntEco already has a system in place to do this but we will make it more prominent and remind members to do so when they believe it to be appropriate. We will add a point regarding this to our website. In addition on awarding funds we remind members to acknowledge AntEco in their publications. However, point 1 above should be noted again.

### **3. Contributions to the Antarctic Environments Portal should be profiled more, as well as wider distribution of the Biogeographic Atlas.**

The Biogeographic Atlas had a significant media impact with its launch at the SCAR OSC in 2014, with over 60 media articles published online following the press release including ABC News (Australia) and the BBC news website. Radio interviews included voice of Russia, RTE (Ireland) and the BBC World Service. Printed media included The Irish Times, El Mundo and the Independent (UK). It has since been advertised on the SCAR website, APECS and SCAR Biology Facebook pages and has been very

positively reviewed in relevant scientific journals (Antarctic Science, Scientia Marina and Polar Record).<sup>WP 11b</sup>

AntEco members have had good engagement with the Environmental Portal, both in regard to the editorial process and the preparation of content. Most of the AntEco generated content is still in various stages of preparation. We will continue to assist with the Portal in this regard, and as content comes online, ensure that it is disseminated widely, both through the AntEco network and through the various SCAR reporting processes. It should be noted that, not least through what could be seen as political interference, there has been obstruction of the contribution of specific AntEco members to Portal pieces that should ideally also refer to locations north of the 60 degree latitude line, in particular to maritime and sub-Antarctic islands that fall in this category – as SCAR well and properly recognize, these ‘associated and dependent ecosystems cannot be ignored in any programme such as AntEco, and indeed a large proportion of our members have the focus of their research in this region.

Publicity campaigns are not a trivial undertaking and require time and resources. The press releases for the Atlas launch were prepared months in advance and required assistance from the media and outreach departments of the British Antarctic Survey and Australian Antarctic Division. These departments provided their time and contacts for free in this case but it should not be underestimated how much effort it takes to publicize scientific achievements on a wider scale. It should also be appreciated that national operator policies of organisations, such as BAS, are increasingly forcing the costing and charging of all such activities. BAS cannot guarantee that the media and outreach department can always invest this time and effort due to high competition for funds. Perhaps this should be something that SCAR handles centrally as the budgets and volunteer time and expertise of the SRPs are extremely limited.

AntEco does, however, widely publicize events, news, publications and activities through its mailing list, website and social media. These methods are a cost effective and quick way of reaching a wide global audience that are within the capacity of programme participants.

#### **4. A more detailed explanation how Ant-Eco provided support for education and early career scientists should be given (eg. during the SO-AntEco Expedition).**

AntEco has no funding to directly support scientific activities, so instead we negotiated and provided free spaces on board the SO-AntEco expedition for eight early career scientists and supported (with letters of support and references) funding applications by all scientists involved to help cover their transport costs to and from the port of departure/return. The early career scientists were then treated as full members of the team and given roles and responsibilities whilst at the same time receiving training and mentoring from more experienced scientists and crew.

A large portion of the AntEco budget has been used to support travel for early career researchers to conferences, meetings and workshops. Reports from these meetings are then placed on the AntEco website.

#### **5. Outreach efforts should be either better reported, or better defined.**

Outreach efforts are usually on a local or national scale and are difficult to attribute to a single SRP given that the funding does not come from SCAR.

A good example of an international outreach effort that was extremely successful was the social media campaign accompanying the SO-AntEco expedition (not included in previous reports because it happened after the submission deadline). SO-AntEco used a variety of online communication tools including blogs and social media. The most immediate of these were the regular Twitter updates, with the #SOAntEco hashtag reaching an audience of over one million Twitter users.

**6. Even though AntEco has supported conference sessions in countries with less well-developed Antarctic Programs, stimulating interaction between AntEco SRP members and researchers from these nations, with a review of the international involvement, particularly the lack of Asian participants, should be improved.**

AntEco, like SCAR as a whole, has issues with balancing contributions and uptake from different member nations. It is difficult to address this as a single SRP and it might be something better addressed through the national committees and representatives. SCAR and its programmes set out to encourage active participation across the SCAR community – to a large extent it has to rely on national communities and Delegates promulgating this information, and then individuals taking up/being able to take up involvement.

The lack of Asian participants will be addressed by redoubling our efforts to publicise our activities and scientific interests throughout the SCAR community, and particularly through the APECS community which is often characterized by greater openness to new approaches and involvement. Other specific interventions might include, 1) having a specific AntEco travel grant made available for the SCAR Biology conference in 2017, 2) by presenting a poster at the SCAR OSC Malaysia conference encouraging international (and particularly Asian) involvement, and reinforcing this through what we present at the AntEco steering group meeting there, 3) inviting an appropriate member(s) from an Asian country/countries onto the AntEco steering committee, which is intended as with all SCAR bodies to have an element of rolling membership.

**7. The full years of budgets should be reported and detailed, including a more defined breakdown to showcase which person(s) received funding - SC members, early career scientists, developing countries, etc.**

2015 Activities	Participant	Country	Expenditure (USD)
Cross Program Workshop, Accommodation, Spain	H. Griffiths <sup>SC</sup> J. Strugnell <sup>SC</sup> P. Convey <sup>SC</sup> U. Nielsen <sup>ECR</sup> Y. Ropert-Coudert R. Cavanagh <sup>ICED</sup> N. Wilson A. Murray <sup>SC</sup> S. Schiaparelli <sup>SC</sup> A. Post	UK Australia UK Australia France UK Australia USA Italy Australia	\$3,371.88
Cross Program Workshop, Long Haul Travel, Spain	J. Strugnell <sup>SC</sup> , A. Murray <sup>SC</sup> , A. Post, N. Wilson <sup>SC</sup> , U. Nielsen <sup>ECR</sup> , N. Wilson	Australia, USA,	\$6,375.90
ANTOS Workshop, New Zealand	Craig Cary <sup>SC</sup> Vonda Cummings Byron Adams Dana Bergstrom Angelica Casanova-Katny Peter Convey Soon Gyu Hong Ian Hawes Drew Lohrer Sanghee Kim Charles Lee Ian McDonald Adrian McDonald Fraser Morgan	NZ NZ USA Australia Chile UK Korea NZ NZ Korea NZ NZ NZ NZ	\$2,000

	Nicole Stahlmann Stefano Schiaparelli Megumu Tsujimoto Georgia Wakerley Gary Wilson Emmanuelle Sultan Satoshi Imura Annick Wilmotte Michael Axelsson Jean-Pierre Feral Michael Ashcroft	NZ Italy Japan NZ NZ France Japan Belgium Sweden France Australia	WP 11b
XVI COLACMAR-XVI Senalmar Meeting	D. Deregibus <sup>ECR</sup>		\$1,490.19
XII International Symposium on Antarctic Earth Science	C. Gonzalez-Wevar <sup>ECR,SC</sup>	Chile	\$1,100
VIII Southern Connection Congress	A. Murray <sup>SC</sup> I. Hogg	USA NZ	\$5,000

<sup>ECR</sup> = early career researcher, <sup>SC</sup> = steering committee member

**8. Scientifically, if it does not exist, it might be good to give an idea of which indicators need to be developed and/or used to monitor changes in the ecosystem, perhaps as part of a conservation management plan.**

AntEco members were heavily involved (along with members of other SRPs) in developing the recently published manuscript:

Constable, Andrew J., et al. "Developing priority variables ("ecosystem Essential Ocean Variables"—eEOVs) for observing dynamics and change in Southern Ocean ecosystems." *Journal of Marine Systems* (2016).

AntEco also has strong links to the Antarctic Treaty System (ATS) primarily through the Committee for Environmental Protection (CEP) and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). These interactions are typically (but not always) managed through the SCAR Standing Committee on the Antarctic Treaty System (SC-ATS). Both the CEP and CCAMLR have a range of broad strategies for the Antarctic region, which function effectively as conservation management plans. Furthermore, the strong working relationship between AntEco and SC-ATS means that AntEco has had considerable input to the SCAR Conservation for the 21<sup>st</sup> Century Strategy, currently under development and planned for release at the SCAR Open Science Conference in August 2016. AntEco was also well represented in the invited participants of the Monaco Antarctic Biodiversity meeting.

In addition to these links, AntEco members also are heavily involved with the established Southern Ocean Observing System (SOOS) and the developing Antarctic Nearshore and Terrestrial Observing System (ANTOS). Both of these initiatives have established, or are in the process of establishing a range of indicators for monitoring changes in the Antarctic ecosystem over a range of temporal and spatial scales. ANTOS in particular is seeking to establish a transcontinental terrestrial and near shore monitoring network that includes newly developed biosensors. As such, AntEco is already contributing the development of the type of indicators that the reviewer refers to.

In the context of this engagement, AntEco does not intend to try and develop a new set of indicators, or try and start a new and/or separate conservation management plan for the region. AntEco suggests that SRPs are better placed to provide information, data and opinions on a case by case basis to the relevant groups, several of which have been identified above.

**9. The SRP might consider providing evidence of, or reference to, some prior gap analysis to**

**identify ‘critical’ areas of the ecosystem where the paucity of data and information (i.e. composition and status of biodiversity) would pose an obstacle to the development of a sustainable conservation management plan.** <sup>WP 11b</sup>

The Biogeographic Atlas is a summary of all of the biogeographic data assembled so far for the region, including chapters summarizing the state of knowledge and data gaps. AntEco workshops planned for the OSC in 2016 aim to enable the further analysis of this type of data on a circumpolar scale.

AntEco also hosted a workshop at the SCAR Open Science Conference in 2014 entitled Environmental Drivers of Antarctic biodiversity at different spatial scales. Part of the purpose of this workshop was to bring together ecologists across a range of biomes and taxa, to not only assist with the collation of data, but also to identify knowledge gaps and potentially mechanisms for filling these gaps. One of the mechanisms identified in this respect was the use of environmental proxies for biodiversity. Funded projects led by AntEco researchers are currently underway to increase understanding of the linkages between the biological and physical environments, identify both important habitats and important areas of biodiversity, and use this information to inform conservation planning. These findings, together with other research that is underway in AntEco and elsewhere, will also allow the identification of the ‘critical’ areas of the kind identified by the reviewer.

This research, combined with the strong links between AntEco and bodies like the CEP and CCAMLR (see above for more detail) places AntEco in a good position to inform conservation planning across the region. It also allows AntEco to assist in the identification of areas where more knowledge is required. The breadth and scope of the AntEco research community will also allow the active participation of AntEco in filling these knowledge gaps.

**10. AntECO should lead an effort within SCAR to archive education materials, such as the Ocean Teacher Global Academy produced as part of this SRP.**

The AntEco executive would be pleased to send out emails in order to help SCAR to establish such an archive, but we believe that the SCAR office and main SCAR website is the best place for education materials to be archived and disseminated, especially in light of the transient nature of SRPs. Although we are happy to assist and contribute this is outside the scope of our priority objectives and our available time. We strongly believe that additional funds would be necessary for someone to dedicate time to this initiative.

**11. It would be advisable to provide clearer explanations of the relationship with other SRPs in SCAR, such as Ant-ERA, as overlap seems likely.**

The AntEco and Ant-ERA SRPs were developed at the same time period and substantial effort was taken to ensure that overlap was minimized. Records of the development of these programmes at the time should be consulted to demonstrate this rather than re-inventing the wheel here. It should also be noted that the SCAR biology community is very large, routinely contributing a half or more of the contributions to and participation in SCAR meetings and bodies; it is artificial to drive a boundary within such a community, yet with common sense that it can be broadly separated as happens now. To do any less would be to seriously under-represent or reflect within SCAR the structure and activity of SCAR’s own science community. Broadly speaking Ant-ERA deals with processes occurring within the organism- i.e. biological processes occurring within organisms at ecological time scales, whilst AntEco focuses on an ecosystem scale. AntEco has a dedicated cross-linkage member of the Ant-ERA steering committee (Don Cowan) and the Chair of Ant-ERA sits on the AntEco steering committee in a similar role. This enables both steering committee to actively encourage collaboration whilst avoiding duplication.

**12. An emphasis on synthesis of the information collected by the SRP should be a priority over the next review period.**

AntEco has a strong focus on synthesis, and this is exemplified by several synthesis style papers that AntEco members have been actively involved in over the last few years (e.g. Terauds et al 2012, Convey et al. 2014, Bennett et al 2015; Chown et al., 2015...more to come) These papers are already contributing to the bigger picture understanding of the type the reviewer is recommending and their point is well made. As more of the AntEco research is completed, more comprehensive and larger syntheses will be possible, allowing the collation of data and ideas into papers that will provide guidance on what is currently known about certain biomes, how this can contribute to their conservation and management and where future efforts should be directed in the future. The workshops that AntEco have held, and will continue to hold, also form a very useful avenue for bringing researchers together and facilitating the synthesis of information.

#### **SCADm Comments:**

**AntEco has a section on data and metadata, no mention of the AMD specifically, but data is fed into the biodiversity.aq, a SCAR data product that feeds into the AMD. However there is no outlined protocol. Some specific contributions are listed.**

AntEco will work closely with SCADm to develop an outlined protocol for data and metadata to ensure that it fully meets the required standards. This will be done through our existing cross-linkages with SCADm.