



International
Science Council

Paper No: 29 **Agenda item: 16.2**

SRP: AntEco

SG: LS

Person

Huw Griffiths

Responsible:

SCAR Delegates Report 2020

State of the Antarctic Ecosystem (AntEco) Final Report

Summary

Report Authors

Jan Strugnell (Australia) & Huw Griffiths (UK), Steering Committee (international)

Background to Programme

AntEco aimed 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.

Biological diversity is the sum of all organisms in a system. These organisms collectively determine how ecosystems function and underpin the life-support system of our planet. The SCAR-Biology Programme - State of the Antarctic Ecosystem (AntEco) was 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 were 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.

Major achievements and legacies

Networking, workshops and supporting early career researchers.

An Expansive list of publications (over 200 articles, reports and book chapters) including the SCAR Biogeographic Atlas of the Southern Ocean.

SO-AntEco expedition to the South Orkney Island Marine Protected Area.

Founding members of the Marine Ecosystem Assessment of the Southern Ocean.

AntEco has also had several new significant contributions to the Antarctic Environments Portal.

Final procedural recommendations to Delegates

AntEco members have played very active roles in formulating the new SRPs. As such, future research recommendations have been captured. We recommend that SCAR continues to support the community established by AntEco (and Ant-ERA) through continuing to support sessions at conferences and the existing mailing lists. (see main text for an explanation)

Main report

Original rationale and objectives

Through the development and maintenance of an international research network, AntEco aimed 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.

To do so we promoted the use of both established and innovative technologies, on scales from the latest molecular analyses to remote sensing, that will provide the means for synthesis and integration across the entire region over physical and temporal scales and resolutions that until now have not been possible. While the scope of research activities supported was broad, research priorities were directed towards science that is policy relevant and assists in guiding management and conservation in the region.

AntEco was structured into five research sectors each with its own objectives: Spatial Ecology, Molecular Ecology and Evolution, Ecoinformatics and Systems Biology, Paleoecology and Impacts, trends and conservation. For more details, please see www.scar.org/science/anteco/about.

Main scientific achievements

International research network:

Networking, workshops and supporting early career researchers. >90 researchers funded to attend conferences and workshops. >50% Early Career Researchers or from developing Antarctic nations. 26 conference sessions and 20 workshops.

Understanding of current biodiversity:

An Expansive list of publications (over 200 articles, reports and book chapters) including the SCAR Biogeographic Atlas of the Southern Ocean.

Policy relevant:

AntEco had several new significant contributions to the Antarctic Environments Portal on important topics (marine plastics, marine biodiversity, pathways for the introduction of terrestrial non-native species, non-native microbial introductions, specially protected and managed areas in Antarctica and the status of known non-native species introductions and impacts).

SO-AntEco expedition to the South Orkney Island Marine Protected Area.

Delivery against original implementation plan

AntEco was structured under 3 overarching interdisciplinary questions:

1. How has Antarctic biodiversity evolved in response to past environmental change and what does this tell us about its capacity to respond to future changes?
2. What are the systematic and environmental geographic features of Antarctic biodiversity, and what mechanisms underpin the current distribution and abundance of biodiversity?

3. Given the evolved geographic distribution of diversity and forecast threats, what conservation actions are required for the preservation of biodiversity, and mitigation of, and adaptation to, change?

Research sectors falling within these questions included A) Spatial ecology, B) Molecular Ecology & Evolution, C) Ecoinformatics & systems biology, D) Paleoecology, E) Impacts, trends & conservation. Deliverables within AntEco fall under the following categories and we provide selected examples as follows:

I. Primary publications in peer-reviewed journals

Publications in peer-reviewed journals formed the primary deliverable of the program. We supported and encouraged collaborations across disciplines and groups and our Steering Group played a key role in establishing and developing publications. We exceeded our target of at least 2 publications in international peer-reviewed journals for each of our five sectors in each year of the programme (see annual reports for details). We highlight papers for each research sector across the life of the programme in the 'notable papers' section below.

II. Major reports

The SO-AntEco expedition produced two reports to CCAMLR and a published scientific paper examining Vulnerable Marine Ecosystem (VME) taxa both inside and outside of the Marine Protected Area. Two reports to CCAMLR (see grey literature section) and Brasier, M. J., et al. "Benthic biodiversity in the South Orkney Islands Southern shelf marine protected area." Biodiversity. A further paper analysed the seafloor photographs to investigate the consequences of potential biodiversity loss and damage to VME taxa on the benthic ecosystem: Mitchell, Emily G., Rowan J. Whittle, and Huw J. Griffiths. "Benthic ecosystem cascade effects in Antarctica using Bayesian network inference." Communications biology.

The Biogeographic Atlas of the Southern Ocean 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.

'The Monaco Assessment' (www.scar.org/monaco-assessment) is a statement on Antarctic and Southern Ocean conservation in the context of the Strategic Plan for Biodiversity 2011-2020. Aleks Terauds and Pete Convey from the AntEco Steering Group attended three day meeting. 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, but that prospects for effective action over the next five years to improve the outlook are exceptional.

AntEco members (Cowan, Brandt) played key roles in the Antarctic and Southern Ocean Horizon Scan and many members of AntEco contributed questions to surveys that formed the foundation of the scan.

III. Other reports and grey literature

Although publications in peer-reviewed journals and major reports to international bodies form the majority of AntEco outputs, other reports and grey literature were prepared as required. WG-EMM-16/13 Preliminary report on SO-AntEco (South Orkneys – State of the Antarctic Ecosystem) benthic survey (JR15005) around the South Orkney Plateau (February–March 2016), WG-EMM-17/37 SO-AntEco: Contributing information and scientific advice on benthic biodiversity in the South Orkney Islands (Domain 1) region.

IV. Workshops and other key meetings

AntEco members played a lead role in convening sessions and workshops at each of the SCAR OSC and SCAR Biology Symposia. We also attended and participated in additional international workshops and key meetings such as the first Marine Ecosystem Assessment of the Southern Ocean (MEASO) workshop and the cross programme Barcelona workshop and the SOOS eEOV workshop. In addition, AntEco members were invited to present research at keynote lectures at international conferences (e.g. Jan Strugnell presented an invited keynote on the use of genetic tools to explore Southern Ocean biodiversity at the 8th International barcode of life (iBol) conference in Norway in June, 2019).

We supported and/or played a role in delivering several other workshops focussed on building capacity and providing the foundational meeting for papers and grants. Key examples include: 1) Workshop on microbial resilience, emerging knowledge from Antarctic ecosystems, 2) Tools for Southern Ocean spatial analysis and modelling course and a 3) Modelling polar ecosystem health synthesis & workshop.

Main education, outreach and capacity building achievements

#SOAntEco reaching an audience of over one million Twitter users

AntEco science advising BBC Blue Planet 2, Seven Worlds, One Planet & Frozen Planet 2

'Antarctica and the Strategic Plan for Biodiversity 2011-2020: The Monaco Assessment'

Submissions to The Antarctic Environments Portal

Face to face outreach to over 50k people.

Dr Huw Griffiths (co-chair) received the SCAR Medal for Education and Communication.

Partnerships made and support received

SCAR SRPS: AntClim21, AnT-ERA, and PAIS – joint workshops, publications and conference sessions.

SCAR Groups: Plastics in Polar Environments, EGABI, EGBAMM, ANTOS, BEPSII

International Groups: APECS, Minorities in Polar Research, Women in Polar Science and Pride in Polar Research

International Programmes: MEASO, ICED, SOOS, Biodiversity.aq

National Operators: British Antarctic Survey funded the ship time for SO-AntEco

Draft final Budget summary

	2019	2020
	Spent	Allocated
(US\$)	18,489	26,783

Please also provide a breakdown of the following:

- Total expenditure
- Total direct support received from other sources
- Total budget used to support ECRs
- Total budget used to support countries with developing programmes

Unfortunately we were unable to spend our budget in 2020 as planned. We had intended to spend the majority of the money of ECR travel to SCAR meetings and workshops (all cancelled or moved online due to the global pandemic). We have earmarked funding for a workshop on the palaeontology of Seymour Island, but we are waiting to hear if that will still go ahead.

Final future research recommendations to Delegates

AntEco members have played very active roles in formulating the new SRPs. As such, future research recommendations have been captured. We also recommend that SCAR continues to support the community established by AntEco (and Ant-ERA) through continuing to support sessions at conferences and the existing mailing lists

Final procedural recommendations

We have felt well supported by the SCAR Secretariat during the lifetime of the programme and have appreciated attempts to reduce the reporting burden.

Notable Papers

A) Spatial ecology

Jansen, J., Hill, N.A., Dunstan, P.K., McKinlay, J., Sumner, M.D., Post, A.L., ... & Johnson, C.R. 2018. Abundance and richness of key Antarctic seafloor fauna correlates with modelled food availability. *Nature Ecology & Evolution*, **2(1)**, 71.

This work explores the strength of pelagic–benthic coupling along the East Antarctic shelf and its dependence on both physical processes and the types of benthic organisms considered.

B) Molecular Ecology & Evolution

Strugnell, J.M., Pedro, J., Wilson, N.G. (2018) Dating Antarctic ice sheet collapse: proposing a molecular genetic approach. *Quaternary Science Reviews*.
<https://doi.org/10.1016/j.quascirev.2017.11.014>

This perspective piece sets out an ecological genetics method to help resolve when the West Antarctic Ice Shelf last collapsed.

Biersma E.M., Jackson J., Hyvönen, J., Koskinen, S., Linse K., Griffiths H. & Convey, P. (2017). Global movements in bipolar moss species. *Royal Society Open Science* **4**: 170147. doi: 10.1098/rsos.170147

First use of molecular biological approaches to document and estimate timing of (rare) bipolar dispersal events into and from both Polar Regions over multimillion year timescales in a major bipolar moss genus.

C) Ecoinformatics & systems biology

Archer SDJ, *et al.*, 2019. Airborne microbial transport limitation to isolated Antarctic soil habitats. *Nature Microbiology*.

This paper demonstrates, for the first time, there is evidence for very limited local aerial transport of soil particles and their associated microbiomes in Antarctica, which has implications for local microbiome endemism in Antarctic Dry Valleys.

D) Paleoecology

Roberts, S.J., Monien, P., Foster, L.C., Lofffield, J., Hocking, E.P., Schnetger, B., Pearson, E.J., Juggins, S., Fretwell, P., Ireland, L., Ochyra, R., Haworth, A.R., Allen, C.S., Moreton, S.G., Davies, S.J., Brumsack, H.-J., Bentley, M.J., Hodgson, D.A. (2017) Past penguin colony responses to explosive volcanism on the Antarctic Peninsula. *Nature Communications*, **8**. 16 pp. doi:10.1038/ncomms14914

Amesbury, M.J., Roland, T.P., Royles, J., Hodgson, D.A., Convey, P., Griffiths, H. & Charman, D.J. (2017). Widespread biological response to rapid warming on the Antarctic Peninsula. *Current Biology* **27**, 1616-1622, doi 10.1016/j.cub.2017.04.034.

Paper using palaeobiological evidence from moss peat cores and contained microbiota to infer wide scale responses over time to climate change across the entire Antarctic Peninsula.

E) Impacts, trends & conservation

Griffiths, H. J., Meijers, A. J., & Bracegirdle, T. J. 2017. More losers than winners in a century of future Southern Ocean seafloor warming. *Nature Climate Change*, **7(10)**, 749.

This work provides insights into the potential impacts of climate change on benthic species and communities in the Southern Ocean. It uses data collected for the SCAR Biogeographic Atlas to form the basis of the analyses.

Lee, J.R., Raymond, B., Bracegirdle, T.J., Chadès, I., Fuller, R.A., Shaw, J. D., & Terauds, A. 2017. Climate change drives expansion of Antarctic ice-free habitat. *Nature*, **547(7661)**, 49.

The authors find that isolated ice-free areas will coalesce over the twenty-first century due to climate change. While the effects on biodiversity are uncertain, they hypothesize that changes could eventually lead to increasing biotic homogenization, the extinction of less-competitive species and the spread of invasive species.

Budget

Planned use of remaining funds

Year (YYYY)	Purpose/Activity	Amount (in USD)

Membership

Leadership

Role	First Name	Last Name	Affiliation	Country	Email	Date Started
Co-chair	Jan	Strugnell	James Cook University	Australia	jan.strugnell@jcu.edu.au	2013
Co-chair	Huw	Griffiths	BAS	UK	hjpg@bas.ac.uk	2013
Co-deputy	Don	Cowan	U. Pretoria	South Africa		2013
Co-deputy	Pete	Convey	BAS	UK		2013

*Please identify early-career researchers with * in first column*

Other members

First Name	Last Name	Affiliation	Country	Email
Aleks	Terauds	AAD	Australia	
Angelika	Brandt	Senckenberg Museum	Germany	
Alison	Murray	DRI	USA	
Annick	Willemotte	U. Liège	Belgium	
Craig	Cary	U. Waikato	New Zealand	
Guido	di Prisco	U. Naples	Italy	
Claudio	Gonzales-Wevar	U. Chile	Chile	
Dom	Hodgson	BAS	UK	
Anton	van de Putte	RBINS	Belgium	
Stefano	Schiaparelli	U. Genoa	Italy	
Mary-Ann	Lea	IMAS, U Tas	Australia	
Conxita	Avila	U. Barcelona	Spain	
Andres	Barbosa Alcon	MNCN	Spain	
Lucas	Ruberto	Instituto de Nanobiotecnología	Argentina	
Satoshi	Imura	NIPR	Japan	
Julian	Gutt	A. W. Inst.	Germany	

*Please identify early-career researchers with * in first column*