



EXCOM/COs Meeting 2011
Edinburgh, 16,18,19th July 2011

Agenda Item: 2.4.6
Person Responsible: K Conlan

AntETR: Antarctic Ecosystem Thresholds and Resilience

Executive Summary (1 page)

Title: AntETR: Antarctic Ecosystem Thresholds and Resilience

Authors: J. Gutt, K. Conlan

Introduction/ Background: Important Issues or Factors: see following

Recommendations/Actions and Justification: EXCOM are asked to note progress

Expected Benefits/Outcomes: A new high profile and relevant SRP

Partners: AntECO and other new SRPs.

Budget Implications: no additional funds requested at this stage

Program Summary

Antarctica is changing, and parts of it are changing very rapidly. Pressures on the Antarctic environment result mainly from global climate change, invasive species, human impacts, and extreme events. These stresses may be convergent, and their interactions can lead to threshold changes in communities, populations and individual organisms. AntETR will examine the current biological *processes* in Antarctic ecosystems, to define their tolerance limits as well as thresholds and thereby determine resistance and resilience to change. Such ecosystem processes depend on a cascade of organismal responses from the genomic through cellular to physiological. Recent studies have shown that microevolutionary adaptation to the polar environment may constrain an organism's ability to respond to environmental change. The extreme environment and marked difference in community complexity between the polar regions and much of the rest of the planet may mean that consequences of stress for ecosystem function and services, and their resistance and resilience, will differ from elsewhere. Polar ecosystem processes are therefore key to informing wider ecological debate about the nature of stability and change in ecosystems.

The main goal of AntETR is to define and facilitate the science required to determine the resistance, resilience and vulnerability to change of Antarctic biological systems. In particular, the science needs to determine the likelihood of cataclysmic shifts or "tipping points" in Antarctic ecosystems: How close to the cliff are we? Three key questions have been identified:

(1) What are the genetic underpinnings to the life history, phenotypic plasticity and physiological adaptations of polar organisms that determine their resilience and resistance to ongoing and future change?

(2) How do species traits impact on community interactions and stability and in turn influence nutrient cycles, energy transfer and productivity? Will invasive species have catastrophic impacts on these community interactions, and thus on ecosystem processes?

(3) What are the likely consequences of a changing environment for ecosystem functioning and ecosystem services provided by the Antarctic biosphere? How do changing biogeochemical cycles interact with and influence biological systems in Antarctica?

In addition, AntETR will recommend tools to understand organismal physiology, systems biology and the drivers of productivity in the context of stress. Addressing these questions will encourage new capacity in the Antarctic community and combine bottom-up and top-down application of advanced approaches *in situ*, in the laboratory (e.g. 'omics' approaches) and *in silico* (e.g. process modelling and advanced database mining) to provide an integrative view of the vulnerability of the Antarctic biota. We will exploit the full range of Antarctic ecosystems from continental to sub-Antarctic, including marine, limnic and terrestrial habitats and in a manner that facilitates a bipolar approach.

Progress report on the development of the (potential) new SCAR biology programme “Antarctic Ecosystem Resilience and Thresholds” (AntETR)

Julian Gutt

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The future of biological activities coordinated by SCAR after the official end of the current programme EBA in 2013 was discussed in a workshop held in Castiglionchello, Italy, in May 2010. A larger group of biologists with experience in Antarctic research and being involved in SCAR science and business agreed that two biology programmes should be developed and proposed due to the following reasons. Biology is very complex, especially when ecosystem-relevant aspects are to be considered. With two narrower scopes we will be successful not only to design a framework for a variety of topics but also to have two clear foci and, thus, two true programmes. After this decision had been made a first concept for both proposals was developed. The main idea was that AntEco deals with biological structure and large scale patterns and AntETR works mainly on processes being efficient at smaller spatial and shorter temporal scales, especially those related to environmental changes. During SCAR workshops and business meetings in Buenos Aires in 2010 the outlines were discussed within the scientific community. They were also presented to the delegates and finally accepted.

After the workshop I have been nominated as the discussion leader of AntETR. Based on a document produced during the workshop in Castiglionchello a framework for AntETR was developed. Its main structure follows general rules of SCAR, which had to be adapted to the specific requirements of a modern biology programme (see annex). In the meantime a team of lead-authors was formed (see annex) and it was decided that the phase between March and August will be used to write drafts for the major components of the proposal. During a workshop planned for 17.-20. October to be held in Delmenhorst, Germany, these components will be presented, overarching key aspects decided, missing points added, and the components will be adjusted to each other. Finally, next steps of action are to be discussed. Senior scientists with overseeing responsibility will follow this process and especially take care that both programme proposals, AntEco and AntETR, will not become redundant, but complement each other. SCAR, Hanse-Wissenschaftskolleg (Delmenhorst), Deutsche Forschungsgemeinschaft, and AWI sponsor the workshop. The final product will be a complete draft of the proposal. It is planned to circulate this draft within a wider community of Antarctic specific and general marine biologists to ask them for comments. On the one hand this strategy should support the publicity of the potential new programme and on the other hand it should give us the chance to respond to criticism and, thus, improve the proposal. The final text will be available early in 2012.

The planned workshop mentioned above and, thus, the progress of AntETR would significantly benefit from additional financial support of an equivalent of one (expensive) trans-ocean travel of approx \$ 3500,- for an additional member of the programme planning group.

Besides funding of the workshop the challenge to assemble a team of lead-authors was solved by finding a good compromise: to cover a fair geopolitical equilibrium, to find experienced experts who are willing to be in charge for specific components of the proposal and to consider the gender question. Consequently, at present there are not problems and the preparation of AntETR is in good shape.



Julian Gutt

Annex**Antarctic Ecosystem: Adaptation, Thresholds and Resilience (AntETR)**

Framework for a proposal for a new SCAR biology-program presented by the Standing Scientific Group on Life Sciences (SSG-LS)

Expected duration: 10 years (2012-2022)

Estimated SCAR funding required over the total program lifetime: USD X00.000,00

Program Summary

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The main goal of AntETR is to define and facilitate the science required to determine the resistance, resilience and vulnerability to change of Antarctic biological systems. In particular, the science needs to determine the likelihood of cataclysmic shifts or "tipping points" in Antarctic ecosystems: How close to the cliff are we? Three key questions have been identified:

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In addition, AntETR will recommend tools to understand organismal physiology, systems biology and the drivers of productivity in the context of stress. Addressing these questions will encourage new capacity in the Antarctic community and combine bottom-up and top-down application of advanced approaches *in situ*, in the laboratory (e.g. 'omics' approaches) and *in silico* (e.g. process modelling and advanced database mining) to provide an integrative view of the vulnerability of the Antarctic biota. We will exploit the full range of Antarctic ecosystems from continental to sub-Antarctic, including marine, limnic and terrestrial habitats and in a manner that facilitates a bipolar approach.

B1 General objective (Irene Schloss)

The overarching objective of this program is to define and facilitate the science required to determine the resistance, resilience and vulnerability to change of Antarctic biological systems and, as a consequence

define thresholds. In particular, the science needs to determine the likelihood of cataclysmic shifts or “tipping points” in Antarctic ecosystems: How close to the cliff are we? As a consequence AntETR will focus on the current biological *processes* in Antarctic ecosystems, which depend on a cascade of responses from the genomic through cellular and physiological to ecosystem. In this way, the awareness of decision makers and scientists that not only physical parameters but the complex life in the Antarctic will change and impact the global environment should be strengthened. This program will facilitate engagement of Antarctic biologists across disciplines, nations and capacities, and will include interactions with CCAMLR and the SCAR Birds and Mammals Expert Group. We will contribute directly to the SC-ATS, allowing clear scientific information to be provided to CEP and the Antarctic Treaty system as a whole. The programme will integrate information from current projects and encourage new projects to identify stresses and their impacts on key biological processes. It will identify organism and ecosystem thresholds (vulnerability), their resilience to stress, and the implications of crossing biological thresholds. We will prioritise establishing links with physical scientists and modellers to inform projections of future scenarios, and our focus on *process* will complement that of the proposed STATE programme, which addresses the origins and evolution of current large scale biological patterns. Critical to the identification of tipping points will be the maintenance of long-term environmental data sets such as „Southern Ocean Observing System“ (SOOS), with a key priority being the establishment of parallel observing systems in non-marine environments. The integration of functional process information will be an essential new layer contributing to existing databases such as ANTABIF, essential repositories of data as well as tools for analysis.