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Future Challenges in Southern Ocean Ecology Research: another outcome of the 1st SCAR Horizon Scan

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**Information paper submitted by Portugal, Belgium, Brazil, France, Germany, Netherlands,
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Summary

The 1st SCAR Antarctic and Southern Ocean Science Horizon Scan aimed to identify the most important scientific questions in and about the Antarctic that should be addressed over the next two decades and beyond. This information paper reports another output of this initiative, focused on high-interest research areas related specifically to Southern Ocean life and ecology that, although not all retained as the top priorities among the addressed scientific domains, are of considerable relevance to the biology and ecology of the Southern Ocean.

Introduction

The 1st SCAR Antarctic and Southern Ocean Science Horizon Scan was carried out in 2014, bringing together more than 70 of the world's leading Antarctic scientists, policy makers and visionaries (including some early career scientists from a number of countries) to identify the most important scientific questions in and about the Antarctic (ATCM XXXVII /IP13; ATCM XXXVIII/IP20). The Horizon Scan process was a community-based effort to identify the most compelling and important scientific questions to be addressed over the next two decades and beyond in and from Antarctica and the Southern Ocean (for a comprehensive information on the SCAR Horizon Scan, including planning documents, various supporting resources and outcomes are available at www.scar.org/horizonscanning/ (Kennicutt *et al.*, 2014; Kennicutt *et al.*, 2015). In relation specifically to Southern Ocean research, benchmark knowledge has been gathered through the Census of Antarctic Marine Life (CAML), which investigated, among others, the diversity, distribution, functions, and abundance of Southern Ocean marine organisms, culminating into the Biogeographic Atlas of the Southern Ocean (edited by De Broyer and colleagues). However, knowledge gaps are still present concerning a wide range of Southern Ocean related science disciplines.

Outcomes and conclusions

A recent study published by Xavier *et al.* (2016) is a further outcome out of the 1st Horizon Scan which specifically addresses research areas related to the Southern Ocean of considerable importance, but that were not necessarily retained in the top 80 most important Antarctic research questions. The study reached several key conclusions. At the species level, basic biological information on the taxonomy of numerous organisms is still lacking for areas such as deep-ocean floor or the under-ice environments.

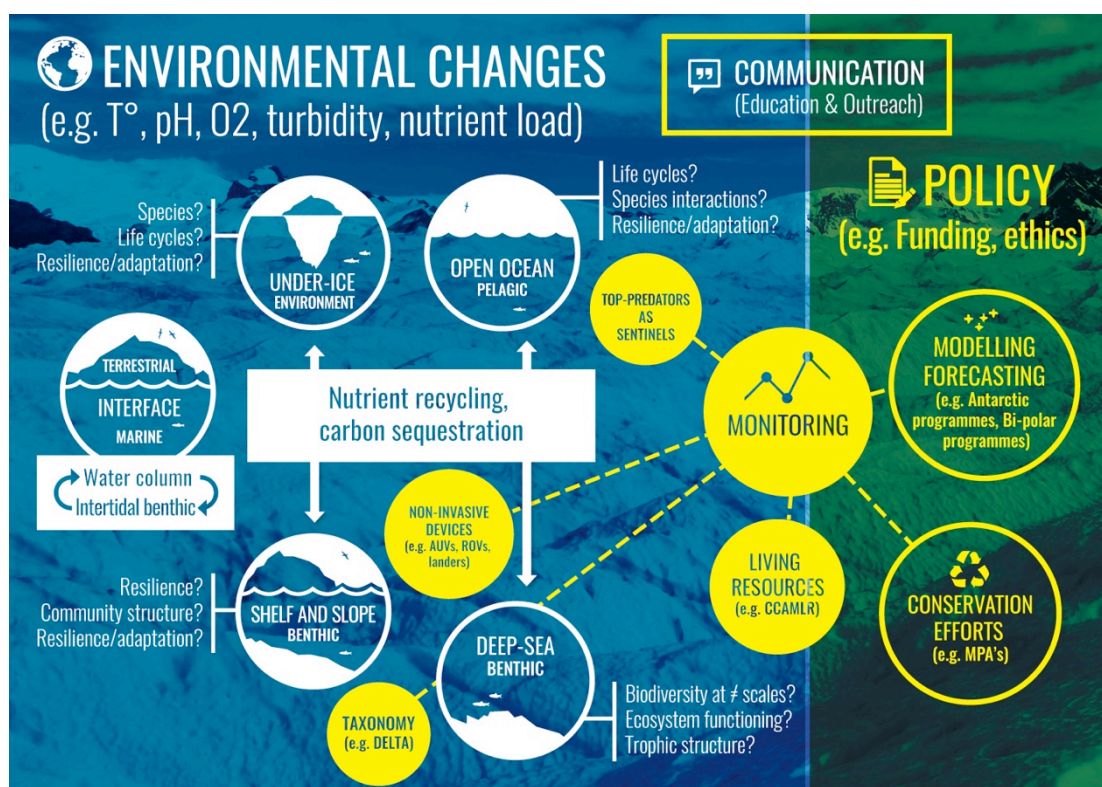


Figure 1. Conceptual diagram illustrating gaps of knowledge in Southern Ocean life and ecology research, examples of the main needs for technological developments, and how these must be linked to monitoring and modeling efforts to forecast future changes in the Southern Ocean. The results of these research fields/gaps may have policy applications, such as guiding conservation efforts, concomitant with a strong communication (education and outreach) component.

At an ecosystem level, the response and resilience to change is largely unknown, rendering accurate forecasting problematic in the near future. However, a future thorough understanding of these responses will be crucial for quantifying the importance of the various components of Antarctic ecosystem services (e.g. biodiversity and carbon sequestration), and the relative impact of future environmental change on these services. Filling in these gaps will require the continuation of a long-term commitment and the development and use of innovative technology to adequately research and monitor Southern Ocean ecosystems, to detect changes at an early stage, and to evaluate multi-stressor effects in marine ecosystems in order to improve modeling efforts focused on interactive effects. Importantly, disciplines like taxonomy and activities such as long-term monitoring should receive strong logistical and financial support if we are to predict likely consequences of climate change and other threats. Finally, informing stakeholders, policy makers and the general public on the results of these studies will draw attention to the importance of this unique ecosystem, emphasize its global pivotal role, and most importantly, its increasing vulnerability to human-induced changes.

Final remarks from a policy perspective

Southern Ocean ecological research will require long-term commitment by parties to conduct international and interdisciplinary research, aided by the development of technology (in cooperation with organizations such as COMNAP and SCAR), education and outreach. Coordinated funding strategies for the various stakeholders will be essential to successfully address the challenges in Antarctic research.

Reference

Xavier, J. C., Brandt, A., Ropert-Coudert, Y., Badhe, R., Gutt, J., Havermans, C., Jones, C., Costa, E. S., Lochte, K., Schloss, I. R., Kennicutt, C., & Sutherland, W. J. (2016). Future challenges in Southern Ocean life and ecology research. *Frontiers in Marine Science* 3:94 DOI: 10.3389/fmars.2016.00094