

# The Scientific Committee on Antarctic Research (SCAR) Annual Report 2018/2019



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## **1. Summary**

SCAR is an interdisciplinary body of the International Science Council (ISC), comprising 44 member countries, nine ISC unions and many individual scientists. SCAR is charged with initiating, developing and coordinating high quality international scientific research in, from and about the Antarctic and the Southern Ocean, and providing objective, independent scientific advice.

SCAR's Mission is to advance Antarctic research, including observations from Antarctica, and to promote scientific knowledge, understanding and education on any aspect of the Antarctic region and its role in the Earth System. SCAR also provides independent and objective scientific advice and information to the Antarctic Treaty System and other bodies and facilitates the international exchange of Antarctic information within the scientific community.

Here, SCAR reports on recent and future activities of relevance to CCAMLR.

## **2. Introduction**

As an official Observer to the Antarctic Treaty, SCAR provides independent, objective scientific advice to the Antarctic Treaty Consultative Meetings (ATCM) and to those bodies that form part of the broader Antarctic Treaty System such as the Committee on Environmental Protection (CEP) and CCAMLR.

SCAR also provides advice to other bodies such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC). In addition to responding to requests for advice, SCAR also identifies issues resulting from greater scientific understanding of the Antarctic region and the Southern Ocean and brings them to the attention of policymakers.

SCAR's coordination of scientific research adds value to national efforts by enabling national researchers to collaborate on large-scale scientific programmes to accomplish objectives not easily obtainable by any single country. SCAR's success depends largely on the quality and timeliness of its scientific outputs and advice. Descriptions of SCAR's research programmes and scientific outputs are available at: [www.scar.org](http://www.scar.org).

SCAR produces an electronic Newsletter (<https://www.scar.org/scar-newsletter/>) highlighting relevant science and is also available on Facebook and Twitter (@scar\_tweets).

### 3. Engagement between CCAMLR and SCAR

SCAR and CCAMLR have a history of cooperation, and representatives of each group continue to meet regularly to maintain and develop the productive working relationship by identifying current areas of mutual interest. The Chief Officer of SCAR SC-ATS (the SCAR Group with a key responsibility for external policy-related advice) and the Chair of SC-CAMLR, continue to maintain regular communications regarding priority areas of research and key issues that would benefit from scientific advice from SCAR.

Several recent developments reflect the commitment of SCAR to continuing its engagement with CCAMLR, particularly with regard to the development of research that is relevant to priorities and contemporary discussion within CCAMLR. Here we highlight three of these developments.

#### 3.1 The Retrospective Analysis of Antarctic Tracking Data (RAATD)

RAATD has consolidated tracking data for multiple species of Antarctic, marine predators to identify Areas of Ecological Significance in the Southern Ocean. The first output of the project has now been accepted for publication [1].

This work presents the compiled tracking data from 1991 to 2016. The data are publicly available through SCAR's [biodiversity.aq](http://biodiversity.aq) page and the Global Biodiversity Information Facility. The archive comprises tracking data from over 70 contributors across 12 national Antarctic programs, and includes data from 17 predator species, 4060 individual animals, and over 2.9 million observed locations. The Areas of Ecological Significance analyses have been completed and are now under consideration for publication with an expected date of release for either late 2019 or in 2020. In collaboration with the lead authors of the work, SCAR intends to develop a synopsis of the outcomes for presentation to CCAMLR at a future meeting.

#### 3.2 SCAR Krill Action Group (SKAG)

SKAG was approved by the SCAR Delegates in 2018 and has met several times to develop its work. At its most recent meeting, SKAG identified “Krill Recruitment” and “Krill’s plasticity to climate change” as the two major knowledge gaps to improve mechanistic understanding of krill abundance, distribution behaviour and movement. Improved knowledge on the range of their optimal performance was also considered important for predicting the stock dynamic under different IPCC scenarios. Key research questions were identified to fill up these gaps:

- i) What are the drivers of recruitment variability (including factors leading to successful spawning, importance of sea ice for juvenile transport of larvae, food source etc.)?
- ii) Where are the source areas of the population (e.g. where are the locations of egg production that lead to a successful development)?
- iii) What is the importance of the spawning stock to the overall krill population?
- iv) What are the consequences of combined environmental factors, in relation to climate change, on krill population dynamic in the future? (e.g. decrease in winter sea ice, increase in ocean acidification and water temperature as well as food quantity and quality)?

Facilitation of such work is now underway and SCAR invites anyone interested in the work to contact SKAG via the SCAR Secretariat ([info@scar.org](mailto:info@scar.org)).

### 3.3 Southern Ocean Diet and Energetics Database (SO-Diet)

SO-Diet has expanded its scope. Originally, it included only conventional diet (stomach content, regurgitate, etc.) and stable isotope (d13C, d15N) data, but the database now encompasses molecular diet data, fatty acids, energetic content, a larger suite of stable isotope data, and allometric equations that provide relationships between body measurements and size or other characteristics.

Effort over the last 12 months has focused primarily on data entry, now with ~275 000 records in total (~230 000 DNA diet records plus ~45 000 records in the other categories), with synthetic work now starting to appear [2].

This work will be of considerable interest to those developing bioenergetic and food web models to predict changes through time in the capacity of Antarctic ecosystems to support marine life. While data are available for myctophid fishes, other fish families, crustaceans, squid, jelly fish, polychaetes, and chaetognaths, important taxa in Antarctic food webs, such as copepods, squid and small euphausiids, remain under-sampled. The work provides models to estimate energy density more quickly using a species' physical parameters.

The SO-Diet database can be accessed here:

<https://www.scar.org/data-products/southern-ocean-diet-energetics/>

### 3.4 Antarctic and Southern Ocean Science Horizon Scan Update

In 2014, a group of researchers, policy makers, logisticians and others sought advice from across the Antarctic and Southern Ocean community about the most important questions facing science for the region and how to deliver that science from a support perspective. Eighty questions and a range of support requirements were identified.

Five years later, progress against addressing these questions has been reviewed from an integrated perspective [3].

The progress assessment is ordered according to the seven clusters of questions identified by the Scan: **1.** Antarctic atmosphere and global connections, **2.** Southern Ocean and sea ice in a warming world, **3.** Ice sheets and sea level, **4.** The dynamic Earth: probing beneath Antarctic ice, **5.** Life on the precipice, **6.** Near-Earth space and beyond, and **7.** Human presence in Antarctica.

An eighth topic, regarding effective engagement of diverse audiences, assesses the impact, delivery, and uptake of the Scan and COMNAP Antarctic Roadmap Challenges outputs with a goal of discerning lessons learned for effective communication that influences societal actions.

Outcomes of several of the cluster reviews are relevant to CCAMLR's interests, of which two examples illustrate the potential significance.

For the Southern Ocean and Sea Ice cluster, compelling evidence from models and observations shows that the Southern Ocean is the dominant contributor to ocean storage of anthropogenic heat and carbon dioxide, which is then swept northward by the overturning circulation, delaying warming near Antarctica. Since the original scan, Antarctic sea ice has

shifted from record high to record low extents, underscoring the incomplete understanding of processes influencing Antarctic sea ice distributions. Antarctic bottom water continues to warm, freshen, and reduce in volume, contributing to changes in ocean heat content and sea level.

In the Antarctic Life on the Precipice cluster, progress has been made on understanding the effects of extreme events on biodiversity. For example, ice-shelf loss leads to the loss of under ice-shelf communities while opening ocean and seabed areas to new colonization. These events alter community structure and diversity, favouring carbon sequestration. The Brunt Ice Shelf collapse in the Weddell Sea provides a recent example of an extreme event that has eliminated habitat for the world's second largest Emperor penguin colony. In marine systems along the Antarctic Peninsula, southward shifts in the distribution of krill, leading to declines of abundance in the north and increases in the south, have also been documented, with profound implications for predators, ecosystems, and their interactions with fishing interests in krill.

Questions that remain largely unaddressed include the effects of year-round ice-free intertidal conditions on biodiversity, the response of Antarctic marine species to changing soundscapes, and the synergistic effects of multiple stressors on Antarctic biota. Studies of the effects of changing ocean front dynamics are also limited. What future sea-ice loss and habitat loss will mean for winter-breeding seals, effects on pelagic and epontic (sea-ice associated) productivity, and impacts on benthic resource supply remain poorly known.

These two examples demonstrate the progress that has been made, but also the considerable work that still needs to be done to understand the future of the Antarctic and Southern Ocean regions region and their functioning.

The outcomes of the scan update, available through the publication *One Earth*, are free for download (<https://www.cell.com/one-earth/home>), but can also be obtained via the SCAR Secretariat.

### 3.5 SCAR Sponsored Programs

SCAR co-sponsors several programs that are of relevance to the work of CCAMLR, including the Southern Ocean Observing System (SOOS) (<https://www.soos.aq/>) and the Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) programme (<https://www.iced.ac.uk/>).

Much new work has been done by both over the past year. SCAR directs those interested in this progress to the pages of the organisations and to relevant papers submitted to WG-EMM and to SC-CAMLR.

## 4. Planning for new SCAR Scientific Research Programmes

SCAR facilitates science through a range of subsidiary activities, among which are the key SCAR Scientific Research Programmes (SRPs) (<https://www.scar.org/science/srp/>). In 2020, SCAR's current SRP suite will come to an end, having facilitated exceptional scientific understanding of Antarctica and the Southern Ocean, our world, and also fundamental questions about the nature of the Universe. These outcomes will be highlighted at the SCAR Open Science Conference in 2020.

Proposals for three new SCAR Scientific Research Programmes are close to completion and will be considered by the SCAR Delegates in 2020. These proposed new SRPs are:

#### 4.1 Integrated Science to Inform Antarctic and Southern Ocean Conservation (Ant-ICON)

Ant-ICON aims to answer fundamental science questions relating to the conservation and management of Antarctica and the Southern Ocean. The programme will support the SCAR Standing Committee on the Antarctic Treaty System with outputs that are of direct relevance to Antarctic and Southern Ocean policy makers, including in the CEP and SC-CAMLR. For more information and key contacts, see <https://scar.org/science/ant-icon/home/>.

#### 4.2 Antarctic Ice Dynamics and Sea Level (AIDSL)

AIDSL is an interdisciplinary, integrated proposed SRP which seeks to quantify the Antarctic ice sheet contribution to past and future global sea-level change, from improved understanding of climate, ocean and solid Earth interactions and feedbacks with the ice, and including the use of biological proxies. The programme will help inform decision-makers to better anticipate and assess the risk to manage and adapt to future sea-level rise and evaluate mitigation pathways. For more information and key contacts see <https://scar.org/science/aidsl/home/>.

#### 4.3 Near-term Variability and Prediction of the Antarctic Climate System (AntClim<sup>now</sup>)

AntClim<sup>now</sup> aims to answer fundamental science questions relating to Antarctic climate variability. Many of the most important questions in Antarctic and Southern Ocean climate science are related to understanding present-day climatic trends and estimating future change in the near term (present day to mid-21st century). This topic is a key gap in the scope of the current SCAR SRPs. For more information and key contacts see <https://scar.org/science/antclimnow/home/>.

### 5. SCAR Open Science Conference and Delegates Meeting

The forthcoming 9<sup>th</sup> SCAR Open Science Conference and Delegates meeting will be held in Hobart, Tasmania from 31 July to 11 August 2020.

The theme is *Antarctic Science – Global Connections*.

This theme highlights the significance of the scientific connections between Antarctica and global earth systems while highlighting the strongly connected Antarctic science community. The theme also reflects the importance of collaboration in Antarctic science, in line with the principles of the Antarctic Treaty System.

The COMNAP Annual General Meeting will run concurrently.

SCAR is pleased to invite all those interested in understanding the current state of and future prospects for Antarctica and the Southern Ocean in a global context, and would be especially pleased to welcome CCAMLR attendees to the OSC.

Abstract submissions for the Open Science Conference open on 31 October 2019. For more information, see <https://www.scarcomnap2020.org>.

## 6. References

1. Ropert-Coudert, Y., et al. 2019. The retrospective analysis of Antarctic tracking data project. *Nature Scientific Data*, in press.
2. Schaafsma, F.L., et al. 2018. The energetic value of zooplankton and nekton species of the Southern Ocean. *Marine Biology* **165**, 129.
3. Kennicutt, M.C. II, et al. 2019. Sustained Antarctic Research – a 21<sup>st</sup> Century Imperative. *One Earth*, in press. <https://doi.org/10.1016/j.oneear.2019.08.014>