

Online workshop to evaluate change within the krill-based food web and to develop solutions for the future sampling of krill

File SKAG_2021Workshop OBJECTIVES and TIMETABLEv4.3.21

Timing:

26-30 April 2021. Meeting duration: 2h each day

Given the global distribution of participants, our zoom-based workshop has to be at unsuitable hours for some. This must be weighed against jetlag, sitting around in airports, hotels plus a heavy carbon footprint for an in-person meeting. Most of the 70+ participants registered so far are from Europe, so we have timed our daily zoom to be in working hours for these, with apologies to colleagues (and especially presenters) from around each side of the Pacific.

Local times for a meeting at 13:00-15:00 GMT each day:

14:00-16:00 London

15:00-17:00 Berlin

09:00-11:00 Santiago, New York

06:00-08:00 Los Angeles

22:00-00:00 Toyko, Seoul

23:00-01:00 Hobart

Introduction

The SCAR Krill Action Group (SKAG) provides a forum to guide research directions, promote collaboration, improve understanding of krill biology and ecology, and facilitate information exchange. A key activity this year is a scientific workshop, supported by WWF, which aims to address one of the major issues in current understanding of Antarctic krill ecology: How the krill-based food web changes over time. What do indices of krill, derived from variety sampling methods including predators and the krill fishery itself, tell us about change in the amounts and distribution of krill?

Objectives

The workshop will address the following questions:

1. *What do existing sampling methods tell us about changes in the krill-populations?*
2. *How can newly emerging approaches and the next generation of krill scientists help us understand changes in krill populations?*

Background

Scientific background. The recent SKAG paper (Meyer et al 2020; <https://doi.org/10.1038/s43247-020-00026-1>) showed that we are entering uncharted waters for the management of the fishery for Antarctic krill, with a suite of changes:

- The fishery is slowly increasing;
- it is becoming more concentrated spatially;
- it is becoming a more autumn/winter operation;
- the climate is changing and projected to change further in future;
- reports on apparent stability and decline in krill are conflicting;
- current management policy is being challenged in the scientific literature; and
- the way we sample and monitor krill is changing.

The SKAG paper identified a series of stand-out issues that scientists need to solve in order to provide the improved understanding needed to respond to the above challenges. One major issue concerns the longer-term trajectory of the stock, and whether it is fairly stable or is declining/showing step-changes and thus likely to change in future in response to climate change.

The first objective of the workshop specifically tackles this issue, aiming to provide the “best, independent, objective advice” (consistent with CCAMLR Resolution 31/XXVIII) of the SKAG community on the detection of past and future change in the SW Atlantic krill stock. It will be forward-looking, identifying the opportunities for construction of future time series.

There are currently a series of seemingly conflicting reports of both change and stability in krill stocks in the SW Atlantic sector. As well as being important scientifically, this confusion impedes clear advice to management on whether the species is sensitive to rapid climate change. The confusion also prevents any firm basis for future projection. Our workshop will focus on the insights gained from a series of methods of sampling krill. We will compare the types of information gained from each method (species, time and depth resolution; spatial coverage of data; relationship between abundance and biomass units; process level insights) to ask our first key question:

1: What do existing sampling methods tell us about changes within the krill-based food-web?

Given the termination of some key time series and changes in emphasis (e.g. increased autumn-winter fishing, increasing use of moorings, gliders and acoustics over nets, new methods of analysing krill) our second key question is:

2. How can newly emerging approaches and the next generation of krill scientists help us understand change within the krill-based food web?

We are entering a transition period in how we sample krill, with some countries reducing their sampling while others, for example China and Korea, are increasing their Antarctic presence. Commensurate with this is a change in sampling methods, for example nets at pre-fixed locations are being used less, while other methods, for example gliders, moorings, fisheries data are partially replacing them, posing both opportunities but also questions for the long-term integrity of time series observations. New stable isotope and other stable dietary marker methods are also being developed, which can be applied to time series samples to understand change in the krill-based food web. This section of the workshop would evaluate the strengths and weaknesses of these newly emerging types of data, in terms of financial cost, data quality, taxonomic resolution, spatial/temporal/depth coverage, ambiguity of result, with recommendations for sampling and harmonisation going forward. The workshop will also promote SKAG aims for information sharing, effective science communication and the role of diversifying krill research through early career scientists. This includes a self-organising early career researcher session on Friday.

Draft timetable.

The table below illustrates the main topics covered on each day (the exact order of presentations each day may change, to reduce the requirement of presenters to talk too early in the morning or too late at night)

The first morning will feature zoom-based questionnaires and participant polling to act as icebreakers, as well as an introduction to SKAG and the aims of the workshop. It will be followed by presentations where the speakers listed below have kindly agreed to provide brief overviews of key issues and how they map onto the needs of management and conservation. Sessions (see Table below) will address a series of topics pertinent to the key questions, followed by structured discussion. A key aim of this workshop is a scientific paper (see “Outputs section for details) and we will provide a link for those

registered to shareable document space, such as googledocs). Comments and suggested input to the Abstracts of the talks on each day can serve as optional “homework” between each zoom session. Interspersed with the presentations and their discussions we will run participant polling via zoom questionnaires to examine, for instance, how emerging sampling methods map onto identified priority areas for krill research.

Section	Topic	Main presenter	Helper, mentor, or 2 nd presenter	Broad topics covered
Monday: Introduction	Introduction	Meyer	Kawaguchi	Introduction to workshop and SKAG. Introducing the key knowledge gaps needed for improved management and conservation
Monday: Introduction	This workshop from perspective of krill fisheries management	Reid		Science needed for krill fishery management. Overview of data already produced by the krill fishery
Monday: Introduction	Changes in SO environment that may impact on krill and the krill food web	Piñones	Murphy	Context of past environmental changes, especially over the last century, briefly touching on future projections
Tuesday: Millennial to decadal scale	Beyond the instrument period: reconstructions using molecular, isotopic techniques etc	Polito		Reviewing various approaches to reconstruct the past over longer time scales, emphasising changes involving krill-based food webs. Insights are described here, for instance, based on stable isotope methods applied on krill predators
Tuesday: Millennial to decadal scale	Net time series	Conroy	Perry	Insights on trends in krill larvae and adults, based on net sampling. Strengths and weaknesses of the methods and of the time series
Tuesday decadal scale	Acoustic time series	Fielding	Reiss	Ship-based acoustics, including wider scale major efforts to determine biomass as well as more local time series. Strengths and weaknesses of the methods and of the time series
Wednesday: decadal scale	Predator indices of krill availability	Hinke	Forcada	Monitoring indices of foraging and diet of krill predators, which provide indices of changing krill availability over time
Wednesday: decadal scale	Fisheries data	Krüger	Arata	Includes discussion of potentially new sampling potential using the fishery, as well as more detail on whether the fishery has already detected any kind of change in krill (including seasonal and vertical distribution etc)
Wednesday: decadal scale	Various indices of recruitment and evidence of changes in pop. structure	Veytia	Hill	Recruitment and population structure of krill can be derived from a variety of sources. This overview will focus on assessing the evidence whether recruitment or population structure of krill has changed or not
Thursday: Intra-annual, fine spatial scale	Moorings	La	Saunders	Strengths and weaknesses of moored acoustics. Can include discussion of indices from sediment traps (biogeochemical imprint) as well as moored acoustics.
Thursday: Intra-annual, fine spatial scale	Instrumented predators	Huckstädt	Takahashi	Some overlap potential with “predator indices of krill availability” above, but Thursday is moving towards method development so this could also mention how the methods can be taken into the future? Cameras on predators included here, we guess
Thursday: Intra-annual, fine spatial scale	Under ice krill sampling	Driscoll	Meyer	Same comments as above: overview of what under ice sampling has told us in the past, with a methods-based forward look. AUVs and gliders going under ice is more naturally covered in AUV/glider section on Friday
Thursday: Emerging techniques	Remote sensing of surface krill swarms	Belcher	Tarling	Moved from Friday on request.
Friday: Emerging techniques	Lowered cameras and direct krill observation	Kane	Atkinson	Includes all kinds of direct image-based observation of krill, including divers and cameras, with appraisal of developing in-situ imaging technology
Friday: Emerging techniques	Gliders and AUVs	Bernard	Watters	Includes potential for under-ice observations. Includes scales of observation, instrumentation available, integration of programmes to address larger scale questions, uses and limitations
Friday: Emerging techniques	New food web marker methods	Schmidt	Yang	Overview of methods, e.g., marker fatty acids, CSIA, sterols, HBIs, to examine food web linkages, and potential for these to be developed to examine food web linkages, including construction of time series of these indices or compilation for examination of spatial change in the krill-based food web
Friday: half-hour early career researcher session: -				Self-organised session led by early career researchers

Workshop output.

This workshop will be focussed on producing a scientific paper from the outset. Presenters listed in table below will be the core authors, supplemented by other participants who contribute substantially to the initiative. Presenters will submit a ~300 word “Abstract” of their presentations, for sharing and discussion at the workshop. Together, these abstracts will form the starting point for the actual manuscript. Such a plan will provide a tangible output at the end of the week and a good head start for the paper.

The paper can be accompanied by a plain-language briefing note displaying the key findings, possibly by means of an infographic for presentation at CCAMLR and other fora. The paper structure will not overlap with an excellent series of recent reviews and initiatives such as Constable et al. (2014), Rogers et al. (2019), IPCC (2019), Meyer et al (2020) or MEASO, because it will:

- A. Use the larger number of participants available in a zoom format meeting to provide a modern krill research sample in a series of zoom “questionnaires” to gauge their balance of expertise, opinions, allowing identification of potential skills gaps or research requirements.
- B. Likewise, it will provide a consensus opinion of how existing and newly developing sampling methods and researcher skills map onto SKAG-identified research priority areas for krill fisheries management. This methods-based forward look will identify priorities and approaches needed to provide the kind of data and knowledge we need.
- C. It is also different to the above reviews because it will provide a more nuanced understanding of how differing indices of krill abundance/availability differ, as well as rationalising, where possible, seemingly conflicting conclusions over how and whether these indices of krill abundance have changed over the last century, based on using differing krill indices, sampling regions and sampling periods.