CCAMLR

Commission for the Conservation of Antarctic Marine Living Resources
Commission pour la conservation de la faune et la flore marines de l'Antarctique
Комиссия по сохранению морских живых ресурсов Антарктики
Comisión para la Conservación de los Recursos Vivos Marinos Antárticos

SCIENTIFIC COMMITTEE

SC-CAMLR-38/BG/22

21 September 2019

Original: English

Moving towards a new era in ecosystem-based krill fishery management

Submitted by ASOC

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Moving towards a new era in ecosystem-based krill fishery management

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Abstract

To move towards ecosystem-based management of the Antarctic krill fishery and meet the requirements of Article II of the Convention, ASOC recommends that:

- SC-CAMLR endorses the work plan proposed by WG-EMM and prioritizes implementation of the work plan to enable revision of Conservation Measure (CM) 51-07.
- SC-CAMLR agrees on the need to conduct subarea or finer scale stock assessments on a regular basis, reconciles methodological discrepancies between the 2000 and 2019 surveys, and develops standardised survey methods prior to conducting any future surveys.
- SC-CAMLR provides advice on changes to krill catch reporting including 1) developing methods to accurately report catch despite differences in greenweight across vessels; 2) ensuring guides for finfish larvae and ice krill are provided to SISO observers; 3) ensuring a method for bycatch reporting at 2-hour intervals in the continuous mid-water trawl method.
- CCAMLR reviews CM 21-03 to incorporate the agreed methodology to estimate 2-hour interval catches in the continuous mid-water trawl fishing gear.
- SC-CAMLR organizes a technical workshop to undertake a comprehensive review of CEMP, considering the growing ecosystem monitoring requirements of CCAMLR.

Introduction

2019 saw major developments in the progression of precautionary ecosystem-based management for the Antarctic krill fishery. CCAMLR Member nations undertook the first synoptic survey for krill in the South Atlantic sector of the Southern Ocean in 19 years. A workshop in June brought together CCAMLR scientists, industry, and the NGO community to work collaboratively toward a collective vision for the krill fishery. In addition, WG-EMM agreed to a detailed and timed action plan on krill fisheries management, proposing coordination groups for members, and prescribing science priorities needed to advance beyond CM 51-07 in time for its expiration in 2021.

At a time of increased fishing pressure and growing climate change impacts, these developments are particularly timely and welcome. Will the Scientific Committee and Commission members seize the opportunities presented in 2019 to further demonstrate global leadership in achieving precautionary ecosystem-based fisheries management?

Status update on the krill fishery – catches, notifications and changes to the krill-based ecosystem

The total catch of krill has been increasing in recent years, with the 2017/18 season catch of 312,743 tonnes (table 1) being the highest catch since the early 1990s (CCAMLR Krill Fishery Report 2018). In addition, fishing during the 2017/18 season took place in Subarea 48.2 in the period from July to October for the first time since records began, and catches in that subarea in the summer (December to March) have increased compared to the previous season.

In the 2017/18 and in the 2018/19 fishing seasons, the fishery in Subarea 48.1 was closed on 25 of June and on 13 of July, respectively, when the catch limit for that subarea was reached. The maximum annual catch

[1]Lead authors Rodolfo Werner and Nikki Bransome, with contributions from Claire Christian, Ricardo Roura, Barry Weeber and WWF.

limit for Subarea 48.1 has been reached seven times since 2010, resulting in the closure of the fishery prior to the end of the fishing season. In addition, the total catches for Area 48 by August 31st, 2019 (373,085 tonnes) were already higher than in previous years, although fishing was still continuing at that time.

Total krill catch in Area 48 by season (tonnes)				
	Area 48	Subarea 48.1	Subarea 48.2	Subarea 48.3
2017/2018	312,743	151,692	137,878	23,173
2018/2019[2]	373,085	155,907	162,417	54,761

Table 1. Total krill catch in CCAMLR Area 48 by season.

In the 2018/19 fishing season, five Members notified their intention to fish for krill with a total of 12 vessels[3] and for the upcoming fishing season (2019/20) the same five Members notified their intention to fish for krill using 14 vessels[4]. These notifications include two new, purpose-built krill fishing vessels. One of them, the *Shen Lan* from China is specialized in Antarctic krill, with media reports calling it the largest krill fishing vessel in the world with onboard processing technology (Godfrey, 2019). With the addition of these two vessels, the total potential processing capacity of notified krill vessels (if all actually fish) increases from 4,620 tonnes per day to 5,750 tonnes, an increase of 25% from 2018/19.

Also in July 2018, ARK (Association of Responsible Krill fishing companies) launched a set of voluntary measures proposed to improve the long-term sustainability of the krill fishery. The Voluntary Restriction Zones (VRZs) were developed as a precautionary action while waiting for CCAMLR to introduce a spatial management measure in Area 48. Based on the VRZs, buffer zones up to a maximum of 40 km of land around the Antarctic Peninsula, the Gerlache Strait and the South Shetland Islands were closed to krill fishing during the fishing season 2018-19 at the time of penguin breeding. As part of the review process of the VRZs, an Expert Panel (EP) was established to objectively review the compliance of the measures during this first season in operation. The EP will produce a report for a Review Panel that would assess the effectiveness of the measures.

One issue of serious concern is the likely negative effect of krill fishing at current levels and concentration on localized predator populations in years with unfavorable environmental conditions in the Bransfield and Gerlache Straits. This was determined by two separate modeling approaches analyzing probable impacts of concentrated krill fishing on penguin populations (SC-CAMLR-38/03; paragraph 4.41). The projections resulting from these two models indicate a need for highly precautionary krill fisheries management in this area.

Meanwhile, recent evidence indicates that over the past 90 years, the population of Antarctic krill in the Atlantic sector of the Southern Ocean has contracted southward during recent warming in its key habitat (Atkinson et al., 2019). These researchers also found evidence for reduced recruitment of juvenile krill, with reduced density of juveniles following positive anomalies of the Southern Annular Mode (SAM). They suggest that climate driven changes in krill distribution may already be affecting the krill-centered food

[2]Catch data for the 2018/2019 season reflect reporting through 31 August 2019.CCAMLR Monthly Fishery Catch Report: August 2019.

[3] Vessels notifying to fish for krill in the 2018/19 fishing season were: *Cabo de Hornos, Antarctic Endeavour* (Chile); *Fu Rong Hai, Long Teng, Kai Fu Hao*(China), *Kwang Ja Ho, Insung Ho, Sejong* (Korea), *Antarctic Endurance, Antarctic Sea, Saga Sea* (Norway); *More Sodruzhestva* (Ukraine).

[4] Vessels notifying to fish for krill during the upcoming season (2019/2020) are: *Antarctic Endeavour* (Chile); *Fu Rong Hai, Long Teng, Long Fa, Fu Yuan Hai 98, Shen Lan* (China), *Kwang Ja Ho, Unsung Ho, Sejong* (Korea), *Antarctic Endurance, Antarctic Sea, Saga Sea, Jewel* (Norway); *More Sodruzhestva* (Ukraine).

web (i.e. reduced birth weights of fur seals at South Georgia in the northern part of krill's distribution range) and krill-driven biogeochemical cycling, including carbon export from krill school fecal pellets and krill feeding mobilizing iron, that helps to fertilize phytoplankton blooms. This study (Atkinson et al 2019) and Hill *et al.*(2019) report that evidence for a decline in krill density stands, despite alternative conclusions obtained by analyzing the same data set (Cox *et al.*, 2018). In addition to impacts on their prey resources, researchers found that within the current krill fishing region, mesopredators expected to be impacted by climate change include chinstrap and Adélie penguins, fur seals, humpback whales, and killer whales (Morley *et al*., 2019).

A work plan to further develop ecosystem-based management measures for the krill fishery

A workshop on Krill Fishery Management for Subareas 48.1 and 48.2 was held in Concarneau, France from 10-14 June 2019, convened by Drs George Watters and Phil Trathan. The workshop was attended by scientists from many CCAMLR Member countries, and representatives of ARK, ASOC, Pew, and WWF. Supporting funds were provided by ARK, Pew, and WWF.

The objective of the workshop was to explore how management strategies for the krill fishery can be integrated and harmonized. Such strategies include, but are not limited to, feedback management, the use of research zones, and advice developed from risk assessments and ecosystem models. The results were introduced at the WG-EMM-2019 meeting, which considered workshop recommendations during its discussions. Further information on the workshop can be found in SC-CAMLR-38/16 and SC-CAMLR-38/BG/18.

ASOC was pleased to see that WG-EMM-2019 subsequently developed a proposed work plan for the further development of krill fishery management, particularly to enable revision of Conservation Measure 51-07. In that context, the WG recognized that a simple approach strategy would facilitate near-term implementation and agreed on a series of relevant elements; which include, among others, a krill stock assessment, predator data to inform a risk assessment, and information on fishery dynamics.

The WG agreed on an approach towards developing a strategy to manage the krill fishery (SC-CAMLR-38/03; paragraph 2.18), which includes:

1. Development of a stock assessment to estimate precautionary harvest rates;
2. Development of an updated biomass estimate, initially at the subarea scale (but potentially at multiple scales);
3. Advancement of the risk assessment framework to inform the spatial allocation of catch.

Furthermore, six key actions were identified that will enable WG-EMM to provide advice to the SC regarding the revision of CM 51-07 (SC-CAMLR-38/03; paragraph 2.17), which will expire at the end of the 2020/21 fishing season unless an update or replacement has been agreed. These actions were to:

1. Update the time series of biomass estimates of krill;
2. Estimate krill flux;
3. Develop a preliminary risk assessment including predator, krill and bycatch layers;
4. Review CEMP to ensure effective coverage of fished and non-fished areas, and development of indices for rapid assessment of predator responses;
5. Develop a harvest strategy for krill fishing, including catch limits and spatial distribution of catches;
6. Develop recommendations for the process to develop a scientific basis for revision of CM 51-07.

These actions are aimed at developing the scientific basis for a revision to CM 51-07 while making progress on a management strategy for the krill fishery. The intention is for this strategy to include catch limits and enhanced spatial distribution in area 48 to be agreed by the Commission in 2021.

If there is a delay in providing this advice, CCAMLR will need to agree on interim krill fisheries management measures that are no less precautionary than the current combination of CMs 51-01 and 51-07 to fulfill the conservation objectives of the Convention.

ASOC recommends that SC-CAMLR endorses the work plan proposed by WG-EMM and prioritizes implementation of that plan to enable revision of Conservation Measure 51-07.

A krill biomass assessment based on spatial distribution and trends in stock size

The field work for the International Synoptic Krill Survey 2019 for Area 48 was successfully completed. This survey was a major undertaking amongst multiple Members, under the coordination of Norway[5] and with important contributions by the members of the Association of Responsible Krill harvesting companies (ARK). The joint research and the collaboration of multiple vessels is a good example of the benefits of international cooperation including engagement by the krill fishing industry.

According to the Subgroup ASAM (SC-CAMLR-38/06), the krill biomass estimate for Area 48 based on the 2019 International Synoptic Krill Survey was 62.6 million tonnes. Extreme caution should be taken in comparing estimates from the 2000 and the 2019 krill synoptic surveys and using the results to inform management. Invertebrate species like krill have huge interannual variation in abundance based on environmentally-driven variability in recruitment. Thus, use of only two data points could mask a (potentially negative) trend between years and repeated surveys will be required to determine if there is any trend. ASOC believes that fisheries management should be informed by stock assessments conducted on a regular basis at the subarea or finer scale, based on time series of krill abundance.

Furthermore, differences between the methodologies of the 2000 and 2019 krill surveys prevent direct comparison. While fishing vessels did undergo a systematic calibration of their echosounders, there are four known methodological differences[6] between the CCAMLR-2000 Survey and the 2019 Area 48 krill synoptic survey identified by WG-EMM (SC-CAMLR-38/03). Finally, the scale of the estimate is not necessarily appropriate, as it does not necessarily consider krill availability in predator foraging grounds.

In addition to the 2019 International Synoptic Krill Survey in Area 48, Australia plans to conduct a krill survey in Division 58.4.2-East between January and March 2021 to estimate biomass of krill. Australia also plans to design a long-term monitoring plan for krill and evaluate the potential of spatial management for the krill fishery in this area. The results from this survey will add to the recent Japanese survey in Division 58.4.1 conducted in 2018/19 (SC-CAMLR-38/06; paragraph 2.40).

In addition, India is planning to conduct a survey from December 2019 to February 2020 in the Prydz Bay region to understand the distribution and biomass of krill in the western Indian Ocean sector of the Southern Ocean. Given concern over methodological differences between years for the synoptic surveys in Area 48, it is important that Members planning future surveys ensure adequate sampling standardization prior to commencing sampling.

[5] CCAMLR Member participants in the International Synoptic Krill Survey in 2019 were: Norway, UK, Ukraine, Korea and China.

[6]Differences between survey methods include: 1) the method used to identify krill targets in the acoustic data 2) the different trawls used on the various vessels 3) conducting acoustic transects during the night and day (versus only day in 2000) and 4) the length of time (one versus three months) and direction of the survey (with versus against the current), the latter two differences potentially leading to double counting.

ASOC recommends that SC-CAMLR agrees on the need to conduct subarea or finer scale stock assessments on a regular basis, reconciles methodological discrepancies between the 2000 and 2019 surveys, and develops standardised survey methods prior to conducting any future surveys.

Accurate catch reporting to minimize unintended ecosystem impacts

Variations in methods to estimate greenweight mean that there are differences in the ways the catch weight is recorded, which leads to a potential underestimate of the impacts of the fishery on krill and the ecosystem. Thus, the development of methods to standardize the reporting of catch weight across different fishing gears is essential. The recent information on the Antarctic Endeavour (during her first year of operation) showed a substantial variability in green weight to meal conversion factors (SC-CAMLR-38/03; 3.40 – 3.41). All this emphasizes the need for vessels to provide individual reports to help understand how catch data are being estimated on those vessels based on green weight estimates, followed by development of methods for standardization.

Following concern that the fishery for Antarctic krill may be catching ice krill as bycatch, the Scientific Committee in 2018 endorsed the inclusion of invertebrate bycatch during reporting in addition to finfish bycatch (SC-CAMLR-XXXVII). However, as of 16 September 2019, appropriate guides for identifying finfish larvae at a species level as well as materials to identify ice krill were not available to fishing observers on the CCAMLR website (CCAMLR 2019) and should be made readily available for the upcoming 2019/20 fishing season.

In 2018, the Scientific Committee (SC-CAMLR-XXXVII; paragraph 3.11) noted that it was not possible to quantify the level of fish bycatch for fishing vessels using the continuous mid-water trawl system. This is incompatible with CCAMLR CMs 33-01,[7] 21-03, and 51-06 and hampers the ability of CCAMLR scientists to accurately quantify the ecosystem impacts of krill fishing. Therefore, SC-CAMLR must require development of a method to standardize quantitative bycatch reporting at 2-hour intervals for vessels using the continuous mid-water trawl method.

In previous years, operators using the continuous mid-water trawl method were reporting catches at six-hour intervals instead of the two-hour intervals required by CCAMLR measures.[8] However, new methods have made it possible to estimate the catch weight by two-hour intervals by monitoring the change in the filling level of the tanks during fishing (a method now being used on all Norwegian krill fishing vessels). WG-EMM-2019 supported this new method. Now the SC should recommend the revision of CM 21-03 to incorporate this agreed methodology.

ASOC recommends that SC-CAMLR provides advice on changes to krill catch reporting including 1) developing methods to accurately report catch despite differences in greenweight across vessels; 2) ensuring guides for finfish larvae and ice krill are provided to SISO observers; 3) ensuring a method for bycatch reporting at 2-hour intervals in the continuous mid-water trawl method.

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[7] CM 33-01 (1995) calls for limitation of the bycatch of particular species of finfish in statistical Subarea 48.3, all of which are included in the publication "Common fish by-catch species in CCAMLR krill fisheries (for observers)". Conservation Measure 51-06 (2016) requires that observers conduct "sampling according to the instructions in the observer logbook for finfish by-catch," where the 2019 Observer Krill Trawl Logbook – Instructions (CCAMLR 2019) states that, "in order to quantify the by-catch of fish and invertebrates, the observer should select a haul or a two-hour haul unit period for continuous fishing…". In addition, in 2019 WG-EMM identified inclusion of data on *Euphausia* species by-catch and juvenile fish by-catch in Subareas 48.1, 48.2 and 48.3 for risk assessment analyses of the krill fishery.

[8]The failure to report catch at proper intervals resulted in catch data not being reported at proper locations. In consequence, recent trials were conducted to use the holding tank volume recorded at two-hour intervals to estimate the green weight of krill (i.e. the relation between tank volume and krill biomass was estimated for individual holding tanks). Every 24 hours interval if there is a discrepancy between total catches estimated every two hours and the total catch determined by the flow scale, the 2-hour catch estimates are adjusted proportionally to compensate for any difference.

Furthermore, ASOC recommends that CCAMLR reviews CM 21-03 to incorporate the agreed methodology to estimate 2-hour interval catches in the continuous mid-water trawl fishing gear.

A comprehensive monitoring program useful for tracking ecosystem changes

Historically, the CCAMLR Ecosystem Monitoring Program (CEMP) has mainly focused on land-breeding predators. In the future, CEMP should be expanded to monitor the status of pelagic predators. The revision should include additional datasets with information on krill-dependent cetaceans, pack-ice seals, and demographic groups other than adult penguins. In Area 48, the CEMP framework will need to be adapted to provide the necessary data to satisfy the needs of spatial management frameworks under development including risk assessments, FBM, and the D1MPA.

The need to review CEMP was highlighted as one of the actions to develop advice to enable revision of Conservation Measure 51-07 discussed at the last WG-EMM meeting. The WG discussed reviewing CEMP to ensure effective coverage of fished and non-fished areas, and to develop indices for rapid assessment of predator responses. Reviewing CEMP has been proposed repeatedly but it is even more urgent in the context of the upcoming revision of CM 51-07.

ASOC recommends that SC-CAMLR organizes a technical workshop to undertake a comprehensive review of CEMP, considering the growing ecosystem monitoring requirements of CCAMLR.

Recommendations

In summary, ASOC recommends that:

- SC-CAMLR endorses the work plan proposed by WG-EMM and prioritizes implementation of the work plan to enable revision of Conservation Measure (CM) 51-07.
- SC-CAMLR agrees on the need to conduct subarea or finer scale stock assessments on a regular basis, reconciles methodological discrepancies between the 2000 and 2019 surveys, and develops standardised survey methods prior to conducting any future surveys.
- SC-CAMLR provides advice on changes to krill catch reporting including 1) developing methods to accurately report catch despite differences in greenweight across vessels; 2) ensuring guides for finfish larvae and ice krill are provided to SISO observers; 3) ensuring a method for bycatch reporting at 2-hour intervals in the continuous mid-water trawl method.
- CCAMLR reviews CM 21-03 to incorporate the agreed methodology to estimate 2-hour interval catches in the continuous mid-water trawl fishing gear.
- SC-CAMLR organizes a technical workshop to undertake a comprehensive review of CEMP, considering the growing ecosystem monitoring requirements of CCAMLR.

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