Annex 10

Report of the Krill Fishery Observer Workshop 2023 (WS-KFO-2023)
(Shanghai, People's Republic of China, 19 to 21 July 2023)

Contents

Report of the Krill Fishery Observer Workshop 2023 (WS-KFO-2023)
(Shanghai, People's Republic of China, 19 to 21 July 2023)

Opening of the meeting

1.1 The CCAMLR Krill Fishery Observer Workshop (WS-KFO-2023) was held on the campus of Shanghai Ocean University in Shanghai, People's Republic of China from 19 to 21 July 2023.

1.2 The Workshop co-conveners, Professor G. Zhu (China) and Dr S. Kawaguchi (Australia), opened the Workshop, welcoming participants (Appendix A) to the Shanghai Ocean University campus and noting the long delay of three years in holding the Workshop due to the Covid-19 pandemic. They recalled the importance of this Workshop to the development of the krill management framework and looked forward to an enjoyable and productive Workshop.

1.3 Participants were welcomed by the vice president of Shanghai Ocean University, Professor Jiang Min, who noted the longstanding history of Shanghai Ocean University in krill research, the strong connections with the Secretariat and collaborations with many Members on krill biology. She also noted that the University supports the krill observer programme and welcomed overseas experts coming to China to discuss the important topic of observer tasks in supporting the management of the Antarctic krill fishery.

Adoption of the agenda

1.4 The agenda was adopted.

1.5 Documents submitted to the Workshop are listed in Appendix B. The Workshop thanked all authors of papers for their valuable contributions to the work presented to the Workshop. A glossary of acronyms and abbreviations used in CCAMLR reports is available online.

1.6 In this report, paragraphs that provide advice to the Scientific Committee and its working groups have been indicated in grey. A summary of these paragraphs and additional advice are provided under 'Advice to the Scientific Committee and its working groups'.

1.7 The report was prepared by J. Arata (Invited expert), I. Forster (Secretariat), S. Parker (Secretariat), G. Robson (UK), and Y. Ying (China).

Review of the development of data sampling protocols by the Scientific Committee and its working groups

2.1 WS-KFO-2023/02 reviewed the history of the Scheme for International Scientific Observation (SISO) program, established in 1992. Data collected by SISO helps to identify the effects of fishing on target and dependent species, understanding krill population dynamics and conducting stock assessments. It noted that the development of the new krill management

approach for krill fishery will demand more high-quality data, which requires existing protocols to be standardized while being easily applicable. The terms of reference for the WS-KFO-2023 included reviewing the tasks undertaken by the CCAMLR SISO observers (hereby referred to as observers) and improving data collection. The paper identifies three main tasks undertaken by observers:

(i) krill biological sampling,

(ii) fish by-catch sampling, and

(iii) warp observation for bird strikes.

These tasks sometimes implied competing efforts and require a revision of the observer workload and a review of its prioritisation.

2.2 The Workshop welcomed the paper and highlighted the important role that observers have within CCAMLR approach to managing fisheries and appreciated their continuous efforts and efforts of their national coordinators.

2.3 The Workshop noted that along with reviewing sampling protocols to help them understand the purpose of the sampling, it would be beneficial for observer coordinators and scientific observers to be provided with background information on how the data will be used.

2.4 The Workshop noted that the tasks requested of observers have changed over the years due to changing priorities, thus the importance of reviewing the current needs to fulfill the new krill management strategy. The Workshop also noted the need to discuss sampling priorities when more than one observer is onboard.

2.5 The Workshop noted that traditional trawlers target large, dense swarms, while continuous trawlers target large and less dense swarms as they do not stop pumping in between swarms, therefore the krill they catch may have different characteristics.

2.6 The Workshop noted the need to consider training requirements for observers along with the development of new sampling protocols. The Workshop further noted the importance of the specifications of the equipment needed for sampling krill properly, in order to achieve a high level of sampling standardization.

2.7 The Workshop noted that the only current requirement specified under Conservation Measure (CM) 51-06 is krill biological sampling. Fish bycatch, warp strike observations, and observations of incidental mortality associated with fishing are tasked to observers, but the frequency of those tasks is not specified under any Conservation Measure (with the exception of continuous trawl vessel requirements under CM 25-03). As result, each observer program applies different sampling priorities.

2.8 The co-conveners of the Workshop provided a summary on the status of krill fishery management and the importance of observer data. In 2022 the Scientific Committee agreed that the revised catch limit for Subarea 48.1 was based on the best available science but noted that its implementation will require a commensurate increase in data collection and monitoring on krill population, as well as measures to mitigate potential impacts on other components of the ecosystem, including interactions with seabird and marine mammals (SC-CAMLR-41, paragraphs 3.51 and 3.63). During WG-EMM-2023, the SCAR Krill Expert Group (SKEG)

presented a first draft on a krill stock hypothesis (WG-EMM-2023, paragraphs 4.28 and 4.29). The Workshop noted that krill fishing vessels could provide almost year-round data that would aid in testing the krill stock hypothesis.

2.9 WG-EMM-2023 proposed a combination of biological, genomics and physical oceanography sampling to achieve a greater understanding of krill stock structure and dynamics (WG-EMM-2023, paragraph 4.32, Table 1). To implement this plan, observers could contribute with biological and environmental information. These data would help to identify spatial-temporal distribution of krill and aid in identifying high-density areas.

2.10 The co-conveners reflected on the recommendations from WG-EMM-2023 and implications regarding this Workshop:

(i) the observer protocols should be modified to include a random selection of individual krill to measure,

(ii) measurements should be taken at a similar time of day, the entire sample should be measured,

(iii) observers should have appropriate equipment (e.g., a stereomicroscope),

(iv) regular krill observer training workshops should be held,

(v) the impact on observer workload needs to be considered when making the recommendations on sampling frequency,

(vi) the requirements of the data collection have changed from historic needs, and current requirements should also be considered if tasking the observers with additional measurements.

2.11 Based on the above, the Workshop developed advice on the following topics:

(i) length frequency sampling protocol,

(ii) equipment requirements to execute the protocol,

(iii) training requirements,

(iv) actual time budget of observer tasks on each type of vessel to understand potential conflicts in scheduling,

(v) improvements needed and challenges for future data collection.

Management of appropriate workload

3.1 WG-EMM-2023/23 presented an analysis of observer sampling rates in the krill fishery for each vessel that fished for krill from 2018 to 2022, including krill biological sampling, fish by-catch sampling, and warp observations following a request by WG-FSA-2022 (paragraphs 8.25 and 8.26). Current sampling rate requirements were given to aid in the interpretation of results. Results indicated that the majority of krill biological sampling rates were above the

required minimum rate, by-catch sampling rates were generally high despite the absence of a required minimum rate, and warp observations rates did not always reach the suggested rate (one sample per day).

3.2 The Workshop welcomed this analysis and noted the higher krill biological observation rates for traditional trawlers than for vessels using the continuous trawling system, as well as the potential need for higher sampling rates in particular geographical areas or when krill catches are large.

3.3 The Workshop noted that other factors could be influencing the sampling rates achieved in the krill fishery, including gear type (continuous and traditional trawl), the number of observers on board, other competing sampling tasks, and the type of sampling.

3.4 The Workshop noted that the seasonal change in krill length sampling frequency, every three days during summer and every five days in winter, began voluntarily in 2010 and became a requirement in 2012 (SC-CAMLR-XXXI, paragraph 7.16 and Annex 6, paragraph 2.40). This was implemented to capture the rapid growth period of krill in the summer but may need to be revised to effectively detect this now that the fishery moves around more (paragraph 6.7).

3.5 WS-KFO-2023/03 investigated the variability in krill length and duration of observation by observers involved in krill biological data collection in the Antarctic krill fishery. The results of the analysis showed larger krill were caught during the daytime compared to that at night, and krill size, colour and period affected workload of observers. The authors therefore recommended that a minimum sample size of 100 krill is enough for determining representative krill length frequency distribution of catch, the priorities of observers' tasks need to be redefined, and the sampling design of current biological data collection needs to be reconsidered along with the consideration of workload.

3.6 The Workshop welcomed the paper and noted the conditions of workload dedicated to krill biological data collection could be considered for revision of biological data collection requirements in the Scientific Observer Manual – Krill Fisheries. The Workshop further noted the importance that any changes to observer sampling requirements provide a clear rationale for the data to be collected to promote their use in management of the fishery. The Workshop supported the ongoing improvement of data quality, and the need to give consideration to observer workload in revising requirements.

3.7 The Workshop noted that WG-ASAM-2023 discussed how and when to collect a krill sample along a nominated acoustic transect from a fishing vessel and the appropriate sample size needed to obtain a representative length frequency for krill (WG-ASAM-2023, paragraphs 4.16 to 4.18), and noted that this was dependent on the intended use of these data and the spatial resolution needed.

3.8 WS-KFO-2023/06 summarised the current observer tasks in the krill fishery and responses to the observer survey questionnaire (included in the paper). There were 30 responses to the observer questionnaire survey: from China (17), United Kingdom (7), Korea (3), Chile (2) and Ukraine (1). Twenty-one of the observers had experience on traditional trawlers only, four had experience on continuous trawlers only and five had experience on both trawler types.

3.9 The results of the questionnaire showed variability in how tasks are conducted by different Member programmes. Krill and bycatch sampling were identified as priority tasks

while bycatch and IMAF observations for net monitor cable trials were reported to create conflict on time demands, and the time and location of sampling was not necessarily random.

3.10 The Workshop noted the variability among responses and noted the importance of clearly defined sampling specifications for observers that are scientifically supported and practical to implement. The Workshop also noted the value of including feedback from experienced observers with direct experience in the krill fishery in addition to krill fishery managers, observer coordinators and scientists.

3.11 The Workshop noted that historically, observer deployments on the Chinese krill vessels averaged about two months in duration, whereas current deployments can last for close to one year in duration. The Workshop thanked all of the observers for their ongoing commitment and hard work in collecting this valuable information and considered that a prize could be awarded based on length of service or other metrics in recognition of these efforts.

3.12 The Workshop considered the tasks conducted by observers on board krill fishing vessels and developed a table to summarise the amount of time each type of sampling event and task typically entailed (Annex 1, Text of the SISO), with a time range indicated when conditions created variability in the time required (Table 1). The Workshop noted that Table 1 provides a summary of many averages of times required, which may vary the total time required from day to day. Noting that those on the vessel work consecutive days throughout their deployment, the Workshop requested the Scientific Committee provide priorities for the tasks to guide the observer in time allocation among tasks.

3.13 The Workshop noted that only Krill biological sampling and net cable trial monitoring on continuous trawl vessels were specified in Conservation Measures 51-06 and 25-03 respectively, but that other tasks are needed in accordance with the text of the CCAMLR SISO. The Workshop noted that most of the tasks were defined in the Scientific Observer's Manual – Krill Fisheries, but that some ancillary tasks were detailed in Table 1 to account for the time observers spend conducting their duties. The Workshop further estimated the actual average time per day from 2022 data on sampling rates from WG-EMM-2023/23.

3.14 The Workshop noted that identified sampling and supporting activities, that if conducted all in one day, would require an observer to spend almost 12 hours on average across the fishing fleet, and that with large sampling tasks spread over multiple days, the actual average amount of time spent in 2022 was over 9 hours per day on traditional trawl vessels, and over 11 hours per day on continuous trawl vessels due to the net monitoring cable trial requirements. The Workshop further noted that because only two tasks were specified by Conservation Measures while other tasks are outlined in the text of SISO, Annex 1, the specified duties, including ancillary activities would require between 4.2 and 4.7 hours on traditional trawl vessels, and 6.5 to 7.0 hours on continuous trawl vessels depending on the season (Table 1).

3.15 The Workshop noted that time estimates for all tasks were based on the tasks being undertaken by experienced observers. The Workshop further noted that this was the first occasion that estimated observer time allocation for tasking in the krill fishery had been summarised and welcomed the information to support planning within the Scientific Committee and its working groups.

Refinement of sampling and reporting protocols

4.1 WG-EMM-2023/05 presented a comparison of length frequency sampling between krill researchers and scientific observers on board a commercial krill fishing vessel over several seasons. Observers are required to sample 200 individuals every 3 or 5 days, depending on season and other requirements according to CM 51-06, whereas researchers sampled every day at the same time and analysed krill from one or two subsamples. Observers tended to use a monocular microscope that had lower magnification, and there were differences in how the two groups defined maturity stages. There were significant differences in the length frequency distributions for most of the compared samples. The paper concluded that current observer protocols tended to under-sample small krill, the juvenile component of the catch, and the different staging protocols resulted in different life-stage compositions. The bias, as a result, will have effects on estimating the spawning component of the catch and determining the amount of sub-adult stages that will develop into mature krill the following season.

4.2 The Workshop noted that the paper clearly demonstrated the differences in measurements between krill researchers and observers and agreed that there was a need to improve accuracy when measuring and determining sex of krill, particularly for the juveniles.

4.3 The Workshop considered that taking measurements of krill at randomized periods throughout a 24-h cycle would potentially reduce systematic measurement bias as studies have shown that vertical migration of krill can result in different length frequency distributions between day and night periods paragraph 3.5).

4.4 The Workshop further noted the recommendation in the paper that krill sampling be performed daily and reflected that this would require consideration of observer workloads, as a daily sampling frequency would be a significant increase on the current krill sampling requirements (Table 1).

4.5 The Workshop noted the recommendation from WG-EMM-2023 (paragraph 4.3) to consider the draft length frequency sampling protocol developed by WG-EMM-2023 Appendix D for better application on traditional trawling vessels. The Workshop undertook a revision of this protocol, detailed in Appendix D.

4.6 The Workshop noted that the revised krill sampling protocol (Appendix D) may in some cases result in a significant increase in the workload of the observer. The Workshop requested that the Scientific Committee consider the appropriate Working Group to assess whether any krill sampling protocol requires a minimum number of individuals to be measured and sexed, or whether the sampling can be volume based (paragraph 6.7).

4.7 The Workshop suggested that the Scientific Committee consider the frequency of krill biological sampling according to the purpose of the data collection.

4. 8 WS-KFO-2023/01 presented a guide to determining sex and maturity stage of Antarctic krill and provided detailed explanations and high-resolution images of sexual organs to assist observers' krill sampling tasks onboard fishing vessels.

4.9 The Workshop welcomed the guide and the commitment by Dr Kawaguchi to share the materials with the Secretariat for inclusion in the Scientific Observer Manual – Krill Fisheries.

4.10 The Workshop recommended the use of a stereoscopic microscope for aiding sex determination of krill, and thus requested the inclusion of a minimum set of standards of an appropriate quality stereoscopic microscope with upward looking or flexible light source to be added to the observer manual, to assist observer programmes and vessels when they are sourcing equipment.

4.11 WS-KFO-2023/04 presented the results of a study that addressed data quality issues in the CCAMLR krill fishery database, particularly relating to data consistency and accuracy. Historical data links (2000 – 2012) between observer data and C1 vessel data were examined which resulted in 5 660 newly created links and 4 253 updated historical links of the 11 907 records with issues, making a significant improvement. Data accuracy issues were also identified, including unit errors and missing values, which affected the analysis of fish by-catch in the krill fishery. To improve data quality suggestions included enhancing the types of data checks, conducting regular diagnostics, and providing diagnostic tools for observers.

4.12 The Workshop welcomed the results of the study and supported the recommendations to develop better observer advice relative to data checking procedures, as well as the provision of improved diagnostic tools for observers and vessels.

4.13 The Workshop noted that data from CCAMLR krill fisheries has improved in quality since 2012.

4.14 The Workshop noted that the project was undertaken through the CCAMLR international internship programme with support provided by China Fund, the China Scholarship Council and Shanghai Ocean University. The Workshop noted the historic success of the CCAMLR internship programme, and that many graduates had moved on to roles within Members' delegations. The Workshop encouraged Members to engage and continue their support of the CCAMLR internship programme given the increased capacity benefits that had been achieved.

4.15 The Workshop received a summary from Ms Robson on progress with an analysis to determine a krill length frequency sample size that would best reflect the overall length distribution of the catch in a Subarea. The analysis used bootstrapping to develop a power analysis of existing samples. The Working Group noted this progress report was also presented to WG-SAM-2023 (paragraphs 3.4 and 3.5)

4.16 The Workshop noted that the analysis would provide useful information about the estimation of size distribution of the catch and recommended that a paper be prepared and submitted to WG-SAM-2024 for review.

4.17 WS-KFO-2023/05 presented a draft data collection template and accompanying instructions for krill trawling vessels to report standardised data in the event of a whale

mortality event. The draft data collection form was provided to WS-KFO-2023 to support any potential discussions around priorities for observers, observer workload and safety and for suggested refinements prior to the template being presented to WG-IMAF-2023.

4.18 The Workshop noted that basic metadata fields regarding the haul position, date and time and fishing depth should be placed first and recommended the addition of a field for haul

number to link the data in the cetacean mortality form with fishing vessel data for verification purposes.

4.19 The Workshop recommended that detail on how to distinguish between fresh, decomposed, or very decomposed categories for whale condition, and additional classifications of floating, tangled in net but in the water, and on board be developed to ensure that observers recorded accurate and comparable data in these fields. The Workshop further noted that data such as blubber thickness may be difficult to obtain and should only be performed when safe to do so.

Training materials for krill sex determination and length measurement

5.1 The Workshop noted many Members conducted their current observer training programmes regularly every year immediately following the annual meetings of the Scientific Committee and the Commission.

5.2 The Workshop encouraged Members to contribute their training materials, experiences and multimedia records for developing training materials for scientific observations to the Secretariat.

5.3 The Workshop noted the cooperation among Members or between Members and the Secretariat on observer training that has been implemented and encouraged such collaborative efforts.

5.4 The Workshop encouraged the Secretariat to develop a poster or workstation summary instructions translating the observation tasks from the detailed Scientific Observer Manual – Krill Fisheries into specific items which can be easily followed and directly implemented by the observers. This should be translated into the native languages of the observers.

5.5 The Workshop noted the need to distribute the most updated observation tasks and Conservation Measures to observers in a timely manner, and ensure that fishing vessels and technical coordinators of Members are promptly informed with any updates.

5.6 The Workshop suggested that the Secretariat develop a summary of scientific observation efforts to be included in the krill fishery reports as feedback for observers, and seek confirmation from the observer designating nations before releasing such information.

Advice to the Scientific Committee and its working groups

6.1 The Workshop included a discussion on challenges and opportunities for future developments to improve the krill fishery observer program. These suggestions spanned improvements to the Scientific Observer Manual – Krill Fisheries to clarify sampling priorities and future development recommendations as detailed below.

6.2 The Workshop noted that the draft cetacean sampling form developed in collaboration with the International Whaling Commission (WS-KFO-2023/05) would require specific training and instructions for observers. The Workshop sought clarification on the conditions

required for sampling to occur, as it was unclear what data should be collected if a cetacean could not be brought on board versus if it could.

6.3 The Workshop requested that the Scientific Committee consider procedures to follow for the sampling and measurement of bycatch when large numbers of larvae or other small taxa are found in the 25 kg krill bycatch sample. In addition, the Workshop requested the Scientific Committee consider the frequency of sampling for bycatch species and size composition.

6.4 The Workshop noted that observers may be asked by vessels to assist with activities that are not specifically assigned observer tasks, such as completing C1 forms or conducting volume to mass conversion factor tests for the estimation of krill green weight. The Workshop requested the Scientific Committee clarify the intent and prioritisation of observer tasking.

6.5 The Workshop noted that WG-ASAM-2023 developed instructions for acoustic data to be collected by fishing vessels but did not specify if this would be a vessel task or an observer task. The Workshop requested the Scientific Committee consider the role of observers in the collection of acoustic data and metadata, and if tasked to provide training to ensure observers are appropriately skilled for the task.

6.6 The Workshop noted that improvements to sampling procedures, equipment specifications (including stereomicroscope) and training materials (e.g., sex and stage identification) may require updates to both observer forms and instructions. The Workshop noted that some innovative methods to determine sex of krill using bright light (e.g., from a cell phone) were introduced during the Workshop, that such a procedure could provide a fast method with no specialist equipment requirements, and suggested future research detailing and comparing the method with current sex determination methods be presented to the appropriate Scientific Committee Working Group.

6.7 The Workshop requested the Scientific Committee consider the purposes for krill length frequency data collection from fishing vessels and given the purpose, the appropriate minimum number or volume of krill to be measured and the frequency of sampling (paragraph 4.6).

6.8 The Workshop noted that mechanisms existed to improve observer and vessel data quality and requested the Scientific Committee support the development of improved error trapping during data entry, diagnostic capabilities, and training in the use of these methods (paragraph 4.10).

6.9 The Workshop noted the new procedures in development will require improved training and training materials and requested the Scientific Committee consider the development of modern internet-based tools to assist in providing consistent training information among scientific observer training programs.

6.10 The Workshop noted the krill data collection workplan included additional workshops and suggested that the Scientific Committee progress these given the importance and interlinked data collection activities (SC-CAMLR-41, Table 11).

6.11 The Workshop noted that observer time is limited and that automated methods using for example, electronic monitoring, artificial intelligence and machine learning could be used to free observer time for more complex tasks and requested Members to develop these mechanisms to improve the amount and quality of data collected where possible.

6.12 The Workshop noted of the limited time available for observers to conduct necessary activities and requested that the Scientific Committee consider their workloads when prioritising and allocating observer tasks.

Adoption of the report and close of the meeting

7.1 The report of the Workshop was adopted, requiring 2.5 hours of discussion.

7.2 At the close of the Workshop, Professor Zhu thanked Secretariat, co-convener, observers for productive discussions, industry for support and collaboration, and further thanked the support of China Fund on the Workshop, Dr X. Zhao (China) for clarifying contributions, and students from Shanghai Ocean University for their enthusiastic support and discussions. Co-convener Dr Kawaguchi concurred and thanked Professor Zhu for his generosity and expertise in the many aspects of supporting this meeting.

7.3 The co-conveners noted the value of bringing together the fishing industry, observers, and scientists to build common understanding and relationships to improve the scientific information provided to CCAMLR for fishery management.

7.4 Dr Zhao, on behalf of the participants, thanked the co-conveners for their efficient guidance. He noted that we now have an observer task time budget for the first time in CCAMLR history. He also thanked the Secretariat and the rapporteurs for their excellent text.

7.5 Mr Xu Yucheng and Mr Han Yu (China) expressed their appreciation to the participants of the Workshop for their important contributions and looked forward to further development of the observer programme and to support their work.

7.6 Mr Forster congratulated the participants for the fastest report adoption he has witnessed, and thanked all the participants for willingness to travel and contribute to helping us all learn more about data collection in the krill fishery.

7.7 The invited expert, Dr Arata, thanked the Workshop and the co-conveners for inviting him to the Workshop and for giving him the opportunity to contribute to the further development of the observer programme.

7.8 The Workshop thanked the graduate student volunteers Mr Sisong Dong, Ms Yafei Dong, Mr Juntao Du, Ms Linhong Li, Mr Weichang Li, Mr Shiyu Lin, Ms Hui Liu, Ms Jinhui Liu, Ms Yu Liu, Ms Hurui Qian, Ms Chongchong Wang, Mr Huaimo Wang, Mr Jialong Wang, Mr Feng Xue, and Ms Mengchen Zhang (Shanghai Ocean University) for their work in supporting the logistics of the Workshop.

Table 1: Estimated times for conducting current SISO observer tasks in CCAMLR krill fisheries. Unless specified, figures are expressed in hours per day. CT = Continuous Trawlers, TT = Traditional Trawlers. "November – February" and "March – October" headings indicate periods where krill biology sampling requirements are specified under Conservation Measure 51-06.

CCAMLR SISO observer tasks	Time required per event (h)	Average time for daily sampling (h)	Actual average time per day	November – February	March – October	Comments
Krill Biology	3–4	3.5	1.84*	1.2	0.7	* Mean daily sampling rate calculated from 2022 data (WG-EMM-2023/23)
Bycatch composition and measurement	2–4	3.0	2.22*	Tasks not specified under any Conservation Measure. Based on current observer tasking from the actual average time per day, the total number of hours per day for these categories is expected to be 3.26 h. This is not included in the total time required.		* Mean daily sampling rate calculated from 2022 data (WG-EMM-2023/23)
Warp strike observation	0.5	0.5	0.46*			* Mean daily sampling rate calculated from 2022 data (WG-EMM-2023/23)
IMAF during haul	0.75	0.8	0.8			
Vessel sightings (IUU)						
Waste disposal observation	0–1	0.5	0.5			
Marine debris observation						
Cruise report diary	0.5	0.5	0.5	0.5	0.5	
Net monitoring cable	1.5–3	2.3	2.3	2.3	2.3	Continuous trawl vessel specific, additional to warp strike
Mammal mortality sampling	Case specific					Priority to be determined by Scientific Committee
Logbook worksheet data entry/verification/diagnostics	1–3	2.0	1.5	1.5	1.5	Including remote validation
Communication with vessel crew	0.5	0.5	0.5	0.5	0.5	
Subtotal		13.5 CT, 11.2 TT	10.5 CT, 8.2. TT	6.0 CT, 3.7 TT	5.5 CT, 3.2 TT	

(continued)

Table 1 (continued)

CCAMLR vessel tasks with potential SISO observer input	Time required per event (h)	Average time for daily sampling (h)	Actual average time per day	November – February	March – October	Comments
Vessel data collection (C1, CE)	0–2					Vessel specific
Assist vessel species ID	0.5–0.75					
Green weight estimation	2					Only calculated infrequently
Acoustics	1					Vessel specific
Interim reporting	0.5					
Subtotal		1	1	1	1	As considerable variation exists between vessels, WS-KFO estimated an average of one hour per day for all tasks observers provide vessels with assistance.
Total time required		14.5 CT, 12.2 TT	11.5 CT, 9.2 TT	7.0 CT, 4.7 TT	6.5 CT, 4.2 TT	

Appendix A

List of Registered Participants

Krill Fishery Observer Workshop
(Shanghai, People's Republic of China, 19 to 21 July 2023)

Chair		Dr So Kawaguchi Australian Antarctic Division, Department of Climate Change, Energy, the Environment and Water
Chair		Professor Guoping Zhu Shanghai Ocean University
Invited Expert		Dr Javier Arata Association of Responsible Krill harvesting companies (ARK)
China, People's Republic of	Representative:	Mr Jiancheng Zhu Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Science
	Advisers:	Mr Zhuang Chen Shanghai Ocean University
		Mr Lian Chi Jiangsu Sunline Deep Sea Fishery Co., Ltd
		Mr Gangzhou Fan Yellow Sea Fisheries Research Institute
		Mr Xu Gao China national fisheries corp.
		Mr Hongliang Huang East China Sea Fisheries Research Institute, Chinese Academy of Fishery Science
		Mr Kai Huang Shanghai Ocean University

Mr Shuai Li
East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences

Mr Ling Zhi Li
East China Sea Fisheries Research Institute

Mr Rundong Lin
Fujian Zhengguan Fishery Development Company, Ltd

Mr Peiyan Liu
China National Fisheries Corporation

Mr Jun Rong Luo
Fujian Zhengguan Fishery Development Co., Ltd.

Dr Xinliang Wang
Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Science

Ms Bixue Wang
Shanghai Ocean University

Mr Wan Yong Wang
Jiangsu Sunline Deep Sea Fishery Co., Ltd

Mr Yucheng Xu
Liaoning Pelagic Fisheries Co., Ltd

Ms Mei Xue
Shanghai Ocean University

Dr Yi-Ping Ying
Yellow Sea Fisheries Research Institute

Mr Han Yu
Liaoning Pelagic Fisheries Co., Ltd

Mr Xinggao Zhang
China National Fisheries Corp.

Mr Guoqing Zhao
East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences

		Dr Xianyong Zhao Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Science
		Mr Jiuyang Zhu Shanghai Ocean University
Germany	Representative:	Professor Bettina Meyer Alfred Wegener Institute for Polar and Marine Research
South Africa	Adviser:	Mrs Melanie Williamson Capricorn Marine Environmental (CapMarine)
Ukraine	Representative:	Mr Viktor Podhornyi Institute of Fisheries and Marine Ecology (IFME)
United Kingdom	Adviser:	Ms Georgia Robson Centre for Environment, Fisheries and Aquaculture Science (Cefas)
Secretariat		Dr Steve Parker
		Mr Isaac Forster

Appendix B

Agenda

Krill Fishery Observer Workshop
(Shanghai, People's Republic of China, 19 to 21 July 2023)

1. Introduction

    1.1 Opening of the meeting
    1.2 Adoption of the Agenda

2. Review of the development of data sampling protocols by the Scientific Committee and its working groups

3. Management of appropriate workload

4. Refinement of sampling and reporting protocols

5. Training materials for krill sex determination and length measurement

6. Advice to the Scientific Committee and its working groups

7. Adoption of the report and close of the meeting

List of Documents

Krill Fishery Observer Workshop
(Shanghai, People's Republic of China, 19 to 21 July 2023)

WS-KFO-2023/01	A guide to sexing Antarctic krill, with pictures! Melvin, J.
WS-KFO-2023/02	Krill Observer Workshop, what to expect Zhu, G.P. and S. Kawaguchi
WS-KFO-2023/03	An investigation of variability in krill length and observation duration of scientific observer involving in krill biological data collection in Antarctic krill fishery Zhu, G.P., Z.H. Zheng and S. Qiu
WS-KFO-2023/04	Data quality screening for data reported from vessels and observers in the krill fishery Huang, K., D. De Pooter and S. Parker
WS-KFO-2023/05	Draft data collection form for whale incidental mortality events in the krill trawl fishery Kelly, N.
WS-KFO-2023/06 Rev. 1	A summary of current SISO observer tasks in the krill fishery, and responses to the krill observer survey questionnaire. CCAMLR Secretariat

Appendix D

Protocol for length-frequency measurements, sex and stage determination of krill (*Euphausia superba*) on board traditional trawl krill fishing vessels

Background:

Length measurements and sex and stage determinations of krill will provide data that gives insight into its demographic structure (proportion of juvenile and adult krill, sex ratio). By determining the sex and length of a random subsample of ~200 krill individuals, a representative picture of the targeted krill swarm`s demography can be drawn. Simultaneous collection of simple metadata on position, date, time of day, fishing depth and bathymetry, provides valuable insights into understanding krill distribution, behaviour, and life history across seasons and may contribute to managing the krill fishery.

Materials:

- 3x Plastic buckets/ containers (~5 L volume), can be white or transparent (see example in figure 1)
- 1x One litre container/ bucket if sampling from the fishpond/ hold
- 1x Shovel
- 2x Graduated measuring jugs (500 ml volume, see figure 1)
- 1x Ladle
- 1x Laminated millimeter-gridded paper (spanning at least 0 to 70 mm)
- Paper tissue
- 1x Stereomicroscope (minimum requirements detailed in Scientific Observer Manual - Krill Fisheries)
- 1 x Set of forceps

Sampling:

Prior to the krill sampling procedure, have all the devices you need in place (see Materials above) and check the steps in Figure 1:

Three buckets or containers, with two of them filled with cool surface seawater; one litre container or bucket if sampling from fishpond, one shovel if sampling from conveyer, two graduated measuring jugs, a ladle.

Work with the vessel to determine the safest and most appropriate location to take fresh krill samples. Ideally these should be taken from the fishpond or hold as soon as practicable after the landing of a haul. If it is not possible to take samples from the fishpond or hold then samples can be taken from the factory conveyer belt provided they are fresh, and not from old krill

landed in previous hauls. It is not recommended to take samples directly from the trawl net as the trawl deck can be a hazardous environment.

(i) Take 3 x one litre samples of krill, ideally from separate locations within the fishpond or hold if possible. If sampling from the conveyer belt take three shovelfuls of krill. Place either your 3 x one litre samples, or 3 x shovelfuls into a bucket,and mix gently, if required add some seawater to prevent damage to the krill during mixing. (see step 1 in Figure 1).

(ii) From this bucket, fill one graduated measuring jug to the ~200 ml mark with the ladle and the other one to the ~50–100 ml mark (see step 2 in Figure 1). The 200 ml size is suggested as this should contain approximately 200 krill, however as krill size is variable, this 200 ml sample could be adjusted appropriately.

(iii) The krill in each jug should be transferred to each of the two buckets previously filled with cool surface seawater to prevent degradation of the krill (see step 3 in Figure 1).

(iv) In the laboratory, place the bucket with the ~200 ml krill, when possible, on ice and store the bucket with the ~50–100 ml subsample in a refrigerator (see step 4 in Figure 1).

The bucket with the ~50–100 ml subsample will be used as a backup sample in case the first bucket does not contain at least 200 krill. Have the laminated millimetre paper, forceps and paper tissue beside the stereomicroscope in place before starting the length-frequency measurements and sex determination of the krill.

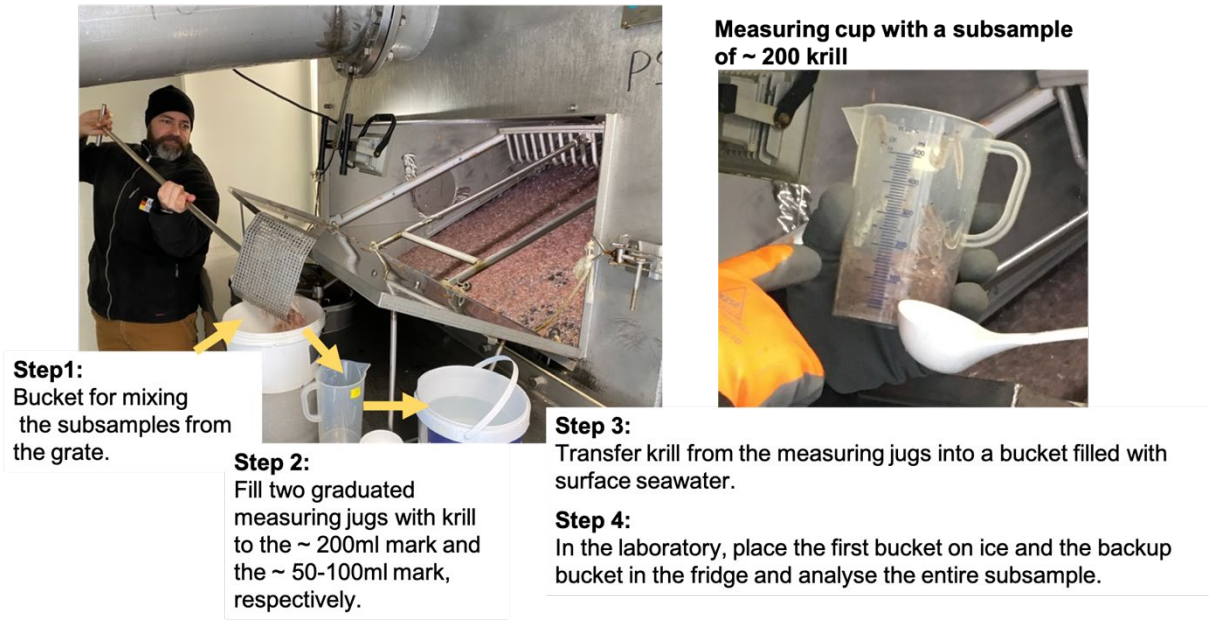

Figure 1: Procedure of krill sampling from the grate in the de-watering or conveyer location. The Workshop noted that the pictures in the draft protocol will be replaced with images taken from traditional trawl vessels before finalising.

Length-frequency measurements and sex determination of krill

To ensure a representative measurement of the length-frequency and sex distribution of the sampled krill, it is essential that all krill individuals in a bucket are processed (length and sex determination), irrespective of the number of individuals in the bucket. Therefore, start with the bucket with the ~200 ml krill subsample and process all krill as described below. If all krill in this bucket are processed, and the number of krill is below 200, process all krill from the bucket containing the ~50–100 ml backup subsample.

For each krill individual, determine and note the length and sex. To determine the length, take one individual with a forceps from the bucket and tap them a few times on the paper tissue to remove the water. Place the krill on the laminated millimeter paper (make sure the animal is stretched out horizontally), and measure the length from the anterior margin of the eye to the tip of the telson, excluding the setae, to the nearest millimeter below.

To determine the sex, krill must be checked for the presence of the male and female copulatory organs, petasma and thelycum, respectively. If you cannot determine the sex of the krill visually (i.e. no eggs are visible for a gravid female or an obvious petasma is not visible for a mature male) it is recommended that you determine the sex under the stereomicroscope. For this, place the individual on its back to look at it ventrally and check between the last pair of exopods for the thelycum (female copulatory organ). In addition, check the inner side of the first pleopod for the presence of a petasma (male copulatory organ). Individuals with a petasma are classified as male and those with thelycum as female. If no petasma or thelycum can be found, krill are categorized as ‘juvenile’ when smaller than 31mm and when larger than 31 mm as ‘unknown’.