

**Report of the Working Group
on Incidental Mortality Associated with Fishing
(Hobart, Australia, 10 to 14 October 2022)**

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**Report of the Working Group on
Incidental Mortality Associated with Fishing**
(Hobart, Australia, 10 to 14 October 2022)

Opening of the meeting

1.1 The meeting of the Working Group on Incidental Mortality Associated with Fishing (WG-IMAF) was held in Hobart, Australia, from 10 to 14 October 2022.

1.2 The Co-conveners, Dr M. Favero (Argentina) and Mr N. Walker (New Zealand), opened the meeting and welcomed participants, including the invited experts Dr I. Debski, Dr J. Arata, Mr R. Arangio and Mr R. Leaper.

Adoption of the agenda

2.1 The provisional agenda for the meeting was discussed and adopted with minor amendments (Appendix A).

2.2 The participants thanked Dr Favero and Mr Walker for their work in preparing for the meeting.

2.3 The report was prepared by J. Barrington (Australia), J. Clark (Norway), S. Kawaguchi and N. Kelly (Australia), A. Lowther (Norway), E. O'Shea (Secretariat), E. Pardo (New Zealand), R. Phillips (UK), C. Van Werven (Secretariat) and includes a List of Registered Participants (Appendix B) and a List of Documents considered at the meeting (Appendix C).

2.4 In this report, paragraphs that provide advice to the Scientific Committee have been highlighted. A list of these paragraphs is provided in Item 10.

Review of incidental mortality in CCAMLR fisheries

3.1 WG-IMAF-2022/07 presented a summary of incidental mortalities of seabirds and marine mammals associated with fishing during the 2021/22 season from data reported by the vessels and Scheme of International Scientific Observation (SISO) observers. The extrapolated total of 15 seabirds caught as of 12 September 2022 is the lowest total on record. One humpback whale (*Megaptera novaeangliae*) was recorded as incidental mortality in krill fisheries in 2022. The paper also presented a review of incidental mortality since 2012 as reported to CCAMLR. Overall, the number of seabirds caught in longline fisheries shows a declining trend since 2012, whilst extrapolated numbers of warp strikes fluctuate between seasons, potentially because of the low observation effort issues.

3.2 The Working Group welcomed the presentation of WG-IMAF-2022/07 by the Secretariat and noted the utility of the plots showing the numbers of seabirds caught by subarea and season. The Working Group requested that the Secretariat include similar graphical analyses in any future iterations of the paper, and present marine mammal mortalities and warp

strike data at subarea and season scale. The Working Group also requested that warp strike rates (birds-per-unit of observed effort (BPUE)) be presented in tables and figures, distinguishing each category of warp observation (shooting, towing, hauling etc.) and that the capture rates of birds in the net should be presented separately.

3.3 The Working Group further requested that the Secretariat present the spatial occurrence of mortality events at subarea scale in the Fishery Report IMAF summary sections as this would increase the accessibility of IMAF information to Members.

3.4 The Working Group welcomed provisional data indicating the lowest-ever estimated seabird mortality numbers recorded in CCAMLR longline fisheries in 2022, noting that fishing operations were still ongoing in Subareas 48.3 and 58.6, and Divisions 58.5.1 and 58.5.2, therefore IMAF numbers for 2022 were incomplete.

3.5 The Working Group noted that extrapolated seabird mortalities during the period 2012–2022 were highest in Division 58.5.1 and noted that understanding any operational differences in this fishery may be useful for elucidating the causes of higher seabird by-catch rates.

3.6 The Working Group noted the occurrence of nine southern elephant seal (*Mirounga leonina*) mortalities across Divisions 58.5.1 and 58.5.2 and one humpback whale mortality in krill fisheries in Subarea 48.2 during the 2021/22 season. The Working Group reflected that the nine southern elephant seal mortalities were an increase on previous CCAMLR seasons.

3.7 The Working Group noted that SISO observer protocols in CCAMLR trawl fisheries only recommend one 15-minute warp strike observation period per day, which focused on high-risk trawling periods (e.g. net setting or high-risk events). The low rate of observation for warp strikes during towing may lead to high uncertainty in extrapolated warp strikes.

3.8 The Working Group further noted that continuous beam trawling vessels tow two nets simultaneously. This can result in up to 48 hours of trawl time per day, which results in lower coverage and greater uncertainties when extrapolating warp strike numbers when only one 15-minute observation per day is conducted by the SISO observer.

3.9 The Working Group considered that the collection of additional environmental information and bird abundance data during warp strike observation periods may assist in understanding potential contributory factors that drive warp strike events.

3.10 The Working Group recalled that in CCAMLR krill trawl fisheries, the SISO observation protocol did not require observers to record the severity of warp strikes, therefore the total numbers of warp strikes could not be used to assess overall seabird mortalities.

3.11 The Working Group recommended the reintroduction of recording severity of warp strikes on krill vessels using the protocols required for SISO observers on finfish trawl vessels.

3.12 The Working Group noted that the current requirement of 1 warp strike observation per day equates to approximately 0.5% of coverage of trawling time in continuous trawl and 1.9% for conventional trawl; a suggested increase to four warp observation periods per day would equate to approximately 2.1% of coverage of trawling time for continuous trawl and 7.7% for conventional trawl. The Working Group noted that the SISO observer protocols need to be modified to reflect any decision on a different minimum number of required observations.

3.13 The Working Group recommended the Scientific Committee consider an increase in the number of warp strike observation periods conducted by SISO observers on trawl vessels to reduce the potential uncertainties in extrapolated warp strikes. The Working Group noted that observer workload and tasking would need to be considered.

3.14 The Working Group also recommended future research to refine the required number of warp strike observation periods per day conducted by SISO observers for finfish trawl fisheries (Table 1) and krill fisheries (SC-CAMLR-41/16 Rev 1).

3.15 The Working Group recommended the correction of the SISO warp strike observation data from the Korean vessels *Adventure* and *Maestro* in the 2011/12 season, by the Secretariat as this data appears erroneous.

Marine mammal incidental mortality

Population status of marine mammals in the CAMLR Convention Area

4.1 WG-EMM-2022/26 Rev. 1 presented a multi-vessel, single-platform cetacean sighting survey undertaken as part of the International 2019 Area 48 survey for krill (see WG-EMM-2022, paragraphs 3.20 and 3.21). The paper reported a design-based abundance estimate of 53 873 (CV = 0.152) fin whales (*Balaenoptera physalus*) for a combined survey area of 2 101 000 km², which roughly overlapped with Subareas 48.1, 48.2, 48.3 and 48.4. Comparison to a fin whale abundance estimate of around 4 600 (CV = 0.424; Reilly et al., 2004) across a similar region, but a slightly smaller area of 1 637 500 km², from the CCAMLR-2000 Survey, indicates a substantial increase in fin whale abundance throughout Subareas 48.1, 48.2, 48.3 and 48.4 over the past two decades.

4.2 The Working Group noted the importance of recent cetacean abundance estimates for regions within the Convention Area to assist in providing management advice for the krill fishery.

4.3 Annex 1 of WG-IMAF-2022/08 provided a summary of the status and trends of baleen whales in Area 48. Baleen whales were heavily exploited throughout the twentieth century, particularly across Area 48, but in the decades since the cessation of commercial whaling, there are indications of recovery for some species, such as humpback whales and fin whales, whilst others have only displayed modest increases, such as Antarctic blue whales (*Balaenoptera musculus intermedia*) and southern right whales (*Eubalaena australis*). Antarctic minke whales (*B. bonaerensis*) may have declined in Area 48 since the mid-1980s.

4.4 The Working Group discussed the potential decline of Antarctic minke whale numbers in Area 48 over the past few decades, and that whilst the International Whaling Commission (IWC) considered the decline was likely to be real, the precise mechanism for that decline was not known.

4.5 WG-IMAF-2022/12 reported on varying levels and types of marine mammal sighting effort undertaken on a Patagonian toothfish fishing vessel operating near South Georgia in the winter of 2021. A total of 2 086 minutes of survey effort was undertaken over 117 n miles of track, yielding around 150 marine mammal sightings, including humpback whales and sperm whales (*Physeter macrocephalus*).

4.6 The Working Group noted that such marine mammal sighting data is of value for understanding the interaction of fishing and predator populations, but also that it can be difficult for non-standardised sighting effort on fishing vessels to yield enough data to undertake distance sampling analyses.

Incidental mortality and risk assessments of marine mammals in CCAMLR fisheries

Review of whale entanglement information

4.7 WG-IMAF-2022/01 presented on the three incidental mortalities of humpback whales during the 2020/21 fishing season (see also SC-CAMLR-40/BG/27) and one incidental mortality reported from Subarea 48.2 during the 2021/22 season. All incidental mortalities were from vessels using the continuous trawling system in the krill fishery. The paper also included descriptions of both existing and proposed whale entanglement mitigation approaches for the continuous trawl krill fishery. After the third incidental mortality of a humpback whale in the 2020/21 season, an extra-large exclusion mesh constructed from Spectra rope was placed at the mouth of the trawl, in addition to existing pinniped exclusion nets. The expectation was that the stronger material would withstand interactions with large cetaceans. Despite this addition, a dead humpback whale was discovered in the trawl mouth of the *Saga Sea* during the 2021/22 fishing season, after which the exclusion net was moved further forward, attached to the trawl mouth opening and the tension in the ropes was increased to reduce any slack (Appendix D). No subsequent incidents have been recorded. The paper detailed additional mitigation measures that could be used in the future such as acoustic deterrent devices, modifications of the marine mammal exclusion device or other gear, such as monitoring of the trawl codend, and direct underwater video surveillance or echosounders at the trawl mouth to detect encounters. Further approaches to better understanding the ultimate causes of whale encounters such as studies of whale behaviour at different spatial scales, and whale population size and spatio-temporal distribution, demographics and energetics were proposed. The implications for move-on rules were briefly summarised, as was the need to standardise reporting of data for future encounters and development of photographic documentation.

4.8 The Working Group recalled that the presence of any of the three dead humpback whales during the 2020/21 fishing season (SC-CAMLR-40, paragraph 3.114) were not detected by the crew using the net monitoring system connected by the net monitoring cable (allowed at present under a derogation of Conservation Measure (CM) 25-03), and noted that given there was no real-time detection of the presence of the whales within or on the nets, it was not possible to estimate when the animals became entangled during trawl operations.

4.9 The Working Group noted that whilst observed whale by-catch in the krill fishery was considered small at present, it may increase with any increase in whale population size or krill fishing effort, particularly noting that both baleen whales and the krill fishery target krill aggregations. The Working Group further noted that the number of cryptic mortalities as a result of whales interacting with krill trawls would be an important parameter to estimate.

4.10 The Working Group commended Norway and industry experts for rapidly seeking to improve mitigation methods after the whale by-catch incidents and encouraged further development of devices that would exclude marine mammals from entering the trawl net.

4.11 WG-IMAF-2022/08 reported on the outcomes of the IWC Scientific Committee intersessional group on whale entanglement in the Southern Ocean krill fishery, which formed during the virtual meeting of the IWC-SC 68D (25 April to 13 May 2022; IWC, 2023, section 12.2.2) after receiving a request for advice from the Scientific Committee (Welsford et al., 2022). Prior to providing advice on whale entanglements, the intersessional group concluded it was highly unlikely that the whales entered the trawls after death, and that the reported lengths of the entangled whales (7–10 m) were consistent with the lengths of dependent, or newly independent, calves. The IWC intersessional group reviewed existing literature on large whale interactions with other trawl fisheries; data collection needs from entangled whales; whale abundance and distribution in Area 48; and collection of relevant data from whale observations. The paper made several recommendations regarding entanglement/by-catch mitigation for continuous trawling in the krill fishery, including avoidance of whales by fishing vessels, technologies such as excluder devices, and management measures such as ‘move-on’ rules. The IWC intersessional group also noted the lack of information to understand whether close encounters of whales with fishing vessels are due to whales feeding on the same swarms of krill that are being fished, the fishing operations using whales as a cue for the location of krill swarms, that whales may be attracted to the trawl vessels, or a combination of these points.

4.12 The Working Group considered the IWC intersessional group’s recommendations on data to be collected by observers and vessel crew in the event of future whale entanglements in krill trawl nets. The Working Group agreed that data collection efforts at the time a whale is detected in trawl nets be improved.

4.13 The Working Group recognised the potential utility of the suggested data template, but also noted varying degrees of difficulty in collecting some of these data, particularly collection of physical samples if the whale carcass cannot be safely accessed and recommended that data collection be prioritised and ranked. The Working Group also noted the potential considerable paperwork required to import whale samples because of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the need for preservatives or dedicated freezer space. Delays in obtaining CITES permits, which in some countries are required for individual shipments, might mean that samples have to be stored on vessels for long periods.

4.14 The Working Group also considered the potential time lag between an entanglement incident and its detection, noting that recording of information such as extant whale densities around the vessel, may not match the conditions at the time of the incident.

4.15 The Working Group considered the possibility of using natural markings, or a human-made markings, on whale carcasses to assist in judging whether it had been sighted previously.

4.16 The Working Group recommended that an intersessional working group including experts from the IWC Scientific Committee intersessional group on whale entanglement in the Southern Ocean krill fishery, be tasked with developing a data collection template and accompanying instructions for vessels to report standardised data in the event of a whale mortality (Table 1).

4.17 The Working Group recommended that the following data and samples, based on the advice from the IWC, be collected (noting two tiers of data collection where i–iv: highest priority and v–vi: moderate priority):

- (i) whale species and length
- (ii) fishing operation (e.g. vessel and fishing gear specifications, time and location where a net was deployed, time and location where the entangled whale was discovered, average trawl depth)
- (iii) photographic records
- (iv) wound details following IWC entanglement response data form (detailed in Table 1 of WG-IMAF-2022/08)
- (v) blubber thickness
- (vi) tissue samples (e.g. skin, blubber, baleen plates); presence (and collection) of whale lice.

Review of recent high rates of seal by-catch reported

4.18 WG-IMAF-2022/07 presented a summary of marine mammal mortalities in CCAMLR fisheries from the last decade (2012–2022). The paper noted that the southern elephant seal was the most common marine mammal species caught in CCAMLR longline fisheries with approximate annual by-catch rates of 2–3 animals per year. In CCAMLR trawl fisheries, the Antarctic fur seal (*Arctocephalus gazella*) was the most commonly caught species, with numbers fluctuating annually over the last decade.

4.19 The Working Group noted that seal mortality events were very rare and no method for determining a seal by-catch rate had been developed and implemented at CCAMLR. The Working Group further noted that information in the SISO observer reports detailed that seal mortalities occur primarily from external net entanglements when trawl nets were at the surface, or from failures in the seal exclusion devices that are required to be fitted in CCAMLR trawl fisheries.

4.20 Dr Y. Ying (China) noted that a two-year observation project was conducted on Chinese trawl vessels, where it was identified that many Antarctic fur seal interactions took place around the codend of the net due to the attraction of prey. The study also noted that seals demonstrated more intensive foraging behaviours towards the net being retrieved on the surface when krill aggregations were deeper, than when krill swarms were located near the surface, suggesting that prey availability was driving attraction to fishing vessels.

4.21 The Working Group reflected that combining studies of fur seal behaviour with krill population dynamics and environmental variables may elucidate factors leading to seal mortality events.

4.22 The Working Group recommended that additional data on sex and total body length for incidental seal mortalities recovered on board vessels be recorded by SISO observers, to determine if incidental seal mortalities in fisheries have adverse effects on particular sex or maturity cohorts in seal populations.

4.23 The Working Group recommended that supporting material should be developed and training provided to enable observers to perform these tasks and asked Members with expertise on the subject to contribute to that end (Table 1).

Mitigation methods for marine mammals

4.24 As recommended by the Scientific Committee in 2021 when WG-IMAF was reconvened (SC-CAMLR-40, paragraph 3.135), some Members and invited experts investigated and documented the use of mitigation devices to reduce marine mammal entrapment in continuous krill trawl nets. The Working Group commended these parties for their efforts and requested them to continue reporting on the efficacy of marine mammal exclusion devices.

4.25 WG-IMAF-2022/09 presented details of how observed New Zealand sea lion by-catch in the southern squid fishery was reduced and noted that these experiences potentially have relevance to CCAMLR krill fisheries. Sea lion exclusion devices (SLEDs) were developed after substantial New Zealand sea lion captures were detected and such devices are now used in 100% of tows, with a minimum of 90% observer coverage across all tows in this fishery. As a consequence, sea lion mortality has been significantly reduced. The use of SLEDs has generated uncertainties about the relative significance of the different types of interactions that an animal can have with the device, including traumatic brain injuries, post-escape drowning and loss of drowned animals after interaction, referred to as ‘cryptic mortality’. Recommendations outlined in WG-IMAF-2022/09 include:

- (i) by-catch mitigation devices are further improved and trialled in CCAMLR krill fisheries
- (ii) estimated cryptic mortality rates are considered when by-catch mitigation devices are used
- (iii) where mitigation devices are used, mitigation device standardisation and certification processes are developed
- (iv) a minimum rate for scientific observer coverage is developed to support the evaluation of marine mammal by-catch mitigation methods.

4.26 The Working Group discussed the recommendations in the paper and on reflected the need for further consideration of these recommendations in the intersessional period.

4.27 The Working Group noted that in typical finfish trawl nets, a seal exclusion device is a sloped or vertical mesh barrier within the net with an opening at the top to allow an animal to escape. In other designs, the exclusion device is typically a mesh net covering the mouth of the trawl as a barrier to marine mammals entering the net.

4.28 The Working Group recommended that the Secretariat develop a library of the different exclusion devices used across different trawl vessels within the Convention Area in consultation with Members (Table 1).

4.29 The Working Group noted the estimation of cryptic mortality needs to consider the specific characteristics of the fishing operations and gear configuration, for example the higher speed in the southern squid fishery compared to the krill fishery. The Working Group further noted that trawl speed could be a variable affecting the degree of injury to marine mammals such as whales, given the current difficulty in directly observing interactions.

4.30 The Working Group noted the use of acoustic pingers during the 2021/22 fishing year, however, considered there is ambiguous evidence concerning the efficacy of acoustic pingers to alert baleen whales to the presence of the net (WG-IMAF-2022/01 and 2022/08). In contrast, the Working Group noted the potential harms that can be inflicted by acoustic harassment devices, either through hearing damage, or that it might cause the animal to be trapped through disorientation.

4.31 The Working Group noted the advice from the IWC expert panel that the whale excluder grid installed near the mouth of the continuous trawl net after the humpback whale entanglement incident in 2021/22 (which differs from the other seal excluder grid) may still allow a whale to be pressed and trapped against the grid, whereas a modification of this net to pull the grid forward into a conical formation may result in a passive whale being deflected away from the mouth of the net.

4.32 Dr U. Lindstrøm (Norway) suggested that before any further modifications to the exclusion devices used in the 2021/22 fishing season are undertaken, a more detailed study of the way baleen whales interact with krill trawling nets would be beneficial.

4.33 The Working Group recognised the importance of understanding environmental variation and whale behaviour over multiple spatio-temporal scales to understand how they interact with krill swarms, and with fishing vessels more broadly.

4.34 The Working Group considered the likely benefits of video surveillance of trawl nets to study whale interactions and potentially detect cryptic mortality events. The Working Group noted that studying small-scale whale movements around, and direct interactions with, trawl nets will not be a trivial observation process to implement, and that considerable technical development will be required. However, the relatively shallow krill trawls should allow for less turbidity to occlude underwater camera vision.

4.35 The Working Group noted the potential benefit of a system to detect direct contact of whales with krill trawl nets to alert the vessel crew. Such a net alarm would require technological development but would be beneficial in understanding exactly when whale interactions with the trawl net occurred and potentially allow the vessel crew to take action to aid the whale in detangling from the net. The Working Group also noted that short-duration suction-cup tags may contribute to quantifying fine-scale movements of whales interacting with trawl nets.

4.36 The Working Group also considered the likely complexity of move-on rules, given the current lack of understanding of the functional relationship between whale densities and krill trawl intensity, and any concomitant relationship with the risk of whale entanglements. The Working Group noted that move-on rules form part of CCAMLR management of other fisheries for other issues.

4.37 The Working Group considered whether marine mammal exclusion devices currently deployed in CCAMR krill fisheries may allow penguins to escape from entanglement. The Working Group noted that whilst the net gauge size of 300 mm used in one of the exclusion devices reviewed could theoretically allow a penguin to breach the device, there are no reports of penguins being by-caught in deployed krill trawl nets (as opposed to documented cases of penguin entanglement when the net is at the surface).

4.38 The Working Group discussed the level of detail on exclusion devices provided in the fishery notifications for krill (under CM 21-03), with reference being made to the need for detailed specification and certification for exclusion devices, as referred in WG-IMAF-2022/09 (see paragraph 4.25iii). An example of the recent modification to a whale exclusion device on a continuous krill trawling net is given in Appendix D.

4.39 The Working Group discussed whether it was appropriate to apply recent developments in exclusion devices in the continuous krill trawling fishery to traditional trawling systems. It noted that while trawl net mouth size was much larger in traditional trawling systems, all krill vessels currently in use implement a somewhat similar (in design) marine mammal exclusion device. The Working Group also noted that there was no evidence at this time to conclude that traditional krill trawling systems posed similar whale entanglement risks compared to continuous krill trawling systems.

4.40 The Working Group discussed the role of the SISO observers in confirming the presence, specification and proper use of exclusion devices on krill trawling operations. The Secretariat reported that observers are not required to test exclusion devices against any specifications provided in the vessel notification to fish, but that they do note and photograph the devices in their observer reports. The Working Group further noted that it is not appropriate that observers be required to offer advice to trawl fishery operators on the use of exclusion devices.

4.41 The Working Group recommended the following advice for krill trawling operators to minimise the risk of whale entanglement in krill trawling operations:

- (i) krill fishing operators consider adopting Norway's modifications to the marine mammal exclusion device for its continuous krill trawling nets
- (ii) the development of technology to study how whales are interacting with krill trawling nets
- (iii) the further development of mitigation measures to decrease the risk of entanglement and by-catch of marine mammals, and the presentation of these developments to future meetings of WG-IMAF or WG-FSA for consideration.

Seabird incidental mortality

Population status of seabird species in the CAMLR Convention Area

5.1 WG-IMAF-2022/03 presented an update from the Agreement on the Conservation of Albatrosses and Petrels (ACAP) on the conservation status of albatrosses and petrels in the CAMLR Convention Area. The report highlighted that there is ongoing serious concern about

the global impact of incidental mortality in longline and trawl fisheries on seabirds, especially albatrosses and large petrels, which are among the most-threatened groups of birds globally. Of the 31 ACAP-listed species, there are 12 albatross and four petrel species that breed and/or forage in the CAMLR Convention Area. The Red List of Threatened Species of the International Union for the Conservation of Nature and Natural Resources (IUCN) lists one species as Critically Endangered, five as Endangered, four as Vulnerable, three as Near Threatened and three as Least Concern. The conservation status for nine of these species has been declining over the past 20 years, two are stable, two are unknown and three are increasing. There are seven ACAP High Priority Populations that breed and/or forage in the CAMLR Convention Area, each representing more than 10% of the species' global population, and which are declining at more than 3% annually over a 20-year period for which a major underlying cause was incidental mortality in fisheries. These comprise: (i) wandering albatross (*Diomedea exulans*), (ii) black-browed albatross (*Thalassarche melanophris*) and (iii) grey-headed albatross (*Thalassarche chrysostoma*) at South Georgia; (iv) sooty albatross (*Phoebastria fusca*) at Crozet Island; (v) Indian yellow-nosed albatross (*Thalassarche carteri*) at Amsterdam Island; (vi) Tristan albatross (*Diomedea dabbenena*) at Gough Island; and (vii) Antipodean albatross (*Diomedea antipodensis*) at Antipodean Island.

5.2 The Working Group noted the relatively low-level of incidental mortalities of seabirds within the CAMLR Convention Area, compared to these levels in adjacent fisheries, and highlighted the importance of cooperation with regional fishery bodies outside the Convention Area to address the cumulative effect of seabird by-catch across fisheries, to reverse the steep population declines affecting the seven ACAP High Priority Populations.

5.3 The Working Group noted that ACAP produces a range of advice, guidelines and resources aimed at furthering the conservation of seabirds, including a range of best-practice advice and fact sheets concerning mitigating seabird by-catch, including for demersal longline, and demersal and pelagic trawl fisheries (presented in WG-IMAF-2022/02 and 2022/06), and data collection guidelines (presented in WG-IMAF-2022/04).

5.4 The Working Group recommended that the Secretariat incorporate the guidelines for the safe handling and release of live-caught seabirds hooked or entangled in longline fishing gear into the SISO manuals and publish the guideline sheets on the CCAMLR website for Members to access (WG-IMAF-2022/05).

Seabird incidental mortality and risk assessments in CCAMLR fisheries

5.5 WG-IMAF-2022/P01 reported on the effects of by-catch mitigation measures on the demography of white-chinned petrels (*Procellaria aequinoctialis*) at Possession Island (Crozet Islands). This population declined by 40% from 1983 to 2004 because of by-catch in longline and trawl fisheries, and reduced breeding success resulting from predation by rats. Both modelled population growth rate and observed breeding densities increased after the mid-2000s, which could be explained by the improvement in survival following implementation of by-catch mitigation measures, in breeding success following local control of rats, and changes in climatic conditions on foraging grounds.

5.6 The Working Group recognised that the study was particularly valuable in demonstrating the conservation benefit of effective fisheries by-catch mitigation for a

wide-ranging seabird species that overlapped extensively with fishing fleets in local and international waters. A low by-catch rate of white-chinned petrels, which are active during both daylight and darkness, and capable of diving to >10 m, likely also indicated low by-catch rates of other, more susceptible, seabird species.

5.7 The Working Group noted that it took several years for the recommended mitigation measures to be fully effective, and that it required the implementation of the seasonal closure in Division 58.5.1 in 2010 for seabird by-catch to be reduced to very low levels. By comparison, seabird by-catch dropped substantially in Subarea 58.6 without a seasonal closure.

5.8 The Working Group also recognised that there were potentially lessons to be learned by CCAMLR from the further development of mitigation methods in fisheries in the French exclusive economic zone, such as the reportedly longer aerial extent of streamer lines achieved on some vessels.

5.9 The Working Group also noted that some fishing operators were finding it difficult to get integrated weight longlines containing lead recycled, and that it would be desirable to find an alternative to lead for use in demersal longline fisheries.

5.10 The Working Group recommended that the Scientific Committee highlight the recovery of the white-chinned petrel population at Possession Island (Crozet Islands) since the mid-2000s, which had occurred through a combination of implementation of effective seabird by-catch mitigation measures at sea (paragraph 5.7), control of rats on land and changes in climatic conditions on foraging grounds.

Mitigation methods for seabirds

5.11 WG-IMAF-2022/02 presented the ACAP review of mitigation measures and best-practice advice for reducing the impact of demersal longline fisheries on seabirds. The criteria used by ACAP to decide on best practice are that the technologies and techniques are shown by experimental research to significantly reduce the rate of seabird incidental mortality to the lowest achievable levels; have clear and proven specifications and minimum performance standards for their deployment and use; be demonstrated to be practical, cost effective and widely available; to the extent practicable, maintain catch rates of target species; to the extent practicable, not increase the by-catch of other taxa; and have minimum performance standards and methods of ensuring compliance is provided and clearly specified.

5.12 The Working Group noted that requirements under the current CCAMLR conservation measures for demersal longline fisheries match closely with ACAP best-practice guidelines. The Working Group noted the distinction between methods for which there was insufficient evidence of effectiveness, that these may be helpful under certain circumstances but do not meet all the criteria to be considered as best-practice.

5.13 WG-IMAF-2022/05 presented the ACAP safe handling and release guidelines for seabirds. These emphasise the importance of careful handling of live-caught seabirds by crew to maximise the likelihood of survival. The guidelines provide information on materials required to remove hooks, how to bring the hooked bird on board, restrain the bird, remove the hook or minimise the length of the trailing line if the hook cannot be removed, management of the bird if waterlogged and how best to release it. The ACAP guidelines are available as

factsheets in various languages. A modified version tailored for birds caught in trawl fisheries is being developed. The Secretariat offered to make the guidelines available on the CCAMLR website and incorporate them into the SISO manuals, providing benefits both for the caught birds and from the perspective of crew and observer safety (paragraph 5.3).

5.14 WG-IMAF-2022/06 presented the ACAP review of mitigation measures and best-practice advice for reducing the impact of pelagic and demersal trawl fisheries on seabirds. These had been developed using the same criteria as for the longline fisheries (paragraph 5.11).

5.15 The Working Group recognised that globally, trawl fisheries are diverse in operation and vessel design, and that the focus of ACAP when developing its guidelines was mainly on large finfish trawl vessels which differ operationally from krill trawl vessels, in particular the continuous trawl vessels.

5.16 The Working Group noted that mitigation of net entanglements is challenging, and that it was important to minimise the time the net is at the surface during hauling. The ACAP guidelines include the design for streamer lines for trawl cables, with a critical consideration being to discourage birds from entering the area where the warps make contact with the sea surface.

5.17 The Working Group recognised the importance of discriminating seabird by-catch associated with cable strikes versus net entanglement, given that different approaches to mitigation are required for these interactions. The Working Group also noted that ACAP may be able to provide advice to CCAMLR on seabird by-catch mitigation specific to the krill trawl fishery.

Review of net monitoring cable trial

5.18 WG-IMAF-2022/10 presented the results of the net monitoring trial in the 2020/21 season from three Norwegian-flagged vessels (two side beam-trawl vessels (*Antarctic Endurance* and *Antarctic Sea*) and one stern beam-trawl vessel (*Saga Sea*)) using the continuous fishing method in Area 48. The trial was undertaken following the requirements of the Scientific Committee (SC-CAMLR-38, paragraph 5.14) and data were collected according to standard SISO protocols, with the addition of video monitoring. Abundance estimates of birds were also obtained. Seabird mitigation measures used on all three vessels followed the ACAP best-practice guidelines and on the side beam-trawl vessels consisted of a set of streamer curtains that surrounded the warps and the net monitoring cable that ran parallel to the warps. The stern beam-trawl vessel used a Brady baffler which was deployed from the stern of the vessel with limited effect. An additional measure was developed for the second trial, a ‘sock’ which enclosed both the net monitoring cable and the warp which was shown to be effective. A combination of deck observations and video monitoring were used to observe warps and monitoring cables, totalling 1 839 hours of at-sea observations, representing 7.1% coverage of the total fishing time. Four 15-minute video observations were performed at set times each day in addition to three standard deck observations. To increase coverage, 180 hours of onshore observations were conducted from footage taken from the *Antarctic Endurance* and the *Saga Sea* during fishing from early April to early June, raising overall coverage to ~20% on one net during this time period. All sets and hauls were also monitored. A total of 304 contacts were observed, of which 187 were with the net monitoring cable. The remaining 117 were with the

warps or the mitigation device. There was only one observed mortality (Antarctic petrel (*Thalassoica antarctica*)) following contact with a trawl warp. Figure 1 and Annex 1 of WG-IMAF-2022/10 provided diagrams and photos of the warp and net monitoring cable configuration along with the mitigation devices used in the trial.

5.19 WG-IMAF-2022/11 presented interim results for the 2021/22 season from the Norwegian vessels engaged in the fishery. Based on the agreed observation effort distribution (in the case of vessels deploying two trawl nets simultaneously, it was based on the observation of a single trawl net) the total trawling time during observations was 3 643 hours and the total observation time 825 hours, leading to a total observation effort of 22.6%. During this period, 77 strikes were observed with a single mortality (cape petrel (*Daption capense*)). Sixty-two strikes were observed on the net monitoring cable, the majority of which were aerial strikes where the bird flew away apparently unharmed. Of these, 52 occurred over a three-day period on one vessel (*Saga Sea*) when one of the mitigation measures (the ‘sock’) had to be removed due to technical difficulties. A further four strikes were observed on the warp on this vessel during this time without mitigation.

5.20 The Working Group noted that of the 77 strikes observed in the 2021/22 season, 69 met the definitions of a heavy strike. In the 2020/21 season, there were a total of 304 strikes observed, and 220 of those were heavy strikes. The Working Group noted that heavy strikes can be considered as a proxy for mortality.

5.21 The Working Group noted that the majority of strikes reported in WG-IMAF-2022/11 occurred during a period when the sock mitigation device was removed for repair on the *Saga Sea* and recommended that multiple replacement devices should be carried on board to facilitate more rapid redeployment.

5.22 The Working Group discussed that while the trials conducted by Norway have focused on the hazard of the net monitoring cable to seabirds, the occurrence of warp strikes on birds suggests the deployment of mitigation measures on all trawl vessels should be considered more explicitly (WG-IMAF-2022/07, Table 6) (Table 1).

5.23 Mr Clark presented a video to the Working Group displaying the potential application of computer vision and artificial intelligence methods to detect potential bird strikes through the analysis of video data. The Working Group agreed that developing new technological approaches to expand observation coverage is useful and should be further explored, and welcomed the progress made on developing these approaches.

5.24 The Working Group recalled the priorities set by the Scientific Committee for WG-IMAF in the context of standardised approaches to calculating extrapolated bird strike numbers from observational data and subsequently implementing an assessment of risk to seabird populations to these extrapolated levels (SC-CAMLR-40, paragraphs 3.135(i) and (iv) respectively). Dr Debski noted that while the development of a Southern Hemisphere seabird risk assessment process is underway, the species that comprise the bird strikes reported in WG-IMAF-2022/10 and 2022/11 are not included within this process, suggesting that further work is required in terms of data collation to conduct an appropriate assessment (Table 1).

5.25 Considering the outcomes of the net monitoring trials in the context of providing advice to the Scientific Committee on the derogation in CM 25-03, Annex 25-03/A, the Working Group recommended that the existing derogation on the use of net monitoring cables in CM 25-03 be extended under the following conditions:

- (i) The three vessels (*Antarctic Endurance*, *Saga Sea* and *Antarctic Sea*) which use a net monitoring cable and have provided a detailed report of trials of mitigation devices as specified in CM 25-03, Annex 25-03/A, continue to utilise and refine current mitigation measures in use and achieve on-vessel observation coverage of at least 5% of total active fishing time. Such vessels should provide a report on the development and use of mitigation measures to WG-IMAF-2023.
- (ii) For vessels which use a net monitoring cable and have not undergone trials of mitigation devices specified in CM 25-03, Annex 25-03/A, they must undertake a trial following these specifications, and report the results of this trial to the next meeting of WG-IMAF. These vessels should additionally provide advance notice to the Secretariat about any net monitoring mitigation technology or technique to be employed to reduce the risk of bird strikes, drawing upon the approaches identified from existing trials for reducing the risk of bird strikes, and outlining how it will respond to any operational difficulties arising during their use.
- (iii) Members with vessels participating in this trial should present specifications under which the net monitoring cable mitigation devices could be used effectively, for review by this Working Group.

5.26 The Working Group noted that progress towards the specification of effective mitigation measures will be reviewed at future WG-IMAF meetings, along with the terms of this derogation for the use of net monitoring cables.

Observer reports and data collection

6.1 SC-CAMLR-41/16 Rev. 1 outlined the proposed work plan for developing data collection needs for krill fisheries and the options for re-scoping the krill fishery observer workshop proposed to be held in China.

6.2 The Working Group was invited to: (i) to review the data collection needs laid out in Table 1 of the paper; (ii) consider the terms of reference in Annex 2 of the paper developed for recording marine mammal interactions and bird strikes; and (iii) review the options for the timing and venue for the workshop, which have still to be agreed. The Working Group's advice would be passed onto the Scientific Committee for consideration.

6.3 The Working Group considered how information for issues regarding marine mammal interactions and sampling, and bird strike events in Table 1 of SC-CAMLR-41/16 Rev. 1 could be updated. In light of discussions by WG-IMAF on marine mammal by-catch (paragraphs 4.12 to 4.16), the Working Group agreed that intersessional work on instructions and types of samples required for marine mammal mortalities would take place (Table 1).

6.4 The Working Group agreed to the reintroduction of recording severity of strike events on krill vessels from the 2023/24 season (paragraph 3.11), using existing protocols for

SISO observers on finfish trawl vessels (*Scientific Observer's Manual – Finfish Fisheries – Version 2023*). The Working Group also agreed to undertake intersessional work on further refinements of the existing protocol (Table 1).

6.5 The Working Group considered that the outcomes of this workshop, and IMAF requirements in general, could provide information for the upcoming CCAMLR Ecosystem Monitoring Program (CEMP) review. The Working Group noted that there is currently little information on marine mammal interactions with fishing vessels and risk assessments developed for warp strikes. These data requirements should be considered and integrated into any monitoring program outlined in SC-CAMLR-41/16 Rev. 1.

6.6 WG-IMAF-2022/04 presented recommendations on data collection guidelines for observers and electronic monitoring programs to effectively monitor seabird interactions, including levels of observer coverage sufficient to assess by-catch rates across fisheries and guidelines produced by ACAP, including warp strike protocols and electronic monitoring. The paper emphasised that it is important to standardise procedures across fisheries, however, customisation of bird groups according to the species present in the relevant fishery was advisable.

6.7 The Working Group noted that in CCAMLR longline and trawl fisheries, data collection requirements cover variables across all of the recommended ACAP categories with the exception of weather-related information and bird abundance. The Working Group highlighted the benefits of recording weather conditions and bird abundance to better understand how seabirds interact with fishing gear and mitigation devices under different wind and swell conditions. While these data may not be useful in a general IMAF summary report, they may be useful explanatory variables when modelling detailed aspects of bird behaviour.

6.8 SC-CAMLR-41/BG/32 examined ways in which electronic monitoring could be applied across CCAMLR fisheries. The paper highlighted how electronic monitoring can be used to enhance the work of the observer, rather than replace them, and can increase observer safety by allowing remote monitoring of some tasks. The paper considered the data collection requirements for each of the working groups and the Standing Committee on Implementation and Compliance and how electronic monitoring could enhance the collection of these data. The paper further examined fishery-specific data collection requirements under SISO and provided recommendations on which elements would potentially benefit from electronic monitoring.

6.9 The Working Group considered the relevance of the paper to IMAF and agreed that it aligned well with ACAP requirements and could be cross-referenced with the ACAP guidance outlined in WG-IMAF-2022/04. The Working Group also considered the implementation plan and how this could be used to harmonise the uptake of electronic monitoring across fisheries, not just within CCAMLR but within different fisheries outside of CCAMLR. This may be particularly relevant for distant-water fleets operating on the high seas.

6.10 WG-EMM-18/33 presented approaches for collecting and analysing data to quantify the overlap between krill fisheries and pelagic krill predators. The paper described three different levels of data collection that could be undertaken by SISO observers depending on particular scientific questions that need answering. These ranged from level 1: simple presence of absence; level 2: quantifying the number of individuals; and level 3: quantifying activity (feeding or not feeding). The paper also suggested more complex data collection techniques that could be implemented during fishery-independent krill surveys using survey transects and dedicated marine mammal observers.

6.11 The Working Group expressed caution at potentially overtasking SISO observers whilst recognising that recording of marine mammal sightings was already being undertaken in CCAMLR longline fisheries, as well as on board krill vessels operating in Subarea 48.3. Standardised counts of birds around vessels have also been useful to inform management decisions in other fisheries.

Collaboration with relevant organisations

7.1 The Co-convenor, Mr Walker, initiated a discussion on mechanisms to potentially streamline effective collaboration with other relevant intergovernmental and industry organisations, noting that the current process of registering invited experts for WG-IMAF and providing access to documents was not straightforward as no procedure for such collaboration has been defined by the Scientific Committee.

7.2 The Working Group reflected that the collaboration with invited experts at the meeting had greatly improved the understanding of participants on relevant issues and had enhanced the provision of advice to the Scientific Committee. The Working Group also noted that the attendance of invited experts allowed for ongoing feedback through various expert subgroups on outstanding issues (e.g. the Sub-Committee on Non-deliberate Human-Induced Mortality of cetaceans within IWC, and ACAP Working Groups and Advisory Committee meetings).

7.3 The Working Group further noted the increasing level and importance of cooperation with other regional organisations (e.g. relevant regional fisheries bodies, BirdLife International, the Scientific Committee on Antarctic Research Expert Group on Birds and Marine Mammals, the International Association of Antarctica Tour Operators and the Convention on the Conservation of Migratory Species of Wild Animals) to reduce the incidental mortality of seabirds and marine mammals within fisheries bordering the Convention Area.

7.4 The Working Group requested the Scientific Committee consider a standing invitation for experts from the following organisations ACAP, the Association of Responsible Krill harvesting companies (ARK), the Coalition of Legal Toothfish Operators (COLTO) and IWC to attend WG-IMAF, noting the valuable contributions made by experts intersessionally and during WG-IMAF-2022.

Future intersessional work

8.1 The Working Group requested that the Scientific Committee consider the potential future tasks for future intersessional work, as described in Table 1.

8.2 The Working Group recommended that an e-group be established to advance intersessional collaborative work on the tasks outlined in the workplan for WG-IMAF (Table 1).

Other business

9.1 The Working Group noted WG-IMAF-2022/08 which outlined a proposal for a workshop to enhance CEMP based on recommendations arising from WG-EMM-2022, in addition to discussions occurring within the CEMP e-group. The proposal included a background to the program alongside draft terms of reference for the workshop/s and future work proposed.

9.2 The Working Group considered CCAMLR-41/08 which presented an overview of the implementation of the Rules for Access and Use of CCAMLR Data in CCAMLR data request procedures, and the procedure for publication of derived materials in the public domain. The Working Group noted the paper and recalled that the paper had previously been discussed during the Scientific Committee Symposium, WG-ASAM and WG-SAM (WG-ASAM-2022/01, paragraphs 5.1 to 5.7; WG-SAM-2022, paragraphs 8.1 to 8.3), and is open for consideration in the ‘Data Services Advisory Group’ e-group.

Review of the Scientific Committee Strategic Plan

9.3 The Chair of the Scientific Committee, Dr D. Welsford (Australia), presented the report of the CCAMLR Scientific Committee Symposium that met virtually on 8 and 10 February 2022 (WG-ASAM-2022/01). The informal Scientific Committee meeting discussed the progress and outcomes from the first CCAMLR Scientific Committee’s workplan (SC-CAMLR-XXXVI/BG/40) and provided an opportunity for participants to propose long-term priorities and strategies to inform the development of the next five-year Strategic Plan (2023–2027). The Working Group noted that the recommendations and plans are being refined during the intersessional period by all working groups and agreed at SC-CAMLR-41, according to the Scientific Committee’s Rules of Procedure. During its meeting, WG-IMAF reviewed its terms of reference and considered priority work items as per the recommendation from the Symposium (Table 1).

9.4 The Working Group noted that many issues were cross cutting in nature among the working groups of the Scientific Committee and agreed that issues of marine debris, climate change impacts on Antarctic marine living resources, data collection plans and all administrative matters identified were important for the consideration of the Working Group.

9.5 The Working Group agreed to the items of the Scientific Committee Strategic Plan that were of the remit of the Working Group and should be considered in the development of future work plans (Table 2).

Review of WG-IMAF terms of reference

9.6 The Working Group reviewed its terms of reference and priorities that were endorsed by the Scientific Committee at SC-CAMLR-40 (SC-CAMLR-40, paragraph 3.135 and Annex 9). The Working Group agreed to update the reference regarding collaboration and coordination with other organisations. The updated WG-IMAF terms of reference are listed in Appendix E.

9.7 The Working Group further agreed to extend this collaboration to all organisations that the Commission has a recognised cooperative arrangement with, including invited experts, as required.

Advice to the Scientific Committee

10.1 The Working Group's advice to the Scientific Committee is summarised below. The body of the report leading to these paragraphs should also be considered:

- (i) Recording of warp strike severity on krill vessels (paragraph 3.11)
- (ii) Frequency of warp strike observation periods conducted by SISO observers on trawl vessels (paragraphs 3.13 and 3.14)
- (iii) Correction of erroneous SISO warp strike observation data from 2012 for two vessels (paragraph 3.15)
- (iv) Standardised sample collection and data reporting in the event of a whale mortality based on advice from IWC (paragraphs 4.16 and 4.17)
- (v) Increased data collection and reporting by SISO observers for incidental seal mortalities recovered on board vessels (paragraph 4.22)
- (vi) Development of educational material and training resources for SISO observers to assist in the sampling and collection of data from incidental seal mortalities (paragraph 4.23)
- (vii) The development of an exclusion device library for trawl vessels (paragraph 4.28)
- (viii) Advice for krill trawling operators to minimise whale entanglement (paragraph 4.41)
- (ix) Incorporation of ACAP guidelines for safe handling and release of live-caught seabirds hooked or entangled in longline fishing gear into the SISO manual (paragraph 5.4)
- (x) Note the successful recovery of the white-chinned petrel population at Possession Island (Crozet Islands) (paragraph 5.10)
- (xi) Extend and review the existing net monitoring cable derogation (paragraphs 5.25 and 5.26)
- (xii) Consider a standing invitation for experts from ACAP, ARK, COLTO and IWC to attend WG-IMAF (paragraph 7.4)
- (xiii) Establishment of an e-group to progress IMAF tasks intersessionally (paragraph 8.2)
- (xiv) Consider the updated WG-IMAF Terms of Reference (paragraph 9.4 and Appendix E).

Adoption of the report

11.1 The report of the meeting of WG-IMAF was adopted.

Close of the meeting

12.1 At the close of the meeting, Mr Walker and Dr Favero thanked all participants, including invited experts, for their patience and hard work that had allowed the Working Group to make significant progress in addressing the priorities of the Scientific Committee, notably through the effective collaboration between participants. They also thanked the rapporteurs and the Secretariat for their efficiency and support throughout the meeting.

12.2 On behalf of the Working Group, Mr I. Forster (Secretariat), thanked Mr Walker and Dr Favero for their helpful guidance during the meeting and their contribution to the development of a significant workplan for WG-IMAF.

References

- IWC. 2023. Report of the Scientific Committee of the International Whaling Commission. *J. Cetacean Res. Manage.* (Supplement) 24. (in prep).
- Reilly, S., S. Hedley, J. Borberg, R. Hewitt, D. Thiele, J. Watkins and M. Naganobu. 2004. Biomass and energy transfer to baleen whales in the South Atlantic sector of the Southern Ocean. *Deep-Sea Res. II*, 51 (12–13): 1397–1409, doi: 10.1016/j.dsr2.2004.06.008.
- Welsford, D., N. Walker, M. Favero, B. Krafft, C. Darby and S. Parker. 2022. CCAMLR-IWC coordination: incidents of whale by-catch in the Antarctic krill fishery. Paper *SC/68D/HIM/04* presented to the Scientific Committee of the International Whaling Commission, 48 pp.

Table 1: Intersessional work plan for WG-IMAF. Timeframe periods are short = 1–2 years, medium = 3–5 years and long = 5+ years. AI = artificial intelligence, EM = electronic monitoring, MMED = marine mammal exclusion device.

Theme	Task	Timeframe	Contributors	Secretariat participation
1. Review of incidental mortality	1.1 Development of a web-based tool to allow examination of interactions and incidental mortality data across CCAMLR fisheries and areas at a finer scale (spatial and temporal) (supplemental information in addition to Secretariat report to WG-IMAF)	Short	Dr Favero, Mr Walker and Prof. Phillips	Yes
2. Marine mammals – incidental mortality	2.1 Refine design of additional data to be collected by observers and crew when whale entanglements occur (see list developed under paragraph 4.17)	Short (2023)	Dr Kelly and Mr Pardo	Yes
	2.2 Investigate the use of underwater sensor/cameras attached to the net (and AI) to provide information on the occurrence of whale interactions and any subsequent entanglements/capture (continuous)	Medium	Dr Kelly, Dr Lowther and Dr Lindstrøm	-
	2.3 Development of protocols for pinniped sex and length sampling and training materials	Short	Mr Pardo	Yes
3. Seabirds and marine mammals – risk assessment	3.1 Consider developing risk assessment for seabirds and marine mammals	Medium	Dr Lindstrøm, Dr Kelly and Prof. Phillips	-
4. Marine mammals – mitigation	4.1 Refine design of MMED, considering a convex shape to the exclusion mesh to deflect whales (and seals) away from the net mouth	Medium/ Long	Dr Kelly, Dr Lowther and Dr Lindstrøm	-
	4.2 Develop specifications for MMED in use in CCAMLR trawl fisheries	Short/ Medium	Mr Pardo	-
	4.3 Undertake experiments into effectiveness of different MMED designs (for various species)	Medium/ Long	Dr Kelly, Dr Lowther and Dr Lindstrøm	-
5. Seabirds – incidental mortality	5.1 Power analysis of required observer sampling required for warp strikes	Short	Dr Kelly, Dr Hinke and Mr Walker	-
	5.2 Redesign the warp strike observation protocols	Short (2023)	Dr Debski	-

(continued)

Table 1 (continued)

Theme	Task	Timeframe	Contributors	Secretariat participation
	5.3 Exploration of approaches to undertake warp strike extrapolations	Short	Dr Favero, Dr Hinke and Mr Walker	Yes
	5.4 Review required levels of observer sampling for seabird incidental mortality with longline fishery	Short	Mr Zhu	
7. Seabirds – mitigation	7.1 Improve design and develop specification of ‘sock’	Short		-
	7.2 Consider performance of trawl warp/cable strike mitigation approaches utilised by continuous trawl vessels (including environmental conditions and other factors)	Short	Dr Debski and Dr Arata	-
	7.3 Review existing use of and consider mitigation requirements in conventional trawl vessels	Short	Dr Debski and Dr Arata	-
	7.4 Review developments in demersal longline mitigation (streamer lines, etc.)	Short	Mr Barrington, Dr Debski and Mr Arangio/ Mr McNeill	-
8. Observer reports and data collection	8.1 Consider IMAF-related tasks for observers in the various CCAMLR fisheries	Medium	Mr Clark	Yes
	8.2 Consider use of EM and AI to add further data collection to aid observers	Medium/ Long	Mr Clark	-
9. Marine debris effects on seabirds and marine mammals	9.1 Review information on the effect of marine debris on marine mammals and seabirds in the Convention Area	Short	Mr Barrington	Yes
10. Light pollution effect on seabirds	10.1 Consider options for the management of light pollution for vessels fishing in the Convention Area	Short	Mr Barrington	-

Table 2: Items tasked to WG-IMAF from the Scientific Committee Strategic Plan (WG-ASAM-2022/01). Numbers refer to the numbering in the original tables.

Table 1: High-priority scientific issues for the Scientific Committee to progress 2023–2027	Providing the scientific advice that underpins an integrated, ecosystem-based approach to fisheries	3. Develop data collection plans to inform and support refined management approaches
		5. Develop methods to detect ecosystem changes and provide advice on adaptive management (e.g. through CEMP and WG-IMAF)
		7. Ensure the effects of fishing on by-catch, dependent, or related species are consistent with Article II
	Addressing cross-cutting scientific topics	2. Improve integrated approaches to fund and build science capacity within CCAMLR, including linkages with external organisations
		4. Review performance of CEMP and SISO data collection programs relative to the Strategic Plan
		5. Collaborate with other organisations (e.g. CEP, SCAR) to provide a synthesis of the state and trajectory of Antarctic marine living resources
Table 2: Priority research topics	1. Target species	(a) Develop methods to estimate biomass for krill (iii) Data collection – SISO, vessels and CEMP (2) Develop diagnostic approaches for data quality Urgency: High
		(b) Develop stock assessments to implement decision rules for krill (i) Krill management approach (synthesis of krill recruitment, spatial scale, biomass estimates, predator risk) Urgency: High
		(b) Develop stock assessments to implement decision rules for krill (iii) Develop ecosystem indicators to inform risk assessment framework Urgency: Low
		(b) Develop stock assessments to implement decision rules for krill (iv) Methods to account for uncertainty in stock status (2) Spatial structure within subareas Urgency: High
	2. Ecosystem impacts	(a) Ecosystem monitoring (Second Performance Review, Recommendation 5) (i) Structured ecosystem monitoring programs (CEMP, fishery) (2) Fishery via SISO Urgency: Medium

(continued)

Table 2 (continued)

	<p>(a) Ecosystem monitoring (Second Performance Review, Recommendation 5)</p> <p>(i) Structured ecosystem monitoring programs (CEMP, fishery)</p> <p>(3) Research Surveys</p> <p>Urgency: Low</p>
	<p>(a) Ecosystem monitoring (Second Performance Review, Recommendation 5)</p> <p>(iv) Marine debris monitoring</p> <p>Urgency: Low</p>
	<p>(c) By-catch risk assessment for krill and finfish fisheries</p> <p>(i) Monitoring status and trends</p> <p>Urgency: High</p>
	<p>(c) By-catch risk assessment for krill and finfish fisheries</p> <p>(i) Monitoring status and trends</p> <p>(1) Implement whale sighting protocols</p> <p>Urgency: High</p>
	<p>(c) By-catch risk assessment for krill and finfish fisheries</p> <p>(ii) By-catch species catch limits</p> <p>Urgency: High</p>
	<p>(c) By-catch risk assessment for krill and finfish fisheries</p> <p>(iii) By-catch mitigation methods</p> <p>Urgency: Low</p>
	<p>(c) By-catch risk assessment for krill and finfish fisheries</p> <p>(iv) Incidental mortality</p> <p>Urgency: Low</p>
	<p>(e) Monitoring and adaptation to effects of climate change, including acidification</p> <p>(i) Develop methods to detect change in ecosystems given variability and uncertainty (Second Performance Review, Recommendation 6)</p> <p>Urgency: Medium</p>
Administrative topics	<p>All listed for WG-IMAF</p> <p>Urgency: variable</p>

List of Registered Participants

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(Hobart, Australia, 10 to 14 October 2022)

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Agenda

Working Group on Incidental Mortality Associated with Fishing (Hobart, Australia, 10 to 14 October 2022)

1. Opening of the meeting
2. Adoption of the agenda
3. Review of incidental mortality in CCAMLR fisheries
4. Marine mammal incidental mortality
 - 4.1 Population status of marine mammals in the CAMLR Convention Area
 - 4.2 Incidental mortality and risk assessments of marine mammals in CCAMLR fisheries
 - 4.2.1 Review of whale entanglement information
 - 4.2.2 Review of recent high rates of seal by-catch reported
 - 4.3 Mitigation methods for marine mammals
5. Seabird incidental mortality
 - 5.1 Population status of seabird species in the CAMLR Convention Area
 - 5.2 Seabird incidental mortality and risk assessments in CCAMLR fisheries
 - 5.3 Mitigation methods for seabirds
 - 5.3.1 Review of net monitoring cable trial
6. Observer reports and data collection
7. Collaboration with relevant organisations
8. Future intersessional work
9. Other business
 - 9.1 Review of the Scientific Committee Strategic Plan
 - 9.2 Review of WG-IMAF terms of reference
10. Advice to the Scientific Committee
11. Adoption of the report
12. Close of the meeting.

List of Documents

Working Group on Incidental Mortality Associated with Fishing
(Hobart, Australia, 10 to 14 October 2022)

WG-IMAF-2022/01	Develop methods for the co-existence of large baleen whales with a sustainable krill fishery B.A. Krafft, U. Lindstrøm, M. Biuw M and A. Lowther
WG-IMAF-2022/02	ACAP review of mitigation measures and best practice advice for reducing the impact of demersal longline fisheries on seabirds Submitted by the Invited Expert Igor Debski
WG-IMAF-2022/03	Update on the conservation status of albatrosses and petrels in the CCAMLR area Submitted by the Invited Expert Igor Debski
WG-IMAF-2022/04	Data collection guidelines for observer and electronic monitoring programs to improve knowledge of fishery impacts on seabirds Submitted by the Invited Expert Igor Debski
WG-IMAF-2022/05	Safe handling and release guidelines for seabirds Submitted by the Invited Expert Igor Debski
WG-IMAF-2022/06	ACAP review of mitigation measures and best-practice advice for reducing the impact of pelagic and demersal trawl fisheries on seabirds Submitted by the Invited Expert Igor Debski
WG-IMAF-2022/07	Summary of incidental mortality associated with fishing activities during the 2022 season, and review of incidental mortality data and warp strike data since 2012 Secretariat
WG-IMAF-2022/08	Report of IWC Scientific Committee intersessional group on whale entanglement in Southern Ocean krill fishery Submitted by the Invited Expert Russell Leaper
WG-IMAF-2022/09	New Zealand sea lion exclusion device as an example of successful by-catch mitigation E. Pardo, G. Lydon, A. Dunn and L. Boren
WG-IMAF-2022/10	Results of the net monitor trial season 2 S. Young, J. Moir Clark, J. Chapman, B. A. Krafft and A. Lowther

WG-IMAF-2022/11	Results of the net monitor trial season 3 S. Young, J. Moir Clark, J. Chapman, B. A. Krafft and A. Lowther
WG-IMAF-2022/12	Observations of marine mammals in Subarea 48.3 of CCAMLR C. Passadore, P. Conti and O. Pin
Other Documents	
CCAMLR-41/08	Review of the Rules for Access and Use of CCAMLR Data Chair of the Data Services Advisory Group (DSAG)
SC-CAMLR-41/BG/32	The application of electronic monitoring in CCAMLR fisheries Delegation of the United Kingdom
SC-CAMLR-41/BG/33	Proposal for a Workshop to enhance the CCAMLR Ecosystem Monitoring Program (CEMP) C. Waluda, M. Collins, M. Korczak-Abshire, J.-H. Kim, G. Milinevsky, A. Kato and S. Olmastroni
WG-ASAM-2022/01	Report of the Chair of the Scientific Committee on the CCAMLR Scientific Committee Symposium Chair of the Scientific Committee
WG-EMM-18/33	Approaches to data collection and analysis for detecting and quantifying functional overlap at the scale of the individual vessel M. Söffker and N. Gasco
WG-EMM-2022/26 Rev. 1	Return of the giants: Summer abundance of fin whales in the Scotia Sea M. Biuw, U. Lindstrøm, J.A. Jackson, M. Baines, N. Kelly, G. McCallum, G. Skaret and B.A. Krafft
WG-FSA-2021/04 Rev. 1	Summary of incidental mortality associated with fishing activities collected in scientific observer and vessel data during the 2020 and 2021 seasons Secretariat

Details of marine mammal exclusion device deployed on Norwegian continuous krill trawl nets, with alterations and modifications made in 2021 and 2022

After the third humpback whale entanglement in April 2021, in which the whale broke through the exclusion device, Aker BioMarine added 8, 10 and 12 mm Spectra ropes to the device to increase the breaking strain. The 12 mm rope has a reported breaking strain of 10 tonnes, which is around five times the strength of the previous material. However, despite this modification, another humpback whale entanglement was recorded in January 2022. Although the animal did not break through the net, it was concluded that the fastening of this reinforced exclusion net was incomplete and too far away from the mouth of the net at its lower end. Modifications were made by attaching the exclusion device tightly to the mouth opening and stringing it tighter to increase the tension (Figure 1). No whale entanglement incidents have been reported since then.

MARINE MAMMAL EXCLUSION DEVICE (MMED) - ALTERATIONS AND REINFORCEMENTS MADE IN 2021 and 2022:

- MATERIAL: Spectra material (minimum 8mm) for enhanced breaking strength (introduced June 2021 on all AKBM vessels)
- FITTING: MMED moved to outer mouth of trawl to reduce risk of entanglement (introduced February 2022 on all AKBM vessels)

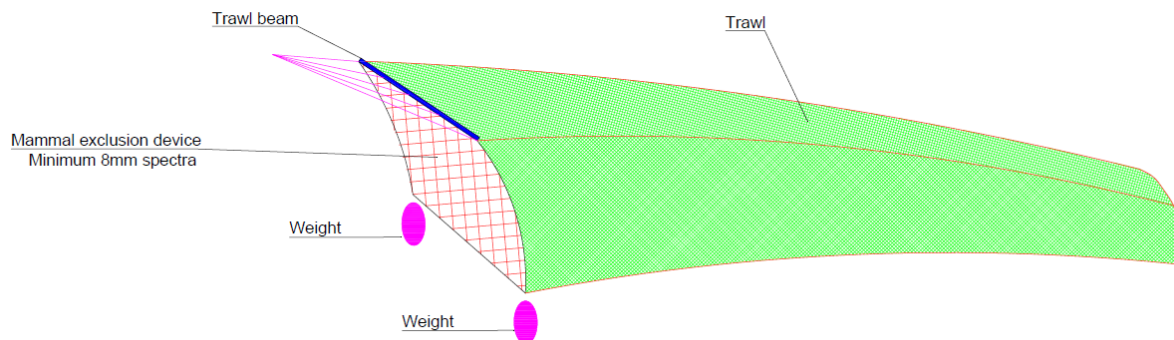


Figure 1: Marine mammal exclusion device deployed on Norwegian continuous krill trawl nets, with alterations and modifications made in 2021 and 2022. For an indication of scale, the mouth of the net is approximately 20 m × 20 m.

**Working Group on Incidental Mortality Associated with Fishing (WG-IMAF)
Terms of Reference¹**

1. The purpose of the Working Group on Incidental Mortality Associated with Fishing (WG-IMAF) is to contribute to the conservation of Convention Area seabirds and marine mammals through the provision of advice to the CCAMLR Scientific Committee and its working groups. To achieve this, WG-IMAF will address the following terms of reference:

- (i) review and analyse data on the level and significance of direct impacts of interactions and incidental mortality associated with fishing
- (ii) review the efficacy of mitigation measures and avoidance techniques currently in use in the Convention Area, and consider improvements to them, taking into account experience both inside and outside the Convention Area
- (iii) review and analyse data on the level and significance of direct impacts of marine debris on seabirds and marine mammals within the Convention Area
- (iv) collaborate and coordinate with organisations that the Commission has a recognised cooperative arrangement with, including invited experts as required
- (v) provide the Scientific Committee with advice for:
 - (a) improvements and/or additions to the reporting and data collection requirements currently in use in the Convention Area
 - (b) improvements and/or additions to the measures in use to avoid or mitigate incidental mortality and interactions associated with fisheries within the Convention Area
 - (c) cooperation with other organisations with relevant expertise
 - (d) approaches to improve the conservation status of Convention Area seabirds and marine mammals directly impacted by fishing outside the Convention Area, including cooperation with adjacent regional fisheries management organisations (RFMOs).

¹ 2022.