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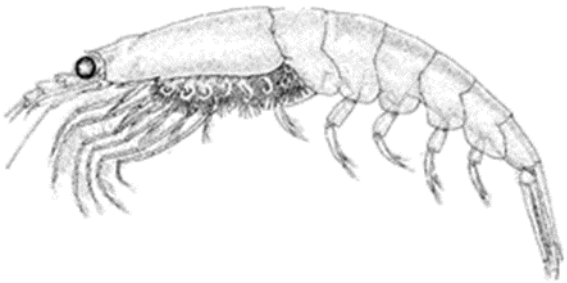
Aker Biomarine Antarctic krill



Public Comment Draft Report

Conformity Assessment Body (CAB)	**Lloyd's Register**
Assessment team	Geir Hønneland, Lucia Revenga & Julian Addison
Fishery client	**Aker Biomarine**
Assessment Type	Second Reassessment

Assessment Data Sheet

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Assessment Team	Team Leader and P3 Assessor	Geir Hønneland
	P2 Assessor	Lucia Revenga
	P1 Assessor	Julian Addison

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2 Glossary

ASOC	Antarctic and Southern Ocean Coalition
APA	Antarctic Protected Area
ASPA	Antarctic Specially Protected Area
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CEMP	CCAMLR Ecosystem Monitoring Programme
CITES	Convention on International Trade in Endangered Species
CPUE	Catch per Unit Effort
ETP	Endangered, Threatened, Protected Species
F	Fishing Mortality
FAO	Food and Agriculture Organisation of the United Nations
GSGSSI	Government of South Georgia and South Sandwich Islands
GYM	Generalised Yield Model
IUU	Illegal, Unregulated and Unreported Fishing
IWC	International Whaling Commission
LTL	Low Trophic level
M	Natural Mortality
MRAG	Marine Resource Assessment Group (London)
MSC	Marine Stewardship Council
OCCAM	Ocean Circulation and Climate Advanced Modelling Project
SGSSI	South Georgia and South Sandwich Islands
SMOM	Spatial Multi-Species Operating Model
SSMU	Small-scale Management Unit
TAC	Total Allowable Catch
VME	Vulnerable Marine Ecosystem
VMS	Vessel Monitoring System
WG-EMM	Working Group on Ecosystem

3 Executive summary

» This report is the Public Comment Draft Report (PCDR) which provides details of the MSC assessment process for the Aker Biomarine Antarctic Krill. The process began with publication of the ACDR on 13th September and was concluded (to be determined at a later date).

» A review of information presented by the client has been scored by the assessment team and through the publication of the ACDR and the site visit that followed in Oslo (16-17 December 2019) and Bergen (18 December 2019), these scores have been reviewed by the assessment team and amended as appropriate.

» Following this, this report has been through peer and client review. The assessment team have reviewed all comments and revised scores appropriately. – please note this **does not** represent a final scoring outcome or a certification decision.

» Stakeholders are once again encouraged to review the PCDR and scoring (and responses to previous input where relevant) presented in this assessment and use the Stakeholder Input Form to provide evidence to the team of where changes to scoring are still necessary.

» The **Target Eligibility Date** for this assessment is the date of recertification.

The assessment team for this fishery assessment comprised of Geir Hønneland who acted as team leader and Principle 3 specialist; Julian Addison who was primarily responsible for evaluation of Principle 1 and Lucia Revenga who was primarily responsible for evaluation of Principle 2.

Client strengths

» The client vessels use a trawl system with a fine mesh that prevents anything larger than krill from entering the system and is monitored by underwater cameras.

» There is 100% observer coverage in the fishery.

» The client works actively with, and provides material support to, NGOs and scientific institutes, contributing to knowledge production beyond that provided by CCAMLR and participating states.

Client weaknesses

» No particular weaknesses are identified for this client.

Rationale

There are a number of areas which reflect positively on the fishery:

» The fishery is operating at catch levels well below what would generally be regarded as a precautionary upper level relative to the best estimates available of stock size.

» Bycatch is negligible, and there is virtually no interaction with species other than the target krill or minimal retained species. Direct effects or interactions between the fishery and ETP species are nil. The gear can only impact the habitat in the case of gear loss, which has happened extremely rarely.

» There is a well-established and well-functioning management regime and enforcement system for the fishery, including requirements of 100% observer coverage and catch reports after each haul.

» The fishery is managed within a precautionary and ecosystem approach.

Conditions & Recommendations

No conditions have been raised at the CPRDR stage. One recommendation has been raised at this re-assessment and two recommendations are still open from the last certification cycle.

For interested readers, the report also provides background to the target species and fishery covered by the assessment, the wider impacts of the fishery and the management regime, supported by full details of the assessment team, a full list of references used and details of the stakeholder consultation process.

Lloyd's Register confirm that this fishery is within scope.

4 Report details

4.1 Authorship and peer review details

All team members listed below have completed all requisite training and signed all relevant forms for assessment team membership on this fishery.

Assessment team leader: Geir Hønneland

Primarily responsible for assessment under Principle 3

Geir Hønneland holds a PhD in political science from the University of Oslo (2000) and has studied international fisheries management (with main emphasis on enforcement and compliance issues), international environmental politics and international politics in Polar regions. He was affiliated with the Fridtjof Nansen Institute in Oslo for more than 20 years, as research fellow (1996-2006), research director (2006-2014) and director (2015-2019). Among his fisheries-related books are Making Fishery Agreements Work (Edward Elgar, 2012; China Ocean Press, 2016). Before embarking on an academic career, he worked five years for the Norwegian Coast Guard, where he was trained and certified as a fisheries inspector. Geir has been involved in MSC assessments since 2009 and has acted as P3 expert in more than 40 full assessments and re-assessments, as well as a number of pre-assessments and surveillance audits. His experience from full assessments includes a large number of demersal, pelagic and reduction fisheries in the Northeast Atlantic, North Pacific and Southern Ocean, as well as inland and bivalve fisheries. In the Northeast Atlantic, he has covered the international management regimes in the Barents Sea, Norwegian Sea, North Sea, Skagerrak, Kattegat and the Baltic Sea, and the national management regimes in Norway, Sweden, Denmark, Russia, Iceland, Faroe Islands, Greenland, Scotland and Germany, as well as the EU level. He is qualified as an MSC Team Leader (Fisheries Standard v2.0, Fisheries Certification Process v2.1) and Chain of Custody Auditor (v2.0) and has also passed the ISO 19011-2018 course as Lead Auditor – Management Systems Auditing. Since 2019, he has been affiliated with Lloyd's Register as Senior Project Manager for Northern Europe, Scandinavia and Russia.

Geir has passed all MSC training and has no Conflict of Interest in this fishery. Full CV available on request.

Expert team member: Julian Addison

Primarily responsible for assessment under Principle 1

*****A variation request was submitted and accepted by the MSC to allow Julian Addison to act as P1 on this assessment without meeting the criteria 1.a or 1.b in Table PC3 (MSC FCP v2.1). Full variation request and MSC response is available on the MSC website here:

https://fisheries.msc.org/en/fisheries/aker-biomarine-antarctic-krill/@@assessments

Dr Julian Addison is an independent fisheries consultant with 30 years' experience of stock assessment and provision of management advice on shellfish fisheries, and a background of scientific research on shellfish biology and population dynamics and inshore fisheries. Until December 2010 he worked at the Centre for Environment, Fisheries and Aquaculture Science (Cefas) in Lowestoft, England where he was Senior Shellfish Advisor to Government policy makers, which involved working closely with marine managers, legislators and stakeholders, Government Statutory Nature Conservation Organisations and environmental NGOs. He has experienced shellfish management approaches in North America as a visiting scientist at DFO in Halifax, Nova Scotia and at NMFS in Woods Hole, Massachusetts. For four years he was a member of the Scientific Committee and the UK delegation to the International Whaling Commission providing scientific advice to the UK Commissioner. He has worked extensively with ICES and most recently was Chair of the Working Group on the Biology and Life History of Crabs, a member of the Working Group on Crangon Fisheries and Life History and a member of the Steering Group on Ecosystems Function. He has extensive experience of the MSC certification process primarily as a P1 team member but also as a P2 team member and team leader. He has undertaken over 30 MSC full assessments of crustacean and mollusc fisheries worldwide which use a wide range of stock assessment methodologies and fishing gears. He has also undertaken MSC pre-assessments in Europe, North America and Australia and over 60 annual surveillance audits and technical reviews. He is a member of the MSC Peer Review College and has carried out peer reviews of MSC assessments worldwide of a wide range of fish and shellfish fisheries. Other recent work includes a review of the stock assessment model for blue crabs in Chesapeake Bay, USA, and an assessment of three Alaskan crab fisheries under the FAO-based Responsible Fisheries Management scheme.

Julian has passed all MSC training and has no Conflict of Interest in this fishery. Full CV available on request.

Expert team member: Lucia Revenga Grietych

Primarily responsible for assessment under Principle 2

P2 Expert Lucia Revenga is a marine scientist, specializing in Fisheries Biology. Lucia holds degrees in Marine Sciences and in Environmental Sciences both by Cadiz University (Spain). Between years 2005 - 2010 Lucia worked with

TRAGSA for the Spanish General Marine Secretariat, the Spanish Institute of Oceanography and the Canary Islands Marine Sciences Institute, conducting researches and writing reports concerning the biology and stock status of different species, studying and analysing the catch composition and population of the stocks, the species biology (sex and maturity), as well as reporting all the information concerning retained species. Lucia worked with different species (bluefin tunas, skipjack tunas, albacores, mackerels, sardines, eels, scarlet shrimps, prawns, Norway lobsters, soles, halibuts, hakes, seabreams), on board fishing vessels with different fishing gears (bottom trawlers, tuna traps and artisanal fleet) on Atlantic waters (NAFO area, Moroccan and Spanish waters). Lucia has worked closely with different stakeholders, including fishermen, shipowners, institutional partners and the scientific Surveillance Announcement - Version 3.0 (09/04/15) community. Lucia has also taken part in oceanographic surveys focused in the search of vulnerable marine ecosystems, sampling benthic habitats of deep-water canyons.

Since 2011 Lucia has worked for IFAPA (Institute for Research and Training in Fisheries) as a Fisheries biology teacher for fishermen. Lucia also conducts research in fishery local activities and tries to increase community awareness of the conservation of coastal ecosystems and encourage sustainable fishing practices.

Previously Lucia worked as a teacher and technician of environmental issues related to the ISO-14000 and ISO-9000 norms.

Lucia has passed all MSC training and has no Conflict of Interest in this fishery. Full CV available on request.

4.2 Peer Reviewers

Peer reviewers used for this report were David Japp and Earl Dawe. A summary CV for each is available in the **Assessment downloads** section of the fishery's entry on the MSC website.

David Japp

David Japp is a Fisheries Scientist with an undergraduate degree in Zoology and Oceanography and post graduate degrees (Masters and Honours) in Fisheries Science. Presently he is director of Capricorn Fisheries Monitoring (CapFish) in South Africa, working extensively in fisheries in South Africa as well as regionally and internationally.

He was previously employed at the Sea Fisheries Research Institute (SFRI) from 1988 to 1997 as a biologist and manager and at the time he left this institution was head of the offshore resources section (demersal and pelagic stocks). His role at SFRI (now The Department of Agriculture Forestry and Fisheries) was primarily management, biology and resource assessment and he was responsible for the submission of management advice on hake and other demersal stocks. He was also responsible for, planned and lead demersal biomass surveys in the period employed at SFRI. Mr Japp has retained an intimate knowledge of all aspects of the demersal and other fisheries including the trawling methods. He has authored many fisheries-related papers as well as numerous technical reports for the FAO. Mr Japp has also provided many expert reports for Environmental Impact Assessments relating to fisheries and has an intimate knowledge of Southern African and global fisheries and associated recruitment processes and related environmental characteristics. He also consults to FAO and the World Bank on fisheries-related issues including high-seas guidelines, Ecosystem Approach to Fisheries (EAF) and project development, appraisal and implementation in the East African and West Indian Ocean regions. Regarding the Marine Stewardship Council (MSC), Mr Japp was an assessor of the South African hake fishery from 2002 through to reassessment in 2009. He has been on the assessment teams for Tristan da Chuna lobster, Sea of Okhotsk Pollock, Namibian Hake and PNA Purse seine. He has conducted pre-assessments for Kenya lobster, Tanzanian octopus, Mozambique shrimp, Uruguay hake, Patagonian toothfish and South Africa tuna pole (albacore) amongst others. He is a member of the MSC peer review college and has refereed numerous MSC assessments and also supervises MSC-related Chain of Custody audits in South Africa.

Earl Dawe

Mr Earl Dawe retired in 2015 following a 35-year research career with Fisheries and Oceans Canada which focused on the fisheries, biology, population dynamics, and ecology of cephalopods and crustaceans. He has published 170 scientific/technical reports and journal articles (58 in the primary, peer reviewed literature) on various aspects of population biology and ecology as well as fishery resource assessment and management of both short-finned squid and snow crab. Research effort has most recently focused on ecosystem structure and functioning, particularly the relative effects of ocean climate versus predation on finfish and crustacean resources. Earl's career included heavy involvement in the review and formulation of scientific advice for management of shellfish resources in Atlantic Canada as well as the advisory/consultative part of managing the Newfoundland and Labrador (NL) fisheries for short-finned squid and snow crab. He has recently participated as a scientific advisor in the MSC certification of the NL snow crab fishery as well as recently served as peer reviewer in MSC certification of the Western Asturias octopus trap fishery.

4.3 RBF Training

Julian Addison has been fully trained in the use of the MSC's Risk Based Framework (RBF).

RBF was not used for this fishery assessment.

4.4 Version details

Table 1: Fisheries program documents versions.

Document	Version number
MSC Fisheries Certification Process	**Version 2.1**
MSC Fisheries Standard*	**Version 2.01**
MSC General Certification Requirements	**Version 2.4.1**
MSC Reporting Template	**Version 1.0**

*MSC Fisheries Standard v2.01 default assessment tree was used with LTL on PI 1.1.1.

5 Unit of Assessment and Certification and results overview

5.1 Unit of Assessment and Unit of Certification

5.1.1 Unit of Assessment

LR have determined that the fishery is within scope of the MSC Fisheries Standard. The Unit of Assessment can be seen in Table 2.

Table 2: Unit of Assessment (UoA)

UoA 1	Description
Species	Antarctic krill *(Euphausia superba)*
Stock	CCAMLR Area 48, Antarctic Sea
Geographical area	Antarctic krill in CCAMLR Area 48
Harvest method / gear	Pelagic trawl using own Eco-Harvesting system
Client group	All Aker Biomarine Antarctic vessels targeting Antarctic Krill in the Antarctic Sea area covered in Area 48, using Pelagic trawl using their own patented EcoHarvesting system.
Other eligible fishers	None

5.1.2 Unit of Certification

Based on information presented in this report the prosed Unit of Certification is presented below.

Table 3: Unit of Certification (UoC)

UoC 1	Description
Species	Antarctic krill *(Euphausia superba)*
Stock	CCAMLR Area 48, Antarctic Sea
Geographical area	Antarctic krill in CCAMLR Area 48
Harvest method / gear	Pelagic trawl using own Eco-Harvesting system
Client group	All Aker Biomarine Antarctic vessels targeting Antarctic Krill in the Antarctic Sea area covered in Area 48, using Pelagic trawl using their own patented EcoHarvesting system.
Other eligible fishers	None

5.2 Assessment results overview

5.2.1 Determination, formal conclusion and agreement

To be drafted at Final Draft Report

To be completed at Public Certification Report

The report shall include a formal statement as to the certification determination recommendation reached by the assessment team on whether the fishery should be certified.

The report shall include a formal statement as to the certification action taken by the CAB's official decision-makers in response to the Determination recommendation.

Reference(s): FCP v2.1 Section 7.21

5.2.2 Principle level scores

Table 4: Principle level scores

Principle	UoA 1
Principle 1 – Target species	89.2
Principle 2 – Ecosystem impacts	96.7
Principle 3 – Management system	96.0

5.2.3 Summary of conditions

No conditions have been raised at the CPRDR stage, however, the scoring presented in this report has not been reviewed by stakeholders – this step will all take place from here onwards.

5.2.4 Recommendations

There are two recommendations from the previous assessment cycle which still apply:

Recommendation 1:

Aker Biomarine should continue implementing the standard operating procedure they agreed to during the 2nd surveillance of its 1st MSC certification (prior to the establishment of CM 51-07). This was described as follows, 'AKBM have introduced a standard operating procedure (covering both Saga Sea and Antarctic Sea) requiring skippers to determine the availability of krill in an area; if the swarm being fished seems to be the only available in an area, then the vessel will move on before fishing the available krill – so fishing in a manner that would help to prevent localised depletion within an area.'

Progress at Surveillance Audit 4: Aker Biomarine continues to implement the standard operating procedure whereby the fishing vessels move on before fishing the available krill if the swarm being fished seems to be the only one available in the area. The recommendation is on target.

Recommendation 2:

Bearing in mind the importance of data collection and the ratio of bycatch in the assessment process, the client is recommended to collect and prepare information on bycatch in order to update the 2012 information on bycatch levels and on the bycatch species composition for the recertification process. The client is encouraged to maintain the <2% bycatch level.

Progress at Surveillance Audit 4: Recommendation 2 was set at the 3rd surveillance. This recommendation is behind target. Information on bycatch levels is collected by observers however it is not gathered nor processed to prepare any

general report on bycatch levels. Observer reports show anyway that bycatch levels continue to be well below the 2% threshold limits.

There is one recommendation for the fishery at 2nd Re-assessment:

Recommendation 3 - PI 2.2.1.b:

It is recommended that attention is given to the identification of other krill species (apart from *Euphasia superba*) in the catch, identification tools and guides are provided in order to better identify other krill species and observer reports highlight the presence of ice krill and other krill species when found.

6 Evaluation results

6.1 Eligibility date

Target eligibility date for this fishery is the date of recertification.

6.2 Traceability within the fishery

Traceability up to the point of first landing has been scrutinised as part of this assessment and the positive results reflect that the systems in place are deemed adequate to ensure fish is caught in a legal manner and is accurately recorded. The report and scoring tables describe these systems in more detail, but briefly traceability can be verified by:

- VMS/electronic logbook reporting to enforcement bodies after every haul
- 100% observer coverage
- no possibilities for mixture of certified with non-certified catch; only krill delivered to client's own transport vessel; only client vessel catch delivered to the client's own production facility
- labelling of catch with an identification key which is traceable all the way to the end user.

The client vessels are 100% krill vessels only participating in the Antarctic krill fishery in CCAMLR Area 48, including South Georgia. All catches are reported continuously during the fishing operations to the Norwegian authorities and CCAMLR. Norwegian-licensed vessels are obliged to report catches from each haul through their electronic logbooks; for client vessels this implies reporting with two-hour intervals. In the hypothetical cases where the signal from the vessel is temporarily lost, the information can subsequently be recovered because all data are stored automatically on board. Aker Biomarine also uses independent observers on board 100% of the time, the CCAMLR requirement being only 50%. Catch reporting includes information about the quantity of catch, location, time and vessel license number.

All catch is transhipped to the client's own transport vessels and subsequently delivered to the client's own warehouse facility in Uruguay. Products from there are transported directly to processing plants in Spain and the US to be further processed into human Omega 3 products, or to the end customer (meal-to-feed customers). Products from Uruguay are transported to customers using conventional shipping lines. Only client vessels deliver krill to the client's own transport ship. Furthermore, only these ships deliver krill to the client's storage facility in Uruguay, so there is no risk of catch from units outside the UoC being sold as certified. There is no risk of substitution of certified and non-certified catch prior to the point of landing, because the vessels only fish for krill, and only the vessels covered by this certification deliver catches to the client's transport ship.

The krill catch is processed on board to a krill meal. It is bagged in sacks which clearly state that they contain krill from the client vessels and also display the license numbers of the vessel. All krill products are marketed as 100% krill product and no other products are produced by the vessels, with all products being labelled accordingly. All products from the fishery are labelled with an identification key which is traceable all the way to the end-user. This identification key includes the catch coordinates of the krill, vessel license number, catch date and production date.

Table 5: Traceability information

Factor	Description
Will the fishery use gears that are not part of the UoC? If yes, please describe: - If this may occur on the same trip, on the same vessels, or during the same season; - How any risks are mitigated.	No
Will vessels in the UoC also fish outside the UoC geographic area? If yes, please describe: - If this may occur on the same trip; - How any risks are mitigated.	No

Do the fishery client members ever handle certified and non-certified products during any of the activities covered by the fishery certificate? This refers to both at-sea activities and on-land activities. - Transport - Storage - Processing - Landing - Auction If yes, please describe how any risks are mitigated.	No
Does transhipment occur within the fishery? If yes, please describe: - If transhipment takes place at-sea, in port, or both; - If the transhipment vessel may handle product from outside the UoC; - How any risks are mitigated.	Yes. At sea – only krill, only with the client's own vessels and within their MSC Chain of Custody certificate, as well as in accordance with CCAMLR regulations.
Are there any other risks of mixing or substitution between certified and non-certified fish? If yes, please describe how any risks are mitigated.	No

6.3 Eligibility to enter further chains of custody

Only krill caught in the manner defined in the Unit of Certification under restrictions detailed throughout the body of the final Public Certification Report for this fishery shall be eligible to enter the Chain of Custody. Chain of Custody should commence following the first point of landing, at which point the product shall be eligible to carry the MSC logo (under restrictions imposed by the MSC Chain of Custody standard). There are no restrictions on the fully certified product entering further chains of custody.

Aker Biomarine Antarctic Krill has its own chain of custody certificate.

Eligible point of landing is the client's facility in Nueva Palmira close to Montevideo, Uruguay.

6.4 Eligibility of Inseparable or Practicably Inseparable (IPI) stock(s) to enter further chains of custody

The below text gives a description of the stocks identified as Inseparable or Practicably Inseparable (IPI) and confirmation they are within scope of IPI. The format is laid out as to address how the catches under consideration fulfil the requirements of FCP v2.1 7.5.8.1 and to indicate fish and fish products from IPI stocks may enter further chains of custody with an exemption to additional assessment requirements (FCP v2.1 7.5.11.b). Exemption to additional assessment requirements is appropriate as detailed in MSC requirements FCP v2.1 7.5.11. b. A full rationale is given showing that the catch proportion of IPI stocks is less than or equal to 2% and the total catch of IPI stock(s) by the fishery under assessment does not create a significant impact on the IPI stock(s) as a whole.

FCP v2.1 7.5.8.1

b. When distinguishable, it is not commercially feasible to separate due to the practical operation of the fishery that would require significant modification to existing harvesting and processing methods.

According to the different CCAMLR scientific observer reports from the UoA, all species recorded in the catch composition are used in the intended products, mainly fishmeal and krill oil. The continuous pumping system transfers the catch to a conveyor belt on board the vessel (s), which moves the catch into the hold. There is no size sorting of the krill caught and all species in the catch are retained. The ability to separate these out from some of the krill products is not practicable.

c. The total combined proportion of catches from the IPI stock(s) do not exceed 15% by weight of the total combined catches of target and IPI stock(s) for the UoA.

The UoA has 100% observer coverage. The tasks of the observer are specified in the Scientific Observers Manual, following the CCAMLR Scheme of International Scientific Observation. The observer's tasks are listed in Annex I of the Manual, and include, among others:

• sampling of catches to determine biological characteristics,

• recording biological data by species caught,

• recording bycatches, their quantity and other biological data,

• recording entanglement and incidental mortality of birds and mammals,

• recording the procedure by which declared catch weight is measured.

Data from the official CCAMLR observer scheme was reviewed by MRAG in order to conduct an analysis of larval fish bycatch by the UoA. This analysis concluded (as shown in MRAG Report, 2012) that the estimates of fish larval bycatch in the Aker krill fishery accounted for a 0.2% of the total catch (taking into consideration all retained species, this is, lanternfish, icefish) and that the impact of the Aker krill fishery on these stocks is negligible (even considering both Aker vessels fishing at their maximum annual capacity).

d. The IPI stocks are not endangered, threatened or protected (ETP) species.

The results of the 2007-2011 analysis show that myctophid (lanternfish) and channichthyid (icefish) species dominated the bycatch, but with occasional small quantities of nototheniids present too. A list of the species caught is given in Table 6. None of the species recorded in Table 6 are classified as ETP species.

Table 6: Unstandardized total numbers of fish larvae in the *Saga Sea* catch by species code and species name, 2007–2011.

Code	Species name	English name	Area 48.1	Area 48.2	Area 48.3	Total
ANI	*Champsocephalus gunnari*	Mackerel icefish	3	2	367	**372**
ANS	*Pleuragramma antarcticum*	Antarctic silverfish	5	20	0	**25**
ART	*Artedidraco spp*	-	1	0	0	**1**
BTI	*Bathydraconidae*	Bathydraconidae	0	2	0	**2**
ELN	*Electrona antarctica*	-	0	6	0	**6**
FIC	*Cryodraco antarcticus*	Long-fingered Icefish	9	1	0	**10**
ICX	*Channichthyidae*	Icefish spp	24	150	22	**196**
JIC	*Neopagetopsis ionah*	Crocodile icefishes	3	20	0	**23**
KRA	*Krefftichthys anderssoni*	Lanternfish spp.	0	4	16	**20**
LXX	*Myctophidae*	Lanternfish	10	337	213	**560**
MIC	*Chionodraco myersi*	Myers' icefish	2	1	0	**3**
MOY	*Muraenolepis microps*	Smalleye moray cod	0	9	26	**35**
MRL	*Muraenolepis spp*	Moray cods	0	0	2	**2**
NOC	*Notothenia coriiceps*	Black rockcod	0	5	0	**5**
NOG	*Notothenia gibberifrons*	Humped rockcod	1	44	1	**46**
NOL	*Nototheniops larseni*	Painted rockcod	1	5	14	**20**
NOT	*Patagonotothen brevicauda*	Patagonian rockcod	0	19	0	**19**
NOX	*Nototheniidae*	Rockcods	3	12	23	**38**
NTO	*Notolepis coatsi*	Antarctic jonasfish	0	38	0	**38**
PGE	*Parachaenichthys georgianus*	Bathydraconidae	0	3	0	**3**
PRE	*Protomyctophum tenisoni*	-	0	5	0	**5**
RTX	*Macrouridae*	Grenadiers, rattails nei	1	0	0	**1**
SGI	*Pseudochaenichthys georgianus*	South Georgia icefish	9	15	0	**24**
SSI	*Chaenocephalus aceratus*	Blackfin icefish	22	3	0	**25**
TIC	*Chionodraco hamatus*	-	6	0	0	**6**
TOA	*Dissostichus mawsoni*	Antarctic toothfish	1	5	0	**6**
TOT	*Dissostichus spp*	Toothfish spp	0	0	2	**2**
TRT	*Trematomus spp*	Trematomus spp	3	0	0	**3**
WIC	*Chaenodraco wilsoni*	Spiny icefish	17	2	0	**19**
YDB	*Cryodraco spp*	-	48	11	0	**59**

e. The IPI stocks are not certified separately

Antarctic Krill (Euphausia superba) is the only species certified under the Aker Biomarine Antarctic Krill certificate.

Considering the above text, it is considered that the IPI catches in the Aker krill fishery meet the requirements in FCP v2.1 7.5.8.1 b-e.

MSC FCP v2.1 7.5.11 b.i.

A. The catch proportion of IPI stocks calculated in 7.5.8.1.c is less than or equal to 2% and the total catch of IPI stock(s) by the UoA does not create a significant impact on the IPI stock(s) as a whole.

MRAG (2012) analysis on bycatch species shows standardized counts of icefish, lanternfish and notothenid individuals per tonne sampled. Together, the three groups account for ~1000 individuals per sampled tonne. As a precautionary proxy, one could consider that each larva weighs about 2 g, which would yield a final weight of 2 kg of retained larvae per tonne sampled. In other words, a maximum of 0.2% of the catch composition can be considered as retained species other than krill. The gear and the fishing strategy can be considered as highly selective.

MRAG report (2012) also provides the precautionary total larval fish bycatch estimates (numbers and tonnes) by subarea, species group and season for a normal ice year and a low ice year (see Table 7). The report assumes that the bycatches of channichthyiids and notothenids were exclusively Champsocephalus gunnari and Notothenia rossii, respectively, the species of greatest concern in the analysis. It is also of note that very few of the icefish larvae recorded in Subarea 48.1 and 48.2 were actually C. gunnari, the main species of concern in the area.

Table 7: Precautionary total larval bycatch estimates (numbers and tonnes) by subarea, species group and season for a normal ice year and a low ice year.

Scenario	Area	Species code	Summer (number)	Winter (number)	Total (number)	Total (tonnes)
Normal ice year	48.1	ICE	18 816	6 272	25 088	0.132
	48.2	ICE	88 549	24 913	113 462	0.596
	48.3	ICE	0	175 911	175 911	0.925
	48.1	LAN	0	0	0	0
	48.2	LAN	79 222	106 777	185 999	1.019
	48.3	LAN	0	176 677	176 677	0.968
	48.1	NOT	2 514	838	3 352	0.008
	48.2	NOT	28 154	37 946	66 100	0.160
	48.3	NOT	0	12 936	12 936	0.031
Low ice year	48.1	ICE	31 360	344 956	376 316	1.978
	48.2	ICE	111 648	4 018	115 667	0.608
	48.3	ICE	0	45 234	45 234	0.238
	48.1	LAN	0	0	0	0
	48.2	LAN	99 888	17 222	117 110	0.641
	48.3	LAN	0	45 431	45 431	0.249
	48.1	NOT	4 189	46 084	50 273	0.122
	48.2	NOT	35 498	6 120	41 618	0.101
	48.3	NOT	0	3 326	3 326	0.008

The MRAG report concludes that it is highly unlikely that the rates of larval fish bycatch of the Saga Sea pose any threat to lanternfish, icefish or notothenid stocks in Area 48. MRAG report also concludes that it is unlikely that the addition of the Antarctic Sea to the UoA (with both vessels fishing at their maximum possible annual capacity) would result in significant risk to these stocks.

B. The CAB shall note that significant impact will be assessed on basis of the status of the IPI stock, and the risk that the IPI catch poses to the health of the IPI stock.

The IPI stocks under consideration will be scored under PI 2.1.1 & 2.2.1 as retained catch.

7 Scoring

7.1 Summary of Performance Indicator level scores

Table 8: Fishery Assessment Scoring Worksheet

Principle	Component	Performance Indicator (PI)		Score
One	Outcome	1.1.1	Stock Status	90
		1.1.2	Stock Rebuilding	NA
	Management	1.2.1	Harvest Strategy	95
		1.2.2	Harvest Control rules & tools	85
		1.2.3	Information & monitoring	90
		1.2.4	Assessment of stock status	85
Two	Primary Species	2.1.1	Outcome	100
		2.1.2	Management strategy	100
		2.1.3	Information / Monitoring	100
	Secondary Species	2.2.1	Outcome	80
		2.2.2	Management strategy	100
		2.2.3	Information / Monitoring	95
	ETP Species	2.3.1	Outcome	100
		2.3.2	Management strategy	100
		2.3.3	Information strategy	100
	Habitats	2.4.1	Outcome	100
		2.4.2	Management strategy	100
		2.4.3	Information strategy	85
	Ecosystems	2.5.1	Outcome	100
		2.5.2	Management strategy	95
		2.5.3	Information	95
Three	Governance and policy	3.1.1	Legal &/or customary framework	95
		3.1.2	Consultation, roles & responsibilities	100
		3.1.3	Long term objectives	100
	Fishery specific management system	3.2.1	Fishery specific objectives	90
		3.2.2	Decision making processes	95
		3.2.3	Compliance & enforcement	100
		3.2.4	Monitoring & management performance	90

7.2 Principle 1

7.2.1 Biology and Life History

Krill are small crustaceans of the order Euphausiacea and the Antarctic krill (*Euphausia superba*) is distributed widely across the 36 million km^2 of the Southern Ocean extending from the high Antarctic continental shelf to the Antarctic Polar Front Zone (Everson, 2000). With its widespread distribution, swarming behaviour and much of its distribution covered by sea ice, there are significant logistical problems in estimating krill abundance. The densest concentrations of krill are found in CCAMLR Area 48, and the krill fisheries have therefore focused in this area. On a broad scale, krill distribution is influenced by hydrography and bathymetry. Krill are found in depths of up to 600m or more and exhibit diurnal vertical migrations from deeper waters in the day to shallower waters at night. Krill are also found generally in deeper waters in the winter than the summer. Through diel vertical migration and swarming, krill may be retained in the deep troughs and canyons where phytoplankton biomass is concentrated (Siegel and Watkins, 2016). Swarming may also be a response to predation. There is some evidence that krill are active swimmers that can maintain their position within favourable habitats (Miller and Hampton, 1989).

As noted above, *Euphausia superba* are widespread across the Southern Ocean and so there may be multiple stocks across that area. However, there is no evidence of genetic differences between krill in different regions of the Southern Ocean, and so it seems reasonable to assume that there is a single stock across Area 48. For management purposes CCAMLR has defined sub-areas of Area 48 based on the assumption that krill are unlikely to move between these smaller areas and based upon knowledge of oceanography in the area (Figure 1).

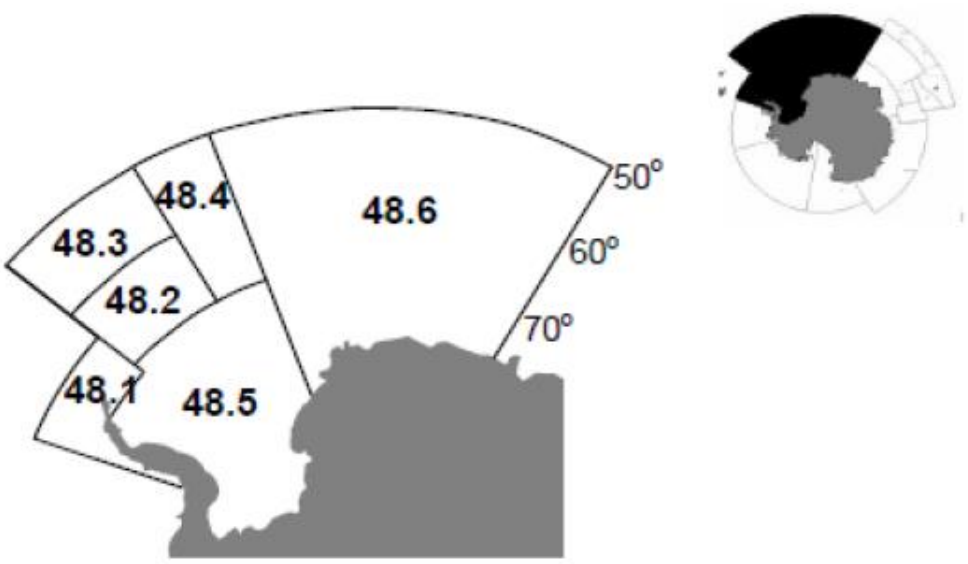

Figure 1: Location of sub-areas in Area 48, and the entire CCAMLR Convention Area (inset). (Source: CCAMLR)

As with all crustacean species, the lack of hard parts precludes routine ageing of krill, and therefore good information is not available on growth rates and longevity. Best estimates are that krill reach a maximum length of more than 60mm at an age of 5 or more years, but the proportion of krill over 5 years in the population is considered to be very low. Female krill spawn from age 2 years near the surface and then the eggs sink into deeper water where they hatch. After hatching, the larvae rise in the water column whilst they continue development. Male krill mature at age 3 years. Spawning of mature krill takes place primarily from late November to late March but may vary temporally and spatially. Krill are batch spawners with 3 to 9 batches per year dependent on food availability and environmental conditions, with batches of eggs ranging from 6,000 to 10,000 eggs. However not all females spawn every year.

In their first winter, krill will feed on algae on the underside of the sea ice cover, which provides a nursery ground for the larval krill. Adult krill will also feed on the ice algae in the spring when other food sources are scarce, but then the phytoplankton bloom that occurs when the sea ice retreats enhances krill growth and maturation prior to reproduction. Recruitment of krill is therefore strongly influenced by the timing of these phases in the life history during the calendar year. However, the report from the 2018 meeting of CCAMLR's Working Group on Ecosystem Monitoring and Management (WG-EMM-18) describes research which challenges the traditional paradigm that krill recruitment is

enhanced by prolonged sea-ice conditions (CCAMLR, 2018). As krill may be dependent on sea ice, any long-term changes in temperature due to climate change could impact on krill population dynamics. In addition, krill eggs will be sensitive to any future ocean acidification through increased levels of CO_2.

Reviews of the biology and life history of krill can be found in Ikeda (1985), Everson (2000), Miller (2003) and Nicol (2009).

7.2.2 Feeding, predators and the role of *Euphausia superba* in the ecosystem

Krill graze on phytoplankton and are therefore important processors of primary production. Protozoans and small copepods are ingested simultaneously and represent an important food resource year-round (Schmidt and Atkinson, 2016). Predators of krill include baleen whales, seals, fish species, a wide range of species of penguins, squid and seabirds such as albatross. Whilst individual seals and penguins may consume large amounts of krill, the overall predation of fish species on krill is greater than that of penguins, whales and seals combined (Hill *et al*., 2007). There have been some observed declines in penguin populations, but there is currently no evidence linking these declines to the fishery for krill.

It is necessary to determine whether *Euphausia superba* can be considered as a key Low Trophic Level (LTL) species as defined by MSC Fisheries Standard v2.01. A simplified food web of the Southern Ocean (Figure 2) shows that linkages across trophic levels are centred around krill (Everson, 2000). *E. superba* plays a key role in the Antarctic ecosystem providing a vital energy link between primary production and higher predators such as baleen whales, seals, fish, birds and cephalopods by feeding on phytoplankton and to a lesser extent also zooplankton, converting them into a form suitable as an energy source for those predators for whom krill make up a large part of the diet.

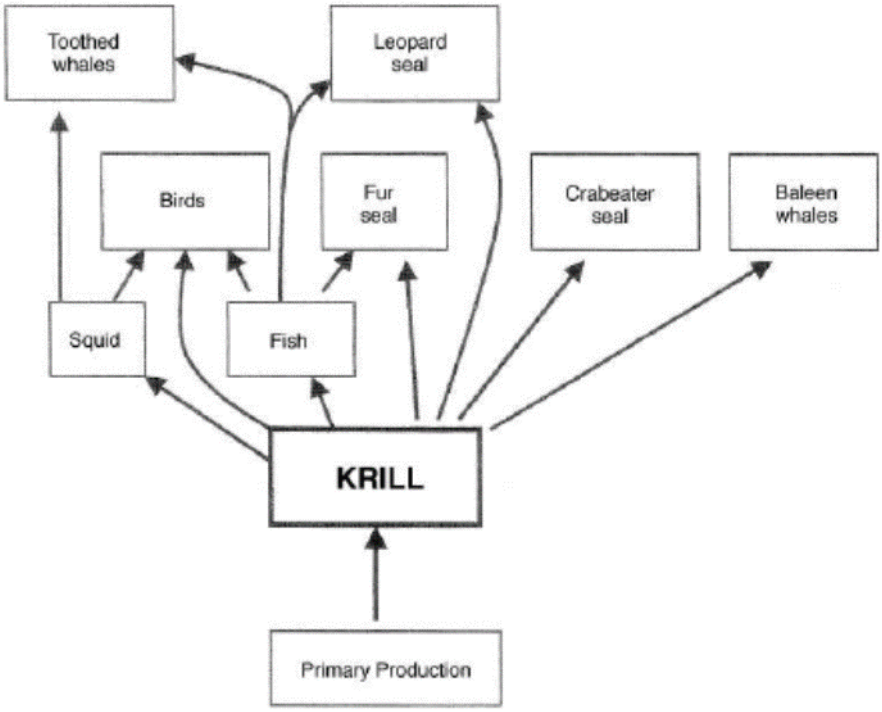

Figure 2: A simplified representation of the Southern Ocean food web. (Source: Everson, 2000)

Antarctic krill are one of the species listed in Box SA1 of MSC Fisheries Standard v2.01, and therefore krill could be considered as a key LTL stock if it meets two of the following criteria as set out in SA2.2.9ai-iii:

(i) A large portion of the trophic connections in the ecosystem involves this stock, leading to significant predator dependency;

(ii) A large volume of the energy passing between lower and higher trophic levels passes through this stock;

(iii) There are few other species at this trophic level through which energy can be transmitted from lower to higher trophic levels, such that a high proportion of the total energy passing between lower and higher trophic levels passes through this stock (i.e. the ecosystem is ‘wasp-waisted’)

All the evidence on Southern Ocean food webs points to krill meeting criteria (i) and (ii) above, and therefore the assessment team concluded that *Euphausia superba* should be considered as a key LTL species in this fishery assessment. The same conclusion was also reached in the certification report of the Deris S.A. krill fishery (Roel *et al*., 2018) which assessed the Chilean fleet fishing *E. superba* in the same geographical area in the Southern Ocean.

7.2.3 Harvest strategy

The overarching body for management and development of the harvest strategy for the krill fishery in the Antarctic is the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), which establishes a Precautionary Upper Catch Limit and a catch trigger level for the krill fishery. CCAMLR distributes quotas across subareas of Area 48, and coordinates both research and observer programmes. Management of the krill fishery by CCAMLR is based upon the precautionary approach and the Ecosystem Monitoring Program (CEMP) provides a basis for regulating harvesting of Antarctic marine living resources in accordance with the ecosystem approach. In particular krill is a key species within the Antarctic marine ecosystem and therefore krill fishing needs to be managed by CCAMLR to ensure there are no detrimental effects on predator species.

In Norway, fisheries are managed under the 2008 Marine Resources Act, which requires that Norwegian fisheries management be guided by the precautionary approach and by an ecosystem approach that takes into account habitats and biodiversity. The Norwegian Ministry and Directorate of Fisheries issue fishery permits and monitor Norwegian fishing companies to ensure that their national vessels in the UoC comply with CCAMLR regulations including monitoring of quotas. Norwegian vessels land their catches in Uruguay, so landing of krill by Norwegian vessels may be subject to Uruguayan management regulations. In addition, all krill producing fishing companies are members of the Association of Responsible Krill harvesting companies (ARK) whose objective is the maintenance of a sustainable harvest of Antarctic krill in an ecosystem context.

A key element of the harvest strategy is the setting of precautionary catch limits based upon recruitment and biomass escapement reference points, with particular regard to minimising the impact on any land-based predators of krill.

Regulations

The krill fishery is regulated through CCAMLR Conservation Measures. Vessels must be licensed to fish for krill and their fishing activity is monitored through a Vessel Monitoring System (VMS). Within the UoC, there are currently three vessels licensed to fish for krill – Saga Sea, Antarctic Sea, and Antarctic Endurance. There are no regulations such as days-at-sea that limit the overall fishing effort of the three licensed vessels.

There are a series of Marine Protected Areas (MPAs) within Area 48 where krill fishing is not permitted. There are no seasonal restrictions in the fishery with a season considered to run from 1 December to 30 November in the following calendar year.

CCAMLR regulates the rigging of the gear through various conservation measures (CMs). The fishery uses a mid-water trawl in depths between 200 and 600 m and trawl cod end mesh size (15 mm inner, 100 mm outer) is regulated under CCAMLR CM22-01-04. Marine mammal exclusion devices, which consist of a ramp that lets krill through, but pushes seals to an escape hole in the roof of the net, are mandatory within the fishery. CCAMLR CM25-03 (2016) requires that the fishery shall operate in such a way as to minimise the incidental mortality of seabirds and marine mammals.

A Precautionary Catch Level (PCL) of 5.61 million tonnes is set for Area 48, which is approximately 9% of the estimated biomass in 2000 and is therefore considered to be highly precautionary. However, the PCL is not formally implemented in practice, and instead a much more precautionary overall TAC (described as a trigger level for the krill fishery) is set at 620,000 tonnes for CCAMLR subareas 48.1, 48.2, 48.3, 48.4. The quota is open to all vessels and not sub-divided by nations, and there are no individual vessel quotas. The current trigger level of 620,000 tonnes is set out under CCAMLR CM 51-01 (2010), and is equivalent to 11% of the PCL, and consequently only 1% of the estimated biomass in 2000.

Historically there was no sub-division of this quota across the four sub-areas, but concerns over the potential impact of high removals of krill within a small geographical area, in particular to ensure that land-based predator populations would not be inadvertently and disproportionately affected by fishing activity, resulted in the implementation of CCAMLR CM 51-07 (2016) which provides an interim distribution of the trigger level in the fishery as set out in Table 9 below. These catch limits are set for the 2018/19 and 2019/20 seasons.

Table 9: **Trigger levels for krill catches for each of the sub-areas in Area 48. (Note that the total percentage distribution sums to over 100%, so CCAMLR still monitors catches to ensure that the overall trigger level of 620,000 tonnes for Area 48 is not exceeded.)**

Area	Maximum percentage of total catch from area	Maximum catch based on trigger level of 620,000 tonnes
48.1	25%	155,000 tonnes
48.2	45%	279,000 tonnes
48.3	45%	279,000 tonnes
48.4	15%	93,000 tonnes

There are no regulations governing the levels of bycatch species.

The work of CCAMLR has undergone two performance reviews in 2008 (CCAMLR, 2008) and 2016 (CCAMLR, 2017a), from which a number of recommendations resulted. These include improved management of the spatial management of catches in Area 48 and developing harvest strategies which take into account ecosystem changes.

7.2.4 Data/Monitoring/Enforcement

CCAMLR carries out fisheries monitoring, scientific observer and ecosystem monitoring programmes and has implemented a series of Conservation Measures (CMs) in relation to the krill stocks in Area 48. Fishing activity of the three Norwegian vessels is monitored through the on-board Vessel Monitoring System (VMS) which is polled every hour. In addition, there is a CCAMLR requirement to notify the commission when a vessel enters or leaves a subarea of Area 48. As with all national fleets, full details of the vessel and fishing gear characteristics of the three Norwegian vessels are maintained through CCAMLR's active vessel registry.

All vessels must complete logbooks detailing catch and effort and this information must be transmitted to CCAMLR secretariat and to the Norwegian authorities. The CCAMLR requirement is that catch returns must be made on a monthly basis. However, once the overall catch limits reach 80% of the trigger level within sub-areas, then catch returns must be made every 5 days. In sub-area 48.1 trigger levels have been reached in recent years, and so for season 2018/19, catch returns must be made every 5 days from the start of the season. The Norwegian Directorate of Fisheries requires that vessels report their catches of krill and bycatch species for each haul on electronic logbooks. CCAMLR monitors total uptake of catches in relation to the overall TAC for the area (and for the thresholds determined for each sub-area) and regularly notifies all contracting parties of uptake of overall TAC. Whilst catches are recorded every 24 hours, CCAMLR requires that an estimate of catch is made every two hours on the vessels as catch limits are based upon wet weight. However, there is some uncertainty around the accuracy of two-hourly counts as it is sometimes difficult to differentiate between krill and water in the catches, and the Norwegian vessels uses a buffer tank for the catches where water is filtered out to obtain a more accurate estimate of krill catch. The vessels may also fish in the South Georgia Maritime Zone, where they need to apply for a licence and be inspected by the South Georgia administration before they start fishing. Catches in the South Georgia area must be reported on a daily basis and may be inspected by a patrol vessel during the fishing operation.

The Norwegian vessels tranship their krill catches to a 'carrier' vessel which then sails to Uruguay to land the catch. Catches are recorded on logbooks, and two-hourly on board the vessels. The Client records the catches transferred to the carrier vessels as required by the Norwegian Directorate of Fisheries under regulation J-208-2017, and landings made at the landing point in Uruguay are reported through sales notes. In this way the Norwegian authorities are able to monitor that quantities caught correspond with quantities transshipped and landed. However, cross-checking of logbook records and transhipments to the carrier vessels and recorded landings in Uruguay is not straightforward as raw wet weight catches may be recorded on logbooks whereas processed catches are recorded later in the commercial process.

All krill fishing trips must have an observer on board the vessel, and where possible, a scientific observer will also be present to record all catches and discards. Norway uses only non-Norwegian observers. Observers will report any violations/infringements to both Norwegian authorities and CCAMLR. The CCAMLR Scheme of International Scientific Observation (SISO) requires that no less than 75% of vessels should be covered by observers during the 2018/19 and 2019/20 fishing seasons. The observer programme provides data on length composition, sex and maturity stage, fish by-catch and the collection of acoustic data for krill. Observers also collect information on wind, sea and air temperatures during fishing operations.

Estimates of stock biomass of krill are made through fishery-independent surveys. Biomass of krill is estimated using hydroacoustic surveys which calibrate the signals from echo-sounders with targeted trawl catch information. A major fully synoptic survey of Area 48 was undertaken in 2000, and between 2000 and the next major survey in 2018/19,

smaller-scale surveys have been carried out regularly under national programmes by, for example, Norway and Korea. There is substantial biological information on krill populations that has been built up over many years of surveys. For example, the Korean fleet undertakes scientific research on annual research cruises by conducting standardised acoustic transects in Bransfield Strait, using the standard CCAMLR protocols, and in future will undertake monthly sampling to examine the dynamics of krill.

CCAMLR also conducts stock surveys of krill predators and maintains a network of stations through the CCAMLR Ecosystem Monitoring Program (CEMP) where information has been collected since 1989 on other components of the Antarctic ecosystem to monitor change.

7.2.5 Stock assessment methodology

Stock assessment of krill in Area 48 is undertaken by the CCAMLR Scientific Committee and reviewed at annual meetings of the Working Group on Ecosystem Monitoring and Management (WG-EMM). CCAMLR considers that managing Area 48 as a single stock is appropriate. Whilst recruitment may be distributed across Areas 48, 58 and 88, there has been virtually no fishing in the other two areas in recent years, so Area 48 can be considered as a single management unit. Area 48 is divided into a number of small-scale management units (SSMUs) based upon the distribution of krill, the fishery, oceanographic factors and krill predators.

Previously the estimated biomass of krill in Area 48 has been based upon a fully synoptic survey of the whole fishing area carried out in 2000. The objective of the survey was to provide a pre-exploitation biomass estimate of krill (B_0) to be used in the krill population model to estimate a sustainable yield from the stock. Full details of the survey methodology can be found in Trathan *et al.* (2001). This estimate has been improved over recent years following improvements in analysis of acoustic data, particularly target strength estimates. CCAMLR undertakes an annual review of stock status which evaluates the 2000 survey results in conjunction with smaller scale surveys that are undertaken from time to time by various nations. In 2010 the CCAMLR Scientific Committee concluded that the best estimate of pre-exploitation biomass was 60.3 million tonnes with a survey coefficient of variation (CV) of 12.8%. This estimate of biomass is used to determine a sustainable yield from the fishery, but it is recognised that the harvest strategy is therefore based upon an estimate of abundance from almost 20 years ago. Until 2018, no such synoptic survey had been conducted since 2000, but there were biomass indices available that were estimated from local monitoring surveys in individual sub-areas of Area 48 carried out previously by the United States and Norway, and more recently by Korea and China (Table 10; Kinsey *et al*., 2014; Skaret *et al*., 2015; Fielding *et al*., 2014). The relationship between these local estimates of biomass and the biomass across the whole of Area 48 is not clear, and therefore these local biomass estimates cannot be used in assessment models. In addition, biomass estimates in each area show high variability and therefore separating systematic changes in biomass from natural variability is very difficult. Whilst there is general consensus that krill biomass declined in the 1980s (e.g. Watters *et al.*, 2013), two statistical tests of the biomass indices in Table 10 provided no evidence that the stock had declined since the major survey in 2000 (Table 11; Hill *et al*., 2016). An additional source of abundance data for krill is KRILLBASE, a circumpolar database of Antarctic krill and salp numerical densities which has been updated recently by Atkinson *et al*. (2017). KRILLBASE contains data from over 15,000 net hauls including nearly 13,000 with krill abundance data spanning 56 seasons from 1926-1939 and 1976-2016, and the data have been standardised to accommodate variation in sampling methods. The sources of the data, the structure of the database, the variation of sampling coverage and method, inter-annual coverage and standardisation methods are described in Atkinson *et al*. (2017) and the full data set can be found at doi:10.5285/8b00a915-94e3-4a04-a903-dd4956346439. A recent re-analysis of the updated KRILLBASE showed no evidence for a decline in krill density from 1976 to 2016 (Cox *et al*., 2018). The re-analysis showed that after accounting for sampling heterogeneity (location, net-type, within-season time of sampling) and habitat variables (e.g. seabed depth and temperature), average krill density appears to have been stable but with considerable inter-annual variability (Figure 3). However, a recent paper by Hill *et al.* (2019) challenges the conclusions of Cox *et al*. (2018) that there has been no decline in krill density from 1976 to 2016. Hill *et al*. (2019) consider that the approach used by Cox *et al*. (2018) would be unlikely to detect any real decline in krill density because of the exclusion of usable net types, the inclusion of negatively biased data and down-weighting of high densities in the early part of the analysis period, the absence of recent data from the north of the sector, and a lack of statistical hypothesis testing. Hill *et al*. (2019) consider that existing evidence for a late twentieth century decline in krill density still stands, although it should be noted that the studies to date do not conclude that there has been a significant decline since the wide-scale synoptic survey conducted in 2000. Other traditional approaches to assessing changes in stock abundance have not proved insightful for krill stocks. Catch per unit effort data are not considered reliable indicators of krill abundance (Butterworth, 1988) and recent comparison of Fishery Performance Indicators (FPI) based on catch and effort data have not shown conclusively that success of the fishery is directly related to krill abundance.

The 2019 large-scale survey was undertaken by 6 vessels surveying transects corresponding to those used in the CCAMLR 2000 survey in the period 13-18 December 2018 and 16 January to 2 March 2019, while those corresponding to the regular US surveys around South Shetland Island (AMLR surveys) were run in the period 5-10 February and 8-15 March 2019 (Macauley *et al*., 2019). The survey methodology used was similar to that used in the CCAMLR 2000

survey with acoustic surveys used to estimate mean krill target strength which is then calibrated with krill length distributions observed from trawl samples. Acoustic backscatter at 120 kHz was attributed to krill swarms, and then backscatter from krill were delineated using the 'swarms' method (Cox *et al*., 2016) and integrated to produce distribution maps of krill areal density and survey standing stock estimates. Full details of the survey methodology and results can be found in Macauley *et al*. (2019).

An initial analysis of krill areal density estimated in the 2019 survey for the CCAMLR 2000 strata was 35.2 g m^{-2}, producing a standing stock estimate of 72 million tonnes with a sampling CV of 13% (Macauley *et al*., 2019). However, the survey data were re-analysed at a meeting of the Acoustic Survey and Analysis Methods sub-group of CCAMLR's Scientific Committee in August 2019 (SG-ASAM-2019). The initial analysis made several processing decisions and assumptions that were discussed and revised during SG-ASAM-2019. Some processing errors were also discovered. Implementing these revisions and correcting errors produced a new krill biomass estimate from the 2019 Area 48 Survey of 62.6 million tonnes with a coefficient of variation (CV) of 13% (CCAMLR, 2019a). The full Scientific Committee of CCAMLR endorsed this revised estimate of krill biomass. This standing stock estimate is slightly higher than the estimate of pre-exploitation biomass of 60.3 million tonnes (CV of 12.8%) from the CCAMLR 2000 survey. SG-ASAM reviewed the potential effect of various differences between the methodology used for the survey in 2019 with that used during the 2000 survey. In 2019, the swarms method was used for krill discrimination as opposed to the standard dB-difference approach used in 2000, the new survey was carried out 24 hours a day as opposed to the daytime-only stations employed in 2000, and there were some slight differences in the net sampling equipment used on different vessels in 2019. An evaluation of these different aspects of the methodologies concluded that they had little effect on stock biomass estimation. Whilst these biomass estimates are sensitive to the choice of length distributions used to convert acoustic backscatter into krill density estimates (Macauley *et al*., 2019), there does not appear to be any evidence that krill biomass has declined since the previous fully synoptic survey in 2000, and therefore the management strategy including the setting of trigger catch levels can still be considered to be precautionary.

Table 10: Krill biomass indices from local biomass surveys (tonnes km^{-2}). (Source: Hill *et al*., 2016)

Year	Subarea		
	48.1 (Kinzey et al., 2015)	48.2 Skaret et al., 2015)*	48.3 (Fielding et al., 2014)
1996	35.5		
1997	46.5		31.7
1998	20.7		38.9
1999	7.8		9.7
2000	23.6		2.7
2001	4.1		36.7
2002	2.2		137.0
2003	16.6		84.6
2004	3.7		26.1
2005	5.9		89.4
2006	9.7		119.1
2007	32.4		61.1
2008	16.8		
2009	16.1		28.8
2010	13.3		15.1
2011	13.2	212.8	59.0
2012		94.8	90.1
2013			61.8
2014		301.4	31.1

Table 11: **Two statistical tests for a decline in krill biomass indices from Table 10 between 2000 and 2014. A negative correlation (r) between year and biomass, or a mean that is lower in the later period than the earlier period could indicate a decline, if the P value indicated a low probability (i.e. <0.05) that the result was due to chance. None of these tests indicate a decline in krill biomass. (Source: Hill *et al*., 2016)**

Statistic	Subarea		
	48.1	48.2	48.3
r	0.22	0.59	–0.08
P (trend)	0.25	0.12	0.49
	2000–2005		2000–2005
mean	9.4		70.8
CV	0.9		0.8
	2006–2014		2009–2014
mean	16.9	203.0	47.6
CV	0.5	0.5	0.6
P (difference in means)	0.15		0.53

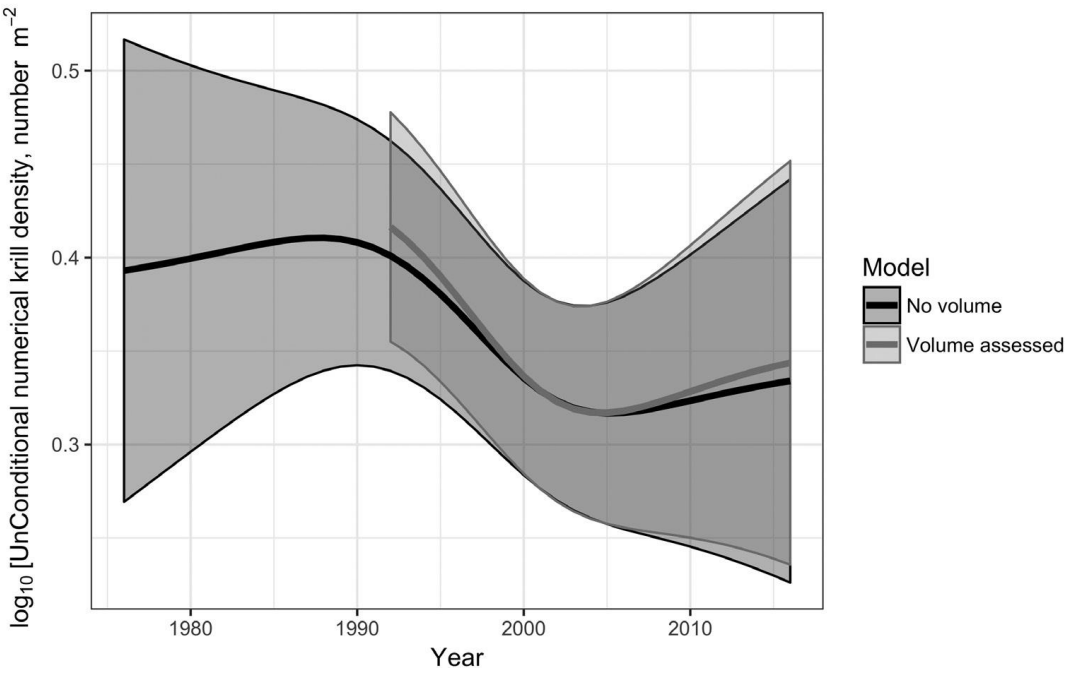

Figure 3: **Evaluation of krill abundance data from KRILLBASE. Densities of krill (*Euphausia superba*) considering the krill-presence models: volume not considered (No volume) and volume sampled modelled (volume assessed) and conditional density. Mean unconditional density is shown as solid lines and confidence intervals as shaded areas. (Source: Cox *et al*., 2018)**

The approach used by CCAMLR is to estimate a sustainable yield using a Generalised Yield Model (GYM) (Constable and de la Mare, 2003). A simple population model, which includes random variability in recruitment, is used within a simulation framework to project forward the krill population with varying values for growth, mortality and abundance drawn at random from plausible statistical distributions, and therefore to allow the effects of different catch levels to be simulated. This approach takes into account natural variability in the population and uncertainty in the parameter estimates to be incorporated in the projection model. The simulation model calculates a distribution of possible population sizes both in the absence of fishing and at various fishing mortalities.

These distributions are used to determine the proportion ɣ (gamma) of an estimate of the unexploited biomass B_0 estimated from the hydroacoustic survey in 2000 (Constable *et al.*, 2000) that would support a sustainable harvest. CCAMLR sets a PCL for krill using a set of "decision rules" to determine the proportion of the stock that can be fished. The catch limit is estimated using the GYM projecting the pre-exploitation population forward with different yield levels (ɣ) based on the following rules:

1. Choose a yield level, ɣ 1, so that the probability of the spawning biomass dropping below 20% of its median pre-exploitation level over a 20-year harvesting period is 10%.
2. Choose a yield level, ɣ 2, so that the median escapement at the end of a 20-year period is 75% of the median pre-exploitation level.
3. Select the lower of ɣ 1 and ɣ 2 as the yield level.

The catch limit is the value of gamma selected by rule 3.

Rule 1 is equivalent to a limit reference point with an overfishing threshold of 20% of B_0, and Rule 2 is a target reference point for stock biomass based upon an escapement criterion.

Using this approach, a PCL was determined based upon an unexploited biomass (B_0) of 60.3 million tonnes and a CV of 12.8% and a gamma value of 0.093. Such a PCL equates to an annual catch of 5.61 million tonnes. Whilst this PCL is a highly precautionary harvest rate, there may be negative ecosystem impacts if such a harvest is taken in a spatially restricted area, rather than distributed across the whole krill stock. CCAMLR therefore introduced a much more precautionary catch trigger level of 620,000 tonnes. This catch trigger level is based upon the total of the maximum catches recorded in each of the sub-areas of Area 48 over the history of the fishery, although it should be emphasised that the overall catch from Area 48 has never exceeded 620,000 tonnes.

The annual PCL of 5.61 million tonnes has remained constant since 2010. However, such a large figure for extraction overall (the PCL), or even the much more precautionary catch trigger level of 620,000 tonnes carries with it a risk that the fishery could be spatially restricted, resulting in localised, potentially negative, ecosystem impacts, and so the overall catch trigger level has been disaggregated across the four sub-areas of Area 48 (Table 9). It is not envisioned that the overall catch trigger level will be revised until the 2019 full synoptic survey has been fully analysed.

Clearly this approach to determining the PCL takes into account uncertainty due to parameter estimation and different modelling approaches have been evaluated. Whilst there are also uncertainties in relation to the development of the fishery, estimates of stock biomass and the impact of the fishery on the ecosystem, the PCL is set at a precautionary level of 9.3%, and the catch trigger levels are set at a more precautionary level. The catch trigger level combined with conservative estimates of sub-area biomass derived from localised sub-area surveys allows a calculation of an upper limit to exploitation rates: taking of the full catch trigger levels would be equivalent to an average exploitation rate of 6%, whereas evaluation of actual recorded catches in relation to localised survey estimates suggests that exploitation rates in the fishery have averaged around 1% across all areas since 1996 (Hill *et al*., 2016).

Previously there were clearly some concerns that the stock assessment was based upon a synoptic survey carried out in 2000, and that significant changes in krill biomass and krill predator biomass may have taken place since then, and indeed environmental conditions may have changed since the last survey. However, the harvest strategy is highly precautionary, so the fishery was still unlikely to have any impact on the stock. Until 2019, the synoptic survey had not been repeated since 2000 primarily due to the cost of such a large-scale survey, but there are now new estimates of krill biomass from the 2019 survey which used the same survey strata as the CCAMLR 2000 survey and the AMLR strata. As noted above, the estimate of krill biomass from the 2019 synoptic survey did not suggest that there had been any significant decline in krill biomass since the 2000 survey and therefore the previous concerns about using survey data that was nearly 20 years old have been allayed.

In summary the fishery appears to be operating sustainably because annual catches are well below a very conservatively set PCL, and overall there is confidence that current catch levels will not affect the total krill biomass adversely even if extraneous ecosystem and oceanographic/climate factors come into play.

The assessment team notes that CCAMLR Conservation Measure (CM) 51-07, which sets the trigger levels for the various sub-areas of Area 48 (see Table 8 above), is due to expire after the 2020/2021 season, and that an alternative approach (using for example risk assessment, spatial management methods or a Feedback Management System) must be implemented no later than during the 2019 meeting. The Commission and Scientific Committee of CCAMLR met in October 2019. The Scientific Committee's Working Group on Ecosystem Monitoring and Management (WG-EMM) concluded that the most appropriate approach to management of the krill fishery would be to take a sub-area based-approach, nested within an overall large-scale approach, for Subareas 48.1 to 48.4 based on sub-area-scale stock assessment models and biomass estimates from regular surveys within sub-areas, to determine precautionary catch limits. The spatial distribution and scaling of the catch limits would then be based on the risk assessment framework (CCAMLR, 2019b), WG-EMM concluded that this will require the development of:

(i) an implementation of the GYM and the krill decision rules that is appropriate for estimating area and sub-area catch limits

(ii) methods to estimate area and sub-area biomass or density based on available surveys

(iii) data layers and implementation of the risk assessment framework to evaluate catch distribution options at the area, sub-area and fishing ground scales

(iv) a management strategy evaluation.

On the basis of the work of WG-EMM, the Scientific Committee proposed a work plan toward a preferred management strategy for the krill fishery by 2021. This strategy consists of three components:

(i) a stock assessment to estimate precautionary harvest rates

(ii) updated biomass estimates, initially at the subarea scale, but potentially at multiple scales

(iii) a risk assessment to inform the spatial allocation of catch.

The Commission endorsed the Scientific Committee's proposal, although it was recognised that development of these three elements of the strategy before the expiration of CM51-07 at the end of the 2010/21 season would be a significant challenge.

In the interim, the setting of the trigger levels for the various sub-areas of Area 48 as prescribed under CM51-07 would remain in force for the 2019/20 season.

7.2.6 History of Fishery and its management

The commercial fishery for Antarctic krill began in the 1972/73 season and landings increased rapidly in the 1970s peaking with landings of around 530,000 tonnes in 1981/82 before stabilising in the 1980s and early 1990s (Figure 2). These early catches were dominated by former Soviet Bloc countries and when this fleet stopped fishing for economic reasons in 1991/92, annual catches declined to around 80,000 tonnes. However, from the early 2000s, catches began to rise again as vessels from many nations joined the fishery. Vessels from Norway currently take the majority (60%) of the krill catch in Area 48, with vessels from Korea taking an average of around 20% in recent years, and vessels from China, Chile and Ukraine making up the remainder of the catches. Catches peaked at 316,000 tonnes in the 2014 fishing season and were the largest reported annual krill catch since 1991, when the Soviet bloc fishery ended. Catches declined in 2015 but were stable at around 230,000 tonnes from 2015 to 2017 following the gradual increase in catches observed in recent years (Figure 4). In 2018 catches increased to 312,000 tonnes. In summary recent overall catches in Area 48 are significantly below the trigger level of 620,000 and are therefore, highly likely to be sustainable. CCAMLR's formal fishing season has been 1 December to 30 November of the following year (Conservation Measure [CM] 32-01), but historically krill fishing in sub-area 48.3 tends to start later in each season than in sub-areas 48.1 and 48.2. Catch rates are lower during the earlier part of the fishing season when krill aggregations are less, but catches increase as day length peaks during summer. Later in the season in autumn as day length shortens, sea-ice cover spreads north, the southern fishing grounds (e.g. subarea 48.1) become less accessible to the fleet, and total catches generally drop, although this pattern may vary with variations between years in sea-ice cover.

Whilst the overall trigger level for Area 48 has not been exceeded in recent years, as discussed above, an interim distribution of the overall trigger level of 620,000 tonnes across the sub-areas of Area 48 has been agreed under CM51-07 to ensure that there are no local depletions which could impact on predators of krill. Norwegian vessels currently fish in subareas 48.1, 48.2 and 48.3. Catches in sub-area 48.1 reached their trigger level in 2018 and 2019 and the sub-area was closed on 25 June and 13 July respectively. The trigger levels defined for sub-areas 48.2 and 48.3 were not exceeded in 2018 and 2019. This element of the harvest strategy appears to be working well. Preliminary information for 2019 provided in the draft report of CCAMLR-XXXVIII shows that the fishery had caught 382,000 tonnes of krill by the end of September 2019 (CCAMLR, 2019c). For the first time in recent years some small catches of krill were recorded from sub-area 48.4 in 2017 (513 tonnes), 2018 (246 tonnes) and 2019 (12 tonnes).

CCAMLR is currently developing a new approach to krill management entitled Feedback Management System (FBM) (CCAMLR, 2017b; Watters *et al.*, 2016) incorporating routine acoustic data collection and intermittent land-based predator studies, and this approach may in future replace the current sub-division of the catch trigger levels set out in CCAMLR CM 51-07.

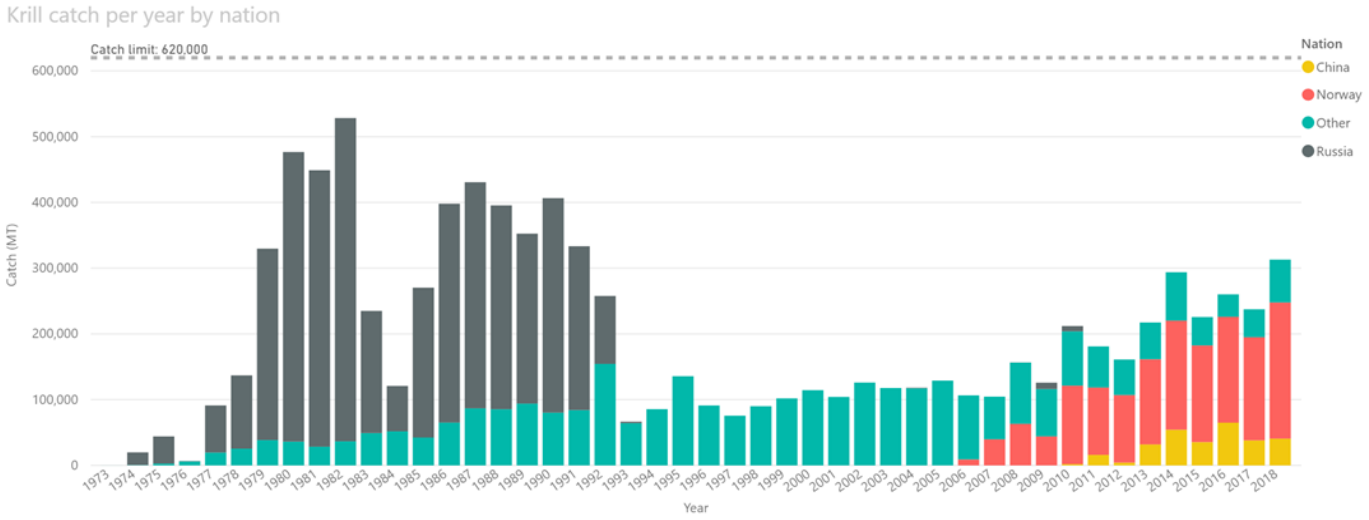

Figure 4: Total annual catches of krill (*Euphausia superba*) in the CCAMLR Area from 1973 to 2018. (Source: CCAMLR)

7.3 Total Allowable Catch (TAC) and catch data

Table 12: Total Allowable Catch (TAC) and catch data

TAC*	**Year**	**2018/19**	**Amount**	**620,000 tonnes**
UoA share of TAC*	Year	**2018/19**	Amount	**620,000 tonnes**
Total green weight catch by UoC	Year (most recent)	**2017/18**	Amount	**153,316 tonnes**
Total green weight catch by UoC	Year (second most recent)	**2016/17**	Amount	**159,103 tonnes**

* The TAC for the krill fishery is based on an Olympic system with no allocation of the overall TAC to individual nation's fleets.

7.4 Principle 1 Performance Indicator scores and rationales

PI 1.1.1A – key Low Trophic-Level

PI 1.1.1A		The stock is at a level which has a low probability of serious ecosystem impacts		
Scoring Issue		SG 60	SG 80	SG 100
a	Stock status relative to ecosystem impairment			
	Guide post	It is **likely** that the stock is above the point where serious ecosystem impacts could occur.	It is **highly likely** that the stock is above the point where serious ecosystem impacts could occur.	There is a **high degree of certainty** that the stock is above the point where serious ecosystem impacts could occur.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

The krill fishery is managed by setting catch limits based upon a Generalised Yield Model (GYM), and the estimate of sustainable yield (Precautionary Catch Level (PCL)) is chosen so that the probability of the spawning biomass dropping below 20% of its median pre-exploitation level (B_0) over a 20-year harvesting period is 10%. The 20% B_0 level is considered a limit reference point below which krill recruitment would be impaired, and in light of the role that krill plays in the Antarctic ecosystem, any such recruitment failure in krill would undoubtedly result in serious ecosystem impacts. The limit reference point set for krill is therefore in line with MSC Fisheries Standard v2.01, SA2.2.12a which considers that for key LTL species the point where serious ecosystem impacts could occur shall not be less than 20% of the spawning stock level that would be expected in the absence of fishing. In addition, a highly precautionary catch trigger level has been set at 620,000 tonnes which represents only 11 % of the PCL, and the catch trigger level has been disaggregated across sub-areas of Area 48 to minimise any adverse effects on land-based predators of krill. The overall catch trigger level has never been exceeded for Area 48, and the fishery is closed if the sub-area catch triggers are approached. Recording of catches is rigorously monitored, and all krill taken by the fishing gear are processed onboard. Unobserved mortalities are considered to be minimal. CCAMLR has implemented measures to prevent IUU fishing and the eco-harvesting system used in the fishery is not considered to damage any krill that is not captured.

The 2019 large-scale survey provided an estimate of krill biomass above the pre-exploitation level (B_0) estimated from the 2000 synoptic survey, and therefore well above 20% of virgin biomass, the point at which there could be serious ecosystem impacts. Supplementary data from small-scale surveys undertaken between the synoptic surveys of 2000 and 2019 show a high degree of variability making it very difficult to separate systematic changes in biomass from natural variability, but statistical tests of these biomass indices provided no evidence that the stock had declined since the major survey in 2000 (Hill *et al*., 2016). In addition, a re-analysis of abundance data for krill on KRILLBASE, a circumpolar database of Antarctic krill and salp numerical densities, showed no evidence for a decline in krill density from 1976 to 2016 (Cox *et al*., 2018). Whilst this re-analysis has recently been challenged (Hill *et al*., 2019), there is no evidence from recent studies that krill density has declined since 2000. In conclusion the key evidence from the 2019 synoptic survey that the current biomass is at a similar level to the pre-exploitation level estimated from the 2000 survey demonstrates that there is a high degree of certainty that the krill stock is above the point where serious ecosystem impacts could occur. The SG60, SG80 and SG100 are met.

b	Stock status in relation to ecosystem needs			
	Guide post		The stock is at or fluctuating around a level consistent with ecosystem needs.	There is a **high degree of certainty** that the stock has been fluctuating around a level consistent with ecosystem needs or has been above this level over recent years.
	Met?		**Yes**	**No**

Rationale

The krill fishery is managed to ensure that exploitation levels are set at levels that do not have any deleterious impacts on krill predators. A target level for the krill stock has been set at 75% of the median pre-exploitation biomass (B_0), i.e.

at a level significantly higher than is required if only the target species is being considered and a level in line with MSC Fisheries Standard v2.01, SA2.2.13a. Recent studies that evaluated the impact of the krill fishery on predators (Smith *et al.* 2011, Plaganyi and Butterworth 2012, Watters *et al*. 2013) indicate that such a target would satisfy ecosystem needs. The Generalised Yield Model predicts that if catches are kept below the Precautionary Catch Limit (PCL) of 5.61 million tonnes, then the stock will fluctuate about the reference target level with high probability. In practice, the catch limit has been set at a highly precautionary level of 620,000 tonnes, and this level has not been exceeded in any year throughout the history of the fishery. In addition, in response to concerns that high removals of krill concentrated within a small geographical area could inadvertently and disproportionately impact land-based predator populations, CCAMLR CM 51-07 stipulates that the overall catch limit in Area 48 must be distributed across the various sub-areas of the fishery. These disaggregated catch limits remain in place for the 2019/20 season.

The 2019 large-scale survey provided an estimate of krill biomass above the pre-exploitation level (B_0) estimated from the 2000 synoptic survey, and therefore the current stock biomass (62.6 million tonnes) is well above the target reference point of 75% of the median pre-exploitation biomass (45.23 million tonnes). Supplementary data from small-scale surveys undertaken between the synoptic surveys of 2000 and 2019 show a high degree of variability making it very difficult to separate systematic changes in biomass from natural variability, but statistical tests of these biomass indices provided no evidence that the stock had declined since the major survey in 2000. In addition, a re-analysis of abundance data for krill on KRILLBASE, a circumpolar database of Antarctic krill and salp numerical densities, showed no evidence for a decline in krill density from 1976 to 2016. Whilst this re-analysis has recently been challenged, there is no evidence from recent studies that krill density has declined since 2000. Stock biomass estimates from the 2019 synoptic survey which show that the current biomass is at a similar level to the pre-exploitation level estimated from the 2000 stock survey, and confirmation that the precautionary catch limits set for the whole fishery and the disaggregated catch limits for the various sub-areas have not been exceeded in recent years provide strong evidence that the current stock is at or fluctuating around a level consistent with ecosystem needs. The SG80 is met.

Whilst the Generalised Yield Model predicts that exploitation rates of 9.3% should maintain the krill stock and not impact on krill predators, and that the actual exploitation rate in the sub-areas has remained at less than 3%, there is still some concern that krill catches could have a significant impact on the ecosystem if they are concentrated in small localised areas which are important foraging grounds for dependent krill predators. The current sub-division across sub-areas of the catch trigger levels set out in CCAMLR CM 51-07 were only implemented as a temporary measure until more information was available on how biomass estimates at the whole fishery level relate to biomass estimates at a local level. CCAMLR's WG-EMM concluded that the most appropriate approach to management of the krill fishery would be to take a sub-area based approach, nested within an overall large-scale approach, for Subareas 48.1 to 48.4 based on sub-area-scale stock assessment models and biomass estimates from regular surveys within sub-areas, to determine precautionary catch limits. The spatial distribution and scaling of the catch limits would then be based on the risk assessment framework. This major work is planned over the next year and until that work is completed, the assessment team concluded that there is not a high degree of certainty that the stock has been fluctuating around a level consistent with ecosystem needs or has been above this level over recent years. The SG100 is not met.

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Stock status relative to reference points			
	Type of reference point	Value of reference point	Current stock status relative to reference point
Reference point used in scoring stock relative to ecosystem impairment (SIa)	**≤10% probability of the spawning biomass dropping below 20% of its median pre-exploitation level (B_0) of 60.3 million tonnes**	**12.06 million tonnes**	**2019 estimate of stock biomass is 62.6 million tonnes** **Current stock status is 62.6 / 20%B_0 = 5.19**
Reference point used in scoring stock relative to ecosystem needs (SIb)	**Median escapement at the end of a 20-year exploitation period is 75% of B_0 (60.3 million tonnes)**	**45.23 million tonnes**	**2019 estimate of stock biomass is 62.6 million tonnes** **Current stock status is 62.6 / 75%B_0 = 1.38**
Overall Performance Indicator score		**90**	
Condition number (if relevant)		**NA**	

PI 1.1.2 – Stock rebuilding

PI 1.1.2		Where the stock is reduced, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Rebuilding timeframes			
	Guide post	A rebuilding timeframe is specified for the stock that is the **shorter of 20 years or 2 times its generation time**. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.		The shortest practicable rebuilding timeframe is specified which does not exceed **one generation time** for the stock.
	Met?	**NA**		**NA**
Rationale				
There is no evidence that the stock is depleted and therefore this Performance Indicator is not scored.				
b	Rebuilding evaluation			
	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within the specified timeframe.	There is **evidence** that the rebuilding strategies are rebuilding stocks, **or it is likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the **specified timeframe**.	There is **strong evidence** that the rebuilding strategies are rebuilding stocks, **or it is highly likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the **specified timeframe**.
	Met?	**NA**	**NA**	**NA**
Rationale				
There is no evidence that the stock is depleted and therefore this Performance Indicator is not scored.				
References				
NA				
Overall Performance Indicator score			**NA**	
Condition number (if relevant)			**NA**	

PI 1.2.1 – Harvest strategy

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Harvest strategy design			
	Guide post	The harvest strategy is **expected** to achieve stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy **work together** towards achieving stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and is **designed** to achieve stock management objectives reflected in PI 1.1.1 SG80.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

The harvest strategy is underpinned by CCAMLR management regulations which are based upon the precautionary approach and the Ecosystem Monitoring Program (CEMP) which provides a basis for regulating harvesting of Antarctic marine living resources in accordance with the ecosystem approach. Norwegian fisheries are regulated under the Norwegian Marine Resources Act, which requires that management be guided by the precautionary approach and by an ecosystem approach that takes into account habitats and biodiversity. The harvest strategy consists of licensing of all vessels, precautionary catch limits, gear regulations including trawl mesh size and incorporation of marine mammal exclusion devices, monitoring of catches and fishing activity through logbooks, VMS and an observer scheme, and there is a rigorous monitoring and enforcement scheme in place. The key element of the harvest strategy is the setting of precautionary catch limits based upon recruitment and biomass escapement reference points, with particular regard to minimising the impact on any land-based predators of krill, and a well-defined harvest control rule. In particular the harvest strategy is designed to minimise the impact on both krill and its predators through disaggregating catch trigger levels across sub-areas. A Precautionary Catch Level (PCL) of 5.61 million tonnes is set for Area 48, which is approximately 9% of the estimated biomass in 2000 and is therefore considered to be highly precautionary. However, the PCL is not formally implemented in practice, and instead a much more precautionary overall TAC (described as a trigger level for the krill fishery) is set at 620,000 tonnes for CCAMLR subareas 48.1, 48.2, 48.3 and 48.4. Historically there was no sub-division of this quota across the four sub-areas, but concerns over the potential impact of high removals of krill within a small geographical area, in particular to ensure that land-based predator populations would not be inadvertently and disproportionately affected by fishing activity, resulted in the implementation of CCAMLR CM 51-07 which provides an interim distribution of the trigger level across the sub-areas of Area 48 (see Table 9). The harvest strategy is therefore responsive to the state of the stock and, for a key LTL species, is designed to ensure that the stock is (a) above the point where serious ecosystem impacts could occur and (b) around a level consistent with ecosystem needs. SG60, SG80 and SG100 are met.

b	Harvest strategy evaluation			
	Guide post	The harvest strategy is **likely** to work based on prior experience or plausible argument.	The harvest strategy may not have been fully **tested** but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been **fully evaluated** and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	**Yes**	**Yes**	**No**

Rationale

A harvest strategy consisting of highly precautionary catch limits, clearly defined reference points and a harvest control rule is likely to work based on prior experience in other fisheries. The fishery appears to be operating sustainably because annual catches are well below a very conservatively set precautionary catch limit (PCL), and overall there is

confidence that current catch levels will not affect the total krill biomass adversely even if extraneous ecosystem and oceanographic/climate factors come into play. The SG60 is met.

There is no evidence of catch levels exceeding the catch trigger levels and sub-areas of Area 48 have been closed in recent years when the catch trigger levels have been approached. The most recent full survey of krill distribution provides evidence that krill biomass has not declined since the previous large-scale survey in 2000, and a reanalysis of abundance data for krill on KRILLBASE, a circumpolar database of Antarctic krill and salp numerical densities, showed no evidence for a decline in krill density from 1976 to 2016. There is evidence that the harvest strategy is achieving its objective and the SG80 is met.

Whilst the effects of different catch levels have been simulated using the GYM, the performance of the harvest strategy has not been fully evaluated through, for example, a Management Strategy Evaluation (MSE), SG100 is not met.

c	Harvest strategy monitoring			
	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	**Yes**		

Rationale

Fishing activity of the three Norwegian vessels is monitored through the on-board Vessel Monitoring System (VMS) which is polled every hour. There is also a CCAMLR requirement to notify the commission when a vessel enters or leaves a subarea of Area 48. All vessels must complete logbooks detailing catch and effort and this information must be transmitted regularly to CCAMLR secretariat and to the Norwegian authorities. All krill fishing trips must have an observer on board the vessel, and where possible, a scientific observer will also be present to record all catches and discards, and there is a rigorous monitoring and enforcement scheme in place. CCAMLR monitors total uptake of catches in relation to the overall TAC for the area (and for the thresholds determined for each sub-area) and regularly notifies all contracting parties of uptake of overall TAC. Estimates of stock biomass of krill are made through fishery-independent surveys and the Ecosystem Monitoring Programme (CEMP) monitors the potential impact of the krill fisheries on the ecosystem components. All these elements of the monitoring programme provide information on whether the harvest strategy is working. The SG60 is met.

d	Harvest strategy review			
	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			**Yes**

Rationale

The work of CCAMLR has undergone two performance reviews in 2008 and 2016, from which a number of recommendations resulted. These include improved management of the spatial management of catches in Area 48 and developing harvest strategies which take into account ecosystem changes. In addition, the Working Group on Ecosystem Monitoring and Management (WG-EMM) meets annually to review all elements of the management of the krill fishery based on up-to-date data and research. For example, catch limits are reviewed regularly, stock assessment methodologies are fine-tuned, sub-area based catch triggers have been introduced recently, and stock survey methodologies have been fully reviewed prior to the 2019 synoptic survey. CCAMLR is currently developing a Feedback Management System (FBM) incorporating routine acoustic data collection and intermittent land-based predator studies, and this approach may in future replace the current approach where catch trigger levels are disaggregated by sub-areas. SG 100 is met.

e	Shark finning			
	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**NA**	**NA**	**NA**

Rationale
Sharks are not a target species in this fishery, so this scoring issue is not scored.

f	Review of alternative measures			
	Guide post	There has been a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock, and they are implemented, as appropriate.
	Met?	**NA**	**NA**	**NA**

Rationale
All krill caught in the trawl are processed on board the vessel and so there is no unwanted catch of the target stock (MSC Fisheries Standard v2.01, SA3.1.6 & SA3.5.3). There is no requirement therefore to score this scoring issue.

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Overall Performance Indicator score	**95**
Condition number (if relevant)	**NA**

PI 1.2.2 – Harvest control rules and tools

PI 1.2.2		There are well defined and effective harvest control rules (HCRs) in place		
Scoring Issue		SG 60	SG 80	SG 100
a	HCRs design and application			
	Guide post	**Generally understood** HCRs are in place **or available** that are **expected** to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached.	**Well defined** HCRs are **in place** that **ensure** that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock **fluctuating around** a target level consistent with (or above) MSY, or for key LTL species a level consistent with ecosystem needs.	The HCRs are expected to keep the stock **fluctuating at or above** a target level consistent with MSY, or another more appropriate level taking into account the ecological role of the stock, **most** of the time.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

A Generalised Linear Model (GYM) was used to calculate a distribution of possible population sizes both in the absence of fishing and at various fishing mortalities. These distributions are used to determine the proportion ɣ (gamma) of an estimate of the unexploited biomass B_0 that would support a sustainable harvest. CCAMLR sets a PCL for krill using a set of "decision rules" to determine the proportion of the stock that can be fished. The catch limit is estimated using the GYM projecting the pre-exploitation population forward with different yield levels (ɣ) based on the following rules:

1. Choose a yield level, ɣ 1, so that the probability of the spawning biomass dropping below 20% of its median pre-exploitation level over a 20-year harvesting period is 10%.
2. Choose a yield level, ɣ 2, so that the median escapement at the end of a 20-year period is 75% of the median pre-exploitation level.
3. Select the lower of ɣ 1 and ɣ 2 as the yield level.

The catch limit is the value of gamma selected by rule 3.

Rule 1 is equivalent to a limit reference point with an overfishing threshold of 20% of B_0, and Rule 2 is a target reference point for stock biomass based upon an escapement criterion.

Using this approach, a PCL was determined based upon an unexploited biomass (B_0) of 60.3 million tonnes and a CV of 12.8% and a gamma value of 0.093. Such a PCL equates to an annual catch of 5.61 million tonnes. Whilst this PCL is a highly precautionary harvest rate, there may be negative ecosystem impacts if such a harvest is taken in a spatially restricted area, rather than distributed across the whole krill stock. CCAMLR therefore introduced a much more precautionary catch trigger level of 620,000 tonnes. This catch trigger level is based upon the total of the maximum catches recorded in each of the sub-areas of Area 48 over the history of the fishery, although it should be emphasised that the overall catch from Area 48 has never exceeded 620,000 tonnes. This more precautionary catch trigger level of 620,000 tonnes still carries with it a risk that the fishery could be spatially restricted, resulting in localised, potentially negative, ecosystem impacts, and so the overall catch trigger level has been disaggregated across the four sub-areas of Area 48 (see Table 10). Whilst these sub-area trigger catches sum to more than 620 000 tonnes, there is evidence that fishing has been suspended if the sub-area trigger level is approached, and management experience has shown clearly that stopping fishing in one sub-area virtually stops fishing anywhere in the management area, so the overall trigger level has yet to be reached.

This harvest control rule is clearly understood and well-defined and results in the exploitation rate being maintained at a level which ensures that the point of recruitment impairment (PRI) is not approached. SG60 is met. The overall catch trigger level is 11% of the PCL, which was calculated to ensure that the stock remains above the target reference point of 75% of B_0. In practice this means that the exploitation rate cannot approach either the target or limit reference point, and therefore the HCR ensures that the exploitation rate is expected to keep the stock fluctuating around a level consistent with ecosystem needs (SG80 is met) and indeed above a level consistent with ecosystem needs (SG100 is met).

b	HCRs robustness to uncertainty			
	Guide post		The HCRs are likely to be robust to the main uncertainties.	The HCRs take account of a **wide** range of uncertainties including the ecological role of the stock, and there is **evidence** that the HCRs are robust to the main uncertainties.
	Met?		**Yes**	**No**

Rationale

The development of the HCRs took into account parameter uncertainty in both the fishery and the ecosystem as well as model uncertainty as different population models were evaluated. The overall catch trigger permitted in the fishery is only 11% of the PCL estimated from the assessment model as a highly precautionary PCL designed to keep the stock above 75% of B_0. The HCRs are based upon a precautionary estimate of B_0. Uncertainty related to the potential impact on land-based predator populations of high removals of krill concentrated within a small geographical area have been taken into account by disaggregating the overall catch trigger level across the four sub-areas of Area 48. The HCRs are therefore likely to be robust to the main uncertainties. SG80 is met.

Whilst the HCRs take into account the ecological role of krill as important prey items of a range of predators, there are uncertainties relating to the potential effect of climate change on krill, increases in predators such as baleen whales and oceanographic patterns which do not appear to have been taken into account. SG100 is not met.

c	HCRs evaluation			
	Guide post	There is **some evidence** that tools used **or available** to implement HCRs are appropriate and effective in controlling exploitation.	**Available evidence indicates** that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.	**Evidence clearly shows** that the tools in use are effective in achieving the exploitation levels required under the HCRs.
	Met?	**Yes**	**Yes**	**No**

Rationale

There is good evidence that the harvest tools (robust recording of catches, observer trips, precautionary catch trigger levels, sub-area closures) are effective in achieving exploitation levels required under the HCRs. In recent years catches have not exceeded even the highly precautionary overall catch trigger of 620,000 tonnes, let alone the PCL of 5.61 million tonnes, and there is evidence in recent years that sub-areas of Area 48 have been closed when catch levels have approached the disaggregated sub-area catch triggers set out in CCAMLR CM 51-07. The large-scale survey undertaken in 2019 provided evidence that the krill stock has not been diminished by fishing and therefore the HCRs appear to be working. The SG60 and SG80 are met.

Whilst catches are recorded every 24 hours, CCAMLR requires that an estimate of catch is made every two hours on the vessels as catch limits are based upon wet weight. However, there is some uncertainty around the accuracy of two-hourly counts as it is sometimes difficult to differentiate between krill and water in the catches. The Norwegian vessels uses a buffer tank for the catches where water is filtered out to obtain a more accurate estimate of krill catch, but there are inconsistencies across the various fleets in recording of green weight and these need to be resolved in order to provide clear evidence that the exploitation levels required under the HCRs are achieved. SG100 is not met.

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Overall Performance Indicator score	**85**
Condition number (if relevant)	**NA**

PI 1.2.3 – Information and monitoring

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Range of information			
	Guide post	**Some** relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	**Sufficient** relevant information related to stock structure, stock productivity, fleet composition and other data are available to support the harvest strategy.	A **comprehensive range** of information (on stock structure, stock productivity, fleet composition, stock abundance, UoA removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				
Information is available on stock abundance and stock structure from the two full large-scale krill stock surveys of Area 48 undertaken in 2000 and 2019. These surveys include hydroacoustic surveys which calibrate the signals from echo-sounders with targeted trawl catch information on length distributions. Antarctic krill is assessed and managed as a single stock, and there is no evidence from genetics studies or larvae dynamics in relation to oceanographic factors to refute the assumption of a single stock. There have been regular stock surveys of individual sub-areas of Area 48 which have provided detailed information on length distributions, but the biomass estimates have shown high variability making it very difficult to separate systematic changes in biomass from natural variability. The stock surveys also collect a wide range of environmental information through for example the use of CTDs. The observer programme provides data on length composition, sex and maturity stage and fish by-catch. Observers also collect information on wind, sea and air temperatures during fishing operations. Biological studies in the laboratory and at sea on krill age, growth, mortality and recruitment dynamics over the last 30 years have provided sufficient knowledge on krill productivity to support the harvest strategy. There is excellent information on fleet composition collated under CCAMLR's active vessel registry. UoA removals are rigorously recorded through electronic logbooks. The SG60 and SG80 are met. In addition to information on krill abundance and distribution, regular surveys of krill predators are undertaken, and the CCAMLR Ecosystem Monitoring Program (CEMP) provides information to monitor ecosystem change. The information available is comprehensive and includes some environmental information such as wind, sea and air temperatures that may not be directly related to the harvest strategy. SG100 is met.			
b	Monitoring			
	Guide post	Stock abundance and UoA removals are monitored and **at least one indicator** is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and UoA removals are **regularly monitored at a level of accuracy and coverage consistent with the harvest control rule**, and **one or more indicators** are available and monitored with sufficient frequency to support the harvest control rule.	**All information** required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent **uncertainties** in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Stock abundance has been monitored through two large-scale stock surveys in 2000 and 2019, and in sub-areas of Area 48 through regular stock surveys in the period between the full stock surveys. Abundance data for krill is also available on KRILLBASE, a circumpolar database of Antarctic krill and salp numerical densities, and a recent re-analysis of this time series of krill abundance data provided evidence that average krill density appears to have been stable but with considerable inter-annual variability. SG60 is met. The Norwegian Directorate of Fisheries requires that vessels report their catches of krill and bycatch species for each haul on electronic logbooks. CCAMLR monitors total uptake of catches in relation to the overall catch trigger limit for the area (and for the triggers determined for each sub-area) and regularly notifies all contracting parties of uptake of overall catch quota which allows closure of sub-areas if the recorded catches approach the trigger levels. Stock abundance and UoA removals are monitored at a level consistent with the harvest control rule, and although the full stock surveys are not undertaken regularly, they are sufficiently frequent to support the highly precautionary harvest control rule. SG80 is met.

As noted in relation to PI 1.2.2 above, there are some inconsistencies across the various fleets in recording of green weight of krill, and therefore UoA removals are not monitored with a high degree of certainty. Whilst there is a good understanding of the inherent uncertainties in the data and the robustness of assessment and management to that uncertainty, the large-scale stock surveys are not conducted every year, or indeed every few years, and therefore SG100 is not met.

c	Comprehensiveness of information			
	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		**Yes**	

Rationale

Whilst there is no strong evidence relating to stock structure of krill, and there may be a single stock that extends beyond Area 48, almost all the catch is taken from the area targeted by the UoC, and there is little or no krill caught in adjacent areas that might hold part of the same stock, and none from outside the CCAMLR area. All fishery removals are well documented by CCAMLR and there is no incentive in the UoC fishery or outside the UoC to misreport catches. SG80 is met.

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Overall Performance Indicator score	**90**
Condition number (if relevant)	**NA**

PI 1.2.4 – Assessment of stock status

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Appropriateness of assessment to stock under consideration			
	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment takes into account the major features relevant to the biology of the species and the nature of the UoA.
	Met?		**Yes**	**No**

Rationale

A key component of the assessment is a krill stock survey which estimates stock biomass with acoustic surveys that estimate mean krill target strength which is then calibrated with krill length distributions observed from trawl samples. Acoustic backscatter at 120 kHz is attributed to krill swarms, and then backscatter from krill are delineated using the 'swarms' method and integrated to produce distribution maps of krill areal density and survey standing stock estimates. Full large-scale stock surveys have been undertaken in 2000 and 2019. In intervening years smaller-scale stock surveys have been undertaken, and although statistical analysis of these biomass indices provided no evidence that the stock had declined since the major survey in 2000, the biomass estimates have shown such high variability that it is very difficult to separate systematic changes in biomass from natural variability. Trends in abundance can also be identified through analysis of data on KRILLBASE, a circumpolar database of Antarctic krill and salp numerical densities.

A GYM is used to estimate a sustainable yield. The model simulates a distribution of possible population sizes both in the absence of fishing and at various fishing mortalities, and these distributions are used to determine the proportion γ (gamma) of the unexploited biomass B_0 estimated from the hydroacoustic survey in 2000 that would support a sustainable harvest. A PCL is estimated using the GYM projecting the pre-exploitation population forward with different yield levels (γ) based on generic reference points appropriate to krill stock dynamics. The assessment has defined a limit reference point at 20% of its median pre-exploitation level in line with MSC Fisheries Standard v2.01, SA2.2.12a which considers that for key LTL species the point where serious ecosystem impacts could occur shall not be less than 20% of the spawning stock level that would be expected in the absence of fishing, and the target level has been set at 75% of the median pre-exploitation biomass, i.e. at a level significantly higher than is required if only the target species is being considered and a level in line with MSC Fisheries Standard v2.01, SA2.2.13a. Recent studies that evaluated the impact of the krill fishery on predators (Smith *et al*. 2011, Plaganyi and Butterworth 2012, Watters *et al*. 2013) indicate that such a target would satisfy ecosystem needs. Krill is a key LTL within the Antarctic ecosystem, and therefore the assessment must take into account the potential impact of krill fishery removals on the ecosystem, particularly on land-based predators. Catch trigger levels set under the PCL (5.61 million tonnes) may cause negative ecosystem impacts and so the PCL has been replaced with a highly precautionary catch trigger level of 620,000 tonnes (11% of the PCL), and the overall catch trigger level is disaggregated across the sub-areas of Area 48 to ensure that high krill removals cannot be concentrated in one sub-area and cause adverse ecosystem impacts. The assessment is therefore appropriate to the stock and for the harvest control rule. SG80 is met.

In the absence of more regular large-scale stock surveys, and the need (as stated by WG-EMM) for sub-area-scale stock assessment models and biomass estimates from regular surveys within sub-areas in order to determine precautionary catch limits, the assessment team concluded that the assessment does not fully take into account krill's role within the ecosystem as a key LTL species and therefore SG100 is not met.

b	Assessment approach			
	Guide post	The assessment estimates stock status relative to generic reference points appropriate to the species category.	The assessment estimates stock status relative to reference points that are appropriate to the stock and can be estimated.	
	Met?	**Yes**	**Yes**	

Rationale

The assessment estimates stock status relative to two generic reference points, a limit reference point with an overfishing threshold of 20% of unexploited biomass (B_0), and a target or escapement target reference point of 75% of B_0. The target reference point is set at a level significantly higher than is required if only the target species is being considered and based on studies to evaluate the impact of the krill fishery on predators, the target reference point is determined to be appropriate to satisfy ecosystem needs. The reference points are therefore appropriate to a key LTL species. SG60 is met.

The reference points were estimated based on the results of the CCAMLR-2000 krill stock survey of Area 48 which provided data to estimate krill biomass in Subareas 48.1–48.4. Following an updated full stock survey in 2019, reference points may be adjusted in the future. SG80 is met.

c	Uncertainty in the assessment			
	Guide post	The assessment **identifies major sources** of uncertainty.	The assessment **takes uncertainty into account**.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a **probabilistic** way.
	Met?	**Yes**	**Yes**	**No**

Rationale

PCLs take into account uncertainty due to parameter estimation and different modelling approaches have been evaluated. The PCL for krill is calculated probabilistically using Monte Carlo integration. The model incorporates natural variability in recruitment and uncertainty in growth, natural mortality and abundance. The simulation model is used to calculate a distribution of possible population sizes both in the absence of fishing and at various fishing mortalities. Whilst there are also uncertainties in relation to the development of the fishery, estimates of stock biomass and the impact of the fishery on the ecosystem, the lowest of several candidate values for unexploited biomass (B_0) is used to determine the catch limit, and the PCL is set at a precautionary level of 9.3% of the estimate of unexploited biomass (B_0), and the catch trigger levels are set at an even more precautionary level. The assessment has therefore identified the major sources of uncertainty (SG60 is met), takes into account uncertainty (SG80 is met) and is evaluating stock status relative to reference points in a probabilistic way (SG100 is met) for the wide-scale stock surveys. However, there are still some uncertainties in relation to setting precautionary catch limits at the sub-area level. Preliminary precautionary catch trigger levels have been set for each of the sub-areas of Area 48 to ensure that high krill removals cannot be concentrated in one sub-area and cause adverse ecosystem impacts, so uncertainty about local impacts of krill fishing is taken into account. WG-EMM is currently developing sub-area-scale stock assessment models and biomass estimates from regular surveys within sub-areas in order to determine precautionary catch limits and potentially set stock reference points at a sub-area level, and therefore evaluate stock status against those sub-area reference points. The SG80 is therefore met at the sub-area scale, but the SG100 is not met. The overall score for this scoring issue is therefore 80.

d	Evaluation of assessment			
	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
	Met?			**No**

Rationale

The stock assessment was based on the CCAMLR-2000 large-scale survey of Area 48, and the estimates of stock biomass from the 2000 survey has been revised regularly in recent years (including using information from the small-scale stock surveys) through, for example, improvements in assessing target strength in acoustic assessments, and the assessment has been shown to be robust. The methodology for the 2019 stock survey has been fully tested and a rigorous analysis of the estimates from the survey including sensitivity of the estimates to any differences in methodologies for the 2000 and 2019 surveys was undertaken by SG-ASAM and the biomass estimates from the two surveys were shown to be robust. During the development of the GYM, other assessment models were evaluated, and at present CCAMLR WG-EMM are developing an integrated stock assessment model intended to make use of multiple data sources and in particular are evaluating the development of sub-area-scale stock assessment models

and biomass estimates from regular surveys within sub-areas in order to determine precautionary catch limits. . However, these alternative approaches have not yet been rigorously explored. SG100 is not met.

e	Peer review of assessment			
	Guide post		The assessment of stock status is subject to peer review.	The assessment has been **internally and externally** peer reviewed.
	Met?		**Yes**	**Yes**

Rationale

The methodology and results from the CCAMLR-2000 survey and the GYM have been published in the peer-reviewed literature, and survey results and assessments are peer reviewed within the CCAMLR Working Group system. The survey methodology for the 2019 full-scale stock survey was rigorously peer-reviewed within CCAMLR Working Groups. The assessment of stock status is therefore subject to peer review, and so SG80 is met. Whilst most of the annual review of stock assessment is through the CCAMLR WG system, these meetings are attended by highly competent stock assessment scientists from several countries and therefore constitute a form of external peer review. In conjunction with occasional external peer reviews of specific elements of the stock assessment process, and the publishing of the 2000 survey methodology and GYM in the peer-reviewed literature, it can be concluded that the assessment has been internally and externally peer-reviewed. SG100 is met.

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Overall Performance Indicator score	**85**
Condition number (if relevant)	**NA**

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7.6 Principle 2

7.6.1 Bycatch fish species: Primary and secondary species

Most of the background information for Principle 2 indicators is taken from the Honneland et al., 2015 MSC final certification report for the AKER Biomarine krill fishery.

CCAMLR Conservation Measure 51-06 (2019), which covers general measures for scientific observation in fisheries for *Euphausia superba*, states the need for adequate monitoring and management of the krill fishery and recommends no less than 75% observer coverage during the 2019/2020 fishing season and 100% observer coverage from the 2020-2021 and subsequent fishing seasons. Vessels shall ensure that the scientific observer has access to sufficient samples to fulfil the sampling and data collection as per the requirements specified in the Observer Krill Trawl logbook and Scientific Observer's Manual. AKER Biomarine fishing vessels have been meeting the requirements of 100% observer coverage for more than 10 years so far, long before required by CCAMLR.

The observer's tasks are listed in Annex I of the Scientific Observer Manual, and include, among others:

- sampling of catches to determine biological characteristics,
- recording biological data by species caught,
- recording bycatches, their quantity and other biological data,
- recording entanglement and incidental mortality of birds and mammals,
- recording the procedure by which declared catch weight is measured.

According to the different CCAMLR scientific observer reports from the UoA, all species recorded in the catch composition are used in the intended products, mainly fishmeal and krill oil. The continuous pumping system transfers the catch to a conveyor belt on board the vessels, which moves the catch into the hold. There is no size sorting of the krill caught and all species in the catch are retained.

Cruise reports submitted by CCAMLR scientific observers record catch details for all species and provides a summary of the biological data collected. Comprehensive information on the length, weight, sex and maturity of the individuals sampled is recorded in the observer's electronic logbook.

Sampling methodology is established in Part II, section 11 of the Manual. The observer is requested to select a haul or a two-hour period of continuous fishing, and to ensure that all large fish are removed from the conveyor during this haul/time-period and are retained for subsequent weighing and identification. At the same time, the observer is instructed to take a 25 kg sample, to remove all fish and to record the total mass of each fish species. Then he/she has to take a 10 kg subsample from the remaining krill sample and to sort carefully through this, again removing any fish and recording the total mass of each fish species. Following that, the requirement is to take two 1-kg subsamples from the remaining krill sample and to sort through each of these, again removing and recording the total mass of any remaining fish species (paying particular attention to larval fish). When accurate taxonomic identification of material is impossible, samples are photographed and kept for later study. CCAMLR WG-EMM-18/30 outlined a DNA study carried out to examine the accuracy of juvenile fish taxonomy as reported by observers in the Antarctic krill fishery and concluded that the observer taxonomic identification was reasonably accurate.

Following AKER BioMarine's first MSC certification (2010), and in order to meet the second condition that arose then, information from observers' reports for the period 2007–2011 was submitted to MRAG for analysis of larval fish bycatch. Although outdated, the MRAG 2012 report continues to provide comprehensive information on catch composition in the AKER krill fishery. Updated information on catch composition continues to be collected on a continuous basis through the CCAMLR Scheme of International Scientific Observation. The results of MRAG 2007-2011 analysis showed that myctophid (lanternfish) and channichthyid (icefish) species dominated the bycatch, but with occasional small quantities of nototheniids present too. A list of the species caught is given in Table 13.

The MRAG 2012 report also summarizes bycatch rates of the different species into species groups (

Table 14), where ICE refers to all icefish species group, LAN to myctophids (lanternfish) and NOT to the notothenid species group. FIN refers to all other finfish species.

Table 14 is therefore a summary version of Table 13.

MRAG (2012) analysis on bycatch species shows standardized counts of icefish, lanternfish and notothenid individuals per tonne sampled. Together, the three groups account for ~1000 individuals per sampled tonne. As a precautionary

proxy, one could consider that each larva weighs about 2g, which would yield a final weight of 2kg of retained larvae per tonne sampled. In other words, 0.2% of the catch composition can be considered as retained species other than krill. The gear and the fishing strategy can be considered as highly selective. However, because this small weight represents a large number of individuals, continued monitoring of fish larvae is necessary in future.

Table 13: Unstandardized total numbers of fish larvae in the *Saga Sea* catch by species code and species name, 2007–2011. Source: Analysis of larval bycatch report, MRAG 2012

Code	Species name	English name	Area 48.1	Area 48.2	Area 48.3	Total
ANI	*Champsocephalus gunnari*	Mackerel icefish	3	2	367	**372**
ANS	*Pleuragramma antarcticum*	Antarctic silverfish	5	20	0	**25**
ART	*Artedidraco spp*	-	1	0	0	**1**
BTI	*Bathydraconidae*	Bathydraconidae	0	2	0	**2**
ELN	*Electrona antarctica*	-	0	6	0	**6**
FIC	*Cryodraco antarcticus*	Long-fingered Icefish	9	1	0	**10**
ICX	*Channichthyidae*	Icefish spp	24	150	22	**196**
JIC	*Neopagetopsis ionah*	Crocodile icefishes	3	20	0	**23**
KRA	*Krefftichthys anderssoni*	Lanternfish spp.	0	**4**	16	**20**
LXX	*Myctophidae*	Lanternfish	10	337	213	**560**
MIC	*Chionodraco myersi*	Myers' icefish	2	1	0	**3**
MOY	*Muraenolepis microps*	Smalleye moray cod	0	9	26	**35**
MRL	*Muraenolepis spp*	Moray cods	0	0	2	**2**
NOC	*Notothenia coriiceps*	Black rockcod	0	5	0	**5**
NOG	*Notothenia gibberifrons*	Humped rockcod	1	**44**	1	**46**
NOL	*Nototheniops larseni*	Painted rockcod	1	5	14	**20**
NOT	*Patagonotothen brevicauda*	Patagonian rockcod	0	19	0	**19**
NOX	*Nototheniidae*	Rockcods	3	12	23	**38**
NTO	*Notolepis coatsi*	Antarctic jonasfish	0	38	0	**38**
PGE	*Parachaenichthys georgianus*	Bathydraconidae	0	3	0	**3**
PRE	*Protomyctophum tenisoni*	-	0	5	0	**5**
RTX	*Macrouridae*	Grenadiers, rattails nei	1	0	0	**1**
SGI	*Pseudochaenichthys georgianus*	South Georgia icefish	9	15	0	**24**
SSI	*Chaenocephalus aceratus*	Blackfin icefish	22	3	0	**25**
TIC	*Chionodraco hamatus*	-	6	0	0	**6**
TOA	*Dissostichus mawsoni*	Antarctic toothfish	1	5	0	**6**
TOT	*Dissostichus spp*	Toothfish spp	0	0	2	**2**
TRT	*Trematomus spp*	Trematomus spp	3	0	0	**3**
WIC	*Chaenodraco wilsoni*	Spiny icefish	17	2	0	**19**
YDB	*Cryodraco spp*	-	48	11	0	**59**
TOTALS			**169**	**719**	**686**	**1 574**

Table **15** lists the species groups, subarea and season-specific bycatch rates of fish larvae (number of individuals per tonne of krill caught), and

Table 16 is precautionary total larval fish bycatch estimates (numbers and tonnes) by subarea, species group and season for a normal ice year and a low ice year. The MRAG report (MRAG 2012) assumes that the bycatches of channichthyiids and notothenioids were exclusively *Champsocephalus gunnari* and *Notothenia rossii*, respectively, the species of greatest concern in the analysis. It is also of note that very few of the icefish larvae recorded in Subarea 48.1 and 48.2 were actually *C. gunnari*, the main species of concern in the area.

Table 14: Total numbers of fish larvae in the *Saga Sea* catch composition by species group, 2007–2011. Source: Analysis of larval bycatch report, MRAG 2012

Code	English name	Area 48.1	Area 48.2	Area 48.3	Total
FIN	Finfish group	2	47	28	77
ICE	Icefish group	143	210	389	742
LAN	Lanternfish group	10	352	229	591
NOT	Notothenioid group	14	110	40	164
Totals		169	719	686	1 574

Table 15: Species group, subarea and season-specific bycatch rates of fish larvae (number of individuals per tonne of krill caught). Source: Analysis of larval bycatch report, MRAG 2012

Area	Species code	Number of individuals per tonne of krill caught.	
		Summer	Winter
48.1	ICE	6 272	6 272
48.2	ICE	3 850	804
48.3	ICE	0	5 026
48.1	LAN	0	0
48.2	LAN	3 444	3 444
48.3	LAN	0	5 048
48.1	NOT	838	838
48.2	NOT	1 224	1 224
48.3	NOT	0	370

The MRAG 2012 report concludes that it is highly unlikely that the rates of larval fish bycatch of the *Saga Sea* pose any threat to lanternfish, icefish or notothenioid stocks in Area 48.

Table 16: Precautionary total larval bycatch estimates (numbers and tonnes) by subarea, species group and season for a normal ice year and a low ice year. Source: Analysis of larval bycatch report, MRAG 2012

Scenario	Area	Species code	Summer (number)	Winter (number)	Total (number)	Total (tonnes)
Normal ice year	48.1	ICE	18 816	6 272	25 088	0.132
	48.2	ICE	88 549	24 913	113 462	0.596
	48.3	ICE	0	175 911	175 911	0.925
	48.1	LAN	0	0	0	0
	48.2	LAN	79 222	106 777	185 999	1.019
	48.3	LAN	0	176 677	176 677	0.968
	48.1	NOT	2 514	838	3 352	0.008
	48.2	NOT	28 154	37 946	66 100	0.160
	48.3	NOT	0	12 936	12 936	0.031
Low ice year	48.1	ICE	31 360	344 956	376 316	1.978
	48.2	ICE	111 648	4 018	115 667	0.608
	48.3	ICE	0	45 234	45 234	0.238
	48.1	LAN	0	0	0	0
	48.2	LAN	99 888	17 222	117 110	0.641
	48.3	LAN	0	45 431	45 431	0.249

	48.1	NOT	4 189	46 084	50 273	0.122
	48.2	NOT	35 498	6 120	41 618	0.101
	48.3	NOT	0	3 326	3 326	0.008

Of the mentioned species, icefish and toothfish would be considered as primary species, as they are managed in CCAMLR subarea 48.3 (and subarea 48.4 for toothfish too). As they comprise less than 5% of the catch they are considered as minor primary species. Lanternfish and notothenid species are not managed in CCAMLR area and are therefore considered as secondary species together with out of scope species such as non-protected birds or marine mammals.

CCAMLR provides scientific advice and management measures for Icefish (see CM 42-01, 2019, https://www.ccamlr.org/en/measure-42-01-2019) and therefore considered as a primary species in the scope of this assessment. The total catch of *Champsocephalus gunnari* in Statistical Subarea 48.3 in the 2019/20 season shall be limited to 3,225 tonnes, and in the 2020/2021 season shall be limited to 2132 tonnes.

According to CCAMLR Fishery Report 2018 (latest available): *Champsocephalus gunnar*i South Georgia (Subarea 48.3), (https://www.ccamlr.org/en/system/files/01%20ANI483%202018.pdf), in 2017 (latest assessment) the stock was slightly above the average of the time series, with the median demersal biomass estimated at 91,531 tonnes, and a one-sided lower 95% confidence interval of 47,424 tonnes. The CCAMLR harvest control rule, using a length-based approach, has been demonstrated to provide robust precautionary estimates of catch limits and exploitation rates for *C. gunnari* in Subarea 48.3.

As regards toothfish, CCAMLR also provides scientific advice and management measures for the species (see CM 41-02, 2019, https://www.ccamlr.org/en/measure-41-02-2019). The total catch of *Dissostichus eleginoides* in Statistical Subarea 48.3 in the 2019/20 and 2020/2021 seasons shall be limited to 2,327 tonnes per season.

According to CCAMLR Fishery Report 2018 (latest available): *Dissostichus eleginoides* South Georgia (Subarea 48.3) (https://www.ccamlr.org/en/system/files/03%20TOP483%202018.pdf), estimates of initial biomass levels and current biomass levels show that the stock remained at around 52% of B0 in 2015. Stochastic long-term projections conducted in accordance with the CCAMLR procedures for yield calculations indicate that a constant yield of 2,600 tonnes will maintain spawning stock biomass (SSB) at 50% of B0 over the next 35 years with 50% probability.

As mentioned above, minor secondary species to consider would be the bycatch of Lanternfish and notothenid species. Besides, CCAMLR's 2018 Report by Working Group on Ecosystem Monitoring and Management (WG-EMM) states the following:

- *"2.15 WG-EMM-18/05 analysed publicly available aggregated decadal-scale krill catch data to evaluate the likelihood that ice krill (Euphausia crystallorophias) will have been included in the reported Antarctic krill catch. The Antarctic krill fishery operates in geographic areas that overlap with the known range of ice krill, potentially occupying similar depths in the water column. The authors of the paper concluded that as both species are morphologically similar, the possibility of ice krill being caught as by-catch, and the failure to detect it, cannot be dismissed and that the likelihood of ice krill by-catch is effectively 100%.*
- *2.16 The Working Group noted that some krill fishery operations occur in areas where datasets from scientific net hauls indicate the likelihood of co-existence of these two species. The Working Group further noted that the absence of ice krill reports does not necessarily indicate an absence of ice krill by-catch and underlined the importance of providing scientific observers with the appropriate materials needed to identify ice krill in their routine observations"*

At present there is little information on the distribution of ice (crystal) krill or its overlap with Antarctic krill. Davis et al. (2017) concluded that, while not representative due to the limited sampling which only took place in the summer months, "*the general characteristics of the distributions of the 2 krill species show clear and distinct patterns in the Ross Sea. Each species occupies a localized habitat that is defined by different environmental characteristics". "Separation of Antarctic krill and crystal krill habitats in the western Ross Sea has been described for specific times and locations, but this study shows that the separation is a general characteristic of the 2 species.*"

CCAMLR observer reports sample size and sex of krill, and analysis have not highlighted the presence of ice krill so far. However, due to the uncertainties raised by WG-EMM 2018 the team has set a recommendation to improve identification of ice krill if present and to highlight the presence of ice krill when identified by observers.

MSC FS v2.01 SA 3.1.4.2, the team shall consider species that are out of scope of the program, but where the definition of ETP species is not applicable, as main secondary species. Interactions with these species (birds, penguins or marine mammals) is also recorded by scientific observers on board the vessels. The observation methodology in terms of the interactions between seabirds and marine mammals and fishing operations is provided in Part II, section 12 of the CCAMLR Scientific Observer Manual, and the periods and durations of the observations are detailed.

The fishing strategy in the UoA, with long hauls of 20 or 25 days (proxy), slow towing speed (2 knots), quick sinking of the net on deployment, and the rigging of the trawl warps, which enter the water close to the stern of the vessel in order to reduce the potential for birds to strike the warps during fishing operations, all contribute to the low number of interactions as recorded by observers during fishing operations. The Saga Sea and the Antarctic Sea vessels deploy the net on the stern of the vessel, however the recently built Antarctic Endurance vessels deploys the net on the starboard of the vessel.

7.6.2 Bycatch out-of-scope species: Secondary and ETP species

7.6.3 Secondary species

The assessment team had access to all observer reports for all vessels in the UoA for the year 2018. These reports show that the vessels in the UoA had no fatal interactions with birds nor marine mammals at least in 2018. Observer reports for years 2012-2014 were also revised at the reassessment of the fishery in 2015 showing similar results.

CCAMLR Conservation Measure 25-03 (2019) covers the issue of minimizing incidental mortality of seabirds and marine mammals in the course of trawling in the Convention Area, and it requires the fisheries to develop gear configurations that reduce the chance of birds or marine mammals encountering the net.

Specifically, the Saga Sea vessel has installed a streamer line to reduce possible interactions, and cameras at the stern of the vessel to monitor these interactions from the deck (Figure 5 and Figure 6).

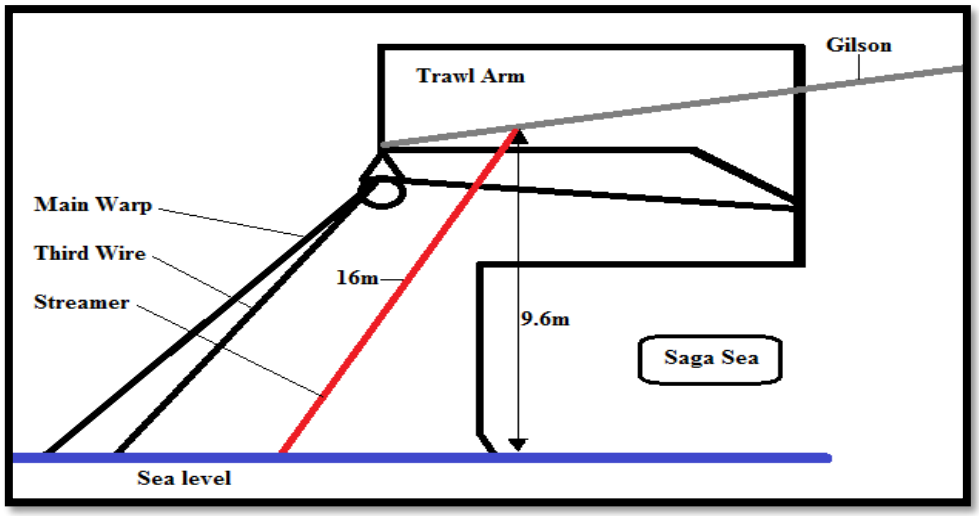

Figure 5: A diagram of the streamer line in relation to the third wire and main trawl warp. Source: Saga Sea CCAMLR observer report for the 10/11/17 - 28/03/2018 trip.

Figure 6: Screenshot of the camera system installed in the stern of the Saga Sea vessel to monitor the third wire for bird interactions. Source: Saga Sea CCAMLR observer report for the 10/11/17 - 28/03/2018 trip.

The 2018 krill fishery report (latest available) (https://www.ccamlr.org/en/document/publications/krill-fishery-report-2018) provides a summary of interacted species in the past years. Specifically, in 2018, there were two seabird mortalities reported from the krill fishery (all fleet, this is 11 vessels), one snow petrel (*Pagodroma nivea*) in Subarea 48.1 and one cape petrel (*Daption capense*) in Subarea 48.2. The 2017 krill fishery report (https://www.ccamlr.org/en/system/files/00%20KRI48%202017.pdf) reports two seabird mortalities (unspecified species, one in subarea 48.1 and one in subarea 48.2) for the whole fleet in 2017 and nine seabird (unspecified) mortalities in 2016, one in Subarea 48.2 and eight in Subarea 48.1. According to observer reports for the UoA, these interactions did not take place with vessels under the UoA. However, on a precautionary approach the team has considered these species as main secondary species as there is a possibility of sporadic interactions taking place in the future.

According to information from Birdlife International (http://datazone.birdlife.org/species/factsheet/snow-petrel-pagodroma-nivea/details), the population of snow petrels in Antarctica exceeds 4 million individuals, and the population is stable (BirdLife International (2019) Species factsheet: *Pagodroma nivea*.). As for the cape petrel, its population exceeds 2 million individuals and is also expected to be stable (BirdLife International (2019) Species factsheet: *Daption capense).* Both species are listed as Least Concern by IUCN.

A Marine Mammal Exclusion Device (Figure 7) is present in each of the nets to prevent marine mammal entanglements, particularly by seals. There are eight escape holes (1 m diameter each) cut out at the top of the net panel to facilitate marine mammal escape. The net opening is covered by a fine-mesh excluder that actively excludes marine mammals and penguins from the net and hence becoming trapped.

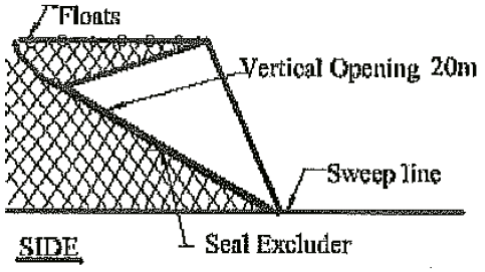

Figure 7: Marine mammal exclusion device in the UoA. Source: AKER BioMarine

As stated above, direct interactions with seabirds or mammals have been reported to be minimal. Indirect effects of the fishery on predators such as crabeater seals, Adélie, chinstrap, gentoo and macaroni penguins have been studied by mapping selected krill predator summer foraging ranges and overlaying it on known fishing activity areas of AKER Biomarine's *Saga Sea* for the period 2007–2011 (Nicoll and Douglas 2012).

Species such as the macaroni penguin overlap with summer krill-fishing operations around the Antarctic Peninsula, but there is much less overlap elsewhere. Crabeater seals appear to have a moderate to high degree of overlap between year-round krill-fishing operations and their projected foraging distribution. Adélie penguin summer foraging activity shows an overall low level of overlap with fishing activity throughout the year. For chinstrap and gentoo penguins, there is a low overall level of overlap between their foraging distribution and the fishing activities.

Fraser and Hofmann (2003) reported that during the breeding season, Adélie penguin foraging trip duration varied in a non-linear manner, but in accordance with sea-ice extent and changes in krill abundance. Years with the lowest sea-ice extent were associated with the longest foraging trip durations and the lowest measures of krill abundance. Years with intermediate or extensive sea-ice cover were associated with shorter foraging trip durations and greater krill abundance. These relationships are particularly evident during the breeding season.

According to Murphy *et al.* (2007), some species also look for alternative breeding options in years when krill are scarcer (Figure 8).

Seabird and seal predation in the Scotia Sea, and their dependence on krill abundance, were also studied by Murphy *et al.* (2007) – see Figure 9. As the estimates provided are based mainly on summer studies, however, they are likely to overestimate the importance of krill in the diet.

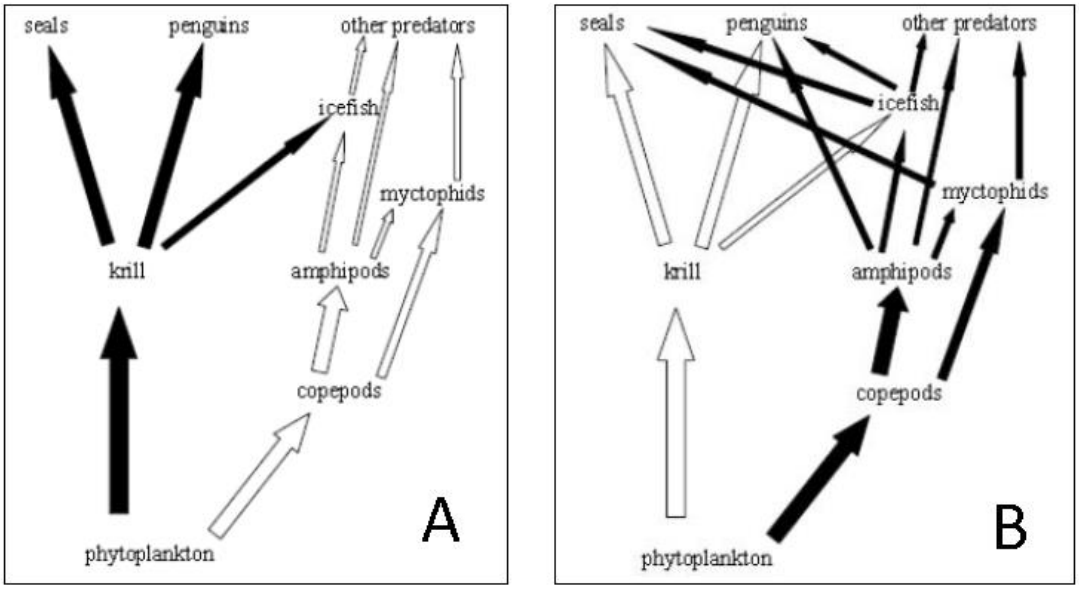

Figure 8: Schematic illustration of alternative pathways in part of the Scotia Sea food web, showing shifts between (A) years when krill are abundant throughout the Scotia Sea, and (B) years when krill are scarce. Major pathways are shown as black arrows. Source: Murphy et al. (2007).

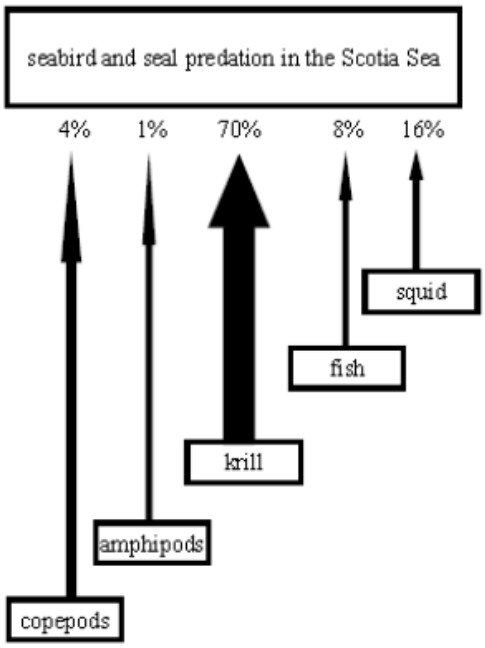

Figure 9: Proportional consumption of different groups of prey by the major predators in the Scotia Sea. Source: Murphy *et al*. (2007).

Removals by the fishery have been estimated to be orders of magnitude below both the demand by predators and the biomass available to both predators and the fishery. Hewitt *et al.* (2004) estimated the annual consumption of krill in Area 48 for different predators to be 15 223 000 t. Murphy *et al.* (2007) also estimated the annual consumption of krill (in 10^6 t per year) by the main krill predators in the Scotia Sea food web (Figure 10). However, those estimates are based mainly on summer studies that are likely to overestimate the importance of krill in the diet.

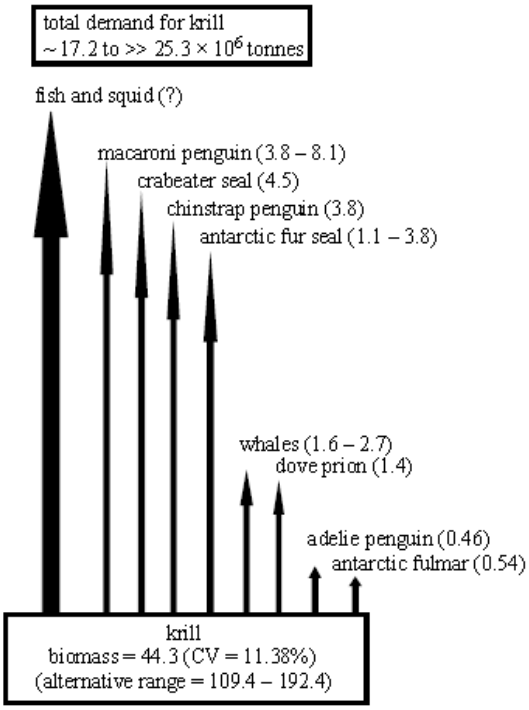

Figure 10: Estimates of annual consumption of krill (10^6 t) by the main krill predators in the Scotia Sea food web. Source: Murphy *et al*. (2007).

In order to limit the indirect effects that harvesting for krill may have on penguin colonies, the Association of responsible krill harvesting companies (ARK) and its members (including AKER Biomarine) have committed themselves, as from

January 2019, to voluntary restrictions in the Antarctic Peninsula covering about 74000 km^2 around penguin colonies, to ensure the long-term viability of krill stocks and that the krill fishing industry does not compete with penguin colonies during their breeding season (Figure 11). With this commitment, ARK companies pledge to keep fishing effort up to 40 kilometres away from the coast from October to March, depending on the conservation needs of colonies of Adélie, chinstrap and gentoo penguins while breeding around the Antarctic Peninsula, off South Shetland and in Gerlache strait. The commitment will see the seasonal closure gradually implemented into a permanent closure from 2020, of which size and limits are to be decided after an independent review of the implementation, of scientific data collected and the potential impact on the commercial fishery (http://www.ark-krill.org/index.cfm/7/News). This voluntary restricted zone is expected to be implemented until similar management measures are adopted by CCAMLR.

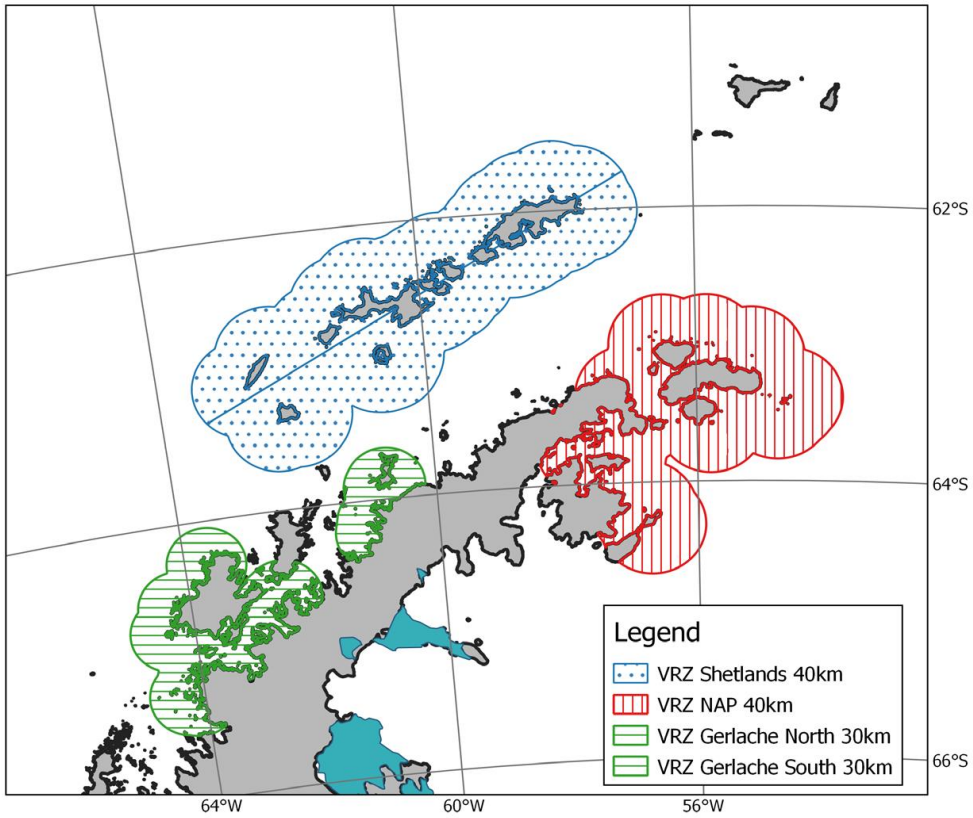

Figure 11: Map depicting the Voluntary Restricted Zones (VRZs) around the South Shetland Islands (40 km buffer zone), the northern tip of the Antarctic Peninsula (NAP, 40 km buffer zone), and northern and southern areas of the Gerlache Strait (30 km buffer zone). Source: ARK Expert panel report 2019 on the evaluation of the VRZs during the 2018/2019 fishing season.

7.6.4 ETP Species

According to MSC FS v2.01, SA 3.1.5, the team shall assign ETP (endangered, threatened or protected) species as follows:

- Species that are recognised by national ETP legislation
- Species listed in the binding international agreements given below:
    - Appendix 1 of the Convention on International Trade in Endangered Species (CITES), unless it can be shown that the particular stock of the CITES listed species impacted by the UoA under assessment is not endangered.
    - Binding agreements concluded under the Convention on Migratory Species (CMS), including: ii. Annex 1 of the Agreement on Conservation of Albatross and Petrels (ACAP);
    - Table 1 Column A of the African-Eurasian Migratory Water bird Agreement (AEWA);
    - Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS);
    - Annex 1, Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS);
    - Wadden Sea Seals Agreement;
    - Any other binding agreements that list relevant ETP species concluded under this Convention

- Species classified as 'out-of-scope' (amphibians, reptiles, birds and mammals) that are listed in the IUCN Redlist as vulnerable (VU), endangered (EN) or critically endangered (CE).

Given this guidelines, ETP species to consider will be those species listed in CITES Appendix I which have been identified in the South Georgia and South Sandwich Islands waters:

- *Australophocoena dioptrica* (spectacled porpoise)
- *Balaenoptera bonaerensis* (Antarctic minke whale)
- *Balaenoptera borealis* (sei whale)
- *Balaenoptera musculus* (blue whale)
- *Balaenoptera physalis* (fin whale)
- *Cephalorhynchus commersonii* (piebald dolphin)
- *Eubalaena australis* (southern right whale)
- *Hyperodon planifrons* (southern bottlenose whale)
- *Megaptera novaeangliae* (humpback whale)
- *Mirounga leonine* (elephant seal)
- *Phocoena dioptrica* (spectacled porpoise)
- *Physeter macrocephalus* (sperm whale)

Specifically, South Georgia and South Sandwich Islands Wildlife and Protected Areas Ordinance 2011 bans any intentional damage to any native animal in subareas 48.3 and 48.4. Based on this, all out-of-scope species interacted in subareas 48.3 and 48.4 are considered as ETP species. Unintentional hinder is however not covered in this regulation. (http://www.gov.gs/docsarchive/Legislation/Wildlife%20and%20Protected%20Areas%20Ordinance%202011-1.pdf).

The team has been made aware that during the 2019 one AKER BioMarine krill fishing vessel had a fatal interaction with one Antarctic fur seal in subarea 48.3. The species is classified as Least Concern by IUCN and is listed in CITES Appendix II. Given that the species is protected by SGSSI regulation, it is considered in this assessment as an ETP species.

The CCAMLR krill fishery 2018 report (https://www.ccamlr.org/en/document/publications/krill-fishery-report-2018) provides information on possible interactions with marine mammals. There are no records of such interactions prior to 2008, when the use of seal exclusion devices (SLED) became mandatory in the krill fishery.

There were no seal mortalities reported between 2008 and 2014, however, there were three mortalities of Antarctic fur seals in 2015 and 2016, none in 2017 and 19 in 2018. Of the 19 reported mortalities of Antarctic fur seal in 2018, 18 of which were reported from the same vessel. These mortalities all took place in subarea 48.3.

The team has had access to all observer reports for the UoA in 2018, showing that vessels included within the UoA had no interactions with seals for 2018. However, the team has been informed that the Saga Sea vessel had one entanglement of fur seal in 2019. Antarctic fur seal population is decreasing and is estimated to range between 700.000-1.000.000 individuals. In any case, the species is still considered as Least Concern by IUCN (https://www.iucnredlist.org/species/2058/66993062).

As mentioned above, CCAMLR Conservation Measure 25-03 (2019) covers the subject of minimizing the incidental mortality of seabirds and marine mammals in the course of trawling in the Convention Area and requires the fisheries to develop gear configurations that reduce the chance of birds or marine mammals encountering the net, such as the Marine Mammal Exclusion Device shown in Figure 7 above.

Indirect effects of the fishery on predators such as Antarctic fur seals have also been studied along with effects on other species such as crabeater seals, Adélie, chinstrap, gentoo and macaroni penguins, by mapping selected krill predator summer foraging ranges and overlaying it on known fishing activity areas of Aker Biomarine's *Saga Sea* for the period 2007–2011 (Nicoll and Douglas 2012). For the Antarctic fur seal (a CITES-listed species), the analysis showed a high degree of overlap of year-round fishing operations and the summer foraging ranges of the species (Fig. A in Nicoll and Douglas 2012, Figure 12).

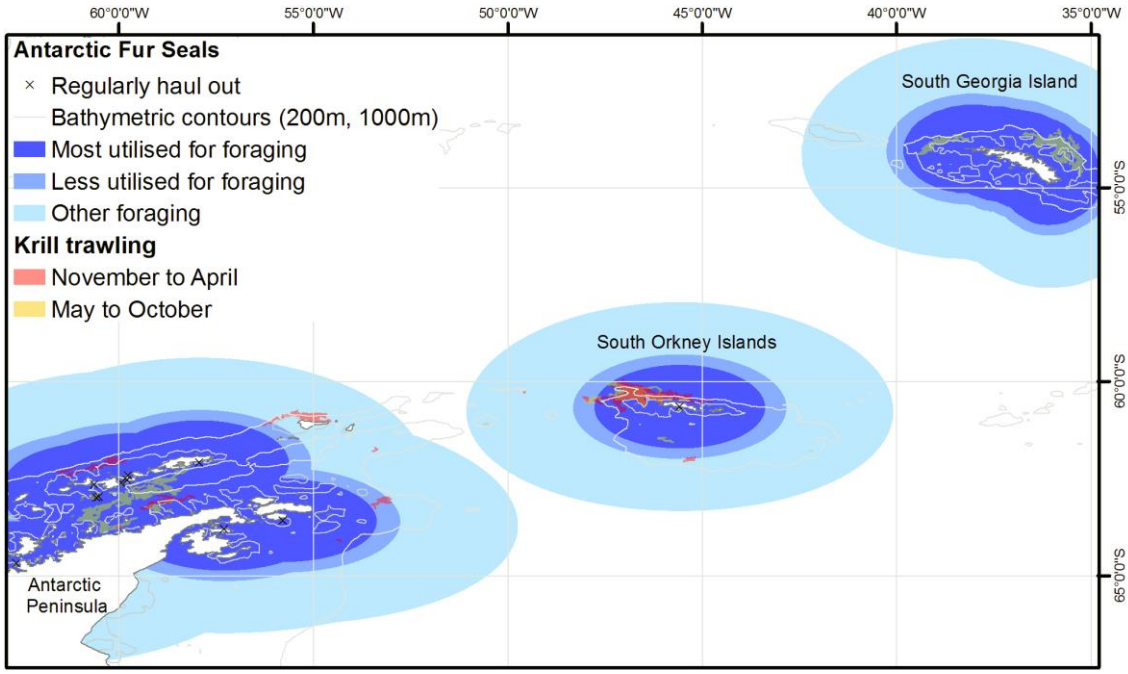

Figure 12: *Saga Sea* summer and non-summer fishing effort, 2007–2011, and summer foraging ranges of Antarctic fur seals. Source: Mapping selected krill predator summer foraging ranges with fishing activity of AKER BioMarine's *Saga Sea* 2007-2011.

As mentioned above some species also look for alternative breeding options in years when krill are scarce.

In order to protect predators and their foraging areas, the South Georgia and South Sandwich Islands have established a no-take zone around the islands, consisting of a seasonal closure for the krill fishery from 1 October to 30 April along with minimum (700 m) and maximum (2500 m) depths at which trawling can take place (http://www.gov.gs/32110-2/). This is in addition to the voluntary buffer closures afforded by ARK in the Antarctic Peninsula and the South Shetland Islands.

7.6.5 Benthic habitats

As the fishing vessels operate in pelagic waters (towing at depths <150m) with a pelagic net, no interactions with cnidarians or hydrozoans at the seabed, or with the seabed itself, are expected. The fishing gear would only rarely impact the seafloor or its benthic habitats. Such interaction is anyway actively avoided because it would damage the net to the extent that repairs on board would probably be impossible. The only possible interaction of the net with the seafloor, therefore, would be loss of the net, which would happen rarely and would always report on formal observer reports if it transpires. According to CCAMLR 2018 Observer reports for the UoA, no gear was lost during fishing activities. Occasionally, though, a float or a small section of rope would be lost during shooting or hauling the nets.

Benthic sediments in Antarctica have been studies by different researchers, such as Goodell et al (1973) or by Clarke A (1995). Like the abyssal plains elsewhere, those around Antarctica are composed primarily of soft sediments (Figure 13). They differ from sediments in most other deep-sea areas in two ways: the low temperatures of the surface waters mean that these sediments are siliceous rather than the carbonates typical of lower latitudes, and there is a strong influence of glacial processes. Close to the Antarctic continent the sediments contain an abundant silt fraction comprised of rock flour with coarse poorly sorted debris and containing little calcite or biogenic material. These types of sediment are termed *glacial marine* and they form a wide circumpolar band around Antarctica (Clarke A. 1995).

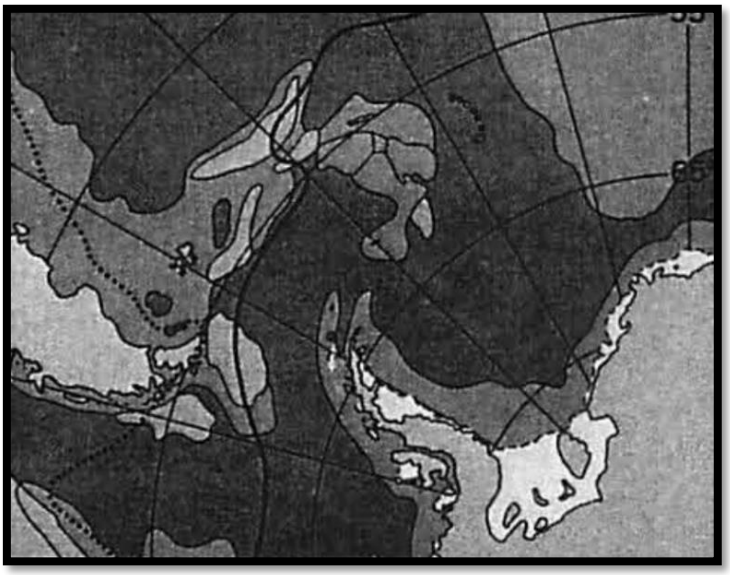

Figure 13: A map showing the main sediment types around Antarctica. Note the distribution of the major sediments in broad swathes around Antarctica. Closest to the continent are submarine tills and glacial marine sediments; outside this (and dominating the western South Atlantic) is a narrow band of clay-silt (dark grey) and surrounding this a broad band of siliceous ooze (pale grey). Source: Clarke A., reproduced from Goodell et al. (1973).

More recently, Douglass et al (2014) identified benthic habitat types through a benthic bioregionalization work, based on physical proxies such as depth, seabed slope, water column or seabed temperature and primary productivity. The authors identified 23 different ecoregions, 9 bathomes and 107 spatially restricted environmental types (see Figure 14). The UoA overlaps with three of those ecoregions (Antarctic Peninsula, South Orkney Islands and South Sandwich Islands) and several restricted environmental types (in particular around the does around the islands).

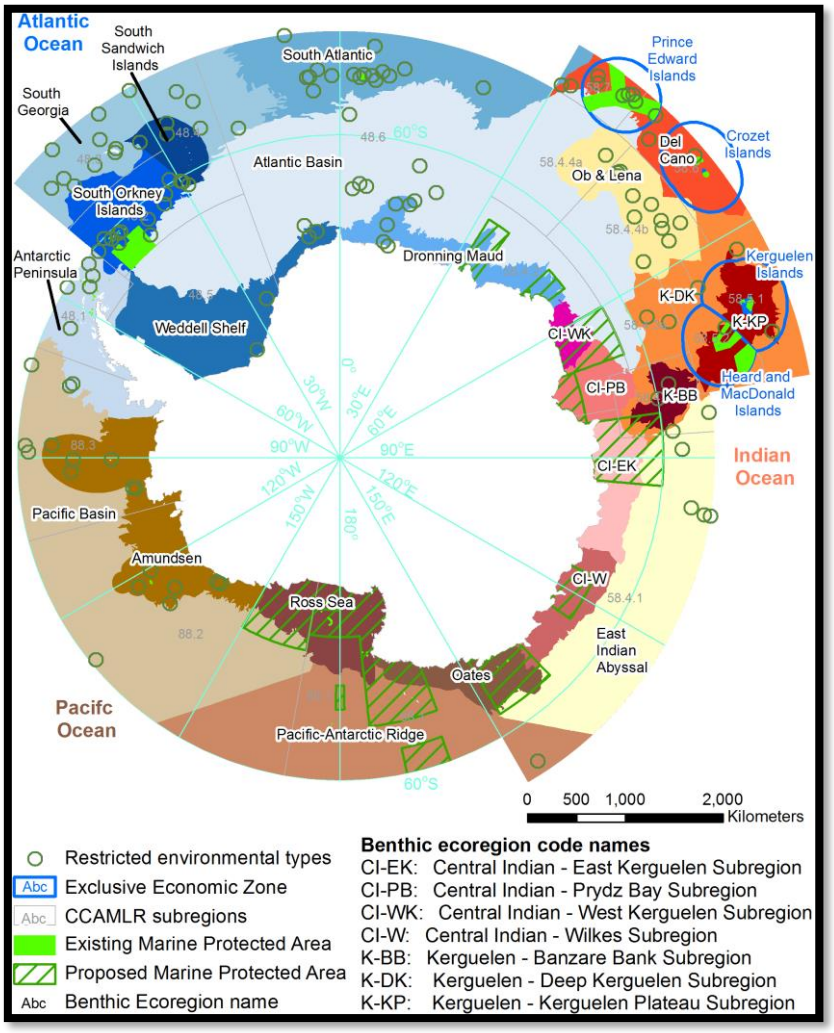

Figure 14: The benthic ecoregions, restricted environments and marine protected areas identified within the Southern Ocean. Source: Douglas et al 2014.

VME are identified in the Southern Ocean. The 'CCAMLR VME Registry' records the locations and taxa of Vulnerable Marine Ecosystems (VMEs) and associated areas in the Convention Area which have been notified under CM 22-06 (2019) and CM 22-07 (2013) (https://www.ccamlr.org/en/document/data/ccamlr-vme-registry). Access to this registry is open to everybody. Figure 15 below shows the location of areas holding VME.

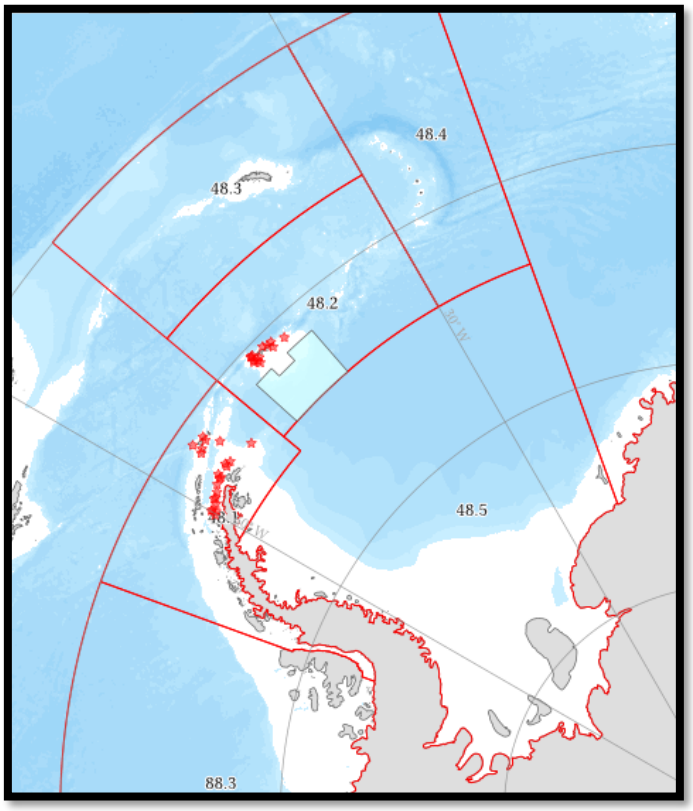

Figure 15: Location of encounters with VME in the UoA fishing grounds. Red dots indicate such location. Source: https://gis.ccamlr.org/

CCAMLR Conservation Measures 91-01 (2004), 91-02 (2012), 91-03 (2009), 91-04 (2011) and 91-05 (2016) describe the protected areas in Antarctic waters (https://www.ccamlr.org/en/conservation-and-management/browse-conservation-measures).

In 2009, a Marine Protected Area in Subarea 48.2, to protect the South Orkney Islands southern shelf, was established by CCAMLR Conservation Measure 91-03. Marine Protected Areas (MPAs) are recognized as one of the most effective means of achieving ecosystem-level conservation, protecting marine biodiversity, and mitigating key threats and pressures on marine environments and the resources they contain. They help to achieve conservation and fisheries management objectives, as well as providing a foundation for ecosystem-based management (Toropova *et al*. 2010).

The CCAMLR Marine Protected Area in the South Orkney Islands southern shelf is bounded by a line starting at 61°30'S 41°W, thence due west to 44°W longitude, due south to 62°S, due west to 46°W, due north to 61°30'S, due west to 48°W, due south to 64°S, due east to 41ºW, and finally due north back to the starting point. The Measure prohibits all types of fishing activities within the defined area, with the exception of scientific fishing research activities agreed by the Commission for monitoring or other purposes.

Conservation Measure 91-04 provides a General framework for the establishment of CCAMLR Marine Protected Areas and states that the Commission will, on the basis of the advice of the Scientific Committee, adopt a research and monitoring plan for an MPA. Every five years, Members conducting activities according or related to the research and monitoring plan, will compile a report on those activities, including any preliminary results for review by the Scientific Committee. Figure 16 shows this Marine Protected Area as a heavy black line, with depth contours at intervals of 1000m.

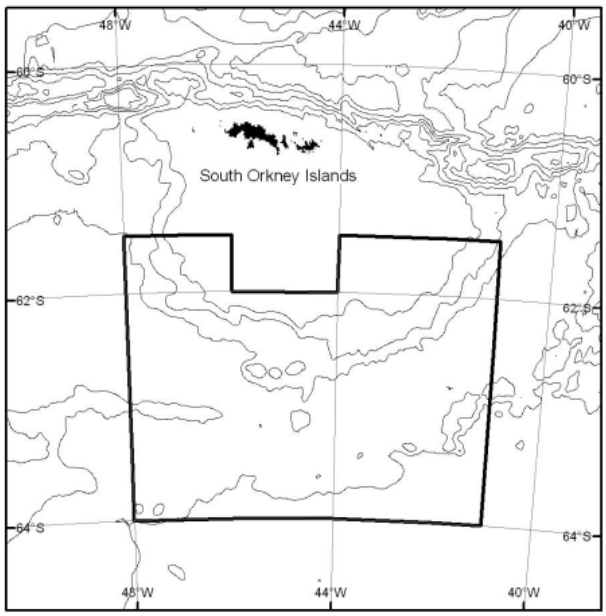

Figure 16: CCAMLR Marine Protected Are for the protection of the South Orkney Islands. Source: CCAMLR Conservation Measure 91-03

Conservation Measure 91-05 (2016) establishes the Ross Sea region Marine Protected Area (Figure 17), the world's largest marine protected area, covering 1.55 million square kilometres, of which 1.12 million square kilometres are fully protected. This MPA is located in CCAMLR subarea 88.1 and does not overlap with the UoA.

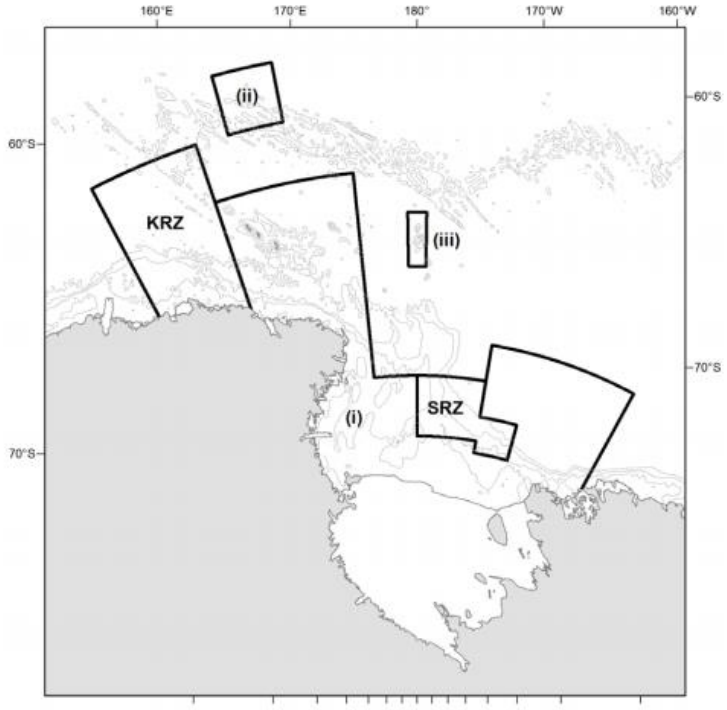

Figure 17: The Ross Sea region marine protected area, including the boundaries of the General Protection Zone, composed of areas (i), (ii), and (iii), the Special Research Zone (SRZ), and the Krill Research Zone (KRZ). Depth contours are at 500, 1 500 and 2 500 m. Source: https://www.ccamlr.org/en/measure-91-05-2016

Other protected areas are Antarctic Specially Protected Areas (ASPAs) and Antarctic Specially Managed Areas (ASMAs), which are designated under the Antarctic Treaty as areas of special scientific or biological significance. They are areas designated under CCAMLR Conservation Measure 91-02 (2012) on the Protection of the values of Antarctic

Specially Managed and Protected Areas. The Secretariat of the Antarctic Treaty manages a database on the locations of ASPAs and ASMAs and holds information on their management plans and purposes for designation. The management plans for all these areas can be found on the Antarctic Protected Areas (APA) database on the Antarctic Treaty Secretariat (ATS) website: https://www.ats.aq/devPH/apa/ep_protected.aspx?lang=e&lang=e

The following list contains those ASPAs and ASMAs containing marine areas within Area 48:

- ASPA 144, Chile Bay, Greenwich Island, South Shetland Islands (Subarea 48.1)
- ASPA 145, Port Foster, Deception Island, South Shetland Islands (Subarea 48.1)
- ASPA 146, South Bay, Doumer Island, Palmer Archipelago (Subarea 48.1)
- ASPA 152, Western Bransfield Strait, South Shetland Islands (Subarea 48.1)
- ASPA 153, Eastern Dallmann Bay, Palmer Archipelago (Subarea 48.1)
- ASPA 149, Cape Shirreff, South Shetland Islands (Subarea 48.1)
- ASPA 151, Lions Rump, South Shetland Islands (Subarea 48.1)
- ASMA 1, Admiralty Bay, South Shetland Islands (Subarea 48.1)
- ASMA 3, Deception Island, South Shetland Islands (Subarea 48.1)
- ASMA 7, Southwest Anvers Island, Palmer Archipelago (Subarea 48.1).

South Georgia and the South Sandwich Islands are home to a tremendous abundance and diversity of birds, marine flora and fauna and marine-dependent predators, and are a hotspot of benthic biodiversity. In 2012 the South Georgia and South Sandwich Islands declared a Marine Protected Area (**Figure 18**) with spatial and temporal limits on the fisheries in their waters.

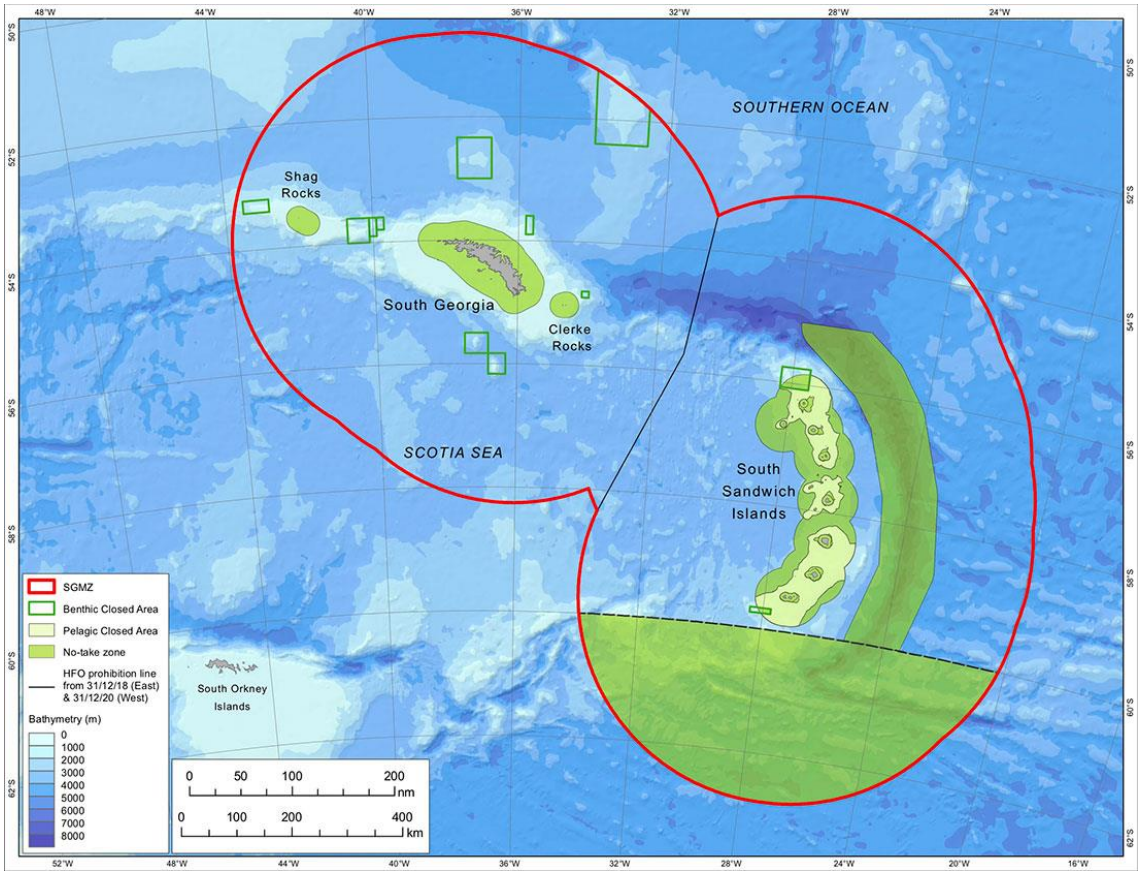

Figure 18: Chart illustrating the location of the South Georgia and South Sandwich Islands Marine Protected Area and the additional No-take Zones. The section of the Maritime Zone south of 60ºS is not part of this MPA, but no fishing is licensed there. Source: SGSSI Marine Protected Area Management Plan. Source: http://www.gov.gs/32110-2/

Limitations on the South Georgia and South Sandwich Islands include:

- seasonal closure (1 November to 31 March) of the Antarctic krill fishery;
- ban on bottom fishing in waters shallower than 700 m or deeper than 2250 m;
- a 12 nautical mile No-take Zone around the Clerke Rocks and the Shag Rocks, and a 30 km no-take zone around the South Georgia Island.
- A 3 nautical mile No-take Zone around each of the South Sandwich Islands and a 12 nautical mile area around each of the islands closed to pelagic fishing; The enhanced measures will greatly increase both the size of the total NTZ and the pelagic closed area by prohibiting all commercial fishing activity within 50km of the SSI except for a small, highly regulated amount of fishing for toothfish.
- The enhanced measures will greatly increase both the size of the total NTZ and the pelagic closed area by prohibiting all commercial fishing activity within 50km of the SSI except for a small, highly regulated amount of fishing for toothfish which will be strictly limited to depths between 700m and 2,250m (see map).
- Bottom trawling is prohibited in the Marine Protected Area and bottom fishing with other gears is only allowed between the depths of 700 and 2,250 m.
- The GSGSSI will formally designate the region of its Maritime Zone located south of 60º South as a full NTZ within the MPA which will be closed to all commercial fishing activity

In addition, there also are Benthic Closed Areas:

- West Shag
- West Gully
- The Northern benthic closed area
- The Eastern benthic closed area
- Southern Seamounts
- North Georgia Rise
- North East Georgia Rise
- Protector Shoals
- Kemp Seamount and Calderas

Regardless of the habitat description under this section, it needs to be remembered that, as stated above, the krill fishery operates with pelagic gear that should not come into contact with the seabed.

7.6.6 Ecosystem

Most of the biological activity in the Southern Ocean occurs in the top 300 m where light and nutrients combined are at their maximum. This is often referred to as the ‘mixed layer’ as the water is well mixed due to the prevailing winds stirring up the surface of the ocean. The depth of the mixed layer can be as shallow as 50 metres in summer due to weaker winds combined with a shallow stratification of the water column (resulting from sea ice melt in spring and the warming of the surface waters in summer). The Antarctic krill concentrates in this epipelagic area feeding on phytoplankton, and subsequently this is also the area the fishery targets using midwater trawls.

Grant et al (2006) performed a broad-scale primary regionalisation of the pelagic regions of the Southern Ocean, describing 14 different pelagic regions. This regionalisation differentiates on the broad scale between coastal Antarctica, the sea-ice zone and the northern open-ocean waters. The analysis highlights the different environmental characteristics of large regions including the continental shelf and slope, frontal features (SAF, PF, SACCF), the deep ocean, banks and basins, island groups and gyre systems (Figure 19).

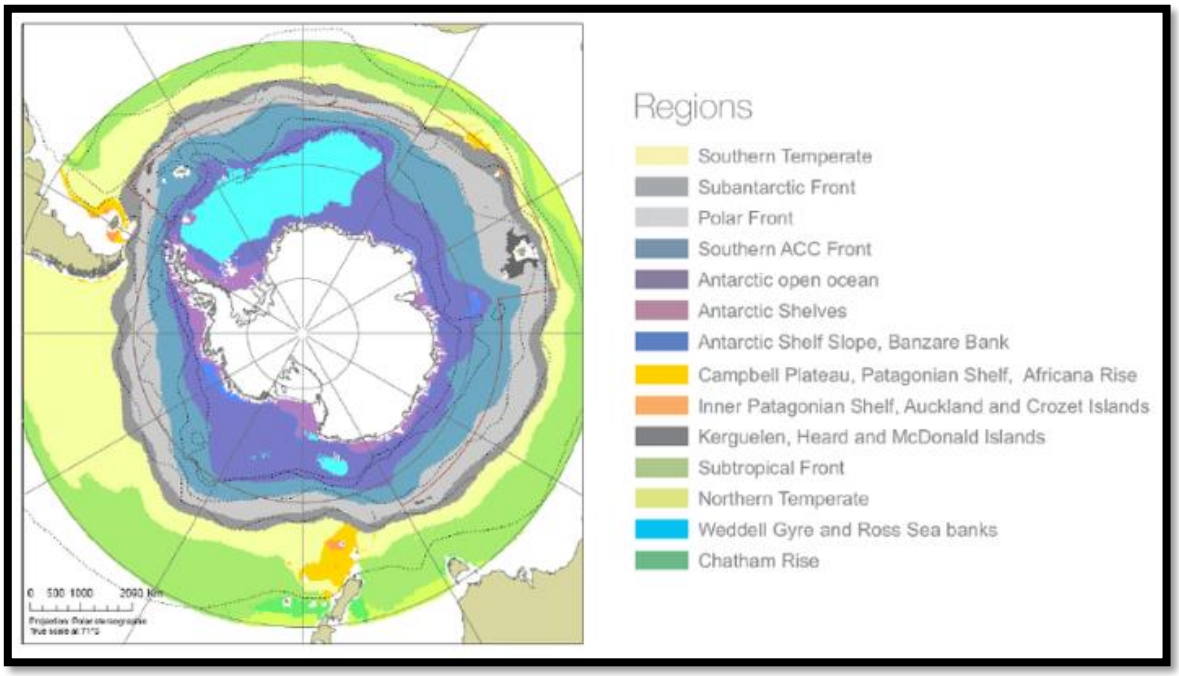

Figure 19: Primary pelagic regionalisation from the 2006 workshop on Bioregionalisation of the Southern Ocean (reproduced from Grant et al. 2006).

CCAMLR's Ecosystem Monitoring Programme (CEMP) was established in 1989 to monitor the effects of fishing on both harvested species (target species) and dependent species (predators), so as to assist CCAMLR with its task of regulating the commercial harvesting of Antarctic marine living resources in accordance with the ecosystem approach embodied in Article II (www.ccamlr.org).

The two aims of CEMP are:

1. to detect and record significant changes in critical components of the marine ecosystem within the Convention Area, to serve as a basis for the conservation of Antarctic marine living resources;
2. to distinguish between changes attributable to harvesting of commercial species and changes attributable to environmental variability, both physical and biological.

CEMP's major function is to monitor the key life-history parameters of selected dependent species to detect changes in the abundance of harvested species. So-called "dependent species" are marine predators for which species targeted by commercial fisheries are a major component of their diet. "Krill-dependent species" of interest to CEMP include land-based species such as seals, penguins, petrels and albatrosses, a decision consistent with the existing overlap between krill fishing areas and the foraging ranges of these predators. However, the potential impact of fishing on pelagic predators such as whales is not yet measured.

CCAMLR has adopted a feedback approach to krill fisheries management, such that management measures need to be adjusted continuously to relevant information -- as it becomes available -- on the interactions between krill fishing and krill predators. Therefore, it was expected that such a monitoring programme would enable CCAMLR to adjust management measures in response to new information, but that the CEMP assessment of the impacts of krill fishing on dependent species still remains to be integrated into long-term management procedures. Hence, because there is no direct link between the monitoring programme and a specific management objective, CEMP is not generally considered to be truly effective. However, by 2021 the WG-EMM is committed to conduct a preliminary risk assessment including predator, krill and by-catch data layers which should contribute to the review of the present management strategy and Conservation Measure 51-07 (which expires in 2021) on the interim distribution of the trigger level of krill catch in subareas 48.1-48.4.

CCAMLR members take part in CEMP voluntarily, so contributions to data gathering depend on national research programmes and priorities. In terms of environmental protection of CEMP sites, there is no direct mechanism to protect them, but 7 of the 13 currently active CEMP monitoring sites south of 60°S are within ASPAs or ASMAs.

The Working Group on Ecosystem Monitoring and Management (WG-EMM) first met in 1995 after the amalgamation of the WG on krill (WG Krill) and the WG on the CCAMLR Ecosystem Monitoring Programme (WG-CEMP). WG-EMM is responsible for the design and coordination of the monitoring programme and the analysis and interpretation of the data

arising from it. The programme's biggest component is the monitoring of dependent species (predators), but in order to distinguish between changes attributable to harvesting and those attributable to environmental variability, the programme also monitors harvested species, harvesting strategies and environmental parameters, and requires analysis of these data at an annual ecosystem assessment.

According to CCAMLR, the WG-EMM shall:

- assess the status of krill;
- assess the status and trends of dependent and related populations, including identification of the information required to evaluate predator/prey/fisheries interactions and their relationship to environmental features;
- assess the environmental features and trends that may influence abundance and distribution of harvested, dependent, related and/or depleted populations;
- identify, recommend and coordinate the research necessary to obtain information on predator/ prey/fisheries interactions, particularly where it involves harvested, dependent, related and/or depleted populations;
- liaise with WG-FSA on matters related to stock assessment;
- develop further, coordinate the implementation of, and ensure continuity in CEMP;
- taking into account the assessments and research carried out, the WG shall develop management advice on the status of Antarctic marine ecosystems and for managing krill fisheries in full accord with CCAMLR Convention Article II.
- provide advice on aspects of spatial protection, including marine protected areas and vulnerable marine ecosystems.

In order to facilitate data analysis and comparison between predator monitoring studies in the context of CEMP, the Scientific Committee developed a set of CCAMLR Ecosystem Monitoring Programme Standard Methods for monitoring predator parameters that include details of how the data should be collected, the formats for submission of the data to the CCAMLR Secretariat and procedures for data analysis.

WG-EMM has acknowledged difficulties in differentiating the effects of fishing from those of climate change, and has reported that:

- at current harvesting levels, it is unlikely that the existing design of CEMP, with the data available to it, would be sufficient to distinguish between ecosystem changes attributable to harvesting of commercial species and changes attributable to environmental variability, whether physical or biological;
- with the existing design of CEMP, it may never be possible to distinguish between these different and potentially confounding causal factors, so recommends that the Scientific Committee seek advice from the Commission on the extent to which further work should be directed towards this topic;
- without a real ability to separate the confounding effects of harvesting and environmental variation and in the context of uncertainty, the Scientific Committee should seek advice from the Commission about the policy of how management should proceed when a significant change is detected, but no single causal factor can be attributed;
- one possible method that may assist in the separation of confounding effects of harvesting and environmental variation would be the establishment of an experimental fishing regime whereby fishing would be concentrated in local areas in conjunction with an appropriate predator monitoring programme.

In order to understand and interpret natural ecosystem variability and how large-scale physical processes influence small-scale ecology in the Antarctic, long-term data series of krill predators are necessary (Reid and Croxall 2001).

According to Hewitt and Low (2000), an extensive and well-designed monitoring programme, covering both fishing and non-fishing areas, will be key to the timely detection of local or regional adverse effects on krill or krill predators from a long-term krill decline that may be magnified by the krill fishery.

Scientists agree that there is a need for more protected areas in the region:

- in areas with high species biodiversity, particularly for those predators that feed on krill, in order to improve the knowledge of how the ecosystem operates in the absence of fishing; it could be that the combination of bathymetry, oceanography and the movements of krill could explain the biodiversity in the area;
- as reference areas (with no fishing), in order to evaluate the impacts of climate change without the impact of fishing.

As was acknowledged by CCAMLR's WG-EMM at its 2009 meeting, climate change may induce rapid changes within the ecosystem, impacting the way indices generated by CEMP are being used to detect fisheries impacts, because the life history and demography of Antarctic krill are intimately tied to seasonal sea-ice conditions, climate and the physical forcing of ocean currents. Key spawning, recruitment and nursery areas of krill are located around the western Antarctic Peninsula (Constable *et al*. 2003). The climate there is warming rapidly, so the extent and duration of winter sea ice is dropping (Parkinson 2012). Constable *et al*. (2003) also show that diminished sea-ice cover over the past 20 years might result in greater recruitment variability and lower overall abundance of krill in the Southwest Atlantic, whereas recruitment may have been more stable and less variable previously. Changes in krill abundance will surely be having an impact on krill-dependent predators.

As reported by Smith *et al*. (2011), fishing low trophic level (LTL) species, even at conventional levels associated with maximum sustainable yield (MSY), can have a great impact on other parts of the ecosystem, particularly when they constitute a high proportion of the biomass in the ecosystem or are highly connected in the food web.

There is a global need to develop strategic frameworks for assessing uncertainty in ecosystem dynamics models. Such models have already been used within CCAMLR to evaluate options for managing the Antarctic krill fishery in the Scotia Sea and southern Drake Passage (Hill and Mathews 2013). However, the use of models to evaluate catch allocation options illustrates the tension between the ideal of well-constrained models and the reality of ecosystem-based management problems in which data are sparse, structure complex and uncertainty rife (Hill *et al*. 2007; Plagányi 2007).

There is tension between the parameter stability benefits of well-constrained models and the use of model conditioning to identify plausible alternative hypotheses in data-poor situations (Hill and Mathews 2013).

The Southern Ocean is a major component within the global ocean and climate system and potentially the location where the most rapid climate change is most likely to happen, particularly in high latitude polar regions. In such regions, even small temperature changes can potentially lead to major environmental perturbations, and failure of Antarctic krill recruitment would inevitably foreshadow recruitment failures in a range of higher trophic-level marine predators (Trathan *et al.* 2007).

The main physical and biological processes important in determining the dynamics of the Scotia Sea ecosystem have been studied by Murphy *et al*. (2007). Figure 20 shows the spatial and temporal scales for these processes.

One of the major nursery grounds for Antarctic krill lies to the north of the Antarctic Peninsula (Siegel 1988; Brinton 1991; Spiridonov 1995; Siegel *et al.* 2002), close to the area of recent rapid regional warming (King 1994). Ocean currents are thought to carry krill from this area to other areas of the Southwest Atlantic (Hofmann *et al*. 1998; Murphy *et al*. 1998, Thorpe *et al*. 2004). Consequently, changes in the environment close to the nursery grounds have the potential to have far-reaching impacts on both local and more-distant marine communities (Trathan *et al*. 2007). Ecosystem studies in the Southwest Atlantic have pointed to strong relationships between temperature and the abundance of Antarctic krill (Trathan *et al*. 2003), so climate warming needs to be taken into account in CCAMLR fisheries management strategy, as suggested by the CCAMLR Scientific Committee (SC-CAMLR-XXXII, pp. 63-65).

Temporal patterns in krill recruitment suggest that there is a direct causal relationship between variability in sea-ice cover, krill recruitment, prey availability and predator foraging ecology, and that large-scale forcing associated with climate variability may be governing ecological interactions between ice, krill and their predators in the western Antarctic Peninsula and Scotia Sea regions (Fraser and Hofmann 2003).

Recent rapid climate change is now well documented in the Antarctic, particularly close to the Antarctic Peninsula. One of the most evident signs of climate change has been ice-shelf collapse; overall, 87% of the Peninsula's glaciers have retreated in recent decades. Further ice-shelf collapse will lead to the loss of existing marine habitats and to the creation of new ones, with consequent changes in both ecological processes and in community structure, with changes from a unique ice-shelf-covered ecosystem to a typical Antarctic shelf ecosystem, and high primary production during a short summer. This process is likely to be among the largest ecosystem changes on the planet (Trathan and Grant 2013).

Changes in the physical properties of the marine system are especially important for CCAMLR and include, *inter alia*, changes in ocean temperature (Gille 2002) and ocean acidification (Bednarek *et al*. 2012), reductions in the extent and timing of seasonal sea-ice (Stammerjohn *et al*. 2008) and the retreat and collapse of ice shelves, glaciers and ice tongues (Cook and Vaughan, 2010; Cook *et al.* 2005; Gutt *et al*. 2010, 2013; Rignot *et al*. 2013).

Habitats previously covered under ice shelves present outstanding opportunities to undertake science related to habitat colonization. Studying them when they become available would provide valuable scientific insights into how communities develop over timescales ranging from years to decades. Habitats under ice shelves have been closed to both terrestrial and pelagic community interactions over recent geological timescales. If exposed, they would offer a range of opportunistic study sites, often with contrasting ecological scenarios. Long-term reference areas would facilitate scientific study of the effects of such changes, primarily in the absence of any effects caused by other human activities (Trathan and Grant 2013).

Figure 21 depicts the main physical processes generating variation in the Scotia Sea ecosystem. These processes also influence krill recruitment trends and dispersal across the region, generating observed correlations of changes in krill density and biomass and higher trophic level predator foraging and breeding performance with sea ice and larger indices of oceanic and climatic variation (Murphy *et al*. 2007).

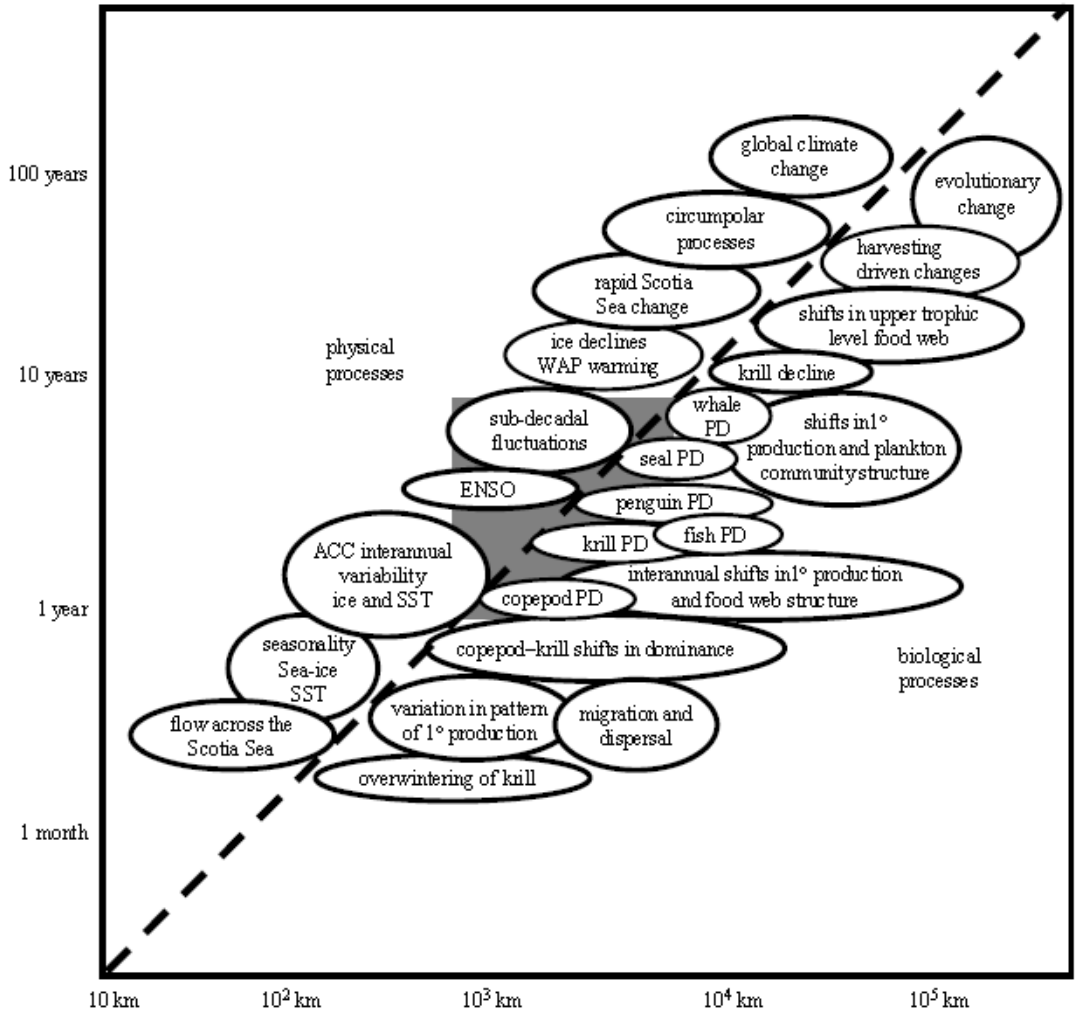

Figure 20: Schematic of the temporal and spatial scales of the main physical and biological processes important in determining the dynamics of the Scotia Sea ecosystem. The 1:1 relationship is based on the scale of physical mixing in the oceans. Note that the physical and biological processes are illustrated offset above and below this line, respectively, for clarity. The shaded grey block illustrates the natural spatial and temporal scale of Scotia Sea processes. Acronyms used include PD, Population Dynamics, SST, sea surface temperature and ENSO, *El Niño* Southern Oscillation. Source: Murphy *et al.* (2007)

The food web of the Scotia Sea is highly heterogeneous, widely distributed but dynamically connected through ocean circulation. The ecosystem is dominated by the flows of the major current systems (the Antarctic Circumpolar Current and the Warm Swallow Current) and by its seasonality, manifested by the advance of sea ice across the region during winter. This unique environment is high in both nutrients and chlorophyll-a. The role of krill in the ecosystem is crucial, because the resource provides the major link between LTL production and consumption by higher trophic level predators across the Scotia Sea (Murphy *et al.* 2007). Different ecosystem models show that changes in primary production and detritus are responsible for most of the declines within the model, implying that this is a bottom-up ecosystem (Hoover *et al.* 2012).

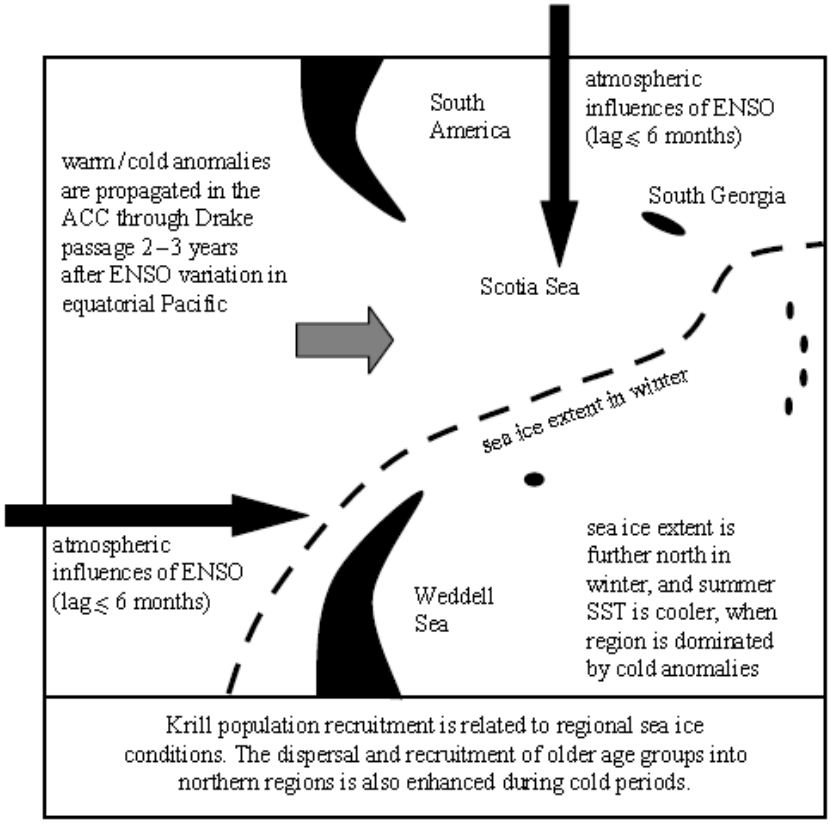

Figure 21: Schematic of the main physical processes generating variation in the Scotia Sea ecosystem. ENSO, *El Niño* Southern Oscillation; ACC, Antarctic Circumpolar Current. Source: Murphy *et al*. (2007)

Krill attract large quantities of top predators (Howard *et al*. 2004) and are considered to be a keystone species (Moline *et al*. 2000), linking most pathways in the food chain from primary producers to top predators. In addition, krill around the Antarctic Peninsula are believed to be the main source of krill populations around the Scotia Sea (Atkinson *et al*. 2004), suggesting that krill are important not only in the immediate area where te population is deemed to be large, but also to surrounding areas, and to predators there (Hofmann *et al*. 1998; Brierley *et al.* 1999; Atkinson *et al*. 2004). Hence, changes to the krill population around the Antarctic Peninsula will affect predators locally and across the Scotia Sea (Hoover *et al.* 2012).

Because of its importance in the Southern Ocean, the krill resource has been subject to many studies and models that try to provide a greater understanding of its role in the ecosystem, but the models may be difficult to apply to real life. Models that incorporate interspecific interaction typically have more parameters than single-species models. However, increasing complexity leads too to accumulation of uncertainties and increased difficulty in interpreting results (Fulton *et al.* 2003; Raick *et al.* 2006; Plagányi 2007; Hill *et al.* 2007).

Atkinson *et al.* (2012) described different methods for sampling krill, such as:

- with nets (for historical time-series, demographic information and live krill);
- acoustics (distribution, time-series, biomass and swarm-scale information);
- the fishery (sustained sampling in one place and wide area and time coverage);
- via predators (long time-series, demographic indices).

Different broad categories of model representing Antarctic krill, their data sources and limitations were reviewed by Atkinson *et al.* (2012). The categories include:

- models exploring specific aspects of krill biology such as life cycle, energetics or behaviour (Hofmann and Hùsrevõglu 2003; Murphy *et al.* 2004);
- multispecies population models, simulating either historical changes in the abundance of krill and its predators or the effects of harvesting on interacting species (May *et al*. 1979; Murphy 1995);
- single species population projection models, for instance to quantify regional catch limits (Constable *et al*. 2000);

- spatial single species models, such as that of Marin and Delgado (2001), which showed that some 80% of the krill catch was taken from within penguin foraging areas near the Antarctic Peninsula, suggesting that fisheries are in direct spatial competition with predators (Hewitt *et al.* 2002, 2004);
- mass-balance regional foodweb models incorporating krill, such as the preliminary Ecopath with Ecosim (EwE) model of the Antarctic Peninsula ecosystem, Subarea 48.1 (Cornejo-Donoso and Antezana 2008); the model shows that phytoplankton, zooplankton and krill account for most of the mass flow, and describes the food web as dominated by the phytoplankton-krill-top predators chain, complemented with alternative food pathways (e.g. through *Electrona antarctica*);
- a spatial multispecies operating model (SMOM) of krill–predator fishery dynamics, which has been used to evaluate proposed management measures for the krill fishery in the Scotia and Bellingshausen Seas (Plagányi and Butterworth 2012); the model describes the underlying population dynamics, is used in simulations to compare different management options for adjusting fishing activities (e.g. different spatial distribution of catches), and allows the discrimination of the ecosystem impacts of different spatial fishing allocations;
- models of krill transport at the maximum advection rate indicated by the Ocean Circulation and Climate Advanced Modelling Project (OCCAM), with the aim of evaluating the large-scale ocean circulation and interpreting data coming from the World Ocean Circulation Experiment (WOCE; Rintoul *et al*. 2001).

In terms of other environmental issues that may arise while fishing takes place, CCAMLR established Conservation Measure 26-01 (2018) in terms of General environmental protection during fishing. The measure regulates the disposal of plastic packaging bands, food waste, sewage, incineration output, and prohibits the dumping or discharging of garbage and oil or fuel products or oily residues into the sea. How well this Conservation Measure is met is also being reported by scientific observers.

Table 17: Scoring elements

Component	Scoring elements	Designation	Data-deficient
Principle 1	Krill *Euphasia superba*	N/A	No
Primary	Icefish species *Champsocephalus gunnari*	Minor IPI	No
Primary	Toothfish species *Dissostichus eleginoides*	Minor IPI	No
Secondary	Lanternfish species	Minor IPI	Yes
Secondary	Notothenіid species	Minor IPI	Yes
Secondary	Ice krill (*Euphasia crystallorophias*)	Minor IPI	Yes
Secondary	Snow petrel *Pagodroma nivea*	Main	No
Secondary	Cape petrel *Daption capense*	Main	No
ETP	Antarctic fur seal *Arctocephalus gazelle*	No recorded interactions	No
Habitat	Epipelagic and mesopelagic habitats	Common habitat types	No
Habitat	Seamounts hydrothermal vents cold-water corals	VME	No

	Sponges		
Habitat		Minor habitat types	No

7.7 Principle 2 Performance Indicator scores and rationales

PI 2.1.1 – Primary species outcome

PI 2.1.1		The UoA aims to maintain primary species above the point where recruitment would be impaired (PRI) and does not hinder recovery of primary species if they are below the PRI		
Scoring Issue		SG 60	SG 80	SG 100
a	Main primary species stock status			
	Guide post	Main primary species are **likely** to be above the PRI. OR If the species is below the PRI, the UoA has measures in place that are **expected** to ensure that the UoA does not hinder recovery and rebuilding.	Main primary species are **highly likely** to be above the PRI. OR If the species is below the PRI, there is either **evidence of recovery** or a demonstrably effective strategy in place **between all MSC UoAs which categorise this species as main**, to ensure that they collectively do not hinder recovery and rebuilding.	There is a **high degree of certainty** that main primary species are above the PRI **and are** fluctuating around a level consistent with MSY.
	Met?	**NA**	**NA**	**NA**
Rationale				

According to information provided in scientific observer reports there are no main primary species to consider, so this scoring issue is not scored.

b	Minor primary species stock status			
	Guide post			Minor primary species are highly likely to be above the PRI. OR If below the PRI, there is evidence that the UoA does not hinder the recovery and rebuilding of minor primary species.
	Met?			**Yes**
Rationale				

Since this is a reduction fishery all minor primary and secondary species account as inseparable species, since they are not separated at any point from the targeted krill.

Minor primary species to consider are icefish (*Champsocephalus gunnari)* and toothfish (*Dissostichus eleginoides).*

Both species are managed in CCAMLR subarea 48.3 (and subarea 48.4 for toothfish too). According to observer reports, they comprise less than 0.2% of the catch.

According to CCAMLR Fishery Report 2018: *Champsocephalus gunnari* South Georgia (Subarea 48.3), (https://www.ccamlr.org/en/system/files/01%20ANI483%202018.pdf), in 2017 (latest assessment) the stock was slightly above the average of the time series, with the median demersal biomass estimated at 91 531 tonnes, and a one-sided lower 95% confidence interval of 47 424 tonnes. The CCAMLR harvest control rule, using a length-based approach, has been demonstrated to provide robust precautionary estimates of catch limits and exploitation rates for *C. gunnari* in Subarea 48.3. CCAMLR provides scientific advice and management measures for Icefish (see CM 42-01, 2017, https://www.ccamlr.org/sites/default/files/42-01_51.pdf). The total catch of *Champsocephalus gunnari* in Statistical Subarea 48.3 in the 2019/20 season shall be limited to 3,225 tonnes, and in the 2020/2021 season shall be limited to 2132 tonnes.

As regards toothfish, and according to CCAMLR Fishery Report 2018: *Dissostichus eleginoides* South Georgia (Subarea 48.3) (https://www.ccamlr.org/en/system/files/03%20TOP483%202018.pdf), estimates of initial biomass levels and current biomass levels show that the stock remained at around 52% of B_0 in 2015. Stochastic long-term projections conducted in accordance with the CCAMLR procedures for yield calculations indicate that a constant yield of 2,600 tonnes will maintain spawning stock biomass (SSB) at 50% of B_0 over the next 35 years with 50% probability.

CCAMLR also provides scientific advice and management measures for the species (see CM 41-02, 2017, https://www.ccamlr.org/sites/default/files/41-02_46.pdf). The total catch of *Dissostichus eleginoides* in Statistical Subarea 48.3 in the 2019/20 and 2020/2021 seasons shall be limited to 2,327 tonnes per season.

Given the amount of catch taken by the UoA and the existence of directed fisheries for these species, the team considers that the low catch taken by the UoA serves as evidence that the UoA is not hindering the recovery of these species. SG100 is met.

References

CCAMLR Scientific observer reports for the UoA for 2018.

CCAMLR Fishery Report 2018: *Champsocephalus gunnari* South Georgia (Subarea 48.3), https://www.ccamlr.org/en/system/files/01%20ANI483%202018.pdf

CCAMLR CM 42-01 (2019)

CCAMLR Fishery Report 2018: *Dissostichus eleginoides* South Georgia (Subarea 48.3) (https://www.ccamlr.org/en/system/files/03%20TOP483%202018.pdf),

CCAMLR CM 41-02 (2019).

Overall Performance Indicator score	**100**
Condition number (if relevant)	**N/A**

PI 2.1.2 – Primary species management strategy

PI 2.1.2		There is a strategy in place that is designed to maintain or to not hinder rebuilding of primary species, and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place for the UoA, if necessary, that are expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are likely to be above the PRI.	There is a **partial strategy** in place for the UoA, if necessary, that is expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are highly likely to be above the PRI.	There is a **strategy** in place for the UoA for managing main and minor primary species.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

There are no main primary species to consider. SG 60 and 80 met by default.

As regards to minor IPI primary species, the fishing strategy allows for a very selective catch of the targeted krill, which limits the catch of icefish and toothfish species to levels lower than 0.2%. This high level of selectivity is obtained by using echosounders that identify krill shoals. Given the low level of bycatch the team considers that the fishing strategy is adequate for managing minor IPI primary species. SG100 is met.

b	Management strategy evaluation			
	Guide post	The measures are considered **likely** to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/species).	There is some **objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the fishery and/or species involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly about the fishery and/or species involved.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

CCAMLR Observer reports for the UoA dating back to 2008 show that this low level of non-targeted catch has remained stable for more than 10 years. Given this, the measures are considered likely to work. SG60 is met. Moreover, there is some objective basis for confidence that the measures (considered as a strategy) will work. SG80 is met.

The management strategy to avoid such catch is empirically tested and gives a high degree of confidence on its effectiveness. The high degree of confidence is given by the low bycatch ratios as reported in observer reports since 2008. SG100 is met.

c	Management strategy implementation			
	Guide post		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is **clear evidence** that the partial strategy/strategy is being **implemented successfully and is achieving its overall objective as set out in scoring issue (a).**
	Met?		**Yes**	**Yes**

Rationale

CCAMLR observer reports dating back to 2008 showing that non-targeted krill adds up to less than 0.2% of the catch serve as a clear evidence that the strategy is implemented successfully and achieving its overall objective. SG80 and SG100 are met.

	Shark finning			
d	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**NA**	**NA**	**NA**
Rationale				

There are no sharks in the catch composition. This SI is not applicable.

	Review of alternative measures			
e	Guide post	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of all primary species, and they are implemented, as appropriate.
	Met?	**NA**	**NA**	**NA**
Rationale				

Given the low level of non-targeted species in the catch, the team considers that there is no unwanted catch of primary species. Therefore, this SI is not applicable.

References

CCAMLR 2018 observer reports for the UoA.

Overall Performance Indicator score	**100**
Condition number (if relevant)	**N/A**

PI 2.1.3 – Primary species information

PI 2.1.3		Information on the nature and extent of primary species is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage primary species		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impact on main primary species			
	Guide post	Qualitative information is **adequate to estimate** the impact of the UoA on the main primary species with respect to status. **OR** **If RBF is used to score PI 2.1.1 for the UoA:** Qualitative information is adequate to estimate productivity and susceptibility attributes for main primary species.	Some quantitative information is available and is **adequate to assess** the impact of the UoA on the main primary species with respect to status. **OR** **If RBF is used to score PI 2.1.1 for the UoA:** Some quantitative information is adequate to assess productivity and susceptibility attributes for main primary species.	Quantitative information is available and is **adequate to assess with a high degree of certainty** the impact of the UoA on main primary species with respect to status.
	Met?	**NA**	**NA**	**NA**
Rationale				

There are no main primary species, so this scoring issue is not scored.

b	Information adequacy for assessment of impact on minor primary species			
	Guide post			Some quantitative information is adequate to estimate the impact of the UoA on minor primary species with respect to status.
	Met?			**Yes**
Rationale				

There is quantitative estimated information both on the amount of primary species caught by the UoA (0.2% of the krill catch) and there is also some quantitative information on the status of both stocks (as reported in CCAMLR Fishery Report 2018: *Champsocephalus gunnari* South Georgia (Subarea 48.3) and CCAMLR Fishery Report 2018: *Dissostichus eleginoides* South Georgia (Subarea 48.3)). There is also information available on the impacts on these stocks by other CCAMLR fisheries. This information allows to estimate the impact of the UoA on minor primary species with respect to status. SG100 is met.

c	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage **main** primary species.	Information is adequate to support a **partial strategy** to manage **main** primary species.	Information is adequate to support a **strategy** to manage **all** primary species, and evaluate with a **high degree of certainty** whether the strategy is achieving its objective.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

There are no main primary species to consider. SG 60 and 80 are met by default.

As regards minor IPI species, there is information both on the quantity taken by the UoA and on the status of both stocks. This information is considered adequate to support a strategy to manage all primary species and evaluate with a high degree of certainty whether the strategy is achieving its objective. SG100 is met.

References

CCAMLR Scientific observer reports for the UoA for 2018.

CCAMLR Fishery Report 2018: *Champsocephalus gunnari* South Georgia (Subarea 48.3), https://www.ccamlr.org/en/system/files/01%20ANI483%202018.pdf

CCAMLR CM 42-01 (2019).

CCAMLR Fishery Report 2018: *Dissostichus eleginoides* South Georgia (Subarea 48.3) (https://www.ccamlr.org/en/system/files/03%20TOP483%202018.pdf),

CCAMLR CM 41-02 (2019).

Overall Performance Indicator score	**100**
Condition number (if relevant)	**N/A**

PI 2.2.1 – Secondary species outcome

PI 2.2.1		The UoA aims to maintain secondary species above a biologically based limit and does not hinder recovery of secondary species if they are below a biological based limit		
Scoring Issue		SG 60	SG 80	SG 100
	Main secondary species stock status			
a	Guide post	Main secondary species are **likely** to be above biologically based limits. OR If below biologically based limits, there are **measures** in place expected to ensure that the UoA does not hinder recovery and rebuilding.	Main secondary species are **highly likely** to be above biologically based limits. OR If below biologically based limits, there is either **evidence of recovery** or a **demonstrably effective partial strategy** in place such that the UoA does not hinder recovery and rebuilding. AND Where catches of a main secondary species outside of biological limits are **considerable**, there is either **evidence of recovery** or a, **demonstrably effective strategy in place between those MSC UoAs that have considerable catches of the species**, to ensure that they collectively do not hinder recovery and rebuilding.	There is a **high degree of certainty** that main secondary species are above biologically based limits.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

According to information collected in CCAMLR observer reports, there are no main secondary fish species to consider.

There are however other out of scope species to be considered as main secondary species. While CCAMLR observer reports for 2018 show that the UoA had no fatal interactions with birds nor marine mammals at least in 2018, the team has considered both snow petrel and cape petrel as main secondary species, as the CCAMLR 2018 krill fishery report (https://www.ccamlr.org/en/document/publications/krill-fishery-report-2018) provides a summary of interacted species in the past years. CCAMLR holds annual meetings amongst its members in which updates are shared about the different fisheries operating in the Southern Ocean. The WG-EMM (Working Group on Ecosystem Monitoring and Management) also meets annually and discusses the effectiveness of implemented measures to avoid mortality of unwanted catch. These measures are considered effective as interactions with out of scope species are low over the years.

Specifically, in 2018, there were two seabird mortalities reported from the krill fishery (all fleet, this is, 11 vessels), one snow petrel (*Pagodroma nivea*) in Subarea 48.1 and one cape petrel (*Daption capense*) in Subarea 48.2. The 2017 krill fishery report (https://www.ccamlr.org/en/system/files/00%20KRI48%202017.pdf) reports two seabird mortalities (unspecified species, one in subarea 48.1 and one in subarea 48.2) for the whole fleet in 2017 and nine seabird (unspecified) mortalities in 2016, one in Subarea 48.2 and eight in Subarea 48.1. (None of these mortalities took place in subareas 48.3 nor 48.4, which are managed by the SGSSI management authorities).

According to information from Birdlife International (http://datazone.birdlife.org/species/factsheet/snow-petrel-pagodroma-nivea/details), the population of snow petrels in Antarctica exceeds 4 million individuals, and the population is stable (BirdLife International (2019) Species factsheet: *Pagodroma nivea*.). As for the cape petrel, its population exceeds 2 million individuals and is also expected to be stable (BirdLife International (2019) Species factsheet: *Daption capense).* Both species are listed as Least Concern by IUCN.

As the secondary 'main' species under assessment here are not data deficient all species are scored against the default assessment tree. Given the available information, the team considers that there is a high degree of certainty that both main secondary species are above biological based limits. SG60, SG80 and SG100 are met.

	Minor secondary species stock status			
b	Guide post			Minor secondary species are highly likely to be above biologically based limits. OR If below biologically based limits', there is evidence that the UoA does not hinder the recovery and rebuilding of secondary species
	Met?			**No**
Rationale				

Since this is a reduction fishery all minor primary and secondary species account as IPI species, since they are not separated at any point from the targeted krill.

Minor secondary species to consider are lanternfish and notothenid species, which account for less than 0.2% of the total catch by the UoA. Besides, and due to uncertainties highlighted in CCAMLR WG-EMM regarding the possibility of ice krill being taken by the fishery, ice krill (*Euphasia crystallorophias*) has also been considered as a minor secondary species, although Davis et al (2017) conclude that separated distribution is a general characteristic for these two krill species. In any case, a recommendation has been raised in order to improve identification of ice krill in the catch by the UoA.

While there is accurate information on the impact of the UoA on these species (as reported in CCAMLR observer reports) and given the amount of fish bycatch taken by the UoA (considered here as minor secondary species), it would be feasible to consider that the UoA is not hindering the recovery and rebuilding of these species. However, the team could not confirm if these stocks are above or below biological based limits and neither could find an evidence that the UoA is not hindering the recovery of these species. The requirements at SG100 are not met for minor secondary species.

References

CCAMLR observer reports for 2018 for the UoA.

CCAMLR 2018 krill fishery report (https://www.ccamlr.org/en/document/publications/krill-fishery-report-2018)

CCAMLR 2017 krill fishery report (https://www.ccamlr.org/en/system/files/00%20KRI48%202017.pdf)

Birdlife International (http://datazone.birdlife.org/species/factsheet/snow-petrel-pagodroma-nivea/details

BirdLife International (2019) Species factsheet: *Pagodroma nivea*.

BirdLife International (2019) Species factsheet: *Daption capense.*

Davis et al 2017.

Overall Performance Indicator score	**80**
Condition number (if relevant)	**N/A**

Overall PI Score Rational = Given the amount of bycatch taken by the UoA (considered here as minor secondary species) it would be feasible to consider that the UoA is not hindering the recovery and rebuilding of Secondary minor species. However, the team could not confirm if these stocks are above or below biological based limits and neither could find an evidence that the UoA is not hindering the recovery of these species. These Secondary Minor Species are therefore considered data deficient and RBF should be applied. However, the audit team have adopted MSC FCP v2.01 PF5.3.2 and PF5.3.2.1. Where the final PI Score shall be capped by the audit team in cases where

only a subset of the total number of species has been evaluated. The final PI score shall be capped no greater than 80. Overall PI score awarded = 80.

PI 2.2.2 – Secondary species management strategy

PI 2.2.2		There is a strategy in place for managing secondary species that is designed to maintain or to not hinder rebuilding of secondary species and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place, if necessary, which are expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be above biologically based limits or to ensure that the UoA does not hinder their recovery.	There is a **partial strategy** in place, if necessary, for the UoA that is expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be above biologically based limits or to ensure that the UoA does not hinder their recovery.	There is a **strategy** in place for the UoA for managing main and minor secondary species.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

All krill vessels operating in Area 48 have to apply CCAMLR Conservation Measures 26-01 (2018), 51-01(2010) and 25-03 (2018) to minimize incidental mortalities of marine mammals and seabirds.

Therefore, there are measures in place expected to maintain secondary species to levels which are highly likely to be above biologically based limits. SG60 is met.

These measures include:

- The mandatory use of a marine mammal exclusion device
- Fine-mesh exclusion net at the cod end
- Long hauls of 20 or 25 days (proxy)
- A slow towing speed (2 knots) that allows animals to avoid the net
- Retention on board of all material captured
- The quick sinking of the net on deployment (so that bird scaring lines, so-called tori lines, are not required). Besides, nets are deployed once every 20-25 days.
- Spatial and seasonal limitations around South Georgia and the South Sandwich Islands.
- The trawl warps enter the water very close to the stern of the vessel, reducing the potential for birds to strike them during fishing operations.
- Specifically, the Saga Sea vessel (one of the vessels in the UoA) has installed a streamer line to reduce possible seabird interactions (if any) and cameras at the stern of the vessel to monitor these interactions from the deck.

The grouping of these measures and their periodic review are considered as a strategy for the UoA for managing main secondary species, SG80 is met. In addition to the measures listed above and in regard to minor fish species, the fishing strategy allows for a very selective catch of the targeted krill, which limits the catch of ice krill and lanternfish and nototheniid species to levels lower than 0.2%. This high level of selectivity is obtained by using echosounders that identify krill shoals. Given the low level of bycatch as confirmed by 100% observer coverage the team considers that the fishing strategy is adequate for managing all main and minor primary species. SG100 is met.

b	Management strategy evaluation			
	Guide post	The measures are considered **likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar UoAs/species).	There is **some objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the UoA and/or species involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly about the UoA and/or species involved.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

CCAMLR scientific observer reports for the UoA have not recorded any fatal interaction with main secondary species for 2018. In any case, information provided in the CCAMLR 2018 krill fishery report shows that interactions by the UoA with bird species could occur, so on a precautionary approach the team has considered these bird species as main secondary species regardless of interactions not taking place in the past years.

The list of measures mentioned in SIa are all considered likely to work, as they limit the time of the hauling of the net (when interactions could be most expected). SG60 is met.

The low level of interactions (nil) and the high surveillance of these interactions (given the 100% observer coverage) give some objective basis for confidence that the strategy will work. SG80 is met.

Again, the low level of interactions (as recorded in CCAMLR observer reports of the UoA vessels and summarised in the CCAMLR 2018 krill fishery report for all krill vessels), and the safe biological status of the affected main species (snow petrel and cape petrel) and the low proportion of minor secondary species (Lanternfish and notothenid species) in the catch all serve as empirical testing supporting with a high degree of confidence that the strategy is working effectively. SG100 is met.

	Management strategy implementation			
c	Guide post		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is **clear evidence** that the partial strategy/strategy is being **implemented successfully and is achieving its objective as set out in scoring issue (a).**
	Met?		**Yes**	**Yes**
Rationale				

CCAMLR Conservation Measures have been implemented for more than 5 years now, some for more than 10 years. CCAMLR observer reports together with CCAMLR krill fishery reports for the different years, showing that these management measures are effectively implemented) serve as clear evidence that the strategy is successfully implemented. The low level of interactions as recorded by the 100% observer coverage serve as an evidence that the strategy is achieving its objective. SG80 and SG100 are met.

	Shark finning			
d	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**NA**	**NA**	**NA**
Rationale				

There are no sharks in the catch composition. This SI is not applicable.

	Review of alternative measures to minimise mortality of unwanted catch			
e	Guide post	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of main secondary species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of main secondary species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of all secondary species, and they are implemented, as appropriate.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

CCAMLR holds annual meetings amongst its members in which updates are shared about the different fisheries operating in the Southern Ocean. The WG-EMM (Working Group on Ecosystem Monitoring and Management) also meets annually and discusses the effectiveness of implemented measures to avoid mortality of unwanted catch. Latest meeting was held in July 2019 in France.

Given the frequency of these meetings, the requirements at SG60, SG80 and SG100 are met.

References

https://www.ccamlr.org/en/conservation-and-management/browse-conservation-measures

CCAMLR CM 26-01 (2018). https://www.ccamlr.org/en/measure-26-01-2018

CCAMLR CM 51-01(2010). https://www.ccamlr.org/en/measure-51-01-2010

CCAMLR CM 25-03 (2018). https://www.ccamlr.org/en/measure-25-03-2018

CCAMLR observer reports for the UoA

CCAMLR 2018 krill fishery report. https://www.ccamlr.org/en/document/publications/krill-fishery-report-2018

CCAMLR Scientific Observer Manual. http://www.ccamlr.org/en/system/files/obsman.pdf

https://www.ccamlr.org/en/wg-emm-2019

https://www.ccamlr.org/en/meetings-and-publications/meetings-publications

Overall Performance Indicator score	**100**
Condition number (if relevant)	**N/A**

PI 2.2.3 – Secondary species information

PI 2.2.3		Information on the nature and amount of secondary species taken is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage secondary species		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impacts on main secondary species			
	Guide post	Qualitative information is **adequate to estimate** the impact of the UoA on the main secondary species with respect to status. OR **If RBF is used to score PI 2.2.1 for the UoA:** Qualitative information is adequate to estimate productivity and susceptibility attributes for main secondary species.	Some quantitative information is available and **adequate to assess** the impact of the UoA on main secondary species with respect to status. OR **If RBF is used to score PI 2.2.1 for the UoA:** Some quantitative information is adequate to assess productivity and susceptibility attributes for main secondary species.	Quantitative information is available and **adequate to assess with a high degree of certainty** the impact of the UoA on main secondary species with respect to status.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

Main secondary species to consider are snow petrel and cape petrel.

There is qualitative and quantitative information both on the impact on these species by the UoA and by the whole krill fishery (obtained in the UoA CCAMLR observer reports and in the CCAMLR 2018 krill fishery report), as well as on the population status for both species (see Birdlife International 2019 species factsheets for *Pagodroma nivea* and for *Daption capense).*

All this qualitative and quantitative information is available and is considered as adequate to assess with a high degree of certainty the impact of the UoA on main secondary species with respect to status. SG60, SG80 and SG100 are met.

b	Information adequacy for assessment of impacts on minor secondary species			
	Guide post			Some quantitative information is adequate to estimate the impact of the UoA on minor secondary species with respect to status.
	Met?			**No**
Rationale				

Minor species to consider are lanternfish, notothenid fish species and ice krill.

While there is accurate information on the impact of the UoA on these species (as reported in CCAMLR observer reports), and the impact is considered to be very low, it is not possible to correlate this impact with the status of these species. Therefore, SG100 is not met.

c	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage **main** secondary species.	Information is adequate to support a **partial strategy** to manage **main** secondary species.	Information is adequate to support a **strategy** to manage **all** secondary species, and **evaluate** with a **high degree**

				of certainty whether the strategy is **achieving its objective**.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

Information on catch is reported to CCAMLR on a continuous basis. 100% international observer coverage ensures sampling and recording of information on catch composition according to the CCAMLR Scientific observer's manual, including information on targeted krill, untargeted minor species and out of scope species. The CCAMLR observer programme provides adequate information to support the strategy directed to managing main and minor secondary species, and to evaluate its effectiveness. SG60, SG80 and SG100 are met.

References

CCAMLR Scientific observer's manual.

CCAMLR 2018 observer reports for the UoA.

Overall Performance Indicator score	**95**
Condition number (if relevant)	**N/A**

PI 2.3.1 – ETP species outcome

PI 2.3.1		The UoA meets national and international requirements for the protection of ETP species The UoA does not hinder recovery of ETP species		
Scoring Issue		SG 60	SG 80	SG 100
a	Effects of the UoA on population/stock within national or international limits, where applicable			
	Guide post	Where national and/or international requirements set limits for ETP species, the **effects of the UoA** on the population/ stock are known and **likely** to be within these limits.	Where national and/or international requirements set limits for ETP species, the **combined effects of the MSC UoAs** on the population /stock are known and **highly likely** to be within these limits.	Where national and/or international requirements set limits for ETP species, there is a **high degree of certainty** that the **combined effects of the MSC UoAs** are within these limits.
	Met?	**NA**	**NA**	**NA**
Rationale				

Although CCAMLR Conservation Measure 25-03 (2018) sets the requirements to prevent and minimise incidental mortalities of seabirds and sea mammals, this CM does not set limits for ETP species as such.

SGSSI Wildlife and Protected Areas Ordinance 2011 (http://www.gov.gs/docsarchive/Legislation/Wildlife%20and%20Protected%20Areas%20Ordinance%202011-1.pdf) sets that it is an offence to hinder any native species in subareas 48.3 and 48.4. Therefore, all seabirds, marine mammals or other animals and plants are protected from any intentional damage in this jurisdiction. However, unintentional damage is not covered by this ordinance and there are no limits to unintentional damage to these species.

This SI is not applicable.

b	Direct effects			
	Guide post	Known direct effects of the UoA are likely to not **hinder recovery** of ETP species.	Direct effects of the UoA are **highly likely** to not **hinder recovery** of ETP species.	There is a **high degree of confidence** that there are no **significant detrimental direct effects** of the UoA on ETP species.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

There were no seal mortalities reported in the CCAMLR krill fishery between 2008 and 2014, however, there were three mortalities of Antarctic fur seals in 2015 and 2016, none in 2017 and 19 in 2018. Of the 19 reported mortalities of Antarctic fur seal in 2018, 18 were reported from the same vessel (not in the UoA). As reported in CCAMLR observer reports for the UoA, none of these mortalities took place in the UoA vessels. However, the team has been made aware that there was one fatal interaction with an Antarctic fur seal by one of AKER's vessel in subarea 48.3 during 2019.

All marine mammals and seabirds are considered as ETP species when interactions take place in subareas 48.3 and 48.4, since SGSSI Wildlife and Protected Areas Ordinance 2011 protects all native species in the area.

Antarctic fur seals are the most abundant species of Fur Seal and is estimated to range between 700.000-1.000.000 individuals. In any case, the species is still considered as Least Concern by IUCN (https://www.iucnredlist.org/species/2058/66993062). and are classified as Least Concern by IUCN in its latest assessment published in 2016 (http://www.iucnredlist.org/details/2058/0). According to IUCN assessment, the greatest threat to this species is considered to be the impact of climate change on its physical environment and populations of its prey. The impacts of other threats, including the impact of incipient fishing industries on prey populations and entanglement in anthropogenic debris, remain low.

Marine mammal and bird observations and interactions are recorded in CCAMLR Scientific Observer Reports in accord with the CCAMLR Observers Manual. Identification guides are available for all observers on the bridge of the vessels.

Given the low level of interactions, known direct effects of the UoA are likely to not hinder the recovery of ETP species. Gears, if lost (which has not happened in the past years) would be retrieved as they are expensive, so if any, impacts of ETP species with lost gears would be temporary. SG60 is met.

CCAMLR Conservation Measure 25-03 covers the subject of minimizing the incidental mortality of seabirds and marine mammals in the course of trawling in the Convention Area and requires the fisheries to develop gear configurations that reduce the chance of birds or marine mammals encountering the net, such as the Sea Lion Exclusion Device (SLED). SG80 is met.

The 100% comprehensive scientific observer coverage showing minimal fatal interactions by the UoA with fur seals provide a high degree of certainty that there are no significant detrimental effects of the UoA on the population status of ETP species. SG100 is met.

	Indirect effects			
c	Guide post		Indirect effects have been considered for the UoA and are thought to be **highly likely** to not create unacceptable impacts.	There is a **high degree of confidence** that there are no **significant detrimental indirect effects** of the UoA on ETP species.
	Met?		**Yes**	**Yes**
Rationale				

Indirect effects of the fishery on predators such as Antarctic fur seals have been studied along with effects on other species such as crabeater seals, Adélie, chinstrap, gentoo and macaroni penguins, by mapping selected krill predator summer foraging ranges and overlaying it on known fishing activity areas of Aker Biomarine's *Saga Sea* for the period 2007–2011 (Nicoll and Douglas 2012). For the Antarctic fur seal, the analysis showed a high degree of overlap of year-round fishing operations and the summer foraging ranges of the species.

In order to protect predators and their foraging areas, the South Georgia and South Sandwich Islands have established a no-take zone around the islands, consisting of a seasonal closure for the krill fishery from 1 October to 30 April along with minimum (700 m) and maximum (2500 m) depths at which trawling can take place. Both the seasonal closure and the extension of the no-take zone for the krill fishery have been extended since the past reassessment, however their limits have been made wider.

Besides, and in order to limit the indirect effects that harvesting for krill may have on penguin colonies, the Association of responsible krill harvesting companies (ARK) and its members (including AKER Biomarine) have committed themselves, as from January 2019, to voluntary restrictions in the Antarctic Peninsula covering about 74000 km^2 around penguin colonies, to ensure the long-term viability of krill stocks and that the krill fishing industry does not compete with penguin colonies during their breeding season. With this commitment, ARK companies pledge to keep fishing effort up to 40 kilometres away from the coast from October to March, depending on the conservation needs of colonies of Adélie, chinstrap and gentoo penguins while breeding around the Antarctic Peninsula, off South Shetland and in Gerlache strait. The commitment will see the seasonal closure gradually implemented into a permanent closure from 2020.

According to Hewitt *et al*. (2004), the estimated annual consumption of krill in Area 48 shows that fur seals would eat 706.7 thousand tonnes per year, whales 2360 thousand tonnes, fish 2963.9 thousand tonnes and penguins up to 9192.1 thousand tonnes. These estimates add up to 15 223 thousand tonnes of krill potentially consumed annually by the different predators.

Removals by the fishery have been estimated to be several orders of magnitude less than both the demand from predators and the biomass available for both predators and the fishery.

Given the level of consumption of krill by ETP species, the catch taken by the krill fishery (subject to annual review of catch limits and to partial closures of the fishery) and the establishment of no-take zone around foraging areas, the team considers that there is a high degree of confidence that there are no significant detrimental indirect effects of the UoA on ETP species. SG80 and SG100 are met.

References

CCAMLR 2018 krill fishery report (https://www.ccamlr.org/en/document/publications/krill-fishery-report-2018). (accessed 09/08/19).

http://files.zetta.no/www-ark-krill-org/_upl/ark_vrz_map_rev.jpg (accessed 09/08/19).

Hewitt et al. 2004. Options for allocating the precautionary catch limit of krill among small scale management units in the Scotia Sea. *CCAMLR Science, Vol.* 11 (2004): 81–97. http://www.ccamlr.org/en/system/files/science_journal_papers/05hewitt-etal.pdf (accessed 09/08/19).

Nicoll, R., and Douglass, L. 2012. Project report: Mapping krill trawling and predator distribution.

https://en.mercopress.com/2019/06/07/south-georgia-marine-protected-area-enhancement-announced-last-december-comes-into-effect (accessed 09/08/19)

http://www.gov.gs/32110-2/ (accessed 09/08/19)

SGSSI Wildlife and Protected Areas Ordinance 2011 (http://www.gov.gs/docsarchive/Legislation/Wildlife%20and%20Protected%20Areas%20Ordinance%202011-1.pdf) (accessed 23/12/2019)

Overall Performance Indicator score	**100**
Condition number (if relevant)	**N/A**

PI 2.3.2 – ETP species management strategy

PI 2.3.2	The UoA has in place precautionary management strategies designed to: - meet national and international requirements; - ensure the UoA does not hinder recovery of ETP species. Also, the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of ETP species		
Scoring Issue	SG 60	SG 80	SG 100
a Management strategy in place (national and international requirements)			
Guide post	There are **measures** in place that minimise the UoA-related mortality of ETP species, and are expected to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **strategy** in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **comprehensive strategy** in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to **achieve above** national and international requirements for the protection of ETP species.
Met?	**Yes**	**Yes**	**Yes**
Rationale			

CCAMLR requirements for the protection of ETP species are specified in Conservation Measure 25-03 (2018), which sets the requirements to prevent and minimise incidental mortalities of seabirds and sea mammals through the mandatory use of Sea Lion Exclusion Devices. Vessels in the UoA comply with this requirement, as recorded in CCAMLR observer reports. Besides, Conservation Measures 26-01 (on general environmental protection) and 51-01 (on precautionary catch limits in the krill fishery) also work in preventing further damage from the fishery to the ecosystem.

Besides, the fishing strategy itself, which limits interactions with primary and secondary species, also works effectively in limiting interactions with ETP species. This strategy includes measures such as:

Fine-mesh exclusion net at the cod end
Long hauls of 20 or 25 days (proxy)
A slow towing speed (2 knots) that allows animals to avoid the net
Retention on board of all material captured
The trawl warps enter the water very close to the stern of the vessel, reducing the potential for birds to strike them during fishing operations.
Tori lines in the Saga Sea vessel
The quick sinking of the net on deployment (so that bird scaring lines, so-called tori lines, are not required)
Spatial and seasonal limitations around South Georgia and the South Sandwich Islands.
Voluntary spatial and seasonal limitations around the Antarctic Peninsula as proposed by ARK.

This group of measures, together with the accomplishment of CM 25-03, 26-01 and 51-01, form a comprehensive strategy for managing the UoA's impact on ETP species as described under SG100. SG60, SG80 and SG100 are met.

b Management strategy in place (alternative)				
	Guide post	There are **measures** in place that are expected to ensure the UoA does not hinder the recovery of ETP species.	There is a **strategy** in place that is expected to ensure the UoA does not hinder the recovery of ETP species.	There is a **comprehensive strategy** in place for managing ETP species, to ensure the UoA does not hinder the recovery of ETP species.
	Met?	**N/A**	**N/A**	**N/A**
Rationale				

	Management strategy evaluation			
c	Guide post	The measures are **considered likely** to work, based on **plausible argument** (e.g., general experience, theory or comparison with similar fisheries/species).	There is an **objective basis for confidence** that the measures/strategy will work, based on **information** directly about the fishery and/or the species involved.	The strategy/comprehensive strategy is mainly based on information directly about the fishery and/or species involved, and a **quantitative analysis** supports **high confidence** that the strategy will work.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The implementation of the mandatory use of SLED dates back to 2008. According to the CCAMLR 2018 krill fishery report, entanglements with Antarctic fur seal was significantly reduced after this implementation. While the CCAMLR 2018 krill fishery report shows a noticeable increase in catches of fur seals in 2018 (with 19 individuals entangled by the whole krill fishery, this is, 11 vessels), all catches but one were taken by the same vessels (not in the UoA), which had a problem with its exclusion device. Nonetheless, the UoA had one fatal interaction with an Antarctic fur seal in subarea 48.3 during 2019.

As regards the UoA, marine mammals and birds in the vicinity of the operation are counted and their presence documented formally by the observer. CCAMLR scientific observer reports have not recorded any significant or fatal interactions on ETP species in the fishing operation of the UoA. Given that this strategy is implemented since 2008 and that observer records show minimal interactions, the team concludes that there is a quantitative analysis supporting with high confidence that the strategy will work (and is already working). SG60, SG80 and SG100 are met.

	Management strategy implementation			
d	Guide post		There is some **evidence** that the measures/strategy is being implemented successfully.	There is **clear evidence** that the strategy/comprehensive strategy is being implemented successfully and **is achieving its objective as set out in scoring issue (a) or (b).**
	Met?		**Yes**	**Yes**
Rationale				

Clear evidence of the strategy being implemented can be found in CCAMLR Scientific Observer Reports, CCAMLR Annual Observer Reports and Annual Fishery Reports. The strategy is considered to be achieving its objective because there are no significant interactions recorded on the manifold observer reports perused. SG80 and SG100 are met.

	Review of alternative measures to minimize mortality of ETP species			
e	Guide post	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality ETP species, and they are implemented, as appropriate.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

CCAMLR members meet annually to review the state of resources in the Southern Ocean. This convention includes meetings of different working groups including the working group on ecosystem monitoring and management (which would detect any risk to ETP species or any trend on their population) and the krill fishery members, which would detect

any increase in interactions with these species. These meetings are held every year (normally in October) and their results are published in CCAMLR website. SG60, SG80 and SG100 are met.

References

CCAMLR Annual Fishery Reports

CCAMLR Observer's reports for the UoA

CCAMLR Conservation Measure 25-03 on the minimization of incidental mortalities of seabirds and marine mammals in the course of trawl fishing in the Convention Area. http://www.ccamlr.org/en/measure-25-03-2011

CCAMLR Conservation Measure 26-01 on general environmental protection during fishing. http://www.ccamlr.org/en/measure-26-01-2009

CCAMLR Conservation Measure 51-01 regarding Precautionary catch limitations on *Euphausia superba* in Statistical Subareas 48.1, 48.2, 48.3 and 48.4. http://www.ccamlr.org/sites/drupal.ccamlr.org/files//51-01.pdf

CCAMLR Scientific Observer Manual. http://www.ccamlr.org/en/system/files/obsman.pdf

https://www.ccamlr.org/en/meetings-and-publications/meetings-publications

Overall Performance Indicator score	**100**
Condition number (if relevant)	**N/A**

PI 2.3.3 – ETP species information

PI 2.3.3		Relevant information is collected to support the management of UoA impacts on ETP species, including: - Information for the development of the management strategy; - Information to assess the effectiveness of the management strategy; and - Information to determine the outcome status of ETP species		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impacts			
	Guide post	Qualitative information is **adequate to estimate** the UoA related mortality on ETP species. **OR** **If RBF is used to score PI 2.3.1 for the UoA:** Qualitative information is **adequate to estimate productivity and susceptibility** attributes for ETP species.	Some quantitative information is **adequate to assess** the UoA related mortality and impact and to determine whether the UoA may be a threat to protection and recovery of the ETP species. **OR** **If RBF is used to score PI 2.3.1 for the UoA:** Some quantitative information is **adequate to assess productivity and susceptibility attributes** for ETP species.	Quantitative information is available to assess with a high degree of certainty the **magnitude of UoA-related impacts, mortalities and injuries and the consequences for the status** of ETP species.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The 2013 South Georgia and the South Sandwich Islands Marine Protected Area Management Plan (Appendix 9) describes the ETP species present in that region. Besides, SGSSI Wildlife and Protected Areas Ordinance 2011 protect all native species from any intentional damage.

The overlap between some of the predators' summer foraging ranges and the krill fishery is mapped and fishing restrictions have been stablished in foraging areas of the Antarctic Peninsula and of the South Georgia and South Sandwich Islands. Changes in the relationship between predators and krill in terms of, for instance, penguin densities, species composition and diet changes in certain areas have been documented (Trathan *et al.* 2011, 2012, Nicoll R. *et al.* 2012), but the effects in the area on the recovery of populations of whales and fur seals are still poorly described (Christensen 2006, Nicol S. *et al*. 2008, IWC 2010).

The UoA has a 100% observer coverage collecting qualitative and quantitative information on interactions, impacts, injuries or mortalities of ETP (and non-ETP) species.

Collected information provides accurate information to assess with a high degree of certainty the magnitude of all impacts and the consequences for the status in the region of ETP species. SG60, SG80 and SG100 are met.

b	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage the impacts on ETP species.	Information is adequate to measure trends and support a **strategy** to manage impacts on ETP species.	Information is adequate to support a **comprehensive strategy** to manage impacts, minimize mortality and injury of ETP species, and evaluate with a **high degree of certainty** whether a strategy is achieving its objectives.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

The CCAMLR observer programme provides adequate information to support a comprehensive strategy to manage the UoA impacts on ETP species. Information is also adequate to evaluate the effectiveness of this strategy, as injuries to or mortalities of ETP species are minimal. The strategy is effective and achieving its objectives. SG60, SG80 and SG100 are met.

References

CCAMLR-IWC Joint Workshop to Review Input Data for Antarctic Marine Ecosystem Models report. *J. Cetacean Res. Manage. 11 (suppl.2),* 2010. http://iwc.int/cache/downloads/i5flpo5e6coog0c04g40scg0/SC-61-Rep2-JCRM11(2).pdf

Christenesen L.B. (2006) Marine mammal populations; reconstructing historical abundances at the global scale. *Fish Cent Res Rep* 14:1-161.

Government of South Georgia and the South Sandwich Islands. 2013. The South Georgia and South Sandwich Islands Marine Protected Area management plan. http://www.sgisland.gs/download/MPA/MPA%20Management%20Plan%20v2.0.pdf

Nicoll, R., Douglass, L. 2012. Project report: Mapping krill trawling and predator distribution

Nicol S, Worby A, Leaper R (2008) Changes in the Antarctic sea ice ecosystem: potential effects on krill and baleen whales. *Mar Freshw res* 59:361-382.

Trathan P.N., Fretwell P.T., Stonehouse B. 2011 First recorded loss of an emperor penguin colony in the recent period of Antarctic regional warming: implications for other colonies. *PLos ONE* 6: e14738.

Trathan P.N., Ratcliff N., Masden E.A. 2012 Ecological drivers of change at South Georgia: the krill surplus, or climate variability. *Ecography* 35:983-993.

https://en.mercopress.com/2019/06/07/south-georgia-marine-protected-area-enhancement-announced-last-december-comes-into-effect (accessed 09/08/19)

http://files.zetta.no/www-ark-krill-org/_upl/ark_vrz_map_rev.jpg (accessed 09/08/19)

Overall Performance Indicator score	**100**
Condition number (if relevant)	**N/A**

PI 2.4.1 – Habitats outcome

PI 2.4.1		The UoA does not cause serious or irreversible harm to habitat structure and function, considered on the basis of the area covered by the governance body(s) responsible for fisheries management in the area(s) where the UoA operates		
Scoring Issue		SG 60	SG 80	SG 100
a	Commonly encountered habitat status			
	Guide post	The UoA is **unlikely** to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.	The UoA is **highly unlikely** to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The UoA operates with a continuous pumping system set it a pelagic gear. According to MSC FS v2.01 GSA 3.13.2, "usually habitats impacted by the UoA are benthic habitats (i.e., associated with or occurring on the bottom) rather than pelagic habitats (i.e., near the surface or in the open water column), but impacts on the biotic aspects of pelagic habitats could be considered". MSC interpretations website (https://mscportal.force.com/interpret/s/article/pelagic-habitats-and-gear-Box-GSA7-1527262009346) clarifies that in a pelagic gear situation, it is expected that the commonly encountered habitat would be the water column, and the minor habitat(s) would be anything the gear may accidentally contact when gear loss/malfunction occurs.

The krill fishery operates with midwater trawls designed to operate in the water column, between 7 and 300m depth (and with bottom depths ranging from 150m to >1000m), without any contact with the sea bottom (as they would be seriously damaged). Therefore, for the purpose of this assessment epipelagic and mesopelagic habitats are considered as commonly encountered habitats.

Grant et al (2006) performed a broad-scale primary regionalisation of the pelagic regions of the Southern Ocean, taking into consideration physicochemical variables such as surface temperature, depth and sea ice formation, and finally describing 14 different pelagic regions. This regionalisation differentiates on the broad scale between coastal Antarctica, the sea-ice zone and the northern open-ocean waters. The analysis highlights the different environmental characteristics of large regions including the continental shelf and slope, frontal features (SAF, PF, SACCF), the deep ocean, banks and basins, island groups and gyre systems. The UoA fishing grounds overlap with the Antarctic shelves, Antarctic open ocean, Weddell Gyre and Ross Sea banks and Southern ACC front. Physicochemical parameters of these pelagic areas are not influenced by the UoA. SG60, SG80 and SG100 are met for both epipelagic and mesopelagic habitats.

b	VME habitat status			
	Guide post	The UoA is **unlikely** to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.	The UoA is **highly unlikely** to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

VMEs are identified in the Southern Ocean. The 'CCAMLR VME Registry' records the locations and taxa of Vulnerable Marine Ecosystems (VMEs) and associated areas in the Convention Area which have been notified under CM 22-06 and CM 22-07.

CM 22-06 establishes a set of measures for the management, assessment, monitoring and control and data collection, reporting and scientific research for bottom fishing. For the purposes of this CM, the term 'vulnerable marine ecosystems' in the context of CCAMLR and all its area of management includes **seamounts, hydrothermal vents, cold water**

corals and sponge fields. These VMEs are distributed within the whole CCAMLR management area (and not only in the fishing grounds under assessment here).

CM 22-07 establishes some requirements in order to acquire additional data to contribute to assessments and advice on a long-term precautionary approach to avoiding significant adverse impacts on VMEs. For the purpose of this measure, VME indicator organism' means any benthic organism listed in the CCAMLR VME Taxa Classification Guide (available from the CCAMLR Secretariat and on the CCAMLR website).

Access to the CCAMLR VME Registry is open to everybody. (https://www.ccamlr.org/en/document/data/ccamlr-vme-registry).

Besides, CCAMLR Conservation Measures 91-01 (2004), 91-02 (2012), 91-03 (2009), 91-04 (2011) and 91-05 (2016) describe the protected areas in Antarctic waters (https://www.ccamlr.org/en/conservation-and-management/browse-conservation-measures).

Given the identification and location of VME in an open registry, the protection measures afforded by CCAMLR, and the pelagic nature of the fishing gear the team considers that it is unlikely and highly unlikely that the UoA would reduce structure and function of VME habitats to a point where there would be serious or irreversible harm. SG60 and SG80 are met for all elements. Evidence is found as no interactions with the bottom have been recorded by international observers during their 100% coverage of the fishery. SG100 is met for all elements.

	Minor habitat status			
c	Guide post			There is **evidence** that the UoA is highly unlikely to reduce structure and function of the minor habitats to a point where there would be serious or irreversible harm.
	Met?			**Yes**

Rationale

Benthic sediments in Antarctica have been studied by different researchers, such as Goodell et al (1973) or by Clarke A (1995). Common benthic habitats around Antarctica are soft sediments. They differ from sediments in most other deep-sea areas in two ways: the low temperatures of the surface waters mean that these sediments are siliceous rather than the carbonates typical of lower latitudes, and there is a strong influence of glacial processes. Close to the Antarctic continent the sediments contain an abundant silt fraction comprised of rock flour with coarse poorly sorted debris and containing little calcite or biogenic material. These types of sediment are termed *glacial marine* and they form a wide circumpolar band around Antarctica (Clarke A. 1995).

In any case, owing to the pelagic nature of the trawling operations there is no interaction with the seafloor, so there is little potential for damaging the benthic ecosystem. Such damage could only take place in the case of gear loss, which is a rare and avoided event.

The pelagic nature of the fishing gear makes it unlikely and highly unlikely that the UoA would reduce structure and function of minor habitats. Its minimal contact with the seafloor, and the fact that the seafloor is formed by soft sediments (which recover quicker from disturbance than coarser sediments) serve as evidence that the UoA is highly unlikely to reduce structure and function of the minor habitats to a point where there would be serious or irreversible harm. SG100 is met.

References

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https://www.ccamlr.org/en/conservation-and-management/browse-conservation-measures.

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Overall Performance Indicator score	**100**
Condition number (if relevant)	**N/A**

PI 2.4.2 – Habitats management strategy

PI 2.4.2		There is a strategy in place that is designed to ensure the UoA does not pose a risk of serious or irreversible harm to the habitats		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place, if necessary, that are expected to achieve the Habitat Outcome 80 level of performance.	There is a **partial strategy** in place, if necessary, that is expected to achieve the Habitat Outcome 80 level of performance or above.	There is a **strategy** in place for managing the impact of all MSC UoAs/non-MSC fisheries on habitats.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

As stated above, the gear can only impact the habitat in the case of gear loss. CCAMLR Conservation Measures 21-03 and 51-01 restrict the type of fishing gear to be used to pelagic gear only. This is generally operated at depths of about 150 m (proxy), over much deeper water. No interactions with the bottom have been recorded by international observers during their 100% coverage of the fishery. Therefore, management measures such as move on rules are not considered necessary for the pelagic fishery.

CCAMLR Conservation Measures 91-01 (2004), 91-02 (2012), 91-03 (2009), 91-04 (2011) and 91-05 (2016) describe the protected areas in Antarctic waters. In 2009 CCAMLR designated the South Orkney Islands southern shelf as its first Marine Protected Area, located in subarea 48.2. Latest (2016) designated MPA is the Ross Sea region Marine Protected Area, the world's largest marine protected area, located in CCAMLR subarea 88.1. Besides, the 'CCAMLR VME Registry' records the locations and taxa of Vulnerable Marine Ecosystems (VMEs) and associated areas in the Convention Area which have been notified under CM 22-06 and CM 22-07.

The Antarctic Treaty System has different means of spatially managing and protecting the marine environment. Antarctic Specially Protected Areas (ASPAs) and Antarctic Specially Managed Area (ASMAs) under Annex V of the Protocol on Environmental Protection may be used as tools for spatial management and essential recognition of outstanding values in the Southern Ocean. The implementation of marine spatial protection and management measures through the Antarctic Treaty Consultative Meeting (ATCM) is currently primarily small-scale, coastal based. Marine spatial protection and management measures will contribute towards effective, representative and coherent spatial protection of marine biodiversity within the Antarctic Treaty Area.

The South Georgia and South Sandwich Islands Marine Protected Area, established in 2012, and reviewed in 2019, establishes a 30km no-take zone around the islands and a seasonal closure of the fishery for Antarctic krill from 1 November to 31 March, to avoid competition with krill-eating predators (particularly penguins and fur seals) during their breeding seasons, a minimum 700 m depth for trawling and (although it is not relevant for the UoC fishery) a ban on all bottom fishing deeper than 2250 m, to protect deep-water habitats, and additional closed areas to protect sensitive benthic fauna and provide refugia for Patagonian toothfish.

Fishing is also restricted around the CCAMLR Ecosystem Monitoring Programme (CEMP) management sites.

CCAMLR Conservation measures apply to all fisheries in the Southern Ocean, regardless of being MSC certified. At-sea inspections are carried out under the auspices of CCAMLR and also by South Georgia Fisheries Patrol Vessels.

Given the different management measures afforded to the protection of marine ecosystems, including benthic habitats, the team considers that there is a strategy in place for managing the impact of all fisheries on habitats. SG60, SG80 and SG100 are met.

b	Management strategy evaluation			
	Guide post	The measures are **considered likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar UoAs/habitats).	There is some **objective basis for confidence** that the measures/partial strategy will work, based on **information directly about the UoA and/or habitats** involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on **information directly about the UoA and/or habitats** involved.

	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The establishment and location of marine protected areas have taken into account scientific opinion on the crucial areas associated with breeding seabird colonies. The area covered by MPAs has increased in the past years with the creation of the Ross Sea Region MPA. The CEMP (CCAMLR Ecosystem Monitoring Programme), the international scientific observer coverage and the rigorous enforcement in the area by patrol vessels lends confidence to the efficiency of the strategy in mitigating against habitat harm. No interaction of the gear with the seabed also contributes to the efficiency of this strategy. SG60, SG80 and SG100 are met.

c	Management strategy implementation			
	Guide post		There is **some quantitative evidence** that the measures/partial strategy is being implemented successfully.	There is **clear quantitative evidence** that the partial strategy/strategy is being implemented successfully and is achieving its objective, as outlined in scoring issue (a).
	Met?		**Yes**	**Yes**
Rationale				

VMS (vessel monitoring system) data and manifold observer scientific reports show how localized the fishery is, seeking out the few very large aggregations of krill. Operating pelagic gear precludes any interactions with the seafloor and sampling of all retained species is carried out in a rigorous manner according to formal CCAMLR observer protocols, which would allow the observation of benthic organisms in the catch, if any.

Most of the marine protected areas are of recent creation, which gives an idea of the involvement of CCAMLR and the South Georgia and South Sandwich Islands in protecting these habitats and ecosystems. Regulations covering these areas and patrol inspections contribute to the successful enforcement of the strategy, along with VMS tracks and observer coverage. Annual CCAMLR review of the performance of the krill fishery in the Southern Ocean (and other CCAMLR fisheries) identifying constrains of the fishery and possible infractions serve as a clear quantitative evidence that the strategy is implemented successfully and achieving its objective SG80 and SG100 are met.

d	Compliance with management requirements and other MSC UoAs'/non-MSC fisheries' measures to protect VMEs			
	Guide post	There is **qualitative evidence** that the UoA complies with its management requirements to protect VMEs.	There is **some quantitative evidence** that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant.	There is **clear quantitative evidence** that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

All Southern Ocean fisheries have to comply with CCAMLR requirements afforded to the protection of VMEs. To the team's knowledge, there are no other management requirements directed to the protection of VME afforded by other fisheries. Clear quantitative evidence of the UoA compliance with management requirements and protection measures afforded to the protection of VMEs can be obtained from VMS tracking records and from patrol inspection reports. SG60, SG80 and SG100 are met.

References

CCAMLR Conservation Measure 21-03 (2013). Notifications of intent to participate in a fishery for *Euphausia superba*. http://www.ccamlr.org/en/measure-21-03-2013

CCAMLR Conservation Measure 51-01 (2010) regarding Precautionary catch limitations on *Euphausia superba* in Statistical Subareas 48.1, 48.2, 48.3 and 48.4. http://www.ccamlr.org/sites/drupal.ccamlr.org/files//51-01.pdf

CCAMLR Conservation Measures 91-01 (2004),

CCAMLR Conservation Measure 91-02 (2012)

CCAMLR Conservation Measure 91-03 (2009)

CCAMLR Conservation Measure 91-04 (2011)

CCAMLR Conservation Measure 91-05 (2016)

CCAMLR Conservation Measure 22-06 (2017)

CCAMLR Conservation Measure 22-07 (2013)

CCAMLR VME Registry

IUCN. Antarctic Treaty Consultative Meeting XXXV. Hobart 2012. (IP34) Using ASMAs and ASPAs when necessary to complement CCAMLR MPAs http://www.ats.aq/index_e.htm

Government of South Georgia and the South Sandwich Islands. 2013. The South Georgia and South Sandwich Islands Marine Protected Area management plan.
http://www.sgisland.gs/download/MPA/MPA%20Management%20Plan%20v2.0.pdf

Overall Performance Indicator score	**100**
Condition number (if relevant)	**N/A**

PI 2.4.3 – Habitats information

PI 2.4.3		Information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat		
Scoring Issue		SG 60	SG 80	SG 100
a	Information quality			
	Guide post	The types and distribution of the main habitats are **broadly understood**. **OR** **If CSA is used to score PI 2.4.1 for the UoA:** Qualitative information is adequate to estimate the types and distribution of the main habitats.	The nature, distribution and **vulnerability** of the main habitats in the UoA area are known at a level of detail relevant to the scale and intensity of the UoA. **OR** **If CSA is used to score PI 2.4.1 for the UoA:** Some quantitative information is available and is adequate to estimate the types and distribution of the main habitats.	The distribution of all habitats is known over their range, with particular attention to the occurrence of vulnerable habitats.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Benthic habitat types in Antarctica have been studied by different researchers, such as Goodell et al (1973), Clarke A (1995) or Douglass et al (2014). Pelagic habitats have also been studied by Grant et al (2006) and other researchers afterwards (Constable 2011). These studies serve to broadly understand the types and distribution of main habitat types. SG60 is met.

Compared to many global ocean areas where bottom fishing occurs, the Southern Ocean is characterised by extremely limited data on both the prevailing bottom topography and associated benthic marine ecosystems. This is exemplified by the proportion of new species discovered by recent focused research efforts to study the marine benthic fauna of the region. CCAMLR recognizes this shortage and tries to overcome it by engaging the vessel to monitor and report encounters with potential VMEs during the course of bottom fishing activities as described in CM 22-07, and to contribute to the 'CCAMLR VME Registry'. Given the pelagic nature of the fishing gear operating in the UoA and in the krill fishery, the team considers that available information on habitat types is adequate taking into consideration the scale and intensity of the UoA. SG80 is met.

While the team considers that information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat, at present there is room for improvement in the knowledge of the distribution of all habitats including VMEs. SG100 is not met.

b	Information adequacy for assessment of impacts			
	Guide post	Information is adequate to broadly understand the nature of the main impacts of gear use on the main habitats, including spatial overlap of habitat with fishing gear. OR **If CSA is used to score PI 2.4.1 for the UoA:**	Information is adequate to allow for identification of the main impacts of the UoA on the main habitats, and there is reliable information on the spatial extent of interaction and on the timing and location of use of the fishing gear. OR	The physical impacts of the gear on all habitats have been quantified fully.

		Qualitative information is adequate to estimate the consequence and spatial attributes of the main habitats.	**If CSA is used to score PI 2.4.1 for the UoA:** Some quantitative information is available and is adequate to estimate the consequence and spatial attributes of the main habitats.	
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

VMS tracks serve to monitor the UoA performance as regards entrance on MPAs. Gear operated in the pelagic zone of the sea does not interact with the seafloor (the net is not constructed anyway to withstand contact with the seabed). The presence of international 100% observer coverage serve to quantify cases of gear losses (none in the reviewed 2018 observer reports, and in the 2012-2013 previously reviewed reports). Captain consulted during the site visit also confirmed that he had never lost a gear in the region but in the event of this event happening, the vessel is equipped with a retrieving tool to recover it. SG60, SG80 and SG100 are met.

	Monitoring			
c	Guide post		Adequate information continues to be collected to detect any increase in risk to the main habitats.	Changes in all habitat distributions over time are measured.
	Met?		**Yes**	**No**
Rationale				

Information on the distribution of VMEs is now taking place through the CCAMLR VME registry.

Given the pelagic nature of the fishing gear, available information is considered adequate to detect any increase in risk to the main habitats. SG80 is met. Changes in terrestrial habitats are measured, but not marine benthic habitats where the fishery takes place. While there is continued research and monitoring of the Southern Ocean ecosystem, this is not specifically focused on benthic habitats. SG100 is not met.

References

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Goodell, H.G. et al. Marine sediments of the Southern Oceans, Antarctic Map Folio Series, Folio 17, American Geophysical Union, Washington, 1-18, 1973.

CCAMLR CM 22-07

CCAMLR 2018 observer reports for the UoA.

Douglass LL, Turner J, Grantham HS, Kaiser S, Constable A, et al. (2014) A Hierarchical Classification of Benthic Biodiversity and Assessment of Protected Areas in the Southern Ocean. PLoSONE 9(7): e100551. doi: 10.1371/journal.pone.0100551

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Overall Performance Indicator score	**85**
Condition number (if relevant)	**N/A**

PI 2.5.1 – Ecosystem outcome

PI 2.5.1		The UoA does not cause serious or irreversible harm to the key elements of ecosystem structure and function		
Scoring Issue		SG 60	SG 80	SG 100
a	Ecosystem status			
	Guide post	The UoA is **unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	The UoA is **highly unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The total allowable catch for the southwest Atlantic is currently about 5.6 million tonnes annually. However, CCAMLR has decided that the catch will be regulated within a 620,000 tonne 'trigger' level which is distributed across four regions in the southwest Atlantic. The lower (trigger) limit is intended, *inter alia*, to ensure that in terms of CCAMLR primary objectives, the impact of the fishery on krill-dependent predators is minimized.

Most of the krill catch in Area 48 is made in Subareas 48.1, 48.2 and 48.3. In 2009 CCAMLR introduced trigger level limits for each subarea (see Conservation Measure 51-01 (2010) and Conservation Measure 51-07 (2016)). Those subarea trigger levels are calculated using the GYM. According to Peatman *et al*. (2011), the probability of stock depletion increases substantially with increased recruitment variability, although in absolute terms it remains negligible. Kinzey *et al*. (2013) note that the proportional recruitment option in the GYM does not appear to be able to model recruitment consistently, and that the precautionary catch limit meeting of CCAMLR criteria relies on the maintenance of a natural mortality of no more than 0.8. If the trigger level is reached in any of the subareas or the total area, the fishery is obliged to either halt operations there or to move elsewhere to a position where notification of fishing activity has already been given.

Removals by the krill fishery have been estimated to be orders of magnitude below the demand from predators and the biomass available to both predators and the fishery (Nicoll and Douglass 2012) The annual predator demand for krill in Area 48 was estimated by Hewitt *et al.* (2004) as orders of magnitude higher than the current fishery take. Moreover, according to Murphy *et al*. (2007), some species also seek alternative breeding options in years when krill are relatively scarce.

The 620,000 tons 'trigger' level represents approximately 1% of the estimated 62.6 million tonnes of the unexploited biomass, or virgin size, of the krill population in this region (CCAMLR WG-ASAM 2019 Report). The actual annual catch is around 0.3% of the unexploited biomass of krill (https://www.ccamlr.org/en/fisheries/krill-fisheries-and-sustainability). The estimated 62.6 million tons of unexploited biomass were estimated in early 2019. Previous estimations were made in 2000 and estimated a biomass of 60 million tons.

Krill tend to be in layers and patches ranging from a few square metres across, through shoals, schools, swarms and up to super swarms covering more than 100 km2, which makes the catch very homogeneous. The whole catch of the UoA fishery is considered to be krill because there is no sorting or discarding. International observers conduct a thorough sampling of the catch composition that shows that larvae retained are relatively few (<0.2%), and that all are identified and recorded.

Among their duties observers also record any sighting of ETP species as well as interactions with birds and marine mammals. The records show very little bycatch fatality, with only a few birds fatally entangled per year. Fishing vessels are normally accompanied by >100 birds, and this number increases to >500 birds at the time of hauling. Since the hauls last up to 25 days, hauling is not a frequent operation. As regards marine mammals, there were no entanglements in the UoA in the past years. For all the reasons given above, the team and virtually all of the consultees considered that at the current harvesting rate it is highly unlikely that the fishery would cause serious or irreversible harm to the key elements of ecosystem structure and function. Any substantial future increases in krill harvests in Area 48 beyond the trigger level, however, will require verification that krill recruitment variability, natural mortality and other parameters specified by Kinzey *et al*. (2013) in the scenarios used to test management criteria, adequately represent the range of plausible values encompassing krill population biology.

Observer reports, along with papers by the aforementioned authors, can be considered as evidence here. SG60, 80 and 100 are met.

References

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Peatman, T., Clarke, J. M., and Agnew, D. J. 2011. Estimation of management reference points consistent with the catch trigger level for the Antarctic krill fishery in Area 48. WG-EMM-11-17. CCAMLR, Hobart. https://www.ccamlr.org/es/node/65473

Overall Performance Indicator score	**100**
Condition number (if relevant)	**N/A**

PI 2.5.2 – Ecosystem management strategy

PI 2.5.2		There are measures in place to ensure the UoA does not pose a risk of serious or irreversible harm to ecosystem structure and function		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place, if necessary which take into account the **potential impacts** of the UoA on key elements of the ecosystem.	There is a **partial strategy** in place, if necessary, which takes into account **available information and is expected to restrain impacts** of the UoA on the ecosystem so as to achieve the Ecosystem Outcome 80 level of performance.	There is a **strategy** that consists of a **plan**, in place which contains measures to **address all main impacts of the UoA** on the ecosystem, and at least some of these measures are in place.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

Fisheries operating within the Convention Area are subject to several regulations directed to the management of the ecosystem:

- A set of Conservation Measures that allow control of the fleet accessing the fishery, including licensing and inspection obligations (CM 10/02, CM 10/03), VMS (CM 10/04), technical characteristics of the fishing gear (CM 10/01, 22/01, 22/02) and, in the case of the krill fishery, a notification of intent to participate (CM21/03),
- Enforcement of collection and reporting of catches (CM23/01, CM 23/02, CM 23/03, CM 23-06), including haul by haul data to complete CCAMLR fine scale catch and effort data form (Form C1).
- Scheme of International Scientific Observation (SISO) targeting, in the case of the krill fishery a 100% on-board observer's coverage for the 2019/2020 fishing season (CM 51/06). The UoA has had 100% for several years so far, year before being mandatory by CCAMLR. Observer duties are: (i) to identify and sample bycatches (i) to record incidental mortality of birds and mammals and warp strikes; (ii) to inspect whether environmental requirements included in CM 26-01 (see below) are being accomplished and report non-compliances.
- CM 51-01 (2010) included the mandatory use of marine mammal exclusion devices on trawls in the krill fishery, and it also establishes a trigger limit of 620,000 tonnes for catches in Subareas 48.1, 48.2, 48.3 and 48.4.
- CM 51-07 (2016) establishes an interim distribution of the trigger level determined in CM 51-01 between the different subareas. The purpose of the trigger levels being set at such precautionary levels is, *inter alia*, for sufficient krill resource to be preserved for predators within the ecosystem to be able to exist, as well as to underpin any recovery from depressed levels. In 2019 this trigger level was reached on the 13th July in subarea 48.1, resulting in the closure of subarea 48.1 According to CCAMLR Scientific Committee (SC-CAMLR-38/BG/01 Rev. 1) in 2017/18 (1 December 2017 to 30 November 2018), 10 vessels fished in Subareas 48.1, 48.2, 48.3 and Division 58.4.2, and the total catch of krill reported was 312 991 tonnes of which 151 691 tonnes, 137 879 tonnes 23 175 tonnes and 246 tonnes were taken from Subareas 48.1, 48.2, 48.3 and Division 58.4.2 respectively. In 2018/19 (to 13 September 2019), 11 vessels fished in Subareas 48.1, 48.2, 48.3, and Division 58.4.2, and the total catch of krill reported in catch and effort reports was 381 934 tonnes of which 155 907 tonnes, 162 416 tonnes, 63 599 tonnes and 12 tonnes were taken from Subareas 48.1, 48.2, 48.3 and Division 58.4.2 respectively.
- CM 25-03 establishes a set of measures to all trawl fisheries in order to minimize incidental mortality of seabirds and marine mammals.
- CMs 22-05, 22-06 and 22-07 aims to protect benthic habitats, in particular VMEs.
- CM 26-01 establishes a set of measures to protect the marine environment.

Other elements of the strategy to manage ecosystem impacts are:

- CCAMLR Ecosystem Monitoring Program, focused on the monitoring of predators to detect changes in their populations and distinguish between changes attributable to fisheries and environmental variation. WG-EMM

updates and reviews information on the krill fishery (including bycatches and incidental mortality), MPAs (monitoring on the existing ones and progress on the proposed ones), and CEMP data. This information is compiled in several documents (e.g. the annual krill fishery report, the WG-EMM annual meeting report). CCAMLR envisions to achieve a feedback management for the krill fishery which integrates information from CEMP, but to date such data is not yet being used to develop Conservation Measures, so there is no management feedback policy in place to regulate the ecosystem impacts of fishing activities. However, it is planned that this system will be implemented by 2021 and there is a workplan defining the role of each WG towards achieving this goal in time.

- Creation of CCAMLR MPAs, specifically the South Orkney Islands Southern Shelf MPA (created in 2009) and the Ross Sea MPA (created in 2017), in addition to benthic area closures. Besides, the South Georgia and South Sandwich Islands Government have established different MPAs in their territorial waters (subarea 48.3). Also, ARK members (to which the UoA belongs) have voluntary agreed to no-go areas around breeding sites in order to prevent krill depletion in foraging places.

The different measures described above are considered a plan to address all main impacts that the UoA may cause on the ecosystem. This plan is directed to all fisheries in the Southern Ocean. SG60, SG80 and SG100 are met.

	Management strategy evaluation			
b	Guide post	The **measures** are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar UoAs/ ecosystems).	There is **some objective basis for confidence** that the measures/ partial strategy will work, based on some information directly about the UoA and/or the ecosystem involved.	**Testing** supports **high confidence** that the partial strategy/ strategy will work, based on information directly about the UoA and/or ecosystem involved.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The different CCAMLR Conservation Measures cover much of the different topics related to the protection of the ecosystem and its elements. The establishment of subarea trigger levels ensures that the fishery does not cause irreversible harm to the fishery or to local predators. All CCAMLR fisheries shall report catch and effort data on a haul-by-haul basis, which facilitates monitoring of cumulative catch in each subarea. Data gathered through this monitoring are used to monitor fishery activity and quantify catches of target and bycatch species. Given the level of monitoring in the fishery the measures are considered likely to work. SG60 is met.

Moreover, CCAMLR Scientific Committee and WGs meet annually to review the performance of the different fisheries and suggest modifications to fishing practices when unacceptable impacts are detected. Besides, voluntary management measures such as ARK's no-take zone around the Peninsula or the area closures in SGSSI's take into consideration information on the breeding patterns of penguin colonies in the area. CCAMLR's periodic review and the consideration of predator needs when establishing no-go areas give an objective basis for confidence that the strategy will work. SG80 is met.

100% observer coverage and their reports show that the UoA has very limited impact on primary, secondary, ETP species or in benthic habitats. 2019 acoustic research shows that estimated biomass of krill population is in line with previous estimations (with 60 million tonnes estimated in 2000 and 62.6 tonnes estimated in 2019). Both the low level of impacts as recorded by international 100% observer coverage together with the high estimates of krill biomass serve as testing of the actual management strategy which supports with a high degree of confidence that the strategy is working ensuring that the UoA does not pose a risk of serious harm to ecosystem structure and function, as shown in the CCAMLR observer reports and in the updated estimates of krill biomass. SG100 is met.

	Management strategy implementation			
c	Guide post		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is **clear evidence** that the partial strategy/strategy is being **implemented successfully and is achieving its objective as set out in scoring issue (a).**
	Met?		**Yes**	**No**

Rationale

Catches of the fishery have always remained below the trigger level. However, subarea catch limits have been reached in several occasions. Subarea 48.1 was closed on the 25th June 2018 and on 13th July 2019, in accordance with Conservation Measure 51-07, when the catch limit was reached. The same applies to previous fishing years. Besides, international 100% observer coverage shows limited impacts of other ecosystem elements such as primary, secondary ETP species and habitats. The team considers that there is evidence of the successful implementation of management controls over the ecosystem. SG80 is met.

Although there has been improvement at CCAMLR regardless the implementation of a Feedback Management Strategy, this is still a goal to achieve. Further steps towards developing the implementation of an ecosystem-based management strategy for the krill fishery have already been decided and there is a workplan on the steps to take, but it is not expected to be implemented until 2021. Neither the ambitious feedback management including SSMUs (Hewitt et al 2004, Watters et al 2013) nor the development of the risk-based system based in overlapping indices (Hinke et al 2017) have been implemented yet. SG100 is not met.

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Overall Performance Indicator score	**95**
Condition number (if relevant)	**N/A**

PI 2.5.3 – Ecosystem information

PI 2.5.3		There is adequate knowledge of the impacts of the UoA on the ecosystem		
Scoring Issue		SG 60	SG 80	SG 100
a	Information quality			
	Guide post	Information is adequate to **identify** the key elements of the ecosystem.	Information is adequate to **broadly understand** the key elements of the ecosystem.	
	Met?	**Yes**	**Yes**	
Rationale				

Different studies have investigated environmental factors affecting krill biomass and distribution. Using transfer function models Quiroz et al (2011) found that atmospheric pressure at sea level (APSL) influences CPUE of Antarctic krill. Kasatkina and Shnar (2016) showed that the presence or absence of krill in a subareas/SSMUs in the Scotia Sea is in a greater degree a reflection of the dynamics of krill geostrophic transport and is not determined by the krill stock state or not determined by the influence of krill fishery.

The role of krill in the ecosystem is crucial, because the resource provides the major link between LTL production and consumption by higher trophic level predators across the Scotia Sea (Murphy et al. 2007). Murphy et al. (2016) state that the Antarctic krill is the main prey species in the areas of the West Antarctic Peninsula and over the South Georgia shelf, although they recognise that other species of meso and macro zooplankton are important in energy flow to fish and other larger species.

Monitoring at CEMP (CCAMLR Ecosystem Monitoring Program)-sites provides valuable information on the distribution, forage behaviour, population trends and response to environmental parameters of krill dependant predators, specifically species of marine mammals and seabirds. CEMP also monitors environmental parameters, such as hydrographic and sea-ice cover information. The CCAMLR Working Group on Ecosystem Monitoring and Management (WG-EMM), considering data generated through the monitoring of CEMP areas and information collated in scientific observer reports, monitors the effect the fishery may be having on the ecosystem. Several ecosystem models have been developed covering krill and associated food webs in the Southern Ocean.

Different institutions such as the International Whaling Commission, the Southern Ocean Observing System (SOOS), the British Antarctic Survey, the Norwegian Institute of Marine Research, the US Antarctic Marine Living Resources Program, the South Georgia and South Sandwich Islands government, Australia's Integrated Marine Observing System (IMOS) and other institutions and NGOs provide even more knowledge of the region's ecosystem.

Information gathered through these means is adequate to broadly understand the key elements of the ecosystem, despite the challenges posed by the impact of climate change on these marine ecosystems. SG60 and SG80 are met.

b	Investigation of UoA impacts			
	Guide post	Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, but **have not been investigated** in detail.	Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, and **some have been investigated in detail**.	Main interactions between the UoA and these ecosystem elements can be inferred from existing information, and **have been investigated in detail**.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

Information collected by international observers provide detailed information on impacts of the UoA on krill stock and krill-dependent species. SG60 is met.

CEMP's major function is to monitor the key life-history parameters of selected dependent species to detect changes in the abundance of harvested species which would be caused by changes in krill availability. CCAMLR Ecosystem Monitoring Program was implemented in 1990. Consequently, the CEMP database consequently forms a very powerful archive with which to study ecosystem interactions (Everson 2000).

CCAMLR reviews and analyses data from CEMP and identifies trends in the monitored parameters by species and site. This information has provided the basis to analyse in detail the overlap between the fishery and krill-predators in the Scotia Sea (e.g. Hinke et al 2017) and it has also fed ecosystem models which are being evaluated as decision making tools for an ecosystem-based management of the fishery (Plangányi et al 2012, Watters et al 2013, Trathan et al 2015). The impact of the krill fishery on the krill stock has been investigated in detail by the WGEMM. SG80 is met.

Besides, main interactions between the krill fishery and biomass and ecosystem elements such as those derived from climate change are also been investigated by different researchers (Hill et al, 2013: Potential climate change effects on the krill fishery, Reiss et al, 2015: Effects of climate change on the krill-predator-fishery interactions). SG100 is met.

c	Understanding of component functions			
	Guide post		The main functions of the components (i.e., P1 target species, primary, secondary and ETP species and Habitats) in the ecosystem are **known**.	The impacts of the UoA on P1 target species, primary, secondary and ETP species and Habitats are identified and the main functions of these components in the ecosystem are **understood**.
	Met?		**Yes**	**Yes**
Rationale				

CCAMLR scientific observer reports identify and record interactions with target, primary, secondary, ETP species and habitats, allowing for the identification of the UoA impacts on these components of the ecosystem. The main functions of these components in the ecosystem are identified and understood.

Special attention is paid in management to studying bycatch species and especially krill predators. The main functions of these components in the ecosystem have been studied through a range of models, which include those exploring specific aspects of krill biology (Hofmann and Hùsrevõglu 2003; Murphy *et al.* 2004), multispecies population models (May *et al*. 1979; Murphy, 1995), single species population projection models to quantify regional catch limits (Constable *et al.* 2000), spatial single species models (e.g. Marin and Delgado 2001), mass-balance regional food web models such as EwE (Cornejo-Donoso and Antezana 2008), a spatial multispecies operating model (SMOM) of krill–predator fishery dynamics (Plagányi and Butterworth 2012), and models of krill transport at the maximum advection rate indicated by the Ocean Circulation and Climate Advanced Modelling Project, OCCAM (Rintoul *et al.* 2001). SG80 and SG100 are met.

d	Information relevance			
	Guide post		Adequate information is available on the impacts of the UoA on these components to allow some of the main consequences for the ecosystem to be inferred.	Adequate information is available on the impacts of the UoA on the components **and elements** to allow the main consequences for the ecosystem to be inferred.
	Met?		**Yes**	**Yes**
Rationale				

The information collected by the SISO observers provides detailed information of the impact of the krill fishery on the affected different components (fish bycatch, seabirds, marine mammals) at a species level. This information is recorded following standardized protocols and compiled and analysed by the WG-EMM. Information derived from SISO reports, CEMP research output, WG-EMM reports and ecosystem studies is available on the CCAMLR website (http://www.ccamlr.org/en/) and through the websites of many other organizations. These provide sufficient information to parameterize the ecosystem models described above. Besides, 2019 acoustic survey provides reliable estimates of krill biomass. This information is considered adequate to assess the impacts that the UoA has on the components and elements of the ecosystem, and to allow the main consequences for the ecosystem to be inferred. SG80 and SG100 are met.

e	Monitoring

	Guide post		Adequate data continue to be collected to detect any increase in risk level.	Information is adequate to support the development of strategies to manage ecosystem impacts.
	Met?		**Yes**	**No**

Rationale

Data is collected on a continuous basis by different groups and institutions, and can be obtained *inter alia* from logbooks, VMS track records, 100% observer coverage in the UoA and CEMP programme. Besides, there is an update (2019) on the krill biomass estimation thanks to the client and ARKs effort. In the team's opinion, it should be sufficient to detect increases in risk levels to both target stock and the ecosystem in which it is found. SG80 is met.

Modern fishing vessels are excellent platforms for collecting scientific data (Godø et al. 2014). In recent years CCAMLR has focused on the utilizing this potential for collecting acoustic densities of krill. A feasibility program was initiated based on CCAMLR instructions, highlighting the potential to support the development of FBM by collecting information from dedicated acoustic transects. This has also been highlighted by WG-EMM and SG-ASAM repeatedly during recent years. The fleets capacity and competence in demonstrating satisfactory performance quality has been acknowledged by the SG-ASAM 2019 (SC-CCAMLR 2019).

However, there is concern on the vulnerability of the Southern Ocean and on the impact climate change may bring to it. Further knowledge on the krill and krill dependant predator's response to climate change would be needed to address ecosystem impacts of the krill fishery. The use of the fishing fleet as observation platforms is a potential contributor to filling this information gap. SG100 is not met.

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Overall Performance Indicator score	**95**
Condition number (if relevant)	**N/A**

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7.9 Principle 3

7.9.1 Jurisdiction

This fishery operates in CCAMLR waters and is managed by CCAMLR in cooperation with the Norwegian Ministry of Industry, Trade and Fisheries/Directorate of Fisheries, and the Government of South Georgia and the South Sandwich Islands (GSGSSI).

7.9.2 Objectives

According to its Article II, the objective of the CCAMLR Convention is the conservation of Antarctic marine living resources, and any harvesting shall be conducted in accordance with the following three principles of conservation: i) prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment; ii) maintenance of the ecological relationships between harvested, dependent and related populations and the restoration of depleted populations; and iii) prevention of changes or minimisation of the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades, taking into account the state of available knowledge of the direct and indirect impact of harvesting, the effect of the introduction of alien species, the effects of associated activities on the marine ecosystem and of the effects of environmental changes, with the aim of making possible the sustained conservation of Antarctic marine living resources. These requirements equal those of the precautionary approach, as laid out in the FAO Code of Conduct.

At national level in Norway, the 2008 Marine Resources Act requires that Norwegian fisheries management be guided by the precautionary approach, in line with international treaties and guidelines, and by an ecosystem approach that takes into account habitats and biodiversity. The same objectives are found in the most relevant policy documents, such as the integrated management plans for the different ocean areas under Norwegian jurisdiction.

7.9.3 Legal basis and management set-up

CCAMLR coordinates scientific research and observer programmes, establishes TAC and distributes quotas between subareas. This is an Olympic fishery, so there are no national quotas. The Norwegian Directorate of Fisheries issues fishing permits and keeps track of the client vessels' fishing activity. GSGSSI issues permits for the vessels in the SGSSI Maritime Zone. CCAMLR determines the regulatory framework applied to the management of each fishery in the Convention Area, including catch limits and seasonal or area closures and measures aimed at minimizing potential impacts of fishing activities on non-target species and the ecosystem. The Standing Committee on Implementation and Compliance, subordinate to the Commission, provides it with information, advice, recommendations on fishery monitoring and compliance. The Scientific Committee provides the Commission with the best available scientific information on harvesting levels and other management issues. In turn, the Commission is obliged by the Convention to take full account of the recommendations and advice of the Scientific Committee in making its decisions. The Scientific Committee takes into account the outcomes of research from national programmes of CCAMLR members. In addition, CCAMLR has established a number of programmes to collect the data required for the effective management of the Southern Ocean, including fisheries monitoring, scientific observers on fishing vessels and ecosystem monitoring.

Norway has a well-established system for fisheries management, which has evolved over more than a century and is now codified in the 2008 Marine Resources Act. The Act provides for a formal system of cooperation between regulatory bodies of governance, such as the Ministry of Trade, Industry and Fisheries, the Directorate of Fisheries and the Coast Guard, and further for cooperation between management authorities and scientific research institutes, primarily the Institute of Marine Research. Fisheries management authorities coordinate their regulatory work with that of other bodies of governance, for instance the Ministry of Climate and Environment and the Norwegian Environmental Agency, which are responsible for the implementation of the integrated management plans for different marine areas under Norwegian jurisdiction. In the krill management, the Ministry of Foreign Affairs is also involved since it has the overall responsibility for Norwegian politics in the Antarctic and heads the Norwegian delegation to CCAMLR.

GSGSSI is involved in the licensing of vessels that fish in the South Georgia Maritime Zone, catch monitoring at King Edward Point in South Georgia and at-sea surveillance in the Maritime Zone. The national and international legal documents refer to and are in compliance with relevant international agreements, such as the 1982 Law of the Sea Convention and the 1995 Fish Stocks Agreement. Norwegian and South Georgia fishery authorities liaise closely with CCAMLR. The system is considered to be effective insofar as it constitutes a coherent set of rule-making practices at national and international level.

7.9.4 Stakeholders and consultation processes

The Antarctic and Southern Ocean Coalition (ASOC) has been actively involved in marine management in the Antarctic since the establishment of CCAMLR and was given observer status in 1991. ASOC is also a key partner to the Antarctic Krill Conservation Project, which is an international effort managed by the Pew Foundation, to secure from CCAMLR an ecosystem-based fisheries management programme for krill which is highly precautionary, scientifically based and protects the unique environment of the southern polar region. The client is part of the Association of Responsible Krill Harvesting Companies (ARK), which as, among other thing, organized meetings between industry, science, NGOs and management authorities prior to sessions in CCAMLR.

Norway has a long tradition of including non-governmental organizations in fisheries management, with continuous consultation and close cooperation between governmental agencies and user-group organizations, in particular the Norwegian Fishermen's Association. These organizations have regional branches, whose representatives are actively involved in policy-making, ensuring that local knowledge is also taken into consideration in the management process. So-called Regulatory Meetings are organized twice a year are open to all; user-group organizations and NGOs attend on a regular basis. In addition, there is day-to-day contact by telephone and email between authorities, user groups and other interested parties. Distribution of the national quota between different gear and fishing fleets has in practice been delegated to the Norwegian Association of Fishermen, which includes all fishermen from the smallest coastal vessels to ocean-going trawlers. Hence, the inherent conflict of interest between different vessel types is handled at the level of the Fishermen's Association, and the outcome is formalized by the Ministry or Directorate after agreement has been reached within the Association. Norwegian management authorities actively seek advice from user groups in preparation for all international consultations and negotiations, and user groups are included in the Norwegian delegation. In the krill fishery, there is continuous and close contact between the client, the Ministry of Foreign Affairs, the Ministry of Trade, Industry and Fisheries and the Institute of Marine Research.

7.9.5 Enforcement and sanctions

CCAMLR provides a clear and comprehensive monitoring system and control framework for Antarctic fisheries. CCAMLR conservation measures support a number of compliance mechanisms, including vessel licensing (Conservation Measure 10-02), monitoring of vessel movements (Conservation Measure 10-04), monitoring of vessel transhipments (Conservation Measure 10-09), the System of Inspection, the Vessel Monitoring System (Conservation Measure 10-04) and the Catch Documentation Scheme (Conservation Measure 10-05). The System of Inspection was established in 1989 to support the comprehensive inspections of vessels by Contracting Parties, providing for procedures for the designation of inspectors, the rights and responsibilities of inspectors, procedures for boarding and inspection, inspection reporting and the procedures for flag state prosecutions and sanctions based on evidence acquired under the System of Inspection.

Surveillance of CCAMLR fisheries is undertaken by Member States and incorporates the CCAMLR observer scheme. For the client fishery, enforcement is mainly taken care of by the Norwegian Directorate of Fisheries, which has demonstrated a consistent ability to enforce relevant regulations. Vessels are licensed on an annual basis and report catches from each haul through their electronic logbooks. VMS is obligatory. All landings are also reported to Norwegian enforcement authorities. In order to receive a license for the Antarctic krill fishery, Norwegian vessels are obliged to have an observer on board at all times. When entering the South Georgia Maritime Zone, vessels need to apply for a licence and pay a fee. All vessels are inspected by the South Georgia administration at King Edward Point before they are allowed to start fishing. They have to report catches on a daily basis and are also inspected by a patrol vessel during fishing operations. Before being granted a license, the fishing vessels have to produce flag-state validated VMS charts for the two preceding years.

The implementation of sanctions to deal with non-compliance is an issue for the CCAMLR Member States, either through flag state control (here: Norway), or, in the case of South Georgia through GSGSSI, coastal state jurisdiction over the Maritime Zone. The Norwegian Marine Resources Act provides statutory authority for the use of sanctions in the event of infringements of fisheries regulations. Intentional or negligent violations are punished with fines or prison up to one year, while infringements committed with gross intent or negligence may be punished with prison up to six years. Alternatively, catch, gear, vessels or other properties can be confiscated. The Norwegian enforcement agencies use a graduated sanctioning system, with sanctions ranging from oral warnings, written warnings and administrative fines to formal prosecution. If the fishers do not accept the fines issued by the enforcement or prosecution authority, the case goes to court. The decision of a lower-level court can then be appealed to higher-level courts. Sanctions within the South Georgia Maritime Zone are also applied at a level appropriate for deterring illegal fishing.

7.9.6 Review of the management system

There are various mechanisms in place to evaluate parts of the fishery-specific management system, but at varied levels of ambition and coverage. CCAMLR conducts ongoing internal reviews of its processes and the performance of its Member States to meet the fishery-specific management requirements outlined. These requirements are reviewed

annually (to fit in with the annual fisheries cycle) by the appropriate CCAMLR Working Groups (e.g. seabird mortality will be analysed by the Working Group on Incidental Mortality of Associated Fauna). The international side to the Norwegian fisheries management system is reviewed by the Parliament upon submission by the Government (through the Ministry of Trade, Industry and Fisheries) of annual reports on the agreements concluded with other states for the coming year, including under CCAMLR, and the previous year's fishing in accordance with such agreements. The Office of the Auditor General regularly carries out holistic reviews of different sectors of the Norwegian bureaucracy (so-called 'management audits', as opposed to the more traditional financial audits). Such comprehensive reviews have been carried out for the Barents Sea (2007 and 2011) and the North Sea and Skagerrak (2017), but not for the Southern Ocean fisheries.

CCAMLR was subject to a comprehensive external performance review in 2008, carried out by a panel appointed by the Commission composed of nine persons (see http://www.ccamlr.org/pu/E/revpanrep.htm). The purpose of the performance review was to evaluate the Commission 's performance against comprehensive criteria and specifically against the objectives and principles set out in Article II of the Convention. The review stated that the stock status and trends are broadly consistent with Article II of the Convention and international best practice. With particular reference to krill fisheries, it identified the need for ongoing research into predator–prey linkages in ecosystem modelling and adequate monitoring and management within krill fisheries. A second review was carried out in 2016/2017 by a panel of eight independent experts. The evaluation addressed a wide range of topics and noted good progress in implementing the recommendations from the first review.

7.10 Principle 3 Performance Indicator scores and rationales

PI 3.1.1 – Legal and/or customary framework

PI 3.1.1		The management system exists within an appropriate legal and/or customary framework which ensures that it: - Is capable of delivering sustainability in the UoA(s); - Observes the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; and - Incorporates an appropriate dispute resolution framework		
Scoring Issue		SG 60	SG 80	SG 100
a	Compatibility of laws or standards with effective management			
	Guide post	There is an effective national legal system **and a framework for cooperation** with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2	There is an effective national legal system and **organised and effective cooperation** with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2.	There is an effective national legal system and **binding procedures governing cooperation with other parties** which delivers management outcomes consistent with MSC Principles 1 and 2.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

The fishery is managed by CCAMLR, in interaction with the Norwegian Ministry of Industry, Trade and Fisheries/Directorate of Fisheries, and the Government of South Georgia and the South Sandwich Islands (GSGSSI). CCAMLR coordinates scientific research and observer programmes, establishes TAC and distributes quotas between subareas. This is an Olympic fishery, so there are no national quotas. The Norwegian Directorate of Fisheries issues fishing permits and keeps track of the client vessels' fishing activity. GSGSSI issues permits for the vessels in the SGSSI Maritime Zone. CCAMLR determines the regulatory framework applied to the management of each fishery in the Convention Area, including catch limits and seasonal or area closures and measures aimed at minimizing potential impacts of fishing activities on non-target species and the ecosystem. The Standing Committee on Implementation and Compliance, subordinate to the Commission, provides it with information, advice, recommendations on fishery monitoring and compliance. The Scientific Committee provides the Commission with the best available scientific information on harvesting levels and other management issues. In turn, the Commission is obliged by the Convention to take full account of the recommendations and advice of the Scientific Committee in making its decisions. The Scientific Committee takes into account the outcomes of research from national programmes of CCAMLR members. In addition, CCAMLR has established a number of programmes to collect the data required for the effective management of the Southern Ocean, including fisheries monitoring, scientific observers on fishing vessels and ecosystem monitoring.

Norway has a well-established system for fisheries management, which has evolved over more than a century and is now codified in the 2008 Marine Resources Act. The Act provides for a formal system of cooperation between regulatory bodies of governance, such as the Ministry of Trade, Industry and Fisheries, the Directorate of Fisheries and the Coast Guard, and further for cooperation between management authorities and scientific research institutes, primarily the Institute of Marine Research. Fisheries management authorities coordinate their regulatory work with that of other bodies of governance, for instance the Ministry of Climate and Environment and the Norwegian Environmental Agency, which are responsible for the implementation of the integrated management plans for different marine areas under Norwegian jurisdiction. In the krill management, the Ministry of Foreign Affairs is also involved since it has the overall responsibility for Norwegian politics in the Antarctic and heads the Norwegian delegation to CCAMLR.

GSGSSI is involved in the licensing of vessels that fish in the South Georgia Maritime Zone, catch monitoring at King Edward Point in South Georgia and at-sea surveillance in the Maritime Zone. The national and international legal documents refer to and are in compliance with relevant international agreements, such as the 1982 Law of the Sea Convention and the 1995 Fish Stocks Agreement. Norwegian and South Georgia fishery authorities liaise closely with CCAMLR. The system is considered to be effective insofar as it constitutes a coherent set of rule-making practices at national and international level.

Hence, there is an effective national legal system in place and a framework for cooperation with other parties to deliver management outcomes consistent with MSC Principles 1 and 2. SG 60 is met. The cooperation between states in CCAMLR can be characterized as organized and effective. SG 80 is met. It also contains binding procedures insofar as it is based on binding international agreements. SG 100 is met.

b	Resolution of disputes			
	Guide post	The management system incorporates or is subject by law to a **mechanism** for the resolution of legal disputes arising within the system.	The management system incorporates or is subject by law to a **transparent mechanism** for the resolution of legal disputes which is **considered to be effective** in dealing with most issues and that is appropriate to the context of the UoA.	The management system incorporates or is subject by law to a **transparent mechanism** for the resolution of legal disputes that is appropriate to the context of the fishery and has been **tested and proven to be effective**.
	Met?	**Yes**	**Yes**	**No**

Rationale

The CCAMLR Convention Article XXV states that if any dispute arises between two or more of the Contracting Parties concerning the interpretation or application of the Convention, they shall consult among themselves with a view to having the dispute resolved by negotiation, inquiry, mediation, conciliation, arbitration, judicial settlement or other peaceful means of their own choice. If agreement is not reached, the matter can be referred for settlement to the International Court of Justice or to arbitration. In practice, any issues of contention among the CCAMLR member states can be raised and discussed at the meetings of the Commission and subordinate bodies. These processes are transparent and subject to scrutiny by all member states.

At the national level in Norway, there is an effective, transparent dispute resolution system in place, as fishers can take their case to court if they do not accept the rationale behind an infringement accusation by enforcement authorities, or the fees levied against them. Verdicts at the lower court levels can be appealed to higher levels.

Hence, the management system incorporates or is subject by law to a mechanism for the resolution of legal disputes. SG 60 is met. These mechanisms are transparent and considered to be effective in dealing with most issues and is appropriate to the context of the UoA. SG 80 is met. It has been tested and proven to be effective at the national level, but less so at the international level. SG 100 is not met.

c	Respect for rights			
	Guide post	The management system has a mechanism to **generally respect** the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to **observe** the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to **formally commit** to the legal rights created explicitly or established by custom of people dependent on fishing for food and livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

There are no people directly dependent on fishing for food or livelihood in the Antarctica, but the nations taking part in the fishery have established traditional fishing rights in the Southern Ocean, which are now codified in the CCAMLR Convention and supporting documents, like the annual Fishery Reports, At national level in Norway, the fisheries management system includes various mechanisms that secure the rights of the coastal population. For the most important species, significantly and proportionately larger quota shares are allotted to coastal fisheries than to the ocean going fleet (see, for instance, the Regulation on Participation in Fisheries for an overview), with particular attention to the traditional fisheries of the coastal Sami population in the northernmost part of the country.

Hence, the management system has a mechanism to generally respect the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2. SG 60 is met. The system has mechanisms to observe such rights, so SG 80 is also met.

Since they are founded in binding agreement (at international level) and formal law (at national level), the mechanisms formally commit to these rights, and SG 100 is met.

References

Bodin, Ö., H. Österblom (2013), 'International fisheries regime effectiveness – Activities and resources of key actors in the Southern Ocean', *Global Environmental Change* 23: 948-956.

CCAMLR annual Fishery Reports.

CCAMLR Basic Documents, December 2018.

CCAMLR website.

Constable, A.J. (2011), 'Lessons from CCAMLR on the implementation of the ecosystem approach to managing fisheries', *Fish and Fisheries* 12: 138-151.

Convention for the Conservation of Antarctic Marine Living Resources (CAMLR Convention), 1980.

Interviews with representatives of AkerBioMarine, the Directorate of Fisheries, GSGSSI, the Institute of Marine Research and the Ministry of Trade, Industry and Fisheries during the site visit.

Jacquet, J., E. Blood-Patterson, C. Brooks, D. Ainley (2016), '" Rational use" in Antarctic waters', *Marine Policy* 63: 28-34.

Lov om forvaltning av viltlevande marine ressursar (havressurslova), LOV-2008-06-06-37, 2008 (Marine Resources Act).

Meld. St. 15 (2018–2019) Noregs fiskeriavtalar for 2019 og fisket etter avtalane i 2017 og 2018 (White Paper No. 15 2017–2018 on Norway's fisheries agreements with other states).

Nicol, S., J. Foster, S. Kawaguchi (2012), 'The fishery for Antarctic krill – recent developments', *Fish and Fisheries*, 13: 30-40.

Nilsson, J.A., E.A. Fulton, M. Haward, C. Johnson (2016), 'Consensus management in Antarctica's high seas – Past success and current challenges, *Marine Policy* 73: 172-180.

Overall Performance Indicator score	**95**
Condition number (if relevant)	**NA**

PI 3.1.2 – Consultation, roles and responsibilities

PI 3.1.2		**The management system has effective consultation processes that are open to interested and affected parties** **The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties**		
Scoring Issue		SG 60	SG 80	SG 100
a	Roles and responsibilities			
	Guide post	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **generally understood**.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **explicitly defined and well understood for key areas** of responsibility and interaction.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **explicitly defined and well understood for all areas** of responsibility and interaction.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

Overall management lines and the responsibilities of different management bodies are clear. The main responsibility for developing and promulgating the management plan for the fishery within Area 48 lies with CCAMLR, within the framework of the Antarctic Treaty. Article XVII of the Convention details the role of the Executive Secretary of CCAMLR and any other staff that they may need to appoint. Scientists appointed by CCAMLR members meet annually in Working Groups to undertake stock assessments and prepare scientific advice for the Commission. This scientific advice is reviewed annually by the CCAMLR Scientific Committee, which provides management advice to the Commission. Management policies and procedures are implemented through Conservation Measures and Resolutions. The CAMLR Convention sets out the terms under which observers can attend and participate in its statutory meetings. Within the CCAMLR Secretariat, the roles for the management of the different aspects of the fishery (compliance, data, observers etc.) are well defined and operate in a clear and efficient manner.

Within the SGSSI Maritime Zone, the only relevant actor is GSGSSI, which is responsible for licensing and enforcement. Their role is clearly defined and well understood by participants in the fishery.

The most important organizations involved at national level in Norway are government bodies such as the Ministry of Foreign Affairs, the Ministry of Trade, Industry and Fisheries, the Directorate of Fisheries and the Coast Guard, sales organizations such as the Norwegian Fishermen's Sales Organization, fishermen's organizations such as the Norwegian Fishermen's Association and environmental NGOs such as WWF.

Organisations and individuals involved in the management process have been identified, and their functions, roles and responsibilities appear to be generally understood. SG 60 is met. The functions, roles and responsibilities are explicitly defined in legislation and long-standing practice and well understood for key areas of responsibility and interaction. SG 80 is met. It is a principal challenge to claim that 'all' areas of responsibility and interaction are well understood, but our interviews at the site visit indicate that this is the case. SG 100 is met.

b	Consultation processes			
	Guide post	The management system includes consultation processes that **obtain relevant information** from the main affected parties, including local knowledge, to inform the management system.	The management system includes consultation processes that **regularly seek and accept** relevant information, including local knowledge. The management system demonstrates consideration of the information obtained.	The management system includes consultation processes that **regularly seek and accept** relevant information, including local knowledge. The management system demonstrates consideration of the information and **explains how it is used or not used**.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

The Antarctic and Southern Ocean Coalition (ASOC) has been actively involved in marine management in the Antarctic since the establishment of CCAMLR and was given observer status in 1991. ASOC is also a key partner to the Antarctic Krill Conservation Project, which is an international effort managed by the Pew Foundation, to secure from CCAMLR an ecosystem-based fisheries management programme for krill which is highly precautionary, scientifically based and protects the unique environment of the southern polar region. The client is part of the Association of Responsible Krill Harvesting Companies (ARK), which as, among other thing, organized meetings between industry, science, NGOs and management authorities prior to sessions in CCAMLR.

Norway has a long tradition of including non-governmental organizations in fisheries management, with continuous consultation and close cooperation between governmental agencies and user-group organizations, in particular the Norwegian Fishermen's Association. These organizations have regional branches, whose representatives are actively involved in policy-making, ensuring that local knowledge is also taken into consideration in the management process. So-called Regulatory Meetings are organized twice a year are open to all; user-group organizations and NGOs attend on a regular basis. In addition, there is day-to-day contact by telephone and email between authorities, user groups and other interested parties. Distribution of the national quota between different gear and fishing fleets has in practice been delegated to the Norwegian Association of Fishermen, which includes all fishermen from the smallest coastal vessels to ocean-going trawlers. Hence, the inherent conflict of interest between different vessel types is handled at the level of the Fishermen's Association, and the outcome is formalized by the Ministry or Directorate after agreement has been reached within the Association. Norwegian management authorities actively seek advice from user groups in preparation for all international consultations and negotiations, and user groups are included in the Norwegian delegation. In the krill fishery, there is continuous and close contact between the client, the Ministry of Foreign Affairs, the Ministry of Trade, Industry and Fisheries and the Institute of Marine Research. All stakeholders interviewed at the site visit claim that the relationship between the client, management and science is very close, at a formal and an informal level.

Hence, the management system includes consultation processes that obtain relevant information from the main affected parties, including local knowledge, to inform the management system. SG 60 is met. The processes regularly seek and accept relevant information, and the management system demonstrates consideration of the information obtained, as clearly shown by the minutes from the Regulatory Meetings. SG 80 is met. All stakeholders interviewed at the site visit claim that the management system also explains how their input is used on not used. SG 100 is met.

c	Participation			
	Guide post		The consultation process **provides opportunity** for all interested and affected parties to be involved.	The consultation process provides **opportunity and encouragement** for all interested and affected parties to be involved, and **facilitates** their effective engagement.
	Met?		**Yes**	**Yes**

Rationale

As follows from SI 3.1.2b above, the consultation processes provide opportunity for all interested and affected parties to be involved at both international and national level. Meetings are publicly announced, and stakeholders receive formal invitations to take part. Hence, the consultation process provides opportunity for all interested and affected parties to be involved. SG 80 is met. All stakeholders interviewed at the site visit claim that the authorities actively encourage all stakeholders, such as environmental NGOs, to be involved and facilitate their effective engagement. SG 100 is met.

References

Bodin, Ö., H. Österblom (2013), 'International fisheries regime effectiveness – Activities and resources of key actors in the Southern Ocean', *Global Environmental Change* 23: 948-956.

Cavangh, R.D., S.L. Hill, C.A. Knowland, S.M. Grant (2016), 'Stakeholder perspectives on ecosystem-based management of the Antarctic krill fishery', *Marine Policy* 68: 205-211.

CCAMLR annual Fishery Reports.

CCAMLR website.

Convention for the Conservation of Antarctic Marine Living Resources (CAMLR Convention), 1980.

Interviews with representatives of AkerBioMarine, the Directorate of Fisheries, GSGSSI, the Institute of Marine Research and the Ministry of Trade, Industry and Fisheries during the site visit.

Lov om forvaltning av viltlevande marine ressursar (havressurslova), LOV-2008-06-06-37, 2008 (Marine Resources Act).

Meld. St. 15 (2018–2019) Noregs fiskeriavtalar for 2019 og fisket etter avtalane i 2017 og 2018 (White Paper No. 15 2017–2018 on Norway's fisheries agreements with other states).

Referat fra reguleringsmøtet 6. juni 2019 ('Minutes from the Regulatory Meeting 6 June 2019'), Directorate of Fisheries, Norway, 2019.

Overall Performance Indicator score	**100**
Condition number (if relevant)	**NA**

PI 3.1.3 – Long term objectives

PI 3.1.3		The management policy has clear long-term objectives to guide decision-making that are consistent with MSC Fisheries Standard, and incorporates the precautionary approach		
Scoring Issue		SG 60	SG 80	SG 100
a	Objectives			
	Guide post	Long-term objectives to guide decision-making, consistent with the MSC Fisheries Standard and the precautionary approach, are **implicit** within management policy.	**Clear** long-term objectives that guide decision-making, consistent with MSC Fisheries Standard and the precautionary approach are **explicit** within management policy.	**Clear** long-term objectives that guide decision-making, consistent with MSC Fisheries Standard and the precautionary approach, are **explicit** within **and required by** management policy.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

According to its Article II, the objective of the CCAMLR Convention is the conservation of Antarctic marine living resources, and any harvesting shall be conducted in accordance with the following three principles of conservation: i) prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment; ii) maintenance of the ecological relationships between harvested, dependent and related populations and the restoration of depleted populations; and iii) prevention of changes or minimisation of the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades, taking into account the state of available knowledge of the direct and indirect impact of harvesting, the effect of the introduction of alien species, the effects of associated activities on the marine ecosystem and of the effects of environmental changes, with the aim of making possible the sustained conservation of Antarctic marine living resources. These requirements equal those of the precautionary approach, as laid out in the FAO Code of Conduct.

At national level, the 2008 Marine Resources Act requires that Norwegian fisheries management be guided by the precautionary approach, in line with international treaties and guidelines (§ 7 a)), and by an ecosystem approach that takes into account habitats and biodiversity (§ 7 b)). The same objectives are found in the most relevant policy documents, such as the integrated management plans for the different ocean areas under Norwegian jurisdiction.

Hence, long-term objectives to guide decision-making, consistent with the MSC fisheries standard and the precautionary approach are in place. SG 60 is met. These objectives are clear and explicit within the management policy, so SG 80 is met. Since they are required by law and binding international agreement, SG 100 is also met.

References

Convention for the Conservation of Antarctic Marine Living Resources (CAMLR Convention), 1980.

FAO Code of Conduct for Responsible Fisheries, 1995.

Lov om forvaltning av viltlevande marine ressursar (havressurslova), LOV-2008-06-06-37, 2008 (Marine Resources Act).

Meld. St. 35 (2016–2017) Oppdatering av forvaltningsplanen for Norskehavet, 2017 (Update of the [Integrated] Management Plan for the Norwegian Sea).

Overall Performance Indicator score	**100**
Condition number (if relevant)	**NA**

PI 3.2.1 – Fishery-specific objectives

PI 3.2.1		The fishery-specific management system has clear, specific objectives designed to achieve the outcomes expressed by MSC's Principles 1 and 2		
Scoring Issue		SG 60	SG 80	SG 100
a	Objectives			
	Guide post	**Objectives**, which are broadly consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **implicit** within the fishery-specific management system.	**Short and long-term objectives**, which are consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **explicit** within the fishery-specific management system.	**Well defined and measurable short and long-term objectives**, which are demonstrably consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **explicit** within the fishery-specific management system.
	Met?	**Yes**	**Yes**	**Partial**

Rationale

CCAMLR's overarching objectives are laid out in PI 3.1.3 above. The more specific, short- and long-term strategy for achieving these objectives is reflected in Conservation Measure 51-01 (2010). A precautionary krill catch limit of 5.61 million tonnes is set for Area 48, based on the potential yield estimate. This is well above the current catch and will allow for expansion. However, a 'catch trigger' (620,000 t) is set not to be exceeded until a procedure for division of the overall catch limit into smaller management units has been established, based on advice from the Scientific Committee. The objective of this division is to avoid possible unacceptable concentration of catch within the foraging areas of vulnerable predators. Although the trigger level is close to the highest global annual catch to date, it is significantly more than the largest annual catch to date in Area 48.

Objectives consistent with achieving the outcomes expressed by MSC's Principles are not only implicit (the SG 60 requirement), but also explicit in the fishery-specific management system. These are both short- and long-term, so SG 80 is met. P1 objectives are well defined and measurable, but this seems to a lesser extent to be the case with P2 objectives. This warrants a partial score on SG 100.

References

CCAMLR Conservation Measure 51-01 regarding Precautionary catch limitations on *Euphausia superba* in Statistical Subareas 48.1, 48.2, 48.3 and 48.4. http://www.ccamlr.org/sites/drupal.ccamlr.org/files//51-01.pdf

Convention on the Conservation of Antarctic Marine Living Resources, 1982.

Lov om forvaltning av viltlevande marine ressursar (havressurslova), LOV-2008-06-06-37, 2008 (Marine Resources Act).

Meld. St. 15 (2018–2019) Noregs fiskeriavtalar for 2019 og fisket etter avtalane i 2017 og 2018 (White Paper No. 15 2017–2018 on Norway's fisheries agreements with other states).

Overall Performance Indicator score	**90**
Condition number (if relevant)	**NA**

PI 3.2.2 – Decision-making processes

PI 3.2.2		The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives, and has an appropriate approach to actual disputes in the fishery		
Scoring Issue		SG 60	SG 80	SG 100
a	Decision-making processes			
	Guide post	There are **some** decision-making processes in place that result in measures and strategies to achieve the fishery-specific objectives.	There are **established** decision-making processes that result in measures and strategies to achieve the fishery-specific objectives.	
	Met?	**Yes**	**Yes**	
Rationale				
CCAMLR has well established decision-making processes. They allow for stakeholder input and clear scientific analysis of the data available within the Commission, Working Groups and Scientific Committee, and they result in conservation measures and fisheries strategies designed to achieve their short- and long-term fishery-specific objectives. At the national level in Norway, the Ministry of Trade, Industry and Fisheries decides on policy and regulatory schemes, while the Directorate of Fisheries acts as a technical body with a main responsibility for secondary legislation. The Directorate and the Coast Guard perform compliance control, on shore and at sea respectively. The decision-making processes include the allocation of national quotas to different fleet groups and establishment of technical regulations, after consultations with user groups and other stakeholders. Hence, there are decision-making processes in place that result in measures and strategies to achieve the fishery-specific objectives. This applies to the Antarctic krill fishery as it does to Norwegian fisheries in general as well as other CCAMLR fisheries; see PIs 3.1.1 and 3.1.2 above. SG 60 is met. These processes are established – evolved over several decades and now codified in formal law and binding international agreement – so SG 80 is also met.			
b	Responsiveness of decision-making processes			
	Guide post	Decision-making processes respond to **serious issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take some account of the wider implications of decisions.	Decision-making processes respond to **serious and other important issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.	Decision-making processes respond to **all issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.
	Met?	**Yes**	**Yes**	**No**
Rationale				
Fisheries-specific issues identified in relevant research are included in transparent decision-making processes within the CCAMLR Working Groups and the Scientific Committee, as appropriate. Where and when necessary, modifications are made by these and by the Norwegian Directorate of Fisheries and GSGSSI to the monitoring and evaluation of the fisheries (through modifications to the complex data-recording systems and observer logbooks). A clear example of the well-functioning responsiveness of the management system is its ability to halt the fishery within a subarea once the subarea's proportion of the 'trigger level' has been caught. SG 60 is met. Not only serious issues are responded to, so SG 80 is also met. It is a principal question whether it is possible to claim that *all* issues are responded to, but to score precautionarily the assessment team concludes that SG 100 is not met.			
c	Use of precautionary approach			

	Guide post		Decision-making processes use the precautionary approach and are based on best available information.	
	Met?		**Yes**	

Rationale

CCAMLR and Norwegian national decision-making is based on the precautionary approach (see PI 3.1.3) and the best available information by national experts working closely together in CCAMLR Working Groups, the Scientific Committee and the Commission. SG 80 is met.

d	Accountability and transparency of management system and decision-making process			
	Guide post	Some information on the fishery's performance and management action is generally available on request to stakeholders.	**Information on the fishery's performance and management action is available on request**, and explanations are provided for any actions or lack of action associated with findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.	Formal reporting to all interested stakeholders **provides comprehensive information on the fishery's performance and management actions** and describes how the management system responded to findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

CCAMLR reports and information on the CCAMLR website describe how the management system responds to findings and relevant recommendations emerging from research, monitoring, evaluation and review activity. The whole CCAMLR process is based on dialogue, stakeholder involvement and extensive reporting. The same is true for the Norwegian fisheries management system, which in addition to written reports – such as annual reports from the Ministry of Trade, Industry and Fisheries to Parliament – extensively uses informal as well as formal meetings open to all interested stakeholders to describe how available information is responded to. The role of GSGSSI is the management of the fisheries in question is more limited, but they also publish information about licensing and enforcement matters on their website and in written reports.

Hence, information on the fishery's performance and management action is generally available on request. SG 60 is met. In the relevant reports, actions taken or not taken by the relevant authority are accounted for, including those proposed based on information from research, monitoring, evaluation and review activity. SG 80 is met. The websites of CCAML and of the Directorate of Fisheries contain detailed and updated information on quotas and catches broken down to individual vessels, species and gear, among other things. In the opinion of the assessment team, this counts as formal reporting appropriate to the context of the fishery, as much as letters to stakeholders would have done. SG 100 is met.

e	Approach to disputes			
	Guide post	Although the management authority or fishery may be subject to continuing court challenges, it is not indicating a disrespect or defiance of the law by repeatedly violating the same law or regulation necessary for the sustainability for the fishery.	The management system or fishery is attempting to comply in a timely fashion with judicial decisions arising from any legal challenges.	The management system or fishery acts proactively to avoid legal disputes or rapidly implements judicial decisions arising from legal challenges.
	Met?	**Yes**	**Yes**	**Yes**

Rationale
Neither CCAMLR nor Norwegian fisheries management is subject to continuing court challenges or indicating a disrespect or defiance of the law by repeatedly violating the same law or regulation necessary for the sustainability for the fishery. SG 60 is met. When occasionally taken to court by fishing companies, the Norwegian management authority complies with the judicial decision in a timely manner. SG 80 is met. The management authority works proactively to avoid legal disputes, both in CCAMLR and in Norway. This is done partly through the tight cooperation with user groups at the regulatory level (see PI 3.1.2 above), ensuring as high legitimacy as possible for regulations and other management decisions. Since the management system acts proactively to avoid legal disputes and rapidly implements judicial decisions, SG 100 is met.
References
Convention on the Conservation of Antarctic Marine Living Resources, 1982. Interviews with representatives of AkerBioMarine, the Directorate of Fisheries, GSGSSI, the Institute of Marine Research and the Ministry of Trade, Industry and Fisheries during the site visit. Lov om forvaltning av viltlevande marine ressursar (havressurslova), LOV-2008-06-06-37, 2008 (Marine Resources Act). Meld. St. 15 (2018–2019) Noregs fiskeriavtalar for 2019 og fisket etter avtalane i 2017 og 2018 (White Paper No. 15 2017–2018 on Norway's fisheries agreements with other states).

Overall Performance Indicator score	**95**
Condition number (if relevant)	**NA**

PI 3.2.3 – Compliance and enforcement

PI 3.2.3		Monitoring, control and surveillance mechanisms ensure the management measures in the fishery are enforced and complied with		
Scoring Issue		SG 60	SG 80	SG 100
a	MCS implementation			
	Guide post	Monitoring, control and surveillance **mechanisms** exist, and are implemented in the fishery and there is a reasonable expectation that they are effective.	A monitoring, control and surveillance **system** has been implemented in the fishery and has demonstrated an ability to enforce relevant management measures, strategies and/or rules.	A **comprehensive** monitoring, control and surveillance system has been implemented in the fishery and has demonstrated a consistent ability to enforce relevant management measures, strategies and/or rules.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

CCAMLR provides a clear and comprehensive monitoring system and control framework for Antarctic fisheries. CCAMLR conservation measures support a number of compliance mechanisms, including vessel licensing (Conservation Measure 10-02), monitoring of vessel movements (Conservation Measure 10-04), monitoring of vessel transhipments (Conservation Measure 10-09), the System of Inspection, the Vessel Monitoring System (Conservation Measure 10-04) and the Catch Documentation Scheme (Conservation Measure 10-05). The System of Inspection was established in 1989 to support the comprehensive inspections of vessels by Contracting Parties, providing for procedures for the designation of inspectors, the rights and responsibilities of inspectors, procedures for boarding and inspection, inspection reporting and the procedures for flag state prosecutions and sanctions based on evidence acquired under the System of Inspection.

Surveillance of CCAMLR fisheries is undertaken by member states and incorporates the CCAMLR observer scheme. For the client fishery, enforcement is mainly taken care of by the Norwegian Directorate of Fisheries, which has demonstrated a consistent ability to enforce relevant regulations. Vessels are licensed on an annual basis and report catches from each haul through their electronic logbooks. VMS is obligatory. All landings are also reported to Norwegian enforcement authorities. In order to receive a license for the Antarctic krill fishery, Norwegian vessels are obliged to have an observer on board at all times. When entering the South Georgia Maritime Zone, vessels need to apply for a licence and pay a fee. All vessels are inspected by the South Georgia administration at King Edward Point before they are allowed to start fishing. They have to report catches on a daily basis and are also inspected by a patrol vessel during fishing operations. Before being granted a license, the fishing vessels have to produce flag-state validated VMS charts for the two preceding years.

Hence, monitoring, control and surveillance mechanisms exist and are implemented in the fishery, and there is a reasonable expectation that they are effective. SG 60 is met. These measures qualify as a system and have demonstrated an ability to enforce relevant management measures, strategies and rules; see SI 3.2.3c below on compliance. SG 80 is met. The system is comprehensive and has demonstrated a consistent ability to enforce regulations; see SI 3.2.3c below. SG 100 is met.

b	Sanctions			
	Guide post	Sanctions to deal with non-compliance exist and there is some evidence that they are applied.	Sanctions to deal with non-compliance exist, **are consistently applied** and thought to provide effective deterrence.	Sanctions to deal with non-compliance exist, are consistently applied and **demonstrably** provide effective deterrence.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

The implementation of sanctions to deal with non-compliance is an issue for the CCAMLR Member States, either through flag state control (here: Norway), or, in the case of South Georgia through GSGSSI, coastal state jurisdiction over the Maritime Zone.

The Norwegian Marine Resources Act provides statutory authority for the use of sanctions in the event of infringements of fisheries regulations. Intentional or negligent violations are punished with fines or prison up to one year, while infringements committed with gross intent or negligence may be punished with prison up to six years. Alternatively, catch, gear, vessels or other properties can be confiscated. The Norwegian enforcement agencies use a graduated sanctioning system, with sanctions ranging from oral warnings, written warnings and administrative fines to formal prosecution. If the fishers do not accept the fines issued by the enforcement or prosecution authority, the case goes to court. The decision of a lower-level court can then be appealed to higher-level courts. Sanctions within the South Georgia Maritime Zone are also applied at a level appropriate for deterring illegal fishing.

Hence, sanctions to deal with non-compliance exist and there is evidence that they are applied. SG 60 is met. Sanctions are consistently applied and thought to provide effective deterrence; see SI 3.2.3c below on compliance. SG 80 is met. Sanctions demonstrably provide effective deterrence, and SG 100 is met.

c	Compliance			
	Guide post	Fishers are **generally thought** to comply with the management system for the fishery under assessment, including, when required, providing information of importance to the effective management of the fishery.	**Some evidence exists** to demonstrate fishers comply with the management system under assessment, including, when required, providing information of importance to the effective management of the fishery.	There is a **high degree of confidence** that fishers comply with the management system under assessment, including, providing information of importance to the effective management of the fishery.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

The fishery has on board observers at all times, and catches are reported to Norwegian enforcement authorities in real-time, and to GSGSSI authorities when they fish in the GSGSSI maritime zone. Both GSGSSI authorities and the Norwegian Directorate of Fisheries confirm that there have been no infringements by the UoA vessels. Hence, fishers are generally thought to comply with the requirements of the management system, including, when required, providing information of importance to the effective management of the fishery. SG 60 is met. Some evidence exists that this is the case; cf. annual information from Norwegian fishery authorities. SG 80 is met. Clear statements from enforcement authorities from both Norway and the GSGSSI at the site visit that there have never been any compliance issues with the UoA vessels provide for a high degree of confidence that fishers comply with regulations. SG 100 is met.

d	Systematic non-compliance			
	Guide post		There is no evidence of systematic non-compliance.	
	Met?		**Yes**	

Rationale

As demonstrated under PI 3.2.3c above, there is no evidence of systematic non-compliance in the fishery. SG 80 is met.

References

CCAMLR Conservation Measures 10-02, 10-04, 10-05 and 10-09.

Interviews with representatives of AkerBioMarine, the Directorate of Fisheries, GSGSSI, the Institute of Marine Research and the Ministry of Trade, Industry and Fisheries during the site visit.

Lov om forvaltning av viltlevande marine ressursar (havressurslova), LOV-2008-06-06-37, 2008 (Marine Resources Act).

Meld. St. 15 (2018–2019) Noregs fiskeriavtalar for 2019 og fisket etter avtalane i 2017 og 2018 (White Paper No. 15 2017–2018 on Norway's fisheries agreements with other states).

Overall Performance Indicator score	**100**
Condition number (if relevant)	**NA**

PI 3.2.4 – Monitoring and management performance evaluation

PI 3.2.4		There is a system of monitoring and evaluating the performance of the fishery-specific management system against its objectives There is effective and timely review of the fishery-specific management system		
Scoring Issue		SG 60	SG 80	SG 100
a	Evaluation coverage			
	Guide post	There are mechanisms in place to evaluate **some** parts of the fishery-specific management system.	There are mechanisms in place to evaluate **key** parts of the fishery-specific management system.	There are mechanisms in place to evaluate **all** parts of the fishery-specific management system.
	Met?	**Yes**	**Yes**	**No**

Rationale

There are various mechanisms in place to evaluate parts of the fishery-specific management system, but at varied levels of ambition and coverage. CCAMLR conducts ongoing internal reviews of its processes and the performance of its Member States to meet the fishery-specific management requirements outlined. These requirements are reviewed annually (to fit in with the annual fisheries cycle) by the appropriate CCAMLR Working Groups (e.g. seabird mortality will be analysed by the Working Group on Incidental Mortality of Associated Fauna). The international side to the Norwegian fisheries management system is reviewed by the Parliament upon submission by the Government (through the Ministry of Trade, Industry and Fisheries) of annual reports on the agreements concluded with other states for the coming year, including under CCAMLR, and the previous year's fishing in accordance with such agreements. The Office of the Auditor General regularly carries out holistic reviews of different sectors of the Norwegian bureaucracy (so-called 'management audits', as opposed to the more traditional financial audits). Such comprehensive reviews have been carried out for various fisheries in the Northeast Atlantic, but not for the Southern Ocean fisheries.

CCAMLR was subject to a comprehensive external performance review in 2008, carried out by a panel appointed by the Commission composed of nine persons (see http://www.ccamlr.org/pu/E/revpanrep.htm). The purpose of the performance review was to evaluate the Commission 's performance against comprehensive criteria and specifically against the objectives and principles set out in Article II of the Convention. The review states that the stock status and trends are broadly consistent with Article II of the Convention and international best practice. With particular reference to krill fisheries, it identified the need for ongoing research into predator–prey linkages in ecosystem modelling and adequate monitoring and management within krill fisheries. A second review was carried out in 2016/2017 by a panel of eight independent experts. The evaluation addressed a wide range of topics and noted good progress in implementing the recommendations from the first review.

Hence, the fishery has in place mechanisms to evaluate some parts of the management system, so SG 60 is met. Both the CCAMLR performance reviews and the Norwegian reviews of internationally managed fisheries to which Norway takes part are comprehensive and include key parts of the management system. SG 80 is met. It is a principal question whether it is possible to claim that 'all' parts of the management system are subject to review. The comprehensiveness of the CCAMLR performance reviews warrants the conclusion that this is the case for the international component of the management system. Since there have been no management audits at national level of the krill fishery, this is less so the case for the national component of the system. SG 100 is not met.

b	Internal and/or external review			
	Guide post	The fishery-specific management system is subject to **occasional internal** review.	The fishery-specific management system is subject to **regular internal** and **occasional external** review.	The fishery-specific management system is subject to **regular internal and external** review.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

As noted under SI 3.2.4a above, the fishery-specific management system is subject to various forms of internal self-evaluation within CCAMLR and the Norwegian bodies of governance. SG 60 is met. These take place on a regular

basis, and the system is also subject to external review. The national Norwegian component is reviewed by Parliament following the submission of status reports by the Ministry of Trade Industry and Fisheries. As noted, CCAMLR has been subject to extensive external review. SG 80 is met.

It is a principal question whether two external reviews in nine years qualify as 'regular'. Furthermore, while the *extent* of the reviews is at issue under SI 3.2.4a, and their *frequency* under SI 3.2.4b, there is a sliding passage between them. Comprehensive reviews at intervals of some years may be as appropriate as superficial reviews every year. While nine years passed between the first and second review of CCAMLR, the coverage of these reviews is very comprehensive. Hence, it is the expert opinion of the assessment team that this is sufficient to the scale of the fishery to qualify as regular. SG 100 is met.

References

CCAMLR Performance Review Panel Report, 1 September 2008.

Second Performance Review of CCAMLR – Final Report of the Panel, CCAMLR-XXXVI/01, 31 August 2017.

Meld. St. 15 (2018–2019) Noregs fiskeriavtalar for 2019 og fisket etter avtalane i 2017 og 2018 (White Paper No. 15 2017–2018 on Noway's fisheries agreements with other states).

Overall Performance Indicator score	**90**
Condition number (if relevant)	**NA**

7.11 Principle 3 references:

Bodin, Ö., H. Österblom (2013), 'International fisheries regime effectiveness – Activities and resources of key actors in the Southern Ocean', *Global Environmental Change* 23: 948-956.

Cavangh, R.D., S.L. Hill, C.A. Knowland, S.M. Grant (2016), 'Stakeholder perspectives on ecosystem-based management of the Antarctic krill fishery', *Marine Policy* 68: 205-211.

CCAMLR annual Fishery Reports.

CCAMLR Basic Documents, December 2018.

CCAMLR Conservation Measure 10-02, 10-04, 10-05, 10-0 and 51-01.

CCAMLR Performance Review Panel Report, 1 September 2008.

CCAMLR website.

Constable, A.J. (2011), 'Lessons from CCAMLR on the implementation of the ecosystem approach to managing fisheries', *Fish and Fisheries* 12: 138-151.

Convention for the Conservation of Antarctic Marine Living Resources (CAMLR Convention), 1980.

FAO Code of Conduct for Responsible Fisheries, 1995.

Jacquet, J., E. Blood-Patterson, C. Brooks, D. Ainley (2016), '" Rational use" in Antarctic waters', *Marine Policy* 63: 28-34.

Lov om forvaltning av viltlevande marine ressursar (havressurslova), LOV-2008-06-06-37, 2008 (Marine Resources Act).

Meld. St. 9 (2017–2018) Noregs fiskeriavtalar for 2018 og fisket etter avtalane i 2016 og 2017 (White Paper No. 9 2017–2018 on Norway's fisheries agreements with other states).

Meld. St. 15 (2018–2019) Noregs fiskeriavtalar for 2019 og fisket etter avtalane i 2017 og 2018 (White Paper No. 15 2017–2018 on Noway's fisheries agreements with other states).

Nicol, S., J. Foster, S. Kawaguchi (2012), 'The fishery for Antarctic krill – recent developments', *Fish and Fisheries*, 13: 30-40.

Nilsson, J.A., E.A. Fulton, M. Haward, C. Johnson (2016), 'Consensus management in Antarctica's high seas – Past success and current challenges, *Marine Policy* 73: 172-180.

Second Performance Review of CCAMLR – Final Report of the Panel (https://www.ccamlr.org/en/document/publications/second-performance-review-ccamlr- %E2%80%93-final-report-panel)

8 Appendices

8.1 Assessment information

8.1.1 Previous assessments

The fishery was certified 15 June 2010, with three conditions, which were closed in 2011 and 2012; see Table 18. The fishery was recertified 16 June 2015, with no conditions. The Public Certification Reports for the initial assessment and first reassessment are available on the MSC website: https://fisheries.msc.org/en/fisheries/aker-biomarine-antarctic-krill/@@assessments.

Table 18: Summary of previous assessment conditions

Condition	PI(s)	Year closed	Justification
Condition 1, limit and target reference points: Estimate the precautionary fishing mortality and biomass levels consistent with the catch trigger level of 620,000t and (as this is a low trophic level species) assess the associated risk of over-fishing according to the predator and recruitment criteria.	1.1.2	2011	Assessment carried out.
Condition 2, larval fish catch: Assess the risk that the main retained species are beyond biologically based limits as a result of larval fish catch at current and trigger levels; concentrating on *C. gunnari* and *N.rossii* but with consideration for other species which may be of concern.	2.1.1, 2.1.2	2012	Risk assessment carried out.
Condition 3, ecosystem effects: Implement an appropriate strategy to prevent significant local depletion.	2.5.2	2012	Strategy implemented.

8.1.2 Small-scale fisheries

Table 19: Small scale fisheries

Unit of Assessment (UoA)	Percentage of vessels with length <15m	Percentage of fishing activity completed within 12 nautical miles of shore
UoA 1	0 %	0 %

8.2 Evaluation processes and techniques

8.2.1 Site visits

The 4th surveillance audit was combined with the site visit for the 2nd re-assessment of the fishery and took place in Oslo 16-17 December and Bergen 18 December 2019.

8.2.2 Stakeholder participation

Stakeholder participation was encouraged prior to the site visit and throughout the assessment process. The fishery was formally announced as entering re-assessment on the 13th September 2019. In the announcement, stakeholders were notified and encouraged to submit comments on the ACDR. No comments were submitted.

All three team members took part in the site visit: Geir Hønneland (Team Leader and P3 expert), Julian Addison (P1 expert) and Lucia Revenga (P2 expert). Meetings were organized with the following client representatives and stakeholders:

- Pål Skogrand, Aker BioMarine
- Sigve Nordrum, Aker BioMarine
- Frank Grebstad, Aker BioMarine
- Runa Haug Khoury, Aker BioMarine
- Kristoffer Bjørklund, Ministry of Trade, Industry and Fisheries
- Sue Gregory, GSGSSI (via Skype)
- Bjørn A. Krafft, Institute of Marine Research
- Modulf Overvik, Directorate of Fisheries

The fishery's performance against the MSC requirements were discussed at the meetings, and stakeholders were given the opportunity to express any concern they might have.

Stakeholders will have another opportunity to submit comments at the Public Comment Draft Report (PCDR) Stage. All written submissions and a summary of all verbal submissions and interview shall be appended to the reports as the assessment process progresses.

8.2.3 Evaluation techniques

1. Public Announcements

The full assessment was publicly announced on the 13th September 2019 at the MSC website as well as sent by email in the MSC Fishery Announcements newsletter to all registered recipients. The announcement was also distributed to all LR stakeholders via the LR Mailchimp system. This was also the method used for consultation on subsequent steps (e.g. peer reviewers' announcement, new UoA, etc.). See Section 8.4 for a detailed list of all consultations that took place at different stages along the process. At this time, LR also announced the assessment site visit dates and location, as well as the assessment team. This was done according to the process requirements in MSC's Fisheries Certification Process v2.1, and in the MSC Fisheries Standard v2.0/2.01. Together, these media presented the announcement to a wide audience representing industry, agencies, and other stakeholders. Meetings and conference calls held during the site visit constituted the main tool in guaranteeing the participation of relevant stakeholders.

2. Information gathering

The assessment team reviewed documents sent by the client ahead of the onsite visit (catch data, logbooks, internal records of quota monitoring, sales notes and other relevant documents generated after landing, country-specific fisheries and environmental regulations, science and advice reports and other scientific publications). See section 7.5, 0 and 0 for a detailed list of references used. Discussions with the clients and management agencies centred on the content within the provided documentation. In cases where relevant documentation was not provided in advance of the meeting, it was requested by the assessment team and subsequently supplied during, or shortly after the meeting. The assessment team and the clients set up meetings with the relevant stakeholders during the site visit, as per MSC Fisheries Certification Process v2.1, Section 8.2.2.

3. Scoring

Scoring was performed according to the procedure established in Certification Requirement 7.10 (MSC FCR v2.01). In the FCR v2.01 default assessment tree used for this assessment with recognition of LTL target species on PI 1.1.1, the MSC has 28 PIs, six in Principle 1, 15 in Principle 2, and seven in Principle 3. The PIs are grouped in each principle by 'component.' Principle 1 has two components, Principle 2 has five, and Principle 3 has two. Each PI consists of one or more 'scoring issues;' a scoring issue is a specific topic for evaluation. 'Scoring Guideposts' define the requirements for meeting each scoring issue at the 60 (conditional pass), 80 (full pass), and 100 (state of the art) levels.

Note that some scoring issue may not have a scoring guidepost at each of the 60, 80, and 100 levels; in the case of the example above, scoring issue (b) does not have a scoring issue at the SG60 level. The scoring issues and scoring guideposts are cumulative; this means that a PI is scored first at the SG60 levels. If not all of the SG scoring issues meet the 60 requirements, the fishery fails, and no further scoring occurs. If all of the SG60 scoring issues are met, the fishery meets the 60 level, and the scoring moves to SG80 scoring issues. If no scoring issues meet the requirements at the SG80 level, the fishery receives a score of 60. As the fishery meets increasing numbers of SG80 scoring issues, the score increases above 60 in proportion to the number of scoring issues met; PI scoring occurs at 5-point intervals. If the fishery meets half the scoring issues at the 80 level, the PI would score 70; if it meets a quarter, then it would score 65; and it would score 75 by meeting three-quarters of the scoring issues. If the fishery meets all of the SG80 scoring issues, the scoring moves to the SG100 level. Scoring at the SG100 level follows the same pattern as for SG80. Principle scores result from averaging the scores within each component, and then from averaging the component scores within each Principle. If a Principle averages less than 80, the fishery fails. Scoring for this fishery followed a consensus process in which the assessment team discussed the information available for evaluating PIs to develop a broad opinion of performance of the fishery against each PI. Review of sections 8.3 by all team members assured that the assessment team was aware of the issues for each PI.

The assessment team held preliminary scoring meeting along the site visit where the Performance Indicators of the fishery were evaluated jointly by the team in order to assess whether there was still information needs to be communicated to the client. After the site visit, each team member was assigned their relevant section in the report to complete before proceeding to a joint evaluation of every PI and the pertaining scoring systems and rationales through scoring meetings which took place via conference calls. The assessment team held a scoring meeting on 3rd February, where all individual scores were agreed within the team. Team members are responsible for completing their relevant scoring tables and providing a provisional score. The necessary harmonisation procedure was already described in section 8.7. PI scores were entered into MSC's Fishery Assessment Scoring Worksheet (Section 7.1) to arrive at Principle-level scores.

The Aker Biomarine Antarctic Krill fishery complies with MSC Fisheries Certification Requirements v2.01.

The team has set no binding conditions for certification and no non-binding management recommendations.

4. Scoring elements

A complete list of the different scoring elements as used in the scoring tables is presented in
Table 17: Scoring elements.

5. IPI exemption

Please see Section 6.4 for full explanation of IPI requirements in this fishery.

8.3 Peer Review reports

8.3.1 Peer Reviewer A: General Comments

Question	Yes/No	Peer Reviewer Justification (as given at initial Peer Review stage). Peer Reviewers should provide brief explanations for their 'Yes' or 'No' answers in this table, summarising the detailed comments made in the PI and RBF tables.	CAB Response to Peer Reviewer's comments (as included in the Public Comment Draft Report - PCDR)
Is the scoring of the fishery consistent with the MSC standard, and clearly based on the evidence presented in the assessment report?	No	The scoring of the fishery is consistent with the MSC standard but is not always clearly supported by the information presented. Specifically, scores awarded to three Principle 1 PIs (1.1.1, 1.2.3 and 1.2.4) are justified based on abundance estimates from an acoustic survey conducted only twice in the past 20 years, small-scale surveys that are unreliable and information from another database (KRILLBASE) that are not shown in this report. These sources of evidence do not clearly support some of the scores awarded, especially for PIs 1.2.3 and 1.2.4. Also, as noted in the report (p.34) another Antarctic krill fishery; Deris S.A. - Pesca Chile - Antarctic krill fishery, is currently certified under another MSC certificate, as of Sep 6 2018, However the issue of harmonization of assessment outcomes has not been fully addressed in this report in that comparison of outcomes has been presented (Tables 24-26), but no rationale for scoring differences has been provided.	The peer reviewer's comments in relation to the scores awarded to the various Principle 1 PIs are responded to in detail under the respective PIs. The assessment team notes the peer reviewer's comment that the Client and Peer Review Draft Report (CPRDR) has not fully addressed issues of harmonisation with the Deris SA - Pesca Chile- Antarctic krill fishery. However, the MSC template states that section 8.8 on harmonised fishery assessments should be drafted at the ACDR stage and completed at the Public Certification Report stage, i.e. after all peer reviewer and MSC Technical Oversight comments have been received. There is no requirement therefore to include the results of any harmonisation at the CPRDR stage, however, following the comments of the peer reviewers and discussion with the assessment team for the overlapping Chilean krill fishery, the assessment team has now provided additional information in the Public Comment Draft Report.
Are the condition(s) raised appropriately written to achieve the SG80 outcome within the specified timeframe? [Reference: FCP v2.1, 7.18.1 and sub-clauses]		NA; no conditions raised	NA

Is the client action plan clear and sufficient to close the conditions raised? [Reference FCR v2.0, 7.11.2-7.11.3 and sub-clauses]		NA, no conditions raised	NA
Optional: General Comments on the Peer Review Draft Report (including comments on the adequacy of the background information if necessary)	N/A		NA

8.3.2 Peer Reviewer A: PI Specific Comments

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification (as given at initial Peer Review stage)	CAB Response to Peer Reviewer's comments (as included in the Public Comment Draft Report - PCDR)	CAB Response Code
1.1.1	Yes	No (no score change expected)		The score awarded SG1.1.1a (100) is not appropriately justified. It is concluded that there is a high degree of certainty that the stock has been fluctuating around a level consistent with ecosystem needs or has been above this level over recent years. The justification includes that there is no evidence from small-scale surveys that there has been a decline in abundance. However, these estimates also show no evidence that there has **not** been a decline in abundance, being extremely variable. This conclusion was also justified based on trends from another database (KRILLBASE), but these data are not shown anywhere in the report. A score of 100 is however warranted, based on similar biomass estimates from comprehensive acoustic surveys in 2000 and 2019. These same issues relate to scoring of SG1.1.1b; small-scale survey results do not justify the conclusion and KRILLBASE trends are not shown. .	The assessment team accepts the peer reviewer's view that the key evidence on stock status is that there were similar biomass estimates from wide scale surveys conducted in 2000 and 2019, which demonstrates that the stock is above the point where serious ecosystem impacts could occur and that the stock is at or fluctuating around a level consistent with ecosystem needs. Whilst further information and analysis of data from the small-scale surveys and on the KRILLBASE dataset have now been provided in the background information in section 7.2.5, less emphasis has now been attached to this supplementary evidence in the scoring rationales. On reflection the assessment team considered that the SG100 was still met for scoring issue a. However, after consultation with the assessment team for the overlapping Chilean krill fishery, consideration of continuing uncertainties surrounding the impact on ecosystem needs of concentration of krill catches in small localised areas and until current planned work by WG-EMM is completed, the assessment team reduced the score for scoring issue b from 100 to 80.	Accepted (non-material score reduction)
1.1.2				NA	No response needed.	Accepted (no score change)
1.2.1	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)

1.2.2	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
1.2.3	No (scoring implications unknown)	No (scoring implications unknown)		The scoring of SG 1.2.3a is questioned. The justification states that 'Regular stock surveys of individual sub-areas of Area 48 have provided detailed information on stock structure and stock productivity' However it is doubtful these surveys provide information on stock productivity given that their abundance estimates fluctuate by almost two orders of magnitude. It is also questioned whether they provide information on stock structure given that the background states that. 'it seems reasonable to assume that there is a single stock across Area 48'.	In line with our previous responses to the peer reviewer's comments on the conclusions that can be drawn from the small-scale stock surveys, the scoring rationale has been revised to reduce the emphasis on the results from these surveys and provide additional information about stock structure and productivity. The score for SIa is unchanged.	Accepted (no score change)
1.2.4	No (scoring implications unknown)	No (non-material score reduction expected)		The scoring of SG 1.2.4a is questioned. It is felt that this SG does not achieve SG 80 because it cannot be concluded that the assessment is appropriate for the stock. The comprehensive acoustic assessment has been conducted only twice in the past 20 years, and it is not possible to conduct it with adequate frequency (i.e. annually) due to resource constraints. Therefore, this assessment, while suitable for this stock, is not appropriate for such a keystone LTL species in a sensitive ecosystem highly subject to effects of climate change, because it cannot be applied with adequate frequency. The justification states that 'smaller-scale stock surveys have been undertaken to understand time trends in krill abundance...' and 'Trends in abundance can also be identified through analysis of data on KRILLBASE'. However, as noted above, the small-scale surveys are highly unreliable, and no data are shown from the KRILLBASE database. It is stated that an integrated stock assessment model is being developed 'intended to make use of multiple data sources and to provide an alternative to stock surveys as a means of assessing krill stock status.	We believe that the assessment is appropriate to the stock and the harvest control rule. Firstly the assessment has defined a limit reference point at 20% of its median pre-exploitation level in line with MSC Fisheries Standard v2.01, SA2.2.12a which considers that for key LTL species the point where serious ecosystem impacts could occur shall not be less than 20% of the spawning stock level that would be expected in the absence of fishing, and the target level has been set at 75% of the median pre-exploitation biomass, i.e. at a level significantly higher than is required if only the target species is being considered and a level in line with MSC Fisheries Standard v2.01, SA2.2.13a. Recent studies that evaluated the impact of the krill fishery on predators (Smith et al. 2011, Plaganyi and Butterworth 2012, Watters et al. 2013) indicate that such a target would satisfy ecosystem needs. Secondly the Generalised Yield Model predicts that if catches are kept below the Precautionary Catch Limit (PCL) of 5.61 million tonnes based upon an exploitation rate of 9.3%, then the stock will fluctuate about the reference target	Accepted (non-material score reduction)

				However, these alternative approaches have not yet been rigorously explored'	level with high probability. Thirdly the PCL has been replaced with a highly precautionary catch trigger level of 620,000 tonnes (11% of the PCL), and the overall catch trigger levels are disaggregated across the sub-areas of Area 48 to ensure that high krill removals cannot be concentrated in one sub-area and cause adverse ecosystem impacts. The assessment team believes therefore that the SG80 is met. However, we accept the peer reviewer's comments about the uncertainty surrounding the small-scale stock surveys, and there is a current lack of an integrated stock assessment model. In the absence of more regular large-scale stock surveys, and the need (as stated by WG-EMM) for sub-area-scale stock assessment models and biomass estimates from regular surveys within sub-areas in order to determine precautionary catch limits, the assessment team concluded that the assessment does not fully take into account krill's role within the ecosystem as a key LTL species and therefore SG100 is not met for SIa. The rationale has been revised accordingly.	

1.2.4	No (scoring implications unknown)	No (material score reduction expected to <60)		The scoring of SG 1.2.4c is questioned. The scoring and justification fail to recognize and address the two distinct aspects of the assessment; the comprehensive acoustic survey that is suitable for this stock but not appropriate because it is not conducted with adequate frequency; and second the small-scale surveys that are conducted annually but are highly unreliable. The justification addresses only uncertainty in the comprehensive acoustic survey and fails to address uncertainty in the annual small-scale surveys. Hence, SG 80 is not met. Furthermore, the justification provided indicated that SG 60 is not met because it is stated in justification of SG 1.2.4d that '...information from regular surveys in sub-areas of Area 48 has been used to evaluate and fully test the assessment.....' . This, and justification for SG 1.2.4c, fail to provide any evidence that the major sources of uncertainty associated with the annual small-scale surveys have been identified, such that a score of 60 is not justified. It is strongly felt however that revision of the justification for SG 1.2.4 to acknowledge the uncertainty with the annual small-scale surveys would justify a score of 60.	The assessment team accepts the peer reviewer's comment that the scoring rationale for SIc considers only uncertainties underlying the comprehensive surveys undertaken in 2000 and 2019, and not the small-scale stock surveys undertaken annually. However the small-scale stock surveys are not formally used at present in the assessment of stock status, and WG-EMM is currently engaged on a research programme taking a sub-area based approach, nested within an overall large-scale approach, for Subareas 48.1 to 48.4 based on sub-area-scale stock assessment models and biomass estimates from regular surveys within sub-areas, to determine precautionary catch limits. Whilst the uncertainties around the large-scale survey approach is sufficient to meet the SG100, it was concluded that until the new research programme fully evaluates uncertainties in stock biomass estimates at the sub-area level, then the SG100 is not met. The score for SIc has therefore been reduced from 100 to 80. The rationale for SI1.2.4d has also been revised to clarify that the methodology for estimating stock biomass from the 2000 survey has been revised regularly in recent years including using information from the small-scale stock surveys, and that the 2019 stock survey has been fully tested and shown to be robust. However, the score for SId remains unchanged.	Accepted (non-material score reduction)
2.1.1	yes	yes		scoring agreed	No response needed.	Accepted (no score change)
2.1.2	yes	yes		scoring agreed	No response needed.	Accepted (no score change)

2.1.3	yes	yes		scoring agreed	No response needed.	Accepted (no score change)
2.2.1	Yes	Yes		The overall performance score may be in error; if SG 2.2.1b is scored 80 (which is unclear), then the overall score should be 90 rather than 80.	MSC FCP v2.1 PF5.3.2 and PF5.3.2.1 still apply under PI 2.2.1. Under PF5.3.2 the final PI score shall be capped by the audit team in cases where only a subset of the total number of species has been evaluated. In this assessment minor species have not been evaluated. The Scoring rationale text had been edited for clarity.	Not accepted (no score change)
2.2.2	Yes	Yes			No response needed.	Accepted (no score change)
2.2.3	Yes	No (scoring implications unknown)		The score awarded SIb (80) seems inconsistent with scores awarded SIa (100) and SIc (100). It is difficult to understand why it is concluded that quantitative information is not adequate to estimate the impact of the UoA on minor secondary species with respect to status (SIb), when it has been concluded that....."Quantitative information is available and adequate to assess with a high degree of certainty the impact of the UoA on main secondary species with respect to status' (SI a) and that.....'information is adequate to support a strategy to manage all secondary species, and evaluate with a high degree of certainty whether the strategy is achieving its objective' (SI c).....This issue should be resolved considering also the conclusion on stock status of minor secondary species and associated scoring (PI 2.2.1), which seems well supported. That conclusion suggests that scoring of P2.2.3b is appropriate and scoring of SIs 2.2.3a and 2.2.3c should be reconsidered.	Scoring of SIa only takes into account information on the impact of the UoA on main secondary species with respect to status. Scoring of Sib only takes into account information on the impact of the UoA on minor secondary species with respect to status. In both cases there is comprehensive information on the impact by the UoA, but not on the status of the different populations (specifically minor secondary species). SIc evaluates if this information is adequate to support a strategy to manage all secondary species and evaluate if the strategy is achieving its objective (of not hindering the recovery of all secondary species). The team considers that the scoring of SIc is in concordance with the scoring of SIa and SIb, and that available information is adequate to support a strategy to manage all secondary species and evaluate with a high degree of certainty whether the strategy is achieving its objective. All scoring and rationales remain unchanged.	Accepted (no score change)

2.3.1	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
2.3.2	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
2.3.3	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
2.4.1	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
2.4.2	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
2.4.3	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
2.5.1	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
2.5.2	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
2.5.3	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
3.1.1	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
3.1.2	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)

3.1.3	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
3.2.1	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
3.2.2	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
3.2.3	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)
3.2.4	Yes	Yes		scoring agreed	No response needed.	Accepted (no score change)

8.3.3 Peer Reviewer B: General Comments

Question	Yes/No	Peer Reviewer Justification (as given at initial Peer Review stage). Peer Reviewers should provide brief explanations for their 'Yes' or 'No' answers in this table, summarising the detailed comments made in the PI and RBF tables.	CAB Response to Peer Reviewer's comments (as included in the Public Comment Draft Report - PCDR)
Is the scoring of the fishery consistent with the MSC standard, and clearly based on the evidence presented in the assessment report?	Yes	I have indicated for each PI where rationale can be improved, but overall the scoring is consistent with the MSC standard.	No response required.

Is the scoring of the fishery consistent with the MSC standard, and clearly based on the evidence presented in the assessment report?	No	Reference is made in P2 (2.2.1) to the use of RBF and the PSA in particular for main secondary species - this is not referenced as an appendix - scoring cannot therefore be cross checked / verified.	The text in PI 2.2.1 SI (a) and (b) has been amended for clarity. "As the secondary 'main' species under assessment here are not data deficient all species are scored against the default assessment tree, however, MSC FCP v2.1 PF5.3.2 and PF5.3.2.1 still applies. The final PI score shall be capped by the team in cases where only a subset of the total number of species has been evaluated. The final PI score shall be capped and no greater than 80. SG100 is not met."
Is the client action plan clear and sufficient to close the conditions raised? [Reference FCR v2.0, 7.11.2-7.11.3 and sub-clauses]	Yes	N/A - There is one new recommendation and two carried over from the previous assessment. No specific actions plan related to these are noted	Recommendations are non-binding conditions and as such no CAP is required from the client, however, progress will be checked and reported on at each annual surveillance.
Optional: General Comments on the Peer Review Draft Report (including comments on the adequacy of the background information if necessary)	N/A		

8.3.4 Peer Reviewer B: PI Specific Comments

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification (as given at initial Peer Review stage)	CAB Response to Peer Reviewer's comments (as included in the Public Comment Draft Report - PCDR)	CAB Response Code
1.1.1	Yes	No (no score change expected)	NA	Score 100: A table has been inserted relating to reference points (pg28/29) - this is useful although I had difficulty understanding fully the Slb explanation - where 75% Bo is 45.23 mill t, then based on the 2019 biomass est. of 62.6 mill t then the 75%Bo = 1.38 or 38% higher than 2000/2010 baseline. This interpretation is nevertheless consistent with SA2.2.13. This could be better explained in the rationale as the significance of the 1.38 level is not explicitly given.	The table on stock status in relation to reference points is a standard component of the MSC template for this PI and has not been inserted by the assessment team. The value of the target reference point (45.23 million tonnes) is based upon 75% of the pre-exploitation biomass as estimated from the 2000 survey. The current biomass estimated from the 2019 survey is 62.6 million tonnes, and therefore the ratio of the current biomass to the target reference point is 62.6/45.23 = 1.38. Some text has been added to	Accepted (no score change)

					the scoring rationale for scoring issue b to provide clarification.	
1.1.2	Yes	Yes	NA		No response needed.	Accepted (no score change)
1.2.1	Yes	No (no score change expected)	NA	PI Score 95: Sla: SG 100 - In my view the rationale provided around management measures is more appropriate in P3. The design of the harvest strategy should focus on the stock assessment methodology and the implementation of the PCL and triggers.	We note the views of the peer reviewer that some of the information provided in the scoring rationales for this PI are more appropriate to P3. There is inevitably some overlap between P1 and P3 issues in relation to management measures and harvest strategy, but the assessment team considers that how the management measures dovetail with the harvest strategy are relevant to this PI which provides an overview of the harvest strategy. PI 1.2.4 focusses on stock assessment methodology and PI 1.2.2 focusses on the HCRs. However, in response to the peer reviewer, additional information on the PCR and the setting of trigger levels for each sub-area has been included in the scoring rationale in order to place more emphasis on those components of the harvest strategy.	Accepted (no score change)

1.2.1	Yes	No (no score change expected)	NA	PI Score 95: Slc: SG60 - in my view the management measures in place such as VMS and observers apply to P3. While these measures support the monitoring of the fishery they do not explicitly monitor the harvest strategy - text is therefore not pertinent to HCR.	As noted above for PI 1.2.1a, there is inevitably some overlap between P1 and P3 issues in relation to management measures and harvest strategy. In relation to monitoring, however, the assessment team considers that some management measures support monitoring of the harvest strategy. For example, the harvest strategy is designed to minimise the impact on the wider ecosystem which includes closure of areas to fishing and the requirement for vessels to have on-board VMS enables an evaluation of whether that element of the harvest strategy is working. Similarly, completion of log books, the CCAMLR requirement to notify the commission when a vessel enters or leaves a subarea of Area 48, and the requirement for observers all monitor the fishery to ensure that trigger levels within each sub-area are not exceeded.	Not accepted (no score change)
1.2.2	Yes	No (scoring implications unknown)	NA	PI Score 85: Sic: SG80 - Broadly I would agree with the score, but as with 1.2.1 the rationale related to measures is not HCR evaluation - the HCR is underpinned by the reference points, use of PCL etc - the way the fishery responds to the implementation of the harvest controls is critical - suggest revised rationale.	The peer reviewer's comments are noted. This scoring issue considers the appropriateness and effectiveness of the harvest control tools in achieving the exploitation levels required under the HCRs. To ensure that the stock remains above the target reference point, the key tool is the use of a precautionary catch limit (PCL), and to ensure that the PCL and trigger levels for both the whole of Area 48 and for the separate sub-areas are not exceeded, robust recording of catches and closure of sub-areas is required. The available evidence from recorded catches confirms that the tools have been effective at controlling exploitation rates, and the most recent stock survey showed that the stock was above the target reference point. The scoring rationale has been revised to provide clarification.	Accepted (no score change)

1.2.2	Yes	No (scoring implications unknown)	NA	PI Score 85: Slc: SG 100 - it is not clear to me how disputed estimates of krill green weight relate to HCR evaluation	One of the key tools in ensuring that exploitation levels are maintained at levels required under the HCRs is the robust recording of catches. There are some concerns about inconsistencies about the way in which the volume of krill removals is measured, and therefore there is some uncertainty about the estimate of exploitation rates in the krill fishery. Some further explanatory text has been added.	Accepted (no score change)
1.2.4	Yes	Yes	NA	Score 95: Agreed	No response needed.	Accepted (no score change)
2.1.1	Yes	Yes	NA	Score 100: Agreed	No response needed.	Accepted (no score change)
2.1.2	Yes	No (scoring implications unknown)	NA	PI Score 100: Slb: There is no evidence provided that the MSE is tested - text is weak - the scoring at SG100 needs to provide specific rationale to score at 100	SIB: wording modified. Scoring remains unchanged. MSC definition of testing = The involvement of some sort of structured logical argument and analysis that supports the choice of strategy. In the context of a fishery, it can include the use of experience from analogous fisheries, empirical testing (for example practical experience of performance or evidence of past performance) and simulation testing (for instance using computer-intensive modelling such as management strategy evaluation).	Not accepted (no score change)
2.1.2	Yes	No (scoring implications unknown)	NA	Score 100: Slc : I can see the difficulty here - there is no explicit management strategy relating to bycatch other than that the fishery is highly selective, targets krill swarms and that bycatch is minimal - the rationale (in my view) should focus on this and that the 100% observer effectively monitors for any change in status of bycatch that might require implementation of an explicit management strategy	SIC: Wording has been reviewed. Scoring remains unchanged.	Accepted (no score change)

2.1.3	Yes	No (no score change expected)	NA	Score :100 Slb : I would agree with the score - however the rationale "*information allows to estimate the impact of the UoA on minor primary species with respect to status.* " needs rewording as in my view the stock estimates of icefish and toothfish provide no basis for estimating the impact of the UoA on these stocks - these stocks are impacted by numerous other factors including fishing and climate variability - this should be contextualised in the rational provided to justify the scoring at SG100.	Wording reviewed. Scoring remains unchanged.	Accepted (no score change)
2.2.1	No (scoring implications unknown)	No (scoring implications unknown)	NA	Score 80: Slb :out of scope main secondary species are identified in Sla and ref made to RBF with the use of PSA only for main secondary in Slb and not minor secondary - I would expect the PSA for these main secondary species to be in the appendix particularly as the same species are identified under the harmonisation of assessments (Table 25).	Score of Sib remains at 80. Wording of Sib has been modified as RBF has not been used to score SI (a). "As the secondary 'main' species under assessment here are not data deficient all species are scored against the default assessment tree and not the RBF. However, MSC Standard v2.01 PF5.3.2 and PF5.3.2.1 still applies. The final PI score shall be capped by the team in cases where only a subset of the total number of species has been evaluated. The final PI score shall be capped and no greater than 80. SG100 is not met."	Accepted (no score change)
2.2.2	No (scoring implications unknown)	No (scoring implications unknown)	NA	Score: 100 - Sib: there is some contradiction here - rationale states that in 2018 CCAMLR reports that there were **no** mortalities of main secondary (out of scope) species whereas text (pg 48) states there were mortalities of two bird species classified as main secondary in Area 48. These mortalities may not have occurred in the Aker Biomarine fishery. Scoring reconsideration needed at SG100 to support testing and high confidence in the partial strategy.	Text has been modified in the background section (page48) to highlight that those interactions with seabirds were with vessels not part of the UoA. The wording of Sib has been reviewed but scoring remains unchanged.	Accepted (no score change)
2.2.3	Yes	Yes	NA	Score: 95 - Agreed	No response needed.	Accepted (no score change)

2.3.1	Yes	Yes	NA	Score 100: Agreed	No response needed.	Accepted (no score change)
2.3.2	Yes	Yes	NA	Score 100 : Agreed	No response needed.	Accepted (no score change)
2.3.3	Yes	Yes	NA	Score 100: Agreed	No response needed.	Accepted (no score change)
2.4.1	Yes	Yes	NA	Score 100: Agreed	No response needed.	Accepted (no score change)
2.4.2	Yes	Yes	NA	Score 100 : Agreed	No response needed.	Accepted (no score change)
2.4.3	Yes	Yes	NA	Score 85 : Agreed	No response needed.	Accepted (no score change)
2.5.1	Yes	Yes	NA	Score 100: The text drafted needs to be improved and edited to strengthen SG100 e.g. last para : "F*or all the reasons given above, the team and virtually of the consultees consider that at the current harvesting rate it is highly unlikely that the fishery would cause serious or irreversible harm to the key elements of ecosystem structure and function"*	Wording reviewed. Scoring remains unchanged.	Accepted (no score change)
2.5.2	Yes	No (non-material score reduction expected)	NA	Score 95: Slb: scoring rationale needs to provide more explicit evidence - while for example 100% Observer coverage is an effective measure, it is not "testing" - suggest Slb ok at SG80 but not SG100.	Sib: The assessment team considers the good results of observers as testing, showing very limited interactions. Not the presence of observers per se. MSC defines “testing” as the involvement of some sort of structured logical argument and analysis that supports the choice of strategy. In the context of a fishery, it can include the use of experience from analogous fisheries, empirical testing (for example practical experience of performance or evidence of past performance) and simulation testing (for instance using	Not accepted (no score change)

					computer-intensive modelling such as management strategy evaluation). The low records of interactions as reported by observers is considered as empirical testing, as practical experience of performance supports that interactions are very low. The wording of Sib has been reviewed but scoring remains unchanged at SG100.	
2.5.2	Yes	No (non-material score reduction expected)	NA	Score 95: Slc : scoring rationale needs to provide more explicit evidence - while for example 100% Observer coverage is an effective measure, it is not "testing". Further for Slc score at SG100 = No - more appropriate score for PI = 90 (see also FCR 7.10.5.3 (i)	FCR v2.0 does not apply to this report (see Table 1). The team has granted a PI score of 95 following FCP v2.1 7.17.7.4.a.ii. Observer coverage is not considered an evidence per se. Little interactions as reflected in observer reports are considered as evidence of limited interactions. Scoring and wording of SI c remains unchanged at SG80 and final scoring of PI2.5.2 remains unchanged at 95.	Accepted (no score change)
3.1.1	Yes	No (score increase expected)	Yes	Score 90: I would think this could be scored at 95. Also guidance needed I would think as Slc should nevertheless be scored as meeting SG100 - members states of CCAMLR have historical rights to access resources in CCAMLR ?	SIc has now been scored, and the PI score has been raised from 90 to 95, as suggested by the peer reviewer.	Accepted (score increased)
3.1.2	Yes	Yes	NA	Score 100: Agreed	No response needed.	Accepted (no score change)
3.1.3	Yes	Yes	NA	Score 100: Agreed	No response needed.	Accepted (no score change)
3.2.1	Yes	Yes	NA	Score 90: Agreed - partial scoring at SG100	No response needed.	Accepted (no score change)
3.2.2	Yes	Yes	NA	Score 95: Agreed	No response needed.	Accepted (no score change)
3.2.3	Yes	Yes	NA	Score 100: Agreed	No response needed.	Accepted (no score change)

3.2.4	Yes	Yes	NA	Score 90: Agreed	No response needed.	Accepted (no score change)

8.4 Stakeholder input

At the Announcement Comment Draft report stage there were no comments submitted by stakeholders.

Stakeholders are once again encouraged to review the PCDR and scoring (and responses to previous input where relevant) presented in this assessment and use the Stakeholder Input Form to provide evidence to the team of where changes to scoring are still necessary.

8.5 Conditions

No conditions have been raised at the CPRDR stage, however, the scoring presented in this report has not been reviewed by stakeholders – these steps will all take place from here onwards.

8.6 Surveillance

Table 20: Fishery surveillance program

Surveillance level	Year 1	Year 2	Year 3	Year 4
Level 1	Review of information	Off-site surveillance audit	Review of information	On-site surveillance audit & re-certification site visit

Table 21: Timing of surveillance audit

Year	Anniversary date of certificate	Proposed date of surveillance audit	Rationale
1	To be confirmed	Anniversary date of certificate	

Table 22: Surveillance level rationale

Year	Surveillance activity	Number of auditors	Rationale
1	Review of information	Three auditors off-site	There are no conditions in the fishery. It is in its third certification period and scores highly on all three principles. Each principle expert should, however, review the situation at each surveillance.
2	Off-site surveillance audit	Three auditors off-site	There are no conditions in the fishery. It is in its third certification period and scores highly on all three principles. Each principle expert should, however, review the situation at each surveillance.
3	Review of information	Three auditors off-site	There are no conditions in the fishery. It is in its third certification period and scores highly on all three principles. Each principle expert should, however, review the situation at each surveillance.
4	On-site surveillance audit and re-certification site visit	Three auditors on-site	The full assessment team is required on-site for re-certification.

8.7 Harmonised fishery assessments

The MSC Fisheries Certification Process v2.1 (FCP) sets out procedures for ensuring consistency of outcomes in overlapping fisheries (see Annex PB of the FCP). The intention of this process is to maintain the integrity of MSC fishery assessments.

The audit team have consulted the guidance issued on the MSC's interpretation log to identify the harmonisation requirements for this fishery (see https://mscportal.force.com/interpret/s/article/What-are-the-MSC-requirements-on-harmonisation-multiple-questions-1527586957701). For each overlapping fishery, LR have considered harmonisation requirements for each PI using the table below.

8.7.1 MSC Directions for harmonisation between overlapping MSC fisheries

Table 23: MSC directions for harmonisation between overlapping MSC fisheries

PIs / SIs	Harmonise?	Comments
All P1 PIs	Yes	P1 always considers the impacts of all fisheries on a stock, so any fisheries which have the same P1 species (stocks) should be harmonised.
PI 2.1.1a	Partially	For stocks that are 'main' in both UoAs, harmonise status relative to PRI (at SG60, 80 and 100), and if below PRI, harmonise cumulative impacts at SG80 (not at SG60).
PI 2.2.1a	Partially	For stocks that are 'main' in both UoAs, harmonise status relative to BBL (at SG60, 80 and 100), and if below BBL, harmonise cumulative impacts at SG80 (not at SG60).
PI 2.3.1a	Partially	Harmonise recognition of any limits applicable to both UoAs (at SG60, 80 and 100), and cumulative effects of the UoAs at SG80 and SG100 (not at SG60).
PI 2.4.1b	Partially	Harmonise recognition of VMEs where both UoAs operate in the same 'managed area/s' (as in SA3.13.5).
PI 2.4.2a,c	Partially	Harmonise scoring at SG100, since all fishery impacts are considered (not at SG60 or 80).
All P2 PIs	Yes, if ->	Two UoAs are identical in scope, even if the UoCs are different (e.g. separate clients).
PIs 3.1.1-3	Yes, if ->	Both UoAs are part of the same larger fishery or fleet, or have stocks in either P1 or P2 which are at least partially managed by the same jurisdiction/s (nation states, RFMOs or others) or under the same agreements. Harmonisation may sometimes be possible for those management arrangements that apply to both UoAs (noting the limitations accepted in GPB3).
PIs 3.2.1-4	Yes, if ->	Both UoAs have stocks within either P1 or P2 which are at least partially managed by the same jurisdiction/s (nation states, RFMOs or others) or under the same agreements. Harmonisation is needed for those management arrangements that apply to both UoAs, e.g. at the RFMO level but not the national level in the case of two separate national fleets both fishing the same regional stock.

MSC overlapping fisheries have been identified as fisheries targeting Antarctic krill and operating within CCAMLR Area 48. MSC Fisheries with overlapping UoCs to the UoA under assessment here are detailed below in Table 24 and the relevant PIs which require harmonisation are shown. The scores awarded for the MSC fisheries were analysed during this re-assessment audit (see Table 26-Table 28) and any differences in scoring are explained in Table 29.

Table 24: Overlapping fisheries

Fishery name	Certification status and date	Performance Indicators to harmonise
Aker Biomarine Antarctic Krill CAB – Lloyd's Register (LR)	Undergoing re-assessment v2.01	P1: all PIs P2: PI 2.2.1a; 2.3.1 (a); PI 2.4.1b; PI 2.4.2a ; PI 2.4.2c P3: all PIs (international component of the management system)
Deris S.A. - Pesca Chile - Antarctic krill fishery CAB – Bureau Veritas (BV)	Certified v2.0 – 6th Sept 2018	P1: all PIs P2: PI 2.2.1a; 2.3.1 (a); PI 2.4.1b; PI 2.4.2a; PI 2.4.2c P3: all PIs (international component of the management system)
To be confirmed – Korean Krill Fishery CAB – Control Union Pesca (CUP)	Entering assessment	To be confirmed

Table 25: Overlapping fisheries supporting information

Supporting information	
P1: The target stock is the same, hence harmonisation on all PIs. P2: Principle 2 aspect have been evaluated in respect to Table 23 and presented in Table 27. P3: The international component of the management system (CCAMLR) is the same so must be harmonised. The national component is different, Chilean and Norwegian management systems respectively.	
Was either FCP v2.1 Annex PB1.3.3.4 or PB1.3.4.5 applied when harmonising?	**No**
Date of harmonisation meeting	**Harmonised via email with BV and CUP.**

Table 26: Scoring differences Principle 1

Performance Indicators (PIs)	Aker Biomarine Antarctic Krill	Deris S.A. - Pesca Chile - Antarctic krill fishery
PI 1.1.1	**90**	**90**
PI 1.2.1	**95**	**95**
PI 1.2.2	**85**	**85**
PI 1.2.3	**90**	**90**
PI 1.2.4	**85**	**95**

Table 27: Scoring differences Principle 2 by element

Performance Indicators (PIs)	Aker Biomarine Antarctic Krill	Deris S.A. - Pesca Chile - Antarctic krill fishery
Primary Main PI 2.1.1 a	No overlap	No overlap
Secondary Main PI 2.2.1a	Cape Petrel (100) Snow Petrel (100)	Cape Petrel (100) Snow Petrel (100)
ETP PI 2.3.1a	Antarctic fur seal (NA)	Antarctic fur seal (100)
Habitats PI 2.4.1b	Seamounts (100) hydrothermal vents (100) cold-water corals (100) Sponges (100)	Seamounts (100) hydrothermal vents (100) cold-water corals (100) Sponges (100)
Habitats PI 2.4.2a	As above (100)	As above (100)
Habitats PI 2.4.2c	As above (100)	As above (100)

Table 28: Scoring differences Principle 3

Performance Indicators (PIs)	Aker Biomarine Antarctic Krill	Deris S.A. - Pesca Chile - Antarctic krill fishery
PI 3.1.1	**90**	**95**
PI 3.1.2	**100**	**100**
PI 3.1.3	**100**	**100**
PI 3.2.1	**90**	**90**
PI 3.2.2	**95**	**95**
PI 3.2.3	**100**	**85**
PI 3.2.4	**90**	**90**

Table 29: Rationale for scoring differences

If applicable, explain and justify any difference in scoring and rationale for the relevant Performance Indicators (FCP v2.1 Annex PB1.3.6)

Scoring differences on Principle 1:

Performance Indicators (PIs)	Aker Biomarine Antarctic Krill	Deris S.A. - Pesca Chile - Antarctic krill fishery
PI 1.2.4	**85**	**95**

PI 1.2.4 - Scoring issue (a) has been reduced from 100 to 80 in the Aker Biomarine report following comments from the peer reviewers. The scores for the two fisheries are now harmonised for the scoring issue. The score for PI 1.2.4 (c) in the Aker Biomarine report has been reduced from 100 to 80 following peer review. The score for the Bureau Veritas report is 100. Lloyd's Register and Bureau Veritas both believe that their rationales are justified, and that the differences in scores are due to slightly different interpretations of the information available. Lloyd's Register still argue that the SG100 is not met for PI 1.2.4 (d) because there is a major new research programme developing an integrated stock assessment which will focus on developing stock assessments for the small-scale locations along with stock surveys of those small areas. LR believe that this represents a different assessment approach, and as yet cannot be considered to have been rigorously explored.

Overall the Lloyd's Register score for 1.2.4 for the Aker Biomarine fishery is 85, whereas the overall score of PI 1.2.4 for the Deris (BV) fishery remains at 95. Harmonisation discussions are ongoing.

Scoring differences on Principle 2:

Performance Indicators (PIs)	Aker Biomarine Antarctic Krill	Deris S.A. - Pesca Chile - Antarctic krill fishery
ETP PI 2.3.1a	Antarctic fur seal (NA)	Antarctic fur seal (100)

As regards ETP species, BV report is about a Chilean vessel. Chilean regulation protects Antarctic fur seal. Norwegian regulation doesn't. CCAMLR regulation doesn't.

If exceptional circumstances apply, outline the situation and whether there is agreement between or among teams on this determination

NA

8.8 Objection Procedure

To be added at Public Certification Report stage

The report shall include all written decisions arising from a 'Notice of Objection', if received and accepted by the Independent Adjudicator.

Reference(s): FCP v2.1 Annex PD