Marine Stewardship Council (MSC) Final Draft Report

Jeong Il Corporation Antarctic krill fishery

On Behalf of

Jeong Il Corporation, Seoul

Prepared by

Control Union UK Ltd.

July 2021

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ACDR

Role	Signature and date
Originator:	Henry Ernst – 30th January 2020
Reviewer:	Hugh Jones - 10th February 2020
Approver:	Toru Tsuzaki – 3rd March 2020

CPRDR

Role	Signature and date
Originator:	Henry Ernst - 15th January 2021
Reviewer:	Sophie des Clers - 20th January 2021
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PCDR

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Originator:	Henry Ernst – 14th April 2021
Reviewer:	Hugh Jones – 7th May 2021
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Originator:	Henry Ernst – 21st July
Reviewer:	Emily Vella – 28th July 2021
Approver:	Toru Tsuzaki – 30th July 2021

Glossary

Acronym	Definition
ARK	Association of Responsible Krill
CCAMLR	Convention for the Conservation of Antarctic Marine Living Resources
CEMP	CCAMLR Ecosystem Monitoring Program
CM	Conservation Measures
CP	Contracting Party
CPUE	Catch Per Unit of Effort
CU UK	Control Union United Kingdom (Formerly CU Pesca)
DWFDA	Distant Water Fisheries Development Act
EEZ	Exclusive Economic Zone
EFMS	Electronic Fisheries Monitoring System
EMM	Ecosystem and Monitoring
ETP	Endangered, Threatened and Protected (species)
F	Fishing Mortality
FCR	(MSC) Fishery Certification Requirements
FMC	Fisheries Monitoring Centre
FPI	Fishery Performance Indicators
GYM	Generalised Yield Model
HCR	Harvest Control Rules
IPI	Inseparable or Practicably Inseparable (catches)
IUU	Illegal, Unreported and Unregulated (fishing)
KOFA	Korea Overseas Fisheries Association
LTL	Lower Trophic Level (Species)
MCS	Monitoring Control and Surveillance
MOF	Ministry of Oceans and Fisheries
MPA	Marine Protected Areas
MSC	Marine Stewardship Council
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
NIFS	National Institute of Fisheries Science
PA	Precautionary Approach
PCL	Precautionary Catch Level
PI	Performance Indicator
PRI	Point of Recruitment Impairment
RBF	Risk Based Framework
RFMO	Regional Fisheries Management Organisation

Acronym	Definition
SCIC	Standing Committee on Implementation and Compliance
SG	Scoring Guidepost
SISO	Scheme of International Scientific Observation
SSB	Spawner Stock Biomass
SSMU	Small-Scale Management Units
TAC	Total Allowable Catch
TRP	Trigger Reference Point
UoA	Unit of Assessment
UoC	Unit of Certification
VMS	Vessel Monitoring System
WG-EMM	Working Group on Ecosystem Monitoring and Management

1 Executive Summary

This report is the Final Draft Report for the MSC full assessment of the Jeong Il Corporation Antarctic krill fishery. The CU UK assessment team consists of Henry Ernst (Team Leader), Dr. Julian Addison (Principle 1), Dr Gudrun Gaudian (Principle 2), Dr Sophie des Clers (Principle 3), and Dr Jung-Hee Cho (Principle 3).

CU UK submitted a Variation Request (VR) to the MSC with respect to the MSC COVID-19 derogation effective from the 28th September (https://www.msc.org/docs/default-source/default-document-library/for-business/program-documents/chain-of-custody-supporting-documents/msc-covid-19-guidance-for-cabs-september-2020.pdf) on 09/09/2020 to hold the site visit remotely. The rationale behind the variation request was: there are travel restrictions and health risk concerns related to COVID-19 should the assessment team travel to South Korea to attend the site visit. The full VR and MSC response can be found at: https://fisheries.msc.org/en/fisheries/jeong-il-corporation-antarctic-krill-fishery/@@assessments. The VR was accepted by the MSC on 22nd September 2020. As such, remote meetings were held during the week of the 9th November 2020 and over the course of the following two weeks, due to client and stakeholder availability. A wide range of stakeholders were invited to participate in this assessment. Video-conferencing arrangements will be shared with all stakeholders looking to participate in the assessment.

The assessment is being undertaken in accordance with the MSC Fisheries Certification Procedure (FCP) v2.1 and the MSC Standard 2.01 using the default assessment tree throughout the assessment.

The fishery under assessment is the Jeong Il Corporation krill (*Euphausia superba*) fishery taking place in Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) Subareas 48.1 and 48.2. Fishing activities under assessment are carried out by two vessels, the Sae In Leader and the Sae in Champion, and these have been active in the CCAMLR krill fishery since 2006 and 2000 respectively. Both vessels operate a standard trawling system. The trawl is towed at a depth of <150 m and fishing gear is equipped with a mammal protection net and escape window. Bycatch is extremely low, with over 99 % of the catch weight being comprised of krill. The catch is not sorted or separated (though it is sampled by onboard scientific observers) but frozen as whole krill and krill meal. The product under assessment is transhipped at sea to be landed in Busan (Korea) and Fukuoka (Japan).

Antarctic krill (*Euphausia superba*), the target species of the fishery, is found across most of the Southern Ocean, from the Polar Frontal Zone to the Antarctic Continental shelf. Large scale krill distribution is influenced by hydrography and bathymetry. Their vertical distribution in the water column follows diel vertical migration patterns up to depths of 600 metres. *E. superba* play a major role in the Antarctic marine ecosystem, acting as a direct energy link between primary production and higher predators. Antarctic krill is therefore considered a Key Low Trophic Level (LTL) species in this assessment. The overarching management body for this fishery is the CCAMLR, which has established a Precautionary Upper catch Limit (PCL) and a catch trigger level for this fishery. The management of the krill fishery in Area 48 is based upon the precautionary approach, and the Ecosystem Monitoring programme (CEMP) provides a foundation to regulate the harvest of Antarctic marine living resources in line with the ecosystem approach. The Korean Ministry of Oceans and Fisheries (MOF) issues fishing vessel licences specific to the krill fishery under the Distant Water Fisheries Development Act of 2015. The krill fishery is regulated through CCAMLR Conservation Measures, while the Korean MOF is responsible for monitoring Korean vessels activities (all equipped with VMS) to ensure they comply with CCAMLR regulations. Stock assessment of krill is undertaken by the CCAMLR Scientific Committee and is reviewed annually at meetings of the Working Group on Ecosystem Monitoring and Management. An initial analysis of krill areal density produced a standard stock estimate of 62.6

million tonnes for Area 48 in 2019, with a survey coefficient of variation (CV) of 13 %. The estimated krill biomass does not appear to have declined since the previous fully synoptic survey in 2000. The fishery appears to be operating in a sustainable way, as the annual catches are well below a conservatively set PCL, and there is confidence that current catch levels will not affect total krill biomass adversely even in the event of extraneous ecosystem and climate factors coming into play.

The main source of information on catch composition comes from observer data, which covers 100 % of the trips. Cruise reports submitted by scientific observers trained according to CCAMLR Scheme of International Scientific Observation record catch details for all species and provide a summary of the biological data collected. Sampling procedures are standardised across krill fisheries, 25 kg subsamples are taken from each haul, between 1-8 times per day. Between 2016 and 2018, 4,534 fishing trawls were undertaken, 24 % of which were sampled by observers. Combined catch of non-target species makes up 0.009 % of the catch weight across all observed catches. A potential issue in the Antarctic krill fishery targeting *E. superba* is the possible presence of a similar species *Euphausia crystallorophias* (ice krill) in the catch. Given the difficulties in distinguishing the two krill species, the absence of ice krill in reports does not necessarily mean an absence of ice krill bycatch. A member of the CCAMLR Working Group noted that research surveys in Area 48 did not reveal the presence of ice krill in catches using research gear. Midwater trawling for krill is generally considered as low risk to Endangered, Threatened, and Protected (ETP) species. Nevertheless, several technical measures have been put in place to reduce the risk of bycatch of seabirds and marine mammals; as a result, ETP species mortality is rare. ETP species mortality mitigation measures include seabird bafflers, streamers and sprayers, net weighting, warp deflectors, seal exclusion devices and offal retention for disposal on shore (the offal is transhipped and is either disposed of on shore or is sent to a research institute). The fishing practices (pelagic trawl), and the fact that gear loss is very rare, signify that there is no interaction with the benthos. The region in which the fishery operates is home to many krill predators, and the wider ecosystem impacts for the krill fishery have been thoroughly considered in the fishery's management. Seasonal closures, combined with 12 nm no-take zones around South Georgia, Shag Rocks, Clerke Rocks, and the South Sandwich islands are intended to minimise major impacts on krill-dependent predators. The on-going monitoring of krill-dependent predators suggests that inter-annual variation in krill abundance associated to physical oceanographic factors has a greater impact on predators than the krill fishery currently in the MSC Scheme (either certified or in assessment). Rapid climate change in the region has been well documented, with the most evident sign being ice-shelf collapse. This results in the loss of existing marine habitats and the creation of new ones, with changes to ecological processes and community structures seemingly inevitable. The CCAMLR Working Group on Ecological Monitoring and Management is responsible for krill management scientific advice. This group meets annually to discuss scientific research outcomes and regulates the harvesting of Antarctic marine living resources in accordance with an ecosystem approach.

The fishery operates within a well-defined marine ecosystem and fisheries management framework. Three key jurisdictional levels are involved in its management: CCAMLR, the RFMO in charge of resource management; the Republic of Korea, as flag state is responsible for the vessels' activities in compliance with international and national obligations; and port states where the UoA vessels land or tranship their catch (Japan and Korea). The CCAMLR Commission is the decision-making body. Conservation Measures (CMs) are agreed based on the best available scientific information, with the aim of ensuring the conservation of Antarctic marine ecosystems. CMs are adopted and updated (when necessary) during annual Commission meetings, and a compendium of CMs in force can be found on CCAMLR's official website. Access to the krill fishery is not automatic, and the opportunity to participate in the krill fishery is only open to CCAMLR member vessels. The Republic of Korea was temporarily identified as a potential Illegal, Unreported and Unregulated (IUU) fishing country in September 2019 as the US National Oceanic and Atmospheric Administration (NOAA) deemed that insufficient sanctions were applied to deter its vessels from engaging in fishing activities that violate conservation and management measures adopted by CCAMLR. In response, the Republic of Korea's Distant Water Fisheries Act was amended to allow administrative sanctions to be applied for the violation of such measures. Consequently, Korea was removed from the list of potential IUU fishing countries, after four months of being put on the list. CCAMLR has a comprehensive Monitoring Control and Surveillance (MCS) system in place, which is upheld and implemented by its members. The MCS system includes vessel and fishing gear markings, vessel licensing, monitoring of vessels movements, vessel monitoring systems, a catch documentation scheme, and monitoring of vessel transhipments (amongst other measures). The CCAMLR System of Inspection relies on each member country designating and training Fisheries inspectors to carry out at sea or on land inspections. At the time of writing, CCAMLR has undertaken two external performance reviews.

This fishery is harmonised across P1 performance indicators with the Deris S.A – Pesca Chile Antarctic krill fishery (most recently certified by Bureau Veritas in 2018) and the Aker Biomarine Antarctic Krill fishery (most recently certified by Lloyds Register in 2020). Discussions were held with representatives of Bureau Veritas and of Lloyds Register leading up to the publication of the ACDR and the drafting of the CPRDR to ensure Principle 1 scoring was aligned. The Principle 1 expert on this assessment, Julian Addison is also responsible for Principle 1 in the Aker Biomarine assessment, facilitating harmonisation. Principle 2 was not harmonised, as this Principle is UoA-specific and the Jeong Il Corp krill fishery does not operate in the same statistical areas as the other certified krill fisheries. Principle 3 was also not harmonised, as the Korean management framework is scored differently than the Chilean and Norwegian management systems.

At the ACDR stage, further information was needed to finalise scores for Principle 3, concerning the management system of the Republic of Korea as a whole. It was obtained during the remote site visit. At the site visit, up to date UoA-specific catch data was reviewed, and the team was informed as to how krill catch volumes are recorded and reported by the UoA fishery. Further details on fishing practices were provided by the client, and the stakeholders belonging to the Korean fisheries management framework provided the team with further details on the functioning of this system. Specifically, the stakeholder input opportunities, the workings of the decision-making process, the operation of the monitoring control and surveillance authority, and the conformity of the client fishery. Regarding Principle 1, further information is sought on ways in which krill removals are recorded. Based on the information available to the team, the Jeong Il Corporation Antarctic krill fishery appears to be in conformity with the MSC Standard across all Principles, with all three exceeding or meet the average minimum score requirement of 80.

No conditions were raised following the site visit. Three recommendations have been raised, and further details can be found in section 4.3.

Following comments from the three peer reviewers assigned to this fishery, a condition was raised on PI 1.2.1 – Harvest Strategy. Two peer reviewers drew attention to the fact that the current strategy may not be sufficiently responsive at a fine-scale local level in order to meet ecosystem needs. While the client fishery belongs to ARK, and has voluntarily stopped fishing in areas where there may have been an adverse impact to predators, there is no formal mechanism in place to require restricting such fishing. For this reason, the score of SIa was reduced to SG60, and a condition was raised. One new recommendation was raised in response to peer review comment (see Section 4.3).

The team determines that at this Final Draft Report stage, the Jeong Il Corporation Antarctic krill fishery meets the MSC Standard, and should be certified. This conclusion is not currently final, but will be finalised at the end of the objection period.

2 Report Details

2.1 Authorship and Peer Reviewers

Dr Julian Addison – Principle 1 Expert

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, working closely with marine managers, legislators and stakeholders, Government Statutory Nature Conservation Organisations and environmental NGOs. He has also worked as a visiting scientist at DFO in Halifax, Nova Scotia and at NMFS in Woods Hole, Massachusetts where he experienced shellfish management approaches in North America. 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.

Julian 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.

Julian is a fully trained MSC team member. He is responsible for the assessment of Principle 1.

Dr. Gudrun Gaudian – Principle 2 Expert

Dr Gudrun Gaudian has a BSc in Marine Biology, and a DPhil from University of York (UK) on the topic of "Taxonomy and Ecology of Red Sea Corals". She also completed an LLM Environmental Law and Management. She is an experienced marine ecologist and taxonomist and her work has included coastal marine surveys, EIA's for development and tourism, and research projects in tropical and temperate seas. Since 2011 she has been involved in fisheries certification applying the Marine Stewardship Council standard for sustainable fisheries, concentrating on Principle 2 of the Standard, working on many coastal and marine management issues, such as identifying sustainable coastal development projects, as well as addressing conservation issues, including selection and planning of marine parks and reserves, sustainable utilisation of natural resources and community-based management programmes. Dr. Gaudian meets the requirements in Table PC3 for 'Fishing impacts on aquatic ecosystems'. She has >5 years' experience in research into, policy analysis for, or management of, fisheries impacts on aquatic ecosystems. Gudrun is also fluent in German.

Gudrun is a fully trained MSC team member. She is responsible for the assessment of Principle 2.

Dr Sophie des Clers – Principle 3 Expert

Sophie is an independent scientific expert in fisheries management systems. She is a qualified MSC auditor and a member of the MSC peer review college. She has over 30 years' experience in the formulation, monitoring, and evaluation of fisheries and aquaculture projects to build management capacity in the public and the private sector. Sophie is trained in databases, applied statistics, population dynamics, economics, law and public policy and has a PhD in Biometrics and a Master's degree in Public Policy. Her past research and consultancy projects have taken her to fishing ports around the UK, EU, Norway, Africa, the North Sea, Mediterranean, Atlantic, Pacific, Indian oceans and the Caribbean. She has been involved in a number of previous MSC assessments and pre-assessments including lobster, cod, haddock, saithe, sole, herring, blue whiting, sardine, whelks (within the EU) and tuna and billfish fisheries.

Sophie is a fully trained MSC team member. She is responsible for the assessment of Principle 3, with a focus on CCAMLR management.

Dr Jung Hee Cho – Principle 3 Expert

Jung-Hee studied for his first degree at the In-Ha University in South Korea, following with a Master's degree at the Nova South Eastern University in the US and a Masters and Ph.D from the University of Rhode Island.

Jung-Hee started his career in 1996 as a Research Assistant at the Department of Environmental and Natural Resource Economics, University of Rhode Island and is now a Senior Research Fellow and Director General of the Fisheries Research Division of the Korea Maritime Institute. His experience includes lecturing at the Konkuk University in Seoul and various government delegations involving the FAO, OECD, FTA and WTO. Jung-Hee is currently the Editor-in-Chief at the KMI International Journal of Maritime Affairs and Fisheries.

He is a fully trained MSC team member and for this project, is responsible for the assessment of Principle 3, with a focus on local Korean management.

Henry Ernst – Team Leader / Traceability

Henry obtained an MSci in marine biology from the University of Southampton, UK. He has a broad background in marine research including inshore fisheries, functional marine ecology and aquaculture research. Prior to joining CU Pesca (now CU UK) he was engaged in benthic invertebrate identification and biomass work with the National Oceanographic Centre, Southampton, United Kingdom and data compilation for Antarctic fauna with the British Antarctic Survey.

Henry is a fully trained MSC Team Leader and ISO 9001 qualified. He will be responsible for bringing together the work of the Principle experts and ensuring MSC Processes and Requirements are respected throughout the assessment.

Peer Reviewers:

The MSC Peer Review College compiled a shortlist of potential peer reviewers to undertake the peer review for this fishery. Given that the initial audit was held off-site, three peer reviewers appraised the report (rather than the usual two). In no particular order, the Peer Reviewers for this fishery were:

- Andrew Brierley
- Jim Andrews
- Rebecca Mitchell

A summary of their experience and qualifications is available via this link: https://fisheries.msc.org/en/fisheries/jeong-il-corporation-antarctic-krill-fishery/@@assessments

2.2 Version details

Table 1. Fisheries programme 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 1.1

3 Unit(s) of Assessment and Certification

3.1 Unit(s) of Assessment (UoA)

CU UK confirms that the fishery under assessment is within the scope of the MSC Fisheries Standard (7.4 of the MSC Fisheries Certification Process v2.1):

- The target species is not an amphibian, reptile, bird or mammal;
- The fishery does not use poisons or explosives;
- The fishery is not conducted under a controversial unilateral exemption to an international agreement;
- The client or client group does not include an entity that has been successfully prosecuted for a forced or child labour violation in the last 2 years;
- The fishery has in place a mechanism for resolving disputes, and disputes do not overwhelm the fishery;
- The fishery is not an enhanced fishery as per the MSC FCP 7.4.6; and
- The fishery is not an introduced species-based fishery as per the MSC FCP 7.4.7.

CU UK confirms that the client group has submitted the completed 'Certificate Holder Forced and Child Labour Policies, Practices and Measures Template' prior to the start of this assessment.

The proposed Unit of Assessment (UoA) is given in Table 2.

Table 2. Unit of Assessment (UoA)

Species	Antarctic krill (*Euphausia superba*)
Stock	Subarea 48
Geographical range of fishery	Antarctic waters within the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) subareas 48.1 and 48.2
Harvest method / gear	Stern Trawler and individual Otter trawl hauls
Client group	Jeong Il Corporation, Seoul
Other eligible fishers	None

3.2 Unit(s) of Certification (UoC)

To be completed at Public Certification Report stage

Table 3. Draft Unit of Certification (UoC)

Species	Antarctic krill (*Euphausia superba*)
Stock	Subarea 48

Geographical range of fishery	Antarctic waters within the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) subareas 48.1 and 48.2
Harvest method / gear	Stern Trawler and individual Otter trawl hauls
Client group	Jeong Il Corporation, Seoul
Other eligible fishers	None

4 Assessment results overview

4.1 Determination, formal conclusion and agreement

To be completed at Public Certification Report

The team determines that the Jeong Il Corporation Antarctic krill fishery meets the MSC Standard, and should be certified. This conclusion is not currently final, but will be finalised at the end of the objection period.

4.2 Principle level scores

The principle scores for this fishery are presented in Table 4.

Table 4. Principle scores

Principle	Score
Principle 1 – Target Species	80.0
Principle 2 – Ecosystem	91.7
Principle 3 – Management System	88.1

Summary of condition

Condition 1: PI 1.2.1

Performance Indicator	PI 1.2.1. There is a robust and precautionary harvest strategy in place SIa. 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.
Score	70 (60 for SIa)
Justification	Whilst the harvest strategy appears to be responsive to the state of the stock at the scale of the whole of Area 48, this response is based upon full large-scale synoptic biomass surveys which have taken place only twice in the last 20 years. The harvest strategy does not reflect changes in krill biomass at small geographical scales as identified through regular small scale biomass surveys, or if there is evidence that local depletions of krill biomass may have taken place which impact adversely on dependent land-based predators. In other words, the harvest strategy may not be sufficiently responsive at a fine-scale local level in order to meet ecosystem needs. The krill companies under the umbrella of ARK may have voluntarily stopped fishing in areas where there may be an adverse impact on predators, but there is no formal mechanism in place to restrict fishing in areas where there is local depletion of krill biomass.
Condition	By the end of the certification period a harvest strategy should be implemented which is responsive to the state of the stock and the elements of the harvest strategy work together towards ensuring that the stock is above the point where serious ecosystem impacts could occur, and is at or fluctuating around a level consistent with ecosystem needs at multiple scales.
Milestones	Year 1: Resulting score = 70. The Client should provide evidence that WG-EMM of CCAMLR has made significant progress in the revision of assessment methods and the development of data layers and implementation of the risk assessment framework to evaluate catch distribution options at the area, sub-area and fishing ground scales.

	Year 2: Resulting score = 70. The Client should provide evidence that WG-EMM has made significant progress on the three components of the preferred management approach: risk assessment, krill stock assessment, and subarea biomass estimates. Year 3: Resulting score = 70. The Client should provide evidence that WG-EMM has completed its work on the three components of the preferred management approach and presented its output to the Scientific Committee of CCAMLR. Year 4: Resulting score = 70. The Client should provide evidence that the Scientific Committee of CCAMLR has proposed to the Commission a new harvest strategy that is responsive to the state of the stock and ensures that the stock is above the point where serious ecosystem impacts could occur, and is at or fluctuating around a level consistent with ecosystem needs at multiple scales. Year 5 (end of certification period): Resulting score = ≥80. The Client should provide evidence that CCAMLR has implemented a new harvest strategy that is responsive to the state of the stock and the elements of the harvest strategy work together towards ensuring that the stock is above the point where serious ecosystem impacts could occur, and is at or fluctuating around a level consistent with ecosystem needs at multiple scales.
Consultation on condition	Meeting this condition will require the Client to work closely with the relevant national management authorities and with CCAMLR. Close collaboration with the Clients of overlapping fisheries through the Association of Responsible Krill harvesting companies (ARK) would also be beneficial. In 2019 the WG-EMM of the Scientific Committee (SC) of CCAMLR concluded that the preferred option for 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. In response to the WG-EMM proposed strategy, the SC noted that the preferred management strategy comprised prioritising the development of three key elements: (i) a stock assessment to estimate precautionary harvest rates (ii) regular updates of biomass estimates, initially at the subarea scale, but potentially at multiple scales (iii) a risk assessment framework to inform the spatial allocation of catch. At its annual meeting in 2019 the Commission of CCAMLR endorsed this approach proposed by the SC (paragraph 5.17 of the CCAMLR annual report). Despite inevitable disruptions caused by the COVID-19 pandemic in 2020, WG-EMM reported that progress had been made in relation to the three components of the preferred management approach: risk assessment, krill stock assessment, and subarea biomass estimates. The assessment team are assured therefore that CCAMLR has demonstrated a commitment to find solutions to the issue raised in the condition and that progress has already been made.

4.3 Recommendations

Number	Recommendation	Performance Indicator
1	The assessment team recommends that, within the period of certification, regular sub-area stock surveys are continued, robust estimates of biomass in sub-areas are established, and stock assessment models are developed at a sub-area scale in order to determine appropriate precautionary catch limits which will take into account the potential fine-scale impact of the krill fishery on land-based predators, and to provide sufficiently regular estimates of krill stock biomass in order to assess whether krill stocks have been impacted by ecosystem changes caused by climate change.	1.2.4
2	The assessment team recommends that further attention is given to other krill species in the catch (other than *Euphausia superba*). Identification tools, guides, and methodologies should be applied to better identify other krill species, and observer reports should highlight the presence of other, non-*E. superba* krill species in the catch. Such information will feed into relevant CCAMLR working groups.	2.2.1
3	The assessment team strongly encourages the update and review of CM 51-7 to include the foraging needs of the recovering cetacian population, as well as ensure that the Krill fishery work plan as described above is implemented, including the risk assessment, which is deemed critical to de-concentrating fishing by setting krill catch limits at finer spatial scales in relation to fishing operations and predator feeding. Future surveillance audits will follow up on this important management issue.	2.5.2
4	The assessment team recommends that estimates of the proportion of the adult biomass that spawns successfully should be made.	1.2.3

5 Traceability and eligibility

5.1 Eligibility date

The eligibility date for product caught by UoA vessels has been set at the date of certification (publication of the Public Certification Report). Product caught by the UoA vessels will, from that day forward, be eligible to enter further chains of custody.

5.2 Traceability within the fishery

Krill caught by the UoA are hauled aboard the vessels and are poured into a holding tank. From the holding tank the krill are taken by conveyor into the onboard freezing facility. There is no grading of the krill product before it is frozen. The krill is frozen before being placed in JEONG II marked boxes which are sealed by banding. Each box carries the Jeong Il Corporation design, specifies the vessel the krill was caught on, and has a unique identification number printed on it (see Figure 1) – allowing the tracing of the box back to the vessel on which the krill was caught (sub-UoC level). 100% of the catch is independently observed (by the scientific observers) with the catch volume reported to the CCAMLR secretariat and the Korean officials from the vessel. Catch is reported every 5 days along with a monthly summary. The CCAMLR secretariat notifies regularly to all the vessels and contracting parties how many tonnes are caught and when the TAC is reached.

Figure 1. Jeong Il Corporation frozen krill boxes, with their unique design and identification number (in this picture, the boxes have not yet been not sealed with the banding). (Source: Jeong Il Corp)

Transhipment is completed at sea and takes place in the fishing area (CCAMLR 48.1 or 48.2 oceanic trench) or at port of the Falkland Islands (Islas Malvinas).

The vessel tranships the boxed krill to a carrier vessel, the carrier vessel keeps the fish product in a cold storage. The carrier vessel sails to the destination of the product, and offloads. When transhipment is made the UoA vessel receives a Mate's Receipt (MR) from the carrier vessel. The following steps are undertaken:

1. A carrier vessel is booked and transhipment report is produced 72 hours prior to transhipment. This report goes to the CCAMLR secretariat. This contains the following information:
    a. - Vessel Name, Vessel Registration number
    b. - Vessel nationality
    c. - Vessel type, length, total registered tonnage (GRT), storage capacity
    d. - Time of transhipment, location with longitude and latitude
    e. -Product type and quantity of transhipments (including in case of transhipment of foods, fuels, and etc.)
2. Transhipment report is sent to the Korean FMC 24 hours prior to transhipment.
3. Transhipment to the carrier vessel is made and the UoA vessel receives the MR.
4. A transhipment conclusion report is sent to CCAMLR, Korean FMC and Ministry of Fisheries in Korea.
5. The carrier vessel sails to Korea or Japan. The carrier offloads the cargo in the destination.
6. After the offloading is done, the agency reports the exact amount of cargo to the custom, quarantine station.

When the krill is offloaded in Korea, the UoA report to customs with a declaration of import. In accordance with CCAMLR conservation measures, when the transhipment vessel offloads the cargo a port inspection is conducted at random by the National Fishery Products Quality Management Service. In this case a customs procedure is not required as the catches are caught by Korean vessel and does not constitute an import. In the case of unloading in Japan, the custom procedure is required as it is applicable to the imports.

The first point of sale is at the destination port when the product ownership transfers to an exclusive sale distributer. The product transport and transhipment activities of the fishery are outlined below, by country of destination.

For Korea, Krill is caught in CCAMLR CA → Transhipment → Discharging in Busan from Carrier → Cold storage in → Sale (DAEYANG KRILL CO., LTD, SHINSUN SUSAN CO., LTD).

For China, Catching krill in CCAMLR CA → Transhipment → Discharging in Busan from Carrier → Cold storage in→ Export with Reefer Containers (SHANGHAI YIXIN AQUATIC PR).

For Canada, Catching krill in CCAMLR CA → Transhipment → Discharging in Busan from Carrier → Cold storage in → Export with Reefer Containers (KRILL CANADA CORP).

For Japan, Catching krill in CCAMLR CA → Transhipment → Discharging in Fukuoka from Carrier → Cold storage in→ Sale (Umisato Corporation).

For USA, Catching krill in CCAMLR CA → Transhipment → Discharging in Busan from Carrier → Cold storage in → Export with Reefer Containers (GB AQUA INC.).

For Thailand, Catching krill in CCAMLR CA → Transhipment → Discharging in Busan from Carrier → Cold storage in→ Export with Reefer Containers (REEFER TRADING CO., LTD)

Table 5. Traceability within the fishery

Factor	Description
Will the fishery use gears that are not part of the Unit of Certification (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.	There is no possibility of using uncertified gear, the vessels do not carry any gear other than that which meets the CCAMLR requirements. This is verified by 100 % observer coverage.
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.	The vessels (Sae in Champion, and Sae in Leader) do catch horse mackerel and squid outside of CCAMLR Conservation Area (CA), but only Krill is targeted in CCAMLR CA. Therefore, not possible to use the certification for other products.
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.	Jeong Il operate only two trawl vessels which are registered to CCAMLR there is no possibility to use other vessels.
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, transhipment occurs within the fishery, either at sea or at port in the Falkland Islands (Islas Malvinas). The transhipment vessel will often handle product outside the UoC and UoC-product simultaneously. The boxes produced onboard the vessels are labelled and sealed with banding there is no chances of substitution or addition. Random checks at port confirm weights against CCAMLR records. The transhipment protocol described above gives the team confidence that any risks of substitution or mixing are mitigated.
Are there any other risks of mixing or substitution between certified and non-certified fish? If Yes, please describe how any risks are mitigated.	Krill is caught in CCAMLR CA only. Fishing seasons and ground are controlled through CCAMLR regulations, and vessel monitoring. The main risk area lies during transhipment, but the team has determined that even these risks are mitigated by the protocols and checks in place (described above).

5.3 Eligibility to enter further chains of custody

Antarctic kill (*Euphausia superba*) of the CCAMLR Subarea 48 stock caught in CCAMLR Subareas 48.1 and 48.2 will be eligible to enter further chains of custody upon successful assessment completion after the date of certification. Chain of Custody is required at the point of landing in Korea (Busan) and in Japan (Fukuoka). This is to say, the product requires Chain of Custody once it leaves the carrier vessel (all transport and storage once the product is on land, including offloading from the carrier vessel and cold storage). Only Jeong Il Corporation will be eligible to use the fishery certificate and sell product as MSC certified. As per PA 1.4.1.1 – The MSC ecolabel is only permitted for use on IPI stocks for a maximum of one certification period, see Section 5.4.

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

Inseparable or practicably inseparable catches (IPI) stocks are likely in this fishery. They occur at a scale which is small enough that two other certified fisheries on the same stock have submitted variation requests against FCR 7.4.14.2 (and have had them accepted) to allow these small volumes to enter the chain of custody. The assessment team has, as per FCP 7.5.10, uploaded a MSC IPI Announcement template notifying the stakeholders and the MSC of the identification of IPI stocks (under "General Fishery Documents" - https://fisheries.msc.org/en/fisheries/jeong-il-corporation-antarctic-krill-fishery/@@assessments).

The team believe the UoA meets the IPI requirements set out in FCP 7.5.8:

7.5.8.1 a. The non-target catch is practicably indistinguishable during normal fishing operations (i.e. the catch is from a stock of the same species or a closely related species)

Not applicable as the IPI species are fish larvae.

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

Both fishing vessels of the UoA operate in the same way, through individual otter trawl hauls. After the net is hauled on board, it is emptied into a holding tank (of known volume – this is part of their catch recording process) and is directly moved to a conveyor belt for packaging. All species recorded in the catch composition are used in the intended products, which include krill meal and krill oil (for aquaculture and sport fishing), and krill products for human consumption. Given the operations on board the vessel and the use of the entirety of the catch in the end products, the team deems that it is not commercially feasible to separate the IPI stocks.

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

The UoA activities are under 100 % observer coverage. The Scientific Observers Manual issued by CCAMLR states that the key tasks of the observers include: (ii) sampling of catches to determine biological characteristics, (iii) recording biological data by species caught, (iv) recording bycatch, their quantity and biological data, (vi) recording the procedure by which declared catch weight is measured and collecting data relating to the conversion factor between green weight and final product in the event that catch is recorded on the basis of weight of processed product.

The analysis of Observer reports for this fishery between 2016 and 2019 showed that the combined catch of all non-target species amounts to approximated 0.009 % of the catch by weight. As such, this fishery is far from exceeding the 15 % weight limit set by 7.5.8.1c.

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

Based on the Observer data, it appears that ocellated icefish (*Chionodraco rastrospinus*), mackerel icefish (*Champsocephalus gunnari*), and salps (*Salpidae*) make up the majority of the bycatch (see table below).

Table 6. Catch composition aggregated for both vessels and all samples (2016-2020)

Species		**kg**	**% of Total**	**Designation**
Euphausia superba	Krill - target	53,060,661.800	99.99 %	Target
Champsocephalus gunnari	Mackerel icefish	1,008.388	0.003 %	Primary
Chionodraco rastrospinosus	Ocellated icefish	1,099.675	0.002 %	Secondary
Salpidae	Salps	969.150	0.002 %	Secondary
Chaenodraco wilsoni	Spiny icefish	199.982	0.000 %	Secondary
Pseudochaenichthys georgianus	South Georgia icefish	194.160	0.000 %	Secondary
Chaenocephalus aceratus	Blackfin icefish	159.802	0.000 %	Secondary
Cryodraco antarcticus	Long-fingered icefish	121.388	0.000 %	Secondary
Notothenia gibberifrons	Humped rockcod	102.547	0.000 %	Secondary
Pleuragramma antarcticum	Antarctic silverfish	81.315	0.000 %	Secondary
Electrona carlsbergi	Electron subantarctic lanternfish	78.858	0.000 %	Secondary
Semele radiata	bivalve	66.630	0.000 %	Secondary
Gymnoscopelus nicholsi	Nichol's lanternfish	65.631	0.000 %	Secondary
Pagetopsis macropterus		50.494	0.000 %	Secondary
Notolepis coatsi	Antarctic jonasfish	37.935	0.000 %	Secondary
Neopagetopsis ionah	Crocodile icefish	29.892	0.000 %	Secondary
Geophagus spp		29.204	0.000 %	Secondary
Rhopilema spp	Jellyfish spp	19.50	0.000 %	Secondary
Nototheniops larseni	Painted rockcod	16.434	0.000 %	Secondary
Notothenia coriiceps	Black rockcod	10.155	0.000 %	Secondary
Parachaenichthys charcoti	Antarctic dragonfish sp	8.040	0.000 %	Secondary
Cyclopteridae	Lumpsucker spp	7.90	0.000 %	Secondary
Onykia ingens	Greater hooked squid	7.560	0.000 %	Secondary
Psychroteuthis glacialis	Glacial squid	6.951	0.000 %	Secondary

Species		kg	% of Total	Designation
Notothenia rossii	Marbles rockcod	5.407	0.000 %	Secondary
Trematomus eulepidotus	Blunt scalyhead	4.877	0.000 %	Secondary
Lophius americanus	American anglerfish	4.340	0.000 %	Secondary
Psilodraco breviceps	Antarctic dragonfish sp	3.050	0.000 %	Secondary
Notothenia neglecta	Yellowbelly rockcod	2.10	0.000 %	Secondary
Trematomus newnesi	Notothenid sp	1.867	0.00 0%	Secondary
Onykia knipovitchi	Cephalopod sp	1.580	0.000 %	Secondary
Icichthys australis	Southern driftfish	1.290	0.000 %	Secondary
Dissostichus mawsoni	Antarctic toothfish	0.970	0.000 %	Secondary
Nototheniops nudifrons	Notothenid sp	0.910	0.000 %	Secondary
Trematomus lepidorhinus	Slender scalyhead	0.785	0.000 %	Secondary
Pagetopsis maculatus	Channichthid sp	0.63	0.000 %	Secondary
Magnisudis prionosa	Southern barracudina	0.52	0.000 %	Secondary
Gasterosteus aculeatus	Three-spined stickleback – dubious identification (far outside geographical range)	0.24	0.000 %	Secondary
Paraliparis spp	Snailfish sp	0.225	0.000 %	Secondary
Paradiplospinus antarcticus	Antarctic escolar	0.2	0.000 %	Secondary
Loligo gahi	Cuttlefish	0.165	0.000 %	Secondary
Dacodraco hunteri	Crocodile icefish sp	0.14	0.000 %	Secondary
Nototheniidae	Notothenid sp	0.05	0.000 %	Secondary
Natantia	Decapod sp	0.02	0.000 %	Secondary
Alopias superciliosus	Bigeye thresher – dubious identification (far outside the geographical range)	0.005	0.000 %	Secondary
Octopodidae	Octopus	0.005	0.000 %	Secondary
Artedidraco mirus	Perciform sp	0.001	0.000 %	Secondary

7.5.8.1 e. The IPI stocks are not certified separately

Antarctic krill (*Euphausia superba*) is the only species under assessment in the list above. This stock is currently certified in two other fisheries.

Considering the information presented above, the team believes that the Jeong Il Corporation krill fisheries meets the requirements for FCP v2.1 7.5.8.1 b-e.

Further to this evidence, the rationale for the Variation Request from one of the MSC certified krill fisheries is provided below (Roel et al. 2018):

A small percentage of the catches from the midwater trawl fishery targeting Antarctic krill in CCAMLR subarea 48 is comprised by several fish and non-fish taxa which are caught together with the krill. Due to their small size (modal size class of <10cm, similar to the krill length-frequency distribution), low frequency of occurrence and minimal percentage in volume (between 0.1-0.2 %), it is not commercially feasible to separate them from the krill catch. They can only be detected and identified through observer's sampling (within the CCAMLR area there is a Scheme for International Scientific Observation –SISO- which, among other tasks, is commissioned to perform bycatch samplings). Two comprehensive reviews on fish-bycatch occurrence and species composition have been recently performed by two CCAMLR Working Groups: the working group for Ecosystem Monitoring and Management (WG-EMM) and the Working Group on Fish Stock Assessment (WG-FSA).

The report WG-EMM-14/31 and subsequent WG-FSA-16/04 provided an update on the fish by-catch in the krill fishery using data from SISO and from the commercial fleet to examine the frequency of occurrence (FOO), proportion by mass, length-frequency distribution and geographic provenance of the key fish taxa reported. A total of 9,303 hauls collected on 60 cruises involving 18 different vessels over the period 2010- 2014 were analysed to elaborate the report WG-EMM-14/31. While for the most recent WG-FSA-16/04 updated this study using 2014-2016 data on fish by-catch in the krill fishery from commercial catch data (95,513 hauls) and CCAMLR SISO data (11,875 hauls). Both studies show similar results, in terms of species composition and frequencies of occurrence. For instance, WG-FSA-16/04 estimated that total annual mass of fish bycatch in a 300,000 tonnes krill fishery would be 370 tonnes (meaning 0.12 % of total catch in volume), comprising 50 % mackerel icefish (*C. gunnari*) and 30 % the Nototheniid (*L. larseni*).

6 Scoring

6.1 Summary of PI Level Scores

The following scores include information gathered before and during the site visit, where a wide panel of stakeholders were interviewed. These scores also reflect the opinions of the peer reviewers, where the team has found that the Peer Reviewer's comment merited a change in scoring of the fishery.

Table 7. Performance Indicator scores

Princi-ple	Component	Wt	Performance Indicator (PI)		Wt	Score
One	Outcome	0.33	1.1.1	Stock status	0.5	80
			1.1.2	Stock rebuilding	0.5	NA
	Management	0.67	1.2.1	Harvest strategy	0.25	70
			1.2.2	Harvest control rules & tools	0.25	85
			1.2.3	Information & monitoring	0.25	80
			1.2.4	Assessment of stock status	0.25	85
Two	Primary species	0.2	2.1.1	Outcome	0.33	100
			2.1.2	Management strategy	0.33	100
			2.1.3	Information/Monitoring	0.33	90
	Secondary species	0.2	2.2.1	Outcome	0.33	80
			2.2.2	Management strategy	0.33	100
			2.2.3	Information/Monitoring	0.33	85
	ETP species	0.2	2.3.1	Outcome	0.33	100
			2.3.2	Management strategy	0.33	90
			2.3.3	Information strategy	0.33	90
	Habitats	0.2	2.4.1	Outcome	0.33	100
			2.4.2	Management strategy	0.33	100
			2.4.3	Information	0.33	85
	Ecosystem	0.2	2.5.1	Outcome	0.33	80
			2.5.2	Management	0.33	90
			2.5.3	Information	0.33	85
Three	Governance and policy	0.5	3.1.1	Legal &/or customary framework	0.33	85
			3.1.2	Consultation, roles & responsibilities	0.33	85
			3.1.3	Long term objectives	0.33	100
	Fishery specific management system	0.5	3.2.1	Fishery specific objectives	0.25	90
			3.2.2	Decision making processes	0.25	85
			3.2.3	Compliance & enforcement	0.25	90

Princi-ple	Component	Wt	Performance Indicator (PI)		Wt	Score
			3.2.4	Monitoring & management performance evaluation	0.25	80

6.2 Fishery overview

6.2.1 History of fishery and its management

The international 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 Korea have been fishing for krill in the Antarctic for 28 years with the current two vessels identified in the UoC fishing since 2000 and 2006 respectively. 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 2). 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. Korean 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 2018 (CCAMLR 2019i). 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 2017a; 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.

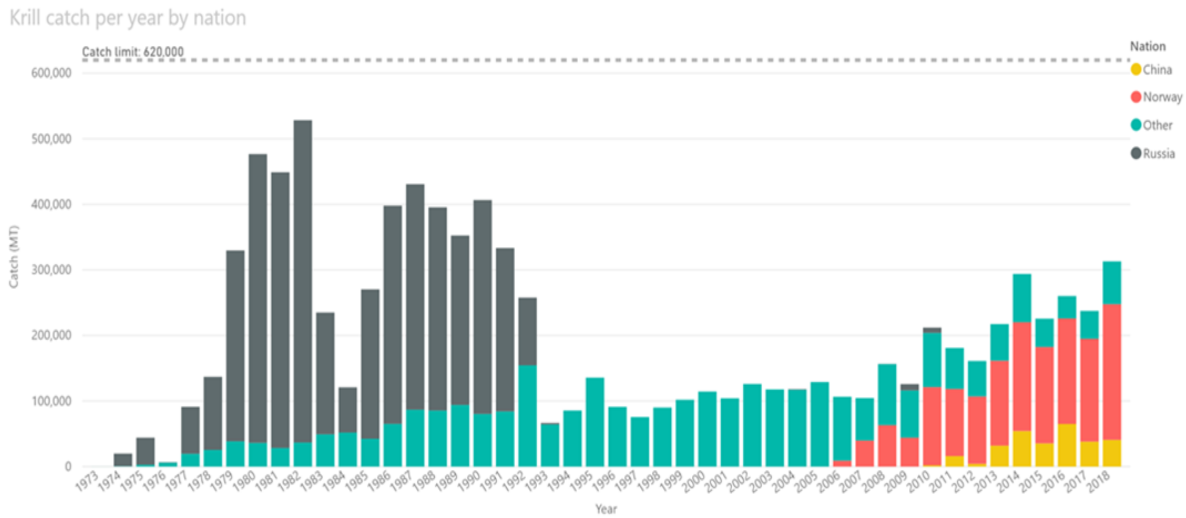

Figure 2. Total annual catches of krill (*Euphausia superba*) in the CCAMLR Area from 1973 to 2018. (Source: CCAMLR)

6.2.2 Gear and operation of the fishery

Fishing vessels:

The two trawler vessels included in the UoA are owned and operated by the JEONG IL Corporation and registered in Busan, the Republic of Korea (CCAMLR vessel registry[1]). Both vessels have similar characteristics (Table 8) and midwater trawl net fishing gear including a marine mammal (sealions) protect net and escape window (Table 9). The two vessels in the fishery operate conventional stern trawls. Korea joined CCAMLR as a Contracting Party (CP) in 1985. The vessels in the UoA have been active in CCAMLR's krill fishery for many years (since 2006 for Kwang Ja Ho – now Sae In Leader, and since 2000 for In Sung Ho – now Sae In Champion).

Table 8. Fishing vessel characteristics (CCAMLR active vessel registry)

Vessel name	Sae In Leader	Sae in Champion
CCAMLR Vessel ID	75742	75739
IMO Number	8505977	7042538
Callsign	DTBP9	6LZT
Year built	1985	1970
Crew Count	96	99
Length	93.50 m	88.94 m
Beam	15.60 m	15.00 m
Gross Tonnage	3012.00 t	2999.12 t
Engine Power	3,603.00 kW	2,794.00 kW
Carrying Capacity	1000.00 t	1500.00 t

[1] https://www.ccamlr.org/en/compliance/list-authorised-vessels

Fish Holds Capacity	2844.50 m^3	5324.00 m^3
Fish Holds Count	1	2

Table 9: Fishing gear characteristics (CCAMLR active vessel registry)

Net measurements	Sae In Leader (2 nets)	Sae in Champion (2 nets)
Net-mouth opening height (m)	30	20
Net-mouth opening width (m)	72	57
Total net length (m) including codend, Measured along the centreline of the net	167.6	105.1
Codend-mouth opening height (m)	1.5	2.1
Codend-mouth opening width (m)	3	2.5
Codend length (m)	32	23
Codend mesh size (mm, stretched mesh)	Inner 15 Outer 100	Inner 15 Outer 150

6.2.3 Fishing areas and seasons

Subarea 48.1 - The waters bounded by a line commencing from a point at 70°00'W longitude on the coast of Antarctica at Palmer Land; thence running across the George VI Sound to a point at 70°00'W longitude on the south coast of Alexander Island; thence along the east coast of this island to a point on the northeast coast at 70°00'W longitude; thence due north to 60°00'S latitude; thence due east to 50°00'W longitude; thence due south to 65°00'S latitude; thence due west to a point on the east coast of the Antarctic Peninsula at 65°00'S latitude; thence running in a north-easterly and then south-westerly direction along the coast of the Antarctic Peninsula to the point of departure.

Subarea 48.2 - The waters bounded by a line running from a point at 64°00'S latitude and 50°00'W longitude; thence due north to a point at 57°00'S latitude and 50°00'W longitude; thence due east to 30°00'W longitude; thence due south to 64°00'S latitude; thence due west to the point of departure.

Subarea 48.3 – the UoA does not include fishing activities in this Subarea. Jeong Il Corporation was granted a license to conduct exploratory fishing in this area in 2020, but these activities are beyond the scope of this assessment. The only fishing activities covered in this assessment are those that take place in Subarea 48.1 and 48.2. Catches from other areas would not be eligible for certification should the outcome of this assessment be positive.

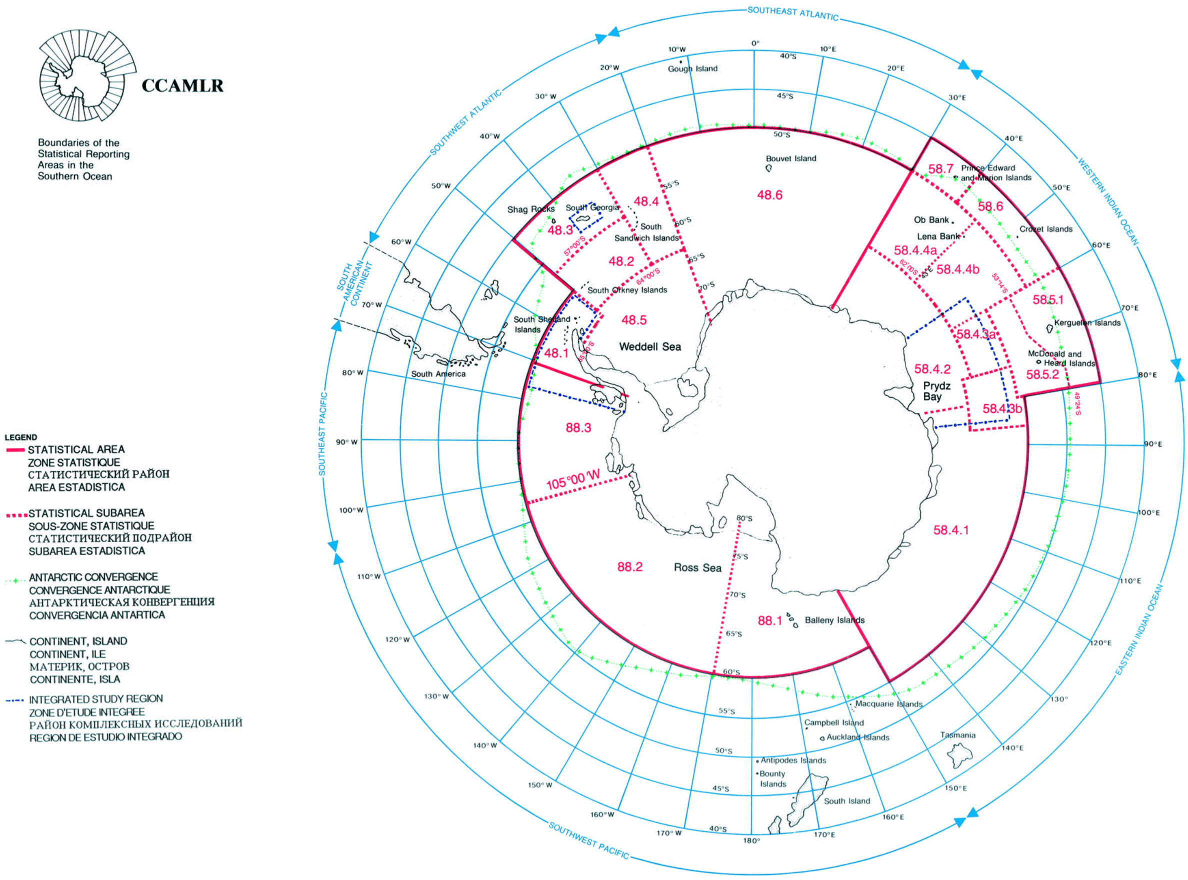

Figure 3: The fishery takes place in the Southwest Atlantic CCAMLR Statistical Area 48. Source CCAMLR.

6.2.4 Catch profiles and data availability

Please refer to Table 6 on Section 5.4.

6.3 Principle 1

6.3.1 Biology and ecology

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 highest density concentrations of krill are found in CCAMLR Area 48, and consequently the krill fisheries have been focussed on this area. On a broad scale, krill distribution is influenced by hydrography and bathymetry. Krill are found in depths of up to 600 m 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 & 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 & Hampton 1989).

As noted above, *E. 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 knowledge of oceanography in the area and on the assumption that krill are unlikely to move between these smaller sub-areas (Figure 3).

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 60 mm 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 2 years of age 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. A review of krill abundance and distribution data by Meyer et al. (2020) suggested that only a small proportion of the total adult biomass may spawn successfully, and these spawners are potentially responsible for replenishing the entire krill population over the whole SW Atlantic sector, although there may be other areas which act as sources to the Area 48 krill population. Meyer et al. (2020) highlight the need to identify the seasonal overlaps between the fishery and successful spawning stock.

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 of a recent 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 2018j). As krill may be dependent on sea ice, any long-term changes in temperature due to climate change could impact on krill population dynamics The distribution of krill has contracted southward over the past 90 years with numerical densities near their northern limit declining sharply and the population has become more concentrated towards the

Antarctic shelves (Atkinson et al., 2019). Hill et al. (2013) estimated that the extent of sea ice able to support krill in the southwest Atlantic sector of the Antarctic will reduce by 20 % by 2100. In addition, krill eggs will be sensitive to any future ocean acidification through increased levels of CO_2 with higher concentrations of CO_2 leading to a decline in embryonic development (Kawaguchi et al. 2013).

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

6.3.2 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 & 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.

Krill therefore play a key role within the Antarctic ecosystem, and previous MSC certification assessment reports have considered whether *E. superba* can therefore be considered as a key Low Trophic Level (LTL) species as defined by MSC Fisheries Standard v2.01. *E. superba* plays a central role in the ecosystem and acts as a direct 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. A simplified food web of the Southern Ocean (Figure 4) shows that linkages across trophic levels are centred around krill (Everson 2000).

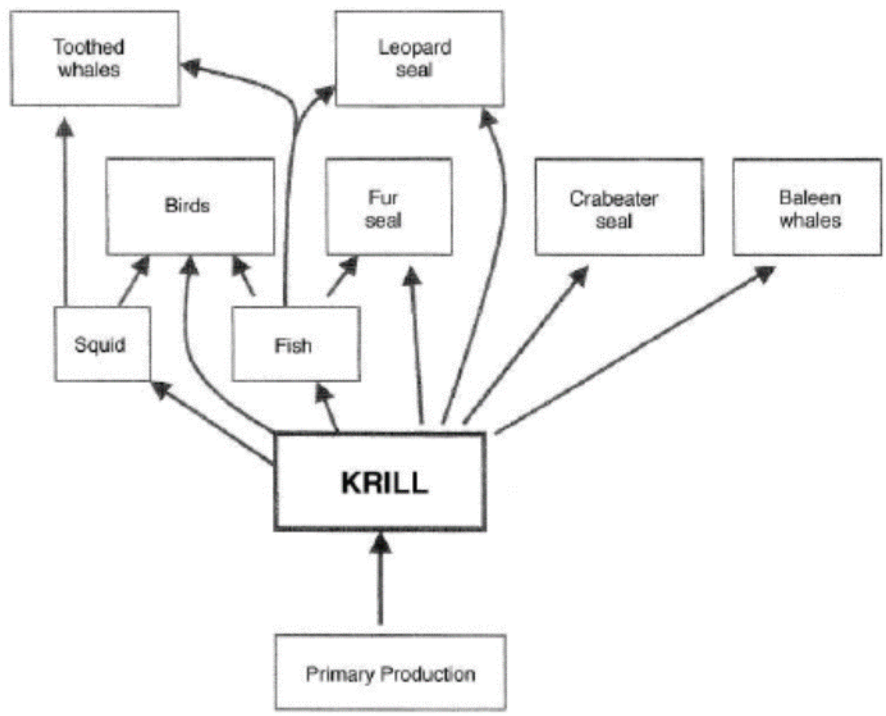

Figure 4. A simplified representation of the Southern Ocean food web. (Source: Everson (2000)**).**

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) and during the reassessment of the Aker Biomarine Antarctic krill fishery (Hønneland et al. 2019) which assessed the Chilean and Norwegian fleets respectively fishing *E. superba* in the same geographical area in the Southern Ocean.

6.3.3 Harvest strategy and regulations

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 (PCL) 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. As noted above, 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.

The Korean Ministry of Ocean and Fisheries is responsible for issuing licenses and for surveillance and monitoring of the Korean fishing companies to ensure that their national vessels comply with CCAMLR regulations including monitoring of quotas. Korean vessels that engage in fishing are managed under the Distant Water Fisheries Development Act 2015 (DWFDA). Article 1 states that the DWFDA "*is to advance the sustainable development of the distant water fisheries industry and contribute to the growth of the national economy through the rational preservation, management, exploitation and utilization of maritime living resources and the promotion of international cooperation.*" Krill may be landed in countries other than Korea, and therefore other Port States will play a role in the monitoring of landings. 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, which are designed to ensure that any impact on any land-based predators is minimised.

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 only two vessels licensed to fish for krill - FV Sae In Champion and FV Sae in Leader. There are no regulations such as days-at-sea that limit the overall fishing effort of the two licensed vessels.

There are a series of Marine Protected Areas (MPAs) within Area 48 where krill fishing is not permitted, and voluntary restrictions including a new agreement in 2020 by ARK members to a 4,500-square-kilometre voluntary restricted zone in the Hope Bay area, which will now be closed to fishing year-round. The newly expanded restricted zones now encompass 74,400 square kilometres of ocean around the South Shetland Islands, northern Antarctic Peninsula, and in the Gerlache Strait. 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 m 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 10 below. These catch limits are set for the 2019/20 season.

Table 10. 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 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.

6.3.4 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 Korean 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 two Korean 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 Korean 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 Korean Fisheries Monitoring Center requires that Korean vessels report their catches of krill and bycatch species electronically every 24 hours. Catches are not graded. 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. The Korean vessels provide records of green weight of krill in the fish pond following capture and use conversion factors to relate weights of frozen krill and krill meal to green weights.

Fishing operations of the Korean vessels are monitored by the Korean Fisheries Monitoring Center (FMC). Krill catches are transhipped to a 'carrier' vessel at which point the fishing vessel is issued with a Mate's Report (MR) from the transhipment vessel. The observer will also record the weight of krill transhipped. The carrier vessel will then sail to either Korea or Japan to land the catch. The whole transhipment and landing processes are reported to CCAMLR and the Korean authorities (FMC and Ministry of Fisheries). Landings of krill in Korea are randomly monitored by the National Fishery Products Quality Management Service (NFQS), who cross-check landings with reported catches. If there is more than a 10 % weight discrepancy by inspector sampling at offloading, or if there is no sampling, then observer data are used to clarify any discrepancy. Observer data are routinely cross-checked for validation with submitted vessel catch data.

All krill fishing trips will have an observer on board the vessel, and where possible, a scientific observer will also be present to record all catches and discards. Observers will report any violations/infringements to both Korean 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. Major fully synoptic surveys of Area 48 were undertaken in 2000 and 2019, and between these two major surveys there have been smaller-scale surveys carried out regularly under national programmes by, for example, Norway and Korea. There is therefore substantial biological information on krill populations that has been built up over many years of surveys. For the Korean fleet, scientific research is undertaken on annual research cruises. Korea has been conducting standardised acoustic transects in Bransfield Strait, using the standard CCAMLR protocols, and will be repeating these in future years, including monthly sampling to examine the dynamics of krill. FV Sae In Leader undertook a research cruise in February 2019.

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.

6.3.5 Stock assessment of krill

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 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 2000 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 2019, 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 11) (Skaret et al. 2015; Fielding et al. 2014; Kinzey et al. 2015). The relationship between these local estimates of biomass and the biomass across the whole of Area 48 is not clear and therefore these 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. Krill appear to exhibit 5-6 year cycles of abundance, and whilst climatic factors were previously thought to be the main driving factor, a recent study by Ryabov et al. (2017) observed that these cycles on the Palmer long-term ecological research (Palmer-LTER) grid in the Western Antarctic Peninsula (WAP) region exhibit two successive strong year classes each followed by successful recruitment one year later which could not be explained purely by climatic variations. Ryabov et al. (2017) used a bioenergetic model to capture the effects of seasonality on reproduction and ontogenetic development of krill during its entire life cycle, and concluded that intraspecific competition for food was the main driver of the krill cycle, while external climatological factors possibly modulate its phase and synchronization over large scales.

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 11 provided no evidence that the stock had declined since the major survey in 2000 (Table 12; (Hill et al. 2016). An additional source of abundance data for krill is KRILLBASE, a circumpolar database of Antarctic krill and salp numerical densities (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 5). 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 (Macaulay 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 Macaulay 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 % (Macaulay et al. 2019). However, the survey data were reanalysed 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 2019k). 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. Whilst these biomass estimates are sensitive to the choice of length distributions used to convert acoustic backscatter into krill density estimates (Macaulay 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 11. 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 12. 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

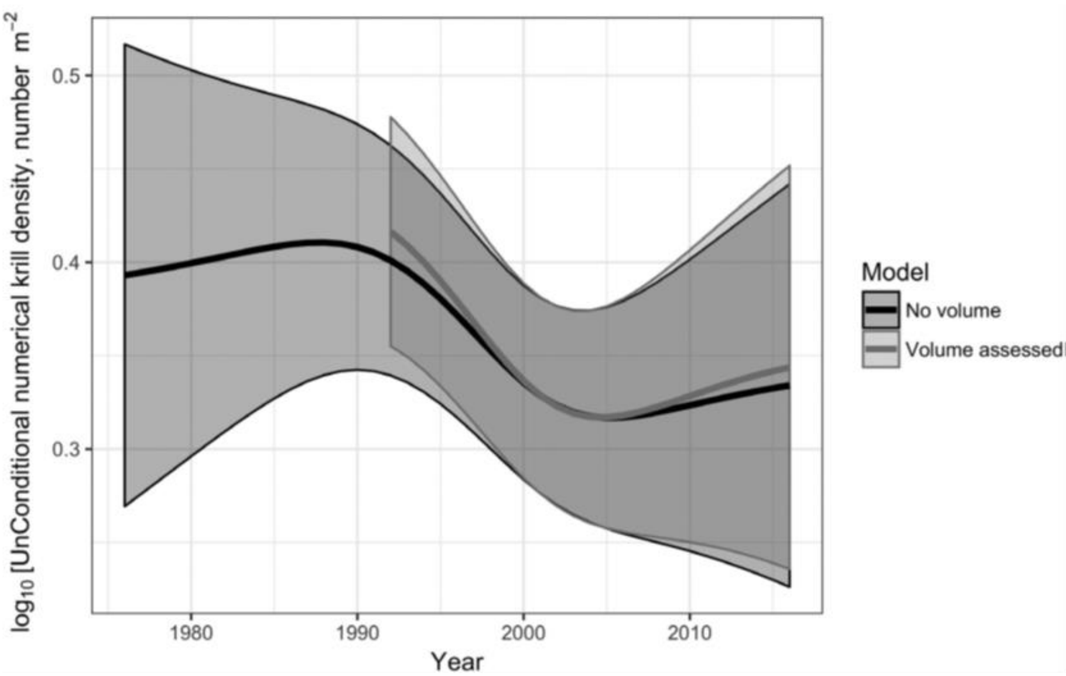

Figure 5. Evaluation of krill abundance data from KRILLBASE. Densities of krill (*Euphausia superba*) considering the krill-presence models: volume not considered (No volume) and volume sampled modelled (volume assessed) and conditional density. Mean unconditional density is shown as solid lines and 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 & 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 int o 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 10). It is not envisioned that the overall catch trigger level will be revised until the 2019 full synoptic survey has been 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 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 one that is consistent with the MSC expectations for key LTL species (MSC Fisheries Standard v2.01, SA2.2.13a). Recent studies that evaluated the impact of the krill fishery on predators (Watters et al. 2013; Plaganyi & Butterworth 2012; Smith et al. 2011) indicate that such a target would satisfy ecosystem needs at the level of the whole of Area 48. The GYM 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. Whilst the GYM 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. For example, Watters et al. (2020) provide evidence that local harvest rates of 10 % or more could impact on penguin populations. Whilst the krill companies under the umbrella of the Association of Responsible Krill harvesting companies (ARK) have voluntarily stopped fishing in areas where there has been concern that krill fishing could impact on dependent predators essentially solving the problem in the short term, formal CCAMLR Conservation Measures are required to provide mitigation against such potential adverse effects of krill fishing.

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 11 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 2019m). 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.

In addition to the need for a sub-area-based approach to stock assessment modelling and management of krill, there is need for a greater understanding of the biological processes underlying population dynamics of krill. As noted above, Ryabov et al. (2017) concluded that intraspecific competition for food was the main driver of the krill cycle, while external climatological factors possibly modulate its phase and synchronization over large scales. Meyer et al. (2020) highlight the need for increased knowledge of the mechanisms of krill recruitment and the relationship between recruitment and sea ice conditions, the identification of potential areas of high spawning success with little spawning in the remainder of the population, the influence of larval advection from those areas and the impact of any concentration of fishing in those areas of high spawning success, the drivers of seasonal krill migration and overwintering spawning stock and the implications of climate change for krill population dynamics and management. In particular Meyer et al. (2020) review published krill abundance and distribution data which suggests that only a small proportion of the total stock biomass successfully spawns and that the impact of fishing may disproportionately affect the portion of the adult stock that successfully spawns. However, Meyer et al. (2020) focus on a spawning hotspot off the South Shetland Islands, but there is also successful recruitment within Area 48.1 in the Western Antarctic Peninsula south of Anver Islands (Conroy et al. 2020) but also further south in the Weddell Sea, both of which could advect recruits into the Bransfield Strait (Conroy et al. 2020; Reiss *et al*. 2020). Whilst concerns expressed by Meyer et al. (2020) over the small proportion of the total stock biomass that successfully spawns, and over gaps in the knowledge of routes of krill transport (both of which result in some uncertainty in relation to whether the catch limits set by CCAMLR are as precautionary as previously thought), krill catches in the area identified by Meyer *et al*. (2020) have been low in comparison with the total biomass available (Wang et al. 2021), and changes in fishing distribution have resulted in almost no fishing in that area during the spawning season (Santa Cruz et al. 2018). In addition, concerns over potential concentration of fishing effort in areas of high spawning success may be mitigated by recent findings, which suggest that krill recruitment at the Northern Antarctic Peninsula area is decoupled from local larval abundance and supports the importance of remote larval supply (Conroy et al. 2020).

6.3.6 Total Allowable Catch (TAC) and Catch Data

The TAC and catch data for UoA 1 are shown below.

Table 13. TAC and Catch Data

TAC*	Year	2019/20	Amount	Subarea 48.1 – 155,000 tonnes Subarea 48.2 – 279,000 tonnes
UoA share of TAC*	Year	2019/20	Amount	Subarea 48.1 – 155,000 tonnes Subarea 48.2 – 279,000 tonnes
UoA share of total TAC*	Year	2019/20	Amount	Subarea 48.1 – 155,000 tonnes Subarea 48.2 – 279,000 tonnes
Total green weight catch by UoA	Year (most recent)	2019/20**	Amount	Subarea 48.1 – 13,332 tonnes Subarea 48.2 – 19,986 tonnes
	Year (second most recent)	2018/19	Amount	Subarea 48.1 – 27,157 tonnes Subarea 48.2 – 13,840 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

** Preliminary figures

6.3.7 Principle 1 Performance Indicator scores and rationales

Scoring table 1. PI 1.1.1A – Stock status

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Stock status relative to recruitment 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	No

Rationale

The krill fishery is managed by setting catch limits based upon a Generalised Yield Model, and the estimate of sustainable yield (Precautionary Catch Level) 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 given the key 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 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. A highly precautionary catch trigger level has been set at 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.

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 (S.L. Hill et al. 2019), there is no evidence from recent studies that krill density has declined since 2000.

Whilst there is little evidence of a stock-recruit relationship, and all observed "poor krill years" have been followed by years of average or high krill biomass (Meyer et al. 2020), there is some evidence of 5-6 year cycles in krill abundance, and Ryabov et al. (2017) observed that such cycles are characterised by two successive strong year classes each followed by successful recruitment one year later and a using a bioenergetic model to capture the effects of seasonality on reproduction and ontogenetic development of krill during its entire life cycle, they concluded that intraspecific competition for food was the main driver of the krill cycle, while external climatological factors possibly modulate its phase and synchronization over large scales. Whilst there is no clear evidence of recruitment impairment related to changes in stock status, a recent review of krill abundance and distribution data suggested that only a small proportion of the total stock biomass successfully spawns and that the impact of fishing may disproportionately affect the portion of the adult stock that successfully spawns (Meyer et al. 2020). However, Meyer et al. (2020) focus on a spawning hotspot off the South Shetland Islands, but there is also successful recruitment within Area 48.1 in the Western Antarctic Peninsula south of Anver Islands (Conroy et al. 2020) and also further south in the Weddell Sea, both of which could advect recruits into the Bransfield Strait (Conroy et al. 2020; Reiss et al. 2020). Whilst concerns expressed by Meyer et al. (2020) over the small proportion of the total stock biomass that successfully spawns and over gaps in the knowledge of routes of krill transport result in some uncertainty in relation to whether the catch limits set by CCAMLR are as precautionary as previously thought, krill catches in the area identified by Meyer et al. (2020) have been low in comparison with the total biomass available (Wang et al. 2021), and changes in fishing distribution have resulted in almost no fishing in that area during the spawning season (Santa Cruz et al. 2018). In addition, concerns over potential concentration of fishing effort in areas of high spawning success may be mitigated by recent findings which suggest that krill recruitment at the Northern Antarctic Peninsula area is decoupled from local larval abundance and supports the importance of remote larval supply (Conroy et al. 2020).

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 and the lack of any clear evidence of recruitment impairment related to changes in stock status demonstrate that it is highly likely that the krill stock in Area 48 as a whole is above the point where serious ecosystem impacts could occur. **The SG60 and SG80 are met.** Concerns have been raised that the impact of fishing may disproportionately affect the portion of the adult stock that successfully spawns within one area of the stock, and although local exploitation rates at this spawning hotspot have remained low, the assessment team has therefore taken a precautionary approach to scoring the SI. It cannot be concluded that there is a high degree of certainty that the krill stock is above the point where serious ecosystem impacts could occur. **The SG100 is not met.**

b	Stock status in relation to achievement of Maximum Sustainable Yield (MSY)			
	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 one that is consistent with the MSC expectations for key LTL species PI SA2.2.13a. Recent studies that evaluated the impact of the krill fishery on predators (Watters et al. 2013; Plaganyi & Butterworth 2012; Smith et al. 2011) indicate that such a target would satisfy ecosystem needs at the level of the whole of Area 48. The GYM 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 removal 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. Whilst the trigger levels for Area 48.1 have been met in 2018/19 and 2019/20 much earlier in the season than in previous years, it is important to note that the disaggregated catch limits have not been exceeded, and therefore the mechanisms to minimise impact on predators appear to work at a sub-area scale as fishing stops when catch limits are reached. The Area 48 sub-areas are still very large geographical areas, and concerns have been raised that krill removals may well have an impact in specific localised areas. In response, the krill companies under the umbrella of the Association of Responsible Krill harvesting companies (ARK) have voluntarily stopped fishing in areas where there has been concern that krill fishing could impact on dependent predators.

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, 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 and voluntary cessation of fishing by krill companies in areas where land-based predators may be impacted by reductions in krill abundance provide strong evidence that the stock has been fluctuating around a level consistent with ecosystem needs. **The SG80 is met.**

Whilst the GYM 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. For example, Watters et al. (2020) provide evidence that local harvest rates of 10% or more could impact on penguin populations. Whilst ARK has voluntarily stopped fishing in areas where there has been concern that krill fishing could impact on dependent predators essentially solving the problem in the short term, formal CCAMLR Conservation Measures are required to provide future mitigation against such potential adverse effects of krill fishing. The current sub-division of the catch trigger levels across sub-areas 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. CM 51-07 expires in November 2021 and therefore a new approach is required urgently. CCAMLR's WG-EMM for 2019 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. Therefore, **SG100 is not met**.

References:

(Constable & Mare 2003; Hill et al. 2016; Atkinson et al. 2017; CCAMLR 2019k; Cox et al. 2018; Macaulay et al. 2019; Plaganyi & Butterworth 2012; Smith et al. 2011; Watters et al. 2016)

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 PRI (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 = 62.6 / 20%B_0 = 5.19
Reference point used in scoring stock relative to MSY (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 = 62.6 / 75%B_0 = 1.38

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	80
Condition number (if relevant)	-

Scoring table 2. 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

PI 1.1.1 scores 80, and therefore this Performance Indicator is not scored (MSC Standard v2.01, SA2.3.1).

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

PI 1.1.1 scores 80, and therefore this Performance Indicator is not scored (MSC Standard v2.01, SA2.3.1).

References

NA

Draft scoring range	NA
Information gap indicator	NA
Overall Performance Indicator score	NA
Condition number (if relevant)	-

Scoring table 3. 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	No	No

Rationale

The harvest strategy is underpinned by CCAMLR Conservation Measures 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. 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. A key element of the harvest strategy is the setting of precautionary catch limits based upon recruitment and biomass escapement reference points and a well-defined harvest control rule. 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. The harvest strategy is therefore expected to achieve the stock management objectives for a key LTL species, of ensuring that the stock is (a) above the point where serious ecosystem impacts could occur and (b) around a level consistent with ecosystem needs across Area 48 as a whole. **SG60 is met.**

Whilst the harvest strategy appears to be responsive to the state of the stock at the scale of the whole of Area 48, this response is based upon full large-scale synoptic biomass surveys which have taken place only twice in the last 20 years. The harvest strategy does not reflect changes in krill biomass at small geographical scales as identified through regular small scale biomass surveys, or if there is evidence that local depletions of krill biomass may have taken place which impact adversely on dependent land-based predators. In other words, the harvest strategy may not be sufficiently responsive at a fine-scale local level in order to meet ecosystem needs. The krill companies under the umbrella of ARK may have voluntarily stopped fishing in areas where there may be an adverse impact on predators, but there is no formal mechanism in place to restrict fishing in areas where there is local depletion of krill biomass. **The SG80 is not met** and therefore a condition is raised.

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 of approximately 0.5 % of the stock biomass will not affect the total krill biomass adversely even if extraneous ecosystem and oceanographic/climate 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 as required under CCAMLR CM50-17 providing evidence of an effective HS, although it should be noted that catch trigger levels are now reached in less time than in previous years. 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 for the whole of Area 48 is achieving its objective. Whilst regular closures at sub-areas scales occur when catch trigger levels have been approached, there is concern that catch trigger levels have been reached more quickly in recent years that in previous years and that local depletions of krill biomass may therefore have taken place which impact adversely on dependent land-based predators. In response, the krill companies under ARK have voluntarily stopped fishing in those localised areas where land-based predators could be affected by reductions in krill biomass, thereby minimising the potential for krill fishing to cause serious ecosystem impacts. The **SG80 is met**.

Whilst the harvest strategy for the whole of Area 48 and at sub-areas is achieving its objectives, there is a need for an evaluation of the spatial resolution of biomass estimates and consequent trigger levels. 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 two Korean vessels is monitored through the on-board Vessel Monitoring System (VMS) which is polled every hour, and there is a CCAMLR requirement to notify the commission when a vessel enters or leaves a sub-area of Area 48. All Korean vessels must complete logbooks detailing catch and effort and this information must be transmitted regularly to CCAMLR secretariat. The Korean Fisheries Monitoring Center requires that Korean vessels report their catches of krill and bycatch species electronically every 24 hours. 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 (further discussed in Section 6.4.2). 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, although full-scale synpotic surveys have only been conducted twice in the last 20 years, 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. **SG60 is met**.

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

Rationale

CCAMLR is the overarching body for management and development of the harvest strategy for the krill fishery, and the work of CCAMLR has undergone two performance reviews in 2008 and 2016 (CCAMLR 2017e; CCAMLR 2008a), 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. It can be concluded that the harvest strategy is perdiocially reviewed and improved as necessary. 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. In addition CCAMLR's Scientific Committee is currently working towards a preferred management strategy which consists of a stock assessment to estimate precautionary harvest rates, updated biomass estimates, initially at the subarea scale, but potentially at multiple scales and a risk assessment to inform the spatial allocation of catch. **SG100 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

The target species is not a shark so this scoring issue is not applicable.

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, and therefore there is no unwanted catch as per definition in SA3.1.6 and SA3.5.3. This scoring issue is not relevant.

References

(CCAMLR 2018j; Constable & Mare 2003; Hill et al. 2016; CCAMLR 2017e; Atkinson et al. 2017; CCAMLR 2017a; CCAMLR 2019k; Cox et al. 2018; Macaulay et al. 2019)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	70

Condition number (if relevant)	1

Scoring table 4. 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 Yield 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 γ (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 (γ) based on the following rules:

1. Choose a yield level, γ 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, γ 2, so that the median escapement at the end of a 20-year period is 70 % of the median pre-exploitation level.

3. Select the lower of γ 1 and γ 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. In addition, the krill companies under ARK have voluntarily stopped fishing in localised areas where dependent predators could be impacted by reductions in krill abundance. The potential for any breeding failures in dependent predators to be caused by high exploitation rates is therefore minimised.

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 which is 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 sub-areas have been taken into account by disaggregating the overall catch trigger level across the four sub-areas of Area 48, and by the implementation of a cessation of fishing by the krill companies in localised areas where dependent predators could be impacted by reductions in krill abundance. 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 by disaggregating catch limits across sub-areas and by krill companies voluntarily ceasing fishing in localised areas where dependent predators could be impacted by reductions in krill abundance, there are still uncertainties concerning the geographical scale at which the formal HCRs may be implemented. In addition, there are uncertainties relating to the proportion of the adult stock which spawns successfully, 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. Whilst regular closures at sub-areas scales occur when catch trigger levels have been approached, there is concern those local depletions of krill biomass may have taken place which impact adversely on dependent land-based predators. In response, the krill companies under ARK have voluntarily stopped fishing in those localised areas where land-based predators could be affected by reductions in krill biomass, thereby minimising the potential for krill fishing to cause serious ecosystem impacts. 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. **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. and there are inconsistencies across the various fleets in recording of green weight. Vessels hauling the trawl after each individual tow (e.g., Korean vessels) record green weight of catches in the fish pond, but this is less straightforward in vessels using continuous flow systems and these inconsistencies need to be resolved in order to provide clear evidence that the exploitation levels required under the HCRs are achieved. **SG100 is not met**.

References

(CCAMLR 2018j; Constable & Mare 2003; CCAMLR 2019k; CCAMLR 2019m; CCAMLR 2019i; Cox et al. 2018; Macaulay et al. 2019); (CCAMLR 2016e)

Draft scoring range	≥80
Information gap indicator	More information sought on the ways in which krill removals are recorded
Overall Performance Indicator score	85
Condition number (if relevant)	-

Scoring table 5. 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	No

Rationale

Information is available on stock abundance and stock structure from the two large-scale 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. Regular stock surveys of individual sub-areas of Area 48 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, and 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. **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 includes some environmental information (wind, sea and air temperatures) that may not be directly related to the harvest strategy. However, the information cannot be considered comprehensive, as there is uncertainty over the proportion of the adult stock that contributes effectively to spawning stock biomass, and stock surveys are not conducted at the scale required to determine whether localised depletion is adversely impacting on dependent land-based predators. **SG100 is not met**. The assessment team recommends that estimates of the proportion of the adult biomass that spawns successfully should be made.

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. 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. UoA removals are rigorously monitored through logbooks, landings records and an observer programme. 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. **SG60 and SG80 are met**.

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

There is good information on all removals from the stock by vessels outside the UoA. Whilst there is no strong evidence relating to stock structure of krill, 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. There is no evidence of IUU fishing on the stock. All fishery removals are well documented by CCAMLR from both within and outside Area 48 and there is no incentive in the UoC fishery or outside the UoC to misreport catches. **SG80 is met.**

References

(CCAMLR 2018j; Atkinson et al. 2017; Cox et al. 2018; Macaulay et al. 2019)

CCAMLR Ecosystem Monitoring Program (CEMP)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	80
Condition number (if relevant)	-
Recommendation: The assessment team recommends that estimates of the proportion of the adult biomass that spawns successfully should be made.	

Scoring table 6. 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

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 ɣ (gamma) of the unexploited biomass B_0 estimated from the hydroacoustic survey in 2000 that would support a sustainable harvest. A Precautionary Catch Level (PCL) is estimated using the GYM projecting the pre-exploitation population forward with different yield levels (ɣ) 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 consider 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). In addition, the overall catch trigger level is disaggregated across the sub-areas of Area 48 (as set out in Table 10) to ensure that high krill removals cannot be concentrated in one sub-area and cause adverse ecosystem impacts.

Estimating stock biomass with acoustic surveys calibrated with length distributions observed from trawl samples is an appropriate assessment methodology for krill stocks. The large-scale krill stock surveys in 2000 and 2019 and the use of the GYM provide an assessment of stock status against reference points set at appropriate levels for key

LTL species. The reference points and harvest control rules were based upon the estimate of stock biomass from the 2000 large-scale survey, and the results from the 2019 survey did not provide any evidence that there had been a decline in krill stock biomass since 2000 and therefore confirmed that the reference points and HCRs were still appropriate. On the basis that there had been a very recent full stock survey, the assessment team concluded that the assessment is appropriate for the stock and for the harvest control rule and therefore **SG80 is met**. However only two large-scale stock surveys have been undertaken in the last 20 years, and more regular surveys will be required for such a key LTL species particularly in the light of likely ecosystem changes caused by climate change. The assessment team notes that the high costs of conducting large-scale stock surveys may preclude further such surveys in the near future, and therefore alternative approaches may be required to ensure that the stock assessment approach remains appropriate to the stock throughout the recertification cycle. At the 2019 meeting, WG-EMM determined that future management should be based on sub-area-scale stock assessment models and biomass estimates from regular surveys within sub-areas, to determine precautionary catch limits. 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.

In the likely 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**.

The assessment team therefore strongly recommends that, within the period of certification, regular sub-area stock surveys are continued, robust estimates of biomass in sub-areas are established, and stock assessment models are developed at a sub-area scale in order to determine appropriate precautionary catch limits which will take into account the potential fine-scale impact of the krill fishery on land-based predators, and to provide sufficiently regular estimates of krill stock biomass in order to assess whether krill stocks have been impacted by ecosystem changes caused by climate change.

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 remain appropriate. **SG80 is met**. Whilst the reference points may still be appropriate, it should be noted that there is some uncertainty about the proportion of the adult stock which spawns successfully, which could influence future calculations of reference points. The assessment team has therefore recommended that estimates of the proportion of the adult biomass that spawns successfully should be made.

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

Precautionary catch limits (PCLs) for krill considers 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 uncertainty into account (**SG80 is met**) and is evaluating stock status relative to reference points in a probabilistic way for the wide-scale synoptic surveys. **SG100 is met** therefore at the whole Area 48 scale. 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. **SG80 is therefore met** at the sub-area scale, but **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 estimate 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**.

References

(CCAMLR 2018j; Constable & Mare 2003; Atkinson et al. 2017; CCAMLR 2019k; CCAMLR 2019m; CCAMLR 2019i; Cox et al. 2016; Cox et al. 2018); (Kinzey et al. 2015; Macaulay et al. 2019; Plaganyi & Butterworth 2012; Smith et al. 2011; Watters et al. 2016) (Atkinson et al., 2019)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	85
Condition number (if relevant)	-
Recommendation: The assessment team recommends that, within the period of certification, regular sub-area stock surveys are continued, robust estimates of biomass in sub-areas are established, and stock assessment models are developed at a sub-area scale in order to determine appropriate precautionary catch limits which will take into account the potential fine-scale impact of the krill fishery on land-based predators, and to provide sufficiently regular estimates of krill stock biomass in order to assess whether krill stocks have been impacted by ecosystem changes caused by climate change.	

6.4 Principle 2

6.4.1 Designation of species under Principle 2

Primary species (MSC Component 2.1) are defined as follows:

- Species in the catch that are not covered under P1;
- Species that are within scope of the MSC program, i.e. no amphibians, reptiles, birds or mammals;
- Species where management tools and measures are in place, intended to achieve stock management objectives reflected in either limit (LRP) or target reference points (TRP). Primary species can therefore also be referred to as 'managed species'.

Secondary species (MSC Component 2.2) are defined as follows:

- Species in the catch that are not covered under P1;
- Species that are not managed in accordance with limit or target reference points, i.e. do not meet the primary species criteria;
- Species that are out of scope of the programme, but where the definition of ETP species is not applicable (see below)

ETP (Endangered, Threatened or Protected) species (MSC Component 2.3) are assigned as follows:

- Species that are recognised by national ETP legislation
- Species listed in binding international agreements (e.g. CITES, Convention on Migratory Species (CMS), ACAP, etc.)
- 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).

Both primary and secondary species are defined as '**main'** if they meet the following criteria:

- The catch comprises 5 % or more by weight of the total catch of all species by the UoC;
- The species is classified as 'Less resilient' and comprises 2 % or more by weight of the total catch of all species by the UoC. Less resilient is defined here as having low to medium productivity, or species for which resilience has been lowered due to anthropogenic or natural changes to its life-history
- The species is out of scope but is not considered an ETP species (secondary species only)
- Exceptions to the rule may apply in the case of exceptionally large catches of bycatch species

6.4.2 Primary and Secondary species

6.4.2.1 Observer reporting

The CCAMLR Scheme of International Scientific Observation was adopted in 1992 under Article XXIV of the Convention. It is one of the most important sources of scientific information that is essential for assessing the impact of fishing on the ecosystem, including the status of target populations, as well as those of related and dependent species. The scheme also plays a crucial role in developing approaches to reducing the impact of fishing on the ecosystem by collecting data on the effectiveness of mitigation measures. All vessels fishing in CCAMLR fisheries are required to carry an observer for some or all of their fishing operations. In fisheries for icefish and toothfish there is a requirement for 100 % coverage by an international (i.e. not from the same flag state as the vessel) observer, while in the krill fishery there is a target coverage of at least 75 % during 2018/19 and 2019/20 fishing seasons; and 100 % coverage in subsequent fishing seasons (CM 51-06 2019), using either international or national observers. The krill fishery under assessment had 100 % observer coverage in 2020 on both vessels (Client interview, 10th Nov 2020).

Observers record information on the gear configuration (including measures to reduce incidental mortality of seabirds and marine mammals), fishing operations (including catch composition), biological measurements of target and by-catch species, details of fish tagging and tag-recaptures, vessel sightings and data on indicators of vulnerable marine ecosystems.

CCAMLR Conservation Measure 51-06 (2016), 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 100 % observer coverage from the 2019-2020 fishing season and the use of the Scientific Observers Manual, according to 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.

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, as well as whole krill. There are no discards, hauled net is emptied into the 'fishtank' below deck from where the krill is transferred onto conveyor belts and processed. There is no size sorting of the krill caught and all species in the catch are retained. These retained species are primarily pelagic larval stages of fish and non-fish organisms. 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.

6.4.2.2 Catch composition

The catch composition data presented in this report is based on Observer data collected between 2016 to 2020 krill fishing seasons. Sampling is a standardised process across the krill fisheries, whereby 25kg sub-samples are taken from a haul daily, up to 1-8 times a day. These sub-samples are analysed in detail as to species composition and krill sizes. A total of 4534 fishing trawls were undertaken (both vessels) between 2016 and 2018, out of which a total of 1077 were sampled. Although observer reports are available for both vessels for 2019 and 2020, the number of fishing trawls and number of samples was not recorded in the report. It appears that there has been a change in recording methodology. The observer based on vessel FV Sae in Leader did not provide a catch profile of the bycaught species, but merely a list of non-krill species.

Table 13. Catch composition aggregated for both vessels and all samples (2016-2020)

Species		kg	% of total	Designation
Euphausia superba	Krill	61089754.8	99.9 9%	Target
Champsocephalus gunnari	Mackerel icefish	1630.148	0.003 %	Primary
Chionodraco rastrospinosus	Ocellated icefish	1107.297	0.002 %	Secondary
Salpidae	Salps	969.464	0.002 %	Secondary
Pseudochaenichthys georgianus	South Georgia icefish	202.555	0.000 %	Secondary
Chaenodraco wilsoni	Spiny icefish	200.304	0.000 %	Secondary
Chaenocephalus aceratus	Blackfin icefish	162.202	0.000 %	Secondary
Cryodraco antarcticus	Long-fingered icefish	122.879	0.000 %	Secondary
Notothenia gibberifrons	Humped rockcod	122.337	0.000 %	Secondary
Pleuragramma antarcticum	Antarctic silverfish	82.367	0.000 %	Secondary
Electrona carlsbergi	Electron subantarctic lanternfish	79.271	0.000 %	Secondary
Semele radiata	Bivalve	66.63	0.000 %	Secondary
Gymnoscopelus nicholsi	Nichol's lanternfish	65.781	0.000 %	Secondary
Pagetopsis macropterus		50.894	0.000 %	Secondary
Notolepis coatsi	Antarctic jonasfish	41.665	0.000 %	Secondary
Neopagetopsis ionah	Crocodile icefish	35.852	0.000 %	Secondary
Geophagus spp		29.204	0.000 %	Secondary
Nototheniops larseni	Painted rockcod	20.034	0.000 %	Secondary
Rhopilema spp	Jellyfish spp	19.5	0.000 %	Secondary
Psychroteuthis glacialis	Glacial squid	18.631	0.000 %	Secondary
Onykia ingens	Greater hooked squid	15.01	0.000 %	Secondary
Notothenia coriiceps	Black rockcod	11.955	0.000 %	Secondary

Parachaenichthys charcoti	Antarctic dragonfish sp	9.885	0.000 %	Secondary
Cyclopteridae	Lumpsucker spp	7.9	0.000 %	Secondary
Notothenia rossii	Marbles rockcod	5.407	0.000 %	Secondary
Lophius americanus	American anglerfish	4.9	0.000 %	Secondary
Trematomus eulepidotus	Blunt scalyhead	4.877	0.000 %	Secondary
Psilodraco breviceps	Antarctic dragonfish sp	3.05	0.000 %	Secondary
Notothenia neglecta	Yellowbelly rockcod	2.1	0.000 %	Secondary
Trematomus newnesi	Notothenid sp	1.867	0.000 %	Secondary
Onykia knipovitchi	Cephalopod sp	1.58	0.000 %	Secondary
Icichthys australis	Southern driftfish	1.29	0.000 %	Secondary
*Dissostichus mawsoni**	Antarctic toothfish	0.97	0.000 %	Secondary
Nototheniops nudifrons	Notothenid sp	0.91	0.000 %	Secondary
Trematomus lepidorhinus	Slender scalyhead	0.785	0.000 %	Secondary
Pagetopsis maculatus	Channichthid sp	0.63	0.000 %	Secondary
Magnisudis prionosa	Southern barracudina	0.52	0.000 %	Secondary
Gasterosteus aculeatus	Three-spined stickleback – dubious identification	0.24	0.000 %	Secondary
Paraliparis spp	Snailfish sp	0.225	0.000 %	Secondary
Paradiplospinus antarcticus	Antarctic escolar	0.2	0.000 %	Secondary
Loligo gahi	Cuttlefish	0.165	0.000 %	Secondary
Dacodraco hunteri	Crocodile icefish sp	0.14	0.000 %	Secondary
Nototheniidae	Notothenid sp	0.05	0.000 %	Secondary
Natantia	Decapod sp	0.02	0.000 %	Secondary
Alopias superciliosus	Bigeye thresher – dubious identification	0.005	0.000 %	Secondary
Octopodidae	Octopus	0.005	0.000 %	Secondary
Artedidraco mirus	Perciform sp	0.001	0.000 %	Secondary

* No targeted fishery in sub area 48.1 and 48.2, an unexploited stock in this area, no reference points, hence the Secondary species designation.

Table gives an indication of the diversity of species caught, showing 46 species/ species groups recorded (excluding the target species). The catch is dominated by krill. Two species, Ocellated icefish and Mackerel icefish, are the only ones which have been caught in large enough quantity to show up as >0.002 % of the total catch. Salps were also caught in 0.002 % of the total catch. The combined catch of all non-target species barely amounted to 0.009 % of the total catch across all observed catches. According to the Observer reports, the fish species taken predominantly corresponded to larval stages. Please note that there may have been misidentification of species by the Observer, notably the Three-spined stickleback (recorded in 2018) which is a freshwater species in the Northern hemisphere, and the Bigeye thresher (which was recorded in 2017). However, as already pointed out above, larval stages are not necessarily easy to identify.

6.4.2.3 Primary Species

According to CCAMLR there are currently active fisheries targeting four species in the Convention Area: Patagonian toothfish (*Dissostichus eleginoides*), Antarctic toothfish (*Dissostichus mawsoni*), mackerel icefish (*Champsocephalus gunnari*) and Antarctic krill (*Euphausia superba*). These fisheries are managed using the ecosystem-based and precautionary approach, and management objectives which balance 'conservation' and 'rational use' of living resources and maintain existing ecological relationships. The fisheries operate in a regulatory framework which regularly adapts and updates the level of information available in order to make appropriate management decisions.

Catch limits in each of these fisheries are agreed using decision rules that ensure the long-term sustainability of the fishery. These limits and the other operational aspects defined in the conservation measures determine when, where and how fisheries are conducted in order to manage the potential impacts on the ecosystem. These regulations are usually specific to a fishing season, and currently apply to toothfish, icefish and krill fisheries. Other fisheries have operated at various times in the past and are no longer active.

Mackerel icefish (*Champsocephalus gunnari*)

Based on the catch composition table calculated from observer data, mackerel icefish (*Champsocephalus gunnari*) at 0.003 % is one of two currently commercial species showing up in the catch statistic (besides the target species krill). Recent (2018) survey biomass estimates from CCAMLR indicate that *C. gunnari* in Subarea 48.3 is well above average and the second highest since 2000 (CCAMLR Krill Fishery report 2018). However, biomass estimates for *C. gunnari* within Subarea 48.1, where the krill fishery under assessment operates, do not appear to be available. Based on the information available, *C.gunnari* is designated a Primary minor species.

Antarctic toothfish (*Dissostichus mawsoni*)

This species appeared in the catch profile for 2019 at 0.000 % - i.e. a very small amount. Although it is an established fishery (using longline gear) in areas 48.4 and exploratory in 48.6, it is not targeted in area 48.1 and 48.2 – the area under consideration in this krill assessment. The Antarctic toothfish stock in 48.1 and 48.2 is unexploited. There is no biomass assessment for this species in those areas, nor reference points or catch limits. Therefore, it was designated Secondary (minor), please see below.

6.4.2.4 Secondary species

All other species listed in the catch profile table (Table) are designated Secondary minor.

The only toothfish species noted in the catch composition is the Antarctic toothfish (*Dissostichus mawsoni*) in small quantities (less than 1kg). Unlike Patagonia toothfish (*Dissostichus eleginoides*), which has an established fishery in a number of regions in the Antarctic, including area 48.3 (these fisheries are licenced and managed through CCAMLR, with catch limits, stock assessment (see CCAMLR (2018i)) and appropriate conservation measures (CM 41-02), there is no established fishery for Antarctic toothfish (*Dissostichus mawsoni)* in area 48.1 and 48.2 and therefore this species is not managed in this area, no stock assessments are available (the Antarctic toothfish fishery currently occurs in 48.4 with exploratory fisheries in 48.6 88.2, 88.1, 58.4.1, 58.4.2, and 58.4.3b). *D.mawsoni* is designated a Secondary minor species.

The low percentage of non-target species in the catch composition compares with other observed krill fisheries and dedicated bycatch studies in krill fisheries. CCAMLR's report WG-EMM-14/31 gathered bycatch information from the commercial fisheries (95,513 hauls) and SISO (Scheme of International Scientific Observation) data (11,875 hauls) (CCAMLR 2017d; CCAMLR 2018i). The analysis showed a consistent overlap of the bycaught taxa reported in both data sources. The two most frequently reported species in both sources were painted rockcod (*Lepidonotothen larseni*) and spiny icefish (*Chaenodraco wilsoni*). *L. larseni* is listed under the scientific name *Nototheniops larseni* (CCAMLR code NOL) at CCAMLR's official bycatch species code list. In terms of total estimated catch, the highest estimated volume amongst bycaught species corresponded to mackerel icefish, *Champsocephalus gunnari* (coded as ANI), followed by *N. larseni*. This partly tallies with the fishery under assessment, although *N.larseni* is by comparison recorded less frequently.

The data assessed by WG-EMM-14/31 showed that "*The estimated total annual mass of fish by-catch in a 300,000 tonnes krill fishery would be 370 tonnes* [=0.12 %]*, comprising 40 % mackerel icefish (Champsocephalus gunnari) and 30 % L. larseni*" (CCAMLR 2017d). A detailed analysis of observer data for the Aker Biomarine certified krill fishery yielded an estimate of 2 kg of fish larvae per tonne of krill taken (i.e. 0.2 %) (Hønneland et al. 2015). If raised to the hypothetical total catch of 300,000 t, this would represent 600 t of larval fish taken.

The CCAMLR's bycatch review further notes that "*The length-frequency distribution of all taxa for which >100 fish were measured had modal size class of <10 cm. The fish species taken as bycatch in the krill fishery are the same species (and size classes) as those reported in the diet of 'krill-dependent' predators*". It also noted that the quality of the reported bycatch data has been increasing, as has the amount of bycatch species reported (CCAMLR 2018i).

Nothothenids are frequently recorded as bycatch in Antarctic krill fisheries. These fish have a number of adaptations that allow them to thrive in cold marine habitats, such as antifreeze proteins in their blood and ample fat to insulate them against heat loss and to offset their lack of a swim bladder. *Notothenids* are diverse regarding their body size, morphology and habitat ranges (Calì et al. 2017). The family encompasses 12 genera and about 50 species. They share a common benthic ancestor, from which the family experienced an evolutionary radiation that allowed notothenid species to colonize cryopelagic, pelagic, semi-pelagic and epibenthic habitats (Calì et al. 2017). The genus *Notothenia* includes five species, three of which (*N. rossii, N. coriiceps* and *N. cyanobrancha*) are typical of Antarctic waters.

N. rossii (marbled rockcod) was fished to depletion during the early stages of Antarctic commercial fisheries in the late 1960s and 1970s. The fishery was finally closed in 1985. However, even after more than 30 years since the closure, the stock has either failed to recover, or is just barely starting to slowly recover (Arriagada & Neira 2014; Marschoff et al. 2012). *N. rossii* is considered to have a high vulnerability to fishing mortality (Fishbase 2019) due to traits such as late sexual maturity and slow growth (Calì et al. 2017).

In contrast, its congeneric species *N. coriiceps*, Black rockcod was never commercially exploited. Its range appears to encompass higher latitudes than that of *N. rossii* (Calì et al. 2017) and is considered to be one of the dominant fish in nearshore waters of the Scotia Sea (Marschoff et al. 2012). A third *notothenid* of interest is Painted Notie, *Nototheniops larseni*. It is mentioned as frequently caught by the Antarctic krill fishery but there is no stock assessment (MBA 2017).

Beyond *notothenids*, there are also a number of other finfish bycaught across the commercial krill fisheries:

- Antarctic Jonasfish, *Notolepis coatsi*, for which there is no current stock assessment. There is anecdotal evidence that Antarctic jonasfish is caught in 5 %-10 % of krill tows (MBA 2017).
- Blackfin Icefish, *Chaenocephalus aceratus* is in similar situation of data deficiency. Whilst the current stock status is unknown, there are signs of a decreasing biomass trend (MBA 2017).
- Spiny Icefish, *Chaenodraco wilsoni*, constitutes a special case because it was targeted by a commercial fishery in the 1970s and 1980s (Mesa et al. 2009). It has widespread distribution on the Antarctic continental shelf at depths from 200m to 800m; however, its stock status is not regularly assessed and hence it is currently unknown (Mesa et al. 2009; MBA 2017).
- Lanternfishes, family *Myctophidae.* Lanternfishes constitute one of the dominant mesopelagic fishes (MBA 2017). Given their abundance and the low percentage in which they appear in the bycatch, they are unlikely to constitute a concern in the fishery.

Following on from the catch composition data presented in Table , there are no Secondary main species, all Secondary species listed are minor.

6.4.2.5 Out of scope species

Out of scope species include amphibians, reptiles, birds and mammals which are not listed in the IUCN Redlist as vulnerable (VU), endangered (EN) or critically endangered (CE). All such out of scope species are considered as Secondary main species.

Observer reports must record any interaction of seabirds and marine mammals with the fishery. Two such records were made: 2018 – one *Bubulcus ibis* (cattle egret) was found dead on the vessel. 2019 – one Antarctic fur seal was found in the net and immediately released alive and unharmed – the fur seal is considered under ETP.

The cattle egret (*Bubulcus ibis*) is not listed in CITES; it is listed as LC in the IUCN Red List; it is listed as LC by Birdlife International (Birdlife_International 2019a). The cattle egret is not an Antarctic species and was likely picked up near the port of departure and died en route of starvation. It was not directly impacted by the fishing gear, it is therefore not considered as an out-of-scope species, indeed it is irrelevant to this fishery.

Observer reports record krill fishery interactions with seabirds and marine mammals, which are then compiled annually in CCAMLR Fishery reports. In 2018 there were two seabird mortalities reported from the whole of the krill fishery, one snow petrel (*Pagodroma nivea*) in Subarea 48.1 and one Cape petrel (*Daption capense*) in Subarea 48.2. There were also 19 reported mortalities of Antarctic fur seal (*Arctocephalus gazella*) in the fishery in Subarea 48.3, of which 18 were reported from the same vessel. None of these records are from the fishery under assessment (Observer reports 2018, 2019).

The CCAMLR krill fishery report (CCAMLR 2017d) reported 2 seabird mortalities (unspecified species, one in subarea 48.1 and one in subarea 48.2) for the whole fleet in 2017 and 9 seabird (unspecified) mortalities in 2016, one in Subarea 48.2 and eight in Subarea 48.1. Based on the Observer reports, none of these records are from the fishery under assessment

The global population of snow petrels exceeds 4 million individuals, and in the absence of evidence for any declines or substantial threats the population is considered stable (Birdlife_International 2019c) Species factsheet: *Pagodroma nivea*). As for the Cape petrel, its population exceeds 2 million individuals and is also expected to be stable in the absence of any evidence to the contrary (Birdlife_International 2019b) Species factsheet: *Daption capense).* Both species are listed as Least Concern by IUCN.

6.4.2.6 Potential IPI issues

IPI – other krill species in catch.

A possibly emerging issue with the Antarctic krill fishery targeting *E. suberba* is the more than likely presence of a similar species, *E. crystallorophias* (ice krill), undetected in the catch. Ice krill might constitute an IPI stock in the UoC and indeed across all Antarctic krill fisheries.

The issue was considered in a document published by ASOC in 2017 (ASOC 2017). During the Third International Krill Symposium in June 2017, representatives of the krill fishing industry indicated that they do not report bycatch of ice krill (*E. crystallorophias*) that might be caught during their operations. While other species of Southern Ocean krill are easily distinguishable from Antarctic krill, *E. superba* and *E. crystallorophias* are almost impossible to differentiate without the aid of a microscope. Since krill fishing operations concentrate in shallow coastal areas, which overlap with the preferred habitat of *E. crystallorophias*, there is concern that *E. crystallorophias* is being caught and landed as *E. superba*.

Uncertainty in which species are being fished undermines science-based fisheries management of Antarctic krill. Thus far in its management of the fishery, CCAMLR has assumed that only *E. superba* is being fished, not a mix of *Euphausiid* species. Therefore, ASOC recommended (ASOC 2017) for CCAMLR to develop requirements for evaluation of representative samples of the krill catch to assess the level of *E. crystallorophias* in the catch. Also, historical samples should be examined to gain new understanding on this particular issue.

More recently, CCAMLR's Working Group on Ecosystem Monitoring and Management (WG-EMM) stated the following (CCAMLR WG-EMM 2018):

- "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".

The CCAMLR Working Group noted that the absence of ice krill in bycatch could be because the fishery is targeting Antarctic krill and avoiding catch of ice krill due to its smaller size and one member of the working group suggested that research surveys in Area 48 did not reveal the presence of ice krill in catches using research gear. This circumstantial evidence alone may be insufficient to address the MSC requirements on IPI stocks. In response to the evidence in WG-EMM-18/05 (CCAMLR WG EMM 2018).

The Working Group requested that Members compile relevant survey and catch data in order to provide advice in the future on bycatch in terms of finfish and invertebrates in the krill fishery.

The client reports that the National Institute of Fisheries Science in Korea currently have no accurate data on ice krill contributions, but they expect that as a result of the Working Group report catch data from CCAMLR vessels will be reviewed and countermeasures will be discussed in future Scientific Committees or Working Group. The client, Jeong Il Corporation, will comply with all conservation measures enacted by CCAMLR in this regard.

Although the issue of Ice krill was raised in 2018 (CCAMLR WG EMM 18/05, 2018) the assessment team found no evidence that this issue has been taken further in terms of incorporating the species on the observer recording sheets, for example. As no detailed information on the species distribution and interaction with *E.superba* is available , it currently (January 2021) looks unlikely that ice krill ought to be considered an IPI species in the UoC.

6.4.2.7 Mitigation measures

Mitigation measures which apply to out-of-scope species (birds and marine mammals in this case) are described in Section 6.4.3.2 (ETP Section)

6.4.3 ETP species

The two main groups of ETP species which might be directly affected by the Antarctic krill fishery are krill predators such as seabirds and marine mammals (especially pinnipeds). These, and other ETP species (e.g., whales), might also be indirectly impacted through the fishery's removal of krill. This aspect will be considered under the ecosystem component.

The marine resources managed by CCAMLR specifically exclude whales and seals, which are the subject of other conventions – namely the International Convention for the Regulation of Whaling and the Convention for the Conservation of Antarctic Seals. In 1994 the International Whaling Commission (IWC) adopted a whale sanctuary covering the waters of the Southern Ocean around Antarctica (the geographical area included in the UoA falls within this sanctuary). Commercial whaling on any whale species is prohibited within this sanctuary.

The following table lists a number of ETP species which occur in the area of the fishery under assessment.

Table 14. List of ETP species which occur in the area of the UoA (CMS – Convention on Migratory species; ACAP – specifically albatross and petrels; CC – Convention for the Conservation of Antarctic seals).

Species	Cites App 1	IUCN	CMS/ ACAP	CC of Antarctic Seals
Arctocephalus gazelle (Antarctic fur seal)				X
Mirounga leonine (Southern elephant seal)				X
Lobodon carcinophagus (Crabeater seal)				X
Leptonychotes weddellii (Weddel seal)				*X*
Balaenoptera borealis (Sei whale)	X			

Species	Cites App 1	IUCN	CMS/ ACAP	CC of Antarctic Seals
Balaenoptera bonaerensis (Antarctic minke whale)	X			
Balaenoptera musculus (Blue whale)	X			
Physeter microcephalus (Sperm whale)	X			
Balaenoptera physalus (Fin whale)	X			
Spheniscus humboldti (Humboldt penguin)	X	VU		
Thalassarche chrysostoma (Grey headed albatross)		EN	X	
Diomedea exulans (Wandering albatross)		VU	X	
Thalassarche melanophris (Black browed albatross)			X	
Phoebetria palpebrata (Light-Mantled Sooty Albatross)			X	
Phoebetria fusca (Sooty Albatross)		EN	X	
Macronectes giganteus (Southern giant petrel)			X	
Macronectes halli (Northern giant petrel)			X	
Procellaria cinereal (Grey Petrel)			X	
Procellaria aequinoctialis (White-chinned Petrel)		VU	X	

Midwater trawling for krill is generally considered a low risk of ETP bycatch (MBA 2017), although some interactions have been recorded, as can be seen in the Observer reports and Krill fishery reports. A number of technical measures have been put in place over the years to reduce the bycatch of seabirds and marine mammals, and as a result ETP mortality events are relatively rare. The total estimated mortalities in this krill fishery are low. The 2018 meeting report of the Working Group on Fish Stock Assessment (CCAMLR 2018k) stated: "*The 11 krill vessels operating in Subareas 48.1, 48.2 and 48.3 reported one seabird mortality and 19 marine mammal mortalities*." (…) "*The 19 Antarctic fur seals (Arctocephalus gazella) caught in 2018 represent a sudden increase* (…) *However, as 18 of the 19 mortalities were reported from one vessel, this indicates that this is likely to be a vessel-specific, rather than a fishery-wide issue* (…)."

The Antarctic fur seal (*Arctocephalus gazella*) is protected under the Convention for the Conservation of Antarctic Seals (which came into force in 1978). This Convention is part of the Antarctic Treaty system, whereby the CAMLR Convention applies to all Antarctic populations of finfish, molluscs, crustacean and sea birds found south of the Antarctic Convergence (the Convention Area).

The breeding range of the Antarctic fur seal, also formerly known as the Kerguelen fur seal, is restricted mainly to seasonally ice-free islands south of, or close to, the Antarctic Polar Front with over 95 % of the species breeding on South Georgia. Other breeding sites, many fuelled by migrants from South Georgia, are established at South Orkney, South Shetland, South Sandwich, Bouvetiya, Heard, Marion, Macquarie, McDonald, Crozet, Prince Edward and Kerguelen Islands. The total population size was estimated as 1.5 million in 1990 but it is thought that the population may have since increased to over 4 million. Wandering seals have been found as far north as Brazil and the Juan Fernandez Islands (SCS 2011).

Antarctic fur seals were almost made extinct by commercial sealing for their fur in the 18th and 19th centuries, perhaps only a few hundred of the seals remaining, and small-scale hunting continued until 1907. The species is now protected by the Convention for the Conservation of Antarctic Seals (CCAS), the Antarctic Treaty and the legislation of various countries within its range. In addition, the Antarctic fur seal is listed as an Appendix II species under CITES. Since protection, the population has been growing steadily, particularly at South Georgia since the 1950s, and population growth is now about 10 % per annum (SCS 2011).

6.4.3.1 Observer programme on ETPs

As part of the records in the Observer reports, a list of seabird species which have been seen during the trip is presented. This is in addition to specific information to be given on any seabird/ fishing operation interactions.

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 (CCAMLR krill fishery report 2018).

The 2019 Observer report for the fishery under assessment recorded one fur seal as being caught in the trawl net and immediately released unharmed and without injuries.

6.4.3.2 Mitigation measures

CCAMLR Conservation Measure 25-03 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. The following figures demonstrate mitigation measures, designed to reduce seabird and mammal bycatch.

Seabirds:

Fishing operations and seabird foraging zones can overlap. Seabirds are attracted to fishing boats as they recognise them as a source of food. Feeding from behind the boat puts the seabird in danger of being injured or killed by fishing gear like trawl nets and warp cables. Their wings can become tangled on the warp wires or in the net and they can be dragged under water, possibly leading to drowning. The following devices are deployed by the fishery under assessment to reduce seabird interaction (as recorded in the Observer reports):

Bird streamers: The streamer line was used during the setting and hauling of the net, with two streamer lines used at any one time. A 200mm diameter plastic buoy attached to the end of the streamer line to keep the line taught.

Figure 6. Streamer Line deployed (Observer report 2016)

Two streamer lines are deployed per vessel, and a buoy is attached to the end of the line to keep it taught. However, during the 2020 season, one of the vessels used bird bafflers instead of streamer lines (Observer report for Kwangjaho (now named Sae in Leader), 2020).

Net Weighting: The net weights used are 1,100kg of steel chain in each net wing, for the quick sinking of the net and holding it taught and in position when trawling.

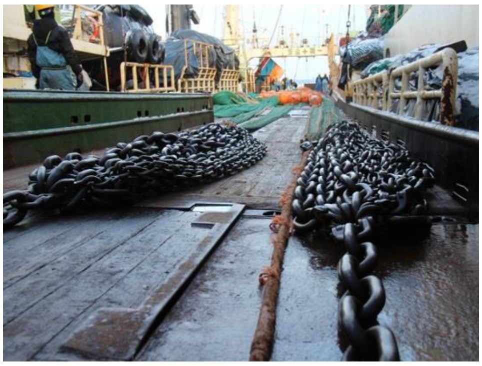

Figure 7. Net weights (Source: Kwang Ja Ho – now Sae In Leader Cruise report 2018)

The Observer Reports for 2016 and 2017 also list the regular deployment of acoustic bird scarers. These devices were listed as "not used" in the 2018 and 2019 Observer reports.

The Observer reports available for the 2020 fishing season also describe the use of bird bafflers as a means to discourage seabird interactions.

Bird bafflers: A bird baffler is a curtain like device which has been designed to deter seabirds from foraging in between the stern of the vessel and where the warps enter the water.

Figure 8. Bird baffler in situ (Source: https://www.afma.gov.au/environment-and-research/reducing-bycatch/bycatch-reduction-devices/bird-baffler)

Bird bafflers contain two booms, one on the port and one on the starboard stern quarters which extend perpendicular to the sides of the vessel, past where the trawl wire enters the water. The booms have droppers hanging down to the water line which act as a curtain, and tori lines extending from the booms. The baffler is designed to prevent seabirds from accessing the front and sides of the warp wire whilst trawl gear is being towed as these are the areas where seabird interactions are most likely to occur.

In order to discourage seabird interactions, the fishery under assessment also cleans the nets before each shot, as well as retains all the offal on board.

There are a number of other mitigation measures to discourage seabird interaction with the krill fishery, but these are not necessarily deployed by the fishery under assessment (ie not mentioned as such in the Observer reports). However, these measures are briefly described here in order to show the potential range of mitigation measures available to fisheries.

<u>Seabird sprayers</u>: Seabird sprayers are an industry designed device that use seawater delivered at high pressure to deter seabirds from the area of water around the warps.

Figure 9. Seabird sprayers in situ (Source: https://www.afma.gov.au/environment-and-research/reducing-bycatch/bycatch-reduction-devices/seabird-sprayer)

<u>Warp deflector</u>: A warp deflector is a plastic “pinkie” buoy attached to fishing boats to prevent seabirds from being injured by coming into contact with the trawl warp wires.

Figure 10. Warp deflector in situ (Source: https://www.afma.gov.au/environment-and-research/reducing-bycatch/bycatch-reduction-devices/warp-deflectors)

Marine mammals

Seal excluder device: Seal Excluder Devices (SEDs) are designed to help seals swim out of a fishing net if they are accidentally caught. The SED has a metal grid which blocks access to the codend, whilst still allowing fish to pass through the bars. The metal grid angled towards the codend, which guides animals out of the escape hole. SEDs also allow larger animals such as sharks and rays to escape the net safely.

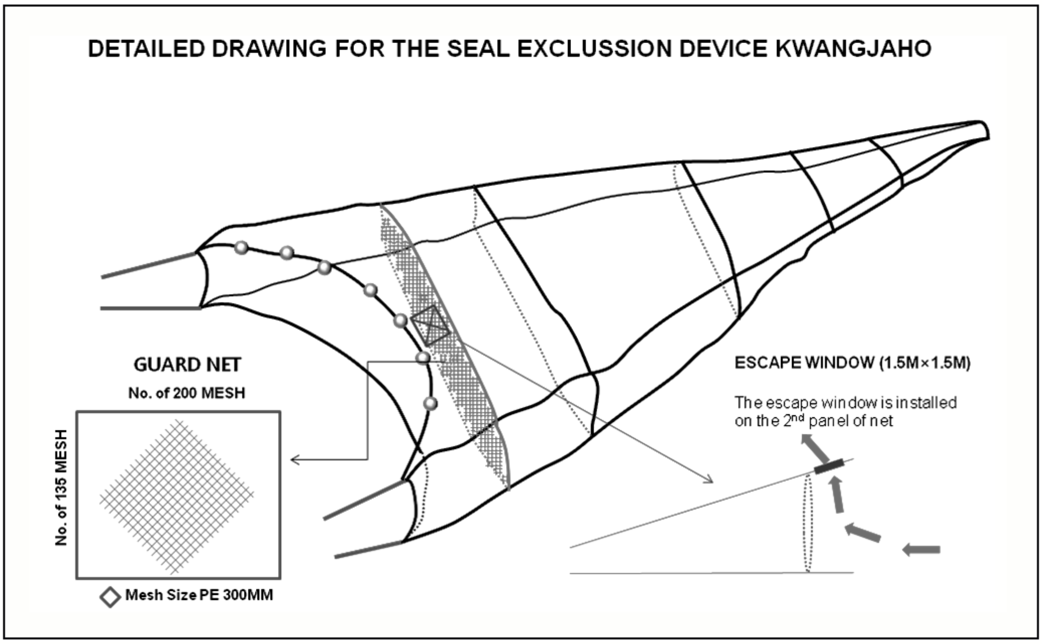

Figure 11. Detailed drawing of the seal exclusion device in use in the fishery (Source: Observer report 2017 Sae In Leader)

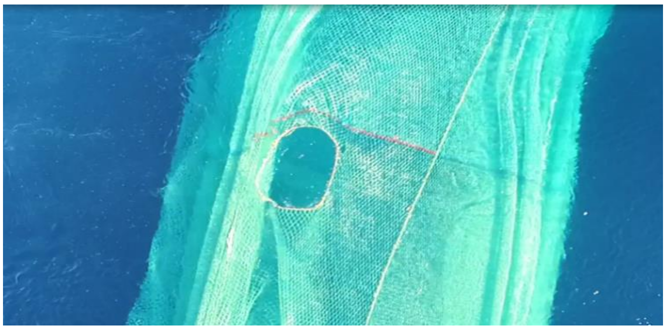

Figure 12. Seal excluder device (Source: https://www.afma.gov.au/environment-and-research/reducing-bycatch/bycatch-reduction-devices/seal-excluder-devices)

Offal management: Offal is managed on board, as recorded in the Observer reports (2014-2020), whereby 'most or all' of the offal is retained for disposal onshore.

Midwater trawling for krill is generally deemed to be a low concern for its risk of ETP bycatch (MBA 2017). This is not to say that bycatch of ETP species is totally absent, but rather that ETP mortality events are rare, and the total estimated mortalities are very low. When compared to the abundance of the species, it becomes clear that detrimental impacts of the UoC upon ETP species are negligible. Hence, the CCAMLR Krill Report (CCAMLR 2018i) stated the following: "In 2018, there were two seabird mortalities reported from the krill fishery, one snow petrel (*Pagodroma nivea*) in Subarea 48.1 and one cape petrel (*Daption capense*) in Subarea 48.2. There were also 19 reported mortalities of Antarctic fur seal (*Arctocephalus gazella*) in the fishery in Subarea 48.3, of which 18 were reported from the same vessel." (which likely indicates that this is a vessel-specific, rather than a fishery-wide issue).

The population of Antarctic fur seals is currently estimated at some 700,000-1,000,000 mature individuals, with 95 % of the population concentrated on South Georgia (Hofmeyr 2016). The 19 mortalities registered in 2018 can be deemed as exceptional; in contrast, there were three reported mortalities of Antarctic fur seal *A. gazella* in the fishery in both 2016, and 2015 (CCAMLR 2016a). CCAMLR reports that there were no fur seal mortalities between 2008 and 2014 (CCAMLR 2017b), although this seems not to be totally correct (Roel et al. 2018); however, it is clear that the total mortality of fur seal in krill fisheries is too low to constitute a significant impact.

The report further states that "*In terms of bird interactions, CCAMLR Conservation Measure 25-03 covers the issue 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 Marine Mammal Exclusion Devices. The observation methodology for interactions of seabirds and marine mammals with fishing operations is established in Part II, section 12 of the CCAMLR Scientific Observer Manual, where periods and duration of these observations are detailed*."

The way krill fishing is conducted, the risk of lethal interactions with seabird species is considerably reduced. "*The fishing strategy, with a slow towing speed (<2 knots), quick sinking of the net on deployment, and the layout of the trawl warps, which enter the water very close to the stern of the vessel and reduce the potential for birds to strike them during fishing operations, all contribute to the sparseness of interactions recorded by observers during fishing operations.*" (Hønneland et al. 2015). At the SC-CAMLR meeting in 2019 (CCAMLR 2019j) it was reported that over the previous two years, 21 bird strikes were observed on continuous krill trawlers, and zero strikes observed from non-continuous trawl vessels. The fishery under assessment uses the non-continuous trawl method of fishing for krill, whereby the net is hauled out and emptied into the 'fishtank'.

The one seabird mortality recorded in 2018 compares to nine seabird mortalities in 2016 and two in 2017 for all krill fisheries combined, (CCAMLR 2017b) and none apply directly to the krill fishery under assessment (Observer reports 2016-2020).

6.4.4 Habitats

6.4.4.1 Commonly encountered habitat and broad ecoregions

The krill fishery is a pelagic trawl fishery, where towing depth is <150m. The fishery uses a pelagic net, which has no interactions with the benthos. Any interaction of the net with the benthos is actively avoided because it would damage the net to the extent that repairs on board would probably be impossible. Pelagic trawl gear is not designed for benthic contact, it would not be robust enough to survive the drag damage. The only potential interaction of the net with the seafloor would be accidental loss of the net, which happens rarely and has to be reported on the formal observer reports if and when it happens, giving exact relevant details. According to CCAMLR krill fisheries report for 2018 and UoA Observer reports from 2016-2020 there has been no trawl gear loss during fishing activities.

The following maps and sections indicate where the fishery operates (Figure 13) in relation to underlying bathymetry (Figure 14) and habitats and marine protected areas.

Figure 13. The UoA operates in 48.1 and 48.2. (Source: Client information, see observer reports)

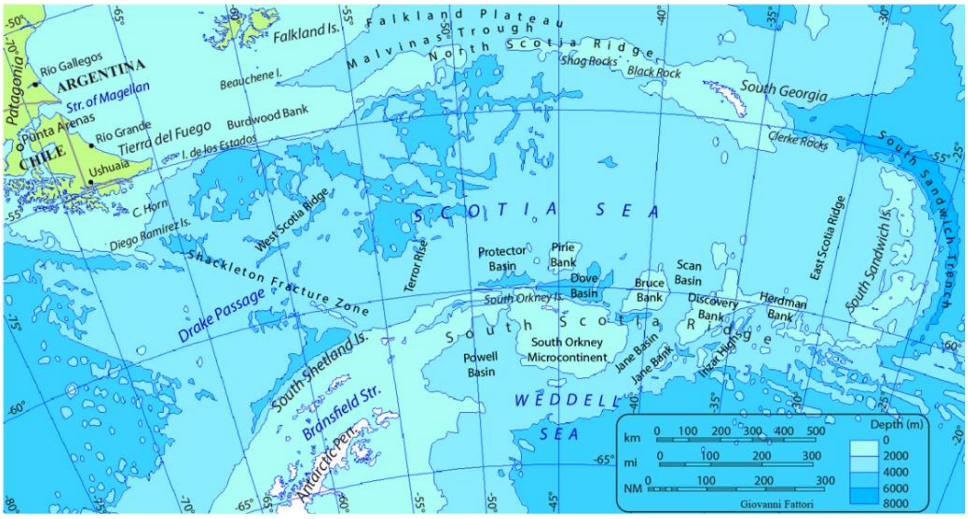

Figure 14. Bathymetry of Scotia Sea and South Scotia Arc region

(Source: https://en.wikipedia.org/wiki/Scotia_Sea#/media/File:Scotia-sea.png)

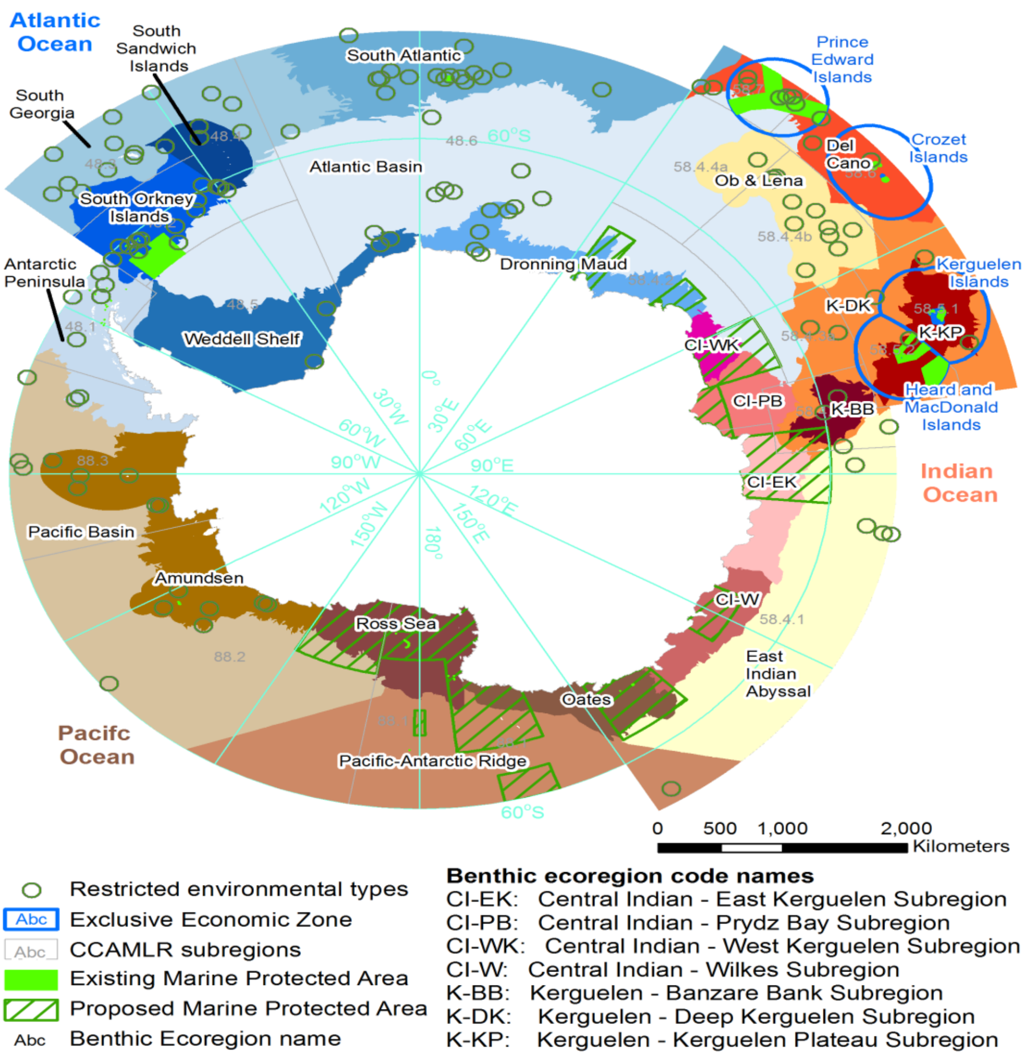

Figure 15. Benthic ecoregions around Antarctica (Source: Douglass et al 2014)

Figure 15 shows the benthic ecoregions, restricted environments and marine protected areas identified within the Southern Ocean. An environmental type is a unique combination of an ecoregion, bathome and geomorphic feature. According to Douglas et al. (2014), Figure 15 also shows existing marine protected areas and regions where planning processes are underway to propose future representation. Where large gaps in existing and proposed representation were found, the locations of geographically restricted environmental types were identified. These restricted environments (eg seamounts) indicate areas of potential future marine protected area selection since there are limited spatial options for protecting the biodiversity for which these environments are a surrogate. The benthic ecoregions relevant to this fishery assessment are:

> The Antarctic Peninsula - The shallow, productive shelf of the west Antarctic Peninsula with a low duration of sea ice cover and warm seabeds relative to other Antarctic shelf areas. The island ecosystems of the South Shetland Islands. 13 endemic molluscs; greater than 10 % of gastropods endemic.
>
> Atlantic Basin: The very deep and very cold rugose ocean floor and abyssal plain of the South Atlantic Ocean Basin and Weddell Sea.

6.4.4.2 Vulnerable Marine Ecosystem - VMEs

Please note (https://mscportal.force.com/interpret/s/global-search/VME): It is not the responsibility of an assessment team to identify habitats as VME within the fished area. Instead, VMEs need to be identified by a local, regional, national, or international management authority/governance body; the history of fishing and when the VME was identified is critical to establishing what the 'unimpacted level' is; if a VME was already impacted by any fishery/UoA prior to its identification as a VME, and fishing impacts occurred prior to 2006, then the 'unimpacted level' is considered to be the status at the point of designation.

VMEs are identified in the Southern Ocean and compiled in the 'CCAMLR VME Registry', which records the location and taxa of Vulnerable Marine Ecosystems (VMEs) and associated areas in the Convention Area. These areas will have been notified under CM 22-06 and CM 22-07 (https://www.ccamlr.org/en/document/data/ccamlr-vme-registry). Access to this registry is open to the public. Figure 16 and Figure 17 show the location of areas holding VME. There are no registered vulnerable marine ecosystems (VMEs) or VME Risk Areas in Subarea 48.3 (in CCAMLR Fishery report 2018: *Dissostichus eleginoides* South Georgia, Subarea 48.3).

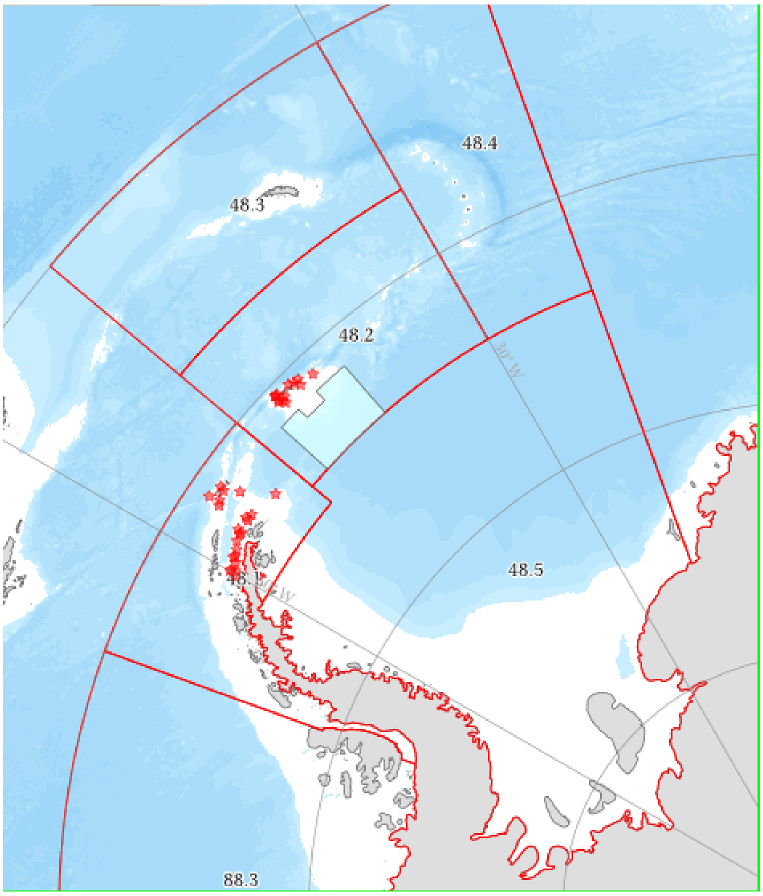

Figure 16. Location of VME present (red dots) in the UoA fishing area (48.1 and 48.2) grounds. The light blue block is the South Orkney southern shelf marine protected area – CM91-03. Source: https://gis.ccamlr.org/

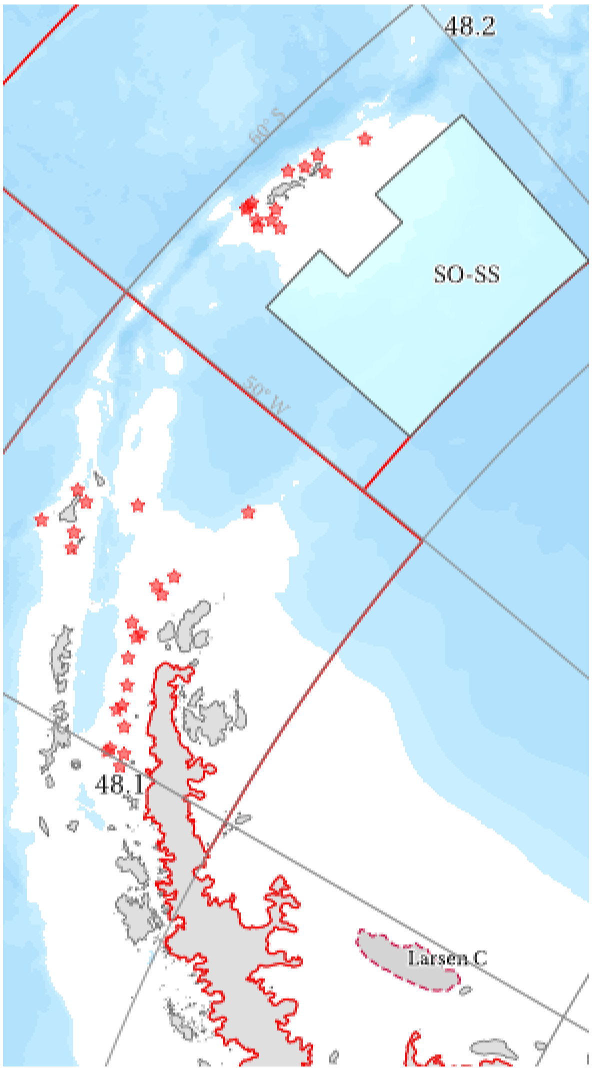

Figure 17. VMEs (enlarged map) to show location more clearly, also showing SO-SS MPA. (Source: https://gis.ccamlr.org/)

The VMEs indicated in Figure 17 are based on benthic species such as aggregations of seapens for example (https://www.ccamlr.org/en/wg-emm-18/36). The VMEs as identified in the map above are closer to shore and in shallower water. Other VME areas are for example based in aggregations of coral species as observed using submarine surveys in Gerlach Strait and Antarctic Sound (Area 48.1; https://www.ccamlr.org/en/wg-emm-18/35). The procedures to be followed by vessels to monitor and report encounters with potential VMEs during the course of bottom fishing are described in CM 22-07. These require fishing vessels to collect and report all catches of a suite of "VME-indicator taxa" that are described in CCAMLR's VME Taxa Classification Guide. This obviously does not apply to the krill fishery under assessment, as it is a pelagic fishery.

6.4.4.3 Marine Protected Areas MPA

CCAMLR defines an MPA as follows: "it is a marine area that provides protection for all or part of the natural resources it contains. Within an MPA certain activities are limited, or entirely prohibited, to meet specific conservation, habitat protection, ecosystem monitoring or fisheries management objectives. MPAs do not necessarily exclude fishing, research or other human activities; in fact, many MPAs are multi-purpose areas. MPAs in which no fishing is allowed are often referred to as 'no-take areas'. Other uses may still be permitted. Areas closed to fishing (or in which fishing activities are restricted) can be used by scientists to compare to areas that are open to fishing to research the relative impacts of fishing and other changes, such as those arising from climate change. This can help scientists understand the range of variables affecting the overall status and health of marine ecosystems including the effects of climate change. CCAMLR has agreed to develop a representative system of MPAs based on the best available science and has also agreed a framework that describes the objectives and requirements for establishing MPAs" (https://www.ccamlr.org/en/science/marine-protected-areas-mpas).

A United Nations special report released in September 2020 found that the Antarctic region is experiencing profound and rapid change, including warming ocean temperatures and acidification. To mitigate these impacts, the U.N. recommended that global leaders focus on increasing the number of marine protected areas in order to make ecosystems more resilient (United in Science, 2020. https://public.wmo.int/en/resources/united_in_science).

CCAMLR has set out to establish a representative series of MPAs within its area (CCAMLR 2011b) and currently has enacted the following four CMs within group 91, protected areas, for that purpose:

1. CM91-01. Provides for the protection of CCAMLR Ecosystem Monitoring Programme (CEMP) sites.

2. CM91-02. Provides for protection of the values of Antarctic Specially Managed and Protected Areas (ASMA and ASPA, respectively).

3. CM91-03 (2009). Provides for protection of part of the South Orkney Islands southern shelf. The 'Protection of the South Orkney Islands southern shelf' has its origins within CCAMLR and has primary aims that include the conservation of biodiversity. That aim is extended to set the area aside as a scientific reference area with representative examples of pelagic and benthic bioregions and also to conserve important predator foraging areas. The SO-SS site is located within 48.2. see also Figure 17 for location of the site.

4. CM91-04. General framework for the establishment of CCAMLR Marine-Protected Areas; it 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.

Conservation Measure 91-05 (2016) establishes the Ross Sea region Marine Protected Area, 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.

The South Orkney Island southern shelf (SO-SS – see location in Figure 17) was the first CCAMLR MPA (CCAMLR 2009), established in 2009, where amongst other management measures the following applies: *All types of fishing activities are prohibited within the defined area, with the exception of scientific fishing research activities agreed by the Commission for monitoring or other purposes on advice from the Scientific Committee and in accordance with Conservation Measure 24-01.*

The South Georgia and South Sandwich Islands Maritime Zone (north of 60°S) (Figure 18) was designated as a sustainable use Marine Protected Area (MPA) in 2012, with additional spatial and seasonal closures added in 2013. The MPA includes a prohibition on bottom trawling throughout, and a range of spatial and temporal closures (Falkland_Islands 2012b). The MZ, which was declared by

Proclamation in 1994, includes a significant area south of 60° South. This area is a de-facto no-take zone and commercial fishing licences are not issued for this area. Four main fisheries operate in the SGSSI Maritime Zone:

(i) the longline fishery for Patagonian toothfish around South Georgia (CCAMLR Statistical Subarea 48.3);

(ii) the longline fishery for Patagonian and Antarctic toothfish around the South Sandwich Islands (CCAMLR Statistical Subarea 48.4);

(iii) the pelagic trawl fishery for Antarctic krill in the SGSSI Maritime Zone (CCAMLR Statistical Subareas 48.3 & 48.4); this includes a seasonal closure of the fishery for Antarctic krill (from November 1st until March 31st) to avoid competition with krill eating predators (particularly penguins & fur seals) during the season breeding, as well as a 12nm pelagic no-take zones around each of the South Sandwich Islands, protecting 18,042 km², including important feeding areas of chinstrap and Adelie penguins;

(iv) the pelagic trawl fishery for mackerel icefish (CCAMLR Statistical Subarea 48.3);

(v) a ban on all bottom fishing deeper than 2250m, which covers 920,000 km² (an area similar to the size of Spain), to protect deep-water habitats (Falkland_Islands 2012a).

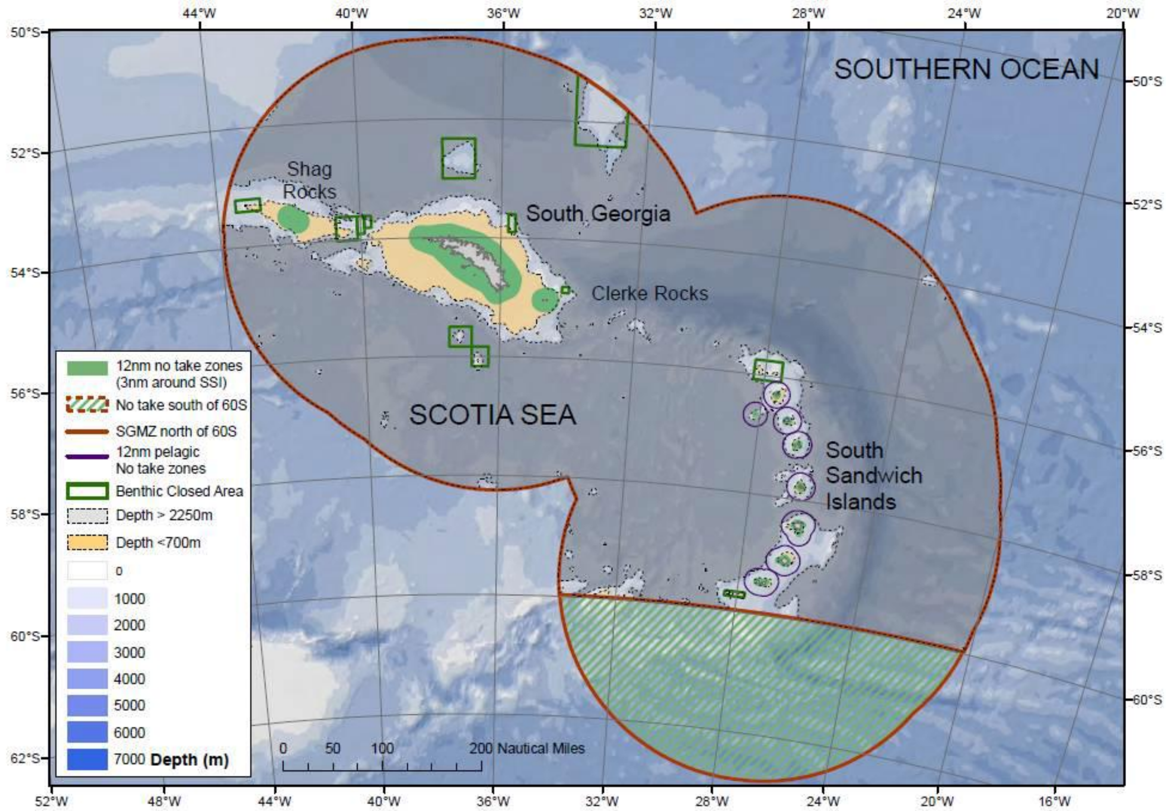

Figure 18. South Georgia and South Sandwich Islands Maritime Zone (MZ), showing the closed areas. The MPA is the area north of 60 S. (Source: www.gov.gs)

1. The green areas are the No-Take zones around South Georgia, Shag Rocks, Clerke Rocks and each of the South Sandwich Islands.
2. The pale orange area indicates depths less than 700 m in which bottom fishing is prohibited.
3. The dark shaded area includes depths greater than 2250 m in which bottom fishing is prohibited.
4. The narrow band between the pale orange area and the shaded area includes the depths between 700 and 2250 in which bottom fishing is permitted.

5. The boxes with a green border are the additional benthic closed areas in which bottom fishing is also prohibited.
6. The blue-bordered areas around the South Sandwich Islands are the pelagic closed areas.
7. The area south of 60ºS, with green stripes, that falls within the SGSSI Maritime Zone whilst not formally part of the MPA is already a no-take zone as no fishing licences are issued for this area.

CCAMLR's commitment to establish a system of Antarctic MPAs as part of a comprehensive, ecosystem-based approach to managing the CCAMLR Area is progressing slowly. To date only two MPAs have been established: The Ross Sea region and South Orkney Islands Southern Shelf MPAs. There are three outstanding proposals currently seeking approval: The East Antarctic MPA, the Weddell Sea MPA and the Domain 1 (aka the Antarctic Peninsula and Scotia Sea) MPA. At the 2020 CCAMLR meeting these proposals were once again not approved. All member states have to agree collectively, two member states (China and Russia) continue to oppose these proposals (39th CCAMLR meeting of Antarctic Experts, Oct 2020; https://www.ccamlr.org/en/news/2020/meeting-antarctic-experts-comes-close; accessed 15th Nov 2020).

Well-managed networks of marine protected areas (MPAs) are considered to be powerful tools that allow wildlife and habitats to recover and build resilience to future disturbances (IUCN 2016; Kenchington et al. 2012); WWF interview site visit 12.Nov.2020).

Other types of 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/en/apa-database - accessed on 5/12/2019). 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).

Figure 19. Antarctic Specially Protected Areas (ASPA) Location (Source: https://gis.ccamlr.org/)

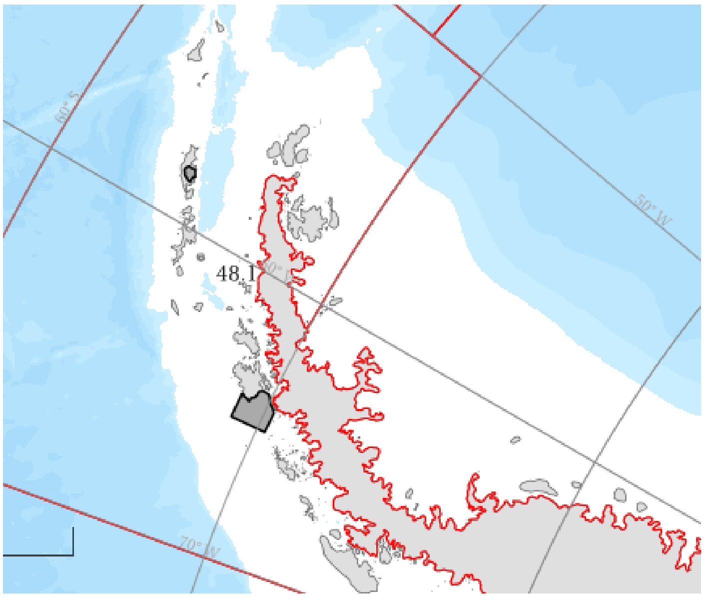

Figure 20. Antarctic Specially Managed Areas (Source: https://gis.ccamlr.org/)

In addition, there is one area for special scientific study, Larsen C.

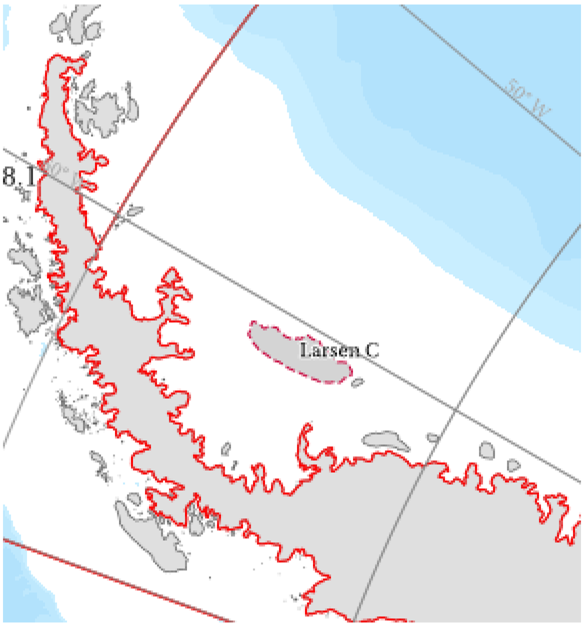

Figure 21. Special Scientific Study area, Larsen C. (Source: https://gis.ccamlr.org/)

6.4.4.4 Voluntary measures, ARK

In order to limit the indirect effects that harvesting for krill may have on penguin colonies, the Association of responsible krill harvesting companies (ARK http://www.ark-krill.org/) and its members (including the fishery under assessment, Jeong Il Corporation) have committed themselves, as from January 2019, to voluntary restrictions in the Antarctic Peninsula covering about 74000 km^2 around penguin colonies. This is 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 (see: http://www.ark-krill.org/index.cfm/7/News). With this commitment, ARK companies pledge to keep fishing effort up to 40 km 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 (Figure 22. Distribution and size of penguin breeding colonies in Subarea 48.1 in relation to ARK VRZs (Source: ark-krill.org)

This voluntary measure is in line with the development of protected areas promoted by CCAMLR. The implementation of this voluntary restriction on fishing is as follows (from https://www.ark-krill.org/ark-voluntary-measures):

- Antarctic Peninsula will be closed to krill fishing (40 km buffer) between 1 October and 1 February.
- Gerlache Strait will be closed to krill fishing (30 km buffer) between 15 October and 15 February.
- South Shetland Islands will be closed to krill fishing (40 km buffer) between 1 November and 1 March.
- A 40 km year-round closure to krill fishing around Hope Bay, Sheppard Nunatak and Sheppard Point, at the tip of the Antarctic Peninsula

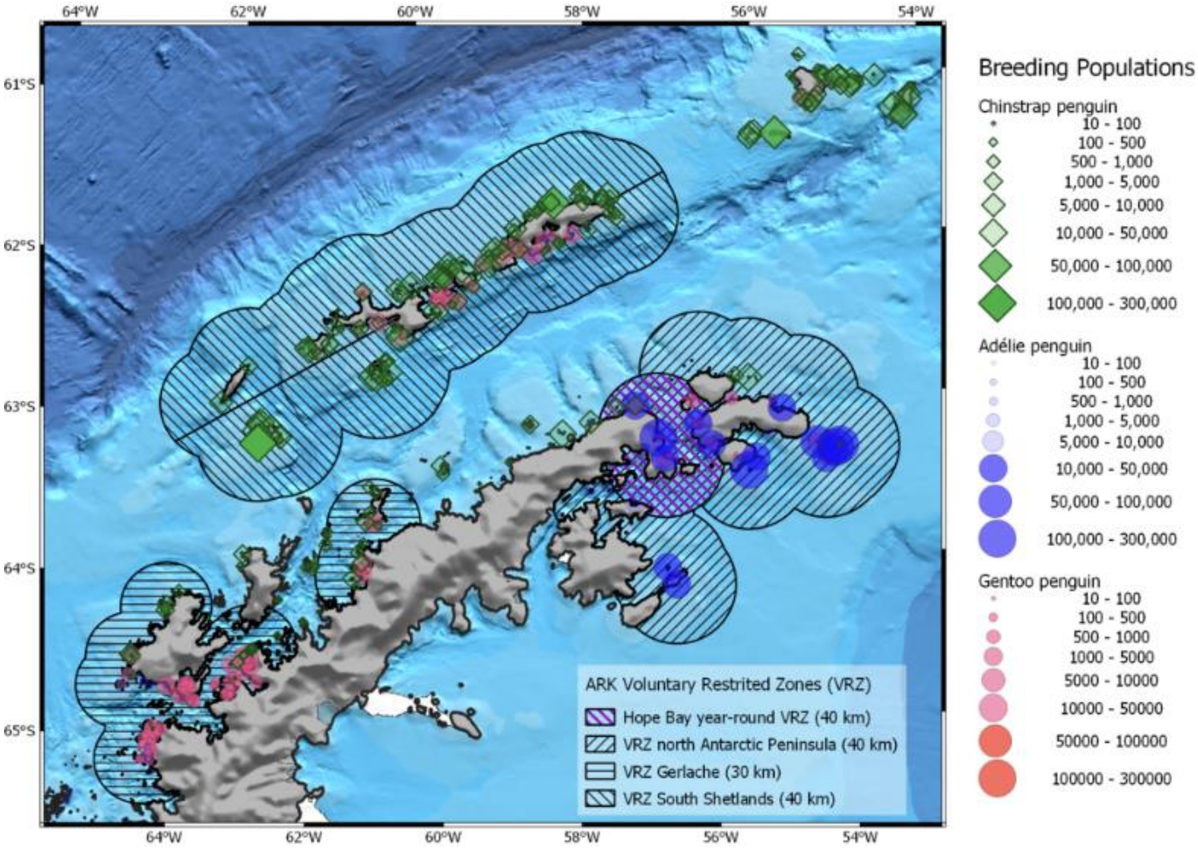

Figure 22. Distribution and size of penguin breeding colonies in Subarea 48.1 in relation to ARK VRZs (Source: ark-krill.org)

Results from the first Review Process found a 100 % compliance with this measure (ark-krill.org, accessed 14th Nov 2020)

At the end of December 2020[2] ARK created a new zone off-limits to fishing in Hope Bay, off the northernmost tip of Antarctica, protecting a vital habitat for several colonies of penguins, thus adding to the VRZs in that area. This means that through this voluntary agreement a 4,500km^2 there is now a restricted zone in the Hope Bay area, which will be closed to fishing year-round.

As of the end of Dec 2020, following CCAMLR meetings, the newly expanded restricted zones now encompass 74,400km^2 of ocean around the South Shetland Islands, northern Antarctic Peninsula, and in the Gerlache Strait. The ARK Expert Panel, a body that provides technical advice to the organization's decision-making body, had urged the extension of non-fishing zones to protect moulting adult penguins and dispersal of newly fledged juveniles.

2 https://www.seafoodsource.com/news/environment-sustainability/krill-fishing-halted-in-penguin-rich-habitat-near-antarctica?utm_source=marketo&utm_medium=email&utm_campaign=newsletter&utm_content=newsletter&mkt_tok=eyJpIjoiTXpoaU1tRTFPRFJtTURsaSIsInQiOiJCM2Fqc2V0eStDeEtEdkdcL1dyK1wvZm5hYUdaNlFCU010bkdNZTJ3QmJMSzU4ZVNnRHFvYzNSZ0p5V2toQk05cEpXa2l3RG1Dd1NJTlhCUWdyS2NcLzg3NVU5WEUrZzlpWTBKeVdaNURYN3VYYzlJRWlTK0ZOUFEweHpwXC9ETVlXYlUifQ%3D%3D

6.4.4.5 Marine Mammal protected Areas

The IUCN Marine Mammal Protected Area task force (MMPATF) was created in 2013 by the International Committee on Marine Mammal Protected Areas (ICMMPA), the International Union for Conservation of Nature's (IUCN) World Commission on Protected Areas (WCPA) Marine Vice-Chair, and members of the IUCN Species Survival Commission (SSC) to help support a stronger global profile for the role of marine mammals in protected areas, and to provide a stronger voice for the MMPA constituency within IUCN. The goal of the MMPATF is to facilitate mechanisms to encourage collaboration, sharing information and experience, accessing and disseminating knowledge and tools for establishing, monitoring, and managing MMPAs. The MMPATF promotes effective spatial solutions and best practices for marine mammal conservation within MMPAs. Important marine mammal areas are identified in order to prioritise their consideration for conservation measures by governments, intergovernmental organisations, conservation groups, and the general public.

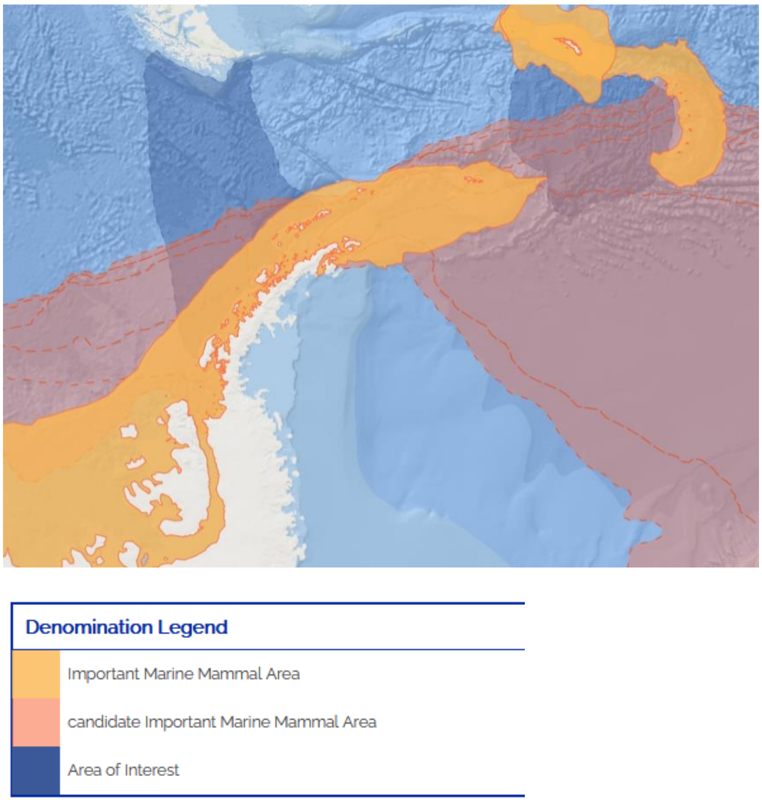

Figure 23 Important Marine Mammal Areas relevant to area 48.1 and 48.2 (Source: https://www.marinemammalhabitat.org/imma-eatlas/)

The Western Antarctic Peninsula and Islands IMMA (Important Marine Mammal Area) is an important feeding area for large baleen whales, orcas, and five species of seals. Humpback whales are the most abundant whale species in the area and largely occupy the coastal areas on the shelf. Vulnerable fin whales, with increasing numbers reported in recent years, tend to concentrate along the shelf edge and in waters beyond the shelf. The Antarctic minke whales mainly inhabit the coastal inshore waters of fjords and bays along the Antarctic Peninsula. Several orca ecotypes are distributed throughout the area, with relatively high concentrations in areas such as Gerlache and Bransfield Straits. Antarctic fur, southern elephant, crabeater, leopard, and Weddell seals reside, breed and forage in the IMMA. In addition to these abundant species, Endangered sei and blue whales, as well as southern right whales, occasionally occur in this area (https://www.marinemammalhabitat.org/imma-eatlas/; accessed 16th Nov 2020).

The Scotia Arc IMMA region is dominated by the Antarctic circumpolar current, which transports nutrients and organisms, particularly krill, from the Antarctic Peninsula across the Scotia Sea to South Georgia. The northwest Scotia Arc comprises the South Georgia Islands with a pelagic ecosystem extremely productive and intense phytoplankton blooms which supports a rich ecosystem, that includes zooplankton, large densities of krill, and marine mammal predators, such as seals and baleen whales. Many cetacean species have been recorded mainly for the northwest Scotia Arc comprising the South Georgia Islands and around the islands. The area surrounding South Georgia includes an important feeding ground for southern right whale from breeding ground of Argentina coast. Furthermore, the northeast of South Georgia and Sandwich Islands are an important foraging ground for humpback whales from breeding stock A (Brazil). In addition to these species, endangered Sei, fin, and Antarctic blue whales also occur in this area.

6.4.5 Ecosystem

6.4.5.1 The Scotia Sea and Antarctic Peninsula ecosystems

The ecosystem under consideration is The Scotia Sea, the boundary between the South Atlantic Ocean and the Southern Ocean. The Drake Passage constitutes its western limit, whilst on the north, east and south it is encompassed by the Scotia Arc; the emerged areas of the Arc form a number of subantarctic islands and archipelagos, such as South Georgia, the South Sandwich and South Orkney. Scotia Sea's total area is about 900,000 km^2. The Antarctic Circumpolar Current (ACC) flows around Antarctica, fully circumnavigating it in approximately six years (Roel et al. 2018).

The Antarctic Peninsula is the northernmost tip of the Antarctic continent. Its coasts (especially the western side) are free of permanent ice and have comparatively the mildest climate in Antarctica. The archipelago of the South Shetland is split from the mainland by the Bransfield Strait, which is currently a key area of krill abundance and thus it is also an area where most krill fishing effort has been concentrated in recent years.

All across the Scotia Sea islands and the fringes of the Antarctic Peninsula (especially its western coast), there is an abundance of krill-dependent predators, such as seals whales and seabirds. The whale and seal species found in Subareas 48.1 and 48.2 include[3] Humpback whale *Megaptera novaeangliae*; Fin whale *Balaenoptera physalus*; Antarctic minke whale *Balaenoptera bonaerensis*; Orcas *Orcinus orca*; Southern Right whale *Eubalaena australis*; Blue whale *Balaenoptera musculus*; Sei whale *Balaenoptera borealis*; Sperm whale *Physeter macrocephalus;* Southern fur seal *Arctocephalus gazella*; Southern elephant seal *Mirounga leonina*; Leopard seal *Hydrurga leptonyx*; crabeater seal *Lobodon carcinophaga*; Weddell seal *Leptonychotes weddellii* (that is five of the six species of seals native to Antarctica, the sixth being Ross seal (*Omimatophoca rossii*) (Roel et al. 2018).

More than thirty flying seabird species are found in Antarctica; many of them have breeding colonies on the Antarctic mainland and/or on the subantarctic islands. Some of these species are: southern fulmar (*Fulmaras glacialoides*), southern giant fulmar (*Macronectes giganteus*), cape pigeon (*Daption capense*), snow petrel (*Pagodroma nivea*), Wilson's storm petrel (*Oceanites oceanicus*), blue-eyed shag (*Phalacrocorax atriceps*), American sheathbill (*Chionis alba*), south polar skua (*Catharacta maccormick*i), brown skua (*Catharacta lonnbergi*), southern black-backed gull (*Larus dominicanus*), and Antarctic tern (*Sterna vittata*).There are also six species of penguin native to the Antarctic region: Adélie penguin (*Pygoscelis adeliae*), chinstrap penguin (*P. antarctica*), gentoo penguin (*P. papua*), emperor penguin (*Aptenodytes forsteri*), king penguin (*A. patagonicus*), rockhopper penguin (*Eudyptes crestatus*), and macaroni penguin (*E. chrysolophus*) (Roel et al. 2018).

The following graphic (Figure 24) shows 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).

[3] According to the IMMA designation https://www.marinemammalhabitat.org/imma-eatlas/

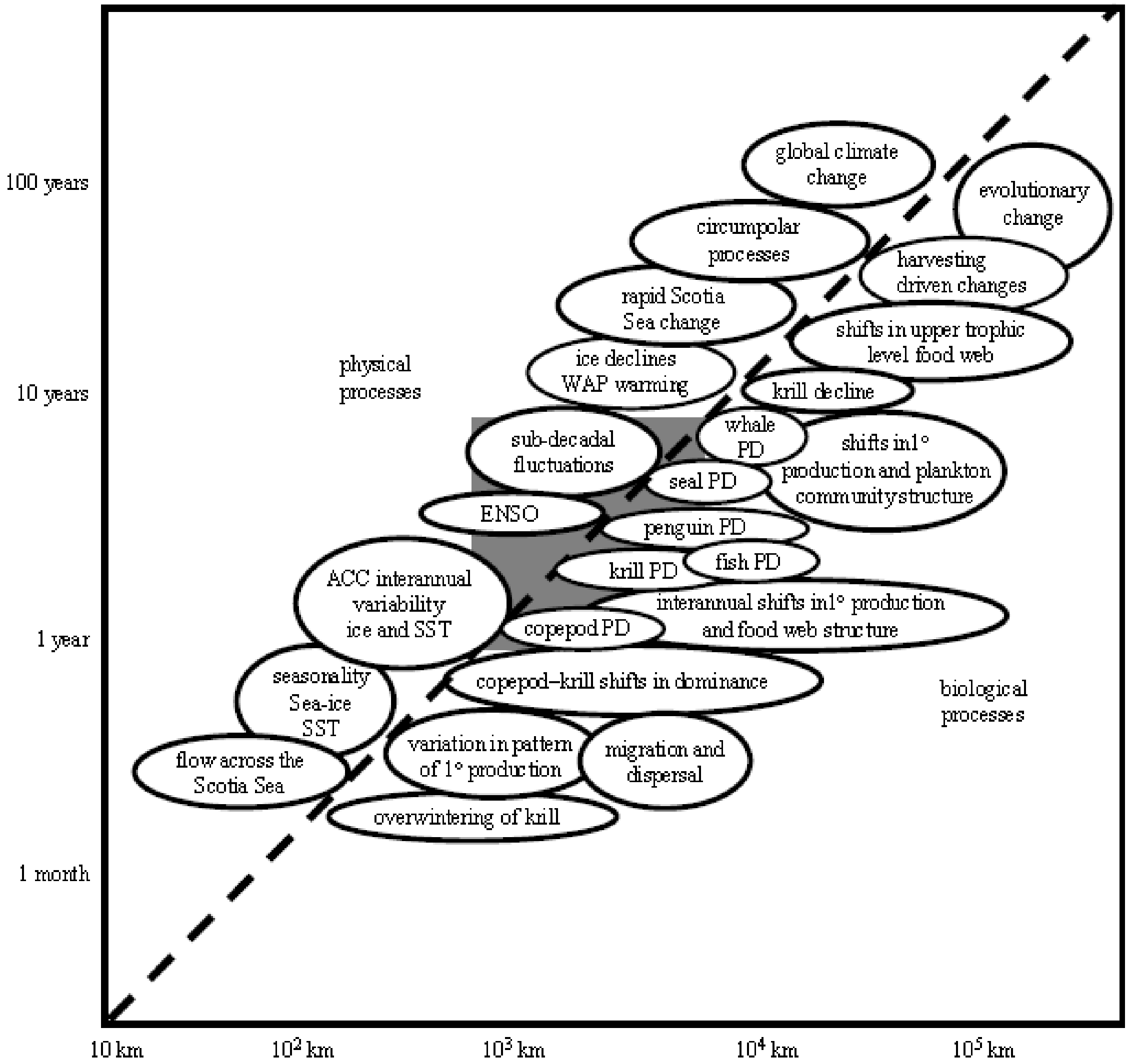

Figure 24. Schematic of the temporal and spatial scales of the main physical and biological processes important in determining the dynamics of the Scotia Sea ecosystem. Source: Murphy et al. (2007)

In Figure 24 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.

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).

6.4.5.2 Krill in the foodweb

There is a diversity of marine life in the Antarctic region and the Southern Ocean. Light and nutrients are concentrated in the upper layer (top 300m) of the water column; it is here where most of the biological processes occur. The prevailing winds contribute to the mixing of the upper layer, as well as vertical migration of species including whales (the so called whale pump of moving nutrients across the water column, described in (James et al. 2017) Whale and Dolphin Conservation report) contribute to the mixing at further depths - hence called the mixed layer. In the summer months winds are weaker, which combined with the melted sea ice produce stratification, and the mixed layer is thus reduced, sometimes to just the top 50 meters. This epipelagic zone is where krill concentrates to feed on phytoplankton, and it is here also that the midwater trawling targets the feeding krill schools (Constable & Doust 2009).

Antarctic krill (*Euphausia superba*) is a key species in the Southern Ocean ecosystem, linking primary production to abundant vertebrate predators in short and highly efficient food chains (Murphy et al., 2007). Krill are principally herbivorous and grow to a maximum size of 60 mm and an age of 5 years. Antarctic krill has a circumpolar distribution but is particularly abundant in the SW Atlantic sector. It is primarily a species of the seasonal sea ice zone and South Georgia is close to the northern limit of their distribution. Krill are dependent on sea ice, with juveniles thought to feed under the ice during the winter. Krill are advected to the South Georgia and South Sandwich Islands region from the seas around the Antarctic Peninsula, and at South Georgia the population is dominated by adult stages, with early larvae rarely seen. Krill forms dense swarms, which are targeted by both the fishery and predators.

South Georgia is home to many land-based krill-dependent predators, including Antarctic fur seals, macaroni and gentoo penguins and many flying seabirds. The South Georgia MZ is also an important foraging area for baleen whales, which also feed on krill.

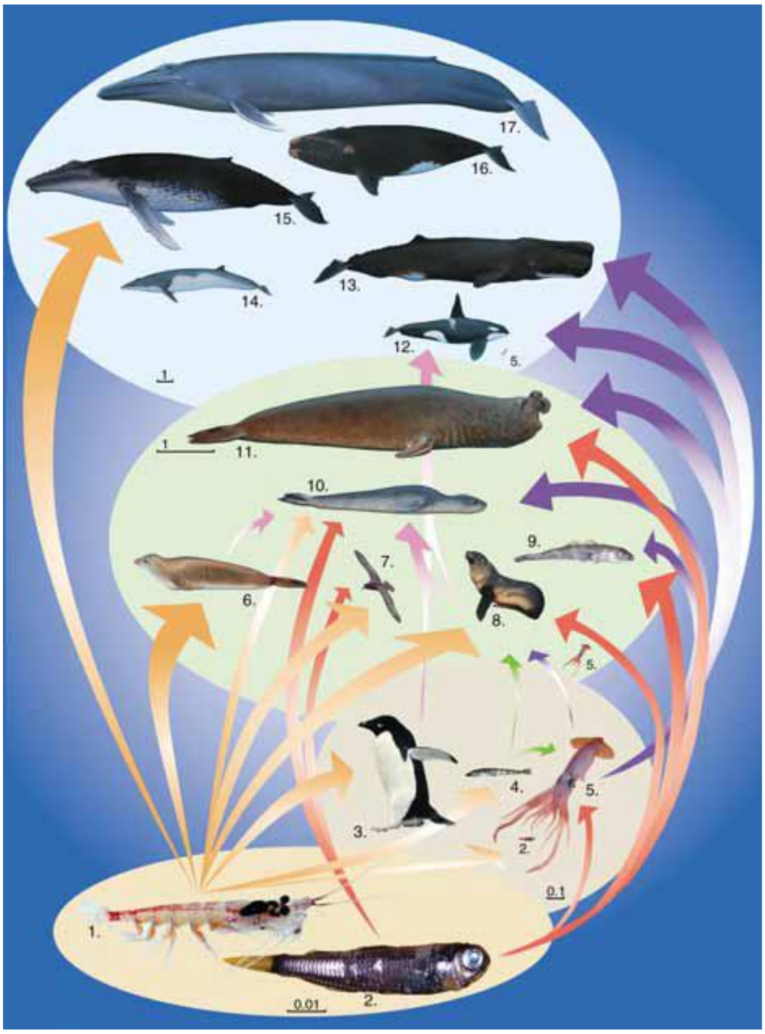

Figure 25. A generalised Southern Ocean foodweb from the krill level upwards (Source: Constable et al 2009)

When modelling the ecosystem (eg Figure 25) four main size groups of animals (each in a coloured ellipse) are suggested (Figure 25; (Constable & Doust 2009). Each animal is shown to scale within each ellipse. Scale bars are present in each ellipse along with a measurement in metres showing how big the bar would be in its natural size. Squid and lantern fish are used for comparing scales between ellipses. Lower orange ellipse: (1) Antarctic krill, (2) lantern fish. Lower middle red ellipse: (2) lantern fish at new scale, (3) Adelie penguin, (4) mackerel icefish, (5) squid. Upper middle green ellipse: (5) squid at new scale, (6) crabeater seal, (7) white-chinned petrel, (8) Antarctic fur seal, (9) Patagonian toothfish, (10) leopard seal, (11) southern elephant seal. Top blue ellipse: (5) squid at new scale, (12) orca (13) sperm whale, (14) minke whale, (15) humpback whale, (16) southern right whale, (17) blue whale.

Several studies address the issue of impact of the krill fishery on dependent predators (Hinke et al. 2017; Plaganyi & Butterworth 2012; Descamps et al. 2016) and how to address the impact on those species in the krill fishery management system (Watters et al. 2013; Hill et al. 2016; Watters et al. 2016). The main threat from the krill fishery comes from the potential for resource competition with krill-eating predators, including with marine mammals and seabirds. The potential for competition is most likely to occur when land-based predators are constrained to feed within a limited distance of their breeding site and when they must also provision their offspring as well as feed themselves (Trathan et al. 2015). Should the krill fishery become aggregated close to these breeding sites, the potential for resource competition may be very significant (Cury et al. 2011). Figure 26 shows the kind of foraging ranges of various species concerned.

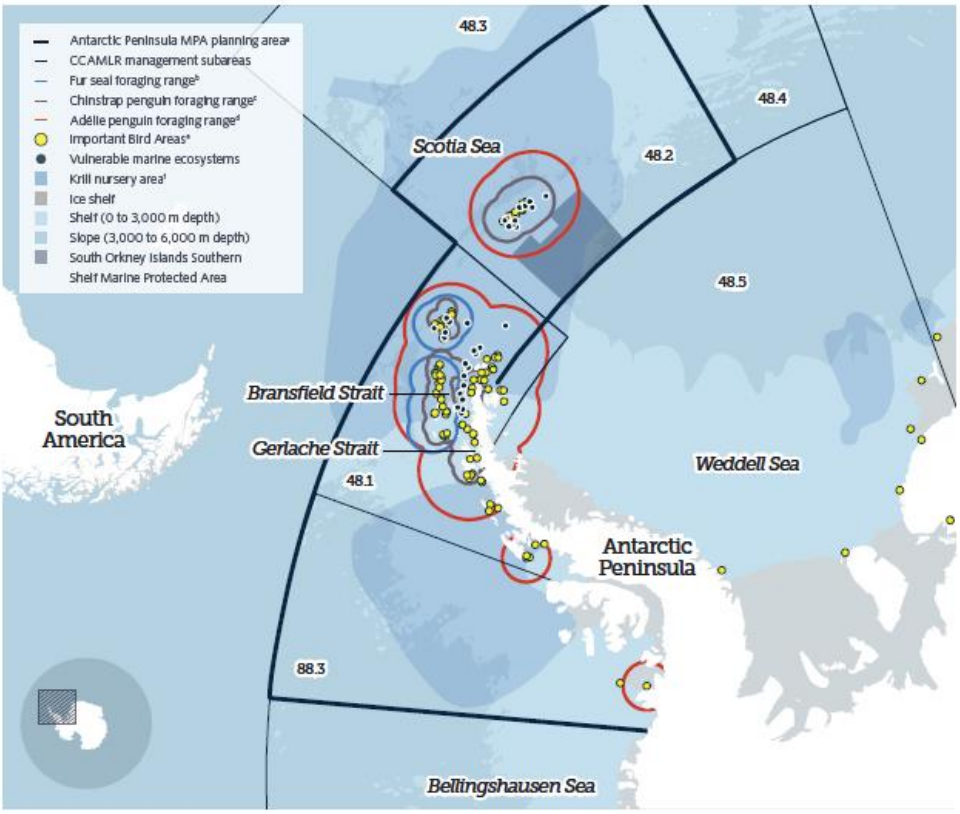

Figure 26. Western Antarctic Peninsula and South Scotia Arc region showing the foraging ranges of several species. (Source: http://www.pewtrusts.org/~/media/assets/2017/10/protection-for-the-antarctic-peninsula-region.pdf)

One important question for the krill fishery is the retention time and replacement time of krill in the fishing grounds. If retention time is short and replacement is rapid, the fishery should not present a significant threat to the krill-dependent predators. The seasonal closure, coupled with the 12 nm mile No-take zones around South Georgia, Shag Rocks, Clerke Rocks and each of the South Sandwich Islands should minimise any impact on dependent predators (see (Trathan et al. 2014), providing that the krill is quickly replenished. The on-going monitoring of krill-dependent predators suggests that inter-annual variation in krill abundance, associated with physical oceanographic factors, has a greater impact on predators than the fishery.

Historically, the densest concentrations of krill have been found in CCAMLR Area 48, thus explaining why the main commercial krill fisheries are located there. Krill density in other CCAMLR areas such as the Indian ocean and the Pacific ocean sectors are deemed to be much lower (Roel et al. 2018). One concern with the krill fishery in Area 48 is the lack of a recent assessment of krill biomass (Hill et al. 2016) but, whilst the fishery remains well below the catch limit, this is not a major concern.

The seabird mortality associated with the fishery, such as gear interactions, appears low as can be seen from the Observer reports as well as the annual CCAMLR Krill fishery reports providing an overall analysis of that year's krill fishing season.

The importance of krill in the diet of Antarctic fur seals at South Georgia could result in the species being affected by an increased krill fishery in the Southern Ocean as well as by increased competition for krill with other marine mammal species that are now recovering from previous exploitation. The entanglement of Antarctic fur seals in man-made debris, particularly around the neck, is a problem as it can cause death by drowning or starvation. A 1988-1989 study at Bird Island, South Georgia, found 208 sightings of entanglement, the main culprits being polypropylene straps, nylon string and fishing net, indicating a figure of 5,000-10,000 fur seals entangled for the entire South Georgia population. The debris is most likely to come from marine traffic in the Southern Ocean (SCS 2011).

6.4.5.3 Contribution of Antarctic krill to the capture and storage of atmospheric carbon

It has recently been shown that krill play a significant role in carbon capture and sequestration processes in the Southern Ocean (Manno et al. 2020; Cavan et al. 2019). The research into biogeochemical cycles showed this contribution in a number of ways: Antarctic krill feed on carbon-rich phytoplankton, through their vertical and horizonal migrations they then provide a key pathway for the carbon to be sequestered at depth in their expelled waste and faecal pellets. They also release limiting nutrients such as iron, which in turn encourages further primary production. Krill shed their exoskeletons approximately every 10 days and the exoskeletons, together with the faecal pellets account for 87% of an annual particulate organic carbon flux in the Southern Ocean (22.8 g m−2 y−1). The movement of the krill encourage biogenic mixing, the process by which nutrients are mixed in the water thus aiding the cycle of critical elements to continue, supporting primary production.

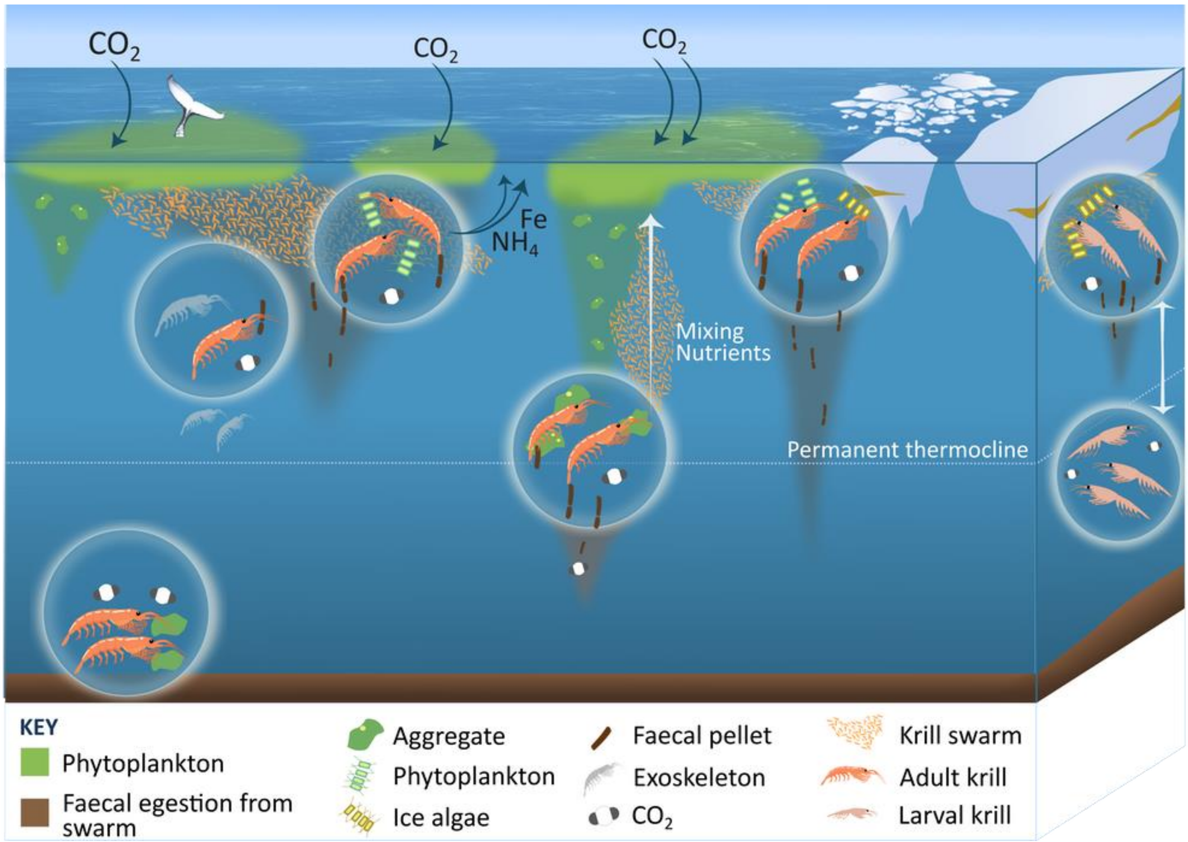

Figure 27. Role of *E.superba* in biogeochemical cycles. (Source: Cavan et al. 2019).

The following is taken directly from Cavan et al 2019: Krill (as swarms and individuals) feed on phytoplankton at the surface (1) leaving only a proportion to sink as phytodetrital aggregates (2), which are broken up easily and may not sink below the permanent thermocline. Krill also release faecal pellets (3) whilst they feed, which can sink to the deep sea but can be consumed (coprophagy) and degraded as they descend (4) by krill, bacteria and zooplankton. In the marginal ice zone, faecal pellet flux can reach greater depths (5). Krill also release moults, which sink and contribute to the carbon flux (6). Nutrients are released by krill during sloppy feeding, excretion and egestion, such as iron and ammonium (7), and if they are released near the surface can stimulate phytoplankton production and further atmospheric CO_2 drawdown. Some adult krill permanently reside deeper in the water column, consuming organic material at depth (8). Any carbon (as organic matter or as CO_2) that sinks below the permanent thermocline is removed from subjection to seasonal mixing and will remain stored in the deep ocean for at least a year (9). The swimming motions of migrating adult krill that migrate can mix nutrient-rich water from the deep (10), further stimulating primary production. Other adult krill forage on the seafloor, releasing respired CO_2 at depth and may be consumed by demersal predators (11). Larval krill, which in the Southern Ocean reside under the sea ice, undergo extensive diurnal vertical migration (12), potentially transferring CO_2 below the permanent thermocline. Krill are consumed by many predators including baleen whales (13), leading to storage of some of the krill carbon as biomass for decades before the whale dies, sinks to the seafloor and is consumed by deep sea organisms

The different mechanisms by which krill might contribute to the carbon sink have been researched in Cavan et al 2019, and include the role of juvenile feeding and vertical migration as well as varying behaviour in different seasons.

The impact of the removal of krill through fishing, on biogeochemical processes is not yet well understood (WWF PCDR contribution June 2021).

6.4.5.4 Monitoring and precautionary management

When the CCAMLR Convention came into force it established the Scientific Committee (SC-CCAMLR) and all Members of the Commission are also Members of the Scientific Committee. The Scientific Committee provides the best available scientific information on harvesting levels and other management issues to the Commission. In turn, the Commission is obligated 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 programs of CCAMLR Members.

The Scientific Committee works through a number of working groups, with the one responsible for krill being WG-EMM, Working Group on Ecological Monitoring and Management. The terms of reference for this WG are specific and deal with krill at its heart.

(https://www.ccamlr.org/en/science/scientific-committee):

(i) Assess status of krill;

(ii) Assess status and trends of dependent and related populations including identification of information required to evaluate predator/prey/fisheries interactions and their relationships to environmental features;

(iii) Assess environmental features and trends which may influence abundance and distribution of harvested, dependent, related and/or depleted populations;

(iv) Identify, recommend and coordinate research necessary to obtain information on predator/ prey/fisheries interactions, particularly those involving harvested, dependent, related and/or depleted populations;

(v) Liaise with WG-FSA on stock assessment related matters;

(vi) Develop further, coordinate the implementation of, and ensure continuity in CEMP;

(vii) Taking into account assessments and research carried out under terms of reference (i) to (v) above, develop management advice on status of Antarctic marine ecosystems and for management of krill fisheries in full accordance with Convention Article II.

(viii) Provide advice on aspects of spatial protection, including marine protected areas and vulnerable marine ecosystems.

The WG-EMM meets annually.

The scientific research outcomes from WG-EMM feed into the broader CCAMLR Ecosystem Monitoring Programme (CEMP), which was established to detect changes in the krill-based ecosystem and to provide a basis for regulating the harvesting of Antarctic living marine resources in accordance with the ‘ecosystem approach’. Recognition of the central role of krill in the ecosystem is at the core of the approach taken by CCAMLR in the management of the krill fishery. The program’s remit is to:

- Detect and record significant changes in critical components of the ecosystem, to serve as a basis for the conservation of Antarctic marine living resources
- Distinguish between changes due to the harvesting of commercial species and changes due to environmental variability, both physical and biological.

In practice, CEMP's major function (via the contributing research from WG-EMM) 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. CEMP-based estimates of predator-prey interaction strength are deemed highly uncertain at this stage, and therefore this information has primarily been used as context to inform management decisions. Predator reference points have yet to be defined (MBA 2017). The reports of the annual meetings of WG-EMM as published on the CCAMLR website provide detailed information of the kind of research and analysis conducted in the preceding year, and how this is taken forward in the management and monitoring of the ecosystem. (eg. WG-EMM 2019 https://www.ccamlr.org/en/wg-emm-2019). It is clear from the detailed research conducted on a wide range of Antarctic ecology that the knowledge base continues to increase, and time series on data sets is beginning to become increasingly more powerful in modelling and empirical studies.

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.

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 60oS are within ASPAs or ASMAs.

Regarding krill catch specifically in the area for the fishery under assessment, and as was discussed under Principle 1, it is deemed that the krill catch limit over CCAMLR Area 48 is precautionary although there is increasing call for an update of CM 54-7. Currently, krill catches are allocated to subareas by CCAMLR Conservation Measure 51-07 (CM 51-07) to allow for inter-annual variation in the distribution of krill aggregations and alleviate the potential for adverse impacts of the fishery in coastal areas on land-based predators. CM 51-07 expires in 2021.

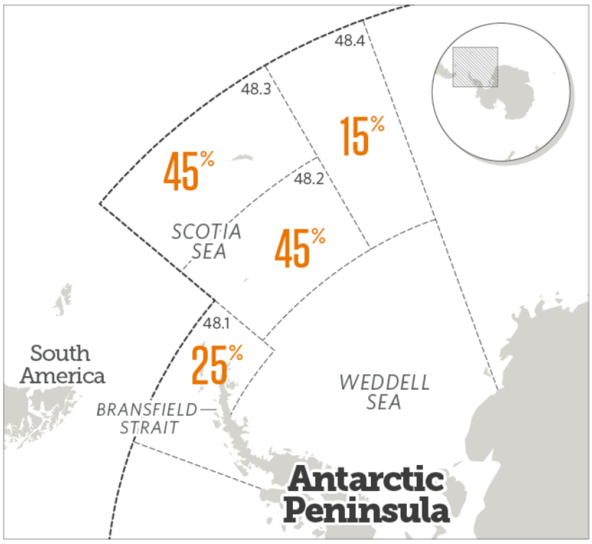

Figure 28. Distribution of allowable krill fishing in Area 48 subareas (CM 51-07): Area 48.1: 155,000 t; 48.2: 279,000 t; 48.3: 279,000 t; 48.4: 93,000 t. The fishery will close in a subarea if the 'trigger level' is reached in a season.

There are some concerns regarding the potential impacts of the krill fishery at the local scale however. CCAMLR set a trigger level limit of 620,000 t over the entire Area 48 (Figure 28). This trigger limit is further subdivided into regional trigger limits per Subareas: each fishing season catches cannot exceed 25 % of the trigger level (155,000 tonnes) in Subarea 48.1 and 45 % (279,000 tonnes) in Subareas 48.2 and 48.3 (CCAMLR 2017c). In addition, in 2003, CCAMLR agreed to the definition of a suite of small-scale management units (SSMUs) in Area 48 that are based on the distribution of krill, krill-predators and the fishery. However, to date there has been no agreement on the allocation of catches at this scale (CCAMLR 2017c). This has prompted concerns that there is a risk of localized predator depletion (MBA 2017).

There is an ongoing debate within CCAMLR as to whether the current approach, and specifically the present level of spatial resolution of the management units, is indeed sufficiently precautionary (MBA 2017). In 2019 CCAMLR agreed to a krill fishery management work plan to improve management of the fishery (CCAMLR 2019j). The work plan includes (as listed under paragraph 5/17):

1. *A stock assessment to estimate precautionary harvest rates (completed in 2019)*
2. *Regular updates of biomass estimates, initially at the subarea scale, but potentially at multiple scales*
3. *A risk assessment framework to inform the spatial allocation of catch across the SMRUs*

Each of these listed work plan elements are designed to answer management questions at a defined spatial scale. The risk assessment is deemed critical to de-concentrating fishing by setting krill catch limits at finer spatial scales in relation to fishing operations and predator feeding. The implementation of this workplan is due to correspond with the expiration of CM 51-07 at the end of the 2020-2021 fishing season.

In line with precautionary trigger levels set out in CCAMLR Conservation Measure 51-07 (CM 51-07), the fishery in subarea 48.1 was closed on May 30, 2020, due to the catch limit for this subarea being exceeded. The fishery in subarea 48.1 has been closed prior to the end of the fishing season eight times since 2010 for this reason (ASOC 2017).

Thus, there is evidence that the overall mechanisms to minimise impact on predators does currently work, as fishing stops when catch limits are met. However, most of the catch within Subarea 48.1 stemmed from the Bransfield Strait. This high concentration of fishing effort in a relatively small area suggests that further trigger limits will need to be implemented at a local scale (MBA 2017). Indeed, concentration of fishing effort and increasing harvest rates are a growing concern in the Antarctic Peninsula and Scotia Sea area (CCAMLR Area 48). The catch of krill in the 2019/20 season was the largest catch ever reported in Area 48, reaching 446,783 tonnes. It took less time to catch this amount, 69 days rather than 130 days (in the previous 5 years). Research on relevant penguin colonies appears to suggest that the current catch limit for the krill fishery, which is set at a regional scale, may not be as precautionary as presumed because fishing effort has concentrated in smaller areas nested within the region, and an impact on penguins in these smaller areas has been observed (Watters et al. 2020).

The research by Watters et al. (2020) further suggests that the impact of krill fishing, even at precautionary limits, is similar to that of pressure from climate change as measured by the Oceanic Nino Index. This is supported by research by (Krueger et al. 2020) who found that increasingly climate change impacts on krill distributions alongside increasing krill catch limits outside the breeding season is having a negative impact on Chinstrap (*Pygoscelis antarcticus*) and gentoo (*P. papua*) populations.

The recovery of cetacean populations in the Southern Ocean also has implications on whether the krill catch levels have taken this into account, and therefore whether the management of the krill fishery continues to be precautionary. An urgent update of CM 51-07 which also considers cetacean population recovery and foraging was discussed at the 2019 CCAMLR meeting (CCAMLR 2019j). At the meeting ASOC (Antarctic and Southern Ocean Coalition) highlighted the need to organise a technical workshop to undertake a comprehensive review of the CCAMLR Ecosystem Monitoring Program (CEMP) given the need to add information on krill-dependent cetaceans, pack-ice seals, and demographic groups other than adult penguins, in order to satisfy future needs for management of the krill fishery and for monitoring the proposed D1MPA (Domain 1 Antarctic Peninsula and Scotia Sea, see https://www.nature.com/articles/d41586-020-02939-5 for useful graphic).

During the 20th century, unchecked commercial whaling dramatically reduced whale populations throughout the Southern Ocean, driving many species to the brink of extinction. Species foraging on Antarctic krill in the region are still recovering. Krill fishing is concentrated in this area (48.1 and 48.2) and overlaps with key feeding areas for large whales (WWF & California Santa Cruz 2018). Cetaceans forage in areas of the Watters et al. (2020) study and it was suggested as part of that study that when determining whether future management of the krill fishery is precautionary, consideration should be given to other krill predators, not just penguins. Furthermore, in their study on humpback whale foraging grounds overlapping with krill fisheries, (Weinstein et al. 2017) also concluded that current management of the krill fishery does not consider or assess the needs and behaviour of the largest krill predators in the Antarctic - baleen whales.

A recently published study by (Meyer et al. 2020) on the need to address uncertainties in krill recruitment, behaviour and ecological adaptation as part of the management of Antarctic krill. The study indicated that the krill catch is concentrated in a small area and has shifted seasonally from summer to autumn/winter. Furthermore, because of the restricted distribution of successfully spawning krill and high inter-annual krill biomass variability, the risk of direct fishery impacts on the krill stock itself might be higher than previously thought. As the authors summarise, such uncertainty on certain aspects of krill ecology should be incorporated into management decisions, and the authors provide a range of projects and measures which would improve knowledge, some with direct input from the fishery. For example, it is recommended that krill fishery management is future proofed for climate change, as model projections suggest future reductions in conditions that are favourable to krill, and contractions of suitable habitat. Such models have highlighted the need to understand the mechanisms behind krill's plasticity within its environment. In particular there is perceived to be a need to ensure that catch limits remain appropriate even in years of climatic extremes or step-changes, since these are projected to increase. The study contents that the risk of fishing on the potential spawning stock in spring and summer is presently slight because the fishery has shifted its main period of activity from mid-summer toward autumn and winter. It is suggested that the protection of spawning areas, using measures, such as seasonal closures, may be necessary to ensure that the numerically-limited spawning stock does not decrease below critical levels in the event of future changes in catch distribution. The authors suggest that such measures may be relatively easy to agree to under present circumstances where there is no immediate conflict with the operation of the fishery.

From the results of recent ecosystem studies and observations mentioned above, it becomes increasingly relevant to set catch limits at a geographic scale over which the predators, prey, and fishery interact. In the case of the krill fishery that might mean setting catch limits for areas smaller than current CCAMLR Statistical Subareas. This would fulfil CCAMLR management requirements that the krill fishery does not interfere with population growth of Antarctic krill predators.

In contrast, the krill fishery in South Georgia waters is currently managed and regulated with greater protection for krill-dependent predators than in Subareas 48.1 or 48.2 (see (RSPB 2017)). The prohibition of fishing within 12nm of South Georgia and each of the South Sandwich Islands for example, coupled with the seasonal closure of the krill fishery (November 1st to March 31st) should avoid any such competition (Trathan et al. 2015). The 12nm No-take zone around South Georgia protects predators such as gentoo penguins, which are present all year round, but forage locally. The seasonal closure should protect predators such as macaroni & chinstrap penguins that forage further from the land but are not in South Georgia waters in the winter. Ratcliffe et al. (2015) looked at the spatial overlap between macaroni penguins and the krill fishery during the winter and concluded that competition between the krill fishery and macaroni penguins is low.

Another main area of concern is the combination of the effects of climate change and the expansion of the krill fishery (MBA 2017). Indeed the Antarctic Peninsula is one of the fastest warming areas at a global scale: along the Western Antarctic Peninsula (WAP), the mean annual air temperature has increased as much as 3.4 °C and the mid-winter temperature has increased 6.0 °C over the past 50 yr (Bockheim et al. 2013).

According to the recent Special Report on the Ocean and Cryosphere in a Changing Climate from the United Nations Intergovernmental Panel on Climate Change (IPCC SROCC), climate change is transforming the Antarctic in lasting and fundamental ways (IPCC 2019). This is of particular concern given krill are highly concentrated in the SW Atlantic sector, the area of the Southern Ocean most impacted by climate change so far (Klein et al. 2018). Krill are reliant on sea ice, particularly in the larval and juvenile life stages, which is reducing around the Antarctic Peninsula due to warming temperatures (Michon 2020) and the distribution of krill is contracting southwards (Atkinson et al. 2019). It is estimated that sea ice extent able to support krill in the SW Atlantic sector will reduce by 20 % by 2100 (Hill et al. 2013), although the authors of the study point out that there is considerable uncertainty in the estimates. The authors highlight that there is a need for more rapid progress in developing methods for evaluating climate change impacts in parallel with improved regional climate projections, and for adaptation to and management of the risks to the Southern Ocean ecosystem that climate change implies.

This warming will undoubtedly have effects at different levels and spatial scales, ranging from a reduction of the ice cover to changes in the water mixing and primary productivity. The outcome of these changes upon the predator populations, when combined with a fishing effort similar or higher than current and as spatially concentrated as it is now, constitutes a main concern over the long-term sustainability of the krill fishery. The WG-EMM at their 2019 meeting agreed that the climate change associated risks to krill and the ecosystem it supports emphasise the need for precautionary management of the krill fishery (CCAMLR 2019j).

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 & Grant 2013).

Changes in the physical properties of the marine system are especially important for CCAMLR and include, *inter alia*, changes in ocean temperature (Guille 2002) and ocean acidification (Bednarsek 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 et al. 2005; Cook & Vaughan 2010; Gutt et al. 2010). Ocean acidification is having an impact on Antarctic krill recruitment. The deeper waters of the Southern Ocean have higher concentrations of CO_2 than surface waters. Krill eggs sink to depth of between 700-1000m where they hatch but these higher concentrations of CO_2 are leading to a decline in embryonic development (Kawaguchi et al. 2013).

CCAMLR has not only established a number of programs to collect the data required for the effective management of the Southern Ocean such as fisheries monitoring, scientific observers on fishing vessels and ecosystem monitoring, but also the marine debris programme. The CCAMLR marine Debris Database was established in 1989 to monitor debris levels in the Convention Area, with specific regard to fishing debris items. Members annually submit data using a standardised form and instructions covering marine debris from beach surveys, debris associated with seabird colonies, entanglements of marine mammals, and hydrocarbon soiling of mammals and seabirds. The CCAMLR Marine Debris Database contains data from 15 sites, predominantly in the Antarctic Peninsula and on Sub-Antarctic islands. In addition to the Marine Debris program, CCAMLR has implemented measures to monitor and reduce the amount of debris entering the marine system and to mitigate its impact in the Convention Area. Specific measures have been implemented to address the risk associated with entanglement of marine mammals in plastic packaging bands (used to secure bait boxes) and the injury to seabirds caused by the discharge of hooks in offal.

CCAMLR has also developed a number of initiatives to educate fishers and fishing vessel operators about the potential impact of marine debris on seabirds and marine mammals. Since 1989, fishing and fisheries research vessels operating in CCAMLR waters have been required to display a marine debris poster, Overboard is not Forgotten, which outlines procedures for the handling, storing and discarding of different types of refuse. This poster, highlighting the dangers posed to marine mammals by plastic debris, has been produced in multiple languages. 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.

6.4.5.5 Ecosystem Models

Different broad categories of model representing Antarctic krill, their data sources and limitations were reviewed by Atkinson et al. (2012). The main groups of sampling krill described included: with nets (for historical time series, demographic information and live krill), acoustics (distribution, time series, biomass and swarm-scale information), the krill fishery (sustained sampling in one place and wide area and time coverage) and via predators (long time series, demographic indices). Observations that krill occupy the under-ice layer, the 0–10 m layer, the deeper water column and the benthos have fundamental implications, both for assessing biomass and for modelling the food web. Temporally, the intense (order of magnitude) interannual variability in krill population size within the southwest (SW) Atlantic sector is a major scale of variability, driven by sea-ice and climate effects on recruitment. This variability masks top–down predation controls that may operate over multi-decadal scales. Growth in spring, summer and autumn is now fairly well quantified. The main predator groups of krill are known, although the extent of predation is more variable and not linear. Krill feed across three trophic levels and can control food populations through locally high grazing impact and nutrient regeneration. They also have fundamental regional differences in overwintering strategies, on-shelf/off-shelf distributions, relationships with sea-ice and diet. Whether this reflects 'subpopulations' with regionally specific life cycles is still unclear, which therefore makes scaling-up food-web models difficult across regions difficult (Atkinson et al. 2012).

The model categories described by Atkinson et al. (2012) include:

- Models exploring specific aspects of krill biology such as life cycle, energetics or behaviour (Hofmann & 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 1979; Murphy et al. 1998);
- 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 & 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; Hewitt et al. 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 & 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 (Plaganyi & 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)).

6.4.6 Cumulative impacts

The MSC introduced requirements for cumulative impact assessments in Principle 2 with the release of the Fisheries Certification Requirements v2.0. These requirements are to ensure that MSC certified fisheries will no longer cumulatively be at risk of generating negative impacts on Principle 2 species (and habitat).

For primary species, cumulative impacts assess whether the collective impact of overlapping MSC fisheries are hindering the recovery of ‘main’ primary species that are below a point of recruitment impairment (PRI); i.e. ensuring that the combined impact of MSC fisheries are not harming the recovery of the stock;

For secondary species, the same intent applies when a species is below a biologically based limit, but only in cases where two or more MSC fisheries have ‘main’ catches that are ‘considerable’, defined as a species being 10 per cent or more of the total catch;

For ETP species, the combined impacts of MSC fisheries on all ETP species needs to be evaluated, but only in cases where either national and/or international requirements set catch limits for ETP species and only for those fisheries subject to the same national legislation or within the area of the same binding agreement’;

For habitats, in contrast, cumulative impacts are evaluated in the management PI (PI 2.4.2). The requirements here aim to ensure that vulnerable marine ecosystems (VMEs) are managed cumulatively to ensure serious and irreversible harm does not occur.

Apart from Krill, there are currently no other directed fisheries in areas 48.1 48.2 (CCAMLR CM 32-02 2017). No finfish are targeted in this area (Table).

Prohibition of Directed Fishing

Taxon / Area	*Chaenocephalus aceratus*	*Dissostichus eleginoides*	*Dissostichus* spp.	*Electrona carlsbergi*	*Gobionotothen gibberifrons*	*Lepidonotothen squamifrons*	*Notothenia rossii*	*Patagonotothen guntheri*	*Pseudochaenichthys georgianus*	All other species of finfish
Subarea 48.1	1,2	1,2	1,2	1,2	1,2	1,2	1,2,4	1,2	1,2	1,2
Subarea 48.2	1,2	1,2	1,2	1,2	1,2	1,2	1,2,4	1,2	1,2	1,2
Subarea 48.3	3			1,2	3	3	4	3	3	

Table 15. Extract from CCAMLR CM 32-02 2017

Table 16. Cumulative impact considerations

Outcome Performance Indicator	Element	Cumulative impact?	Rationale
2.1.1 Primary species (main)	NA	NA	No Primary main species in this UoA
2.2.1 Secondary species (main)	NA	NA	None caught in this UoA
2.3.1 ETP outcome	NA	NA	None caught in this UoA
2.4.2 VME management	NA	NA	A mid-water pelagic fishery

6.4.7 Scoring elements

Table 17. Principle 2 scoring elements

Component	Scoring elements	Designation	Data-deficient
Principle 1	Krill *Euphasia superba*	Target	No
Primary	Icefish species *Champsocephalus gunnari*	Minor IPI	No
Secondary	Ocellated icefish *Chionodraco rastrospinosus*	Minor IPI	No
Secondary	*Daption capense* (cape petrel)*		
Secondary	*Pagodroma nivea* (snow petrel)*		
ETP	*Arctocephalus gazelle* (Antarctic fur seal)	Released live	No
Habitat	Common	NA	
	VME	NA	
	Minor habitat	NA	

* It must be noted that these species were not recorded in the Observer reports for this fishery under assessment, but were recorded in the CCAMLR krill fishery report (2018) as a whole (covering all krill fisheries)

6.4.8 Principle 2 Performance Indicator scores and rationales

Scoring table 7. 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

There are no main primary species in this fishery – according to MSC interpretation 24.02.2017 ID 2845 "If the fishery has no main species, scoring issue (a) is not applicable. In scoring issue (b) each species will score either 80 or 100 depending on whether the SG100 is met or not.

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

This is a reduction fishery all minor primary and secondary species are accounted for as IPI species, as they are not separated at any point from the targeted krill.
Based on the Observer reports, the bycatch has identified one Primary minor species, mackerel icefish (*Champsocephalus gunnari)* at 0.002 % (1,008 kg). This species is commercially targeted. Recent (2018) survey biomass estimates from CCAMLR indicate that *C. gunnari* in Subarea 48.3 is well above average and the second highest since 2000 (CCAMLR Fishery report 2018 for *C.gunnari* 48.3). CCAMLR provides scientific advice and management measures for Icefish (CCAMLR 2019 CM 42-01, https://www.ccamlr.org/sites/default/files/42-01_51.pdf). Although biomass estimates for *C. gunnari* within Subarea 48.1, where the client fishery operates, are not currently available, the areas 48.1 and 48.2 are not currently exploited for mackerel icefish. The stock in 48.3 is carefully managed using a harvest control rule applying a length based approach, which has been demonstrated to provide robust precautionary estimates of catch limits and exploitation rates for *C.gunnari* (CCAMLR Fishery report 2019 for *C.gunnari*), it can therefore be assumed, that since it is not exploited at all in 48.1/2 that the stock levels have recovered there too from historic exploitation levels. Based on the stock assessment for 48.3, the mackerel icefish in 48.1/2 is highly likely to be above PRI. Given the amount of mackerel icefish 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 *C. gunnari*. **SG100 is met**.

References

(CCAMLR 2018a; CCAMLR 2018h)

https://www.ccamlr.org/en/system/files/01%20ANI483%202018.pdf

Conservation Measure 42-01 (2019) Limits on the fishery for *C. gunnari* in Statistical Subarea 48.3 in the 2019/20 and 2020/21 seasons

https://www.ccamlr.org/sites/default/files/42-01_51.pdf

CCAMLR scientific observer reports from 2016-2020

CCAMLR Fishery report 2019 for *C.gunnari* https://fishdocs.ccamlr.org/FishRep_483_ANI_2019.pdf

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI

Overall Performance Indicator score	100
Condition number (if relevant)	-

Scoring table 8. 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 Primary main species recorded in the Observer reports, therefore **SG60 and SG80 are automatically met**.

There is currently no active fishery, and has not been for years, for mackerel icefish in 48.1 and 48.2. The management strategy which applies to mackerel icefish in 48.3 would be applicable here too, as it would be under the management regime of CCAMLR (mackerel icefish in 48.3 is a MSC certified fishery - https://fisheries.msc.org/en/fisheries/south-georgia-icefish-pelagic-trawl/@@view for relevant stock and management details).

There is a strategy in place for the UoA for managing mackerel icefish, the fishing strategy allows for a selective catch of the targeted krill, which limits the catch of the mackerel icefish species to low levels (~0.003 % based on observer data). This is verified by on-board observer reports. Given this high level of selectivity, the team considers that the fishing strategy is adequate for managing 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	There is some **objective basis for confidence** that the measures/partial strategy will work, based on	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on

		experience, theory or comparison with similar fisheries/species).	some information directly about the fishery and/or species involved.	information directly about the fishery and/or species involved.
	Met?	Yes	Yes	Yes

Rationale

The type of fishing gear used and being a pelagic and highly targeted fishery, as well as comprehensive observer coverage providing detailed bycatch information and monitoring of relevant krill conservation measures (gear design, area limits, bycatch limits) as stipulated by CCAMLR (https://www.ccamlr.org/en/conservation-and-management/browse-conservation-measures) **SG60 and SG80 are met**.

Testing 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). In the case of this fishery, there are several years of comprehensive Observer data providing detailed evidence of past performance, and the fishery under assessment is similarly executed and observed as other krill fisheries in Sector 48.1 and 48.2. **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 for this fishery, between 2015 and 2019 for the vessels under assessment, provide clear information on the location and execution of the fishery as well as detailed bycatch reporting. Furthermore, the observer coverage is 100 %, the observer takes photographs of the mitigation measures and gear configurations, and verifies location as stipulated by CCAMLR Conservation Measures and these are part of the report. The bycatch data show that non-target species bycatch is consistently very low, amounting to 0.009 % of the total catch. This provides clear evidence that the strategy is implemented successfully and achieving its overall objective. **SG80 and SG100 are met.**

d	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

No sharks are caught in this fishery. There are no observations to suggest so.

e	Review of alternative measures			
	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

MSC's definition of 'unwanted catch' is as follows (SA3.1.6): the part of the catch that a fisher did not intend to catch but could not avoid, and did not want or chose not to use.

There are no 'main' species identified in the observer data and given the low level of non-targeted species in the catch (<0.01 % of catch by weight), the team considers that there is no unwanted catch of primary species. Therefore, this SI is not applicable.

References

CCAMLR observer reports for this fishery;

(CCAMLR 2018a; CCAMLR 2018h); (CCAMLR 2019g; CCAMLR 2018g)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	100
Condition number (if relevant)	-

Scoring table 9. 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

No main species, so this scoring issue is not applicable.

MSC interpretations 24.02.2017, ID 2845:

'If the fishery has no main species, scoring issue (a) is not applicable. In scoring issue (b) each species will score either 80 or 100 depending on whether the SG100 is met or not.'
Basically you only score the main species in the 'main' (SIa) scoring issue and the minor in the 'minor' (Sib) for 2.1.1 and 2.2.1.

So in your scenario 1, if the fishery has no main species, scoring issue (a) is not applicable, and scoring issue (b) is scored at the 100 level. If it meets it for all species, then score is 100.
In scenario 2, if the fishery has no main species, scoring issue (a) is still not applicable. In scoring issue (b) each species will score either 80 or 100 depending on whether the SG100 is met or not (noting previous interpretation on grouping these).

Clause SA3.2.1 applies when there are no species within a component at all ('If a team determines that a UoA has no impact on a particular component, it shall receive a score of 100 under the Outcome PI'). If no main or minor primary species, for example, then the automatic 2.1.1 score is 100.

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?			No

Rationale

Based on detailed observer records, there is quantitative information on the amount of primary species caught by the UoA. No targeted fishing of mackerel icefish occurs in 48.1 and 48.2. There are up-to-date stock assessments on mackerel icefish *Champsocephalus gunnar*i in area 48.3, and one can extrapolate from these the status of *Champsocephalus gunnar*i in area 48.1 and 48.2 as those areas do not have a targeted fishery. The quantitative information is not adequate to estimate the impact of the UoA on mackerel icefish with respect to status. **SG100 is not 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, **SG60 and SG80 are met** by default.

As regards all primary species, there is detailed information on the quantity taken by the UoA for the one primary species concerned. The status of *C gunnari* is known by extension of updated stock assessments in 48.3 and no targeted fishery in 48.1 and 48.2. The 100 % observer coverage ensures that the Conservation Measures stipulated by CCAMLR are complied with (eg gear design, deployment, fishing location, catch analysis). VMS further verifies the location of the fishery. It is therefore considered, that in this highly targeted fishery the information is adequate to support a strategy to manage all primary species and to evaluate with a high degree of certainty that the strategy is achieving its objective. **SG100 is met**.

References

CCAMLR observer reports for this fishery;

(CCAMLR 2018a; CCAMLR 2018h); (CCAMLR 2019g; CCAMLR 2018g)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	90
Condition number (if relevant)	-

Scoring table 10. 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
a	Main secondary species stock status			
	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

Based on the Observer reports available for this UoA (catch profile Table and section 6.4.2.1), there were no Secondary fish (in-scope) main species recorded in the bycatch of this krill fishery. Out-of-scope non-ETP species such as seabirds are scored as Secondary main species (MSC CR v2.0 SA3.7.1.2).

In 2018 one dead cattle egret (*Bubulcus ibis*) was recovered around the ship's forecastle – it was retained as a sample and sent to the Korean National Institute for Science. The cattle egret's death is not directly related to the act of fishing, but more likely to have been an involuntary passenger on the vessel picked up at port of departure, the circumstances as to why it was found on the vessel are not known. It is not an Antarctic species and is not a seabird. The cattle egret is therefore not considered an out-of-scope (and therefore Secondary main) species, and not scored as part of this fishery, it is not relevant

As this is a relatively new fishery, observers on a krill fishery-wide-basis in the area under assessment were studied as a precaution, and to increase the sample size. Both snow petrel and cape petrel were recorded in the CCAMLR 2018 krill fishery report (and which therefore are regarded as Secondary main species under MSC CR). Specifically, in 2018, there were two seabird mortalities reported from the krill fishery (all fleet of 11 vessels), one snow petrel (*Pagodroma nivea*) in Subarea 48.1 and one cape petrel (*Daption capense*) in Subarea 48.2. The 2017 CCAMLR krill fishery report recorded 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.
Please note: It must be emphasized that snow petrel and cape petrel were not recorded in the Observer reports of the fishery under assessment.

According to information from Birdlife International, 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.

Based on this information on the species, there is a high degree of certainty that main Secondary species (two species of seabirds, caught in the wider krill fishery in the area) are above biological based limits. **SG60, SG80 and SG100 are met**.

b	Minor secondary species stock status			
	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

Minor species relevant to this PI are listed in Table .

Paragraph 7.7.6.5 (MSC CR v2.0) requires that the Risk-Based Framework (RBF) should be used to evaluate scoring elements that are data-deficient. The secondary species identified should therefore be scored using the RBF. However, PF4.1.4 states that "The team may elect to conduct a PSA on "main" species only when evaluating PI 2.1.1 or

2.2.1", and this is the approach taken in this assessment as the secondary species listed in Table were designated as minor secondary species. PF 5.3.2 is therefore applied and the scores for this PI are capped at SG80.

Since this is a reduction fishery all minor primary and secondary species account as IPI species, as they are not separated at any point from the targeted krill. Given the low amount of fish bycatch taken by the UoA (considered here as Secondary minor species), totalling about 0.009 % of the total catch, it may be reasonable to consider that the UoA does not hinder the recovery and rebuilding of these species. However, no evidence could be found of biological based limits for these species. **SG100 is not met**.

References

CCAMLR observer reports for this fishery, from 2016-2020.
(CCAMLR 2017b; Birdlife_International 2019a; Birdlife_International 2019c; Birdlife_International 2019b; CCAMLR 2018 b)
(https://www.ccamlr.org/en/document/publications/krill-fishery-report-2018)
(https://www.ccamlr.org/en/system/files/00%20KRI48%202017.pdf)
(http://datazone.birdlife.org/species/factsheet/snow-petrel-pagodroma-nivea/details)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	80
Condition number (if relevant)	-

Recommendation:
The assessment team recommends that further attention is given to other krill species in the catch (other than *Euphausia superba*). Identification tools, guides, and methodologies should be applied to better identify other krill species, and observer reports should highlight the presence of other, non- *E. superba* krill species in the catch. Such information will feed into relevant CCAMLR working groups.

Scoring table 11. 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

There are no Secondary main in-scope identified in Table (catch profile) so for these elements **SG60 and SG80 are met** by default.

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 out of scope species such as seabirds, namely the snow petrel (*Pagodroma nivea*) and cape petrel (*Daption capense*) (considered Secondary main unless otherwise allocated to ETP).

All krill vessels operating in Area 48 have to comply with a raft of management measures as stipulated by CCAMLR (eg location of fishery, exclusion of certain areas, gear design and configuration, catch and bycatch recording, observer coverage (see https://www.ccamlr.org/en/conservation-and-management/browse-conservation-measures). These measures amount to a strategy as designed by CCAMLR to manage krill fisheries in the area.

This raft of measures includes for example:
- The mandatory use of a marine mammal exclusion device
- Fine-mesh exclusion net at the codend
- Long hauls of 20 or 25 days (proxy)
- A slow towing speed (2 knots) that allows animals to avoid the net
- Square mesh and T90 mesh orientation to reduce the bycatch of juvenile fish and small fish
- Retention on board of all material captured

- The quick sinking of the net on deployment (to further reduce attention from seabirds)
- Spatial and seasonal limitations around South Georgia and the South Sandwich Islands, to reduce interaction with foraging species based on the shores during breeding season.
- The trawl warps enter the water very close to the stern of the vessel, reducing the potential for seabirds to strike them during fishing operations

Furthermore, the net is hauled at regular intervals, and emptied on board, cleaned and released back into the water, this has the advantage that the catch and its composition is monitored closely, whereby avoidance action can be taken if the proportion of juvenile fish increases.

The grouping of these measures, including comprehensive catch and bycatch recording and their periodic review (through the CCAMLR resources management process) are considered to make up a strategy for the UoA to manage main and minor Secondary species, as the monitoring by observers allows the determination of risk level and intervention if necessary through CCAMLR review processes. **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 Secondary main species between 2016-2020. The broader, krill fishery fleet wide information provided in the CCAMLR 2018 and 2017 krill fishery reports showed that interactions by the UoA with seabird species could occur but are also rare (see PI 2.2.1). The list of measures mentioned in SIa are all considered likely to work, as regards seabirds they restrict and discourage access to the net and limit the time of the hauling of the net (when interactions could be most expected). **SG60 is met**.
The low level of interactions and the high surveillance of these interactions (given the 100 % observer coverage – whereby the implementation of measures is observed and recorded as such in the relevant reports) give some objective basis for confidence that the strategy will work. **SG80 is met**.

Testing 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). In the case of this fishery, there are several years of comprehensive Observer data providing detailed evidence of past performance, and the fishery under assessment is similarly executed and observed as other krill fisheries in Sector 48.1 and 48.2. The low level of interactions (as recorded in CCAMLR observer reports and summarised in the CCAMLR 2018 / 2017 krill fishery reports), the safe biological status of the affected main species (snow petrel and cape petrel) and the low proportion of Secondary minor finfish species in the catch all support high confidence that the strategy is working effectively. **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 objective as set out in scoring issue (a).
	Met?		Yes	Yes

Rationale

CCAMLR observer reports for this fishery, dating back to 2016 for the vessels under assessment, provide clear information on the location and execution of the fishery as well as detailed bycatch reporting. The bycatch data show that non-target species bycatch is consistently very low, amounting to 0.009 % of the total catch. Furthermore, the observer coverage is 100 %, the observer takes photographs of the mitigation measures and gear configurations, and these are part of the report. The layout of the observer report template prompts observers to highlight when measures are or aren't used. This provides clear evidence that the strategy is implemented successfully and achieving its overall objective. **SG80 and SG100 are met.**

d	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

No sharks are caught in this fishery according to the observer reports. GSA3.8 on Secondary species management strategy states that MSC Guidance for Primary species management strategy applies (GSA3.5). GSA 3.5.1 states that scoring issue (d) is only scored where the primary (in this case secondary) species is a shark. This is not the case here. As such, this SI is not applicable.

e	Review of alternative measures to minimise mortality of unwanted catch			
	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	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of

			species and they are implemented as appropriate.	**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 on the different fisheries operating in the Southern Ocean. CCAMLR's WG FSA (Working Group on Fish Stock Assessment) and WG EMM (Working Group on Ecosystem Monitoring and Management) meet regularly and annually. The most recent meeting was held in France in July 2019. The WG-EMM discusses, amongst other issues, the effectiveness of implemented measures to avoid mortality of unwanted catch and reviews the effectiveness and usefulness of the data collected. Furthermore, there is no unwanted catch, there is no discarding, all species recorded in the catch composition are used in the intended products, mainly fishmeal and krill oil, as well as whole krill. Given the frequency of these meetings, as well as no unwanted catches, the requirements at **SG60, SG80 and SG100 are met**.

References

https://www.ccamlr.org/en/conservation-and-management/browse-conservation-measures
https://www.ccamlr.org/en/meetings-and-publications/meetings-publications.
CCAMLR observer reports for the UoA
(CCAMLR 2017b; CCAMLR 2019m; CCAMLR 2020; CCAMLR 2018i); (CCAMLR 2018f; CCAMLR 2010; CCAMLR 2018d)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	100
Condition number (if relevant)	-

Scoring table 12. 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?	NA	NA	NA

Rationale

Although no Secondary main species were recorded in this UoA, specifically, as a precaution, observer reports from the wider krill fleet fishing in 48.1 and 48.2 were consulted. The CCAMLR krill fishery report 2017 reported on the krill fleet of 11 vessels, one snow petrel (*Pagodroma nivea*) in Subarea 48.1 and one cape petrel (*Daption capense*) in Subarea 48.2. The 2017 and 2018 CCAMLR krill fishery reports listed 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. From the quantitative information available on the two identified species of seabirds (Snow petrel and cape petrel), Birdlife International provides relevant information on the seabird population numbers.

The global population of snow petrels exceeds 4 million individuals, and in the absence of evidence for any declines or substantial threats the population is considered stable (Birdlife_International 2019c) Species factsheet: *Pagodroma nivea*). As for the Cape petrel, its population exceeds 2 million individuals and is also expected to be stable in the absence of any evidence to the contrary (Birdlife_International 2019b) Species factsheet: *Daption capense).* Both species are listed as Least Concern by IUCN.

So from a wider krill fishery angle, of which the fishery under assessment is part of, some quantitative information is available and adequate to assess the impact of the UoA on main secondary species with respect to status. SG60 and SG80 is met.

A high degree of certainty would demand continuous observer coverage of the fishing operation – ie 2 onboard observers taking turns to observe every haul, over a longer time period (ie covering several years of Observer reports). This is not yet available. SG100 is not 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

Although there is good quantitative information on all those Secondary minor species bycaught in this fishery, based on good observer coverage and extensive sampling of hauls, there is no information on the status of Secondary minor species. **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

Detailed information on bycatch is reported to CCAMLR on a continuous basis, the 100 % international observer coverage ensures detailed sampling and recording of information on catch composition according to the CCAMLR Scientific observer's manual. The collection and analysis of such detailed bycatch data in the krill fishery has been in place for some years, so that the data can be analysed meaningfully for trends and responded to accordingly. This means that the information is adequate to support a strategy to manage all Secondary species and to evaluate its effectiveness. The objective is to minimise non-target species catches. Considering the comparatively low amount of Secondary species caught (0.004 %) and as observer coverage is 100 % with detailed sampling, it can be said that there is a high degree of certainty that the strategy is currently achieving its objective. **SG60, SG80 and SG100 are met**.

References

(CCAMLR 2020)
CCAMLR 2016 to 2020 observer reports for the UoA; CCAMLR krill fishery reports 2017, 2018

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	85
Condition number (if relevant)	-

Scoring table 13. 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

The CCAMLR Schedule of Conservation Measures currently in force were adopted by the Commission at a recent meeting of the par ties (Nov 2019 – Schedule of Conservation Measures in force 2019/20; https://www.ccamlr.org/en/system/files/e-schedule2019-20_1.pdf). The schedule outlines, amongst other measures, the requirements to prevent and minimise incidental mortalities of seabirds and marine mammals. These measures do not set limits for ETP species, the raft of measures across all areas within the Convention Area are designed to prevent incidental mortalities. 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

Marine mammal and seabird observations and interactions are recorded in a standardised format as part of the CCAMLR Scientific Observer Reports in accord with the CCAMLR Observers Manual. Identification guides are available for all observers on each of the fishing vessels. Any interactions are summarised annually in the Krill fishery reports compiled by CCAMLR.

The CCAMLR krill fishery 2018 report (covering all vessels participating in the year's krill fishery) provides information on recent interactions with marine mammals and seabirds. In 2018, there were two seabird mortalities reported from the krill fishery, one snow petrel (*Pagodroma nivea*) in Subarea 48.1 and one cape petrel (*Daption capense*) in Subarea 48.2. These two seabird species are not ETPs, however, but they are mentioned here to indicate that all seabird interactions are recorded by the observers

The use of seal exclusion devices (SED) became mandatory in the krill fishery in 2010 (CCAMLR 2010), prior to that date no seal interactions with the fisheries were recorded. There were no seal mortalities reported in the CCAMLR krill fishery between 2008 and 2014. There were three mortalities of Antarctic fur seals in 2015 and 2016, none in 2017. There were also 19 reported mortalities of Antarctic fur seal (*Arctocephalus gazella*) in the krill fishery in Subarea 48.3, of which 18 were reported from the same vessel (not a UoA vessel). As reported in CCAMLR observer reports for the UoA, none of these mortalities took place in the UoA vessels.

The 2018 Observer report for the UoA recorded one dead cattle egret being found on the forecastle, the bird was retained for further examination to establish the cause of death. The 2019 Observer report recorded one fur seal being caught in the net and released alive and uninjured.

Given the low level of interactions, known direct effects of the UoA are likely to not hinder the recovery of ETP species. **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 risk of seabirds or marine mammals encountering the net, such as the Seal Exclusion Device (SED), as well as a raft of other measures as outlined in the ETP background section of this report (6.4.3). The implementation of these measures is rigorously checked by the Observers. **SG80 is met**.

Considering the interaction with Antarctic fur seals, these are currently classified as LC on the IUCN Redlist (accessed 1st Dec 2019). The most recent assessment of the Antarctic fur seal population was published in 2016 (see IUCN Redlist species detail http://www.iucnredlist.org/details/2058/0). According to this 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, such as entanglement in gears have also been recorded. The impact of incipient fishing industries on prey populations remain low, possibly as a result of the conservative management of these fisheries. The 100 % comprehensive scientific observer coverage showing no fatal interactions by the UoA with fur seals, as well as other marine mammals and seabirds, 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**.

c	Indirect effects			
	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 (Hinke et al 2017). The results showed that direct overlap of krill-dependent predators (including Antarctic fur seals) with the krill fishery on small spatiotemporal scales is relatively common throughout the Antarctic Peninsula region.

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. In order to limit the indirect effects that harvesting for krill may have on penguin colonies, the Association of responsible krill harvesting companies (ARK http://www.ark-krill.org/) and its members (including Jeong Il Corporation) 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 (see: http://www.ark-krill.org/index.cfm/7/News). 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 48.1/.2/.3 shows that fur seals would consume 706.7 thousand tonnes per year, whales 2360 thousand tonnes, fish 2,963.9 thousand tonnes and penguins up to 9,192.1 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. The harvest strategy for krill sets trigger levels. This '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 (for detailed calculations see Section 6.3.5 of this report). This trigger limit was further split into sub-limits for each of the Subareas 48.1 to 48.4 (the calculations behind the trigger level are described in the 2018 Krill fishery report https://www.ccamlr.org/en/system/files/00%20KRI48%202018.pdf). 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.

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), the level of estimated unexploited krill biomass 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

(Hinke et al. 2017; CCAMLR 2018b; Hewitt et al. 2004; CCAMLR 2019n); (CCAMLR 2018e)

IUCN Redlist for fur seal http://www.iucnredlist.org/details/2058/0

www.ark-krill.org

Draft scoring range	≥80
Information gap indicator	More information sought / Information sufficient to score PI
Overall Performance Indicator score	100
Condition number (if relevant)	-

Scoring table 14. 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	No

Rationale

MSC CRv2.1 SA3.11.2.1 Where there are requirements for protection and rebuilding provided through national ETP legislation or international agreements, the team shall score scoring issue (a).

Article II of CCAMLR clearly states the objective of this Convention as being the conservation of Antarctic marine living resources, whereby 'conservation' includes rational use. Harvesting has to be conducted with certain principles of conservation: (a) prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment. For this purpose its size should not be allowed to fall below a level close to that which ensures the greatest net annual increment; (b) maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources and the restoration of depleted populations to the levels defined in sub-paragraph (a) above; and (c) 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.

CCAMLR requirements for the protection of ETP species are specified in Conservation Measure 25-03 (2019) - Minimisation of the incidental mortality of seabirds and marine mammals in the course of trawl fishing in the Convention Area, which sets out a raft of measures on fishing vessels to minimise such bycatch mortalities. Vessels in the UoA comply with this requirement, as recorded in CCAMLR observer reports. In addition, Conservation Measures 26-01 2019 (on general environmental protection) addresses the disposal of plastic (not at sea!), prohibition of discharge (including oil, garbage, organic waste, offal etc), live birds including poultry must not be brought into the Convention area, and any bycatch with a high chance of survival has to be released immediately (after certain recordings have been taken). Conservation Measures 51-01 (2010) addresses the precautionary catch limits in the krill fishery in Statistical Subareas 48.1, 48.2, 48.3 and 48.4; and Conservation Measure 51-06 (2019) is a general measure for scientific observation in fisheries for *Euphausia superba* and includes.

In practice the measures outlined in CM 25-03 (2019) include:

- 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 (apart from those species which have high survivability and are released as quickly as possible)

- 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.

- Streamer lines

- 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 have been implemented by ARK of which the fishery under assessment is a member (https://www.ark-krill.org/ark-voluntary-measures).

These measures are configured on the vessels, in conjunction with CM 25-03, 26-01 and 51-01, 51-06 2019 to form a comprehensive strategy for managing the UoA's impact on ETP species, in that information on the implementation and efficacy of these measures is collected by onboard observers and fed back to CCAMLR which evaluates these measures as part of regular meetings. However, as was pointed out by one of the reviewers, concerning "**above** national and international requirements for the protection of ETP species": since the management strategy is derived from the CCAMLR Conservation Measures, which set the international limits, hence, by definition, therefore cannot set limits that exceed their own limits. **SG60, SG80 are met and SG100 is not 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?	NA	NA	NA

Rationale

This SI was not scored following MSC CR v2.0 SA3.11.2

c	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 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

Fisheries managed by CCAMLR are subject to a proven regulatory framework which includes access control, high frequency of reporting obligations (100 % observer coverage), scientific monitoring of both target species catch and bycatch, mandatory marine mammal exclusion devices, as well as measures aimed specifically at targeting minimizing interaction with and mortality of seabirds and marine mammals (see previous SI for more details on management measures in place). **SG60 is met.**

The CCAMLR Scheme of International Scientific Observation was adopted in 1992 under Article XXIV of the Convention. It is one of the most important sources of scientific information that is essential for assessing the impact of fishing on the ecosystem, including the status of target populations, as well as those of related and dependent species. The scheme also plays a crucial role in developing approaches to reducing the impact of fishing on the ecosystem by collecting data on the effectiveness of mitigation measures. All vessels fishing in CCAMLR fisheries are required to carry an observer for some or all of their fishing operations. In fisheries for icefish and toothfish there is a requirement for 100 % coverage by an international (i.e. not from the same flag state as the vessel) observer, while in the krill fishery there is a target coverage of at least 75 % during 2018/19 and 2019/20 fishing seasons; and 100 % coverage in subsequent fishing seasons (CM 51-06 2019). Observers record information on the gear configuration (including measures to reduce incidental mortality of seabirds and marine mammals), fishing operations (including catch composition), biological measurements of target and by-catch species, details of fish tagging and tag-recaptures, vessel sightings and data on indicators of vulnerable marine ecosystems. All of these data are submitted by observers to the CCAMLR Secretariat on standardised logbook forms designed for longline, trawl (finfish and krill) and pot (crabs and finfish) fisheries.

The fishery under assessment has 100 % observer coverage. Observer reports from both vessels covering 2016-2020 have been made available to the assessment team. The observer reports specific for this UoA recorded one interaction with an Antarctic fur seal which was immediately released alive and uninjured, and one dead cattle egret which was found lying on the forecastle (it was retained for further examination).

There is an objective basis for confidence that the strategy will work. **SG80 is met**.

The CCAMLR 2018 krill fishery report stated that the entanglement and mortality of Antarctic fur seals was significantly reduced over time after the introduction of improved reporting and the implementation of marine mammal exclusion devices (SED) since 2003. The SED technology and configuration has been improved over that time, and CM 25-03 shows that these and related measures have now become mandatory. Over that time period the numbers of fur seals caught has reduced significantly, from 292 in 2004 to single figures in recent years. Although in 2018 there were also 19 reported mortalities of Antarctic fur seal (*Arctocephalus gazella*) in the fishery in Subarea 48.3, of which 18 were reported from the same vessel – not the UoA (CCAMLR 2018i). The same report also noted two seabird mortalities reported from the krill fishery, one snow petrel (*Pagodroma nivea*) in Subarea 48.1 and one cape petrel (*Daption capense*) in Subarea 48.2.

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 no interactions, the team concludes that there is a quantitative analysis supporting with high confidence that the strategy will work (and is already working). **SG100 are met**.

d	Management strategy implementation			
	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

There is clear evidence that the strategy is being implemented successfully and achieving its objective. The observer coverage is 100 %, the observer takes photographs of the mitigation measures and gear configurations, and these are part of the report. The observer reports available to the assessment team cover 2016-2020 for both vessels, and none show fur seal mortalities (one fur seal was caught alive and immediately released unharmed), and one cattle egret (not an ETP) found dead on the forecastle of the ship (retained for further examination). **SG80 and 100 are met.**

e	Review of alternative measures to minimize mortality of ETP species			
	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	No

Rationale

The effectiveness of the measures to minimize UoA-related mortality ETP species is periodically reviewed by CCAMLR, through the annual meetings of the Working Group on Fish Stock Assessment (WG FSA) and on Ecosystem Monitoring and Management (WG EMM), and reports are published accordingly. **SG60 and SG80 are met**. With the introduction of 100 % observer coverage by the 2020/2021 fishing season, any issues with the exclusion devices and mitigation measures will be detected and acted on in a more timely manner (compared to the years it took to install the now mandatory conservation measures to reduce seabird and marine mammals bycatch). In order to meet SG100, it has to be shown that there is a biennial review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality ETP species, and that these are implemented, if appropriate. This cannot be said to be the case for this fishery. **SG100 is not met**.

References

CCAMLR https://www.ccamlr.org/en/organisation/camlr-convention-text#II
(CCAMLR 2017b; CCAMLR 2018e; CCAMLR 2018i; CCAMLR 2010; CCAMLR 2019h; CCAMLR 2019f)
Observer reports; https://www.ark-krill.org/ark-voluntary-measures

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	90
Condition number (if relevant)	-

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Scoring table 15. 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	No

Rationale

The overlap between some of the predators' summer foraging ranges and the krill fishery has been studied. E.g. (Hinke et al. 2017) and continues to be studied (see WG-EMM 2019/23). Fishing restrictions (currently voluntary but with a view to make these mandatory see www.ARK-krill.org) have been established in foraging areas of the Antarctic Peninsula and of the South Georgia and South Sandwich Islands (although the latter two areas are outside of areas 48.1 and 48.2 in which the UoA operates). 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 (Nicol 2009; CCAMLR 2019m; Watters et al. 2016; Hewitt et al. 2004; Trathan et al. 2011; Trathan et al. 2012). Such spatial information is valuable in terms of assessing the risk of gear/ ETP interaction occurring.

There is 100 % observer coverage on both vessels of the fishery under assessment, and with reports available to the assessment team from 2016-2020, providing detailed quantitative information on interactions of the fishery with ETP species. The data is adequate to assess UoA-related mortality. The data shows that incidence of interaction is extremely small (see 2.3.1). Furthermore, the overall catch limit for krill in area 48 is set at 620,000 tonnes, once this is cumulatively reached by all the vessels, fishing for krill stops. As explained in PI2.3.1c, the overall krill biomass is currently estimated at 62.6 million tonnes. Considering this evidence, at this stage the UoA is not a threat to protection and recovery of the ETP species. SG60 and SG80 are met. A high degree of certainty would demand continuous observer coverage of the fishing operation – ie 2 onboard observers taking turns to observe every haul, and a longer time series of observations. **SG100 is not 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 detailed information on ETP interactions available from the Observer reports is adequate to measure trends and support a strategy to manage impacts on ETP species. This is made possible by the high level of observer coverage in the krill fishing fleet. Together with the information recorded across the whole krill fishery fleet operating in the area, using all the same measures and protocols, and this data being collated by CCAMLR as part of the annual reporting process on these fisheries (CCAMLR krill fishery reports 2018, 2017), it can be said that 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. This work is also supported by the Working Group on Ecosystem Monitoring and Management (WG-EMM), which has as one of its remits to "Assess status and trends of [krill] dependent and related populations including identification of information required to evaluate predator/prey/fisheries interactions and their relationships to environmental features". Relevant studies include for instance WG-EMM 2019/23, WG-EMM 2019/26 and 2019/27. **SG60, SG80, and SG100 are met**.

References

UoA Observer reports 2016-2020

(CCAMLR 2017b; Hinke et al. 2017; Nicol 2009; CCAMLR 2018b; Warwick-Evans et al. 2019; Humphries et al. 2019); (Trathan et al. 2011; Trathan et al. 2012)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI

Overall Performance Indicator score	90
Condition number (if relevant)	-

Scoring table 16. 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

This is a pelagic trawl fishery. The commonly encountered habitat is therefore the upper water column, the habitat of the target species. The fishing gear does not come into contact with the benthos – it would severely damage the gear if it did. VMS tracks confirm where the fishery operates. It can therefore be stated that the UoA is highly unlikely to reduce structure and function of the commonly encountered habitat, the open water pelagic habitat, to a point where there would be serious or irreversible harm. **SG60, SG80 and SG100 are met**.

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

This is a pelagic fishery. It does not come into contact with the benthos and therefore any possible VMEs. Furthermore, fishing with bottom gear is highly managed and restricted following CM 22-06 (2019) Bottom Fishing in the Convention Area, applying to areas south of 60°. The UoA therefore does not have any interaction with VME benthic habitats. A map of VME locations in the area where the fishery operates is provided in Section 6.4.4 . Due to the fishing practices, area of activity, and 100 % observer coverage, **SG60, SG80, and SG100 are met**.

c	Minor habitat status			
	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

Minor habitats are defined by MSC as those which do not fall within the classification of Commonly Encountered Habitats or VME (SA3.13.3). Taking into consideration information presented in SI(a) and SI(b), for the purpose of this assessment all benthic habitats excluding seamounts, hydrothermal vents, cold water corals and sponge fields (as defined as VMEs in CM22-06 2019) are considered as Minor habitats. The midwater trawl used in the krill fishery is designed to operate in the water c olumn without any contact with the sea bottom, and the loss of gear is a very rare event, confirmed by the Observer reports (2016-2020) showing zero entry for this (ie. The observer has to record such interaction, and the relevant box was filled as "0"). **SG100 is met**.

References

(CCAMLR 2019d)

Observer reports 2016-2020

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	100
Condition number (if relevant)	-

Scoring table 17. 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

This is a pelagic mid-water trawl fishery for krill, there is no impact of the fisheries on benthic habitat. As to managing the impact of all MSC UoAs/ non-MSC fisheries on habitats in general, there is a strategy in place, designed and implemented through CCAMLR. In the case of the fishery under assessment, the 'managed area' of 48.1 and 48.2 is considered (rather than all of the CCAMLR area around Antarctica – see exceptional cases GSA 3.13.5.

CCAMLR Conservation Measures 21-03 and CM 51-01 restrict the type of fishing gear to be used to pelagic gear only, as well as tightly regulate bottom gear fishing (CM22-06 2019). 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 (Observer reports from 2016-2020).

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 (SO-SS) as its first Marine Protected Area, located in subarea 48.2. 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 several 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 (SGSSI MPA), established in 2012, and reviewed in 2018, establishes a 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 krill fishery under assessment) 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 in the managed area 48.1 and 48.2 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. This is a mid-water pelagic fishery, the habitat involved is the habitat for krill – pelagic. Based on Observer reports, no interaction of the gear with the seabed has been recorded – this has to be recorded as per reporting template. **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) information and detailed observer scientific reports show that this is a localized fishery, seeking out 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.

CCAMLR, as part of its remit, is directly involved in the creation and management of MPAs, in protecting these habitats and e cosystems. 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 (eg Krill fishery report 2018) 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, whether MSC or non-MSC. There is clear quantitative evidence of the UoA compliance with management requirements and protection measures for VMEs in the form of VMS records, compliance inspection reports, and detailed observer reports. **SG60, SG80 and SG100 are met**.

References

(CCAMLR 2018b; CCAMLR 2010; CCAMLR 2019d; CCAMLR 2016b; CCAMLR 2012; CCAMLR 2009; CCAMLR 2011a; CCAMLR 2016f; CCAMLR 2008c; C CAMLR 2013) (CCAMLR 2010; CCAMLR 2019d; CCAMLR 2016b; CCAMLR 2004; CCAMLR 2012; CCAMLR 2009; CCAMLR 2011a; CCAMLR 2016f; CCAMLR 2013)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	100
Condition number (if relevant)	-

Scoring table 18. 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

For the purposes of this PI, the "main" habitats are the commonly encountered habitats and VMEs that the fishery may impact (see GPF7.1.5). This is a pelagic trawl fishery. The commonly encountered/main habitat is therefore the upper water column, the habitat of the target species. The fishing gear does not come into contact with the benthos – it would severely damage the gear if it did.

Although seabed mapping for the area in which the fishery operates is incomplete at a scale that is relevant to managing impacts of some fisheries, such as demersal trawls, this is of little consequence to this assessment, as the fishery under assessment occurs in mid-water and does not directly come in contact with and thus impact on the benthic habitat.

There have been a number of studies and surveys which enable a broad understanding of the types and distribution of the main habitats in the marine Antarctic (Douglass et 2014; Reid 2011; and updates on ongoing research and surveys are published at the CAMLR Science Committee meetings (https://www.ccamlr.org/en/meetings/27, accessed 18th Feb 2020).

Mapping of the seabed and vulnerable seabed habitats is an ongoing process and CCAMLR requires Observers to record benthic organisms (in the relevant fisheries; CM 22-07 2013 Collection and Reporting of VME-Indicator Data and to contribute to the VME Registry). Given the pelagic nature of the krill fishing gear operating in the UoA, the benthic main habitats are therefore not vulnerable to UoA, and the nature and distribution of the main habitats in the UoA area are known at a level of detail relevant to the scale and intensity of the UoA. **SG60 and SG80 are met**.

At this stage the distribution of all habitats is not known over their range. CCAMLR itself acknowledges that: "*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. Furthermore, in the Antarctic, where growth rates of benthic taxa are typically slower than in more temperate regions, the impacts of fishing gear on vulnerable taxa may be magnified because of the much longer time taken to recover.*" (CCAMLR https://www.ccamlr.org/en/compliance/vulnerable-marine-ecosystems-vmes, accessed 1st Dec 2019). 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: Qualitative information is adequate to estimate the consequence and spatial attributes of the main habitats.	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 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.	The physical impacts of the gear on all habitats have been quantified fully.
	Met?	Yes	Yes	Yes

Rationale

This is a pelagic fishery. The fishing gear does not impact or make contact with the seabed. There are no physical impacts. There are no known impacts of the fishing gear on the pelagic habitat; the only possible physical impact of the gear on benthic habitat would be through net entanglement if the gear was to make contact with the seafloor. The nets would snap and break easily, and since nets are expensive, any contact with the seafloor is strenuously avoided. There are no records of gear losses in the fishery by the certified fleet, it is a requirement to record gear loss in the Observer report (Observer coverage is 100 %). **SG60, SG80 and SG100 are met.**

c	Monitoring			
	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

This is a pelagic fishery. There are no known impacts of this pelagic fishery on the main benthic habitat, there is therefore no risk of this fishery to the main habitats.

There is ongoing research and mapping of benthic habitats (CM 22-07 2013; annual CCAMLR Science Committee meetings and reports - https://www.ccamlr.org/en/meetings/27), so SG80 is met. However, the information available to date is too limited to be able to assess changes in all habitat distribution over time. SG100 is not met

References

(CCAMLR 2018b; CCAMLR 2010; CCAMLR 2019d; CCAMLR 2016b; CCAMLR 2004; CCAMLR 2012; CCAMLR 2009; CCAMLR 2011a; CCAMLR 2016f; CCAMLR 2008c) (CCAMLR 2013)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	85
Condition number (if relevant)	-

Scoring table 19. 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	No

Rationale

The krill fishery under assessment is highly selective (targeting dense aggregations of krill using mid-water pelagic trawl gear, where the catch is hauled), has very little or no interaction with ETP species (as can be seen from Observer reports from 2016-2020), and has no impact upon benthic habitats. There is a low amount of bycatch of non-target species, including larval fish, but it represents a low total amount (as estimated by CCAMLR, a krill catch of 300,000 t would include a catch of about 370 t fish bycatch (CCAMLR 2017d)).

Thus, the only main way in which the fishery may have an impact on the ecosystem is through the removal of the krill biomass itself. Krill is a key species and has a central role in the Antarctic food webs. In the Southern Ocean, the Antarctic krill, *Euphausia superba*, makes up an estimated biomass of around 379 000 000 t (Atkinson et al 2009). Of this, over half is eaten by whales, seals, penguins, squid and fish each year, and is replaced through reproduction and subsequent growth of the krill population. Sustainability of the krill fishery is dependent on the size of the catch relative to the population. CCAMLR's approach to managing the krill fishery is to minimise the impact on the ecosystem rather than trying to maximise the size of the fishery. The total allowable catch for the southwest Atlantic is currently about 5.6 million tonnes annually (https://www.ccamlr.org/en/fisheries/krill-fisheries-and-sustainability; CCAMLR 2019j). CCAMLR regulates the catch within a 620 000 t 'trigger' level which is distributed across four regions in the southwest Atlantic (Area 48). This '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 (for detailed calculations see Section 6.3.5 of this report). This trigger limit was further split into sub-limits for each of the Subareas 48.1 to 48.4 (the calculations behind the trigger level are described in the 2018 Krill fishery report https://www.ccamlr.org/en/system/files/00%20KRI48%202018.pdf). In recent years some sub-limits have been reached, especially in Subarea 48.1, and in each case the fishery was closed within the relevant Subareas. The interim total trigger catch of 620,000 t has not been officially reached. The actual annual catch is around 0.3 % of the unexploited biomass of krill. The geographic focus of the krill fishery since 2010 has been area 48 (CCAMLR 2018i).

It has recently been shown that krill play a significant role in carbon capture and sequestration processes in the Southern Ocean (Manno et al. 2020). The research into biogeochemical cycles (Figure 27) showed this contribution in a number of ways, Antarctic krill feed on carbon-rich phytoplankton, through their vertical and horizonal migrations they then provide a key pathway for the carbon to be sequestered at depth in their expelled waste and faecal pellets. They also release limiting nutrients such as iron, which in turn encourages further primary production. Krill shed their exoskeletons approximately every 10 days and the exoskeletons, together with the faecal pellets account for 87% of an annual particulate organic carbon flux in the Southern Ocean (22.8 g m−2 y−1). The movement of the krill encourage biogenic mixing, which is the process by which nutrients are mixed in the water thus aiding the cycle of critical elements to continue, supporting primary production.

At this stage the impact of fishery removal of krill, as another predator, on carbon sequestration processes and consequent climate change impacts is a recent field of research.

Research on relevant penguin colonies appears to suggest that the current catch limit for the krill fishery, which is set at a regional scale, may not be as precautionary as presumed because fishing effort has concentrated in smaller areas nested within the region, and an impact on penguins in these smaller areas has been observed (Watters et al 2020), although it was also stated that a possible krill fishery effect are expected to occur only in years of combined low krill biomass, adverse environmental conditions and high local fishing pressure (Watters et al. 2020). A long-term decline in penguin populations was linked to ecosystem shifts caused by climate change and whales' recovery (Trivelpiece et al. 2011). Climate change is expected to have a profound effect on krill in the future (Piñones A. & Fedorov 2016), thus by extension those species that predate on krill such as penguins. Whales are important predators on krill and may outcompete penguins for this resource as their numbers recover (Commission 2015; Pallin et al. 2018; Zerbini A.N. et al. 2019). Humpback whales population, for example, appears to be recovering well, indicating little food shortage (Pallin et al. 2018). Likewise, the Antarctic fur seal population has increased significantly in South Georgia after their commercial exploitation (Boyd 1993) and are important krill predators around South Georgia (year-round), South Orkneys (fall and winter) and the WAP region (winter) (Lowther et al. 2020), and could have localized impact on penguins colonies. All the above points out to an ecosystem wide phenomena not linked to fishing. The above observations on various species populations indicate the complexity of the ecosystem interactions, not merely a linear predator prey relationship, but also shifting oceanographic factors caused by a changing climate.

CCAMLR has agreed that any expansion in the krill fishery should not happen unless the scientific data indicate that it will continue to be sustainable. The catch information and ecological surveys feed into the population models of krill, and the TAC is precautionary and reviewed and updated annually. Cautious extrapolation from these local monitoring programs provides conservative estimates of the regional biomass in recent years. This suggests that fishing at the trigger level would be equivalent to a long-term exploitation rate (annual catch divided by biomass) of <7 %, which is below the 9.3 % level considered appropriate to maintain the krill stock and support krill predators (Hill et al. 2016). The CCAMLR stock assessment method takes into account the resilience of the ecosystem over a 20 years period when estimating the precautionary catch limit. Biomass estimates for Area 48 (and each Subarea) during summer 2019 indicate that the stock is healthy overall. Under this condition and considering that strong recruitments occur every 4-6 yrs (Conroy et al. 2020), a cease of the fishery would in a short time allow populations to grow at their natural rate. Therefore, the fishery under assessment is deemed highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm, as under current observations the ecosystem would be able to recover regarding to prey (krill) availability within a 5-10 year period if krill fishing ceased.

At current catch levels the UoA is highly unlikely to disrupt the key elements underlying the ecosystem structure and function to a point where there would be serious or irreversible harm. **SG60 and SG80 are met**.

The research by Watters et al (2020) further suggests that the impact of krill fishing, even at precautionary limits, is similar to that of pressure from climate change as measured by the Oceanic Nino Index. This is supported by research by Krüger et al (2020) who found that increasingly climate change impacts on krill distributions. However, as can be seen from stakeholder feedback (see ARK feedback to PCDR in Appendix 4) these studies by Watters et al and Krüger et al are considered as circumstantial rather than impact at population level - which indicates a lively debate around the impact of krill fishing on the Antarctic ecosystem. The recovery of cetacean populations in the Southern Ocean also has implications on whether the krill catch levels have taken this into account, and therefore whether the management of the krill fishery continues to be precautionary. An urgent update of CM 51-07 which also considers cetacean population recovery and foraging was discussed at the 2019 CCAMLR meeting. Although there are regular and detailed Observer reports for this fishery under assessment, which together with the Observer reports from the other krill fisheries in the area are analysed annually and published in the CCAMLR krill reports (2018), the recently published research listed above does not give the evidence needed to meet SG100. **SG100 is not met**.

References

(Trathan & Hill 2016; Atkinson et al. 2009; CCAMLR 2018b; CCAMLR 2011b; Hewitt et al. 2004; Kinzey et al. 2013; Nicol et al. 2011; Peatman et al. 2011; CCAMLR 2016e; CCAMLR 2010) (CCAMLR 2019j; Watters et al. 2020; Krueger et al. 2020; Hill et al. 2013) (Watters et al. 2020; Manno et al. 2020; Conroy et al. 2020; Lowther et al. 2020; Trivelpiece et al. 2011; Piñones A. & Fedorov 2016; Commission 2015; Pallin et al. 2018; Zerbini A.N. et al. 2019)
Observer reports

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	80
Condition number (if relevant)	-

Scoring table 20. 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 a raft of regulations and conservation measures concerning the management of the krill fishery as part of the ecosystem. The overall remit of krill management within CCAMLR starts from a position of recognising the importance of krill within the ecosystem, and therefore krill harvesting is being managed in a very precautionary manner (CCAMLR website accessed 2019 - https://www.ccamlr.org/en/fisheries/krill-fisheries-and-sustainability). Apart from krill, there are currently no other targeted fisheries in areas 48.1 48.2 (CCAMLR CM 32-02 2017). No finfish are targeted in this area.

The conservation measures and regulations designed to sustainably manage fishing as well as krill fishing include 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. 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 2018 this trigger level was reached on the 25th June in subarea 48.1, resulting in the closure of subarea 48.1

- CM 25-03 establishes a set of measures to all trawl fisheries in order to minimize incidental mortality of seabirds and marine mammals.

- CM 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 components of the strategy to manage ecosystem impacts include:

- CCAMLR Ecosystem Monitoring Program (CEMP), is focused on the monitoring of predators to detect changes in their populations and distinguish between changes attributable to fisheries and environmental variation. The Working Group on Environmental Monitoring and Management (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.

- 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. Out of CCAMLR management, the South Georgia and South Sandwich Islands Government established a Marine Protected Area in 2012. Also, the Association of Responsible Krill Harvesting Companies (ARK), to which the UoA belongs, have agreed to voluntary no-go areas around seabird and marine mammal breeding sites in order to prevent krill depletion within foraging ranges. Indeed, towards the end of 2020 ARK has created a new zone off-limits to fishing in Hope Bay, off the northernmost tip of Antarctica, protecting a vital habitat for several colonies of penguins.

The main impacts of the fishery are addressed under the P1 and P2 components above, and are not repeated here. Measures to reduce and address these impacts are listed and described under those components, as well as the additional Conservation Measures listed here (see above).

In this context a ‘plan’ should provide for the development of a full strategy that restrains impacts on the ecosystem to ensure the UoA does not cause serious or irreversible harm (SA3.17.2.1). The concept of a ‘plan’ to conserve Antarctic marine life is the objective of CCAMLR and the reason why it was established in 1982 in the first place. CCAMLR practices an ecosystem-based approach to management and implements a comprehensive set of measures to support the conservation of Antarctic marine living resources and the management of fisheries in the Southern Ocean. These conservation measures are reviewed and developed at each annual meeting of the Commission, and subsequently implemented by Members during the ensuing intersessional period and fishing season. Conservation measures are published in the annual *Schedule of Conservation Measures in Force*. This obviously applies to the krill fishery under assessment too.

In summary, it can be stated that there is a strategy which consists of a plan in place containing a wide range of measures to address all main impacts of the UoA on the ecosystem, and these measures are in place, as it is one of the conditions for a fishery to operate in the Convention area – to abide by these measures. As mentioned above, the strategy is reviewed, as part of the annual CCAMLR meetings, including an upcoming review and update of CM 51-07. **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/ 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 strategy is designed to keep impact of krill fish on the Antarctic ecosystem to a minimum, and the driver of this is to keep within a certain krill catch level – which is achieved (CCAMLR krill report 2018).

The CCAMLR Conservation Measures as implemented cover the different issues related to the protection of the ecosystem and its elements, including bycatch, ETPs, habitat protections, foodweb considerations of krill, compliance and regular collection and analysis of detailed data to inform fisheries management decisions, including target catch and bycatch species. The establishment of subarea trigger levels in area 48 ensures that the fishery does not cause irreversible harm to the local predator populations. All CCAMLR fisheries have to report catch and effort data of krill on a haul-by-haul basis, which facilitates monitoring of cumulative catch in each subarea. 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. This periodic review gives 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, and ETP species, nor on benthic habitats. Recently published research showed that the estimated biomass of krill is higher than expected (Macaulay et al. 2019). This serves as testing (as a form of feedback mechanism showing that the conservation measures in place are working), 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. **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 objective as set out in scoring issue (a).
	Met?		Yes	No

Rationale

CCAMLR krill fishery reports show that krill catches have remained below the trigger level. Bycatch levels are low, and Observer reports show that the relevant Conservation measures are implemented on board the vessels. Subarea catch limits have been reached recently, whereby Subarea 48.1 was closed on the 25th June 2018, in accordance with Conservation Measure 51-07, when the catch limit was reached. The same applies to previous fishing years. This indicates, for example, that CM51-07 is being implemented rigorously. International 100 % observer coverage show limited impacts of other ecosystem elements such as primary, secondary and ETP species, as well as habitats. Such interactions have to be recorded as per reporting template and Conservation measures. The team considers that there is some evidence that the strategy is being implemented successfully. **SG80 is met**.

CCAMLR has acknowledged the need to adopt feedback management procedures for the krill fishery, by which management measures are continuously adjusted to relevant information -as it becomes available- on the interactions between krill, fisheries, krill predators, and the environment. It is also acknowledged that management at a small scale is needed to account for predator-prey relationships. The current management system based on annual krill catch limits for the krill fishery in the South Atlantic is therefore considered by CCAMLR as an interim solution until mechanisms are in place that allow for these feedback management procedures to be developed and implemented. Furthermore, these annual catch limits are complemented by the establishment of a trigger level of 620,000 tonnes in the South Atlantic aimed at ensuring that fishing effort does not greatly exceed historical catches until an adequate, small-scale management regime is in place. Establishing such a small-scale, feedback management regime for the South Atlantic is a complex task. Many scientific uncertainties remain, and monitoring of land-breeding predators is still insufficient to establish a full feedback management regime across the whole area where the fishery operates (ASOC 2007).

It appears that this Feedback Management Strategy is still a goal to achieve. Further steps towards developing the implementation of an ecosystem-based management strategy for the krill fishery are still under discussion, and neither the ambitious feedback management including SSMUs (Watters et al. 2013; Hewitt et al. 2004; S. Hill et al. 2019) nor the development of the risk-based system based on overlapping indices (Hinke et al. 2017; Warwick-Evans et al. 2019) have been implemented yet.

There is an ongoing debate within CCAMLR as to whether the current approach, and specifically the present level of spatial resolution of the management units, is indeed sufficiently precautionary (MBA 2017). In 2019 CCAMLR agreed to a krill fishery management work plan to improve management of the fishery (CCAMLR-38, 2019). The work plan includes (as listed under paragraph 5/17):

1. A stock assessment to estimate precautionary harvest rates (completed in 2019)

2. Regular updates of biomass estimates, initially at the subarea scale, but potentially at multiple scales

3. A risk assessment framework to inform the spatial allocation of catch across the SMRUs

Each of these listed work plan elements are designed to answer management questions at a defined spatial scale. The risk assessment is deemed critical to de-concentrating fishing by setting krill catch limits at finer spatial scales in relation to fishing operations and predator feeding. The implementation of this workplan is due to correspond with the expiration of CM 51-07 at the end of the 2020-2021 fishing season, and its consequent update.

This work is either planned or ongoing, as can be seen from the submissions at the recent (2019) WG-EMM meeting. **SG100 is not met**.

References

(Macaulay et al. 2019; Warwick-Evans et al. 2019; S. Hill et al. 2019; ASOC 2007)

(CCAMLR 2016e; CCAMLR 2010; CCAMLR 2018d; CCAMLR 2019h; CCAMLR 2019f; CCAMLR 2019d; CCAMLR 2008c; CCAMLR 2013; CCAMLR 2019b; CCAMLR 2018c; CCAMLR 2014; CCAMLR 1986; CCAMLR 1984; CCAMLR 2019c; CCAMLR 2019e; CCAMLR 2016c; CCAMLR 2016d)

https://www.seafoodsource.com/news/environment-sustainability/krill-fishing-halted-in-penguin-rich-habitat-near-antarctica?utm_source=marketo&utm_medium=email&utm_campaign=newsletter&utm_content=newsletter&mkt_tok=eyJpIjoiTXpoaU1tRTFPRFJtTURsaSIsInQiOiJCM2Fqc2V0eStDeEtEdkdcL1dyK1wvZm5hYUdaNlFCU010bkdNZTJ3QmJMSzU4ZVNnRHFvYzNSZ0p5V2toQk05cEpXa2l3RG1Dd1NJTlhCUWdyS2NcLzg3NVU5WEUrZzlpWTBKeVdaNURYN3VYYzlJRWlTK0ZOUFEweHpwXC9ETVlXYlUifQ%3D%3D

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	90
Condition number (if relevant)	-
Recommendation: The assessment team strongly encourages the update and review of CM 51-7 to include the foraging needs of the recovering cetacian population, as well as ensure that the Krill fishery work plan as described above is implemented, including the risk assessment, which is deemed critical to de-concentrating fishing by setting krill catch limits at finer spatial scales in relation to fishing operations and predator feeding. Future surveillance audits will follow up on this important management issue.	

Scoring table 21. 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

There is adequate information to broadly understand the key elements of the ecosystem. CCAMLR's WG-EMM publishes research on the various components of Antarctic ecology. 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, such as 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), assesses data generated through the monitoring of CEMP areas and information gathered in scientific observer reports, and monitors the effect the krill fishery may be having on the ecosystem. Several ecosystem models have been developed covering krill and associated food webs in the Southern Ocean. **SG60 is met.**

A number of 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 further add to the knowledge-base of the region's ecosystem. **SG80 is 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	No

Rationale

Detailed information on the krill fishery collected by on board, international observers (100 % cover) is used in the assessment of the impact of the UoA on krill stock and krill-dependent species. This is an ongoing, annual update and analysis, reviewed at CCAMLR meetings.

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 forms an extensive archive with which to study ecosystem interactions and trends (Everson 2000). ARK, of which the fishery under assessment is a member, played a major role during the 2019 large-scale krill survey, which estimated krill biomass for the whole of Area 48. The overall biomass estimated was 62.6 million tonnes, a result very similar to the CCAMLR 2000 Survey. Furthermore, ARK has committed to conducting annual transects at selected areas, following the advice from CCAMLR's Scientific Committee (SC-CAMLR) to understand changes in krill density (https://www.ark-krill.org/projects) **SG60 and SG80 are met.**

The main interactions between the krill fishery and a number of ecosystem elements (such as seabirds, pinnipeds, and cetaceans) has been and continues to be relatively well studied. There are several other groups of krill predators, such as finfish, cephalopods and carnivorous zooplankton, whose trophic dependence on krill remains poorly studied (Trathan et al. 2015) **SG 100 is not 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 P1, 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, as reviewed by Atkinson et al. (2012). The suite of models include those exploring specific aspects of krill biology (Hofmann & Hùsrevõglu 2003; Murphy et al. 2004), multispecies population models (May 1979; Murphy et al. 1998), single species population projection models to quantify regional catch limits (Constable et al. 2000), spatial single species models (Marin & Delgado 2001), mass-balance regional food web models such as EwE (Cornejo-Donoso & Antezana 2008), a spatial multispecies operating model (SMOM) of krill–predator fishery dynamics (Plaganyi & 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	No

Rationale

The data recorded by the SISO observers provides detailed information on the impact of the krill fishery on the affected different components (fish bycatch, seabirds, marine mammals) to 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 and institutes conducting research in the Antarctic. These provide sufficient information to parameterize the ecosystem models described above. This information is considered adequate to assess the impacts that the UoA has on the components of the ecosystem to allow some of the main consequences for the ecosystem to be inferred. **SG80 is met.**

The number of different species encountered in the bycatch, Secondary species, is diverse and covers a range of finfish species, generally juveniles, as well as cephalopods and molluscs (larval). Although the numbers/ amounts caught are small, little is known about the populations of many of those species. Therefore, it cannot be said that information available on the impacts of the UoA on elements is adequate. **SG100 is not 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 ARKs effort. ARK played a key role during the 2019 large-scale krill survey, which estimated krill biomass for the whole of Area 48. The overall biomass estimated was 62.6 million tonnes, a result very similar to the CCAMLR 2000 Survey. Furthermore, ARK has committed to conducting annual transects at selected areas, following the advice from CCAMLR's Scientific Committee (SC-CAMLR) to understand changes in krill density (https://www.ark-krill.org/projects). The data collected is adequate to detect increases in risk levels to both target stock and the associated ecosystem.

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. The potential of this technology has also been highlighted by WG-EMM and SG-ASAM during recent years. The fleets capacity and competence in demonstrating satisfactory performance quality has been acknowledged by the SG-ASAM 2019 (SC-CCAMLR 2019). Such research demonstrates that CCAMLR continues to strive to improve on the data base informing krill management decisions**. SG80 is met**

There is concern regarding the vulnerability of the Southern Ocean to the changing global climate. Resulting changes in water temperature, ocean acidity, currents and ice cover will affect resident seabird and marine mammal populations through changes in prey availability patterns. Furthermore, a recent study by Meyer et al (2020) show that, because of the restricted distribution of successfully spawning krill and high inter-annual variability in their biomass, the risk of direct fishery impacts on the krill stock itself might be higher than previously thought. The study provides a list of projects to improve knowledge, some of which the general krill fishery can contribute to directly. One recommendation proposes research and measures to help future proof krill fishery management for climate change. Research continues to build robust data time series on the krill and krill dependant predators' response to the changing climate, as well as 'normal' ecosystem fluctuations. The changing climate has added layers of complexity to managing ecosystem impacts, therefore it cannot be said that I currently information is adequate to support the development of strategies to manage ecosystem impacts. **SG100 is not met.**

References

Observer reports;

(Atkinson et al. 2012; Plaganyi & Butterworth 2012; Cornejo-Donoso & Antezana 2008; Hofmann & Hùsrevõglu 2003; May 1979; Murphy et al. 1998; Murphy et al. 2004; Rintoul et al. 2001) (Meyer et al. 2020)

CCAMLR website: http://www.ccamlr.org/en/ ; https://www.ark-krill.org/projects

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	85
Condition number (if relevant)	-

6.5 Principle 3

The two vessels in the UoA fish exclusively in international waters inside CCAMLR subareas 48.1 and 48.2 (see section 6.2). There are no coastal states involved. Three jurisdictional levels are key in the management of the fishery: i) CCAMLR is the RFMO in charge of resource management, ii) the Republic of Korea as Flag State is responsible for the vessels' compliance with all international and national obligations, and iii) any port states where the vessel may tranship or land its catch bound by the Port State Measures Agreement (PSMA) implementation.

6.5.1 Legal and customary framework

The fishery resource is managed through the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the regional fisheries management organisation (RFMO) set up under the Antarctic Treaty[4]. The CCAMLR Convention is legally binding for its 26 member countries. It came into force on 7 April 1982, with a further 10 countries having acceded since[5]. Countries parties to the Antarctic Treaty and to the CCAMLR include all those with vessels presently fishing for krill: Chile, China, the Republic of Korea (or Korea), Norway and Ukraine[6].

6.5.1.1 CCAMLR (RFMO)

The Commission is the decision-making body. Based on the best available scientific information, it agrees conservation measures (CM) that determine the use of marine living resources to ensure the conservation of the Antarctic marine ecosystems. The Commission doesn't prevent fishing, provided it is carried out in a sustainable way. CCAMLR's management objectives are set out in Article II of the Convention and bring together the precautionary and ecosystem approaches[7]. The central objective of the Convention is conservation whilst allowing rational use, and it requires that the effects of fishing on the ecosystem are taken into account and minimised.

The CCAMLR subsidiary bodies are as follows:

- Scientific Committee (SC): meets annually prior to the Commission meeting. In order to address the wide range of science areas that might impact on the decisions of the Commission, the Scientific Committee has established a number of working groups that meet during the year and assist in formulating scientific advice on key areas. Presently, the SC has four working groups and one specialist subgroup meet once during the year or at the SC's request, to assist formulating scientific advice based on the best available scientific information:
    - Working Group on Ecosystem Monitoring and Management (WG-EMM)
    - Working Group on Fish Stock Assessment (WG-FSA)
    - Working Group on Statistics, Assessments and Modelling (WG-SAM)
    - Working Group on Incidental Mortality Associated with Fishing (WG-IMAF)
    - Subgroup on Acoustics, Survey and Analysis Methods (SG-ASAM)
- Standing Committee on Implementation and Compliance (SCIC)
- Standing Committee on Administration and Finance (SCAF)

[4] https://www.ccamlr.org/en/organisation/about-ccamlr
[5] https://www.ccamlr.org/en/organisation/status-list-contracting-parties
[6] https://www.ccamlr.org/en/compliance/authorised-vessels-0
[7] Convention : https://www.ccamlr.org/en/system/files/e-pt1_3.pdf

- a Secretariat based in Hobart, Tasmania, that supports the work of the Commission.

Annually, CCAMLR publishes a Commission Report, a Scientific Committee Report, a Statistical Bulletin and Fishery Reports[8]. It also published an international peer-reviewed scientific journal – CCAMLR Science – between 1994 and 2016.

CCAMLR adopts and updates Conservation measures (CM) during its annual Commission meetings. Members are notified of new or amended conservation measures in early November, following the Commission's annual meeting, and these are usually implemented on 1 December to align with the start of the fishing season. Conservation measures become binding, according to Article IX.6 of the Convention, around early May of the following year (180 days after the first notification). A compendium of CMs in force by CCAMLR fishing season is available from its website[9].

Several categories of CCAMLR CMs apply to the fishery. Generic CMs relate to vessel licensing conditions and reporting obligations, as well as general provisions for fisheries management and ecosystem protection. There are also three CM specific to the krill fishery in Area 48 (Table), in particular one to set an overall combined catch limit for Area 48 and proportions for each subarea (CM 51-01), and another that sets out trigger levels (CM 51-07).

CMs may be updated annually. CCAMLR relies on a fully developed fisheries Monitoring, Control and Surveillance (MCS see section 6.5.7) system to support the implementation of its Conservation Measures and to reduce risks that harvesting activities may pose to the sustainability of target species, of species taken incidentally as bycatch and of the marine ecosystem. Specifically, for the krill fisheries, vessels report when the catch in subareas 48.2, 48.3, 48.4 approaches 80 % of the trigger levels set in CMs 51-01 and 51-07, the Secretariat informs Fishery Update Contacts, and vessels active in each fishery must report catch and effort every 5 days for the rest of the season (instead of every month). For the 2018/19 fishing season the Secretariat requested that the 5-day catch-and-effort reporting system be implemented by Members voluntarily from the start of the season in Subarea 48.1. This has been carried over for the 2019/20 season.

As per the Antarctic Treaty, there are no coastal states in the CCAMLR Area, although some unresolved territorial sovereignty claims on the Antarctic continent remain, from seven states (Australia, Argentina, Chile, France, New Zealand, Norway and the United Kingdom), and two "semi-claimants" (Russia and the United States) who reserve a basis of claim without presently asserting claims. Notwithstanding the apparent non-recognition of their claims by the other 186 UN Member States, all seven claimants see themselves as coastal states and there may be challenges ahead (Ferrada 2018; Smith et al. 2015).

Presently, all CCAMLR waters are therefore "High Seas" and there are no automatic fishing rights. However, the opportunity to participate in the krill fishery is only open to CCAMLR member vessels that are duly licensed (CM 10-02), not listed in the IUU Fishing vessel lists (CM 10-06 and CM 10-07), and after prior notification (CM 21-03, Table). Fishing is not permitted unless members reach an agreement to fish. Importantly, access is not automatic. CCAMLR fishing members must notify their intent to fish every year at the annual CCAMLR meeting, and the Commission must then approve their notification via consensus. In addition, all directed fishing is governed by conservation measures adopted by the Commission, so there are no unregulated fisheries. Licenses to fish in the CCAMLR

[8] See https://www.ccamlr.org/en/meetings-and-publications/publications

[9] https://www.ccamlr.org/en/publications/past-conservation-measures

Area are delivered by the Contracting Party (CP), who must be "satisfied of the vessel's ability to exercise its responsibilities under the Convention and its conservation measures" (CM 10-02).

Table 18: CCAMLR Conservation Measures specific to the krill (*E. superba*) fishery in Area 48 for 2019/20

Title	Conservation Measures	Areas
Vessel and fishing gear markings Licensing and inspection obligations Port inspections of vessels carrying Antarctic marine living resources Automated satellite-linked VMS IUU vessels lists Notification of transhipments within the Convention area CCAMLR Compliance evaluation procedure	10-01 10-02 10-03 10-04 10-06 and 10-07 10-09 10-10	All
Notification of intent to participate in a krill fishery (by 1st June), to be considered annually by the Commission, with details of proposed subareas, expected catch, fishing technique, gear configuration etc.	21-03	All
Five-day catch and effort reporting system Five-day (from 2019/20) data reporting system for krill fisheries with provision for small-scale management units (SSMU)	23-01 23-06	All
Catches taken for research purposes are part of catch limits	24-01	All
Bird and marine mammals' incidental mortality in the course of trawl fishing minimisation measures	25-03 (and 51-01)	All
Environmental protection during fishing operations	26-01	All
General measure for the closure of all fisheries	31-02	All
The fishing season for all Convention Area species is 1 December to 30 November	32-01	All
Limitation of the by-catch of *Gobionotothen gibberifrons, Chaenocephalus aceratus, Pseudochaenichthys georgianus, Notothenia rossii and Lepidonotothen squamifrons*	33-01	Subarea 48.3 only
Precautionary catch limitations on *Euphausia superba* in Statistical Subareas 48.1, 48.2, 48.3 and 48.4	51-01	Subarea 48.1, Subarea 48.2, Subarea 48.3, Subarea 48.4
Scientific Observation in krill fisheries	51-06	All
Interim distribution of the trigger level in the fishery for *Euphausia superba* in Statistical Subareas 48.1, 48.2, 48.3 and 48.4 (to end 2020/21)	51-07	Subarea 48.1, Subarea 48.2, Subarea 48.3, Subarea 48.4
CCAMLR Ecosystem Monitoring Program (CEMP) Protection of the values of Antarctic Specially Managed and Protected Areas (Antarctic Specially Protected Area (ASPA) or an Antarctic Specially Managed Area (ASMA))	91-01 91-02	General

The text of the Convention includes a special article (applicable to all fisheries) to deal with disputes (art. XXV), which privileges mechanisms such as negotiation, mediation and conciliation to reach agreement between the parties in case of legal conflicts. Annual meetings of the Commission, preceded by the SC and SCIC meetings, which in turn take place after the working groups meeting, provide a mechanism that prevents conflicts and legal disputes, since all parties have had chances to reach technical and political agreements ahead of time.

A number of important new issues have emerged in recent years for the consideration by the Scientific Committee, including MPA designation in the Convention Area and feedback management for the krill fishery. In order to cope with the increasing workload, an informal executive group comprised of Scientific Committee Chairs and working group conveners facilitated by the Science Manager at the Secretariat was established to work during the Scientific Committee annual meeting, as well as inter-sessionally, to coordinate and streamline the work of working groups and the Scientific Committee.

6.5.1.2 Republic of Korea (Flag State)

The Republic of Korea has an extensive Distant Water fleet of fishing vessels, in numerous fisheries around the world[10]. The vessels that engage in fishing are managed by the Ministry of Oceans and Fisheries (MOF) as per the Distant Water Fisheries Development Act (DWFDA). Article 1 of the DWDFA states that the purpose of the Act is to "*advance the sustainable development of the distant water fisheries industry and contribute to the growth of the national economy through the rational preservation, management, exploitation and utilization of maritime living resources and the promotion of international cooperation*." (Korea 2015). DWFDA Article 13 (Rules for Distant Water Fishery Operators to Observe) sets out that distant-water fishing vessels "*shall conscientiously conduct fishing operations within the permitted scope of operations and shall comply with resolutions made by international fisheries organizations for the conservation and management of resources and international standards regarding fisheries in high seas*" (Korea 2015).

Specifically, Article 13 sets out that no distant water fisheries business shall engage in any of the following activities: "

1. Conducting fishing operations without any valid licence, authorization or permit, or registration issued by the state of flag or the relevant coastal state;
2. Failing to maintain such the amount of catch and detailed records thereof (including the data transmitted from fishing vessels monitoring system) as demanded by an international fisheries organization, or of falsely reporting such allowable amount of catch;
3. Conducting fisheries operations in any marine preserve established by an international fisheries organization or any coastal state, conducting fisheries operations during a prohibitive period of fisheries, or conducting fisheries operations without being allocated a catch quota or in excess of the catch quota;
4. Directly conducting fisheries operations for any resources, the fisheries operations of which are tentatively or permanently prohibited;
5. Fishing with prohibited or unauthorized fishing gear;
6. Forging or concealing a fishing vessel's unique marking/identifier and registered matters;
7. Concealing, damaging, or removing any evidence related to inspections onboard a vessel;
8. Fisheries in violation of conservation and management measures of an RFMO in the areas under the purview of such RFMO;

[10] See http://www.kosfa.org/english/e_fish/e_fish1.asp

9. Transhipping fish or a joint fishing operation, with a vessel listed by any international fisheries organization engaged in illegal, unreported, or unregulated fishing or assisting such vessel;
10. Interrupting the duty performance of an observer, such as the movement, embarking, disembarking and inspection;
11. Interrupting the embarking, disembarking, ship inspection, and communications of an inspector of the Port State or on board or violate any measure following an inspection by the Port State;
12. Failing to install a fishing vessel monitoring system or intentionally not operating the installed fishing vessel monitoring system."

6.5.2 Port States

There are no (designated) fisheries landing ports in the CCAMLR Convention area, but provisions are made to allow transhipments in the Area, provided a notification is received and permission is granted (CM 10-09). In addition, CCAMLR monitors the vessels' entry-exit declarations, and it is the duty of the Flag State to ensure that all catch is declared as it is caught, as it is transhipped and eventually as it is landed. In addition, the observer on board each Korean vessel witnesses all transhipment and report the details to Korean authorities who report them to CCAMLR.

Krill products caught in the CCAMLR Convention Area (CA) by the UoA vessels are all transhipped (see section 5) at sea. Depending on the final product destination (Korea, China, Canada, USA, Thailand), the krill sale process may differ slightly. Products are either exported directly after transhipment in the case of Japan or landed in Busan (Korea) for the domestic market or for export to all other countries. Only two Port states need to be considered, the Republic of Korea and Japan.

6.5.2.1 Republic of Korea (Flag State)

The Republic of Korea acceded to the UN FAO Port State Measures Agreement (PSMA) in 2016 and all key provisions are included in its legislation. Any IUU fishing conducted in waters outside Korea's jurisdiction (EEZs and high seas) by Korean distant water fisheries operators who are authorized by the Korean government would be subject to prosecution and subsequent sanctions in accordance with the Distant Water Fisheries Development Act (DWFDA), which also applies to those who support IUU activities by transporting, processing, distributing and selling the illegal catches. Landing of catches from illegal vessels is not allowed and catches would be confiscated. In recent years, Korea has developed close collaborations with other Port States and international organisations combatting fisheries-related crime such as Interpol.

In October 2018, the Republic of Korea signed a partnership agreement with the European Union in line with the objectives of the EU's Ocean Governance strategy[11], in order to:

- exchange information about suspected IUU-activities;
- enhance global traceability of fishery products threatened by IUU fishing, through a risk-based, electronic catch documentation and certification system;
- join forces in supporting developing states in the fight against IUU fishing and the promotion of sustainable fishing through education and training;

[11] https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/join-2016-49_en.pdf

- strengthen cooperation in international fora, including regional fisheries management organisations.

In order to ensure that its Distant Water fleet is compliant wherever it fishes and lands, catch certificates are checked at all ports of landing[12].

6.5.2.2 Japan

Japan acceded the UN PSMA in 2017, thereby binding its competent authorities to controlling all seafood products catch and provenance documentation upon landing, for its own registered vessels and for all imports. The Ministry of Fisheries and Agriculture Fisheries Division publishes an annual account[13] of the country's provisions to fight IUU fishing activities.

6.5.3 Consultation, roles and responsibilities

6.5.3.1 CCAMLR

CCAMLR Contracting Parties (CP) are States or regional economic integration organisations, such as the European Union, which have committed to the Convention through ratification, acceptance, approval or accession. Members include those CPs that participated in the first meeting at which the Convention was adopted in 1980, as well as States that have subsequently acceded to the Convention and been accepted as Members by the Commission. The Convention is open for accession by any State interested in research or harvesting activities to which the Convention applies. Acceding States do not take part in the decision-making process of the Commission nor contribute to the budget. Consultation processes in place at CCAMLR are well-defined, open and seen to take place at annual meetings, with a diverse and active participation from industry and environmental NGOs encouraged by CCAMLR and by the national delegations including by Korea. The information, analyses and comments from stakeholders with Observer status are presented in the Commission's annual reports (see CCAMLR, 2019).

Research and information contributed by the numerous international environmental and industry NGOs who have CCAMLR Observer Status and submit reports to the Commission[14] to inform WG and Commission deliberations. A list of observers who have contributed topics relating to the Krill fisheries at CCAMLR annual Commission meetings in 2018 and 2019 are listed in Table .

Table 20. International and Korean organisations represented at 2018 CCAMLR Commission meeting.

Organisation represented at 2018 CCAMLR Commission meeting or on Korea's Delegation
MOF – Ministry of Oceans and Fisheries – Distant Water Fisheries Division (Korea)
FMC – Fisheries Monitoring Centre (Korea)
NFS – National Fisheries Product Quality Services (Korea)
Research (Korea): NIFS – National Institute of Fisheries Science, KOPRI - Korea Polar Research Institute, Research Institute of Oceanography, Seoul National University, Korea Fisheries Observer Association
Environment NGOs: Citizens' Institute for Environmental Studies, WWF Korea, ACAP, ASOC, Oceanites

[12] See FMC presentation https://www.wcpfc.int/system/files/Presentation_Korea%20ERandEMWG2%20Agenda%202.2.pdf
[13] See June 2020 https://www.mofa.go.jp/files/100070980.pdf
[14] See https://www.ccamlr.org/en/ccamlr-xxxvii

Organisation represented at 2018 CCAMLR Commission meeting or on Korea's Delegation
Industry: KOFA - Korea Overseas Fisheries Association, ARK - Association of Responsible Krill harvesting companies, Krill Fishing Companies - Jeong Il Corporation, Dongwon Industries

6.5.3.2 Republic of Korea (Flag State)

At Korean level, the relationship between government, vessel owners and crew has been strengthened by the DWFDA amendments of 2015, which provide information and training to the industry actors while relying on their collaboration to improve compliance with RFMO CMs and contribute information and research. Stakeholder engagement is detailed in the Republic of Korea DWFDA, including training and scientific collaboration with industry and public interest groups. The active industry participation through the ARK (see section 6.5.3.4 below) is praised and facilitated by CCAMLR. The roles and means of all partners in the fisheries national management system for DWF have been clarified and improved, including the fisheries research and monitoring capacity of the national fisheries (NIF) and polar research (KOPRI) institutes.

Korea established a Deliberative Committee for Development of the Distant Water Fisheries Industry (the "Deliberative Committee") under the jurisdiction of the Ministry of Oceans and Fisheries to deliberate on matters concerning the development of the distant water fisheries industry (Amended DWFDA Act No. 11690, Mar. 23, 2013 and art.4 DWFD Act 2015) including:

- The formulation of comprehensive plans to develop the distant water fisheries industry;
- The balanced development of the distant water fisheries industry;
- Decisions on permitted quotas for distant water fisheries;
- Matters necessary for the structural improvement of distant water fisheries, strengthening the competitiveness of distant water fisheries, and establishing foundations for the development of the distant water fisheries industry;
- Matters concerning administrative and financial assistance for the development of the distant water fisheries industry.

The Deliberative Committee includes 20 members nominated by the government, including scientists and members of the civil society.

6.5.3.3 Korean Fishing Industry representation

The Korea Overseas Fisheries Association (KOFA[15]) created in 2008 (DWFDA art. 28) represents the fishing companies involved in all DW fisheries and some 200 Korean flagged DWF vessels. It cooperates with MOF and is authorised to act as a go-between to inform the industry of RFMO CM updates. KOFA operates the Overseas Fisheries Information System and regularly cross-checks MOF e-reporting data submissions with submissions directly from vessel owners/ operators. KOFA also compiles production statistics.

[15] http://www.kosfa.org/english/e_info/e_info1.asp

6.5.3.4 ARK

ARK, the Association of Responsible Krill harvesting companies, was founded in 2010, to "facilitate an industry contribution to an ecologically sustainable krill harvest [16]". ARK has Observer status at CCAMLR and the Jeong Il company owner of the vessels in the UoA is one of its seven fishing company members (Norway 2, Korea 2, P.R. China 2 and Chile 1). The ARK openly commits to develop sustainably to ensure long term viability of the krill stocks and dependent predator. It provides representation and research sponsorship. In particular, ARK members have agreed to:

i) Undertake annual transects in Subareas 48.1 and 48.2 to collect raw acoustic data which may be used to provide qualitative and quantifiable information on the distribution and relative abundance of Antarctic krill.
ii) Participate in a multinational large-scale krill synoptic survey in Area 48 in 2019 being proposed by Norway. This survey is intended to update the CCAMLR-2000 survey data which is used to estimate sustainable yield.

ARK has also committed, at a roundtable meeting in Cambridge (UK) on 5 July 2018, to voluntary restricted zones covering about 74 000 km^2 around the Antarctic Peninsula (subarea 48.1). The initiative aims to limit krill harvesting around penguin colonies from 1 January 2019 to ensure that the krill fishing industry does not compete with penguin colonies during their breeding season. 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 [17]. 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.

6.5.4 Long-term objectives

6.5.4.1 CCAMLR

All CCAMLR fisheries are managed using a precautionary and ecosystem approach, as defined by the FAO in its Code of Conduct for Responsible Fisheries. Long-term objectives are defined and required in Article 2 of the Convention as a) prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment; b) maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources; and c) prevention of changes or minimization of the risk of changes in the marine ecosystem.

CCAMLR's management of the krill fishery follows the principles set out in Article II of the Convention on the Conservation of Antarctic Marine Living Resources (www.ccamlr.org/node/74528). Long-term objectives for fished stocks (including krill) and the wider ecosystem, including predators that feed on fished stock are as follows: "Fished stocks must be maintained at or above the level 'which ensures the greatest net annual increment', meaning that fishing should not reduce the ability of each stock to replace itself. The 'ecological relationships between harvested, dependent and related populations' must be maintained and 'the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades must be minimised".

[16] http://www.ark-krill.org
[17] See Map of Voluntary Restriction Zones http://files.zetta.no/www-ark-krill-org/_upl/ark_vrz_map_rev.jpg

(Hill et al. 2016) concluded that CCAMLR's management of the krill fisheries is precautionary at the regional scale, with subarea catch limits set to help prevent excessive concentration of catch at the subarea scale. The study recommended that finer-scale management might be necessary to manage the risk of adverse impacts which might occur as a result of concentrated fishing in sensitive areas or climate change, and that frequent assessment of the krill stock would enhance CCAMLR's ability to manage these risks. This appears to be addressed in recent years, through voluntary and permanent area closures, and the ARK's sponsorship of a research survey to inform a new stock assessment modelling exercise.

6.5.4.2 Republic of Korea (Flag State)

The Republic of Korea is committed to the implementation of international agreements and to the sustainable use of fishery resources (Korea 2015), its long-term management policy objectives coincide with those of the CCAMLR.

Beyond CCAMLR regulations, the Korean government establishes a Distant Water Fisheries Development Plan every five years (as per Article 4 of the Distant Water Fisheries Development Act).

The 3rd "comprehensive plan for development of distant water fisheries industry" was established in December 2018. This plan includes the following agenda;

1. Changes in the environment of marine resources in international waters;
2. Objectives and strategies of national of distant water fisheries industry and implementation plans by phase;
3. Matters concerning a planned survey of marine resources in international waters;
4. Matters concerning strengthening the competitiveness of distant water fisheries industry, and the advancement of and assistance to distant water fisheries industry;
5. Matters concerning the fostering of professional personnel related to distant water fisheries industry and the development of relevant technologies;
6. Matters concerning international cooperation with coastal states, international fisheries organizations, etc.;
7. Other matters necessary for the efficient promotion of distant water fisheries industry.

The main policy agenda of the newly adopted Plan is categorized into five areas, which are 1) enhancing fishing vessels' safety, 2) pioneering fishing grounds, 3) improving crewmen's welfare, 4) reorganizing the industrial structure, and 5) promoting international cooperation. To explain its core contents, Korean government introduces funds for replacing aging deep-sea fishing boats, which is worth up to 170 billion won. Secondly, privately led fisheries agreements will be turned public. Thirdly, the government will invest in improving working conditions on deep sea fishing vessels. Fourthly, government will support industrial diversification in order to improve its global competitiveness. Lastly, Korean government will play an active role in the international community as a global rule-maker. Under this plan, government mainly plans to revamp safety guidelines and the welfare system for deep-sea crew members, and transform Korea's fishing industry to remain globally competitive (government news Agency, see the following article:

http://www.korea.kr/news/policyBriefingView.do?newsId=156312163&pageIndex=1&srchType=&startDate=2008-02-29&endDate=2019-01-07&srchWord).

6.5.5 Fishery specific objectives

CCAMLR, the fishery manager, sets short-term sustainability objectives for the krill resources and the ecosystem. The status of krill fisheries is reviewed annually by CCAMLR's Working Group on Ecosystem Monitoring and Management (WG-EMM) and by the Scientific Committee, which meet annually and bring together government and university researchers from numerous countries (CP and NCP) involved in CCAMLR fisheries and ecosystem research (CCAMLR 2019i). Since 2010 CCAMLR has set a Precautionary catch limitation on *Euphausia superba* in Statistical Subareas 48.1, 48.2, 48.3 and 48.4 at the overall trigger level of 620 000 tonnes agreed by the Scientific Committee (CM 51-01), with an interim distribution of the trigger level in the fishery for *Euphausia superba* in Statistical Subareas 48.1, 48.2, 48.3 and 48.4 of 25 %, 45 %, 45 % and 15 % respectively agreed from 2016 (CM 51-07).

The ecological importance of krill as a key Low trophic level (LTL) species in the Antarctic marine ecosystem is recognised, and the need to manage krill stocks in such a way as to minimise potential ecological risks to both krill (Principle 1), its predators and ecosystem (Principle 2) is reiterated in each Ecosystem and Monitoring (EMM) annual WG report.

6.5.6 Decision-making processes

6.5.6.1 CCAMLR

CCAMLR has well established decision-making processes based on the precautionary approach and the best available information, on dialogue, stakeholder involvement, detailed reporting and consensus. CCAMLR pioneered the ecosystem approach to resource management and is seen as an example of best practice in managing marine resources in international waters. CCAMLR's consensus-based decision-making process has been a central element in shaping outcomes while facing challenges that arise in the balance between 'fishing' and 'conservation' interests, for example in the current debates over climate change and marine protected areas in the Southern Ocean. CCAMLR has been given as an example of best practice in managing marine resources in international waters (Nilsson et al. 2016).

Fisheries-specific issues identified in relevant research are taken into account by the Working Groups and the Scientific Committee. Some issued identified in research, such as the need to operate subarea "trigger" levels are not yet resolved, but the ARK supported area closures and recent scientific data collection attest of close collaboration between key stakeholders.

6.5.6.2 Republic of Korea (Flag State)

Within the Ministry of Oceans and Fisheries (MOF), there are 2 main offices for fisheries with particular relevance to this assessment: Marine Policy and Fisheries Policy. Within the Marine Policy office operate the Marine Industry, Marine Environment, the Overseas Fisheries and International Bureaus. The most important "sub-office" to this assessment is the Overseas Fisheries office, which includes a Distant-Water Fisheries (Resources) Division. This is the Division that is in charge of compliance with the CCAMLR CMs. For example, while there are no licence caps for Korean vessels, government legislation under the DWFDA (2019) calls for adhering to and not exceeding any capacity limits which might be set by any RFMO. Any new licence request is through the MOF to the existing stakeholders for discussions on whether the new entrant might have a negative impact to the industry and the MOF-allocated equitable quota to existing individual vessels (the quotas are in line with RFMO quota).

The Republic of Korea includes public interest representatives on its delegation to CCAMLR meetings. It has strengthened the capacity of government agencies (including legal obligations and the court process) and understanding of fishing companies and vessel crew through training to provide in-depth information of compliance requirements and developed collaborative research to improve management outcomes.

The Republic of Korea has demonstrated an effective and committed collaboration with CCAMLR since the review of its DWFDA in 2015 and subsequent strengthening of its MCS system (see next section).

All illegal, unreported, unregulated (IUU) fishing activities in accordance with Paragraph 3 of IPOA-IUU shall be regulated based on Distant Water Fisheries Development Act. Vessel information such as location are reported through vessel's VMS (Vessel Monitoring System), based on which monitoring of any IUU fishing activities can be conducted. The National Fishery Products Quality Management Service is in charge of issuing catch certificate, share VMS records with FMC to verify potential involvement in IUU fishing when issuing catch certificate. In addition, designation and special management of high risk vessels such as previously penalized for being involved in IUU fishing vessels charged with potential IUU fishing, etc., and constant monitoring of vessels operating in waters with high risk of IUU fishing (Korea 2016a).

6.5.7 Compliance and enforcement

6.5.7.1 CCAMLR

CCAMLR's Convention (Art. XXI) put the responsibility on each Contracting Party to take appropriate measures within its competence to ensure compliance with its provisions and with conservation measures to which the Party is bound in accordance with Article IX. It also binds each CP to transmit to the Commission information on measures taken to ensure compliance, including the imposition of sanctions for any violation.

CCAMLR has a comprehensive MCS system in place, which is implemented by its members, including by onboard observers and captains of vessels active in all CCAMLR fisheries who report any concern. CCAMLR conservation measures include several monitoring and compliance systems and tools as follows:

- Vessel and fishing gear markings (Conservation Measure 10-01)
- Vessel licensing (Conservation Measure 10-02) [18]
- Monitoring of vessel movements (Conservation Measure 10-04)
- Vessel Monitoring System (Conservation Measure 10-04)
- Catch Documentation Scheme (Conservation Measure 10-05)
- Contracting Party IUU Vessel List (Conservation Measure 10-06)
- Non-Contracting Party IUU Vessel List (Conservation Measure 10-07)
- Obligations in respect of the control of nationals from CCAMLR Member countries (Conservation Measure 10-08)
- Monitoring of vessel transhipments (Conservation Measure 10-09)
- System of Inspection.

[18] https://www.ccamlr.org/en/compliance/authorised-vessels-0

The CCAMLR System of Inspection[19] relies on each member country designating and training Fisheries Inspectors to carry out inspections, at sea or on land. Inspection reports are copied to CCAMLR Executive Secretary to be forwarded to the other members. The System of Inspection also requires that the Flag State inform the Secretariat of the laying of charges or the initiation of proceedings relating to a prosecution, and at least once a year, report to the Commission, in writing, about the results of prosecutions and sanctions imposed (art. XII), and that sanctions applied in respect to infringements of CCAMLR provisions shall be sufficiently severe as to effectively ensure compliance with CCAMLR conservation measures and to discourage infringements and shall seek to deprive offenders of any economic benefit accruing from their illegal activities (art. XIII). Finally, the Flag State must ensure that "any of its vessels which have been found to have contravened a CCAMLR conservation measure do not carry out fishing operations within the Convention Area until they have complied with the sanctions imposed" (art.XIV).

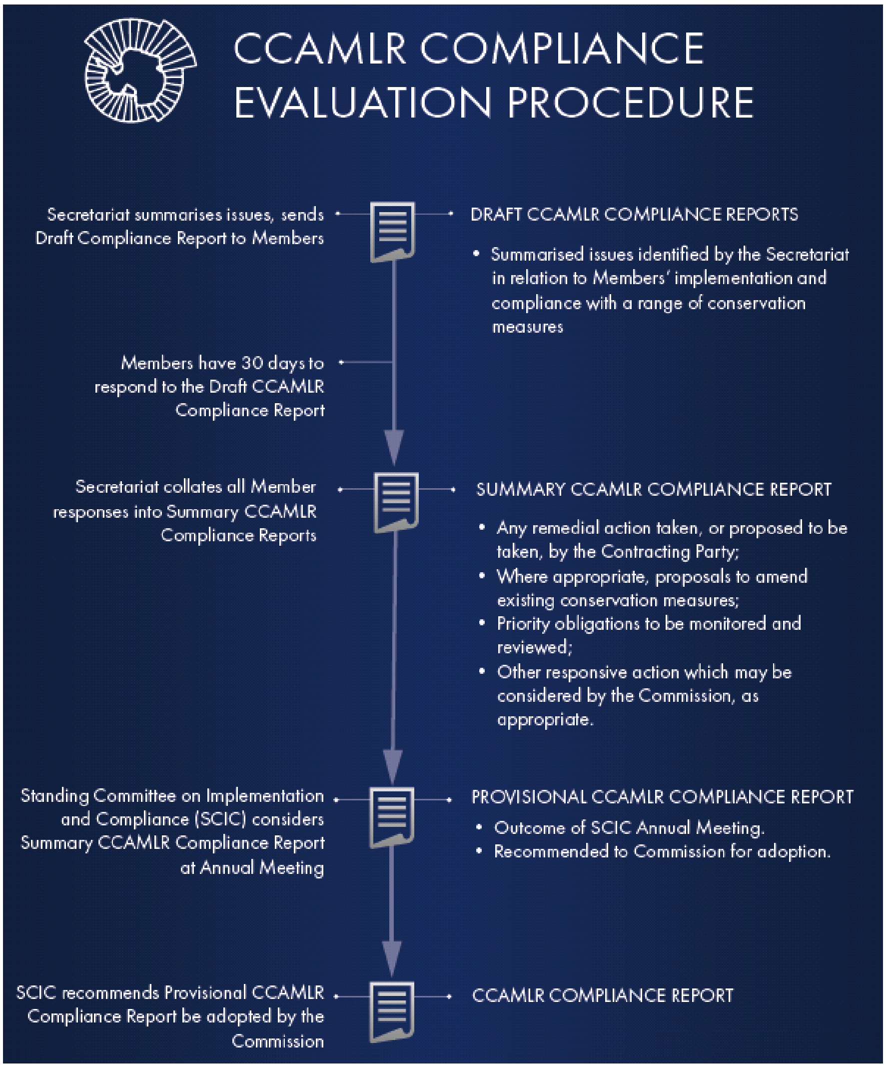

Figure 29. CCAMLR Compliance Evaluation procedure

[19] CCAMLR Basic Documents Part 9. https://www.ccamlr.org/en/system/files/e-pt9_2.pdf

The Standing Committee on Implementation and Compliance (SCIC) meets annually to review the operation of conservation measures and compliance systems and advise the Commission on their refinement and implementation.

CCAMLR implements measures to support the conservation and management of Antarctic living marine resources by reducing the risk harvesting activities may have on the sustainability of target species, on species taken incidentally as by-catch and on the marine ecosystem. CCAMLR seeks to achieve optimal levels of compliance with conservation measures and has been pioneering in its endeavours to achieve this.

CCAMLR has recently adopted a conservation measure to support the implementation of a Compliance Evaluation Procedure (CCEP CM 10-10) for all Members. The CCEP[20] is an annual process with a number of key steps to evaluate Contracting Party implementation of, and compliance with, conservation measures in a responsible, open, transparent, and non-discriminatory manner (see Figure 29. CCAMLR Compliance Evaluation procedure Figure 29). It uses information provided to the Secretariat, as required under the CAMLR Convention, conservation measures and other rules and procedures such as the CCAMLR Scheme of International Scientific Observation (SISO) and the System of Inspection.

CCAMLR's Standing Committee on Implementation and Compliance (SCIC) is the entity responsible for providing information, advice and recommendations on fishery monitoring and compliance. The system is comprehensive and relies on the support of Contracting and non-contracting parties MCS competent authorities as well as vessel captains and opinions and information provided by NGOs.

The current MCS system has been commended by the 2017 2nd Performance review as "an impressive array of monitoring, control and surveillance (MCS) measures and cooperative mechanisms to monitor compliance and detect non-compliance and IUU fishing activities", and "discussions in the Standing Committee on Implementation and Compliance (SCIC) are robust with respect to cases of non-compliance and sharing of information regarding IUU vessel activities and sightings, enforcement patrols, international cooperation, satellite imagery projects, progress in prosecutions and imposition of domestic legal remedies", with notable progress since the 1st Performance Review (CCAMLR 2017e).

Some aspects are flagged for improvement, such as CCAMLR's capacity to monitor transhipment (SCIC 2019 report ASOC point #144, (CCAMLR 2019l)).

6.5.7.2 Republic of Korea (Flag State)

The Korean Fisheries Monitoring Center (FMC) was established in 2014 under the Ministry of Oceans and Fisheries. It is responsible for: (1) conducting real-time monitoring and releasing of IUU alerts; (2) preventing illegal fish from entering the marked by controlling transhipments and landings; (3) cooperating with the international community to strengthen Monitoring, Control and Surveillance (MCS) capabilities for the eradication of IUU fishing; (4) ensuring proper functioning of VMS onboard and maintaining vessel track data for all Korean fishing vessels worldwide; (5) operating the Fisheries Monitoring System (FMS), E-reporting System (daily basis for catch/bycatch/ETP interaction) and the Korean Fisheries Information Management System on a constant basis. Vessel positional data from VMS units are polled hourly and supervised by 11 staff with six inspectors working 365 days per year; (6) verifying catch data; (7) sharing data for stock assessments.

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[20] https://www.ccamlr.org/en/compliance/compliance-evaluation-procedure

The FMC is in charge of monitoring the activity of approximately 260 Korean distant-water fishing vessels. Their comprehensive database includes fishing authorisation, catch data, licences, IUU lists, transhipment/landing authorisation and data, and quota exhaustions. All these elements are incorporated into the FMS so that monitoring agents can conduct data analyses and risk assessments. Once the data have been submitted, (three-day margin for paper submissions) a three day period opens to validate the data input or submit changes (through an official request to NIFS to change the data) if there is more than a 10 % discrepancy per species (EU and Korean tolerance limit) by an inspector sampling at offloading, or if there is no sampling, then observer data are used to clarify any discrepancy.

Korea had a systemic problem of IUU fishing activities until 2013 (see section 6.5.7), which was addressed in a comprehensive manner in 2014 through:

- The publication of Korea's IUU-National Plan Of Action (NPOA) (FAO 2014) [21];
- The amendment of its Distant Water Fisheries Development Act of 2007 in 2014 and in 2015 (DWFDA No. 13001, Jan. 6, 2015)[22]; and
- a fully functional Fisheries Monitoring Centre (FMC). The information flow through the FMC is illustrated in Figure 30.

In December 2017, two South Korean deep-sea fishing vessels conducted fishing operations in the Antarctic even after a closure notice. Later, the judicial authorities of South Korea inflicted little punishment on the vessels. Then, the U.S. National Oceanic and Atmospheric Administration (NOAA) made the preliminary decision to identify South Korea as "failing to apply sufficient sanctions to deter its vessels from engaging in fishing activities that violate conservation and management measures adopted by" the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). Following the process, the U.S. government put South Korea on the list of potential IUU countries in September 2019.

The matter was discussed as part of the environmental chapter of the Korean-USA trade agreement (KORUS). In November 2019, the US Trade Representative applauded the significant efforts Korea has made to strengthen its regime to deter and penalize IUU fishing[23]: "We commend Korea for acting expeditiously to strengthen its regime to combat illegal fishing, which disadvantages law-abiding fishermen everywhere," said U.S. Trade Representative Robert Lighthizer.

The recently adopted amendments to Korea's Distant Water Fisheries Development Act now enable the Minister of Oceans and Fisheries to administer administrative sanctions for violations of conservation and management measures of regional fisheries management organizations, including CCAMLR. Consequently, the U.S. government removed South Korea from its list of potential IUU fishing countries in four months, by the end of 2019.

The reformed institutional structure of the Ministry of Oceans and Fisheries (MOF) Distant Fisheries Division also shows close collaboration between central and provincial government partners (MOF), the National Institute of Fisheries Science (NIFS) and MCS agencies and RFMOs as partners of the Competent Authority (NFQS, the FMC Electronic Fisheries Monitoring System (EFMS) and enforcement agencies), linking the issuing of catch certificates for compliant fishing activities to

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[21] From http://www.fao.org/fishery/docs/DOCUMENT/IPOAS/national/KoreaRep/NPOA_IUU_Korea_Republic.pdf
[22] English translation from http://extwprlegs1.fao.org/docs/pdf/kor160014.pdf
[23] https://ustr.gov/about-us/policy-offices/press-office/press-releases/2019/november/ustr-welcomes-passage-amendments

maritime control of vessel certificates and licences, and to hygiene and food safety certification issued by the National Fisheries products Quality Inspection Service (NFQS). The Korean administrative competent authorities, scientists and NGOs active contributions to CCAMLR's fisheries management are evidenced in CCAMLR's Commission and other reports (see for example (CCAMLR 2019i)).

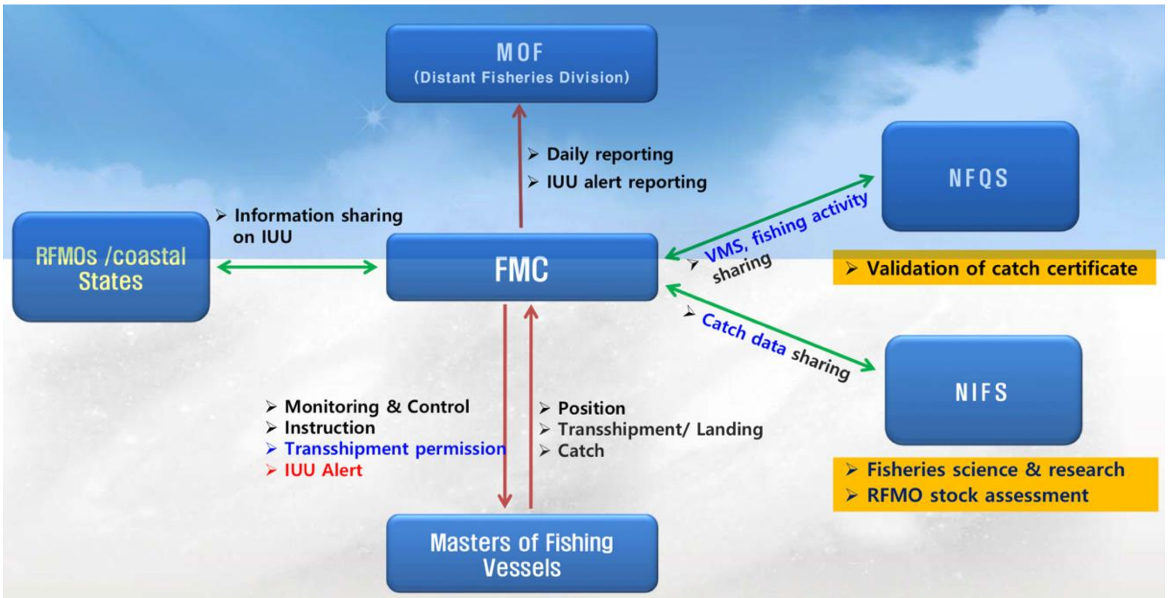

Figure 30. The Republic of Korea IUU Response System (MOF)

The amended Act ((Korea 2014b) and Enforcement decree of the DWFD Act amended Presidential Decree No. 27285, jun. 28, 2016 (Korea 2016b)[24]) give clear regulatory powers and strengthened the national MCS system and government services capacity and the cooperation with coastal states and RFMOs. In the Korean system (Flag State), the loss of fishing vessel licence and fishing rights is linked to compliance with RFMOs CMs.

Following procedures by both the USA and the EU to designate Korea as an IUU fishing nation in 2013, the Republic of Korea reformed and strengthened its MCS system in 2014 and 2015 (see section 6.5.1.2). However, US National Oceanic and Atmospheric Administration (NOAA) made a preliminary decision to designate Korea as an IUU fishing nation in September 2019, finding fault with two Korean fishing boats that had failed to comply with regulations while fishing in the CCAMLR area in 2017. The request came after the release of The U.S. National Marine Fisheries Service (NMFS) biennial report to Congress identifying IUU fishing (NOAA 2019). The NMFS found that South Korea was "failing to apply sufficient sanctions to deter its vessels from engaging in fishing activities that violate conservation and management measures".

Korea's Ministry of Oceans and Fisheries said the move will have no immediate impact on domestic fishery as the designation does not automatically entail trade embargoes or restrictions. But punitive actions may follow if the U.S. finds Korea's efforts to rectify its practices inadequate during the two-year consultation period.

The infractions concerned two longlining vessels targeting toothfish that had set lines in locations within 24 hour of a fishery closure (CCAMLR CM 31-02). Details are given in the most recent SCIC report (CCAMLR 2019l). Notably, that "members also noted that, despite that its domestic law

[24] https://elaw.klri.re.kr/eng_mobile/viewer.do?hseq=47560&type=part&key=28

provides for severe criminal penalties, there seemed to be significant gaps with respect to administrative and other civil tools to address violations, including mechanisms to deprive violators of the economic benefit of their infringements." Consequently "SCIC requested Korea report back on the progress and outcome of the pending prosecution and efforts to review and strengthen its internal legal framework in terms of administrative actions to ensure that it can impose sanctions of sufficient severity to serve as an effective deterrent to IUU fishing in all cases."

Noting that this was the third time this decade that Korea has been listed by a major economy as a nation associated with IUU fishing, the Environmental Justice Foundation (EJF) found, in December 2019[25] that "the Korean government reacted quickly by addressing flaws in the Distant Water Fisheries Development Act that had made it difficult to sanction illegal vessels. The government is now able to take action quickly and effectively when they find a vessel has fished illegally." The EJF and Korean NGOs (the Citizens' Institute for Environmental Studies and the Korean Federation for Environmental Movement) praised the amendment, which was informed by the recommendations of the NGOs. However, they also called for the government to ensure greater transparency in fisheries governance. The publication of key information on vessels, such as license lists, is considered to be a first step, along with full disclosure of any sanctions issued.

The Distant Water Fisheries Development Act has been amended to strengthen transparency and safety management of a distant water fisheries business and to combat illegal fishing (illegal, unreported, and unregulated fishing). In the amendment, the activities related to serious violations in overseas' waters were subdivided (Article 13 para 2) and the legal basis for the imposition of penalties for those who did not obtain a permit to operate in distant water fisheries was newly established (Article 31-2). In addition, it stipulated that the operation of the fisheries monitoring system for enhancing the transparency of fishing vessels (Article 19-2). The amendment was promulgated on Nov. 26, 2019, and is scheduled to take effect Nov. 27, 2020 (Korea 2019).

6.5.8 Monitoring and Management performance evaluation

6.5.8.1 CCAMLR

CCAMLR activities and practices regarding the management of the krill and other main fisheries are reviewed annually by the Commission and SC, as well as by its Standing Committees and Working Groups (such as EMM). In an exemplary fashion, Conservation Measures include a provision for their effectiveness to be reviewed on an annual basis.

Compliance is evaluated by the Standing Committee on Implementation and Compliance (SCIC) annually. It provides an example of internal evaluation of the Commission and its Members' effectiveness. There is also open scientific discussion and peer review of the stock and ecosystem assessment and methods used to provide scientific management advice. Finally, the active collaboration of industry and environmental NGO stakeholders in all CCAMLR work provides for regular reviews.

To date, CCAMLR has undertaken two external performance reviews (PR1 in 2007 and PR2 in 2016), which being only two may not yet qualify as regular.

Regarding the krill fisheries, PR2 noted the following needs (CCAMLR 2017e):

[25] https://ejfoundation.org/news-media/korea

- improved clarity in the management of the krill fishery in its early phases through notifications and the spatial management of the trigger level in Area 48 and CCAMLR established fisheries conservation measures;
- implementation of an ecosystem approach to fisheries derived from Article II of the Convention, including measuring by-catch in the krill fisheries;

and the need for further strengthening of the Scientific Committee to deal with new research issues and coordination. In particular regarding Principle 2:

- relationship between krill and whales;
- Harvest strategies based on decision rules that allow for changes to the ecosystem other than due to natural variability;
- Detection movement of the system from one stable state, say one based on krill, to another stable state, say one based on fish or salps (planktonic tunicates).

Following the first PR, CCAMLR published a record of its follow up activities[26] on its website. The most recent review (PR2) does not have a similarly visible follow up. However, recommendations are examined by all concerned and progress are reported on in the Commission report (CCAMLR 2019i).

6.5.8.2 Republic of Korea (Flag State)

The Republic of Korea has a number of evaluation mechanisms in place, in particular for the implementation of its IUU-IPOA and DWFDA (details to be obtained at initial audit meetings).

A Deliberative Committee for the Development of the Distant Water Fisheries Industry (hereinafter referred to as the "Deliberative Committee") shall be established under the jurisdiction of the Ministry of Oceans and Fisheries (Korea 2015). The Deliberative Committee will deliberate on the following matters concerning the development of the distant water fisheries industry:

1. The formulation of comprehensive plans to develop the distant water fisheries industry;
2. The balanced development of the distant water fisheries industry;
3. Decisions on permitted quotas for distant water fisheries;
4. Matters necessary for the structural improvement of distant water fisheries, strengthening the competitiveness of distant water fisheries, and establishing foundations for the development of the distant water fisheries industry;
5. Matters concerning administrative and financial assistance for the development of the distant water fisheries industry;
6. The formulation of policies to eradicate illegal, unreported, or unregulated fishing; and implementing such policies;
7. Special management of high-risk vessels;
8. The promotion of international fisheries cooperative projects;

[26] https://www.ccamlr.org/en/organisation/performance-review-activities

9. The facilitation of the dissemination of new technology and technique on the distant water fisheries industry;

10. Other important matters tabled by the Minister of Oceans and Fisheries for deliberation with regard to the development of the distant water fisheries industry.

The Deliberative Committee shall be comprised of no more than 20 members, including one Chairperson. Committee members shall be appointed or commissioned by the Minister of Oceans and Fisheries from among the following persons:

1. Public officials at Director General-level or with an equivalent position in a relevant central administrative agency;

2. Persons with abundant knowledge about and experience in the distant water fisheries industry;

3. Persons recommended by the competent Standing Committee of the National Assembly. A majority of the current committee members shall be appointed from among non-public official members, term of office of which shall be two years; renewable for only one further term.

Once the Committee is established and running, it is expected that its meeting minutes will contribute to the DW fisheries management evaluation system (to be confirmed at the remote site visit).

Finally, the worldwide scrutiny of its DW fishing vessels including at CCAMLR, the USA and EU also provides the opportunity for regular internal and external reviews.

6.5.9 Principle 3 Performance Indicator scores and rationales

Scoring table 22. 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

CCAMLR

Two jurisdictions are directly involved in the management of the fishery. CCAMLR is the RFMO in charge of ecosystem and fisheries resource management (MSC Principles 1 and 2) and the Republic of Korea is the Flag State responsible for its vessel's activities and compliance with the management regime and international obligations. They combine to make up a legal system effective for several decades. The CCAMLR Convention provides a framework for effective cooperation between and with other parties and its Conservation Measures are binding, the Republic of Korea has been a Contracting Party (CP) since 1985. **SG60, SG80 and SG100 are met.**

Republic of Korea

The Republic of Korea is a signatory to UNCLOS II as of January 29th 1996, and UNFSA as of February 1st 2008. As a CCAMLR CP, the Republic of Korea is bound to the Conservation Measures set out by CCAMLR. Korea also has national fisheries laws which are binding legal instruments consistent with the principles and provisions of UNCLOS, UNFSA, and the Ecosystem Approach of the UN Convention of Biological Diversity (CBD). Coastal and offshore fisheries are managed under the Fisheries Act and the Fishery Resources Management Act, whereas the fishery under assessment is managed by the Distant Water Fisheries Development Act. The Fisheries Act covers all Korean fisheries, and deals with fishing permit and license issuing of distant water fisheries. Both Korea and Japan are parties of the Agreement on Port State Measures. As such, there is an effective national legal system and organized and effective cooperation between parties involved in the management of fisheries, and SG80 is met **(SG 60 is met** and exceeded, because there is more than just a framework in place). The Republic of Korea is a CCAMLR CP and as such is bound to abide by the Conservation measures of this RFMO, therefore **SG80 is met**. Further, the Distant Water Fisheries Development Act explicitly states that Korean fisheries operators must abide by the management measures of regional management bodies in which they operate (Korea 2015) **SG100 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

CCAMLR

Both CCAMLR and Korea have dispute resolution mechanisms. For CCAMLR, Art. XXV of the Convention (CCAMLR 1980) explicitly considers mechanisms for the resolution of disputes or conflicts which may arise within the fishery, including external arbitration. The mechanisms are considered to be effective, because conflicts do not arise, **SG60 and SG80 are met** for CCAMLR. However, CCAMLR's 1st Performance Review recommended that, in order to be fully effective, *"the binding procedures for dispute settlement set out in Part XV of UNCLOS could be considered by CPs"* (CCAMLR 2008a). Although this recommendation has not been followed by apparent action by the Commission, the matter was not identified as important by the 2nd Performance Review (CCAMLR 2017e). On the basis that it hasn't been tested, **SG100 is not met**.

Republic of Korea

For the Republic of Korea, the Distant Water Fisheries Act Article 32 (hearings) states: When the Minister of Oceans and Fisheries (MOF) intends to cancel or suspend a permit for fisheries under Article 11, he/she shall hold a hearing thereon (Korea 2019). More broadly, Korea does have a Dispute Settlement mechanism which is based on the model of the World Trade Organisation (WTO) Dispute Settlement Understanding, but its procedures are much faster. The first step of the procedure is the consultation between the parties, with a view to reaching a solution. If the parties do not find an agreement, the dispute is referred to an arbitration panel. The panel is composed of three experts that are chosen by the parties or selected by lot from a list agreed in advance. The panel receives submissions from the parties and will hold a hearing that will be open to the public. Interested persons or companies will be allowed to inform the panel of their views by sending *amicus curiae* (friends of the court) submissions, **SG60 is met**.

In addition to the amended Arbitration Act 2016, which is to ensure the appropriate, impartial and prompt settlement of disputes in private laws by arbitration, there are also two other types of Alternative Dispute Resolution Systems that are mostly used in Korea: arbitration and mediation in the form of court-annexed or statutory conciliation. The conciliation system can be classified as either a judicial conciliation, such as those court-annexed conciliation procedures under the CCA or non-judicial conciliation such as statutory conciliation administered by governmental agencies.

These transparent mechanisms under the various Acts for the resolution of legal disputes in Korea are considered effective in dealing with disputes, **SG80 is met**. There is no evidence they have been tested for this or for comparable DW fisheries so the national Korean system **does not meet SG100**.

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	No

Rationale

CCAMLR

There are no coastal states fishers in the CCAMLR area. The opportunity to participate in the krill fishery is currently open to vessels duly licensed (CM 10-02) by a Commission member flag state, not listed in the IUU Fishing vessel lists (CM 10-06 and CM 10-07) after prior notification (CM 21-03), and only if all members agree (CCAMLR 2019n)). With these criteria in place, rights established by historical participation have been respected. Licenses to fish in the CCAMLR Area are delivered by the Contracting Party (CP), who must be "satisfied of the vessel's ability to exercise its responsibilities under the Convention and its conservation measures" (CM 10-02). CCAMLR CMs are binding and consistent with the objectives of MSC Principles 1 and 2 (see Background sections 6.2.1 and 6.2.2). For the CCAMLR management system, **SG60, SG80 and SG100 are met**.

Republic of Korea

In the National Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated (IUU) fishing, Korea explicitly recognises the importance of fisheries resources for food security in small-island developing States and makes provisions to assist these States through "*transferring its knowledge and technologies for fisheries conservation and management*" while implementing the NPOA-IUU (Korea 2014a). Even though the statement on small-island developing states does not apply in this fishery, it demonstrates that 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 such that **SG60 and SG80 are met**, but given there is no formal commitment, **SG100 is not met**.

References

(CCAMLR 2017e; CCAMLR 2019i; CCAMLR 1980; CCAMLR 2008a; CCAMLR 2019n; Ferrada 2018; Korea 2014b; Korea 2016b; Sykora-Bodie & Morrison 2019) (Korea 2014a; Korea 2019)
http://www.fao.org/fileadmin/user_upload/legal/docs/037s-e.pdf

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	85
Condition number (if relevant)	-

Scoring table 23. 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

CCAMLR

CCAMLR structure and conditions of participation are clearly defined in the Convention. CP functions, roles and responsibilities within the Commission, the Scientific Committee, the Standing Committee on Implementation and Compliance (SCIC) and other subsidiary bodies are well understood for all areas of responsibility and interactions, as evidenced in publicly available meeting reports on its website. In support of the Convention, the Commission has adopted a Strategic Plan for the CCAMLR Secretariat for the period 2019–2022, which describes the core services provided to Members and other stakeholders. Functions, roles and responsibilities are clearly defined in the WG meetings' agenda (see for example WG-EMM, which refers to the Scientific Committee and the Commission report), **SG60 and SG80 are met**. Areas of responsibilities and interactions include the criteria and methods to be used in Conservation Measures, regular assessment of status and trends of Antarctic living resources, data collection and data analyses and the formulation of proposals for the conduct of international and national programs of research (Convention Article XV, (CCAMLR 1980). Fishing companies are also organised into the Association of Responsible Krill harvesting companies (ARK), striving to become an information hub and provide links with CCAMLR and the scientific community, to promote research for the sustainable harvest of Antarctic krill in an ecosystem context and work with national CCAMLR delegations. Thus, functions, roles and responsibilities are explicitly defined and well understood for all areas of responsibility and interaction: **SG100 is met**.

Republic of Korea

Organisations and individuals directly involved in the Korean DWF management process and their roles are explicitly defined and well understood for all areas. Other interested parties such as NGOs and industry have been identified as demonstrated by engagement with MOF in Korea on a range of management-related issue. The MOF is the main department responsible for managing all fisheries and marine issues. MOF is comprised of three offices (i) Planning and Coordination Office; (ii) Oceans Policy Office and (iii) Coastal Fisheries Policy Office. The most important office for distant water fisheries is the Oceans Policy Office. Under this Office are three sub-offices with a General Director appointed to manage separate Divisions. Relevant Divisions for the distant water fisheries include the International Cooperation Division and Distant Water Fisheries Division. The Distant Water Fisheries Division administers the distant water fisheries, while the International Cooperation Division works on international relations and negotiations at RFMOs. The MOF also works closely with the National Institute of Fisheries Science (NIFS), which provides fisheries science and technology expertise. The MOF also works closely with the recently established (May 2014) Fisheries Monitoring Centre (FMC), whose responsibility is inter alia to monitor in real time (through vessel monitoring systems (VMS)) and control all distant water fishing vessels and the Korea Maritime Institute (KMI), which specialises in maritime and fishery policy. Functions, roles and responsibilities are explicitly defined and well understood for key areas of responsibility and interaction: **SG 60 and SG80 are met**. According to WWF-Korea (2017) there are over 35 organisations that are relevant to domestic and distant water fisheries, seafood trade, ports etc. The Korean Fishery Association (KFA) and Korea Overseas Fisheries Association (KOFA - established under Article 28 of the DWFDA) are the most relevant associations to this unit of assessment. KFA is the largest corporation and plays a key role in facilitating discussion between central government and fishery stakeholders for the coastal and offshore fisheries sectors, while the KOFA supports the distant water fishing industry, including inter alia providing statistics on fishing activities, analysis and research of foreign markets etc. (WWF 2017). It also plays a key role in non-governmental cooperation with foreign countries (WWF 2017). Stakeholder interviews have demonstrated that functions, roles and responsibilities are explicitly defined and well understood for all areas of responsibility and interaction, **SG100 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	No

Rationale

CCAMLR

Consultation processes take place through the participation to working groups and other work either as members of CP delegations or through the international Observer status. Consultation processes are open and consultees' contribution are evident from annual meeting reports, with a diverse and active participation encouraged by the national delegations, including scientists and experts from Korea. CCAMLR CP and vessel captains are closely involved in the collection of data, in research and welcome on-board Observers, **SG60 and SG80 are met**. The information, analyses and comments from stakeholders with Observer status are presented in the Commission's annual reports (see (CCAMLR 2019i)). All decisions on Conservation Measures and other resolutions are made by consensus with detailed accounts of the information used (or not used) are also given in the Commission's annual reports (see (CCAMLR 2019i)), **SG100 is met**.

Republic of Korea

It is a requirement under the DWFDA that stakeholder information sessions be scheduled whenever any RFMO CM is created or amended, thus potentially requiring the DWFDA to be amended. At these sessions, discussions and explanations of potential consequences are presented to stakeholders and input is sought which can then be taken into consideration when deciding whether the new or amended CM can be implemented effectively in the Korean context. Therefore, a consultation process is set to obtain relevant information from the main affected parties, and **SG60 is met**. Furthermore, various outreach activities are conducted to engage stakeholders and the general public on matters such as IUU fishing and provide an opportunity for information and local knowledge to be incorporated into decision-making. Under Article 5 of the DWFDA, a "Deliberative Committee for Development of the Distant Water Fisheries Industry" is established under the jurisdiction of the MOF to consult on matters such as:

a. The formulation of comprehensive plans to develop the distant water fisheries industry;

b. The balanced development of the distant water fisheries industry;

c. Decisions on permitted quotas for distant water fisheries;

d. Matters necessary for the structural improvement of distant water fisheries, strengthening the competitiveness of distant water fisheries, and establishing foundations for the development of the distant water fisheries industry;

e. Matters concerning administrative and financial assistance for the development of the distant water fisheries industry; and

f. Other important matters tabled by the Minister of Oceans and Fisheries for deliberation with regard to the development of the distant water fisheries industry.

This committee (not to exceed 20 persons) includes government officials, persons with "knowledge about and experience in the distant water fisheries industry" and those recommended by the competent Standing Committee of the National Assembly. This suggest that there are processes in place to obtain relevant information from stakeholders, including local knowledge and that this allows for consideration of the information obtained. Although these are ad hoc processes invoked when Conservation Measures (CM) change, the annual processes within CCAMLR to which the Korean delegation members actively participate mean that they are invoked sufficiently regularly to consider that **SG80 is met**. At the site visit, the team spoke to the Deputy Director of the Ministry of Oceans and Fisheries who provided details on the consultation processes within the Korean fisheries management system. Before any modifications are made to legislation (be it new laws, or modifications to existing legislation), stakeholders are brought together to be consulted on the proposed changes. At these meetings, the changes are agreed, and a further delay is allowed between drafting and implementation to allow for additional meetings to go through the revisions before they are finalised, this second consultation period usually lasts one month. These rounds of meetings likely provide the opportunity for the stakeholders to understand how their information is used (or not used). However, the team was not presented with explicit evidence indicating how stakeholder inputs are used or not used for the Korean management system. As a result, **SG100 is not 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	No

Rationale

CCAMLR
Management of the Antarctic krill fishery is the responsibility of CCAMLR, while the management of fishing activities lies with the Korea as a CP.
CCAMLR was set up within the framework of the Antarctic Treaty. The Convention (art. XVII) set out the role of the Executive Secretary and Secretariat in detail. The latest CCAMLR Secretariat Strategic Plan 2019–2022 sets out specifically to consult widely with Members and other stakeholders and foster engagement by Contracting Parties in the work of CCAMLR (CCAMLR 2019a). Opportunities and encouragement are provided annually for CCAMLR members (CP and NCP) to delegate scientists to take part in Working Groups that prepare scientific advice for the Scientific Committee to review and present to the Commission. Consultation processes in place at CCAMLR are well defined and consultation are open and seen to take place at annual meetings, with a diverse and active participation encouraged by the national delegations. The information submitted by stakeholders with Observer status are presented in the Commission's annual reports and their use (or not) is discussed. For CCAMLR, **SG80 and SG100 are met**.

Republic of Korea
The Korean government (MOF and through KOFA) usually provides the opportunity for representatives from industry and NGOs to attend relevant international negotiations and RFMO meetings as part of the Korean delegation so that their interests can be incorporated into decision-making and so they are aware of the reasoning behind eventual management and policy decisions (refer also to NPOA-IUU, 2014). Furthermore, various outreach activities are conducted to engage stakeholders and the general public on matters such as IUU fishing and provide an opportunity for feedback. When the Korean government implements new policy, this is published for general comment. As previously highlighted under 3.1.2(b) a "Deliberative Committee for Development of the Distant Water Fisheries Industry" is established under the DWFDA, which includes representatives with "knowledge about and experience in the distant water fisheries industry" and provides opportunity for interested parties to be involved in the decision-making process. Based on this **SG80 is met**. Further, the stakeholder consultation process described by the Deputy Director of the Ministry of Oceans and Fisheries in the rationale of SI 3.1.2b indicates that there is ample opportunity for stakeholders to participate in the decision-making process of the fishery. The representative of the Korean Overseas Fisheries Association was able to provide the team with the invitations for such meetings sent out to various stakeholders (see Appendix 8.1). The first group to be consulted is industry, however the invitations indicate that specialists are also involved in the discussions when their expertise is required. According to the Deputy Director of the Ministry of Oceans and Fisheries, NGOs are also consulted during the drafting of laws and regulations, however the team was not able to verify this with any NGO. On a precautionary basis, **SG100 is not met**.

References

(CCAMLR 2019i; CCAMLR 1980; CCAMLR 2019a) (WWF 2017; Korea 2014a)

Stakeholder interviews

Draft scoring range	≥80

Information gap indicator	Information sufficient to score PI for CCAMLR – more information needed on stakeholder engagement processes for Korea
Overall Performance Indicator score	85
Condition number (if relevant)	-

Scoring table 24. 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

CCAMLR

All CCAMLR fisheries are managed using a precautionary and ecosystem approach, as defined by the FAO in its Code of Conduct for Responsible Fisheries. Long-term objectives are defined and required in Article 2 of the Convention as a) prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment; b) maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources; and c) prevention of changes or minimization of the risk of changes in the marine ecosystem, **SG60 is met**. For the krill fishery, management follows the principles set out in Article II of the Convention in particular the “maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources” and the “prevention of changes or minimisation of the risk of changes in the marine ecosystem” ((CCAMLR 1980) www.ccamlr.org/node/74528), **SG80 is met**. Objectives set out in the Convention are binding onto all signatory parties and therefore required by CCAMLR. They are reiterated in every annual Commission report (CCAMLR 2019i), **SG100 is met**.

Republic of Korea

Under Article 1 of the DWFDA, the principal objective is to “*advance the sustainable development of the distant water fisheries industry and contribute to the growth of national economy, through the rational preservation, management, exploitation, and utilisation of maritime living resources, and the promotion of international cooperation*” (Korea 2019). In the formulation of plans for the distant water fisheries specifically, it is an explicit requirement under Article 4 of the DWFDA that the Minister of Oceans and Fisheries include “*matters concerning the rational preservation and management and exploration and exploitation of marine living resources*” where rational preservation and management means "*measures to preserve or manage one or more species of marine and fisheries resources as adopted and applied in accordance with international law*". This is more than implicit, and so SG60 is met. Given Korea is a signatory to UNCLOS and UNFSA, this would therefore include reference to ecosystem-based management and the precautionary approach, which is consistent with the MSC fisheries standard. Indeed, after signing UNCLOS and the UNFSA, the Ministry of Maritime Affairs and Fisheries (MOMAF) in 2006 (as presented in (Zhang et al. 2009) presented a five-year vision for Korean fisheries development with four major goals that included:

(i) rebuilding fishery resources based on an ecosystem approach;
(ii) modifying the structure of fishery production;
(iii) preventing harmful and illegal fishing activities; and
(iv) improving marine environmental quality.

These objectives are consistent with the requirements of the Conservation and Management of Marine Ecosystems Act (coming into effect in 2007, as amended 2017), which specifies that governments must take into account the following measures (which are aligned with MSC P1 and P2) to conserve or manage marine ecosystems under Article 4 (Obligations of State):
1. Formulation and implementation of measures to conserve or manage marine ecosystems, in an effort to prevent inordinate damage to marine ecosystems caused by activities or projects (hereinafter referred to as "development activities, etc.") affecting marine ecosystems, including the development or use of the sea, and to promote the sustainable use of marine ecosystems;
2. Promotion of policies which encourage nationals to take an active part in the conservation or management of marine ecosystems, and the creation of conditions therefore;
3. Investigation, research and technology development concerning the conservation and management of marine ecosystems, and the fosterage of specialised human resources;
4. Formulation and implementation of measures to restore or recover damaged marine ecosystems;
5. Raising public awareness on the importance of marine ecosystems, through education and public relations concerning marine ecosystems; and
6. Promotion of international cooperation concerning the conservation of marine environments.

And even before the 2006 vision statement, MOMAF in 2005 (in (Lee 2011), provided a study on the promotion of a mid and long-term fish stock rebuilding plan. Based on this evidence SG80 is met as there are clear explicit objectives incorporating the precautionary approach and ecosystem approach.

The long-term objectives are explicitly stated within the management policy. Stakeholder interviews during the site visit made it clear that any management measure or strategy adopted by CCAMLR is swiftly taken up by the Korean management system. The Korean Overseas Fishing Association (KOFA) representative (pers. com.) stated that he attends CCAMLR meetings to relay the points discussed and the ensuing legislative changes to the Korean fisheries management back to the fishing companies. This is done through the Korean version of the messaging application Whatsapp, email, official government letters, and meetings with stakeholders. The Deputy Director of the Ministry of Oceans and Fisheries also indicated that any CMMs set by CCAMLR must be followed by the Korean fleet. As such, the objectives **required** by CCAMLR are also required by the Korean fisheries management system, and **SG100 is met**.

References

(CCAMLR 2019i; CCAMLR 1980; Korea 2014b; Korea 2016b) (Korea 2019; Zhang et al. 2009; Lee 2011)

Interviews with stakeholders

http://www.korea.kr/news/policyBriefingView.do?newsId=156312163&pageIndex=1&srchType=&startDate=2008-02-29&endDate=2019-01-07&srchWord=

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	100
Condition number (if relevant)	-

Scoring table 25. 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

CCAMLR, the fishery manager, sets short-term sustainability objectives for the krill resources and the ecosystem. CCAMLR's short- and long-term objectives for the Krill fishery are set out in the Conservation Measures (CM 51-01 and 51-07) that define a precautionary krill catch limits and trigger levels for Area 48 (Principle 1). A "trigger" catch limit not to be exceeded until a procedure for division of the overall catch limit into small-scale management units (SSMU) has been established to avoid possible unacceptable concentration of catch within the foraging areas of vulnerable predators (Principle 2), **SG60 and SG80 are met**. For Principle 1, the objectives are quantitative and therefore well-defined, explicit, understood as they are applied by users within the fishery, **SG100 is met**.

Regarding Principle 2, the recent commitment to voluntary area closures in subarea 48.1 by the ARK addresses CCAMLR's explicit objectives to minimise the fishery's impacts on penguin colonies during the breeding season. However, the WG-EMM is still developing data layers to input into the krill fishery risk assessment (CCAMLR 2019m). Thus, short-term objectives are not yet well-defined and measurable to achieve outcomes expressed by Principle 2.

Overall, **SG100 is only partially met**. The scores also apply to Korea who, as a CP, contributes to the formulation of CCAMLR's binding CMs.

References

(CCAMLR 2019m) (Korea 2015)

Draft scoring range	≥80
Information gap indicator	Information sufficient to score PI
Overall Performance Indicator score	90
Condition number (if relevant)	-

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Scoring table 26. 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

CCAMLR's consensus-based decision-making process has been a central element in shaping outcomes while facing challenges that arise in the balance between 'fishing' and 'conservation' interests, for example in the current debates over climate change and marine protected areas in the Southern Ocean, **SG60 is met**. CCAMLR's established decision-making processes have been given as an example of best practice in managing marine resources in international waters (Nilsson et al. 2016), **SG80 is also met**.

Republic of Korea

Korea participates in these international negotiations and at CCAMLR, stakeholder information sessions are automatically scheduled whenever any RFMO CM is developed or modified requiring the DWFDA to be amended. **SG60 is met**. Discussion and stakeholder input are sought and taken into consideration before a decision is made as to whether the new or amended CM can be implemented in the Korean context. This system of decision-making allows Korean delegation representatives (including industry) at the RFMO meeting and then relevant stakeholders in the Korean national system to be fully informed of the issues under consideration and ensure that decision-making results in measures and strategies to achieve the fishery-specific objectives. Thus, Korean (MOF) processes respond to important issues and allow consultation and participation and these also have established, effective decision-making processes identified in their distant water management plans. These tend to respond to issues identified in relevant research, monitoring, evaluation and consultations. All management measures apply equally inside foreign EEZ as well as on the high seas. The CCAMLR scores also apply to Korea who, as a CP, contributes to the formulation of CCAMLR's binding CMs, **SG80 is 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

CCAMLR

Fisheries-specific issues identified in relevant research are taken into account by CCAMLR's Working Groups and Scientific Committee. A decision-making management loop ensures that serious and important issues are identified through monitoring, research and consultations. **SG60 and SG80 are met**. However, the complexity of rapid environmental and climate change present new challenges and not all issues find quick responses (see section 6.2.3 and (CCAMLR 2019m). For example, the need to operate subarea "trigger" levels are not yet resolved, even though the ARK supported area closures and scientific data collection attest of close collaboration between key stakeholders, **SG100 is not met**.

Republic of Korea

The Republic of Korea has repeatedly responded to serious issues identified in relevant research, monitoring, evaluation and consultation. For example, Korea was "yellow carded", as a potentially non-cooperating country in the fight against IUU fishing by the EU in November 2013 (http://europa.eu/rapid/press-release_IP-13-1162_en.htm) due to deficiencies in fisheries monitoring, control and surveillance (MCS). In response, Korea revised the DWFDA in 2013 and 2014 to strengthen MCS for this sector (e.g. strengthening controls on nationals, greater monitoring of fishing activities and high-risk vessels, port-State controls, VMS e-logbook requirements etc.) and respective sanctions (criminal prosecution and higher financial fines). Korea also created a new FMC, with real-time reporting on the fleet, 100 % VMS and detailed and complete operational data provided to RFMOs and developed a NPOA on IUU fishing. This series of reforms of the legal system and establishment of FMC led to the European Commission lifting its "yellow card" warning to Korea in April 2015 (see: http://europa.eu/rapid/press-release_IP-15-4806_en.htm). This suggests that Korea responds to serious issues identified in relevant research monitoring, evaluation and consultation such that **SG60 is met**. Another more recent example is the response to being identified by NOAA for IUU activities in the 2019 Improving International Fisheries Management Report to Congress (NOAA 2019)). This prompted a further amendment of the DWFDA to increase sanctions for infractions, therefore, **SG80 is met** by Korean management. The Korean management system **does not meet SG100** because there is not enough evidence to demonstrate that all identified issues are responded to.

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

The precautionary approach is required by CCAMLR's Convention. Krill-specific CMs on catch limitation and trigger levels are based on a precautionary approach for the krill resource and its predators. The fishery harvest in Area 48 has been capped at 620 000 tonnes per year, a catch limit or trigger level chosen to be extremely low when compared to an estimated initial virgin biomass. An interim distribution of trigger levels in Subareas 48.1 to 48.4 (CM 51-07) has been set up until the 2020/2021 to reinforce precaution, which the Commission may prolong until further progress is made with the fishery risk assessment (CCAMLR 2019m).

Krill is a keystone component of the Antarctic ecosystem (see LTL species in background section 6.3.2) and its harvest is based on the collection of the best possible scientific information, on the stock and other ecosystem components. **SG80 is met**.

Republic of Korea

It is an explicit requirement under Article 4 of the DWFDA that the Minister of Oceans and Fisheries, when drawing up a management plan, that it include "*matters concerning the rational preservation, management, exploration and exploitation of marine living resources*", where "*measures to preserve or manage one or more species of marine and fisheries resources as adopted and applied in accordance with international law*"(Korea 2019). Given Korea is a signatory to UNCLOS and UNFSA, this would therefore include reference to ecosystem-based management and the precautionary approach. However, WWF (2017) does note that *implementation* of the precautionary approach and ecosystem-based management with current legislation is still needed. For decision making at the national level, it appears that within the Conservation and Management of Marine Ecosystems Act (as amended 2017) the MOF, seeks the best available information in the decision-making process, through extensive consultations with a wide-ranging constituency.
Further, as a CP to CCAMLR, the Republic of Korea contributes to the formulation of binding CMs which are set using the precautionary approach and are based on the best available information as explained above. **SG80 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	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

			research, monitoring, evaluation and review activity.	recommendations emerging from research, monitoring, evaluation and review activity.
	Met?	Yes	Yes	No

Rationale

CCAMLR

CCAMLR provides extensive information on the fishery's performance and management actions, which are publicly available and promptly updated after meetings, **SG60 is met**. Each specific report, starting with the Commission (CCAMLR 2019i) and the Scientific Committee (SCIC) reports provide details of findings obtained from scientific data collection, on board observations, analyses and research, of recommendations and actions taken or not taken. The same applies to CCAMLR's performance reviews (CCAMLR 2008b; CCAMLR 2017e), **SG80 is met**. Stakeholders, either from the national CP and NCP delegations or Observers, are an integral part of the management system. They contribute to all CCAMLR's reports in a transparent process, for the CCAMLR decision-making process, **SG100 is met**.

Republic of Korea

The Republic of Korea has provided some information and explanations for actions or lack of action taken at the national level. For example, the justifications for the amendments to the DWFDA, establishment of the Fisheries Monitoring Centre (FMC) and NPOA-IUU development is clear (i.e. in response to European Commission "yellow card"). Therefore, some information on the fishery's performance and management action is generally available on request to stakeholders. **SG 60 is met**. Within the political structure itself, perhaps it is simply a matter of "need-to-know" as determined by whatever the highest authority deems necessary to divulge. Information on the fishery's performance and management action is more available on specific request through MOF and/or their associated agencies. This has been confirmed to be the case through interviews during the remote site visit. The Team was provided with information in writing on the compliance of the UoA fishery (presented in Appendix 8.1). As such, information on the fishery's performance and management action is available on request**, SG80 is met**. However, information on the rationale behind most other decision-making at national level is not transparent, at least on the MOF website or in various reports or minutes from stakeholders' meetings, there is no comprehensive reporting on the fishery's performance and management actions, **SG100 is not 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

CCAMLR

The Convention foresees the possibility of disputes (art. XXV), to be minimised through mechanisms such as negotiation, mediation and conciliation and reach agreement between parties in case of legal conflicts. Annual SC, SCIC and Commission meetings all provide opportunities for open discussions and proactively avoid the possibility of conflicts or legal disputes, since all parties have had in advance the chances to reach technical and political agreements. There is a general respect and compliance of the management system implemented by CCAMLR in regard to the krill fishery (see also PI 3.2.3). No IUU fishing has been recorded in this fishery in recent times and no legal disputes are pending. For CCAMLR, **SG60, SG80 and SG 100 are met**.

Republic of Korea

As outlined in greater detail in 3.1.1 (b) there are mechanisms in place in Korea to resolve disputes. There is no evidence that Korea is disrespectful or in defiance of national laws or legally binding agreements at the national level. **SG60 is met**. For example, the rapidly implemented changes to the DWFDA in response to being classified as a potential IUU nation by NOAA resulted in Korea being removed from that list within four months. **SG80 is met**. There is evidence that the MOF attempts to proactively avoid legal disputes, by inviting industry to attend RFMO meetings as part of the Korean delegation to ensure their interests are incorporated into decision-making. Industry certainly was made aware of the reasoning behind current agreed current CMs and especially the National Plan of Action-IUU in 2014 (Korea 2014a). And when new CMs are agreed upon at RFMOs, the Korean government will hold stakeholder consultations to explain what the new measure is and what it means for the fishery as the DWFDA requires compliance with all RFMOs binding management measures and requirements. Furthermore, various outreach activities are conducted to engage stakeholders and the general public on matters such as IUU fishing and provide an opportunity for feedback and avoid the potential for future disputes. The above evidence suggests the management system has mechanisms in place to comply in a timely fashion with judicial decisions arising from legal challenges and works proactively to avoid legal disputes. These consultation processes have been confirmed at the site visit. The team was provided documented evidence of industry being invited to discuss new measures prior to being finalised and incorporated in the DWFDA. Ensuring that fishers have had their interests represented during the drafting of these and are aware of the latest regulations can be considered proactive steps to avoid legal disputes. **SG100 is met**.

References

(CCAMLR 2008b; CCAMLR 2017e; CCAMLR 2019m; CCAMLR 2019i; Nilsson et al. 2016) (WWF 2017; Korea 2014a)

Stakeholder interviews

Draft scoring range	60-79
Information gap indicator	Further Korea-specific information is required to finalise the scores
Overall Performance Indicator score	85

Condition number (if relevant)	

Scoring table 27. 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

CCAMLR's Convention (Art. XXI) put the responsibility on each Contracting Party to take appropriate measures within its competence to ensure compliance with its provisions and with conservation measures. CCAMLR has a comprehensive MCS system set out in several CMs (see Background section 6.5.7.1). It is implemented by its members, including by onboard observers and captains of vessels active in all CCAMLR fisheries who report any concern, **SG60 and SG80 are met**. The CCAMLR System of Inspection (CCAMLR 2019m) relies on each member country designating and training Fisheries Inspectors to carry out inspections, at sea or on land. Inspection reports are copied to CCAMLR Executive Secretary to be forwarded to the other members. Any concerns are reported and discussed during annual SCIC meetings (CCAMLR 2019l). There have been no instances of non-compliance in the krill fisheries in recent years. The MCS system is comprehensive and adapted to the risks of IUU catches in the fishery, **SG100 is met.**

Republic of Korea

Korean fishing vessels engaged in distant water fishing in CCAMLR areas 48.1 and 48.2 are managed by the DWFDA. Under DWFDA Article 13, distant water fishing vessels must comply with resolutions made by RFMOs (CCAMLR for this UoA), which apply equally inside EEZs (not relevant to this UoA) and in the high seas (relevant to this UoA). If a violation of these rules occurs then under Article 13, Part 9, the Minister of Oceans and Fisheries can immediately suspend fishing operations of the vessel, entry into designated ports or prohibit discharge and trans-shipment of catch. To ensure compliance, vessels must have a functional VMS prior to departing from port (Article 15) and must obtain a permit in advance to trans ship (Article 16). Vessels suspected of IUU fishing can be denied port entry or prohibited from departing or restricted from unloading etc. and/or use of port services (Article 14). Penalties for non-compliance (fines and imprisonment) are listed in Article 33 (these have been amended in 2019 in response to being put on the IUU fishing nation list by NOAA). Korean fishing vessels are monitored in real-time by the FMC, which has a state-of-the-art monitoring system generating real time reporting on the fleet (Korea 2016a). The FMC ensures proper functioning of VMS and operates the fisheries monitoring system (FMS), e-reporting system (daily basis for catch/bycatch and protected species interactions) and the Korean fisheries information management system (FIMS) on a 24/7 basis. This allows detailed and operational fishery data to be sent to RFMOs and for FMC to also monitor the fleet in real-time to ensure it is complying with regulations, such as not fishing in protected areas. Korea also has a scientific observer programme on distant water fishing vessels, which is administered by the National Institute of Fisheries Science (NIFS), and Observer coverage on the UoA fleet is 100 % at the time of writing. The tasks required of the observers are describes in section 6.4.2.1. Given the mandatory 100 % observer coverage, there is a high degree of confidence that fishing operators comply with the national and international management frameworks in place. As such, 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 and **SG60 and SG80 are met**.

During the site visit, a representative of the FMC provided further details on its role and the activities monitored. The FMC representative confirmed the information above and indicated that the reporting interval is 1 hour. When vessels approach a restricted area, the interval is reduced to every 20/30 minutes, and the interval can be brought down to 5 minutes if necessary. The vessels must report leaving port, arriving at fishing grounds, the gear used and catch quantities of each haul, as well as transhipment activities (reports sent to FMC, and in the case of transhipment, CCAMLR also receives a report). In order for a company to have its fishing license renewed, it must have provided VMS and any relevant information on past infractions (if applicable). This information is also available to RFMOs on request to the FMC before issuing a permit for a vessel to fish in their waters. A representative of the FMC has confirmed that the Korean MCS system covers every aspect of fishing, from departure of port, through to landing, **SG100 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	No

Rationale

CCAMLR

Instances of non-compliance (in the fisheries where they exist) are discussed openly at CCAMLR and remedied by the Flag State authorities, including through the courts if necessary, and there is evidence that they are applied. **SG 60 is met**. Sanctions are thought to provide effective deterrence to the extent that there are no instances of non-compliance in the Krill fishery, **SG80 is met but SG100 is not**.

Republic of Korea

In September 2019 the USA made a preliminary decision to designate Korea as an IUU fishing nation "for failing to apply sufficient sanctions to deter its vessels from engaging in fishing activities that violate conservation and management measures adopted by an international fishery management organization" (NOAA 2019). The fishing activities in questions took place in CCAMLR waters in 2017, in a toothfish fishery. The matters are described in detail in the national report as part of the SCIC annual reports, and in 2019 the SCIC recognised that no further action was required to address the cases involving the Hong Jin No.701 and Southern Ocean (CCAMLR 2019l). However, SCIC noted that Korea had taken swift action by issuing a new Ministerial Directive implementing CM 10-05 (CCAMLR 2019l) and that the recently adopted amendments to Korea's Distant Water Fisheries Development Act now enable the Minister of Oceans and Fisheries to administer administrative sanctions for violations of conservation and management measures of regional fisheries management organizations, including CCAMLR**.** The U.S. government removed South Korea from its list of potential illegal, unreported and unregulated (IUU) fishing countries after four months. **SG60 and SG80 is met**. There has been no instance of non-compliance is this fishery (SIa), but the Korean strengthened regime of sanctions for DW vessels is very recent (2019), therefore **SG100 is not 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

Fishers in the krill fishery are generally though to comply with CCAMLR's MCS system requirement, **SG60 is met**. Evidence provided in the SCIC annual report shows that fishers comply with the management system by providing information before (i.e., notification of intent to fish) and during operations (catch and effort data; VMS data, on-board observers data) and comply other conservation measures, in particular those regarding the environmental protection during fishing and to minimise ecosystem impacts. This is reinforced by the UoA fishing company membership of the Association of Responsible Krill Harvesting Companies (ARK), which comes with its commitments to comply with all CCAMLR's CM's. Evidence of compliance is available from the SCIC compilation for each CM and by country (CP and NCP), **SG80 is met**. The FMC representative interviewed during the site visit indicated that there have been no sanctions or non-compliance issues with the UoA vessels over the past five year (see written evidence in Appendix 8.1). This is confirmed by the CCAMLR inspection reports presented to the team, which indicate that there have been no issues of non-compliance identified during inspections. One of the reports notes the willingness of the captain to comply and be as helpful as possible. These independent sources of data both indicate that the UoA vessels comply with the management system under assessment, **SG100 is met**.

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

Rationale

CCAMLR has a comprehensive MCS system, which is also heavily reliant on the Members cooperation, including Observers and vessel captains in all CCAMLR fisheries who report any concern. The MCS system has been demonstrably effective for this fishery. **SG80 is met for CCAMLR**. The Republic of Korea has completely reformed and strengthened its MCS system in 2014, 2015, and 2019 which is now recognised as highly performant and effective. The FMC representative indicated in writing that there have been no issues of non-compliance for the UoA vessels in the past five years. CCAMLR inspection reports indicating compliance validate this statement, as do the observer reports (100 % observer coverage). **SG80 is met for Republic of Korea**.

References

(CCAMLR 2019l; Korea 2014a; NOAA 2019; CCAMLR 2019g) (Korea 2016a)

Stakeholder interviews, CCAMLR inspection reports

Draft scoring range	60-79
Information gap indicator	More information sought on compliance of the UoA fishery – information sought from CCAMLR and the Republic of Korea
Overall Performance Indicator score	90
Condition number (if relevant)	-

Scoring table 28. 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

CCAMLR

CCAMLR activities and practices are reviewed annually during the Commission and SC meetings as well as during Standing Committees and Working Groups (such as EMM) meetings. The compliance evaluation procedure of the Standing Committee on Implementation and Compliance (SCIC) conducted annually provides an example internal evaluation of the Commission and Members effectiveness. There is also open scientific discussion and peer review of the stock and ecosystem assessment and methods behind scientific management advice, **SG60 and SG80 are met**. Finally, the CCAMLR Secretariat Strategic Plan (CCAMLR 2019a) also provides a means for Members to periodically assess the Secretariat's performance. For CCAMLR, all parts of the fishery-specific management system are under scrutiny and **SG100 is met**.

Republic of Korea

There are mechanisms in place to evaluate key parts of the fishery-specific management system. For example, national legislation for distant water fisheries was reviewed and revised following the issuing of a "yellow card" to Korea by the EU under its IUU Regulation and being put on the NOAA potential IUU fishing nation's list, **SG60 is met**. An internal audit (performance review) of all MOF operations also occurs (Article 16-2 of DWFDA, (Korea 2015)) according to Korean legislation, though the team must verify if this indeed takes place. As highlighted in 3.1.2, when new CMs are agreed upon at RFMOs, the Korean government will hold stakeholder consultations to explain what the new measure is and what it means for the fishery as the DWFDA requires compliance with all RFMO CMs. This allows opportunities to review and evaluate the CMs with relevant stakeholders before changes are made to the DWFDA. The KOFA representative explained the process by which new legislation is drafted for fisheries management in Korea. The regular stakeholder meetings on changes to the Korean fisheries management legislation constitute a mechanism to evaluate key parts of the management system, and update them when required (either by external pressure such as an international IUU yellow card, or through internal pressure such as the needs of industry). The stakeholder consultation allows for a review and evaluation of any changes to the DWFDA. On this basis, **SG80 is met**.

In the absence of evidence that all parts of the fishery specific management system are evaluated, **SG100 cannot be 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	No

Rationale

CCAMLR

CCAMLR has multiple mechanisms to provide regular annual internal reviews, of the Commission CMs, the SC recommendations and SCIC compliance reports. Scientific data collection and analyses are reviewed internally and externally on a regular basis through peer reviewed publications. **SG60 and SG80 are met**. As a whole, CCAMLR has had two external reviews (CCAMLR 2017e; CCAMLR 2008a) of its performance as an RFMO, which cannot yet qualify as regular, **SG100 is not met**.

Republic of Korea

Article 16-2 of the DWFDA states: The Minister of Oceans and Fisheries shall conduct a performance review on the operation of the distant water fisheries industry including, inter alia, illegal, unreported, and unregulated fishing". As highlighted in 3.1.2, when new CMs are agreed upon at RFMOs, the Korean government will hold stakeholder consultations to explain what the new measure is and what it means for the fishery as the DWFDA requires compliance with all RFMO CMs. This allows opportunities to review and evaluate the CMs with relevant stakeholders before changes are made to the DWFDA. **SG60 is met.** Korea has also been externally reviewed by the EU to ensure their management system meets EU IUU Regulations, which has led to new legislation developed and the FMC established. This constitutes an external review of the Korean fisheries management system. The invitations presented in Annex ### demonstrate that the consultations are an implemented process within the Korean fisheries management system. The reviews of legislation taking place in these regular meetings (whenever new legislation is drafted) can be considered internal reviews, **SG80 is met**. External reviews are not regular, **SG100 is not met**.

References

(CCAMLR 2017e; CCAMLR 2008a; CCAMLR 2019a) (Korea 2015)

Draft scoring range	60-79
Information gap indicator	More information sought on the regularity of performance reviews on the operation of distant water fisheries / Information sufficient to score PI for CCAMLR

Overall Performance Indicator score	80
Condition number (if relevant)	-

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8 Appendices

Appendix 1 Assessment information

Appendix 1.1 Small-scale fisheries

Unit of Assessment (UoA)	Percentage of vessels with length <15m	Percentage of fishing activity completed within 12 nautical miles of shore
UoA1	0 %	0 %

Appendix 1.2 Stakeholder input

KOFA invitation to join stakeholder meetings

"해외수산자원 개발 · 생산 · 수출 일대의 장"

KOFA **(특) 한 국 원 양 산 업 협 회**

수신자 수신자 참조
(참조)

제 목 「원양산업발전법」 개정 대응을 위한 회의개최

1. 해양수산부에서는 원양산업의 지속가능한 발전 및 대외 경쟁력 강화, 원양어선 안전관리 체계 구축 등을 위한 합리적 법령개선안을 마련하기 위해 7월말부터 12월까지 업계 및 전문가와 함께하는 민·관 합동 협의체를 운영하고 있습니다.

2. 이와 관련 우리 원양업계의 의견을 모으고 「원양산업발전법」 개정(안)에 대한 검토안 및 대응방안을 마련하기 위해 아래와 같이 회의를 개최하고자 하오니 참석하여 주시기 바라며, 참석자 명단 '17.8.29(화)오전까지 우리 협회로 제출하여 주시기 바랍니다.

\- 아 래 -

○ 일시/장소 : 2017. 8. 29(화), 15:00 / 협회 대회의실
○ 참석대상 : 원양선사 임·직원
○ 내 용 : 「원양산업발전법」 개정(안)에 대한 검토안 및 대응방안 협의
※ 참석자 명단

회사명	직 위	성 명	연락처

끝.

(특)한 국 원 양 산 업 협 회 장

수신자 : [illegible] 이상 11개사

대리 [illegible] 차장 [illegible] 부장 [illegible] [illegible] [illegible]

시행 원양자원부 - 818 (2017.8. 28) 접수 (. .)
우 06775 서울특별시 서초구 논현로 83 8층(양재동, 삼호물산빌딩) / www.kosfa.org
전화 02)589-1611 전송 02)589-1630/1 / [illegible]@kosfa.org / 공개

"해외수산자원 개발 · 생산 · 수출 증대의 해"

(특) 한 국 원 양 산 업 협 회

수신자 회원사
(참조)

제 목 「원양산업발전법」 법령 개선안 마련을 위한 용역 착수보고회 개최

1. 우리협회 회원지원부-842호(20179.4) 및 850호(2017.9.6)관련입니다.

2. 우리 협회에서는 해양수산부에서 추진 중인 「원양산업발전법」 개정에 원양업계의 입장을 제대로 전달하기 위해 「원양산업발전법 개정 대응을 위한 회의('17.8.29)」에서 전문가에게 용역을 수행하도록 하는 방안을 결정한 바 있음을 알려드린 바 있습니다.

3. 이와 관련, 전문가(이광남 박사)와 용역계약을 체결하여 아래와 같이 착수보고회를 개최하고자 하오니 참석(※명단은 9.22일까지 제출요망)하시어 많은 의견을 개진하여 주시기 바랍니다.

- 아 래 -

○ 일시/장소 : 2017. 9. 25(월), 14:00 / 협회 대회의실
○ 참석대상 : 원양선사 임·직원
○ 내 용 : 「원양산업발전법」 법령 개선안 마련을 위한 용역 착수보고
※ 참석자 명단

회사명	직 책	성 명	연락처

끝.

(특)한 국 원 양 산 업 협 회 장

대 리 김효삼 과 장 소기룡 부 장 이성재 회원지원본부장 이종목

시행 회원지원부 - 902 (2017. 9. 20) 접수 (. .)
우 06775 서울특별시 서초구 논현로 83 8층(양재동, 삼호물산빌딩) / www.kosfa.org
전화 02)589-1611 전송 02)589-1630/1 / nomuse@kosfa.org / 공개

Email from FMC representative on the conformity of the UoA vessels:

RE: 3398 (Stakeholder) Jeong Il Corp conformity

F

fmc2014@korea.kr

To Henry Ernst

Cc Eddy Cho

Reply Reply All Forward ...

Mon 23/11/2020 03:3

Follow up. Start by 23 November 2020. Due by 23 November 2020.
You replied to this message on 23/11/2020 10:35.
If there are problems with how this message is displayed, click here to view it in a web browser.
Click here to download pictures. To help protect your privacy, Outlook prevented automatic download of some pictures in this message.

Dear Henry Ernst,

Good day.

It was nice speaking with you last week as well. As requested, I would like to confirm to you that as far as Korean FMC concerns, In Sung Ho and Kwang Ja Ho have had no compliance issue for the past 5 years.

I hope it helps and stay safe.

Regards,

(Mr.) Yoo Seek
Chief Inspector
Fisheries Monitoring Center
Ministry of Oceans and Fisheries

Appendix 2 Evaluation processes and techniques

Appendix 2.1 Site visits

A Variation Request was submitted to the MSC on 09/09/2020 requesting the site visit to be held remotely during the week of the 9th November 2020. The rationale behind the variation request was: there are travel restrictions and health risk concerns related to COVID-19 should the assessment team travel to South Korea to attend the site visit. The full VR and MSc response can be found at: https://fisheries.msc.org/en/fisheries/jeong-il-corporation-antarctic-krill-fishery/@@assessments. The VR was accepted by the MSC on 22/09/2020. As such, remote meetings were held during the week of the 9th November 2020 over the course of the entire week, the following week, due to stakeholder availability. A wide range of stakeholders have participated in this assessment. Videoconferencing arrangements were shared with all stakeholders looking to participate in the assessment.

Table 19. List of attendees at the remote-site meetings.

Name	Position	Type of consultation
Mr. Eddy Cho	CU Korea	Translator
Dr. Julian Addison	CU UK Principle 1 specialist	Assessment team
Dr. Gudrun Gaudian	CU UK Principle 2 specialist	Assessment team
Dr. Sophie des Clers	CU UK International Principle 3 specialist	Assessment team
Dr. Jung-Hee Cho	CU UK Korea Principle 3 specialist	Assessment team
Henry Ernst	CU UK Team Leader	Assessment team
Emily Vella	CU UK Fisheries Officer	Assessment team
Mr. Kunwoong	Jeong Il Corporation	Client representative
Dr. Kang	Jeong Il Corporation	Client representative
Mr. Kim	Ministry of Oceans and Fisheries – Deputy Director	Stakeholder interview
Mrs. Jang Minjoo	Ministry of Oceans and Fisheries – CCAMLR Relations	Stakeholder interview
Mr. Seok-Gwan Choi	National Institute of Fisheries Science	Stakeholder interview
Mr. Dong-Hwan Choi	Korea Overseas Fisheries Association - Director	Stakeholder interview
Mrs. Rhona Kent	WWF UK – Polar Oceans Specialist	Stakeholder interview
Mr. Yoo Seek	Fisheries Monitoring Center – Chief Inspector	Stakeholder interview

Appendix 2.2 Stakeholder participation

The types of information obtained from site visit participants included but is not limited to:

- **Jeong Il Corporation**: Information on the functioning and management of the fishery including operations, gear configurations, fishing method, data gathering and analysis, methods of recording catch data, management structures and responsibilities, management plans, regulations, enforcement, and traceability systems;

- **Ministry of Oceans and Fisheries**: description of the wider fisheries management framework, how changes to legislation are conveyed to stakeholder, how stakeholders are consulted and involved in the decision-making process of Korean fisheries management, general perspectives on the compliance of the Korean Distant Water fleet;
- **National Institute of Fisheries Science:** description of how data is used/the different groups entitled to manipulate and analyse the data, general perspective on the involvement of NIFS in the Korean fisheries management framework;
- **Korea Overseas Fishing Association:** description of their role in the Korean fisheries management system, the opportunities for stakeholders to provide information to the management system, their role in liaising industry and science to the management system;
- **WWF UK**: provision of the latest available literature on the Southern Ocean, the krill fisheries, and the components of the ecosystem in which the UoA operates. Concerns over the assessment of the fishery by the assessment team were raised, and queries on the assessment teams (provisional) scores and rationales were discussed.
- **Fisheries Management Center**: information on enforcement, sanctions and non-compliance, a perspective on the compliance of the fishery under assessment over the past 5 years.

Appendix 2.3 Evaluation techniques

No public announcements were made other than through the MSC website and the MSC update emails, as well as through CU UK's announcement notification, and individual stakeholder outreach. Prior to the site visit, specific stakeholders were contacted to ensure the team was able to meet with them. These stakeholders were selected based on the information gaps identified at the ACDR stage.

The assessment was based on a review of publicly available data and documentation, as well as data, information, and documentation provided by stakeholders leading up to- and during the site visit. The main source for catch data were CCAMLR Observer reports provided to the team from 2016-2020. Scoring was agreed by the team through email correspondence. Consensus was reached for all PIs.

Appendix 3 Peer review reports

Peer Reviewer A

General Comments

Question	Yes/No	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments
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, generally, appears to be based on the most positive possible view of the evidence in the context of the standard. This is particularly the case against P1 and P2.	We hope to have addressed you concerns directly in the relevant PIs. Scores have been modified based on your comments where the team felt this was appropriate. The assessment team would like to highlight to the Peer Reviewer that for P2, the MSC Standard requires that the assessment is centered on UoA impact, that is to say two vessels. While the concerns listed are not unfounded, some are beyond the scope of this MSC assessment, and of the team's interpretation of the MSC Standard.
"Are the condition(s) raised appropriately written to achieve the SG80 outcome within the specified timeframe? [Reference: FCP v2.2, 7.18.1 and sub-clauses]"	NA		
Enhanced fisheries only: Does the report clearly evaluate any additional impacts that might	NA		

Question	Yes/No	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments
arise from enhancement activities?			
Optional: General Comments on the Peer Review Draft Report (including comments on the adequacy of the background information if necessary). Add extra rows if needed below, including the codes in Columns A-C.	NA	The PRDR is clearly written, particularly P1. The background is quite well covered, but there is more made of established literature (e.g. the Everson book) than bang up to date primary literature (e.g. not much emphasis on Watters et al. 2020 or Meyer et al. 2020 (they are mentioned, but key material in both to do with 'precaution' and effective SSB respectively are not given much weight)). Not much consideration is given to interannual variability in krill abundance (which can be high), to the ability of large-scale surveys conducted c. 2 decades apart to resolve this, or causes/consequences. The PRDR does not provide sufficient consideration to small-scale variability in stock distribution (small at a scale relevant to predators; sub-areas are not small in that context!). The potential for bycatch of ice krill is mentioned in the background material, but not considered at all in P2 scoring. Insufficient consideration is given to the fact that disagreement in 2020 between CCAMLR members as to the validity of some on-line CCAMLR meetings has meant that no revisions are in place for a key Conservation Measure (51-07) on the spatial distribution of catch limit which lapses at the end of this (2020/21) fishing season.	P1: Additional information from the recent studies of Meyer et al. (2020) and Watters et al. (2020) has been added to the P1 background information and scoring rationales. Greater consideration has been given to the variability in stock distribution and abundance at a scale relevant to dependent land-based predators. The assessment team has now concluded that the harvest strategy is not fully responsive to the state of the stock given the limited frequency of the full large-scale synoptic biomass surveys, and that it does not take into account results from smaller scale biomass surveys and hence does not respond to potential local depletions of krill biomass that might impact on dependent predators P2: Regarding ice krill, detailed responses have been provided under the relevant PI's. P3: Point addressed for individual SIs, Thank you.

Performance Indicators Comments

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.1.1	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIa: No consideration is given to the possibility that not all adult krill are successful spawners. Mayer et al. (2020) demonstrate (see their Fig Box 1) that if <100 % of adults are contributing spawners then safe exploitation rates may be exceeded. It cannot be concluded that it is 'highly likely' (>80 %) that the stock is above the point where serious ecosystem impacts could occur because failures in recruitment could have sudden and major impact (periodic 'recruitment' failures at South Georgia (due to immigration failure) have catastrophic impacts on dependent predators (see body of work by Reid and colleagues from British Antarctic Survey).	The peer reviewer raises an important point based on the recent paper by Meyer et al. concerning the proportion of the adult stock that spawns successfully. Although the current estimate of biomass is more than 5 times the limit reference point, the assessment team agrees that there is some uncertainty as to whether the krill stock is above the point where serious ecosystem impacts could occur, and therefore the rationale for PI 1.1.1a has been revised and the score reduced from 100 to 80.	Accepted (non-material score reduction)
1.1.1	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	"SIb: Although the catch limit of 620,000 tonnes for the entire Area 48 has not been met recently, trigger levels for Area 48.1 were met in 2018 and 2019. The most recent catch was the highest ever (even compared to 'Soviet' era). Furthermore, despite the cited opinions (Watters et al. 2013; Plaganyi & Butterworth 2012; Smith et al. 2011) that target levels 'would satisfy ecosystem needs', ARK 'voluntarily' stopped fishing in 2018 adjacent to penguin colonies (see https://www.akerbiomarine.com/blog/krill-industry-antarctic-conservation-in-motion) for	The assessment team notes the concern expressed by the peer reviewer that trigger levels in 48.1 were met in 2018/19 and 2019/20 much earlier in the season than in previous years, but it is important to note that the disaggregated catch limits have not been exceeded and therefore the mechanisms to minimise impact on predators appear to work as fishing stops when catch limits are reached. The rationale has been revised to include the outcome of the study by Watters et al.	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
				which concern had been raised that fishing was contributing to reproductive failure. Watters et al. (202, Scientific Reports) have demonstrated that penguin performance can be reduced even in the face of quite modest krill catch. There is NOT a high degree of certainty that the stock has always been consistent with ecosystem needs."	(2020) and the decision by ARK to voluntarily stop fishing in areas where concern has been raised about the effect of fishing on dependent predators, which has provided a short-term solution to the problem. Whilst the assessment team considers that formal CCAMLR Conservation Measures are required in the future to provide mitigation against such potential adverse effects of krill fishing, a score of 80 is justified for this PI and the issue of potential impact of krill fishing on dependent predators is reconsidered under PI 1.2.1 (Harvest strategy). The assessment team agrees with the peer reviewer that "There is NOT a high degree of certainty that the stock has always been consistent with ecosystem needs", which is why the assessment team concluded that the SG100 was not met for SIb.	
1.1.2	No (material score reduction expected to <80)	NA (PI not scored)	NA	SIa. The fact that ARK voluntarily stopped fishing in 2018 is ignored. The fishing was stopped partly because of concern that fishing had locally depleted the stock. Since routes of krill transport remain unresolved, the possibility that locally stocks may take >1 genertaion to rebuild cannot be rejected.	Following the comments of the peer reviewer on PI 1.1.1, the assessment team have reduced the score for PI 1.1.1a. However, PI 1.1.1 still achieves an overall score of 80, and in line with MSC Standard v2.01, SA2.3.1 "Teams shall only score this PI (1.1.2) when Stock Status PI 1.1.1 does	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
				There is evidence from predators that the stock has been depleted: SIa should be scored by the CAB. Note also that my suggested scoring for 1.1.1 is <80.	not achieve an 80 score", this PI is not scored.	
1.1.2	No (material score reduction expected to <80)	NA (PI not scored	NA	SIb. Local surveys are conducted, including by Jeong Il Corporation (see end of para. 1, page 35), but data are not fed in to management. Monitoring is, therefore, in place and, contrary to the assertion that there is 'no evidence that the stock is depleted' ARK has voluntarily stopped fishing (see SIa) in reponse to concern that, locally, stocks may be depleted.	Following the comments of the peer reviewer on PI 1.1.1, the assessment team have reduced the score for PI 1.1.1a. However, PI 1.1.1 still achieves an overall score of 80, and in line with MSC Standard v2.01, SA2.3.1 "Teams shall only score this PI (1.1.2) when Stock Status PI 1.1.1 does not achieve an 80 score", this PI is not scored.	Not accepted (no change)
1.2.1	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIa. Although the Harvest Strategy is responsive to the state of the stock across the whole of Area 48 (as assessed in 2000 and 2019) and is designed to achieve stock management objectives reflected in PI 1.1.1 SG80, because of uncertainty around the proportion of adults effectively contributing to SSB (see 1.1.1) the effectiveness of the HS in unknown.	The assessment team agrees with the peer reviewer that the harvest strategy is responsive to the state of the stock across the whole of Area 48, and in relation to the peer reviewer's comments on SIb the assessment team agrees that the harvest strategy does not reflect changes in krill biomass at small geographical scales as identified through regular small scale biomass surveys, or if there is evidence that local depletions of krill biomass may have taken place which impact adversely on dependent land-based predators. The score	Accepted (material score reduction to <80)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					for SIa has therefore been reduced to 60 and a condition has been raised. The peer reviewer makes a valid point about the uncertainty about what proportion of the adult biomass spawns successfully, and this issue is considered under the scoring of PI 1.1.1 and PI 1.2.3.	
1.2.1	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIb. There is a precautionary harvest strategy in place, but it has not been fully tested. It is designed to achieve stock management objectives set out in 1.1.1, but that design does not consider all relevant factors. The fishery is closed at a sub-Area (e.g. 41.3) level if the trigger level for that sub-Area is met. However, there is no formal mechanism in place to restrict fishing at a smaller scale (e.g. in proximity of breeding colonies) even though there is recognition by the industry (ARK) that fishing may adversely impact predators (as evidenced by the industry's voluntary cessation / buffer-zone implementation; see https://www.akerbiomarine.com/blog/krill-industry-antarctic-conservation-in-motion). Of concern is the fact that voluntary closures argued for by this fishing industry INCREASED the local explotation rate (elapsed time for 5 % to 95 %	The assessment team agrees with the peer reviewer that the harvest strategy is deficient in that it does not respond to changes in krill biomass at a local geographical level and that there is no formal mechanism in place to restrict fishing if there is evidence that dependent land-based predators may be impacted potentially by krill fishing. On that basis, the assessment team has reduced the score for PI 1.2.1a to 60 and raised a condition, and therefore this deficiency has been identified under SIa. The assessment team considered that the harvest strategy was working at the overall Area 48 level, and therefore the fishery meets the SG80 for SIb. The assessment team notes the concerns expressed by the peer reviewer that trigger levels in 48.1 were met in 2018/19 and 2019/20 much earlier in the season than in	Accepted (no score change, change to rationale)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
				capture reduced from a mean of 130 days over 5 previous years to 69 d in 2019/20) (see 'Harvested species para 2.1 SC-CCAMLR 2020). Failure to agree at 2020 on-line CCAMLR meetings (on-line because of Covid-19 barriers to travel) means that CCAMLR Conservation Measure (CM) 51-07 (https://www.ccamlr.org/en/measure-51-07-2016) will expire, and hence that progress towards a 'preferred management strategy for the krill fishery' (page 40) will not have occurred: by definition, then, fishing will be distant from a 'preferred management strategy'.	previous years, but it is important to note that the disaggregated catch limits have not been exceeded and therefore the mechanisms to minimise impact on predators appear to work as fishing stops when catch limits are reached. The assessment team recognises that CM 51-07 expires in November 2021 and therefore the harvest strategy will not effectively include sub-area-based catch limits after that date. However, this assessment is evaluating the harvest strategy at the current time and cannot be based upon what might or might not happen in the future. Of course, if all sub-area-based catch limits are revoked later this year, the harvest strategy PIs would need to be re-evaluated at a surveillance audit or by expedited audit should this fishery be certified.	
1.2.1	Yes	Yes	Yes	SIc met at SG60.	No response required.	NA (No response needed)
1.2.1	Yes	No (non-material score	NA	SId. The Harvest Strategy is reviewed periodically by CCAMLR, but it is not always updated, for example if consensus cannot be reached. Improvement might be necessary (e.g., finer-scale	The assessment team believes that there is sufficiently regular review of the harvest strategy and that changes are implemented such that a score of 100 is justified. Finer	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
		reduction expected)		catch limitation) but has not implemented. Scoring options appear only to be 100 or no-score: 100 does not appear to be met.	scale catch limitation is an element of the harvest strategy that is currently under review and changes may be implemented when that review is complete.	
1.2.1	NA (PI not scored)	NA (PI not scored)	NA	SIe. N/A	No response required.	NA (No response needed)
1.2.1	NA (PI not scored)	NA (PI not scored)	NA	SIf. N/A	No response required.	NA (No response needed)
1.2.2	No (material score reduction expected to <60)	No (material score reduction expected to <60)	NA	SIa. There are well-defined HCRs in place, and they are expected to keep the stock fluctuating around a target level in consideration of the ecological role of the stock, but it cannot be guaranteed that the point of recruitment impairment will not be approached because of limitations in the understanding of the proportion of the adult stock that contributes effectively to SSB.	The assessment team agrees that there are well-defined HCRs in place which are expected to keep the stock fluctuating around a target level in consideration of the ecological role of the stock, and therefore the assessment team stands by its rationale and scoring for SIa. Whilst we note the uncertainty about the proportion of the adult stock that spawns successfully highlighted by the peer reviewer, this issue is considered under PIs 1.1.1 and 1.2.3, where a recommendation is made to provide additional information on the proportion of adult stock that contributes effectively to spawning stock biomass.	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.2.2	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIb. Although thre overall catch trigger level has been disaggregated to sub-Areas, these are not 'small geographic areas' and are certainly too large to account for the potential impact on individual land-based predator colonies of high removals of krill concentrated within a small geographical are.	Additional text has been added to the rationale. The assessment team considers that whilst this provides added justification for not meeting the SG100, there is sufficient justification for meeting the SG80.	Accepted (no score change, additional evidence presented)
1.2.2	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIc. There is 'some evidence' that the available tools may be effective a. However, failure to implement small scale management units means that HCRs' impacts (achievement of conservation goals) on dependent predators may not be met.	The assessment team considers that there is evidence that the tools in use are currently effective in achieving the exploitation levels required under the HCRs, as reference points have not been exceeded, and both the overall catch trigger and the sub-areas triggers have not been exceeded. The score of 80 is justified. The assessment team agrees that the harvest strategy should be improved (see revised rationale for PI 1.2.1a) to ensure that fishing does not cause highly-localised depletion of krill which adversely impacts on dependent predators.	Not accepted (no change)
1.2.3	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIa. Information on stock productivity in terms of effective SSB are lacking. Numerous differences between analysis methods used on 2000 and 2019 'synoptic' surveys render comparisons between surveys problematic, and in any case inferences on 2 data points very distant in time should be treated with extreme caution. Inferences based on 2 points 18 years apart should be viewed with	The peer reviewer lists several areas in which information could be improved. However, the assessment team believes that there is sufficient information available to support the current harvest strategy and therefore the SG80 is met. We agree that in the light of recent studies, the level of information cannot be considered to be	Accepted (non-material score reduction)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
				extreme caution. Nyquist tells us that stocks could have experienced higher-frequency cyclicity (e.g. as driven by the Southern Annular Mode), but that - or any additional fishing impact - would be undetectable in available data. Confidence limits on surveys are large. Surveys at the scale appropriate for the foraging ranges of land-based predator colonies are neither conducted regularly across the area of the fishery, nor incorporated to management. NB fishers would have the capability to conduct surveys at the scale at which they operate, and this could be a way forward. Some relevant information are available, but the modelling by Meyer et al. (2020) suggest that the present state of knowledge is insufficient.	comprehensive and therefore we have reduced the score for this SI from 100 to 80. In particular we have made a recommendation that if possible, estimates of the proportion of the adult biomass that spawns successfully should be made.	
1.2.3	Yes	No (non-material score reduction expected)	NA	SIb. Biomass surveys across Area 48 have only been conducted only twice in the last c. 2 decades. Sufficent harvest data are collected to enable sub-Area HCRs to be implemented (the fishery is closed when sub-Area trigger levels are met).	The rationale states that sufficient harvest data are collected to enable sub-area HCRs to be implemented as the fishery is closed when sub-area trigger levels are reached. The lack of frequent large-scale synoptic stock surveys precludes the fishery from meeting SG100.	Not accepted (no change)
1.2.3	Yes	Yes	NA	SIc. Scoring agreed.	No response required.	NA (No response needed)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.2.4	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIa. Biomass surveys across Area 48 have only been conducted twice in the last > 2 decades. Confidence limits on surveys are large. Surveys at the scale appropriate for the foraging ranges of land-based predator colonies are neither conducted regularly across the area of the fishery, nor incorportaed to management. Further, even if the surveys are adequate to assess biomass, the proportion of the adult biomass effectively contributing to SSB is unknown (Meyer et al. 2020).	The assessment team notes the peer reviewer's concerns about the frequency of large-scale biomass surveys, and the need for more localised surveys. However, the assessment team believes that currently there is still sufficient justification for the SG80 to be met. Estimating stock biomass with acoustic surveys calibrated with length distributions observed from trawl samples is an appropriate assessment methodology for krill stocks. The large-scale krill stock surveys in 2000 and 2019 and the use of the GYM provide an assessment of stock status against reference points set at appropriate levels for key LTL species. The reference points and harvest control rules were based upon the estimate of stock biomass from the 2000 large-scale survey, and the results from the 2019 survey demonstrated that there had been no decline in krill stock biomass and therefore confirmed that the reference points and HCRs were still appropriate. On the basis that there had been a very recent full stock survey, the assessment team concluded that the assessment is appropriate for the stock and for the harvest control rule. Nevertheless, we note that only two large-scale stock surveys have been undertaken in	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					the last 20 years, and more regular surveys will be required for such a key LTL species particularly in the light of likely ecosystem changes caused by climate change. The assessment team notes that the high costs of conducting large-scale stock surveys may preclude further such surveys in the near future, and therefore alternative approaches may be required to ensure that the stock assessment approach remains appropriate to the stock throughout the recertification cycle. We have therefore recommended that within the period of certification, regular sub-area stock surveys are continued, robust estimates of biomass in sub-areas are established, and stock assessment models are developed at a sub-area scale in order to determine appropriate precautionary catch limits which will take into account the potential fine-scale impact of the krill fishery on land-based predators, and to provide sufficiently regular estimates of krill stock biomass in order to assess whether krill stocks have been impacted by ecosystem changes caused by climate change. Such an approach has been agreed by CCAMLR's Scientific Committee and we expect that this recommendation will be met within the period of certification. If not, and no further	

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					full-scale surveys are undertaken during the certification period, it is likely that a condition will be raised at future annual surveillance audits. In conjunction with PI 1.2.3a the assessment team recommends that, if possible, estimates of the proportion of the adult biomass that spawns successfully should be made.	
1.2.4	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIb. Stock status is estimated relative to the CCAMLR 2000 B_sub_zero, which is termed 'pre-exploitation'. It is assumed that 100 % of adult biomas is SSB - this may not be appropriate (Meyer et al. 2020)	The assessment team believes that the current reference points remain appropriate, although it is recognised that the reference points may need to be recalculated when estimates of the proportion of adult stock which spawn successfully become available.	Accepted (no score change, change to rationale)
1.2.4	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIc. The biomass estimate used in the process of calculating TAC has an uncertainty around it, but this is only sampling uncertainty. It is not a full error-budget uncertainty, including uncertainty in - for example - acoustic Target Strength, krill identification, failure-to-detect krill (near surface or deep). Many of these uncertainties have been well known for decades (e.g. Demer PhD thesis from the 1990s) but they are not all considered for the krill stock.	The assessment team provides a justification that the main uncertainties are taken into account, and considers that a full error-budget uncertainty is not required to meet the SG80.	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.2.4	Yes	Yes	NA	SId. SG100 not met	No response required.	NA (No response needed)
1.2.4	Yes	No (non-material score reduction expected)	NA	SIe. Some aspects of stock assessment have been peer reviewed (e.g. multiple papers on the CCAMLR 2000 survey), but this is not the case for the 2019 survey. It could be said that "The survey methodology for the 2019 full-scale stock survey was rigorously peer-reviewed within CCAMLR Working Groups" is akin to marking one's own homework: it is certainly not externally (to CCAMLR) peer reviewed.	As part of the MSC process, review by a wide range of scientists from different countries within Working Groups of large international organisations such as CCAMLR or ICES are generally considered to be external reviews, as such Working Groups are likely to provide a more robust review through additional analysis of data and 'road-testing' of methodologies in comparison with one or two individuals involved in reviewing papers for publication in a peer-reviewed journal. The assessment team consider that a score of 100 is justified.	Not accepted (no change)
2.1.1	Yes	Yes	NA	SIa. Not applicable. SIb. Score agreed		NA (no response needed)
2.1.2	Yes	Yes	NA	SIa, SIb, SIc, scores agreed SId not applicable		NA (no response needed)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.1.3	Yes	Yes	NA	SIa not applicable SIb, SIc, scores agreed		NA (no response needed)
2.2.1	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIa. No consideration is given here for the potential bycatch of ice krill Euphausia crystallorophias. The CAB discuss this species in their background information (and in Section 6.4.2.6), and discussion of it by CCAMLR, but do not attempt to include it in scoring here. Observers report bycatch of fish and cephalopods, but no bycatch of congenerics (other Euphausia spp.) are recorded. There is recognised potential for by catch of ice krill (e.g. 'On the very high likelihood of bycatch of Ice krill (Euphausia crystallorophias) in the present-day fishery for Antarctic krill (E. superba)'. WG-EMM-18/05), which are important prey for numerous predators. Neither 'stock status' of, nor predator demand for, ice krill are well documented.	There is no record of ice krill in the catch profile 2016-2019, therefore it cannot be scored under current MSC CR SA3.1.4 - the team shall assign secondary species in P2 as species in the catch ....; ice krill was not recorded in the catch by the observers. The assessment team cannot speculate whether this is because it was not present or it was mis-identified as the target species Euphausia superba. Scoring issue a) deals with 'main' Secondary species - SA3.4.2, as ice krill is not in the catch profile it is not possible to assign it either 'main' or 'minor' status. Please note that from the publicly available information on ice krill biology this species is found around the coast of Antarctica at latitudes above 74 degrees South [27]. Furthermore, the mid-water trawl fishery operates at a depth of less than 150m,	Not accepted (no change)

[27] http://scientiamarina.revistas.csic.es/index.php/scientiamarina/article/view/571/584

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					whereas according to information available on the biology of ice krill this species is usually found at depths down to 350–600 m There appears to be limited overlap between the ice krill range and the fishery range. The scoring as proposed is not applicable	
2.2.1	No (non-material score reduction expected)	No (non-material score reduction expected)	NA	SIb. Ice krill Euphausia crystallorophias are not listed in Table 13. There are essentiually no data on the impact of the fishery on ice krill. Although, as the CAB's rationale states (2.1.2), the existing observer programme "bycatch data show that non-target species bycatch is consistently very low" the observer programme is not set up to examine bycatch of Euphausiid species including ice krill E. crystallorophias. Thus there is only a partial strategy in place. The observer programme does not have a robust mechanism for assessing bycatch of ice krill.	Ice krill is not in the catch profile, therefore not recorded by the observers. Scoring issue b) does not deal with 'strategy', it deals with 'status'. The recording template and krill recording manual used by the Observers, as designed and prescribed by CCAMLR does not require the identification of different species of krill (see https://www.ccamlr.org/en/node/74770); CM23-06 2019; CM51-06 2019 The scoring as proposed is not applicable However, the assessment team was aware of this issue of possible identification concerns and had included a Recommendation as part of the assessment - see Section 4.3	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.2.2	No (material score reduction expected to <60)	No (material score reduction expected to <60)	NA	SIa. There is no management strategy in place for ice krill. In fact there is no assessment of ice krill catch, nor any measures to avoid catching ice krill (that may include paying close attention to underway echosounder data, and steering the net away from ice-krill like swarms).	Ice krill is not recorded in the catch. CCAMLR does not appear to have implemented a system to manage ice krill - there is no evidence of ice krill specific recording requirements in the CCAMLR prescribed templates, ie no particular attention is drawn to ice krill or any other krill species. The scoring as proposed by the PR is not applicable The team has not been made aware of any recommendation (based on WG-EMM 18/05) being made to and/or addressed by CCAMLR to specifically endeavor to record ice krill as part of the Observer programme, or indeed an evaluation of such a recommendation. There may well be limited overlap between the distribution of ice krill and the fishery, accounting for the no-show in observer records.	Not accepted (no change)
2.2.2	No (material score reduction expected to <60)	No (material score reduction expected to <60)	NA	SIb. There are no measures in place for ice krill.	Ice krill has not been reported in the catch in observer reports available from 2016-2019. Please see team response for PI2.2.1a, PI2.2.2a The scoring as proposed is not applicable	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.2.2	No (material score reduction expected to <60)	No (material score reduction expected to <60)	NA	SIc. The bycatch data may show that non-target FISH and CEPHALOPOD species bycatch is consistently very low, but there are no data presented on ice krill (the species is not even listed in Table 13). There is no strategy for ice krill, so there is no "clear evidence that the strategy is implemented successfully and achieving its overall objective".	Ice krill has not been reported in the catch in observer reports available from 2016-2019. The assessment team cannot evaluate a species that is not in the catch profile. The scoring as proposed is not applicable. see also team response to PI2.2.1a and 2.2.2a regarding actual encounterability of ice krill by the fishery.	Not accepted (no change)
2.2.2	NA (PI not scored)	NA (PI not scored)	NA	SId.		NA (No response needed)
2.2.2	No (material score reduction expected to <60)	No (material score reduction expected to <60)	NA	SIe. There is no review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ice krill.	No ice krill was recorded in the catch profile from 2016-2019 The scoring as proposed is not applicable.	Not accepted (no change)
2.2.3	No (material score reduction expected to <60)	No (material score reduction expected to <60)	NA	SIa. There is not even qualitative information available for ice krill.	No ice krill was recorded in the catch profile from 2016-2019. From the data available to the assessment team it cannot be shown whether the lack of ice krill in the catch profile is due to there	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					actually not being any ice krill, or mis-identification of *E.superba*. The assessment team had raised a recommendation for the observers to give attention to additional krill species identification in collaboration with relevant CCAMLR working groups. The scoring as proposed is not applicable	
2.2.3	Yes	Yes	NA	SIb. Scoring agreed.		NA (No response needed)
2.2.3	No (material score reduction expected to <60)	No (material score reduction expected to <60)	NA	SIc. Understanding of the level of bycatch of ice krill is inadequete to assess threat or, in the face of threat to manage this species.	No ice krill was recorded in the catch profile from 2016-2019. From the data available to the assessment team it cannot be shown whether the lack of ice krill in the catch profile is due to there actually not being any ice krill, or mis-identification of *E.superba*. The assessment team had raised a Recommendation to address this issue, see Section 4.3 of the report The team does not agree with a fail for this SI	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.3.1	No (non-material score reduction expected)	No (non-material score reduction expected)	NA	SIa. Irrespective of CCAMLR position, the fishery still has obligations to avoid impact on ETP species (e.g., albatross). The CAB documentation discusses streamers/bird-kill reduction measures: the SI is surely applicable?	The scoring issue specifically asks for national/ international requirements set limits, and as the justification explains, such limits have not been set. Therefore, this issue is not scored. See SA3.10.1.1	Not accepted (no change)
2.3.1	Yes	Yes	NA	SIb. Scoring agreed.		NA (No response needed)
2.3.1	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIc. There is concern that fishing in the vicinity of central-place foragers such as breeding penguins and fur seals might be in competition with these krill predators, and consequently that fishing may impact predators. Effects of fishing and climate change may be additive. The 2018 voluntary closure of fishing grounds close to penguin colonies attests to this possibility. Watters et al. (2020) have demonstrated that krill fishing may impact penguin performance. Krill abundnace off the Antarctic Peninsula (and South Georgia) shows strong interannual variability (Brierley et al. Marine Biology): impacts from fishing on penguins and other predators may be particulalry marked in years when 'natural' abundnace is low. Although there is considerable research effort on the breeding performance of penguins, very little	Penguins are not ETPs under the MSC CR SA3.1.5. Hence the issue has been dealt with under the ecosystem component. The rationale provided in order to justify a score of SG100 includes quantitative research on ETP and other krill predator's consumption of krill, krill biomass and fishery take. Text has been added to the rationale to show a clearer quantitative distribution of krill take vs availability. The assessment team considers that currently the score is justified, given that both biomass assessments and CM51-07 are reviewed. The team does not agree with a score reduction below 80	Accepted (no score change, change to rationale)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
				is known about he impacts of krill availability outside the breeding season. Juvenille penguins need to find sufficient krill to survive, and adults have to fuel moulting etc: understanding krill/fishing impacts on predators just in the breeding season is not the whole story.		
2.3.2	Yes	No (material score reduction expected to <60)	NA	SIa. There are some measures in place. Spatial and seasonal limitations in fishing activity off the Antarctic Penninsula are voluntary, so not regulated to meet any national or international requirements.	It is considered that SA3.11.2.1 is appropriate to score this Scoring issue, i.e., under a), as CCAMLR is considered an international agreement which requires protection of ETPs. A voluntary measure counts, as in fact in many fisheries voluntary measures are introduced because of MSC certification process. It is up to CCAMLR to make it 'legal', in the meantime the ARK fisheries have moved ahead with voluntary closures to support sustainable fishing see also: https://www.ark-krill.org/ark-voluntary-measures The assessment team does not agree with failing the fishery as proposed by the reviewer with this score of <60	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.3.2	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIb. It could be considered that the "Voluntary spatial and seasonal limitations around the Antarctic Peninsula as proposed by ARK" are 'alternative' to national/international. Their presence recognises a potential problem.	It is considered that SA3.11.2.1 is appropriate to score this Scoring issue, i.e., under a). Indeed, the proposed measures by ARK have now been implemented - see link to website above.	Not accepted (no change)
2.3.2	Yes	No (material score reduction expected to <80)	NA	SIc. An observer scheme is in place, but at present it does not assess ice krill. There is spatial distribution of TAC, but the distribution is not to sufficiently fine scale to exclude the possibility of concentrated effort leading to adverse impact on krill predators.	The issue of ice krill has been addressed under Secondary species above, Ice krill are not an ETP species as defined by MSC under SA3.1.5 SA 3.11.1.1 is used to score this SI. This SI is concerned with the direct effect/ impact of the fishery on ETP species, such as being caught in the gear, and not with indirect impact regarding prey removal. That is only addressed in PI2.3.1c. As well as further under the ecosystem component. The team does not agree with a score reduction below 80.	Not accepted (no change)
2.3.2	Yes	No (material score reduction	NA	SId. There is evidence that the measures are being implemented successfully with regard to some species.	The assessment team are not sure what is meant by this comment. The scoring issue is concerned with management strategy implementation, and is asking for evidence of successful implementation. The rationale covers this by showing that the observer	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
		expected to <80)			coverage is 100 %, and that there is evidence of this from the reports and that the observer takes photographs of the mitigation measures and gear configurations, and these are part of the report. The team does not agree with a score reduction.	
2.3.2	Yes	Yes	NA	SIe. Scoring agreed.		NA (No response needed)
2.3.3	Yes	No (material score reduction expected to <80)	NA	SIa. Data are collected on foraging ranges of, and E. superba consumption by some predators. As the CAB's document notes, changes have been recorded in space/time, and the ability to unambiguosly attribute causes (climate change, fishing, other) in this 'noisy' system is lacking. Data are thus insufficient to quantitatively assess whether fishing, and capture of Eupausia spp. impacts ETPs including some penguins. Observers do not record catch of ice krill, which is an important prey item for some predators.	The issue of ice krill has been addressed under Secondary species above. At SG60 and SG80 SA 3.12.1 is used to score this SI. This SI is concerned with the direct effect/ impact of the fishery on ETP species, UoA related mortality, such as being caught in the gear, and not with indirect impact as stated in the PR comment. Spatial and time information on predators contribute to the risk assessment as to the gear directly interacting with ETPs, i.e., chance of encounters.	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					The team does not agree with the score reduction.	
2.3.3	Yes	No (material score reduction expected to <80)	NA	SIb. WG-EMM is not assessing impact of ice krill capture on predators.	This SI deals with information adequacy for strategically managing ETP interactions with the fishery, applying SA3.12.2, meaning direct UoA related mortality. Ice krill is discussed under Secondary species, and a Recommendation was raised to improve recording by observers where appropriate, in conjunction with relevant working groups at CCAMLR. The team does not agree with the score reduction.	Not accepted (no change)
2.4.1	Yes	No (material score reduction expected to <80)	NA	SIa. There is no direct evidence that the UoA does not reduce the structure and function of the water column. The experiment (comparison of fished v. non-fished volumes) has not been done. I agree that it is highly unlikely that the structure/function is reduced, but we do not have evidence.	The evidence is that this is a pelagic fishery the PR suggestion of a water column habitat does not fit with the MSC clauses for this PI e.g., SA3.13.2 nor the SGs where the consideration is the likelihood of 'serious or irreversible harm'. Serious or irreversible harm' is considered to be reductions in habitat structure and function such that the habitat would be unable to recover at least 80 % of its structure and function within 5-20 years if fishing on the habitat were to cease entirely (SA3.13.4, MSC FCRv2.0). There is no logic in the suggestion that the fishery could cause serious or irreversible	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					harm to the structure and function of the water column	
2.4.1	Yes	No (material score reduction expected to <80)	NA	SIb. The possibility that gear-loss might lead to VME damage cannot be discounted. This is unlikley to happen, but there is no evidence that it will not.	Observers must record gear loss. No such gear loss has been recorded in the reports available - 2016-2020. This is taken as evidence that to date such an event has not occurred. The team does not agree with the score reduction.	Not accepted (no change)
2.4.1	Yes	Yes	NA	SIc. Scoring agreed.		NA (No response needed)
2.4.2	Yes	Yes	NA	Scoring agreed across all SIs		NA (No response needed)
2.4.3	Yes	Yes	NA	SIa. Scoring agreed.		NA (No response needed)
2.4.3	Yes	No (material score reduction	NA	SIb. Assessment of impacts on habitats has been inferred for normal pelagic operation. It has not been assessed. Impact of lost gear on seabed has	Observers must record gear loss, As no such gear loss has been recorded in the reports available - 2016-2020. This is taken as	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
		expected to <80)		not been assessed (notwithstanding that loss is extremely rare).	evidence that to date such an event has not occurred. The team does not agree with the score reduction.	
2.4.3	Yes	Yes	NA	SIc. Scoring agreed.		NA (No response needed)
2.5.1	Yes	Yes	NA	SIa. Scoring agreed		NA (No response needed)
2.5.2	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIa. There is a partial strategy in place. There is no consideration of the potentially ecologically very important ice krill. Conservation measure 51-07 ought to have been revised by now, but it has not (see 3.1.1)	SA3.17.2 was applied. The concept of a 'plan' to conserve Antarctic marine life is the objective of CCAMLR and the reason why it was established in 1982 in the first place. CCAMLR practices an ecosystem-based approach to management and implements a comprehensive set of measures in order to support the conservation of Antarctic marine living resources and the management of fisheries in the Southern Ocean. These conservation measures are reviewed and developed at each annual meeting of the Commission, and subsequently implemented by Members during the ensuing intersessional	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					period and fishing season. Conservation measures are published in the annual Schedule of Conservation Measures in Force. This obviously applies to the krill fishery under assessment too. This is a wide ranging and interactive plan feeding into the strategy SG100 is met. Ice krill is one element. The assessment team has not been made aware of any direct ecosystem issues relating to ice krill, such as for e.g., whether there are species that solely feed on ice krill. Please also see team response to PI2.2.1a and 2.2.2a regarding actual encounterability of ice krill by the fishery. A Recommendation has been made as part of this assessment for observers, in cooperation with the relevant working groups at CCAMLR, to identify where appropriate between different krill species as part of the observers' tasks. The team response to the reviewer's comment at PI3.1.1 applies here too. However, please note that a Recommendation had been made to encourage the soonest possible update of CM51-07, see Section 4.3 of the report, and this will be checked at future surveillance	

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					audits (should the assessment result in the certification of this fishery), possibly raising it to condition level if no progress on the update is made.	
2.5.2	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIb. There is some objective basis for confidence that the partial strategy will work. No confidence whatever can be drawn from the similarity in krill biomass from 2 surveys c. 20 years apart given other higher-frequency variability. For example the possibility that a climate-related increase in krill has not been offset by a fishing-related decrease cannot be excluded given the limited data available. Whilst this scenario is perhaps unlikely, the point is that the limited data available cannot discount this or many other alternative hypotheses. Although there is 100 % observer coverage, the observers are not recording 100 % of the essential information (ice krill).	Regarding ice krill, please see team response to PI2.2.1a and 2.2.2a regarding actual encounterability of ice krill by the fishery. ARK, of which the fishery under assessment is a member, played a key role during the 2019 large-scale krill survey, which estimated krill biomass for the whole of Area 48. The overall biomass estimated was 62.6 million tonnes, a result very similar to the CCAMLR 2000 Survey. Furthermore, ARK has committed to conducting annual transects at selected areas, following the advice from CCAMLR's Scientific Committee (SC-CAMLR) to understand changes in krill density (https://www.ark-krill.org/projects). Such work, together with ongoing research on populations of cetaceans, pinnipeds, seabirds in the region, would suggest that SG80 is met. Further clarification has been added to the rationale.	Accepted (no score change, additional evidence presented)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.5.2	Yes	Yes	NA	SIc. Scoring agreed.		NA (No response needed)
2.5.3	Yes	Yes	NA	SIa. Scoring agreed.		NA (No response needed)
2.5.3	Yes	Yes	NA	SIb. Scoring agreed		NA (No response needed)
2.5.3	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIc. It is probable that one secondary species (ice krill) is not even considered. The main function of the species may be known, but it should be recognised as a secondary species.	Only those species that appear in the catch profile are classified into the various categories, Primary, Secondary, ETP where relevant, main or minor; the assessment team cannot speculate what should be on that profile, it can only assess information actually available. A more detailed response regarding ice krill has been made above (see for e.g., PI2.2.1a and PI2.2.2a)	Not accepted (no change)
2.5.3	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SId. There is inadequete information on the interaction of the fishery with ice krill, which may be one of 'these' ecosystem components.	Please see above	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.5.3	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIe. Adequate data do not 'continue to be collected' to detect increased risk. Area 48 biomass has been quantified only twice in c. 2 decades: that temporal resolution is inadequate to resolve cause-and-effect relationships (hence risk) with factors including climate and fishing that operate at higher frequency. The fishery may gather some data on stock size, but at present there is no mechanism to incorporate those in to management.	Text has been added to the justification to clarify ongoing collaborative projects with ARK and SC-CAMLR/ including Sub-group on Acoustic Survey and Analysis Method. SG80 is appropriate	Accepted (no score change, change to rationale)
3.1.1	Yes	Yes	NA	Scoring agreed across all SIs		NA (no response needed)
3.1.2	Yes	Yes	NA	SIa. Scoring agreed.		NA (no response needed)
3.1.2	No (change to rationale expected, not to scoring)	No (change to rationale expected, not to scoring)	NA	SIb. There is a need for more data on small-scale distribution of the stock, especially in the vicinity of krill-dependent land-based breeding colonies. The fishery has the potential to collect relevant data, but there is at present no mechanism to incorporate such data - even if they were collected - into management.	Please refer to the MSC Fisheries Standard Annex SA: SA4.4.1 Teams shall not focus scoring under this PI on the type of information obtained, or on mandating for what or how it must be used.	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
3.1.2	No (non-material score reduction expected)	No (non-material score reduction expected)	NA	SIc. From a UK perspective, interested parties in academia (outside the habitual CCAMLR WG community) are not encouraged to participate.	The CCAMLR rules of Procedure of the Scientific Committee (SC) are clear and publicly available (see link below) that each Commission member (PR A mentions the UK) is also "a Member of the Scientific Committee, who shall appoint a representative with suitable scientific qualifications, who may be accompanied by other experts and advisers." Therefore, there is a proper channel for PR A to follow to become part of the CCAMLR scientific community. The level of encouragement afforded to individual academics by the UK members of the SC is not audited by this SI. https://www.ccamlr.org/en/system/files/e-pt4_2.pdf	Not accepted (no change)
3.1.3	Yes	Yes	NA	Scoring agreed.		NA (no response needed)
3.2.1	Yes	No (material score reduction	NA	SIa. As the CAB states, SG100 is not met for P2. Ergo SG100 is not met.	Please refer to the MSC Fisheries Certification Process v2.2: Paragraph 7.17.9.3: An exception to 7.17.9.2 is permitted only for those PIs that	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
		expected to <80)			include only a single scoring issue at each SG level. a. For these PIs, it is permitted to partially score the issue to obtain intermediate scores. SG100 met for P1 but not P2 hence a partial score would be given.	
3.2.2	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIa. The decision-making process around the imminent lapse of CM 51 07 has failed (see 1.2.1). Failure to agree at 2020 on-line CCAMLR meetings (on-line because of Covid-19 barriers to travel) means that CCAMLR Conservation Measure (CM) 51-07 (https://www.ccamlr.org/en/measure-51-07-2016) will expire, and hence that progress towards a 'preferred management strategy for the krill fishery' (page 40) will not have occurred: by definition, then, fishing after the end of the 2020/21 season will be distant from a 'preferred management strategy'. It is not clear what will happen at 2021 meetings if they have to be conducted online given the ongoing Covid-19 pandemic: it is not impossible that decisions will fail to be made and that CM51-07 will fail to be revised.	This is a very valid point. The lack of validation of the Scientific Committee (SC) 2020 report by the Commission linked to the lack of presential meeting and limitations of online communications in response to the COVID-19 pandemic is an exceptional response to unique circumstances. In addition, the events are posterior to the site visit (virtual meeting 27-30 October 2020, Commission report signed off November 2020, but only available on the website in February 2021) and therefore could not be taken into account in the report. See clause 7.20.2.c. It appears that communication problems were only experienced by one CCAMLR member, and that solutions are expected to be found soon as CCAMLR "welcomed the offer by the Chair of the Scientific	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					Committee to lead intersessional work to develop agreed rules of procedure for conducting formal online meetings, given the possibility that the COVID-19 pandemic will impact the ability of Members to conduct in-person meetings in 2021." in its 39th report. https://www.ccamlr.org/en/system/files/e-cc-39-rep.pdf SIa SG80 requires that "decision making processes are established. We argue that this is very much the case for CCAMLR, even under this year's exceptional circumstances.	
3.2.2	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SIb. See SIa re. failure to respond in a timely manner to CM 51-07.	See SIa regarding the SC response to remedy the situation before the 2021 meeting. The team cannot speculate regarding what might happen during the 2021 CCAMLR meeting, and can only base its assessment on existing, verifiable, and public information available before the end of the (extended remote) site visit. See clause 7.20.2.c.	Not accepted (no change)
3.2.2	No (material score reduction	No (material score	NA	SIc. Krill is not, strictly speaking, a 'keystone' species: it is numerically extremely abundant. The CCAMLR approach is precautionary, but it must be	SIc assesses the "decision-making processes", the "use the precautionary approach" and whether decision-making	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
	expected to <80)	reduction expected to <80)		remebred that consensu among member nations is required for implementation: consensus is not always met so policies in place do not always accord with 'best available information'. Watters et al. (2020) have pointed out that 'Catch limits that are considered precautionary for forage species simply because the limit is a small proportion of the species' standing biomass may not be precautionary for their predators'.	processes "are based on best available information." It does not assess the content of all decisions made. In addition, we note that George M. Watters, the first author of the recent paper cited (i.e., published after the end of the site visit), sits on CCAMLR's SC. Therefore, ensuring that the best available analyses are used.	
3.2.2	No (material score reduction expected to <80)	No (material score reduction expected to <80)	NA	SId. Some information is available, but details such as spatial breakdown of catch distribution are not freely available (released by CCAMLR) to researchers from nations that are not krill-fishers. Some data are kept closed.	SId. relates to the "fishery's performance and management action" and therefore not to scientific information. However, the Rules for Access and Use of CCAMLR Data specify that information may or may not be in the public domain. This is mostly dictated by the data originators/ owners. It also clearly states that "*Requests to the Secretariat for access and/or use of data maintained by the CCAMLR Data Centre by individual Member scientists/officials shall be approved in writing as appropriate by that Member's Commission Representative, Scientific Committee; Representative, or CDS Officer in consultation with the Commission Representative. Members are responsible for informing individual scientists or*	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					individuals requesting data of the rules governing access and use of CCAMLR data and for obtaining agreement to comply with such rules." Therefore, there are proper channels, which PR A would be free to explore. https://www.ccamlr.org/en/system/files/e-pt11_2.pdf	
3.2.2	Yes	Yes	NA	SIe. Scoring agreed.		
3.2.3	Yes	Yes	NA	Scoring agreed for all SIs.		
3.2.4	Yes	Yes	NA	Scoring agreed for all SIs.		

Peer Reviewer B

General Comments

Question	Yes/No	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments
Is the scoring of the fishery consistent with the MSC standard, and clearly based on the evidence presented in the assessment report?	Yes	The scoring of the fishery is consistent with the MSC Standard, but for a few PIs/SIs the rationales do not always cover all relevant supporting information to justify the scoring. The assessment and associated spatial resolution of the trigger level for krill catches could be considered as the main limitation in scoring the fishery and although this is addressed under scoring of P1.2.2, P1.2.3 and P1.2.4, it has potential impacts across other PIs under P1 (LTL), P2 and P3 through respective links to ecosystem needs. I have attempted to highlight some areas where this may have been overlooked. Under Principle 2, there are inconsistencies in the designation of Primary and Secondary species in the main report text and the related scoring rationales which require review - see below under general comments.	P1: The spatial resolution of the trigger level for krill catches has been explicitly addressed in relation to the scoring of PI 1.2.1. The assessment team has now concluded that the harvest strategy is not fully responsive to the state of the stock given the limited frequency of the full large-scale synoptic biomass surveys, and that it does not take into account results from smaller scale biomass surveys and hence does not respond to potential local depletions of krill biomass that might impact on dependent predators. P2: thank you for highlighting the inconsistencies, these have now been addressed and rectified. P3: The rationale for P3.1.2 has been strengthened following the PR's suggestion, thank you.
Are the condition(s) raised appropriately written to achieve the SG80 outcome within the specified timeframe? [Reference: FCP v2.2, 7.18.1 and sub-clauses]	NA	No Conditions raised.	
Enhanced fisheries only: Does the report clearly evaluate any additional impacts that might	NA		

Question	Yes/No	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments
arise from enhancement activities?			
Optional: General Comments on the Peer Review Draft Report (including comments on the adequacy of the background information if necessary). Add extra rows if needed below, including the codes in Columns A-C.	NA	In general, the background text of the report includes all relevant information; however, some information is not always presented chronologically e.g., there are some minor contradictions in statements/conclusions drawn and terminology used in relation to the most recent studies/surveys, for example within different sections in P1 and between P1, P2 and P3. For example, references made to ecosystem needs considered to be generally met/not met in relation to predator requirements and the respective references (Watters et al., 2013 versus Watters et al., 2020) or the latest synoptic survey referred to as 2000 rather than 2019.	The Watters et al. (2020) paper has now been referenced in both the P1 background information and scoring tables. All references to the latest synoptic survey under P1 are given as 2019.
Optional: General Comments on the Peer Review Draft Report (including comments on the adequacy of the background information if necessary). Add extra rows if needed below, including the codes in Columns A-C.	NA	Under Principle 2 the designation of Primary and Secondary species is inconsistent between Table 13, Table 17 and the P2 scoring rationales. This is unlikely to significantly affect the scores, but it made it difficult to determine whether scoring was appropriate/justified. The rationales and scoring for primary and secondary species need to be reviewed to ensure all relevant scoring elements have been addressed where necessary.	Thank you, this has been addressed and appropriate edits made
Optional: General Comments on the Peer Review Draft Report (including comments on the adequacy of the background information if necessary). Add extra rows if needed below,	NA	In general, and under Principle 3, there is no mention of CCAMLR WG meetings being postponed in 2020 undoubtedly as a result of COVID-19. Some reference to any delays incurred in management processes or work plans as a result of the pandemic should be included where appropriate (possibly under PI3.2.4 and possibly under 2.5.2). For example, has there been a delay in the associated work plan (e.g. krill	For P3: This is correct, the lack of validation of the Scientific Committee (SC) 2020 report by the Commission linked to the lack of presential meeting and limitations of online communications in response to the COVID-19 pandemic is an exceptional response to unique circumstances. In addition, the events are posterior to the site visit (virtual meeting

Question	Yes/No	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments
including the codes in Columns A-C.		feedback management) due to postponement of WG-EMM 2020 which has implications for P1 and P2?	27-30 October 2020, Commission report signed off November 2020, but only available on the website in February 2021) and therefore could not be taken into account in the report. As per clause 7.20.2.c. However, it is worth noting that communication problems were only experienced by one CCAMLR member, and that solutions are expected to be found soon, as CCAMLR "welcomed the offer by the Chair of the Scientific Committee to lead intersessional work to develop agreed rules of procedure for conducting formal online meetings, given the possibility that the COVID-19 pandemic will impact the ability of Members to conduct in-person meetings in 2021." in its 39th report. https://www.ccamlr.org/en/system/files/e-cc-39-rep.pdf

Performance Indicators Comments

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.1.1	No (change to rationale expected, not to scoring)		NA	Scoring issue b: Scoring is agreed, but the rationale could be strengthened as follows. In the first paragraph, reference is made to Watters et.al., 2013; conclusions from the more recent	The peer reviewer makes helpful suggestions as to how the rationale can be improved with the addition of new evidence, and the assessment	Accepted (no score change, additional

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				reference Watters et al. 2020 should also be reflected in this aspect of the rationale or a cross reference made to the related rationale under PI2.5.1.a. The probability level at which the GYM predicts that the stock will fluctuate about the reference target level (if catches are kept below the Precautionary Catch Limit (PCL) of 5.61 million tonnes) could be included. The year of the WG-EMM meeting being referred to in the last paragraph of the rationale should be provided. The expiration of CM 51-07 in Nov 2021 is also relevant here and should at least be mentioned or a cross-reference made to scoring rationale PI1.2.1a and/or b.	team has included that additional evidence, in particular the findings of the study by Watters et al. (2020) have been included in the rationale.	evidence presented)
1.1.2	NA (PI not scored)	NA (PI not scored)	NA	I agree that there is no evidence that the stock is depleted and that no scoring is required for this PI.	No response required.	NA (No response needed)
1.2.1	Yes	No (scoring implications unknown)	NA	Scoring Issue a: Very minor point regarding the rationale wording - CCAMLR management regulations would be better referred to as CCAMLR Conservation Measures. In relation to SG80 scoring however, I question whether it can be said that the harvest strategy is responsive to the status of the stock, given the limited frequency of krill biomass surveys on which the PCL is based. Additional rationale would be helpful to justify this aspect of SG80.	The assessment team agrees that the harvest strategy is not fully responsive to the state of the stock given the limited frequency of the full large-scale synoptic biomass surveys, and that it does not take into account results from smaller scale biomass surveys and hence does not respond to potential local depletions of krill biomass that might	Accepted (material score reduction to <80)

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					impact on dependent predators. The score for SIa has therefore been reduced to 60 and a condition has been raised. As suggested by the peer reviewer, the term 'CCAMLR management regulations' has been replaced with the term 'CCAMLR Conservation Measures'.	
1.2.1	Yes	No (scoring implications unknown)	NA	Scoring Issue a: In relation to SG100 scoring, I also do not feel confident that the harvest strategy is currently 'designed' to achieve a level consistent with ecosystem needs - the distribution of the precautionary catch trigger level across Area 48 is aimed at minimising impacts on krill predators, but the distribution of the catches were set based on historical catches as an interim measure, rather than having been set/designed to meet predator/ecosystem needs in respective areas. It may be sufficient for this to be reflected under scoring issue b on harvest strategy evaluation and the other relevant PIs (1.2.2 and 1.2.3).	The assessment team agrees that the harvest strategy has not been **designed** to achieve a level consistent with ecosystem needs as it has not been developed to meet the needs of dependent predators. As noted above, the score for SIa has been reduced to 60 and a condition has been raised.	Accepted (material score reduction to <80)
1.2.1	Yes	Yes	NA	Scoring issues b: I agree with the scoring but at SG100 the rationale could also refer to the necessary evaluation of the spatial resolution of the trigger level/biomass estimates.	Additional text has been included in the rationale as to why the SG100 is not met.	Accepted (no score change, change to rationale)

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1.2.1		Yes	NA	Scoring issues c: scoring agreed, but perhaps some discussion of the frequency of biomass surveys is warranted here? Alternatively, a cross-reference to PI1.2.3b scoring rationale could be made.	Additional text has been included in the rationale in relation to frequency of full-scale biomass surveys.	Accepted (no score change, change to rationale)
1.2.1		Yes	NA	Scoring issue d: scoring agreed but I think the reference to the development of a Feedback Management System may be less relevant here. The annual reviews of the harvest strategy which take place at the WG and Scientific Committee meetings and the performance review seem sufficient evidence to meet SG100.	The reference to the Feedback Management System has been retained and additional text about sub-area assessments and trigger levels has also been included to strengthen the justification for meeting the SG100.	Accepted (no score change, change to rationale)
1.2.2	Yes	Yes	NA	I agree with scores.	No response required.	NA (No response needed)
1.2.3	Yes	Yes	NA	I agree with scores given.	No response required.	NA (No response needed)
1.2.4	Yes	Yes	NA	Scoring agreed. Scoring rationale for SI c) could be simplified by reorganising text to confirm that SG60, SG80 and SG100 are met in relation to the uncertainty at whole area 48 level, but not at sub-area level for SG100.	The rationale for SIc has been revised.	Accepted (no score change, change to rationale)

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2.1.1	No (scoring implications unknown)		NA	Please review Table 13 and Table 17 of the report as the designations of Primary and Secondary species do not always correspond between these two tables and scoring rationale text. For example, ocellated icefish is designated as a secondary species in Table 13 and a primary IPI species in Table 17. See also PI 2.1.3 and PI 2.2.1.	Thank you, that was a typo, it should be a Secondary species, there are no reference points for ocellated icefish, there is no fishery in subarea 48.1 48.2	Accepted (no score change, change to rationale)
2.1.1		Yes	NA	Rationale under scoring issue b] should be strengthened by providing some detail and/or a reference for why icefish stocks are considered as having 'recovered from previous exploitation levels in 48.3'.	Reference and details added	Accepted (no score change, change to rationale)
2.1.2		Yes	NA	I agree with scoring for all scoring issues under 2.1.2, but query whether additional information should have been included in the rationale for scoring issue e: Scoring issue e (unwanted catch): As all Primary minor species are considered as IPI, should this not be reflected in the scoring rationale with justification as to why this scoring issue is NA i.e., due to small % of catch?		Not accepted (no change)
2.1.3	No (scoring implications unknown)		NA	The rationale under scoring issue b) needs reviewing/editing and scoring elements clarified. Antarctic toothfish is referred to, but no justification is given in relation to this species, and it is not designated as a Primary minor species in Table 13 or 17.	Well spotted. Antarctic tooth fish should not have been listed there, it was not designated a primary species, it is a Secondary minor species - as there are no reference points and there is	Accepted (no score change, change to rationale)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
					no targeted fishery for this species in subarea 48.1/.2.	
2.1.3	No (scoring implications unknown)		NA	The rationale under scoring issue b) needs reviewing/editing and scoring elements clarified. 'both' species are referred to but only one minor Primary species is identified in the rationale under P2.1.1.	Rationale has been edited.	Accepted (no score change, change to rationale)
2.2.1	No (change to rationale expected, not to scoring)		NA	Scoring issue a) the rationale states that cattle egret is not considered as an out of scope Secondary main species, while Table 17 in section 6.4.7 of the report designates it as such, which is confusing, Table 17 should be amended as appropriate. It would help to the reader to confirm which species are considered as Secondary main and minor species through cross reference to Table 13/Table 17 once these have been corrected.	Rationale has been edited.	Accepted (no score change, change to rationale)
2.2.1	Yes	Yes	NA	I agree with the scoring, however under Scoring issue b): the rationale quotes 0.007 % as the total fish bycatch for the fishery; while the report text (Section 6.4.2.2, p65) refers to 0.009 % of total catch for all non-target species and under scoring issues c) for PI2.2.2. non-target bycatch is quoted as being 0.006 % of the total catch - values should be reviewed and corrected/clarified as appropriate.	Rationale and background have been edited.	Accepted (no score change, change to rationale)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.2.2	Yes	Yes	NA	Scoring issue a): I agree with scoring but there is a typographical error in the rationale, 'out of score' should read 'out of scope'.	Thank you	Accepted (no score change, change to rationale)
2.2.2	Yes	Yes	NA	Scoring issue c) - see explanation under 2.2.1 b) above, in relation to the value detailed for bycatch as % of total catch.	Rationale has been edited.	Accepted (no score change, change to rationale)
2.2.2	Yes	Yes	NA	Scoring issue d): The rationale should probably make reference to the thresher shark listed in Table 13, explaining why it has been discounted due to questionable identification.	Thank you, rationale edited	Accepted (no score change, change to rationale)
2.2.3		No (scoring implications unknown)	NA	Scoring issue a): The rationale indicates that there are 'no main species' - this seems to contradict the rationale under PI 2.2.1a) where cape petrel and snow petrel are included as main Secondary species.	Thank you, the rationale has been edited accordingly and rescored.	Accepted (non-material score reduction)
2.3.1	Yes	Yes	NA	Scoring issue a: It would be helpful to clarify why this scoring issue a) under this PI is not applicable. Under the rationale for NOT scoring issue a) - would it be worth clarifying that international conventions do exist, but that they: - include limits but not for the ETP species caught within the fishery under assessment (e.g. Convention on the Conservation of Antarctic Seals) or	Thank you, rationale edited	Accepted (no score change, change to rationale)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
				- only include requirements for protection rather than limits (e.g. Convention on Antarctic Marine Living Resources)?		
2.3.1	Yes	Yes	NA	Scoring issue c) It would be helpful to cross-reference scoring under 2.5.1a in relation to indirect effects on penguins.	Thank you, rationale edited	Accepted (no score change, change to rationale)
2.3.2	Yes	Yes	NA	Scoring issue a) on first reading it is confusing that SI a is scored for this PI and not for 2.3.1 - so some additional clarification under this rationale or under PI 2.3.1. SI a), on why this is the case would help the reader (See above).	Thank you, rationale edited	Accepted (no score change, change to rationale)
2.3.3	Yes	No (scoring implications unknown)	NA	It is not clear why scoring issue a) does not meet SG100 - does this scoring issue consider all potential ETP species or only Antarctic fur seals? If the latter, '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' given the current status of Antarctic fur seals.	This SI has been scored more precautionary because the time series of observer reports is relatively short and compared with other Antarctic fisheries, observer coverage is 'only' 100 %, meaning one observer per vessel. Hence 'high degree of certainty' isn't yet warranted.	Not accepted (no change)
2.4.1	Yes	Yes	NA	Scoring agreed.		NA (No response needed)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.4.2	Yes	Yes	NA	Scoring agreed.		NA (No response needed)
2.4.3	Yes	Yes	NA	Scoring agreed.		NA (No response needed)
2.5.1	Yes	Yes	NA	Scoring agreed.		NA (No response needed)
2.5.2	Yes	Yes	NA	Scoring agreed.		NA (No response needed)
2.5.3	Yes	Yes	NA	Scoring agreed.		NA (No response needed)
3.1.1	Yes	Yes	NA	Scoring agreed.		NA (No response needed)
3.1.2	Yes	Yes	NA	Scoring issue b: The rationale could be strengthened by confirming the regularity of consultation processes within the Korean national fisheries management system - i.e this is on an ad-hoc basis when CM change,	Thank you, the rationale has been modified to reflect this point.	Accepted (no score change, change to rationale)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer’s comments	CAB Response Code
				but due to the annual processes within CCAMLR this is considered as sufficiently regular to meet SG80.		
3.1.3	Yes	Yes	NA	Scoring agreed.		NA (No response needed)
3.2.1	Yes	Yes	NA	Scoring agreed.		NA (No response needed)
3.2.2	Yes	Yes	NA	Scoring agreed.		NA (No response needed)
3.2.3	Yes	Yes	NA	Scoring agreed.		NA (No response needed)
3.2.4	Yes	Yes	NA	Scoring agreed.		NA (No response needed)

Peer Reviewer C

General Comments

Question	Yes/No	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments
Is the scoring of the fishery consistent with the MSC standard, and clearly based on the evidence presented in the assessment report?	Yes	Overall, this is an excellent report and it has been a pleasure to read and review it. The members of the assessment team and CAB are all to be commended on a report that is rich in detail, well presented, with by and large very well-reasoned rationales. I have made some very minor comments on scoring rationales which the team will, I am sure, be able to address very swiftly.	P3: Thank you. Points of details addressed under specific PIs.
"Are the condition(s) raised appropriately written to achieve the SG80 outcome within the specified timeframe? [Reference: FCP v2.2, 7.18.1 and sub-clauses]"	NA	No conditions of certification have been raised, which is appropriate.	
Enhanced fisheries only: Does the report clearly evaluate any additional impacts that might arise from enhancement activities?	NA		
Optional: General Comments on the Peer Review Draft Report (including comments on the adequacy of the background information if necessary). Add extra rows if needed below,	NA	Just a few very minor comments: Can you check whether the correct abbreviation for a Generalised Linear Model is GYM? I had always thought it was GLM.	The report refers to a Generalised Yield Model (not a Generalised Linear Model) and therefore the correct abbreviation is GYM. However, the peer reviewer has indeed picked up an error in the rationale in the scoring table for PI 1.2.2a, where the term

Question	Yes/No	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments
including the codes in Columns A-C.		Catch composition - there are a few species in here which are suspicious; I suspect that FAO three letter codes have been used by observers and transcription errors are to blame here. It seems very unlikely, for instance, that 3 spined sticklebacks (Gasterosteus aculeatus), a freshwater and coastal species from the northern hemisphere, would be caught in this fishery. Likewise the thresher shark that the team was already suspicious about at the ACDR stage; and the alga (Dunaliella tertiolecta) which is microscopic and found in hypersaline environments. A quick sanity check of this list is in order. Similar to the comment above - the cattle egret reported in the list of out of scope species (section 6.4.2.5) seems very unlikely to have any connection with fishing for krill in the Antarctic. Although this makes for an interesting and entertaining diversion in the report, it does seem to be an unnecessary and trivial distraction. Although the removal of the ""cattle egret saga"" would diminish the uniqueness of this report, I think it would improve its clarity and focus. However, I leave this to the team's discretion.	Generalised Linear Model has been used in error. The rationale has now been corrected to Generalised Yield Model. Catch composition: the team double checked the observer reports regarding those unlikely species listed in the catch profile. It is highly likely that a typo may have occurred in the original observer reports - text has been added below the catch composition table to point this out. However, the amounts involved are extremely small, and considering that these are most likely larval stages of fish, apart from the algae, it is conceivable that an error was made by the observer. However, the team cannot second guess what was really under the microscope. Cattle egret: agreed - a trivial matter, but the CR requires that any such species interaction with the fishery have to be considered as part of the assessment. If it is in the Observer report it has to be addressed somehow.

Performance Indicators Comments

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.1.1	Yes	Yes	NA	"The designation of krill as a key LTL species is appropriate and consistent with overlapping MSC-certified krill fisheries. The team's decision to score stock status using PI1.1.1A is therefore correct. The scoring is appropriate, well reasoned and supported by good evidence, including the most recent stock assessment data for krill."	No response required.	NA (No response needed)
1.1.2	NA (PI not scored)	NA (PI not scored)	NA	PI 1.1.1A scores >80 so this PI is not scored.	No response required.	NA (No response needed)
1.2.1	Yes	Yes	NA	The scoring of the HCRs is appropriate. One very minor comment - for SIe (shark finning) it would be more appropriate simply to state that "The target species is not a shark."	The rationale for SIe has been revised as suggested.	Accepted (no score change, change to rationale)
1.2.2	Yes	Yes	NA	The scoring is appropriate and the consideration of uncertainties in SIb and SIc is precautionary.	No response required.	NA (No response needed)
1.2.3	Yes	Yes	NA	The scoring is appropriate and justified by the rationale for each SI.	No response required.	NA (No response needed)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer’s comments	CAB Response Code
1.2.4	Yes	Yes	NA	The scoring is appropriate and supported by a well articulated and comprehensive rationale. The scoring of SIc seems perhaps over-precautionary given the approach to scoring this issue in other (non-krill) fisheries. This has no bearing on the assessment outcome, but a score of 100 might be justified here.	The assessment team notes the peer reviewer's suggestion that a score of 100 could be justified for SIc. However, there is consensus within CCAMLR that a priority is to develop a sub-area-based stock assessment model which can evaluate stock status relative to reference points in a probabilistic way at the sub-area level, and therefore at present the current approach is not sufficient to justify meeting the SG100.	Not accepted (no change)
2.1.1	No (scoring implications unknown)	No (scoring implications unknown)	NA	It is clear that there are no main primary species. *Dissostichus mawsoni* is listed in the catch composition in Table 13. Based on the text in §6.4.2.3 of the report, this is a primary species and should be considered in SIb.	An explanation as to why it was designated Secondary minor was provided at the start of para 6.4.2.4. The team added additional text for clarification to the bottom of para.6.4.2.3. It is not a Primary species in 48.1 and 48.2.	Accepted (no score change, additional evidence presented)
2.1.2	No (scoring implications unknown)	No (scoring implications unknown)	NA	The scoring rationales are appropriate for the species listed, however as noted above it appears that *Dissostichus mawsoni* should have been listed as a minor	see above, *D.mawsoni* is a Secondary species in the area 48.1 and 48.2	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
				primary species, and taken into account in the scoring rationales for each SI.		
2.1.3	No (scoring implications unknown)	No (scoring implications unknown)	NA	The scoring rationales are appropriate for the species listed, however as noted above it appears that *Dissostichus mawsoni* should have been listed as a minor primary species, and taken into account in the scoring rationales for SIb & SIc.	See above	Not accepted (no change)
2.2.1	Yes	Yes	NA	The scoring is appropriate. The saga of the cattle egret is fascinating, and the decision not to regard this as an out of scope (and thus "main secondary") species is appropriate.		NA (No response needed)
2.2.2	No (scoring implications unknown)	No (scoring implications unknown)	NA	SIa: there is a long list of minor secondary species set out in Table 13 of the report, and no evidence presented of a strategy that is designed specifically for the species concerned. In reality, this is a fishery that is subject to a ""raft of management measures"" which represent a ""partial strategy"" for addressing impacts on non-target species: these measures are not designed to manage impacts on this component specifically (see Table GSA3). A score of 80 would seem more appropriate here.	The observer coverage allows for comprehensive information gathering on bycatch and thus evaluation of risk level, which makes it possible to intervene if necessary. Indeed, there is a feedback loop through the comprehensive observer coverage. The Secondary minor species are larval stages and bycaught in comparatively small amounts (the highest percentage being 0.003 %). Some additional text has	Accepted (no score change, change to rationale)

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					been provided to show that these measures and detailed information constitute a strategy.	
2.2.2	No (scoring implications unknown)	No (scoring implications unknown)	NA	SIe: The rationale describes the annual meetings of the CCAMLR WG FSA and WG EMM; it does not set out evidence that alternative measures to minimise unwanted catch are being reviewed and implemented as appropriate. However, it would appear from the description of the fishery that there is in fact no unwanted catch: everything that is caught is used (see §6.4.2.1 of the report).	Text has been added to clarify that there is no unwanted catch. Everything is used/ processed.	Accepted (no score change, change to rationale)
2.2.3	No (non-material score reduction expected)	No (non-material score reduction expected)	NA	SIc: This SI has two criteria at SG100: the first is whether the information available would be adequate to support a strategy; and the second is whether there is a high degree of certainty that the strategy is achieving its objective. It is abundantly clear that the first part of this SI is met. For the second part of this SI to be met it is necessary to indicate what the objectives are of the strategy for all of the secondary species and the extent to which these objectives are being met. It is not at all clear that objectives have been set for all species nor the extent to which they are being met. In the absence of such information for all secondary species (main and minor), SG100 is not met.	The objective is to reduce bycatch of Secondary species. This is not set out for each individual minor Secondary species, but as Secondary minor group in general. Considering that the amount of Secondary species bycaught is low (0.004 %), and that there is no unwanted catch, it is can be justified that SG100 is met.	Not accepted (no change)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.3.1	Yes	Yes	NA	The scoring is appropriate and supported by a comprehensive rationale.		NA (No response needed)
2.3.2	No (non-material score reduction expected)	No (non-material score reduction expected)	NA	SIa: the rationale does not set out sufficient justification for the existence of a ""comprehensive strategy"" for ETP species in the sense defined by the MSC in Table SA8 (i.e., A "comprehensive strategy" (applicable only for ETP component) is a complete and tested strategy made up of linked monitoring, analyses, and management measures and responses.) It is also not at all clear from the information presented here in what way the UoA or comprehensive strategy in place is ""designed to achieve above national and international requirements for the protection of ETP species."", since the only evidence of a management strategy is derived from the CCAMLR Conservation Measures, which set the international limits (and hence, by definition, cannot set limits that exceed their own limits). A score of 80 would be more appropriate for this SI.	Good point. We have amended the justification and reduced the score.	Accepted (non-material score reduction)
2.3.2	Yes	Yes	NA	SIb/c/d/e: The scoring of these SIs is appropriate and supported by adequate justification.		NA (No response needed)
2.3.3	No (scoring implications unknown)	No (scoring implications unknown)	NA	SIa: at the SG80 level there are two distinct criteria to meet.	The justification was edited in order to be more explicit. The 100 % observer	Accepted (no score change,

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				The first is that there is quantitative information available that is adequate to assess UoA related mortality (clearly there is). The second criterion is that the impact can be determined and whether the UoA may be a threat to protection and recovery of the ETP species. This criterion is not clearly and explicitly addressed in the scoring rationale. Finally, the rationale makes inappropriate reference to protection measures that are in place outside the UoA (such as the exclusion zones around South Georgia and the South Sandwich Islands). The report clearly states that the UoA does not include these areas (see §6.2.3) and they should not, therefore, be used to support the score awarded here."	coverage collects detailed quantitative information on interactions with ETP species. Furthermore, an annual catch limit for all krill fisheries operating in area 48 is set at a highly precautionary 620k tonnes, whereby the overall krill biomass is estimated at 62.6 million tonnes.	change to rationale)
2.3.3	No (scoring implications unknown)	No (scoring implications unknown)	NA	SIb: This SI has two criteria at SG100: the first is whether the information available would be adequate to support a comprehensive strategy to manage impacts, minimise mortality and injury of ETP species; and the second is whether there is a high degree of certainty that the strategy is achieving its objective. It is abundantly clear that the first part of this SI is met. For the second part of this SI to be met it is necessary to indicate what the objectives are of the strategy for all of the secondary species and the extent to which these objectives are being met. It is not at all clear that objectives have been set for all species nor the extent to which they are being met. In the absence of such	This component deals with ETP species, not secondary species.	Not accepted (no change)

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				information for all secondary species (main and minor), SG100 is not met.		
2.4.1	Yes	Yes	NA	The scoring is appropriate. The team my wish to note that for pelagic fisheries the MSC has issued an interpretation that for pelagic fisheries the minor habitats are those which may be accidentally encountered when gear loss / malfunction occurs (https://mscportal.force.com/interpret/s/article/pelagic-habitats-and-gear-Box-GSA7-1527262009346)		NA (No response needed)
2.4.2	No (scoring implications unknown)	Yes	NA	Although the scoring is appropriate, the rationale refers to management measures that are not relevant to the UoA because they are relevant to other geographic areas. These included the management measures in place in South Georgia and the South Sandwich Islands and also the Ross Sea. The ban on bottom fishing in waters deeper than 2,250m is also irrelevant. These measures should be removed and the rationale should focus on those measures that are in place within the UoA and which are relevant to the fishing metier under assessment.	SG100 is asking for: 'a strategy in place for managing the impact of all MSC UoAs/non-MSC fisheries on habitats'. This implies an overall strategy, not restricted to a certain area and certain gears. Hence the relevant CMs have been cited to show the spatial management in place.	Not accepted (no change)
2.4.3	No (scoring implications unknown)	No (scoring implications unknown)	NA	There is a non-sequitur between the scoring of SIa and SIb. SIa includes lots of information about seabed habitats; SIb (correctly) points out that this is a pelagic fishery, and does not contact the seabed.	Good point. The justification has been edited to accommodate this helpful observation.	Accepted (no score change, change to rationale)

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				For the purposes of this PI, the ""main"" habitats are the commonly encountered habitats and VMEs that the fishery may impact (see GPF7.1.5). It would be appropriate to revise SIa to align it with this guidance and also the view expressed in the scoring of SIb.		
2.5.1	Yes	Yes	NA	The scoring is appropriate and supported by a well reasoned rationale.		NA (No response needed)
2.5.2	No (non-material score reduction expected)	No (non-material score reduction expected)	NA	SIa: the scoring rationale does not adequately identify the basis for meeting SG60, 80 and 100 separately and independently. It is very clear from the evidence presented that SG60 and SG80 are met. However for SG100, the requirements are that:- - "There is a strategy that consists of a plan" - but there is no evidence presented of the existence of a plan. - This strategy "contains measures to address all main impacts of the UoA on the ecosystem" - but there is no evidence presented to show what all the main impacts of the fishery are, and that the strategy contains measures in place to address each one of them. - And finally that "at least some of these measures are in place" - this much is clearly the case.	Text has been added to the rationale to more clearly show the management strategy in place. The scoring guideposts are not independent, one builds on the other. If they were independent they would constitute a different scoring issue.	Accepted (no score change, change to rationale)

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
				It very much appears at the moment that there are a suite of measures in place, which address some of the impacts that the fishery may have, but not all of the main impacts; and there is no evidence of a plan. Without this information it is not clear that SG100 is met.		
2.5.2	Yes	Yes	NA	SIb&c: the scoring is appropriate.		NA (No response needed)
2.5.3	Yes	Yes	NA	The scoring is appropriate and supported by a well reasoned rationale.		NA (No response needed)
3.1.1	Yes	Yes	NA	The scoring is appropriate and supported by a well reasoned rationale.		NA (No response needed)
3.1.2	Yes	Yes	NA	The scoring is appropriate and supported by a well reasoned rationale. It is evident that the P3 assessor has responded to the ACDR findings by thoroughly investigating the consultation, roles and responsibilities in Korea. The resulting rationale is very detailed and well articulated.		NA (No response needed)
3.1.3	No (scoring implications unknown)	No (scoring implications unknown)	NA	Although it is evident that there are clear long term objectives in place at CCAMLR and in Korea, it is not	This point as been clarified in the rationale. Thank you.	Accepted (no score change,

PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
				entirely clear from the scoring rationale that clear long term objectives are "required by management policy".		change to rationale)
3.2.1	Yes	Yes	NA	The scoring is appropriate, and it is clear from the rationale that SG100 is fully met for P1 but not for P2.		NA (No response needed)
3.2.2	Yes	Yes	NA	The scoring is appropriate. It is clear that during the site visit the assessor has invested considerable time in reviewing the Korean decision-making processes and that this has improved the scoring from the ACDR levels. This thoroughness is commendable.		NA (No response needed)
3.2.3	Yes	Yes	NA	The scoring is appropriate. Again, it is clear that during the site visit the assessor has invested considerable time in reviewing compliance and enforcement issues in Korea.		NA (No response needed)
3.2.4	Yes	Yes	NA	The scoring is appropriate. The changes in scoring from the ACDR reflect again the work that the P3 assessor has carried out.		NA (No response needed)

Appendix 4 Follow-up peer review comments

Peer Reviewer A

General Comments

Question	**Peer Reviewer Justification**	**CAB Response to Peer Reviewer's comments**
List here any issues not covered in the Performance Indicators or Conditions table (following sheet) that you feel have not been adequately addressed in the CAB response and would make a material difference to the scoring of the fishery.	Appropriateness of scale. The CAB acknowledges that "the harvest strategy may not be sufficiently responsive at a fine-scale local level in order to meet ecosystem needs." Nevertheless, they suggest an overall score of 70 for PI 1.2.1, which seems generous given the uncertainty. Furthermore, the CAB raises a condition (Condition number 1) that, "By the end of the certification period a harvest strategy should be implemented which is responsive to the state of the stock". The end of the certification period may be too late. My view is that data on small-scale variability (i.e. a scale appropriate for individual predator colonies) be available BEFORE any fishing activity commence such that HCRs can be set in a framework of knowledge rather than uncertainty. This is consistent with the precautionary approach. CCAMLR may well have committed to find solutions to small-scale variability but, as the C19 pandemic and associated hiatuses have shown us, aspirations to doing work and actually doing the work can become disconnected. It would be prudent to have mechanisms in place in advance of fishing rather than hoping that fishing in the interim - while mechanisms are developed - will not have adverse ecosystem impact.	The assessment team agrees that the harvest strategy may not be sufficiently responsive at a fine-scale local level in order to meet ecosystem needs, and following peer review the score for PI 1.2.1a was reduced and a condition raised. The assessment team acknowledges that there is now a voluntary agreement in place whereby krill fishing companies within ARK do not fish in localised areas where reductions in krill biomass might impact on the reproductive potential of dependent land-based predators. This voluntary agreement should provide the necessary protection until CCAMLR can develop mechanisms to protect against potential localised impacts of krill fishing and to implement new legislation to replace CM 51-07. The deadline for meeting the condition on PI 1.2.1 was set as the end of the certification period (i.e. 5 years) as MSC recognises that developing and implementing management measures by Regional Fisheries Management

Question	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments
		Organisations (RFMO) may take longer than expected. On reflection the assessment team considers that a time period of 2 to 3 years would be needed to implement the required measures, and as the MSC has recently issued a derogation for all certified fisheries that, due to disruptions caused by COVID 19, an additional 12 months can be attached to any condition linked to harvest strategies, management measures or information gathering, a deadline of 4 years would be more appropriate for the condition on PI 1.2.1. The condition has been revised to reduce the deadline to 4 years. The assessment team considers that this timeline is dependent upon the voluntary agreement by ARK fishing companies remaining in place, and that if this agreement lapses, then a number of Performance Indicators may need to be reevaluated at future surveillance audits.
List here any issues not covered in the Performance Indicators or Conditions table (following sheet) that you feel have not been adequately addressed in the CAB response and would make a material difference to the scoring of the fishery.	Ice krill. The CAB are reluctant to acknowledge even the possibility of Ice krill bycatch. They assert - on the basis of selective choice from the literature - that ice krill are coastal and occur deeper than 350 m (without apparently recognising that these are often mutually exclusive). I gain no reassurance from repeated statements that Ice krill have not been reported in catch: I take the view that this is due in no small part to the fact that observers are not looking in sufficient detail to resolve the subtle (to the untrained eye) morphological differences between Antarctic krill and Ice krill.	The assessment team can only audit what is recorded in the catch profile. The assessment team cannot make assumptions what may or may not be on the list of species to be recorded by the observers. The list of species to be recorded by the observers has been designed and implemented by the science of CCAMLR.

Question	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments
		The assessment team has not been made aware that the issue of ice krill recording has been taken up through due process with the CCAMLR science and observer programme in order to include the species in the observer list. It appears from the comments made by this PR regarding ice krill that they should be considered as a stakeholder for this fishery moving forward.

Performance Indicator Comments

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.1.1	No (material score reduction expected to <80)	SIa: The CAB now makes greater recognition of the fact that the proportion of the SSB that spawns effectively is potentially small, but still conclude that it is 'highly likely' that the stock is above the point where serious ecosystem impacts could occur. My view is that this is far too optimistic an interpretation. The precautionary principle should - given the lack of knowledge - lead to a less strident conclusion: 'likely' at best (SG60), but more appropriate would be 'unknown'	The assessment team does not agree with the peer reviewer. Originally in the CPRDR, PI 1.1.1a was scored at 100, and the other two peer reviewers agreed with this scoring. On review of the paper by Meyer et al. (2020), we have provided greater recognition of the potential for only a small proportion of the total stock biomass to successfully spawn and that the impact of fishing may disproportionately affect the portion of the adult stock that successfully spawns. On that basis we reduced the score for this SI to 80. However, there are additional spawning hotspots to that identified by Meyer et al. (2020), local exploitation rates at the spawning hotspot	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
			identified by Meyer et al. have remained low, and concerns over potential concentration of fishing effort in areas of high spawning success may be mitigated by recent findings which suggest that krill recruitment at the Northern Antarctic Peninsula area is decoupled from local larval abundance and supports the importance of remote larval supply. The assessment team considers that a score of 80 for PI 1.1.1a is appropriate.	
1.1.1	No (material score reduction expected to <80)	SIb: The CAB claim "therefore the mechanisms to minimise impact on predators appear to work as fishing stops when catch limits are reached". This ignores the fact that the industry has a 'voluntary' code to stop fishing close to colonies that appear to be suffering an inability to catch adequate prey. This seems explicitly to acknowledge that sub (actually quite large) area-based mechanisms DO NOT work.	The rationale already included reference to the voluntary cessation of fishing by ARK in areas where land-based predators may be impacted by reductions in krill abundance, but the rationale has been strengthened to provide additional evidence that the stock has been fluctuating around a level consistent with ecosystem needs, and therefore the SG80 is met. Whilst it would of course be an improvement if CCAMLR implemented a harvest strategy based upon small geographical areas, which is the reason for raising a condition on PI 1.2.1, the assessment team considers that the voluntary cessation of fishing by ARK in areas where land-based predators are susceptible to declines in krill abundance is nevertheless an important component of the current harvest strategy and should be considered as an important positive change in the overall harvest strategy rather than being seen purely in a negative sense as evidence that the overall harvest strategy is not working.	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.1.2	No (material score reduction expected to <80)	SIa. I contend that this should be scored because my score for 1.1.1 is < 80. My comments from the previous round still stand: "The fact that ARK voluntarily stopped fishing in 2018 is ignored. The fishing was stopped partly because of concern that fishing had locally depleted the stock. Since routes of krill transport remain unresolved, the possibility that locally stocks may take >1 generation to rebuild cannot be rejected. There is evidence from predators that the stock has been depleted: SIa should be scored by the CAB. Note also that my suggested scoring for 1.1.1 is <80."	As noted above, the assessment team considers that the score for PI 1.1.1 should be 80, and therefore there is no requirement to score PI 1.1.2. Some additional text has now been added to the rationale for PI 1.1.1b recognising that there has been some concern expressed that there could be localised impacts of fishing on land-based predators, but that the ARK fishing companies have now voluntarily stopped fishing in that specific area. Whilst there may be some concern about local depletion of the krill stock, the assessment team considers that the voluntary cessation of fishing is a positive element of the harvest strategy as it should mitigate against potential local stock depletions.	Not accepted (no change)
1.1.2	No (material score reduction expected to <80)	SIb. See above: this should be scored and my previous comments remain valid "Local surveys are conducted, including by Jeong Il Corporation (see end of para. 1, page 35), but data are not fed in to management. Monitoring is, therefore, in place and, contrary to the assertion that there is 'no evidence that the stock is depleted' ARK has voluntarily stopped fishing (see SIa) in response to concern that, locally, stocks may be depleted."	As noted above, the assessment team considers that the score for PI 1.1.1 should be 80, and therefore there is no requirement to score PI 1.1.2. The fact that local surveys are conducted but not fed into management is incorporated within the condition raised against PI 1.2.1. The assessment team considered that overall the krill stock is not depleted, but recognised that locally stocks could be depleted and that the ARK fishing companies' voluntary cessation of fishing in the specific area should ensure that krill fishing does not impact on land-based predators prior to formal measures being implemented by CCAMLR.	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.2.1	Yes	SIa. I note that the CAB accept a scoring of 60. Although the harvest strategy is expected not to impact dependent predators, there is evidence - including voluntary cesssation of fishing when penguins have been seen to be struggling to find krill prey - that the expectation may not be met. Data on krill abundance at spatial scales relevant to local predator colonies and time scales appropriate for within breeding season resolution are lacking. (See also my comment on the condition in the general comments table).	The assessment team considers that the voluntary cessation of fishing by ARK fishing companies is an important element of the harvest strategy prior to formal measures being implemented by CCAMLR. The assessment team has responded to the comment on the timeline for the condition in the general comments.	Accepted (no score change, additional evidence presented)
1.2.1	No (material score reduction expected to <80)	SIb: As stated in the previous review, "The fishery is closed at a sub-Area (e.g. 41.3) level if the trigger level for that sub-Area is met. However, there is no formal mechanism in place to restrict fishing at a smaller scale (e.g. in proximity of breeding colonies) even though there is recognition by the industry (ARK) that fishing may adversely impact predators (as evidenced by the industry's voluntary cessation / buffer-zone implementation; see https://www.akerbiomarine.com/blog/krill-industry-antarctic-conservation-in-motion). Of concern is the fact that voluntary closures argued for by this fishing industry INCREASED the local explotation rate (elapsed time for 5% to 95% capture reduced from a mean of 130 days over 5 previous years to 69 d in 2019/20) (see 'Harvested species para 2.1 SC-CCAMLR 2020)." **There is thus evidence that the harvest strategy IS NOT meeting its objectives**. Trigger levels (at a sub-Area scale) may be inappropriate to avoid adverse impacts at predator-breeding-colony scale.	There is recognition by ARK that fishing may adversely impact predators in specific localised areas, and in the current absence of formal mechanisms for restricting fishing at a smaller scale, ARK has voluntarily stopped fishing and implemented a buffer zone. This voluntary cessation of fishing is an important component of the harvest strategy, and therefore minimises the potential for krill fishing to cause serious ecosystem impacts. The assessment team maintains therefore that the harvest strategy is currently achieving its objectives and the SG80 is met. The rationale has been strengthened to emphasise this point. It is implicit that if such voluntary measures break down during the period of certification, then this scoring issue will need to be re-evaluated. The assessment team agrees that trigger levels at a sub-area scale may not be appropriate and this is the rationale behind the raising of the condition against SIa.	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.2.2	No (material score reduction expected to <80)	SIa: Well defined HCRs are in place, but breeding failures in dependent predators occur regularly (c. every 5 years) at the Peninsula. There is thus high likelihood that ecological need will not be met 'most' of the time. The HCRs may be inappropriate since they are not focused on sufficiently small/short scales.	In addition to the well-defined HCRs that are in place, there are catch trigger levels for each sub-area in Area 48 that ensure that individual sub-areas are closed if the catch trigger level is approached. The krill companies under ARK have also voluntarily stopped fishing in localised areas where dependent predators could be impacted by reductions in krill abundance. The potential for any breeding failures in dependent predators to be caused by high exploitation rates is therefore minimised. Whilst the voluntary cessation of fishing remains in place, the HCRs clearly take into account the ecological role of the stock most of the time. The assessment team maintains therefore that a score of 100 is appropriate for PI 1.2.2a.	Not accepted (no change)
1.2.2	No (material score reduction expected to <80)	SIb: HCRs are not robust to the uncertainty in proportion of SSB contributing to recruitment.	In terms of the stock in Area 48 as a whole, the HCRs, which include sub-area catch triggers and a voluntary cessation of fishing in localised areas where dependent predators could be impacted by reductions in krill abundance, are highly precautionary and although the assessment team has noted the conclusions of Meyer et al. (2020) about proportion of SSB contributing to recruitment, there are spawning hotspots other than that identified by Meyer et al. and with evidence from population mixing and larvae supply across Area 48 as a whole, the assessment team considers that a score of 80 remains justified and the uncertainty surrounding the proportion of SSB contributing to recruitment is one factor which precluded the fishery from meeting the SG100.	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.2.2	No (material score reduction expected to <80)	SIc: I note that "The assessment team agrees that the harvest strategy should be improved to ensure that fishing does not cause highly-localised depletion of krill which adversely impacts on dependent predators." By definition then, the tools in use cannot be appropriate, so a score of < 80 follows.	An additional tool in use is the voluntary cessation of fishing by ARK in localised areas where land-based predators could be affected by reductions in krill biomass, which minimises the exploitation rate in those areas and ensures that any reductions in krill biomass are not caused by fishing. The assessment team maintains that a score of 80 for this scoring issue is appropriate.	Not accepted (no change)
1.2.3	No (material score reduction expected to <80)	SIb: The harvest strategy is based on sub-Areas, which is probably inappropriate given the restricted foraging ranges of individual predators during the breeding season. Although sufficient data may be collected to support the harvest strategy, that harvest strategy may itself be inappropriate.	The peer reviewer notes that "Although sufficient data may be collected to support the harvest strategy, that harvest strategy may itself be inappropriate." The assessment team agrees with the peer reviewer that sufficient data are collected and available to support the harvest strategy, and indeed there are regular more localised sub-area scale stock surveys which are additional to the information required for the harvest strategy and harvest control rules. The assessment team maintains therefore that a score of 80 is appropriate for this SI, but that the harvest strategy itself may be inappropriate, which is reflected in the score and raising of a condition against PI 1.2.1.	Not accepted (no change)
1.2.4	No (material score reduction expected to <80)	SIa: The CAB state ""the results from the 2019 survey demonstrated that there had been no decline in krill stock biomass and therefore confirmed that the reference points and HCRs were still appropriate." In fact the variance around the 2000 and 2019 surveys are very large and this leaves it almost impossible to reject with great statistical power alternate hypotheses of reduction or increase. I suggest that it is not	The assessment team agrees with the peer reviewer that it is not necessarily sensible to draw a straight line between two uncertain estimates and conclude 'no change'. Our rationale should have been rephrased more appropriately along the lines of "...the results from the 2019 survey did not provide any evidence that there had been a decline in krill stock biomass since 2000 and	Accepted (no score change, change to rationale)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
		sensible to draw a straight line between 2 uncertain estimates and conclude 'no change'. Additional surveys are required, and I suggest that no conclusions on variability be drawn until such surveys have occurred and been analysed. This is an uncertain and highly dynamic system.	therefore confirmed that the reference points and HCRs were still appropriate." The background information in section 6.3.5 provides that different emphasis and the scoring rationale for SIa has been revised accordingly. Up until 2019 the assessment team considered that the assessment methodology would not meet the SG80, but after many years of no progress, CCAMLR coordinated the large-scale stock survey in 2019 and that with the results from that most recent assessment of stock biomass, the assessment team considered that the methodology was currently sufficient to meet the SG80 and therefore the assessment team does not consider that the score for SIa needs revising. However within the recommendation raised against this scoring issue, the assessment team made it clear that if wide-scale stock surveys are not undertaken regularly, then sub-area stock surveys will need to be continued, robust estimates of biomass in sub-areas will need to be established, and stock assessment models developed at a sub-area scale in order to determine appropriate precautionary catch limits which will take into account the potential fine-scale impact of the krill fishery on land-based predators. If this recommendation is not met within the period of certification, it is implicit that a condition will be raised against this scoring issue.	
1.2.4	No (material score reduction	SIb: The CAB acknowledge that "the reference points may need to be recalculated when estimates of the proportion of adult stock which spawn successfully become available". It therefore	The assessment team does indeed acknowledge that the reference points may need to be recalculated when estimates of the proportion of adult stock which spawn successfully become available. However, the current	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
	expected to <80)	follows that reference points based on the presumption of 100% may well be inappropriate.	reference points are highly precautionary, and the assessment team believes that a recommendation rather than a condition is an appropriate response to this uncertainty. The assessment team reiterates that the SG80 is met.	
1.2.4	No (material score reduction expected to <80)	SIc: I continue to hold that view that a full error budget is required.	The assessment team maintains its original view that the main uncertainties are taken into account, and that a full error-budget is not required to meet the SG80.	Not accepted (no change)
1.2.4	No (material score reduction expected to <80)	SIe: I am of a different opinion to the CAB. The CAB "consider that a score of 100 is justified." I maintain my original view.	The original view of the assessment team that a score of 100 is justified remains unchanged.	Not accepted (no change)
2.2.1	No (material score reduction expected to <80)	SIa and SIb: The CAB is dismissive of the potential for Ice krill bycatch. They state that "from the publicly available information on ice krill biology this species is found around the coast of Antarctica at latitudes above 74 degrees South". This ignores publicly available evidence at https://link.springer.com/article/10.1007/s002270050603. The CAB state that Ice krill are "usually found at depths down to 350–600 m", but do not give a specific reference. This statement is at odds with reports led by Korean colleagues on Ice krill (La and colleagues) that describe these krill in the epipelagic.	Thank you for the link to the paper by Brierley & Brandon 1999. No reference has been given for La and colleagues. The catch profile does not list ice krill, therefore it has not been audited by the assessment team as part of the catch profile. The assessment team can only audit what has been recorded by observers. The question arises whether the peer reviewer has taken up this perceived lack of presence on the list of species to	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
		The CAB repeatedly mentions that Ice krill have not been recorded in catch, but fail to acknowledge that Ice krill have not been searched for in detail. Absence of records does not equate to absence. See previous comment re very high likelihood in overlap of Antarctic krill and Ice krill, and hence bycatch (There is recognised potential for by catch of ice krill (e.g., 'On the very high likelihood of bycatch of Ice krill (Euphausia crystallorophias) in the present-day fishery for Antarctic krill (E. superba)'. WG-EMM-18/05)).	be recorded with the relevant agencies at CCAMLR. WG-EMM-18/05 is a paper by Brierley & Proud 2018, a paper submitted at the 2017 Third International Symposium on Krill held at St Andrews Scotland. There is no further indication that the comments made in that paper resulted in changes to the bycatch recording tables and protocols for observers. It is the expectation that such issues are evaluated and addressed through due process such as review and countermeasures discussed in Scientific Committees or Working Groups. The assessment team could find no evidence of this. The reference for ice krill depth distribution is http://peterbrueggeman.com/nsf/fguide/arthropoda.pdf)	
2.2.2	No (material score reduction expected to <60)	The CAB suggest "There may well be limited overlap between the distribution of ice krill and the fishery, accounting for the no-show in observer records.". Throughout 2.2.2 the CAB simply state "The scoring as proposed is not applicable". I disagree, and contend that my original scoring < 60 for a-e (but not d, which was not scored) should stand.	Please see above.	Not accepted (no change)
2.2.3	No (material score reduction expected to <60)	SIa. Understanding of the level of bycatch of ice krill is inadequate to assess threat or, in the face of threat to manage this species. Unfortunately repeated statement by the CAB that "No ice krill was recorded in the catch profile from 2016-2019." does not persuade me that this potential bycatch is being properly considered. This unfortunately is not in keeping with the precautionary principal.		

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.2.3	No (material score reduction expected to <60)	SIc. Understanding of the level of bycatch of ice krill is inadequete to assess threat or, in the face of threat to manage this species. Unfortunately repeated statement by the CAB that "No ice krill was recorded in the catch profile from 2016-2019." does not pursuade me that this potential bycatch is being properly considered. This unfortunately is not in keeping with the precautionary principal.	See response above.	Not accepted (no change)
2.3.1	Yes	SIa: The CAB explain their non-scoring.		
2.3.1	No (material score reduction expected to <80)	SIc: The CAB have added explanation about the extent of research being conducted, and argue that this makes 100 appropriate. My view is that more directed research is required, and hence I suggest a score of 80 would be more appropriate.	In the opinion of the assessment team the harvest strategy is sufficiently precautionary to incorporate lack of detailed knowledge.	Not accepted (no change)
2.3.2	No (material score reduction expected to <60)	SIa: Implementation of voluntary measures as per the web link provided seems to acknowledge that only adhering to CCAMLR HCRs is inadequate. On the one had the adoption of VMs is to be welcomed, but the weakness that the industry's perceived need for VMs exposes failings in 'official' HCRs.	The assessment team do not consider Voluntary Measures to be a sign of weakness of the existing harvest strategy. They can also be interpreted as a demonstration that the krill fisheries want to fish sustainably by applying industry led initiatives for best fishing practices. Voluntary measures are measures in addition to existing CCAMLR measures and are to be encouraged for all and any fishery, rather than be used as evidence for failings, as this peer reviewer seems to be implying here.	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.3.2	No (material score reduction expected to <80)	SIb: Implementation of voluntary measures as per the web link provided seems to acknowledge that only adhering to CCAMLR HCRs is inadequate. On the one had the adoption of VMs is to be welcomed, but the weakness that the industry's perceived need for VMs exposes failings in 'official' HCRs.	This scoring issue was not scored.	NA (No response needed)
2.3.2	Yes	SIc: I defer to the view that Ice krill are not ETP.		NA (No response needed)
2.3.3	No (material score reduction expected to <80)	SIb: A recommendation to 'improve recording', but as things stand recording is inadequate.	This information PI relates to ETPs only. The assessment team does not agree with the peer reviewer, the information is adequate to meet this scoring issue at SG100.	Not accepted (no change)
2.4.1	Yes	I agree with the CAB's new statements.		NA (No response needed)
2.4.2	Yes	I agree with the CAB's new statements.		NA (No response needed)
2.5.2	No (material score reduction	SIa: The argument re "whether there are species that solely feed on ice krill." is bogus. There is a reft of ecological evidence to show that if a predator's preferred prey is reduced that the predator does less well. Many species include Ice krill in their diet.	The original response to this issue as provided for the PCDR stands.	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
	expected to <80)			
2.5.2	No (material score reduction expected to <80)	SIb: The CAB accept that "No confidence whatever can be drawn from the similarity in krill biomass from 2 surveys c. 20 years apart given other higher-frequency variability". It remains to be seen whether planned surveys provide sufficient time/space data to enable small-scale/high-frequency events to be resolved. Until such time, score < 80 is appropriate. The CAB said in their response to 3 of my comments that they could not 'speculate', and in response to my 2.5.3 that it "can only assess information actually available". In that way, it would be unsafe to speculate on whether the planned surveys will occur, and I would reserve judgement until the data are in hand.	The research by Macaulay et al 2019 was used to justify the score given. A certified fishery is subject to annual surveillance audits, when changes to krill biomass estimates are also checked, as well as updates on any surveys. If and when there are observed significant changes this will be reflected in the audit results.	Not accepted (no change)
2.5.3	No (material score reduction expected to <80)	SIc and d: The CAB's near refusal to acknowledge the possibility of impact on Ice krill is disappointing. None of their responses speak to the very high likelihood that Ice krill are caught but just not recognised. Ice krill will not appear in the catch profile if their is no mechanism in place to identify them.	It is through the CCAMLR science and observer programmes that such mechanism are introduced so that the recording protocol can be properly tested and observers properly trained on all relevant krill fishery vessels. In order to affect change of the recording and analysis protocols there are CCAMLR procedures to go through. For such bycatch data to be meaningful it has to be done on all krill vessels, following the same protocol. When such bycatch data is available any assessment team will evaluate it accordingly, in the meantime, to score a fishery based on speculation rather than hard data, is just not possible.	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
3.2.1	Yes	SIa: I defer to the CAB's understanding of the process		NA (No response needed)
3.2.2	No (material score reduction expected to <80)	SIa: The CCAMLR website suggests that WG-EMM-2021 will be held online 5-16 July. It may be prudent to await the outcome of that meeting (the end of which will, after all, not be very much after the next stage of this assessment), before fixing this score. There would then be no need for speculation on outcome regarding replacement (or not) of the important CM 51 07.	Scoring issue (a) regards "established decision-making processes", which exist. It doesn't concern outcomes of specific WG. SG80 is met.	Not accepted (no change)
3.2.2	No (material score reduction expected to <80)	SIb: The position re CM 51 07 remains unresolved.	As per our previous response: "The team cannot speculate regarding what might happen during the 2021 CCAMLR meeting, and can only base its assessment on existing, verifiable and public information available before the end of the (extended remote) site visit. See clause 7.20.2.c."	Not accepted (no change)
3.2.2	No (material score reduction expected to <80)	SIc: CCAMLR operates by consensus. It does not follow that having the best information available leads to best implementation on the basis of that information.	Indeed, however, as per our previous response: SIc assesses the "decision-making processes", the "use the precautionary approach" and whether decision-making processes "are based on best available information." It does not assess the content of all decisions made."	Not accepted (no change)

Peer Reviewer B

Peer Reviewer B was satisfied with the team's responses and did not wish to add any further comment.

Peer Reviewer C

General Comments

Question	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments
List here any issues not covered in the Performance Indicators or Conditions table (following sheet) that you feel have not been adequately addressed in the CAB response and would make a material difference to the scoring of the fishery.	The report was excellent in the first place and the team has responded to my comments in a detailed and constructive manner. There are just two SIs (PI2.3.3 SIb and PI2.4.2 SIa) that I would ask the team to have another look at - full details of my rationale in each case is provided. I support the team's approach to the "Mystery of the Cattle Egret".	Thank you for your comments throughout these two reporting stages. The team hopes that the PI-specific issues you bring up here have been adequately addressed in the table below.

Performance Indicator Comment

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
1.2.1	Yes	The team has made a minor amendment to SIe as proposed.		NA (No response needed)
1.2.4	Yes	The team's response to the comments on scoring of SIc address the issues raised.	Thank you.	NA (No response needed)
2.1.1	Yes	The team has clarified the status of Dissostichus mawsoni - my apologies for missing the narrative text previously.		NA (No response needed)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
2.1.2	Yes	The team has clarified the status of Dissostichus mawsoni - my apologies for missing the narrative text previously.		NA (No response needed)
2.1.3	Yes	The team has clarified the status of Dissostichus mawsoni - my apologies for missing the narrative text previously.		NA (No response needed)
2.2.2	Yes	The team's response and revisions to the text are appropriate.		NA (No response needed)
2.2.3	Yes	The team's response provides adequate justification for scoring SIc at 100.		NA (No response needed)
2.3.2	Yes	The team's response and revision to the rationale as well as scoring at SG80 for SIa are appropriate.		NA (No response needed)
2.3.3	Yes	SIa: the revision to the rationale is appropriate.		NA (No response needed)
2.3.3	No (non-material score reduction expected)	SIb: My mistake, I copied the comment from earlier PIs in here and left in some stray text about secondary species in the penultimate line. I think that the team should have worked this out from the earlier text, so the response ("This component deals with ETP species, not secondary species.") is a bit cheeky.	Apologies if the response came across as cheeky, that was not the intent. This assessor has learnt not to assume what a reviewer meant to write compared to what they did write.	Not accepted (no change)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
		This observation notwithstanding I remain concerned that there is not adequate information presented in the report or the rationale to show that the second part of the SG100 requirements are met (i.e. that "Information is adequate to [...] evaluate with a high degree of certainty whether a strategy is achieving its objectives."). To show that this is met, there needs to be a clear understanding of what these objectives are, and also some quantitative evidence to show that the ""high degree of certainty"" criterion (Table SA9) is met. A score of 80 for this SI would still seem to be more appropriate than 100.	This is the information PI and not the management PI. Following the wording of the SI at 100, it is specific to the UoA, the kind of information collected by observers, with 100% observer coverage, the kind of measures in place on board to reduce the risk of interaction with ETPs, and whether the information is good enough. Considering the low direct interaction with ETPs and the observer coverage, it is.	
2.4.2	No (non-material score reduction expected)	SIa: I am not at all certain of the wisdom of the team's approach here. To recap - I had raised concern that the rationale referred to management measures that are not relevant to the UoA because they apply to other geographic areas (i.e. beyond the UoA), and also to management of impacts on habitats that are not impacted by the UoA. The response is that SG100 scoring is "...not restricted to a certain area and certain gears.". Where, then, does the team draw the line? If this is the case, then shouldn't the scoring reflect that there are MSC-certified and non-certified toothfish longline fisheries in the CCAMLR area that are not (yet) subject to a strategy for managing impacts on habitats? The MSC's normative text also requires at SA3.14.2.1 that "In scoring issue (a) at the SG100 level, the “strategy” for a UoA that	Good point, where do we draw the line? There certainly is not the time available for an assessor to review all non-krill fisheries whether they encounter VMEs and if so whether they have conducted comprehensive impact assessments. Considering the broad sweep SI a) text at SG100, which appears to include all fisheries in the managed area, not just krill targeting fisheries, it would be a tall ask. However, guidance is helpful with this, and GSA3.13.5 exceptional cases is applied. Therefore, the justification text for this scoring issue has been edited to make clear that the managed area is 48.1 and 48.2. The text has further been edited to only relate to	Accepted (no score change, change to rationale)

PI	PI Information	Peer Reviewer Justification	CAB Response to Peer Reviewer's comments	CAB Response Code
		encounters VMEs shall include a comprehensive management plan that is supported by a comprehensive impact assessment that determines that all fishing activities will not cause serious or irreversible harm to VMEs." Whilst the team has referred to CCAMLR CMs, I am not convinced that this requirement is fully met. On balance, a score of 80 for this SI still seems more appropriate unless further evidence to address these issues can be provided.	relevant strategy withing that managed area (ie delete such protection strategies in Ross Sea for eg).	
2.5.2	Yes	The team has made amendments to the scoring rationale for SIa which now justify the score awarded.		NA (No response needed)
3.1.3	Yes	The rationale has been appropriately revised in response to the comments made.		NA (No response needed)

Appendix 5 Stakeholder input

<u>WWF comments on the ACDR</u>

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
1.1.1	Climate change impacts on	Using the greenhouse gas emissions scenarios set out in the IPCC report it has been estimated that the Weddell Sea	IPCC. Special Report on the Ocean and Cryosphere in a Changing Climate. (2019).		The assessment team is aware of the recent literature on the potential impact of climate change and ocean acidification	Accepted (no score change)

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
	Antarctic Krill biomass	will become a high-risk area for krill recruitment over the next 100 years and that, if CO2 emissions are not reduced and mitigated that the Antarctic krill population could collapse by 2300. Given that there is no indigenous or local community dependent on krill, or income from krill fishing, there is not substantial reason not to reduce exploitation rates to address these, very serious, issues. CCAMLR's consideration of these impacts of climate change in managing the fishery is inadequate. WWF recommends CCAMLR conservation measures managing the krill fishery must explicitly account for climate change prior to MSC certification.	Klein, E. S., Hill, S. L., Hinke, J. T., Phillips, T. & Watters, G. M. Impacts of rising sea temperature on krill increase risks for predators in the Scotia Sea. PLoS ONE 13, e0191011 (2018). Michon Scott. 2020. https://www.climate.gov/news-features/understanding-climate/understanding-climate-antarctic-sea-ice-extent Atkinson, A., Hill, S.L., Pakhomov, E.A. et al. Krill (Euphausia superba) distribution contracts southward during rapid regional warming. Nature Clim Change 9, 142–147 (2019). https://doi.org/10.1038/s41558-018-0370-z Hill, S.L., Phillips, T. and Atkinson, A. 2013. Potential climate change effects on the habitat of Antarctic krill in the Weddell quadrant of the Southern Ocean. PLoS ONE 8(8):e72246. doi: 10.1371/journal.pone.0072246 Kawaguchi, S., Ishida, A., King, R., Raymond, B., Waller, N., Constable, A., Nicol, S., Wakita, M. and Ishimatsu, A. 2013. Risk maps		on krill abundance and distribution, and we have now included further detail on these potential impacts in the report. The scoring of PI 1.1.1 on stock status is inevitably a snapshot in time when the MSC assessment is conducted and, as with all MSC-certified fisheries, the scoring is reviewed at annual surveillance audits. At present the evidence from the most recent synoptic stock survey in 2019 provided an estimate of krill biomass above the pre-exploitation level (B0) estimated from the 2000 synoptic survey, and therefore well above 20 % of virgin biomass, the point at which there could be serious ecosystem impacts, and above the target reference point of 75 % of the median pre-exploitation biomass. In acknowledgement of the concern that krill catches could have a significant impact on the ecosystem if they are concentrated in small, localised areas which are	

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
			for Antarctic krill under projected Southern Ocean acidification. Nature Climate Change 3: 843-847.		important foraging grounds for dependent krill predators, and in view of the need to re-evaluate the current sub-division of the catch trigger levels across sub-areas set out in CCAMLR CM 51-07, the assessment team gave a precautionary score of 80 (and not 100) to SIb. If in future years, there is clear evidence that krill abundance has declined through climate change or other effects, then the score for PI 1.1.1 will be revised.	
1.2.1	Concentration of effort and increased risk of localised depletions	"Concentration of fishing effort and increasing harvest rates are a growing concern in the Antarctic Peninsula and Scotia Sea area (CCAMLR Area 48). The catch of krill in the 2019/20 season was the largest catch ever reported in Area 48, reaching 446,783 tonnes. The duration in which it was caught was much shorter than over the previous five years - 69 days rather than 130 days. Leading scientists have recently presented the first evidence,	"Scientific Committee for the Conservation of Antarctic Marine Living Resources (SC-CAMLR) Report 2020, Table 2. Watters, G.M., Hinke, J.T. & Reiss, C.S. Long-term observations from Antarctica demonstrate that mismatched scales of fisheries management and predator-prey interaction lead to erroneous conclusions about precaution. Sci Rep 10, 2314 (2020). https://doi.org/10.1038/s41598-020-59223-9		Our report highlights concerns that krill fishing effort is concentrated in Area 48, but notes that the disaggregation of catch quotas across sub-areas as set out in CM51-07 has provided additional precaution to that provided by the overall catch trigger level of 620,000 tonnes. The assessment team notes that the fishery in sub-areas has been closed regularly in recent years when the sub-area trigger level has been reached, which demonstrates that this	Accepted (no score change)

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		based on 30+ years of monitoring data, that krill fishing has had negative impacts on penguins and that these impacts have been about the same magnitude as those of poor environmental conditions. Their results suggest that the current catch limit for the krill fishery, which is set at a regional scale, is not as precautionary as decision makers presumed because fishing effort has concentrated in smaller areas nested within the region, and they have seen the impacts on penguins in these smaller areas. In line with precautionary trigger levels set out in CCAMLR Conservation Measure 51-07 (CM 51-07), the fishery in subarea 48.1 was closed on May 30, 2020, due to the catch limit for this subarea being exceeded. The fishery in subarea 48.1 has been closed prior to the end of the fishing season eight times since 2010 for this reason.	CM 51-07 https://www.ccamlr.org/node/92622 SC-CAMLR-39/BG/47. ASOC. Progress toward ecosystem-based management of the Antarctic krill fishery https://www.ccamlr.org/en/sc-camlr-39/bg/47 "		precautionary harvest strategy has been successfully implemented. We agree that a robust review of CM51-07 is required and note that CCAMLR's research programme will address this as a matter of priority. In relation to the scoring of PI 1.2.4a, the assessment team noted that "...the high costs of conducting large-scale stock surveys may preclude further such surveys in the near future, and therefore alternative approaches may be required to ensure that the stock assessment approach remains appropriate to the stock throughout the recertification cycle" and recommended that the new sub-area assessment approach is developed within the course of the certification cycle. Implicit in these comments is that the SG80 for PI 1.2.4a may not be maintained without either regular synoptic stock surveys or the development of a more precautionary sub-area-based approach.	

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		WWF recommends a robust review of CM 51-07 to include the implementation of small-scale management units (SSMUs) to better account for increased risk of localised depletion by the fishery and improve improved highly precautionary management, prior to MSC certification."				
1.2.3	Also relevant for 3.2.4 Krill fishery management workplan and risk assessment	"Currently, Krill catches are allocated to subareas by CCAMLR Conservation Measure 51-07 (CM 51-07) to allow for inter-annual variation in the distribution of krill aggregations and alleviate the potential for adverse impacts of the fishery in coastal areas on land-based predators (Figure 1). CM 51-07 expires in 2021. In 2019 CCAMLR agreed to a krill fishery management work plan to improve management of the fishery. The work plan includes: 1. A stock assessment to estimate precautionary harvest rates (completed) 2. Regular updates of biomass estimates, initially at the	CCAMLR-38 2019, Annual meeting of the Commission for the Conservation of Antarctic Marie Living Resources, paragraph 5.17		As noted above in our response to the points raised in relation to PI 1.2.1, our report highlights concerns that krill fishing effort is concentrated in Area 48, but notes that the disaggregation of catch quotas across sub-areas as set out in CM51-07 has provided additional precaution to that provided by the overall catch trigger level of 620,000 tonnes. We agree that a robust review of CM51-07 is required and our report provides details of CCAMLR's research programme agreed in 2019 that will address this as a matter of priority. In relation to the scoring of PI 1.2.4a, the	Accepted (no score change)

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		subarea scale, but potentially at multiple scales 3. A risk assessment framework to inform the spatial allocation of catch across the SMRUs Each of the three priority elements of the work plan serves to answer management questions at a defined spatial scale. The risk assessment is an element critical to deconcentrating fishing by setting catch limits at finer spatial scales in relation to fishing operations and predator feeding. The implementation of this workplan is due to correspond with the expiration of CM 51-07 at the end of the 2020-2021 fishing season. "			assessment team noted that "...the high costs of conducting large-scale stock surveys may preclude further such surveys in the near future, and therefore alternative approaches may be required to ensure that the stock assessment approach remains appropriate to the stock throughout the recertification cycle" and recommended that the new sub-area assessment approach is developed within the course of the certification cycle. Implicit in these comments is that the SG80 for PI 1.2.4a may not be maintained without either regular synoptic stock surveys or the development of a more precautionary sub-area-based approach.	
2.3.2	Also related to 3.2.4 By-catch and incidental mortality	"Incidents of incidental mortality of seabirds and seals, particularly related to the krill fishery, are increasing. At the SC-CAMLR meeting in 2019 it was reported that over the previous two years, 21 bird strikes were observed on continuous krill trawlers, and zero strikes	"SC-CAMLR-38, "Report of the Thirty-Eighth Meeting of the Scientific Committee" (2019), https://www.ccamlr.org/en/sc-camlr-38 Scientific Committee for the Conservation of Antarctic Marine		This krill fishery under assessment does not use the continuous trawl method, the net is hauled and emptied into the hold. The 2020 observer coverage was 100 %, for each of the two vessels. The reports for 2020 indicate that there was no seabird nor marine	Accepted (no score change)

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		observed from non-continuous trawl vessels. Despite this, in 2019, Norway was granted an exemption from a prohibition to use net monitoring cables for a one-year trial. The following conditions were also applied to the trial: 1. 100 % observer coverage for any vessel included in the trial 2. the use of a camera or video monitoring system (able to operate in low light conditions) that continuously records the full aerial length of the net monitoring cable and the seaward entry point 3. the observer(s) conduct observations on incidental mortality arising from fishing (IMAF) on the net monitoring cable and trawl warp at least twice daily, following the current standard warp strike observer protocols outlined in the SISO krill logbook instructions 4. the mandatory use of effective mitigation limiting seabird access to the area where warp cables and net monitoring	Living Resources (SC-CAMLR) Report 2020, paragraphs 2.6-2.8."		mammal interaction. The ACDR will be updated with the 2020 reports, as well as recent scientific meetings, to reflect recently published research. Thank you for these.	

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		cables are deployed. Mitigation should be consistent with specifications relevant to trawlers (e.g., ACAP best-practice advice for trawlers). In 2020, research on the net monitoring cables was not delivered and conditions of the trials were not met. Concerns were raised at the CCAMLR 39 meeting because of the high bird strike rate in a very small proportion of the trial which was reported on (only 2 % of fishing was observed). The relevant conservation measure (CM25-03) was approved to allow the derogation to continue for a further year and Norway undertook to report fully in 2021. An intersessional group was established to ensure requirements of the trial are met, including improved mitigation measures, observer coverage and reporting. WWF does not support the continuation of this derogation beyond 2021, without improvements to research design and full reporting requirements being met,				

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		demonstrating the use of technologies and techniques to effectively mitigate seabird bycatch during krill fishing."				
2.5.1	Research on the impact of increasing catch rates on krill predators	"Research published this year has shown that the krill fishery, particularly around the Antarctic Peninsula, may be having a larger negative impact on krill predators in the area than previously thought, particularly Adélie (*Pygoscelis adeliae*), chinstrap (*P. antarcticus*), and gentoo (*P. papua*) penguins. Watters et al. 2020 assessed 20 indices of penguin performance alongside krill harvest rates over the last 30 years and found that overall performance of the three penguin species was reduced when local krill harvest rates were ≥0.1. This is a significant finding that indicates that the management of the fishery may not be as precautionary as previously thought. This work also suggests that the impact of krill fishing, even at precautionary limits, is similar to that of pressure from climate change as measured by the	"Watters, G.M., Hinke, J.T. & Reiss, C.S. Long-term observations from Antarctica demonstrate that mismatched scales of fisheries management and predator-prey interaction lead to erroneous conclusions about precaution. Sci Rep 10, 2314 (2020). https://doi.org/10.1038/s41598-020-59223-9 Krüger, L., Huerta, M.F., Santa Cruz, F. et al. Antarctic krill fishery effects over penguin populations under adverse climate conditions: Implications for the management of fishing practices. Ambio (2020). https://doi.org/10.1007/s13280-020-01386-w WWF & University of California, Santa Cruz. WHALES OF THE ANTARCTIC PENINSULA - Science and Conservation for the 21st Century. A report for policymaker. 10.13140/RG.2.2.29921.76640 Weinstein, B. G., Double, M., Gales, N., Johnston, D. W. &		Thank you for the information. The krill assessment report will be updated to incorporate these recent publications, and the implications of these studies will be evaluated accordingly.	Accepted (non-material score reduction)

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		Oceanic Nino Index. This is further supported by research by Krüger et al (2020) who also found that increasing climate change impacts on krill distributions alongside increasing krill catch limits outside the breeding season is having a negative impact on Chinstrap (*Pygoscelis antarcticus)* and gentoo (P. *papua*) populations. The recovery of cetacean populations in the Southern Ocean also has implications for whether management of the krill fishery will be precautionary. Cetaceans forage in areas of the Watters et al. (2020) study and they suggest determining whether future management of the krill fishery is precautionary would benefit from consideration of such ecosystem perspectives. During the 20th century, unchecked commercial whaling dramatically reduced whale populations throughout the Southern Ocean, driving many species to the brink of extinction. Species foraging on	Friedlaender, A. S. Identifying overlap between humpback whale foraging grounds and the Antarctic krill fi shery. Biol. Conserv. 210, 184–191 (2017). "			

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		Antarctic krill in the region are still recovering. Krill fishing is concentrated in this area and overlaps key feeding areas for large whales. (WWF & UCSC 2018). CCAMLR management guidelines require that the krill fishery not interfere with population growth of Antarctic krill predators. However, current management of the krill fishery has not considered or assessed the needs and behaviour of the largest krill predators in the Antarctic - baleen whales. The broad implication of the paper for ecosystem-based fishery management includes that to conserve predators of forage species that are targeted by fisheries, it is important to set catch limits at a geographic scale over which the predators, prey, and fishery interact. In the case of the krill fishery that might mean setting catch limits for areas smaller than current CCAMLR Statistical Subareas. WWF recommends that CCAMLR respond to the latest scientific evidence of the impact of this				

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		fishery on predator species and better implement a broader range of krill predators including baleen whales in the review of CM 51-07, prior to assessment for MSC certification. "				
2.5.2	CCAMLR Ecosystem Monitoring Program (CEMP) & A slow rollout of the Marine Protected Area (MPA) network	"CCAMLR maintains a network of locations where information is collected on key components of the Antarctic ecosystem to monitor change. This program, the CCAMLR Ecosystem Monitoring Program (CEMP), was established in 1989. The aims are to: 1. 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. distinguish between changes due to harvesting of commercial species and changes due 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	"CCAMLR Ecosystem Monitoring Program (CEMP) https://www.ccamlr.org/en/science/ccamlr-ecosystem-monitoring-program-cemp Johnson, C. et al. WWF Tracking Antarctica - An update on the state of Antarctica and the Southern Ocean. (2016). doi:10.13140/RG.2.2.31957.01767 WWF & University of California, Santa Cruz. WHALES OF THE ANTARCTIC PENINSULA - Science and Conservation for the 21st Century. A report for policymaker. 10.13140/RG.2.2.29921.76640 WWF. Tracking Antarctica - Responding to the Climate Crisis (2019) 10.13140/RG.2.2.30246.47686 Marine protected areas and climate change : adaptation and mitigation synergies,		Thank you for the information. The krill assessment report will be updated to incorporate these recent publications, and the implications of these studies will be evaluated accordingly.	Accepted (no score change)

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		changes in the abundance of harvested species. 'Dependent species' are marine predators for which species targeted by commercial fisheries are a major component of their diet. In the case of 'krill-dependent species' used in CEMP they include land-based species such as seals and penguins. While CEMP focuses a handful of indicator species, new technologies and range of collaborative scientific efforts are underway where CEMP can now be modernised to include baleen whales and other predators as part of its monitoring efforts to get a true picture of the impacts by the fishery. WWF supports a review to modernise the CCAMLR Ecosystem Monitoring Program (CEMP) to account for a greater number of krill predators including baleen whales, prior to assessment for MSC certification. MPAs In 2002, CCAMLR has committed to establish a system of Antarctic	opportunities and challenges. (IUCN, 2016). doi:10.2305/iucn.ch.2016.14.en Kenchington, E., Brock, R. J., Martinez-Arroyo, A. & Commission for Environmental Cooperation. Scientific guidelines for designing resilient marine protected area networks in a changing climate. (Commission for Environmental Cooperation, 2012)."			

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
		MPAs as part of a comprehensive, ecosystem-based approach to managing the CCAMLR Area. Unfortunately to date this has not been delivered with only two MPAs established, the Ross Sea region and South Orkney Islands Southern Shelf MPAs. There are three outstanding proposals currently seeking approval: The East Antarctic MPA, the Weddell Sea MPA and the Domain 1 (aka the Antarctic Peninsula and Scotia Sea) MPA. Well-managed networks of marine protected areas (MPAs) are powerful tools that allow wildlife and habitats to recover and build resilience to future disturbances."				
3.2.3	Transhipment activities	The extent of krill transhipment operations continues to be largely unknown due to CCAMLR's current weak regulations and lack of transparency. This could be addressed with better observer coverage and through the introduction of EM systems.	CCAMLR-39/BG/09 Enhancing CCAMLRs compliance regime ASOC 2020		Thank you. The team recognises that transhipments on the High seas are a risk of IUU activities in CCAMLR waters. However, this does not apply to this fishery, which was found during the site visit to have 100 % Observer coverage of all transhipment activities. This was confirmed	Not accepted (no score change)

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
					by the Korean FMC during the site visit, and examples of transhipment reports required by the flag state FMC and MCS competent authority were communicated to the Team. The sections 5.2, 6.3.4 and 6.5.2 of the report were complemented to reflect this. The Team believes that the current measures put in place by CCAMLR, combined with the measures put in place by the Korean government (dockside checks upon landing, VMS tracking, observer and captain reporting, monitoring of activities at sea by the FMC) are sufficient to provide confidence that the product from this fishery is not being substituted, mixed or tampered with throughout the transshipment process. While the comment made by WWF is aimed at CCAMLR in isolation, the team assesses how the various jurisdictions work together to deliver reliable, sustainable fisheries	

Performance Indicator	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
					management, this includes transshipment activities.	

WWF comments on the PCDR

General comments:

General comments	Evidence or references	CAB response to stakeholder input	CAB response code
WWF welcome the chance to comment on the draft report and thank the authors for their consideration of the previous WWF submission. We are pleased to note the proposed condition and milestones recommended for Performance Indicator 1.2.1 as well as the recommendations for PIs; 1.2.3, 1.2.4, 2.2.1 and 2.5.2. However, as detailed in our previous submission we still have a number of concerns around the management and overall impact of the fishery and we reiterate the recommendation against assessment for certification. WWF would like to present new evidence in addition to the information previously submitted, this is in relation to the following Performance Indicators: 1.2.1 Harvest Strategy 2.5.1 Ecosystem Outcome		Thank you for your submissions throughout the assessment process and for your valuable input to several reporting stages. The team disagrees with the recommendation against assessment for certification – as the fishery does not score below SG60 on any single Scoring Indicator, and the Principle scores all achieve scores equal to- or above 80. The team does note that some of the issues WWF pointed out at the ACDR stage are interesting, and worth taking up with the standard bearer (the MSC) directly. re PI 1.2.1. The assessment team thanks WWF for their support for the condition against Performance Indicator 1.2.1 and the various new recommendations and has	Accepted (no score change - additional evidence presented)

General comments	Evidence or references	CAB response to stakeholder input	CAB response code
		responded below to the more detailed comments against the specific PIs. re PI 2.5.1. Thank you for this interesting additional information - an ever expanding field of research. The information has been added to the relevant ecosystems section as a subheading - 6.4.5.3., as well as to the rationale under PI 2.5.1.	

PI input:

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
1.2.1	New advice from SKAG	Committee on Antarctic Research (SCAR) Krill Action Group (SKAG) to host a online workshop focused on evaluating change within the krill-based food web and developing solutions for the future sampling of krill. SKAG provides a conduit for science to feed into the management of the Antarctic krill fishery. The workshop was attended by over 100 krill scientists and comprised 16 science talks summarising the current traditional and emerging methods to sample and analyse krill, focusing on their ability to observe spatio-temporal change within the krill-based food web.	Report of the online SCAR Krill Action Group (SKAG) workshop, 26-30 April 2021 https://scar.org/library/science-4/life-sciences/skag/5665-skag-workshop-2021/file/		The assessment team welcomes the new information generated following the recent SCAR Krill Action Group (SKAG) workshop. Whilst this new information has become available technically outside the cut-off point for information being used in the assessment, the workshop nevertheless highlights many of the ongoing research initiatives that are providing new insights and understanding of spatio-temporal change within the krill-based food	Not accepted (no change)

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
		The large number of attendees provided sufficient sample size for zoom polling; the clear consensus of attendees was that that there is a requirement for changes to be made in how science is linked to management of krill fishery. There was further agreement that changes will be best achieved through both the provision of data and improved communication with the management organisation (CCAMLR). Further research is currently underway on the basis of the workshop outcomes to provide advice on how to best improve management of the fishery. WWF recommends that the MSC assessment of the fishery is postponed until such time as this research and any recommendations are published, along with the ongoing Risk Assessment and workplan.			web and future sampling of krill. These issues are reflected in the condition raised against PI 1.2.1 and the recommendation on PI 1.2.4. The assessment team does not agree with WWF that certification should be delayed until such time as this research and any recommendations are published. We emphasise that certified fisheries are subject to annual surveillance audits at which Performance Indicators can be rescored if new evidence becomes available.	
2.5.1	The contribution of Antarctic krill to the capture and storage of atmospheric carbon	In the previous submission we highlighted the impact that climate change is having and will have on the size and distribution of the krill population. However, it is also worth considering the roll that krill play in carbon capture and sequestration processes in the Southern Ocean, which is a key Nature Based Solution in the fight against climate change. Recent research has highlighted that Antarctic krill contribute to carbon sequestration in a number of key ways (see figure 1); Antarctic krill feed on carbon-rich phytoplankton, through their vertical and horizonal migrations they then	Tarling, G.A. and Johnson, M.L. 2006. Satiation gives krill that sinking feeling. Current Biology 16: R83-84. Manno, C., Fielding, S., Stowasser, G. et al. Continuous moulting by Antarctic krill drives major pulses of carbon export in the north Scotia Sea, Southern Ocean. Nat Commun		Thank you for the extra information, considerations, context, and references. This valuable input has been incorporated into the report.	Accepted (no score change - additional evidence presented)

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
		provide a key pathway for the carbon to be sequestered at depth in their expelled waste and faecal pellets, they also release limiting nutrients such as iron, which in turn encourages further primary production. Krill shed their exoskeletons approximately every 10 days and the exoskeletons , together with the faecal pellets account for 87% of an annual particulate organic carbon flux in the Southern Ocean (22.8 g m−2 y−1). The movement of the krill encourage biogenic mixing, which is the process by which nutrients are mixed in the water thus aiding the cycle of critical elements such as Iron, which is a limiting element in the oceanic carbon cycle and supporting primary production. Figure 1: Highlighting the role of Antarctic krill in the biogeochemical processes that store carbon. Antarctic krill larvae also play an important role in the biogeochemical storage of carbon, though in a different way than adult krill. Larval krill are dependent on sea ice for shelter as well as a food source, feeding on the ice algae. It has been estimated that larval kill consume the equivalent to roughly 26% of their own body weight in carbon per day, which is then excreted through the faecal pellets. Individually, this is a substantially lower volume of carbon deposit than adults, ~1000 times less, however larval krill can be up to 100 times more abundant than adult krill in some regions such as the Scotia Sea. Coupled with the fact that the larvae undertake deeper Diurnal Vertical Migrations (DVM) (to	11, 6051 (2020). https://doi.org/10.1038/s41467-020-19956-7 Kunze, E., Dower, J.F., Beveridge, I., Dewey, R. and Bartlett, K.P. 2006. Observations of biologically generated turbulence in a coastal inlet. Science 313: 1768-1770. Dewar, W. A fishy mix. Nature 460, 581–582 (2009). https://doi.org/10.1038/460581a Nicol, S., Bowie, A., Jarman, S., Lannuzel, D., Meiners, K.M. and van der Merwe, P. 2010. Southern Ocean iron fertilization by baleen whales and Antarctic krill. Fish and Fisheries 11: 203-209. Tim M. Conway, Seth G. John. Quantification of dissolved iron sources to the North Atlantic Ocean. Nature,			

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
		400m compared with adults 200m), it is estimated that Antarctic krill larvae faecal deposits contribute between an additional 1-10% of carbon flux compared with the adult biomass. Potential impacts on carbon storage of changes in Antarctic krill abundance The Antarctic krill fishery has one of the largest landings by biomass globally. However, it has been estimated that the current fishery does not impact too heavily on the krill populations ability to store carbon. This may change as the sea ice recedes further and the fishery is able to exploit new areas, care must be taken to ensure over-exploitation and by-catch of larval and juvenile krill does not occur. The catch of krill in the 2019-20 season was the largest catch ever reported in Area 48 (the Antarctic Peninsula and Scotia Sea area), with 446,783 tonnes being caught (72% of the total interim trigger level/catch limit). The time between 5-95% of catch being taken was 69 days, compared to an average of 130 days over the previous 5 years. While this exploitation level is within the TAC set by CCAMLR, the impact of the reduced biogeochemical processes from the increasing removal of krill is poorly understood.	2014; DOI: 10.1038/nature13482 Cavan, E.L., Belcher, A., Atkinson, A. et al. The importance of Antarctic krill in biogeochemical cycles. Nat Commun 10, 4742 (2019). https://doi.org/10.1038/s41467-019-12668-7 60 https://theconversation.com/how-antarctic-krill-fertilise-the-oceans-and-even-store-carbon-all-with-their-poo-125362 Meyer, B., Freier, U., Grimm, V. et al. The winter pack-ice zone provides a sheltered but food-poor habitat for larval Antarctic krill. Nat Ecol Evol 1, 1853–1861 (2017). https://doi.org/10.1038/s41559-017-0368-3 Meyer, B., Atkinson, A., Blume, B. & Bathmann, U. V. Feeding and energy			

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
			budgets of larval Antarctic krill Euphausia superba in summer. Mar. Ecol.Prog. Ser. 257, 167–178 (2003). Tarling, G. A. & Johnson, M. L. Satiation gives krill that sinking feeling. Curr. Biol. 16, R83–R84 (2006). Brinton, E. The oceanographic structure of the eastern Scotia Sea—III. Distributions of euphausiid species and their developmental stages in 1981 in relation to hydrography. Deep Sea Res. Pt. A. Oceanogr. Res. Pap. 32, 1153–1180 (1985). Tarling, G. A. et al. Varying depth and swarm dimensions of open-ocean Antarctic krill Euphausia superba Dana, 1850 (Euphausiacea) over			

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
			diel cycles. J. Crustac. Biol. 38, 1–12 (2018). Grant, S.M., Hill, S.L., Trathan, P.N. and Murphy, E.J. 2013. Ecosystem services of the Southern Ocean: trade-offs in decision-making. Antarctic Science 25: 603-617.			

ARK comments on the PCDR

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
1.1.1	Report needs to consider a relevant model on krill population self-regulation.	For PI 1.1.1a, the Report considered that "...there is little evidence of a stock-recruitment relationship." None of the reviewers seems to have read the paper by Ryabov et al. (2017); to date, it is the best mechanistic explanation of krill population oscillations. This paper indicates that intrinsic self-regulation of the krill population is the primary driver of recruitment cohorts, being secondarily modulated by environmental conditions (i.e., food availability) and predators (mainly, whale population during the pre-exploitation era). This paper clearly explains that observed fluctuations at the	Ryabov A.B., A.M. de Roos, B. Meyer, S. Kawaguchi, and B. Blasius. 2017. Competition-induced starvation drives large-scale population cycles in Antarctic krill. Ecology and Evolution DOI: 10.1038/s41559-017-0177.		Thank you for alerting the assessment team to the results of this study. Additional text has been added to the background information and to the rationale for PI 1.1.1a. However, from a precautionary standpoint, the assessment team has decided to retain the score of 80 for PI 1.1.1a	Accepted (no score change - additional evidence presented)

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
		subarea scale are within the expected behaviour for krill.				
1.1.1	A large portion of the spawning stock is accessible to the fishery over a generational time, and local exploitation rates at this spawning hotspot have remained low. PI 1.1.1a should be increased.	For PI 1.1.1a, the Report indicates that "...only a small proportion of the total stock biomass successfully spawns and that the impact of the fishery MAY disproportionately affect the portion of the adult stock that successfully spawns (Meyer et al. 2020)." The paper by Meyer et al. (2020) do suggest that female spawning at a specific area may produce a disproportionately large fraction of recruits, but: a. Absolute catches in that area (SSMUs APDPW, APDPE & APPA; CCAMLR's Krill Fishery Report 2020), compared to the total biomass available (Reiss et al. 2008 for area ""West""; Wang et al. 2021 for area ""West""), had been low (Median = 0.7%, Range = 0.2%-6.5%) and below the 9.3% level considered appropriate to maintain the krill stock and support krill predators (Hill et al. 2016). In addition, changes in fishing distribution (Santa Cruz et al. 2018) have resulted in almost no fishing in that area during the spawning season. b. The paper ALSO provides a conceptual model for the seasonal migration of adult krill; in this model (figure 5, Meyer et al. 2020), adults migrate from onshore during winter to offshore during summer (where they spawn) every season. Krill population is panmictic, with no discernable population structure even at large	"-Meyer B., A. Atkinson, K. S. Bernard, A. S. Brierley, R. Driscoll, S. L. Hill, E. Marschoff, D. Maschette, F. A. Perry, C. S. Reiss, E. Rombolá, G. A. Tarling, S. E. Thorpe, P. N. Trathan, G. Zhu, and S. Kawaguchi. 2020. Successful ecosystem-based management of Antarctic krill should address uncertainties in krill recruitment, behaviour and ecological adaptation. Communications Earth & Environment 1:28- https://doi.org/10.1038/s43247-020-00026-1. -Fishery Report 2020: Euphausia superba in Area 48. https://fishdocs.ccamlr.org/FishRep_48_KRI_2020.pdf		The additional information provided by the stakeholder has been incorporated into the background information. The assessment team notes the stakeholder's view that the conclusions drawn from the Meyer et al. (2020) study are counteracted by other evidence about spawning hotspots, population mixing and larvae supply across Area 48 as a whole, but the assessment team decided to take a highly precautionary approach and has retained a score of 80 for PI 1.1.1a.	Accepted (no score change - additional evidence presented)

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
		spatial scales (Deagle et al., 2015); it is expected that the spawning population also has a significant level of mixing subarea scale. Although during a single season ~20% of females are successful breeders, it does not mean that there is a unique 20% of the population that is available to go and spawn at this hotspot every season. On the contrary, it is expected that every winter, the spawning stock congregate in their overwintering area and mix; later, during the next breeding season, they migrate offshore and use different habitats according to their quality, with higher quality habitats been more sought after than poorer habitats (including, spawning grounds). Thus, the fishery is still operating over the majority of the spawning stock over a recruitment cycle (~4-6 years; Kinzey et al. 2015; Conroy et al. 2020). c. This migration pattern is supported by the reversed pattern in krill biomass distribution found during winter, respect summer, at Bransfield vs. West (north of South Shetland Islands) by the US-AMLR program (Reiss et al. 2017).	-Reiss C.S., A.M. Cossio, V. Loeb, and D. A. Demer. 2008. Variations in the biomass of Antarctic krill (Euphausia superba) around the South Shetland Islands, 1996-2006. ICES Journal of Marine Science 65:497-508. -Wang X., X. Yu, X. Zhao, J. Zhang, G. Fan, Y. Ying and J. Zhu. 2021. Biomass estimates of Antarctic krill around the South Shetland Islands based on surveys conducted by a Chinese fishing vessel from 2013 to 2019. WG-ASAM-2021/13. -Hill S.L., A. Atkinson, C. Darby, S. Fielding, B. A. Krafft, O. R. Godø, G. Skaret, P. N. Trathan, and J. L. Watkins. 2016. Is current management of the Antarctic krill fishery in the Atlantic sector of the Southern Ocean precautionary?			

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
			CCAMLR Science 23:31-51. -Santa Cruz F., B. Ernst, J. A. Arata, and C. Parada. 2018. Spatial and temporal dynamics of the Antarctic krill fishery in fishing hotspots in the Bransfield Strait and South Shetland Islands. Fisheries Research 208:157-166. -Deagle B.E., C. Faux, S. Kawaguchi, B. Meyer, and S. N. Jarman. 2015. Antarctic krill population genomics: apparent panmixia, but genome complexity and large population size muddy the water. Molecular Ecology 24:4943-4959. -Kinzey D., G. M. Watters, and C. S. Reiss. 2015. Selectivity and two biomass measures in an age-based assessment of Antarctic krill (Euphausia			

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
			superba). Fisheries Research 168:72-84. -Conroy J.A., C. S. Reiss, M. R. Gleiber, and D. K. Steinberg. 2020. Linking Antarctic krill larval supply and recruitment along the Antarctic Peninsula. Integrative and Comparative Biology 60 (6):1386-1400. -Reiss C.S., A. Cossio, J. A. Santora, K. S. Dietrich, A. Murray, B. G. Mitchell, J. Walsh, E. L. Weiss, C. Gimpel, C. D. Jones, and G. M. Watters. 2017. Overwinter habitat selection by Antarctic krill under varying sea-ice conditions: Implications for top predators and fishery management. Marine Ecology - Progress Series 568:1-16, 2017."			
1.1.1	The information provided is not comprehensive of	PI 1.1.1a assesses the status of the stock at the Area 48 level. Meyer et al. (2020) paper only talk about Subarea 48.1, but it is not comprehensive	"-Quetin L. B. and R. M. Ross. 2003. Episodic recruitment in		The assessment team has incorporated additional information in the background	Accepted (no score change -

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
	all recruitment areas identified in Area 48, thus decreasing its relevance only to one specific sub-region. Accordingly, the score for PI 1.1.1a should be increased.	about Area 48. Available evidence suggests that several spawning hotspots produce successful recruits. In addition to the spawning hotspot offshore the South Shetland Islands identified in Meyer et al. (2020), there is successful recruitment in the Western Antarctic Peninsula south of Anver Islands (Quetin and Ross 2003, Conroy et al. 2020) and the Weddel Sea, both of which could advect recruits into the Bransfield Strait (Conroy et al. 2020, Reiss et al. 2020). Furthermore, recent findings suggest that krill recruitment at the Northern Antarctic Peninsula area is decoupled from local larval abundance and supports the importance of remote larval supply (Conroy et al. 2020). Accordingly, there are several recruitment hotspots within the region. Only one seems to have, although small (see above), impact from the fishery.	Antarctic krill Euphausia superba in the Palmer LTER study region. Marine Ecology - Progress Series 259:185-200. -Conroy J.A., C. S. Reiss, M. R. Gleiber, and D. K. Steinberg. 2020. Linking Antarctic krill larval supply and recruitment along the Antarctic Peninsula. Integrative and Comparative Biology 60 (6):1386-1400. -Reiss C.S., J. T. Hinke, and G. M. Watters. 2020. Demographic and maturity patterns of Antarctic krill (Euphausia superba) in an overwintering hotspot. Polar Biology 43:1233-1245. https://doi.org/10.1007/s00300-020-02704-4."		information of the report. Whilst the assessment team accepts the stakeholder's view that the assessment considers the krill stock in the whole of Area 48, and that there are additional spawning hotspots to that identified by Meyer et al. (2020), from a precautionary standpoint, the assessment team has decided to retain the score of 80 for PI 1.1.1a.	additional evidence presented)
2.5.1	The assessment does not consider what would	PI 2.5.1a scoring is based on an "irreversible harm" to structure and function… such that the			The ref by Conroy et al 2020 seemed the more relevant.	Accepted (no score change -

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
	happen if the fishery stops. Given the low impact of the fishery, and the healthy status and large resilieance of krill, the score for PI 2.5.1a should be increased.	ecosystem would be unable to recover within 5-20 years if fishing ceases entirely. The scoring applied does not seem to consider the resilience of the ecosystem under the scenario that the fishery ceases to operate. By contrast, CCAMLR stock assessment method takes into account the resilience of the ecosystem over a 20 years period when estimating the precautionary catch limit. Biomass estimates for Area 48 (and each Subarea) during summer 2019 indicate that the stock is healthy overall. Under this condition, and considering that strong recruitments occur every 4-6 yr (Kinzey et al. 2015; Conroy et al. 2020), a cease of the fishery would in a short time allow populations to grow at their natural rate.				additional evidence presented)
2.5.1	Widespread declining of penguin populations is product of climate change effects and recovery of previously exploited marine mammals, rather than the krill fishery. Accordingly, the score for PI 2.5.1a	Assessment of the ecosystem impact of the krill fishery by just one component of the ecosystem may be misleading. Long-term decline in penguin populations was linked to ecosystem shifts caused by climate change and whales' recovery (Trivelpiece et al. 2011). Climate change is ongoing and is expected to have a profound effect on krill in the future (Piñones and Federov 2016), thus, continue affecting krill and by extension, penguins. Whales are important predators on krill and may outcompete penguins for this resource as their numbers recoverer (IWC 2015, Zerbini et al. 2019, Pallin et al. 2018). Humpback whales, for	-Trivelpiece W. Z., J. T. Hinke, A. K. Miller, C. S. Reiss, S. G. Trivelpiece, and G. M. Watters. 2011. Variability in krill biomass links harvesting and climate warming to penguin population changes in Antarctica. PNAS 108 (18):7625-7628. -Piñones A. and A. V. Fedorov. 2016. Projected changes of		Thank you for the additional information and references. These have been incorporated into the justification. The point regarding double scoring does not apply in this case, as ecosystem component incorporates includes aspects of the P1 component as krill, the target species, is an important prey species.	Accepted (no score change - additional evidence presented)

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
	should be increased.	example, are growing at exceptionally high rates, showing no evidence of food shortage (Pallin et al. 2018). Likewise, the Antarctic fur seal population have increased significantly in South Georgia after their commercial exploitation (Boyd 1993) and are important krill predators around South Georgia (year-round), South Orkneys (fall and winter) and the WAP region (winter) (Lowther et al. 2020), and could have localized impact on penguins. By contrast, fishery effects, if any, are expected to occur only in years of combined low krill biomass, adverse environmental conditions and high local fishing pressure (i.e., Watters et al. 2020). The declining trend observed in Chinstrap and Adelie penguins in Area 48 occurs even at colonies not exposed to fishing. All the above points out to an ecosystem wide phenomenon not linked to fishing. Finally, the management of local harvest pressure had already been identified as of concern and scored accordingly under PI 1.2.1a ("harvest strategy is responsive to the state of the stock") and shouldn't be assessed twice under different PIs.	Antarctic krill habitat by the end of the 21st century. Geophysical Research Letters 43:8580-8589, doi:10.1002/2016GL069656. -International Whaling Commission. 2015. Report of the Scientific Committee. Annex H: Report of the Sub-Committee on Other Southern Hemisphere Whale Stocks. Presented at the 66a meeting of the Scientific Committee of the International Whaling Commission, San Diego, CA. International Whaling Commission, Cambridge, UK. -Pallin L. J., C. S. Baker, D. Steel, N. M. Kellar, J. Robbins, D. W. Johnston, D. P. Nowacek, A. J. Read, and A. S. Friedlaender. 2018. High pregnancy rates in humpback			

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
			whales (Megaptera novaeangliae) around the Western Antarctic Peninsula, evidence of a rapidly growing population. Royal Society Open Science 5:180017- http://dx.doi.org/10.1098/rsos.180017. -Zerbini A. N., G. Adams, J. Best, P. J. Clapham, J. A. Jackson, and A. E. Punt. 2019. Assessing the recovery of an Antarctic predator from historical exploitation. Royal Society Open Science 6:190368- http://dx.doi.org/10.1098/rsos.190368. -Lowther A. D., I. Staniland, C. Lydersen, and K. M. Kovacs. 2020. Male Antarctic fur seals: neglected food competitors of bioindicator species in the context of an increasing Antarctic krill fishery. Scientific			

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
			Reports 10:18436. https://doi.org/10.1038/s41598-020-75148-9. -Boyd I. L.. 1993. Pup production and distribution of breeding Antarctic fur seals (Arctocephalus gazella) at South Georgia. Antarctic Science 5 (1):17-24. -Watters G. M., J. T. Hinke, and C. S. Reiss. 2020. Long-term observations from Antarctica demonstrate that mismatched scales of fisheries management and predator-prey interaction lead to erroneous conclusions about precaution. Scientific Reports 10:2314- https://doi.org/10.1038/s41598-020-59223-9.			
2.5.1	Evidence quoted for disruption of	The scoring of PI 2.5.1a is based mainly on circumstantial evidence put forward in two	-Krüger L., M. F. Huerta, F. Santa Cruz, and C. A.		Thank you for the detailed breakdown of those studies, which	Accepted (no score

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
	ecosystem structure and function are circunstancial and do not reflect impact at the population level. Accordingly, the score for PI 2.5.1a should be increased.	related papers by Watters et al. (2020) and Krüger et al. (2020). a. Kruger et al. (2020) analyses the correlation between catches around colonies and changes in population size for Chinstrap and Gentoo penguins. Although they found some correlations, it is important to notice that correlation does not mean a cause-effect relationship. The study fails to explain the following relevant aspects: -Chinstrap penguin populations have declined in the whole Antarctic Peninsula Region, including at locations where has not been fishing for decades (Strycker et al. 2020, Fig. 3), such as Anvers Island, NE tip of King George Island (South Shetlands), and colonies on the southern side of the South Orkney Islands. Furthermore, Adélie penguins in the WAP region are showing signs of recovery since 2008 despite increasing fishing in the area (Che-Castaldo et al. 2017). -The model only considers the effects of fishing and SAM on Lambda; it does not consider a self-regulation parameter that could explain part of the observed variability (i.e., Lima & Estay 2013). -LAMBDA (population growth rate) is estimated based on the integration of several years, whereas Fishing catch and SAM are for a single year (season). As Chinstrap populations have declined over the past decades (Strycker et al. 2020), and data is very patchy (only a few censuses for each colony over a long period), Lambda estimates over-emphasizes negative	Cárdenas. 2020. Antarctic krill fishery effects over penguin populations under adverse climate conditions: Implications for the management of fishing practices. Ambio:https://doi.org/ 10.1007/s13280-020-01386-w. -Strycker N., M. Wethington, A. Borowicz, S. Forrest, C. Witharana, T. Hart, and H. J. Lynch. 2020. A global population assessment of the Chinstrap penguin (Pygoscelis antarctica). Scientific Reports 10:19474-https://doi.org/10.1038/s41598-020-76479-3. -Che-Castaldo C., S. Jenouvrier, C. Youngflesh, K. T. Shoemaker, G. R. W. Humphries, P. McDowall, L. Landrum,		indicate a lively and ongoing debate around the issue of fishery impact on the Antarctic ecosystem.	change - additional evidence presented)

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
		population growth. Thus, Krüger et al. compare this integrated Lambda estimates with circumstances happening only in the latest year (Catch and SAM data are annual). For example, for colony ENTR, year 2011, Lambda was calculated over 5 years, 2006-2011, while Fishing catch and SAM values are for 2011 only; thus, the observed popualtiojnchaged could be related to events that happened, 2, 3 or 4 years ago and do not necessarily represent the impact of fishing or SAM in the last year. -The model considers that fishing catch around 30km of the colony affects breeding population size. This assumption seems to ignore that most Chinstrap penguins migrate far from their colonies during the non-breeding season (Hinke et al. 2015, 2019). b. Watters et al. (2020) analyses impact of environmental conditions and local harvest rate on a combination of penguin breeding indeces. The study made several assumptions to run different scenarios for (a) environmental conditions and (b) local krill biomass (information not available for every season). However, the relationships that support the categorization of variables are not available in the paper. For example, for local krill biomass (LKB), we examined the relationship between mean krill size preyed by penguins (Hinke et al. 2007) and krill biomass for gSSM1, gSMM2 and gSSMU(1+2) (Watters et al. 2020, Suppl. 5). We did not find a relationship between mean krill	M. M. Holland, Y. Li, R. Ji, and H. J. Lynch. 2017. Pan-Antarctic analysis aggregating spatial estimates of Adélie penguin abundance reveals robust dynamics despite stochastic noise. Nature Communications 8:832- DOI:10.1038/s41467-017-00890-0. -Lima M. and S.A. Estay. 2013. Warming effects in the western Antarctic Peninsula ecosystem: the role of population dynamic models for explaining and predicting penguin trends. Population Ecology 55 (4):557-565. -Hinke J.T., M. J. Polito, M. E. Goebel, S. Jarvis, C. S. Reiss, S. R. Thorrold, W. Z. Trivelpiece, and G. M. Watters. 2015. Spatial and isotopic niche			

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
		size and local krill biomass; thus, this important assumption needs corroboration. The paper concludes that high Local Harvest Rates (LHR), measured as the ratio of local catch/LKB is high from 2010 onwards. Sadly, acoustic surveys for biomass estimation were discontinued after 2011. Only 3 winter cruises, one with very low coverage, were conducted since. Thus, the paper relies heavily on imputed data for deriving its conclusions. When missing Local Krill Biomass (LKB) data is not imputed, results fall within the long-term mean performance of the colony, revealing little impact from the fishery. Furthermore, intermediate local harvest rates, 0.01 < LHR < 0.10, produced lower penguin performance than higher LHR (>0.10) [Supplmentary Fig. S8], contrary to the paper's conclusions.	partitioning during winter in chinstrap and Adélie penguins from the South Shetland Islands. Ecosphere 6 (7):125. http://dx.doi.org/10.1890/ES14-00287.1. -Hinke J.T., M. M. Santos, M. Korczak-Abshire, G. Milinevsky, and G. M. Watters. 2019. Individual variation in migratory movements of chinstrap penguins leads to widespread occupancy of ice-free winter habitats over the continental shelf and deep ocean basis of the Southern Ocean. PLoS ONE 14(12):e0226207. https://doi.org/10.1371/journal.pone.0226207. -Watters G. M., J. T. Hinke, and C. S. Reiss. 2020. Long-term observations from Antarctica			

Performance Indicator	Input summary	Input detail	Evidence or references	Stakeholder input code	CAB response to stakeholder input	CAB response code
			demonstrate that mismatched scales of fisheries management and predator-prey interaction lead to erroneous conclusions about precaution. Scientific Reports 10:2314- https://doi.org/10.1038/s41598-020-59223-9. -Hinke J. T., K. Salwicka, S. G. Trivelpiece, G. M. Watters, and W. Z. Trivelpiece. 2007. Divergent responses of Pygoscelis penguins reveal a common environmental driver. Oecologia 153:845-855.			

Appendix 6 MSC Technical Oversight

Ref	Type	Page	Requirement	Reference	Details	PI
30957	Minor	P18	FCP-G7.8.1.1 v.2.1	The “eligibility date” is the date from which the CAB determines that product from the certified fishery will be eligible to enter the supply chain. The eligibility date is confirmed in the Public Comment Draft Report. In cases where the UoC could potentially change (e.g. due to some regions or fishing gears being omitted at a late stage), or where there could be further delays to the assessment process, the CAB may want to set the eligibility date as the certification date, rather than the Public Comment Draft Report date. In cases where the eligibility date is set before the certification date, the CAB will need to consider any potential traceability impacts – and for example, the risk of product from outside the UoC being incorrectly identified as an under-assessment product. As a result, CABs should verify traceability and identification systems before the eligibility date. Fisheries handling under-assessment product should be aware of relevant requirements in the Chain of Custody standard, which relate to identification and traceability of under-assessment product.	The “eligibility date” is the date from which the CAB determines that product from the certified fishery will be eligible to enter the supply chain. The eligibility date is confirmed in the Public Comment Draft Report. In cases where the eligibility date is set before the certification date, the CAB will need to consider any potential traceability impacts – and for example, the risk of product from outside the UoC being incorrectly identified as an under-assessment product. As a result, CABs should verify traceability and identification systems before the eligibility date. Reporting template instructions: The report shall include the eligibility date and the justification for selecting this date, including consideration of whether the traceability and segregation systems in the fishery are appropriately implemented.	

Thank you for picking that up and apologies for the oversight. The following text has been added under the relevant heading on Page 18:

The eligibility date for product caught by UoA vessels has been set at the date of certification (publication of the Public Certification Report). Product caught by the UoA vessels will, from that day forward, be eligible to enter further chains of custody.

The CAB also notes that the eligibility date was presented in Section 5.3 at the time of publishing the PCDR.

30958	Guidance	P18	FCP-7.9.1 v.2.1	The CAB shall determine whether the fishery client has sufficient systems of tracking and tracing to ensure all fish and fish products identified and sold as certified by the fishery client originate from an appropriate UoC.	The CAB shall determine whether the fishery client has sufficient systems of tracking and tracing to ensure all fish and fish products identified and sold as certified originate from its UoC. While there is no processing/ grading on board, packing activity has been identified with labelled and sealed banding before offloading in Busan & Fukuoka. The system to track and trace from the start of CoC (the point of landing) back to its UoC are not fully clarified especially in relation to the labelling on the product.	

An extra sentence has been added outlining the specifications of the box in which the krill is packed before transhipment. To supplement this, a picture of a frozen krill box has also been added to the report.

30959	Guidance	P18	FCP-7.9.1 v.2.1	The CAB shall determine whether the fishery client has sufficient systems of tracking and tracing to ensure all fish and fish products identified and sold as certified by the fishery client originate from an appropriate UoC.	The CAB shall determine whether the fishery client has sufficient systems of tracking and tracing to ensure all fish and fish products identified and sold as certified originate from its UoC. While there is no processing/ grading on board, packing activity has been identified with labelled and sealed banding before offloading in Busan & Fukuoka. The system to track and trace from the start of CoC (the point of landing) back to its UoC are not fully clarified especially in relation to the labelling on the product.	

Duplication?

30960	Guidance	P20	FCP-7.9.1.3 v.2.1	The CAB shall document any of the risk factors outlined in the Announcement Comment Draft Report, identifying any areas of risk for the integrity of certified products and how they are managed and mitigated.	P20 Table 5 Row 4 The CAB shall identify any areas of risk for the integrity of certified products and how they are managed and mitigated. According to p. 18 (section 5.2) transhipment at sea or at port of the Falkland Islands (Islas Malvinas) have been identified prior to landing. This is however not specified within the table.	

Additional information has been provided in the table.

30961	Guidance	P20	FCP-7.9.1.5.c v.2.1	7.9.1.5 The CAB shall identify and document in the Announcement Comment Draft Report: c. The point from which subsequent Chain of Custody certification is required.	P20 (5.3)The CAB shall identify and document in the Announcement Comment Draft Report: a. The UoC. b. The point of intended change of ownership of product. c. The point from which subsequent Chain of Custody certification is required. Landing includes multiple steps p. 19 ; offloading, transport and storage. The report did not specify at which specific step of landing subsequent Chain of Custody is required. It is unclear if offlading, transport, and/or coldstorage should be covered by CoC. Additional information about when CoC should begin is necessary to support buyers.	

Further clarification has been added: *This is to say, the product requires Chain of Custody once it leaves the carrier vessel (all transport and storage once the product is on land, including offloading from the carrier vessel and cold storage).*

Appendix 7 Conditions

Table 20. Condition 1

Performance Indicator	PI 1.2.1. There is a robust and precautionary harvest strategy in place SIa. 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.
Score	70 (60 for SIa)
Justification	Whilst the harvest strategy appears to be responsive to the state of the stock at the scale of the whole of Area 48, this response is based upon full large-scale synoptic biomass surveys which have taken place only twice in the last 20 years. The harvest strategy does not reflect changes in krill biomass at small geographical scales as identified through regular small scale biomass surveys, or if there is evidence that local depletions of krill biomass may have taken place which impact adversely on dependent land-based predators. In other words the harvest strategy may not be sufficiently responsive at a fine-scale local level in order to meet ecosystem needs. The krill companies under the umbrella of ARK may have voluntarily stopped fishing in areas where there may be an adverse impact on predators, but there is no formal mechanism in place to restrict fishing in areas where there is local depletion of krill biomass.
Condition	By the end of the certification period a harvest strategy should be implemented which is responsive to the state of the stock and the elements of the harvest strategy work together towards ensuring that the stock is above the point where serious ecosystem impacts could occur, and is at or fluctuating around a level consistent with ecosystem needs at multiple scales.
Milestones	Year 1: Resulting score = 70. The Client should provide evidence that WG-EMM of CCAMLR has made significant progress in the revision of assessment methods, the development of data layers, and implementation of the risk assessment framework, to evaluate catch distribution options at the area, sub-area and fishing ground scales. Year 2: Resulting score = 70. The Client should provide evidence that WG-EMM has made significant progress on the three components of the preferred management approach: risk assessment, krill stock assessment, and subarea biomass estimates. Year 3: Resulting score = 70. The Client should provide evidence that WG-EMM has completed its work on the three components of the preferred management approach and presented its output to the Scientific Committee of CCAMLR, and that the Scientific Committee of CCAMLR has proposed to the Commission a new harvest strategy that is responsive to the state of the stock and ensures that the stock is above the point where serious ecosystem impacts could occur, and is at or fluctuating around a level consistent with ecosystem needs at multiple scales. Year 4: Resulting score ≥80. The Client should provide evidence that CCAMLR has implemented a new harvest strategy that is responsive to the state of the stock and the elements of the harvest strategy work together towards ensuring that the stock is above the point where serious ecosystem impacts could occur, and is at or fluctuating around a level consistent with ecosystem needs at multiple scales.

Consultation on condition	Meeting this condition will require the Client to work closely with the relevant national management authorities and with CCAMLR. Close collaboration with the Clients of overlapping fisheries through the Association of Responsible Krill harvesting companies (ARK) would also be beneficial. In 2019 the WG-EMM of the Scientific Committee (SC) of CCAMLR concluded that the preferred option for 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. In response to the WG-EMM proposed strategy, the SC noted that the preferred management strategy comprised prioritising the development of three key elements: (i) A stock assessment to estimate precautionary harvest rates (ii) Regular updates of biomass estimates, initially at the subarea scale, but potentially at multiple scales (iii) A risk assessment framework to inform the spatial allocation of catch. At its annual meeting in 2019, the Commission of CCAMLR endorsed this approach proposed by the SC (paragraph 5.17 of the CCAMLR annual report). Despite inevitable disruptions caused by the COVID-19 pandemic in 2020, WG-EMM reported that progress had been made in relation to the three components of the preferred management approach: risk assessment, krill stock assessment, and subarea biomass estimates. The assessment team are assured therefore that CCAMLR has demonstrated a commitment to find solutions to the issue raised in the condition and that progress has already been made. The aforementioned CCAMLR workflow assures that CAB that MSC FCP v2.2 clauses 7.19.8a and 7.19.8b are met.

Appendix 8 Client Action Plan

Milestone	Action	Roles & Responsibilities	Outputs
Year 1	Through NIFS and ARK (and in conjunction with the other MSC certified krill fisheries), the client will lobby CCAMLR's WG-EMM (through client representatives bringing up the issue at ARK meetings and also in meetings with Jeong Il Corp. representatives and KOFA/NIFS – ensuring the issues are discussed at CCAMLR level) to revise assessment methods and the development of data layers and implementation of the risk of assessment framework to evaluate catch distribution options at the area, sub-area and fishing ground scales. Further, the client will supporting krill biomass estimate research combining with ARK members.	Leading entity : Jeong Il Corp. Supporting entities : ARK	Evidence of lobbying to CCAMLR's WG from the aforementioned entities. Meeting notes from CCAMLR WG-EMM meetings, and any scientific outputs stemming from these meetings.
Year 2	The client, through NIFS and ARK (and in conjunction with the other MSC certified krill fisheries) will continue to lobby CCAMLR's WG-EMM (through client representatives bringing up the issue at ARK meetings and also in meetings with Jeong Il Corp. representatives and KOFA/NIFS – ensuring the issues are discussed at CCAMLR level) to make significant progress on the three components of the preferred management approach: risk assessment, krill stock assessment, and subarea biomass estimates. Further, a fishing	Leading entity : Jeong Il Corp. Supporting entities : ARK	Evidence of lobbying to CCAMLR's WG from the aforementioned entities. Meeting notes from CCAMLR WG-EMM meetings, and any scientific outputs stemming from these meetings.

	vessel will conduct scientific research with acoustic scanning machine in 48 sub-area. Provide scientific research data to WG-EMM. Suggest to use krill scientific research data to evaluate of harvest strategy for krill.		
Year 3	The client, through NIFS and ARK (and in conjunction with the other MSC certified krill fisheries) will continue to lobby CCAMLR's WG-EMM (through client representatives bringing up the issue at ARK meetings and also in meetings with Jeong Il Corp. representatives and KOFA/NIFS – ensuring the issues are discussed at CCAMLR level) to complete its work on the three components of the preferred management approach and present its output to the Scientific Committee of CCAMLR, and to lobby the Scientific Committee to present a new harvest strategy that is responsive to the state of the stock and ensures that the stock is above the point where serious ecosystem impacts could occur, and is at or fluctuating around a level consistent with ecosystem needs at multiple scales.	Leading entity : Jeong Il Corp. Supporting entities : ARK	Evidence of lobbying to CCAMLR's WG from the aforementioned entities. Meeting notes from CCAMLR WG-EMM meetings, and any scientific outputs stemming from these meetings. Any outputs from the Commission on the updated harvest strategy. CCAMLR-SC address on the report that a new krill harvest strategy and a working group to establish strategy is needed.
Year 4	The client, through NIFS and ARK (and in conjunction with the other MSC certified krill fisheries) will lobby CCAMLR (through client representatives bringing up the issue at ARK meetings and also in meetings with Jeong Il Corp. representatives and KOFA/NIFS – ensuring the issues are discussed at CCAMLR	Leading entity : Jeong Il Corp. Supporting entities : ARK	The new krill harvest strategy made by a working group is adopted in CCAMLR commission meeting, and is presented to the assessment team.

	level) to implement a new harvest strategy that is responsive to the state of the stock and the elements of the harvest strategy work together towards ensuring that the stock is above the point where serious ecosystem impacts could occur, and is at or fluctuating around a level consistent with ecosystem needs at multiple scales.		

Support for the Action Plan:

ASSOCIATION OF RESPONSIBLE
KRILL HARVESTING COMPANIES

Hobart, 13 May 2021

Sang Yong Lee
Director
Jeong-Il Corporation
Seoul, Republic of Korea

Ref. Letter of support

Dear Sang Yong Lee,

The present is to express the support of the Association of Responsible Krill harvesting companies (ARK) to the Action Plan developed by Jeong-Il Corp. as requested by the Marine Stewardship Council (MSC), to contribute to the development of a krill management strategy within waters of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR).

The proposed plan is in line with the mission statement of ARK, and as such, it complements the activities envisaged by ARK for the coming five years. Activities supported by ARK aval the commitment of all ARK Members to the sustainability of the fishery, including the collection of critical data for managing the krill fishery and implementing voluntary measures to protect foraging areas for breeding penguins ahead of the adoption of official measures by CCAMLR. The current Action Plan envisaged by PescaChile provides further evidence of the proactive nature of ARK Members in supporting a sustainable fishery within CCAMLR waters.

Please do not hesitate to contact me for further coordination.

Sincerely,

Dr. JAVIER ARATA
Executive Officer
ARK

Association of Responsible Krill harvesting companies, ARK
1511 Channel Highway, Margate Tas. 7054, Australia

Appendix 9 Surveillance

Table 21. Fishery surveillance programme

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

Yellow highlights are provisional

Table 22. Timing of surveillance audit

Year	Anniversary date of certificate	Proposed date of surveillance audit	Rationale
1	TBC	30 days prior to anniversary date of certificate, should the assessment outcome result in certification	N/a
2	TBC	30 days prior to anniversary date of certificate, should the assessment outcome result in certification	N/a
3	TBC	30 days prior to anniversary date of certificate, should the assessment outcome result in certification	N/a
4	TBC	30 days prior to anniversary date of certificate, should the assessment outcome result in certification	N/a

Table 23. Surveillance level rationale

Year	Surveillance activity	Number of auditors	Rationale
1	On-site audit	1 on site with remote support from 1 auditor	Information across all principles can be provided remotely, as evidenced by the initial full assessment. However, the team recommends two on site audits. This is so that the team could visit the ports where the UoA catch is landed, to further understand processes upon landing, and so that the team has the opportunity to potentially meet a captain, or crew members of one or both of the vessels.
2	Off-site audit	2	
3	Off-site audit	2	
4	On-site audit	2	

Appendix 10 Harmonised fishery assessments

Table 24. Overlapping fisheries

Fishery name	Certification status and date	Performance Indicators to harmonise
Aker Biomarine Antarctic Krill	Certified (Re-assessment final report published on 31/08/2020)	Principle 1: All PIs Principle 2: None Principle 3: All PIs (CCALMR components)
Deris S.A. – Pesca Chile – Antarctic Krill fishery	Certified (initial assessment PCR published on 06/09/2018)	Principle 1: All PIs Principle 2: None Principle 3: All PIs (CCALMR components)

Table 25. Overlapping fisheries

Supporting information	
P1: The target stock is the same, as such, every Principle 1 PI should be harmonised. At the time of writing the P1 scores are not fully harmonised. This is because a condition was raised in this fishery following Peer Review. The same condition will be raised in the harmonised fisheries at the next surveillance audit. Written confirmation has been received stating the above. P2: The fishery under assessment partially overlaps with the fishing area of two MSC-certified krill fisheries. Bycatch relative abundance and profiles are fishery specific, and given the slight differences in areas fished (the fishery under assessment does not operate in Area 48.3) ETP legislation is not the same. P3: The same CCAMLR regulations apply to all three fisheries, but national management systems differ (Chilean, Norwegian, and Korean)	
Was either FCP v2.1 Annex PB1.3.3.4 or PB1.3.4.5 applied when harmonising?	No
Date of harmonisation meeting	Email exchange between CABs throughout 2020 and January, February, and April 2021
If applicable, describe the meeting outcome	
N/a	

Table 26. Scoring differences

Performance Indicators (PIs)	Deris S.A. – Pesca Chile – Antarctic krill (2018)	Aker Biomarine Antarctic Krill (2020)	Jeong Il Corp. Antarctic krill (this fishery)
PI 1.1.1	90	90	80
PI 1.2.1	95	95	70
PI 1.2.2	85	85	85
PI 1.2.3	90	90	80
PI 1.2.4	95	85	85
PI 3.1.1	95	95	85
PI 3.1.2	100	100	85
PI 3.1.3	100	100	100

Performance Indicators (PIs)	Deris S.A. – Pesca Chile – Antarctic krill (2018)	Aker Biomarine Antarctic Krill (2020)	Jeong Il Corp. Antarctic krill (this fishery)
PI 3.2.1	90	90	90
PI 3.2.2	95	95	85
PI 3.2.3	85	100	90
PI 3.2.4	90	90	80

Table 27. 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)
The CU UK fishery has been fully P1 harmonised with the Aker Biomarine Fishery, because the Principle 1 expert is the same across both fisheries. Indeed, the team leader for this assessment chose to hold back the publication of the ACDR until the Peer review comments we fully resolved in the Aker Biomarine fishery to ensure full harmonisation at the ACDR publication stage. For a rationale on the scoring differences between the **Aker Biomarine and the Deris S.A. fisheries, please consult Hønneland et al. (2020):** https://fisheries.msc.org/en/fisheries/aker-biomarine-antarctic-krill/@@assessments There is currently a significant difference in the scoring of PI 1.2.1 (a condition has been raised in this fishery following peer review comments). The new condition has been discussed with the other Certification Assessment Bodies (Lloyd's Register, and Bureau Veritas), and a condition will be raised in these fisheries at the next surveillance audit. An expedited audit is not needed for these, as the FCP 2.2 states that a "material change" (triggering an expedited audit) consists of: a. A PI score falling below 60. b. A Principle score falling below an aggregate 80 score due to the changes to the score for 1 or more PIs. c. A change in scope (as per 7.4, 7.5.2 or 7.5.3). There are no material scoring differences regarding P3 PI scores that relate to the CCAMLR governance and fishery's management system.
If exceptional circumstances apply, outline the situation and whether there is agreement between or among teams on this determination
N/a

Appendix 11 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