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Commission pour la conservation de la faune et la flore marines de l'Antarctique
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Domain 1 MPA Proposal CM 91-XXrev1: Rationale of the changes for the Proposal for the Establishment of a Marine Protected Area in the Western Antarctic Peninsula – South Scotia Arc

Delegations of Argentina and Chile

EN

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Abstract

The present document reflects the changes done on the D1MPA proposal, based on new publications, WG-EMM discussions and documents regarding krill fishery management workplan, and suggestions made during the intersessional discussions after the D1MPA proposal was formally introduced by Chile and Argentina at CCAMLR XXXVII. It also addresses the outstanding issues raised by Members during the last meeting of the Scientific Committee (Hobart, 2018). This document provides detailed information about the rationale behind the modifications included in the D1MPA Model, in a manner that conservation objectives are achieved, while allowing for fishery to redistribute and avoid further spatio-temporal concentration. The specific changes made to the D1MPA model are described.

Background

Conservation

The objective of this Convention is the conservation of Antarctic marine living resources. For the purposes of this Convention, the term 'conservation' includes rational use. Any harvesting shall be conducted aiming the sustained conservation and maintaining the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources and should prevent changes or minimize the irreversible risk of changes in the marine ecosystem, taking into account the state of available knowledge of the direct and indirect impact of harvesting and associated activities, the effect of the introduction of alien species, and the effects of environmental changes.

During recent meetings, it was noted that there is some confusion between rational and sustainable use. This point arose many times during discussions in the Commission and, while no operational definition of "rational" was achieved, it is clear that article II does not mean that both terms are equivalent.

According to the Convention, conservation and rational use cannot be separated. Use of the resources under the Convention are part of conservation and cannot be limited to ensure sustainability. This is so because sustainable use (in the sense that the same ecosystem services can be obtained year after year) will result in changes in the relations between species that cannot be reversed in the 20 – 30 years term established by article II. These include all species south of the Antarctic Convergence (Art. I) and are not limited to exploitable species.

CCAMLR is a standalone organisation with unique characteristics. To quote some, related with the questions at hand:

- Since the first discussions on the Antarctic living resources, as far back as the 1970's, it was established that there will be no economically based regulations, such as a quota system, etc.

- Fishing Members pay an extra annual amount which is not substantial for the functioning of the Commission.
- At variance with fishing organizations CCAMLR accepts new entrants without discriminating against them.

Thus, a balance between conservation and exploitation is not required in the establishment of an MPA by Article II nor by the objectives set out in CM 91-04. Such requirement would be contrary to the principle involved in the definition of conservation, which includes and is not opposed to rational use.

The idea that management measures (any management practice based on the best available science) should be developed *pari passu* with the establishment of an MPA would, inevitably, result in the inadequacy of the MPA when the best available science is changed. For example: limiting fishing mortality to 10% was considered the best available science. Nowadays we know that this is insufficient and the idea of establishing protected areas in the Antarctic emerged in view of the complexity of ecosystems.

Impacted or not impacted?

Considerable discussions have been undertaken regarding the need to prove that there is an impact of the fisheries over the marine ecosystem in order to justify for the creation of an MPA (among others, SC-CCAMLR-36 para. 5.30; SC-CCAMLR-37 para 6.57). This is contrary to the CCAMLR's precautionary approach; once impact is evidenced, the answer will be reactive (to mitigate the impact) not proactive (to prevent threats).

In the foundation of this discussion is quite difficult to sustain that human activities do not have an impact on nature. A huge number of references worldwide tell us that human activities have continuously impacted the marine ecosystems (i.e Vitousek et al. 1997; Halpern et al. 2008; Rockström et al. 2009; Tin et al. 2009; Halpern et al. 2015; Wilcox et al. 2015; Kroodsma et al. 2018), particularly industrial fisheries (i.e. Scheffer et al. 2005; Jackson 2008; Lewison et al. 2009; Komoroske and Lewison 2015; Kroodsma et al. 2018) while at CCAMLR (a used-to-be novel leadership), the discussions are still about the impoliteness of human activities. The argument of "no impact has been proved" prevents further discussions and stops us from developing a more adaptive flexible fishery management approach and slows the development of a Marine Protected area networks.

MPA are tools providing, inter alia, a "backup" against unforeseen consequences of the extraction of resources. As such, MPAs support rational use: otherwise, the extraction of resources must have a previous knowledge of the structure and functioning of the Antarctic ecosystem warranting that the changes induced will be reversible (Article II).

The Western Antarctic Peninsula (WAP) is an area experiencing one of the most rapidly warming on Earth, including significant increases in sea surface temperature and important declines in the duration and extent of sea-ice (Ducklow et *al.* 2013). The designation of D1MPA as place-based and long/term designations, can play an important role in addressing impacts of climate change and building ecological resilience of species and habitats in the face of climate change before significant biodiversity losses occur, by minimizing the additional impacts of non-climate change stressors such as overfishing and habitat destruction (Micheli *et al.* 2012; Griffiths *et al.* 2017, Roberts *et al.* 2017). The importance of protecting the western Antarctic Peninsula (WAP) and the south Scotia Arc (Doman 1) has been extensively discussed and highlighted in Scientific Committee and Commission throughout the process that began in 2012. Worldwide pressures on marine ecosystems are projected to become more intense in the future, as new industries compete for access to resources and space in coastal and offshore regions (Elliott et al., 2019).

Fishery concentration

The krill fishery is a spatially concentrated activity over specific fishing hotspots (Figure 1). Indeed, increasing concentration of catch in space and time is a real concern, as it may affect the level of precaution intended by CM 51-07 (EMM 2019 para. 2.6).

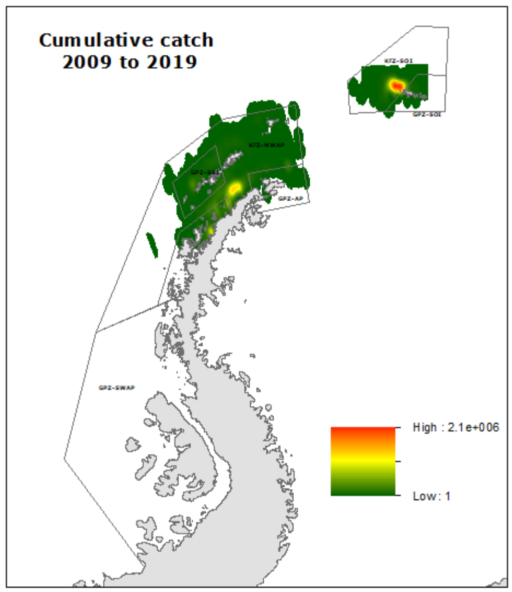

Figure 1. Kernel density of the krill fishery catches between 2009 and 2019.

The concentration of the krill fishery is a latent topic whose discussion has progressed from expressions such as “concentration of fishing in smaller areas can occur” (SC-CCAMLR-XXVIII, para. 4.3) to concrete results such as fleet operations “occur in only 26 % of the area open to krill fishing” (SC-CCAMLR-XXXII, para. 2.26) and increased daily catch rates reflected in “the recent closure occurred in the middle of the fishing season, reflecting a more rapid uptake of the catch during the first half of 2012/13” (SC-CCAMLR-XXXIII, para. 2.7). Later, the Scientific Committee further noted the continued concentration of fishing effort in Bransfield Strait throughout most of the season because of ice-free conditions (SC-CCAMLR-XXXIII, para. 3.2) and stated that krill fishery is not a randomly distributed activity (SC- CCAMLR-XXXV, para. 2.218).

In Subarea 48.2 (SOI) there is a main fishing hotspot off west of Coronation Island which has increased the catch density in the season 2018/19 to more than 40 ton/km^2. A drastic change occurred at Subarea 48.1(NWAP) operations around Elephant Island and west of SSI before the year 2000, now the fleet is concentrated in the centre of the Bransfield Strait and north of Gerlache Strait (Santa Cruz et al. 2018; Krüger 2019), with a stable catch density around 20 ton/km^2 and 10 ton/km^2 respectively (Figure 2).

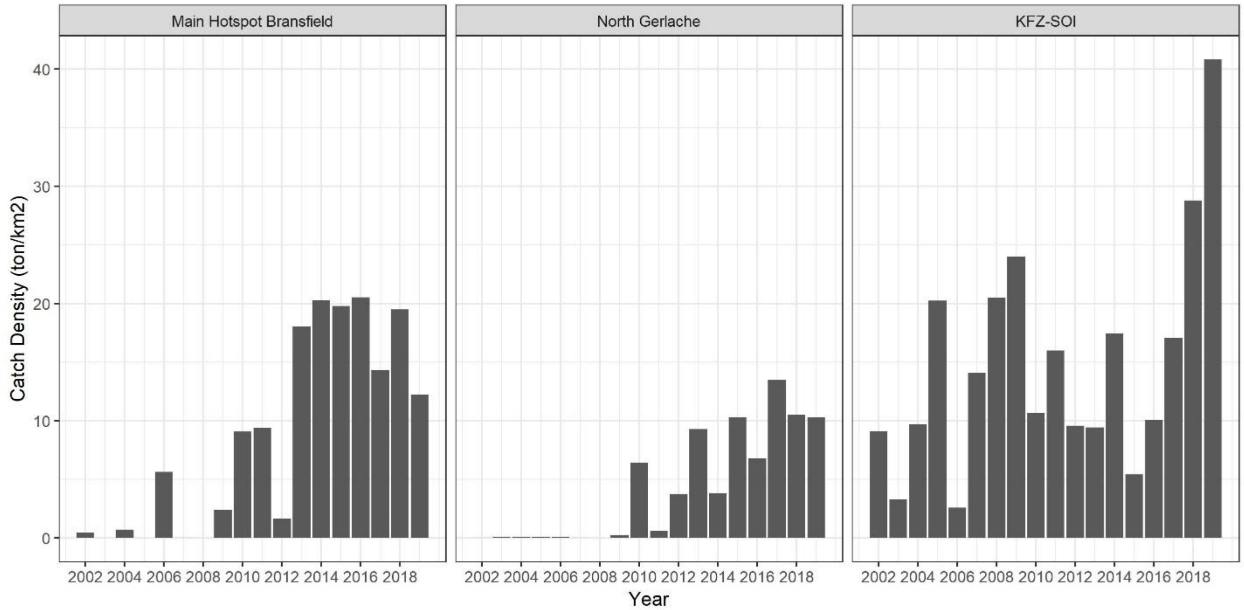

Figure 2. Catch density in the main hotspot of Bransfield Strait, North Gerlache and SOI (Subarea 48.2; West Coronation Is) between 2002-2019.

ARK (Association of responsible Krill Harvesting companies) proposed a voluntary measure of no fishing operation within "coastal buffers" (40 km) between October 2018 and March 2019 (SC-CAMLR-XXXVII/BG/30). This measure allowed reduction of the fishing pressure in the north of Gerlache Strait (sector strongly exploited during 2017 and 2018 where likely evidence of impacts over top-predators has been reported, see WG-EMM-2019/10), however, temporal "coastal buffers" increased the spatial and temporal concentration of catches in the Northern WAP (NWAP) and South Orkney Is (SOI) (Figure 3 and WG-EMM report para 3.45). Comparatively, in NWAP during 2019 there was a daily catch concentration of 738.7 tons / day (96039 tons in 130 days of fishing), higher than 631.0 tons / day of 2018 (104120 tons in 165 days of fishing). While in SOI the temporary concentration reached its maximum value of 1261.1 ton / day.

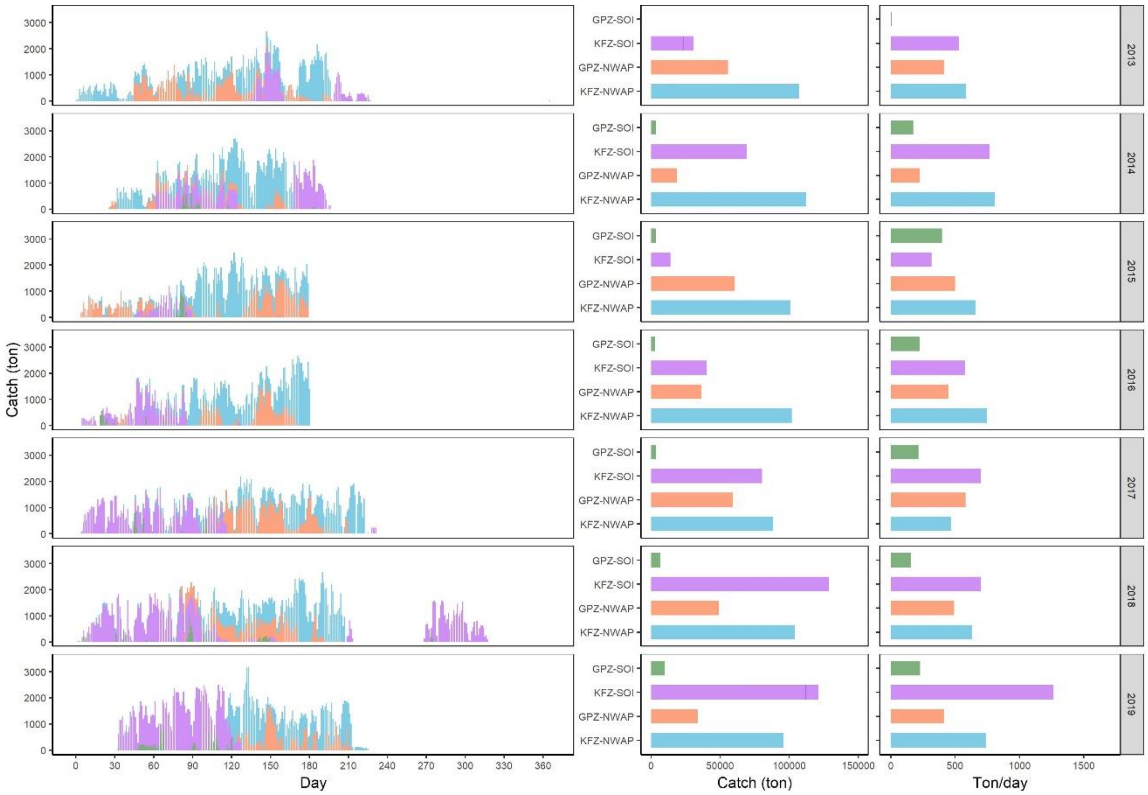

Figure 3. Daily catch through the fishing season (left), total catch (middle) and temporary concentration (ton / day) (right) for each D1MPA-2019 sector between 2013 and 2019.

The concentration of catches could be driving local overfishing. The CPUE of krill, characterized by hyper-stable behavior, showed evidences of negative trends in consecutive years. During 2017 the GPZ-NWAP (north of Gerlache Strait) showed the first negative trend signal. In this regard WG-EMM-19 noted "the need for precaution as this is an important area for predators" (para 3.44) and requesting for monitoring and update. New analyses show that the negative trend persisted in 2018 and 2019, despite the total catch was smaller due the coastal buffers, the catch per unit of time was higher. For the first time a negative trend was observed in KFZ-NWAP during the year 2019 (catches were concentrated in a fishing hotspot in the center of Bransfield Strait, Figure 4).

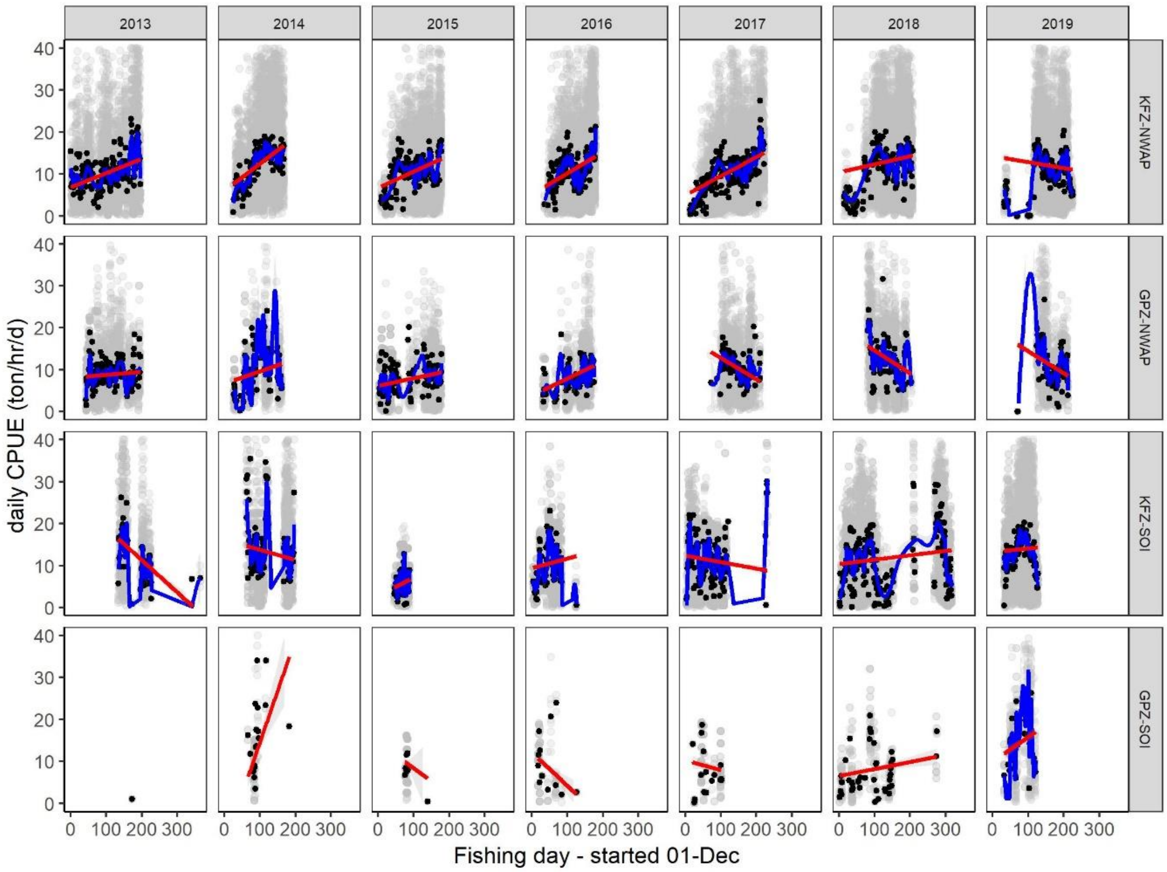

Figure 4. Daily CPUE trend among D1MPA sectors between 2013 to 2019.

Future Management of the krill fishery in Area 48

Following the task given by the Scientific Committee (SC-CAMLR-XXXVII, para. 13.1 to 13.3) and the Commission (CCAMLR-XXXVII, para. 5.9 and 5.10) for advice on the development of a management strategy for krill fishery in Area 48 related to the review of CM 51-07, WG-EMM-19 recommended that the Scientific Committee evaluates and endorses a three-part approach towards a preferred strategy for the krill fishery by 2021 (WG-EMM-19 para. 2.17, 2.60 to 2.64). The new D1MPA model and the changes proposed (reduction in GPZs and exclusion of Krill Fishery Reference Areas) provide the opportunity to implement the new approach which would change the spatial distribution and scaling of the catch limits.

In addition, considering the concerns of the potential increased of the concentration under the current management and implementation of buffer zones or other measures that might increase the risk for predator populations (WG-EMM-19/18 para. 2.17, WG-EMM-19/10, WG-EMM-19/11), the model has been simplified with a reduction of the GPZ in NWAP, allowing for redistribution of catch allocation and minimizing the potential for further spatial and temporal concentration of the krill fishery (Figure 1), hence reducing the risk for predators. Furthermore, the simplified version of the D1MPA model also excludes Krill fishery Reference zones (KFRZ) in response to concerns raised by a few members regarding the design of reference areas and consideration of a potential experimental approach. In this regard, it is expected that once the preferred option is agreed and implemented, the acquired knowledge will allow the Scientific

Committee to agree on the most appropriate experimental approach and design of krill reference zones that could be implemented in the Krill Fishery Zone (KFZ) and included in the Research and Monitoring Plan of the MPA.

Outstanding issues Scientific Committee XXXVII

During the last meeting most Members agreed that the proposal has been developed based on the best available science (Scientific Committee XXXVII para 6.57).

However, outstanding issues were raised by two Members in relation to the D1MPA proposal, including suggestions on the need for:

(i) *further work on the design of reference areas and associated research questions, including consideration of a potential experimental approach, current krill catch levels, similar response to natural variation of the reference area with fishing area, and krill flux between areas.*

a) The identification of reference areas has been removed from the proposal. As mentioned in previous sections, we believe once the preferred management strategy is implemented, there will be enough information for the Scientific Committee to agree on the most appropriate design of reference areas that could be implemented within Krill Fishery Zones (KFZ) as part of the Research and Monitoring plan.

b) Relevant research questions are indicated in Annex C of the proposal and they were indicated in the previous proposal as well.

c) Experimental approach: In 2018, Krill Fishery Research Zones (KFRZ) were included in the MPA model following an experimental approach harmonized with the proposal as requested by the Scientific Committee (SC-CAMLR-XXXVII, para. 3.30 and 6.56) and also included the vision of some members (WS-SM 18/05). The objective of this approach was to establish scientific reference areas to assess the potential impact of krill fisheries on dependent predators.

At the WG-EMM 2019 meeting, the working group agreed on a preferred option for management of the krill fishery (WG-EMM-19 report para- 2.60 to 2.64). In this working plan, the experimental approach was not highlighted. Thus, in order to support the FBM strategy, and considering some Members' concern, this area (Krill fishery research zone-KFRZ) was merged into a single zone now called: Krill Fishery Zone (KFZ). It comprises the ex KFRZ and the Special Fishery Management Zone (SFMZ). In this way, no further concerns regarding "*consideration of a potential experimental approach, current krill catch levels, similar response to natural variation of the reference area with fishing area, and krill flux between areas"* currently apply.

d) Catch limits for krill (and thus how much krill is ultimately caught) will be determined in other CMs that define how fishing is managed in the KFZ. These CMs can be developed independently of the D1MPA (as noted at the Krill Workshop and endorsed by WG-EMM 2019) but will be regularly reviewed to ensure they do not jeopardize achievement of the specific objectives of the D1MPA.

e) Studies of krill flux are highlighted in Annex C, and, importantly, the KFZ is placed in a "sink" area such that it would benefit from broad-scale patterns of flux from the Bellingshausen and Weddell Seas.

(iv) further consideration of how reference areas can be used to study the effects of climate change.

Noting Members´ concerns about the use of the concept of "reference areas", particularly referring to their use for comparison among areas, the term "reference" was deleted from the proposal. Therefore, despite the fact that MPA objective N°9 will not refer to any area as reference area, the objective of conducting scientific research in specific areas of the D1MPA without directed fishing activity was considered and maintained in the MPA proposal.

(vii) The necessity of the inclusion of a krill research zone given the long existence of the krill fishery and scientific research in this region

This area was merged into the KFZ (see point i) above.

Other outstanding issues (Already discussed during the Commission meeting XXXVII, but further reinforced here)

(ii) analysis of threats to the marine ecosystem in Domain 1, given existing management of human activities in the region.

As it was discussed in SC-CAMLR-XXXVII/BG/08 (Delegation of Argentina and Chile) evaluated the risks and costs for both predators and the krill fishery inherent to the implementation of the D1MPA. A key driver of potential costs is the redistribution of fishing effort displaced by an MPA, which can increase pressures in remaining open areas and result in new and unexpected consequences. In this sense, Klein and Watters (WS-SM-18/P03) explored both a static assessment (based on the design of the scenario and the distributions of krill fishing and krill-dependent predators) and a dynamic risk assessment (based on a minimally realistic, spatially explicit ecosystem model), and considered three alternative redistributions of the catches displaced by the MPA. The usefulness of employing both approaches was recognized by the recent workshop on spatial management (WS-SM-18 report paragraph 3.45). Both approaches reached similar conclusions; their results revealed that fishing displaced by MPA could exacerbate depletion of krill predator populations unless closed areas protected ca. 80% of predator foraging distributions.

Also, WG-EMM 2019 noted that two separate modelling approaches using different assumptions (WG-EMM-19/10 and 19/11) came to the same conclusions regarding probable impacts of concentrated krill fishing on the penguin populations and emphasized the need for precautionary management approaches. The Working Group agreed that both studies demonstrate that krill fishing at current levels and concentration in the Bransfield and Gerlache Straits is likely to have had a negative effect on localized predator populations in years with unfavorable environmental conditions. The Working Group further noted that the exact temporal and spatial scale of that impact is unknown and requires further study (para 4.41). Therefore, the synergistic effects of climate change and the way fishery is currently managed (i.e. fixed catch limit and concentration) represent a likely threat that should be considered.

(iii) additional evidence that the proposed MPA could decrease the risks of krill fishing having a negative impact on the ecosystem.

In order to facilitate development of the D1MPA and assess whether it may achieve its objectives, the background paper SC-CAMLR-XXX VIIBG/04 (Delegation of USA) used a dynamic modelling approach to explicitly consider changing environmental conditions. It presented scenarios related to a) sea-ice conditions, b) fishing and c) MPA placement to explore how the biomass of various species might respond to changes in these three factors (for details, please refer to SC-CAMLR- XXXVII BG/04). In this paper, Dahood and colleagues indicate that a well-designed MPA could benefit krill and some krill predators. In fact, fishing scenarios and MPA scenarios had larger impacts on model outcomes than sea-ice scenarios. Fishing scenarios (Status Quo, 5x, or 12x) influenced biomass outcomes and the efficacy (or lack thereof) of an MPA scenario. This paper showed that as fishing pressure increased, the effectiveness of MPAs also increased. That is, as fishing increased MPAs yielded more biomass than would be expected without an MPA under the same fishing and sea-ice scenarios. Patterns of biomass accumulation differed only in magnitude across fishing scenarios.

In addition, their results indicated that krill and Adélie penguins benefitted from protecting a large portion of the southern area of krill concentration. In other words, by increasing the General protection zones in the South of the Western Antarctic Peninsula, the ecosystem benefits, avoiding further fishery concentration in the north.

(vii) Development of indicators to assess the effectiveness of the MPA

During recent WG-EMM meeting, as part of the approach to advance on a preferred strategy to manage the krill fishery, it was prioritized to advance the risk assessment framework to inform spatial allocation of catch. In this regard, WG-EMM identified a set of priority data layers (e.g. pygoscelids penguins' breeding and feeding parameters, census of sea-ice seals, breeding population size of elephant seals and fur seals) and recommended the Scientific Committee to coordinate a focus topic for 2020 to address the development of data standards and quality controls to improve efficiency of the use of these indicators (WG-EMM 19 paras. 2.18 to 2.25, Table 7).

(vi) Further development of objectives, indicators and baseline data for research and monitoring, including within reference areas

The main objectives of the D1MPA have been extensively discussed and are detailed in Annex C of the Conservation Measure (CC-CCAMLR XXXVII/31 and the revised version (2019)). Further development shall be agreed by all Members as it development and implementation will rely on resources, logistics, infrastructure and interests that may vary among different Members. If Members believe that other priority questions have not been considered, we will be pleased to discuss their inclusion. Otherwise, we consider discussion on this topic has been completed and next step should be the discussion between Members about the research and Monitoring Plan, once the Conservation Measure has been agreed.

For further details about indicators and baseline data please see Annex B of this document. It is worth noting that, indicators and baseline data are the same that have been already discussed and agreed by members to be part of the development of the fishery management strategy. No further objections were raised regarding the use of those baseline data and indicators to move forward with the development of the fishery management strategy. Considering WG-EMM-19 recommended the Scientific Committee has endorsed a prioritised approach and to advance a preferred strategy to manage the krill fishery we believe that once the Scientific Committee has endorse it, the agreed data layers and hence MPA indicators and baseline data should be also considered in the same way.

As MPA development is an iterative process, Argentina and Chile requested that Members with pending issues clarify in detail what they refer to in relation to the development of the objectives, indicators and baseline data, and that they provide practical and concrete examples. They proposed three mechanism of communication: a) the D1MPA Expert Group, b) the workshop on management of the krill fishery in 2019 and c) by submitting papers documenting any concerns of scientific nature to WG-EMM-19 (SC-CCAMLR XXXVII-paras. 6.48 and 6.58).

In this regard, it is worth noting that during 2019, none of these channels were used to express further concerns or develop outstanding issues as it was requested by the proponents. Therefore, we assume that all the concerns expressed have been considered in the present draft.

Summary of the changes

The revised D1MPA proposal has an extension of ≈ 670,000 km^2 comprising <u>two</u> different zones: General Protection Zone (GPZ≈423,000 km^2) and Krill Fishery Zone (KFZ≈247,000 km^2). <u>KFZ is the result of the merging of the Krill Fishery Research Zones and the Special Fishery Management Zones (SFMZ),</u> introduced during the Scientific Committee meeting in 2018. These zones protect priority areas for conservation, including predator's populations that showed a significant decline during last decades; and accommodate the need for monitoring the krill fishery activity, while contemplating current fishery management strategy (CM 51-07).

The model has been simplified and some controversial decisions such as, agreement on krill catch limit within experimental zones that might delay adoption, have been deleted.

As in 2018 the Domain 1 MPA includes three ecoregions – Northwest and Southwest Antarctic Peninsula (NWAP and SWAP) and South Orkney Islands (SOI) – each of them presenting particular physical and biological characteristics. The Western Antarctic Peninsula (WAP) is subject to on-going environmental changes including changes in the extension and duration of sea ice, temperature increase, ice shelves collapse, ocean acidification and changes in the wind regime. In particular, the North-South oriented WAP presents a strong latitudinal climate gradient both in temperature and sea ice, characterized by a shorter ice season and more maritime conditions in the North, and a longer ice season and more continental conditions in the South. The SOI region is influenced by the WAP and the Weddell Sea Gyre. For management purposes this domain comprises Subareas 48.1 and 48.2, and 88.3. Considering the krill fishery management, 48.1 and 48.2 are the most relevant subareas.

Therefore, the two different zones (GPZ, KFZ) have been replicated, as far as possible, in each of these three ecoregions (Table 3, Figure 5):

1 GPZs in the SWAP; 1 GPZs in the NWAP (Comprising 3 polygons: Livingston, Joinville and Anvers I) and 1 GPZ in the South Orkney Is.

1 KFZs in the NWAP and 1 KFZ in South Orkney Is., and no KFZ was identified in the SWAP since no direct fishing activity for krill occurs there.

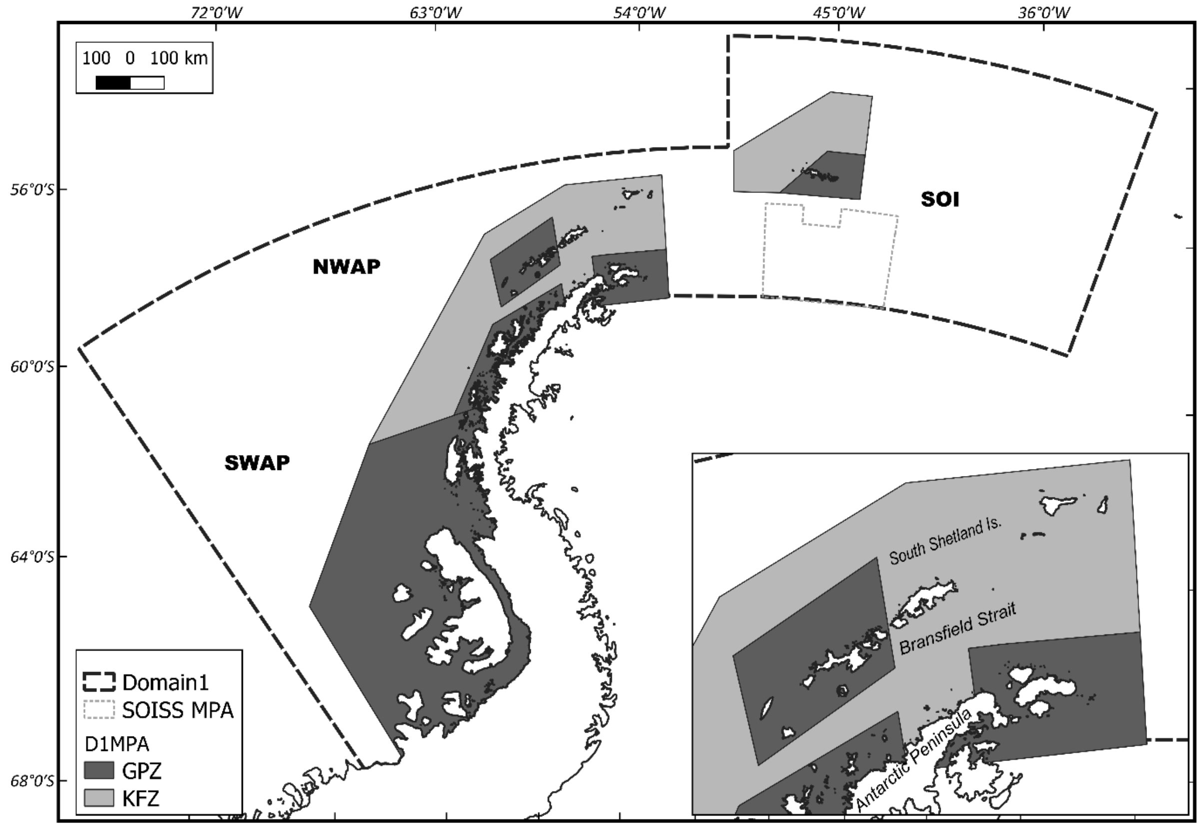

Figure 5. The Domain 1 Marine Protected Area, including the boundaries for the General Protection Zone, composed of GPZ-SWAP, GPZ-NWAP, and GPZ-SOI; the Krill Fishery Zone, composed of KFZ-NWAP and KFZ-SOI. SOISS MPA shall be managed in accordance with Conservation Measure 91-03.

Table 3. Area of each D1MPA zones.

Zones	Sector	Area (km^2)	% from D1
GPZ	SOI	21,831.58	0.92
GPZ	NWAP*	83,570.87	3.52
GPZ	SWAP	318,003.64	13.40
KFZ	SOI	67,488.09	2.84
KFZ	NWAP	179,983.14	7.59
Total	GPZ	423,406.1 (63%)	17.85
	KFZ	247,471.2 (37%)	10.43
	Total	670,877.32	28.28

*Includes three polygons named Joinville, Anvers and Livingston

As in 2018 the MPA were divided in 3 areas (SWAP-NWAP-SOI)

A. **In SWAP** the 3 General protection zones (SWAP-E: SWAP-AI and SWAP-MB) were consolidated into a single GPZ named GPZ-SWAP.

Rationale:

Increased protection of the south that potentially can positively impact the biomass of krill and krill predators

The revised D1MPA proposal simplified the model and reduced fragmentation by merging three of the southern GPZ zones (Emperor, Alexander and Marguerite Bay) into a single one which is connected with the NWAP zone. It also helps improving operational management by making the boundaries easy to depict and enforce. The north sector of the GPZ-SWAP, encompassing Adelaide Island and Marguerite Bay, holds a unique and complex oceanographic system. The Antarctic Circumpolar Current intrudes the bays around Adelaide Islands bringing warmer and nutrient-rich waters into the colder coastal current (Moffat and Meredith 2018; Henley et al. 2019). That process, intensified by glacier melting and higher intrusion of the warmer water from the deep water circumpolar current has increased considerably the productivity of the area (Schofield et al. 2018). Contrasting to the northern of the peninsula (Schofield et al. 2018), the increased productivity seem to be allowing krill-predator populations to increase (Lynch et al. 2012; Casanovas et al. 2015). The SWAP is highly important for early stages of krill, as densities of calyptopes, furcilia and late season juveniles are very high (Perry et al. 2019). Therefore, by holding significant amounts of early stages of krill, the GPZ-SWAP is a key area for krill stocks. Under the fast changes the WAP is experiencing, this zone requires full protection in order to safe-guard krill stocks.

As it was mentioned in previous sections, results of Dahood and colleagues (SC-CAMLR-XXX VII BG/04) indicated that krill and Adélie penguins benefit from protecting a large portion of the southern area of krill concentration. In other words, by increasing the General protection zones in the South of the Western Antarctic Peninsula, the ecosystem benefits without representing any cost for the krill fishery. Thus, this could be a great achievement for CCAMLR.

B. **In NWAP** the model was simplified in 2 zones: GPZ and Krill Fishery Zone (KFZ) with different provisions.

   A) GPZ-NWAP: composed by three polygons: Joinville, Anvers and Livingston.

Rationale:
Important areas for predators

NWAP- comprises the protection of a large quantity of conservation objects but it is mainly characterized by covering important areas for birds and mammals, including breeding foraging distribution of fur seals, and Adélie, chinstrap (*P. antarctica*) and Gentoo (*P. papua*) penguins; and non-breeding foraging distribution of humpback (*Megaptera novaeangliae*), minke (*Balaenoptera acutorostrata*) and killer whales (types A, B1 and B2), Weddell and leopard seals (Fig. 6 in WG-EMM-17/25 rev. 1). It also protects important areas for fish life cycles such as spawning/early stages habitat and occurrence areas for exploited species; important areas for zooplankton life cycles, including the Gerlache and Weddell krill nurseries and the section of the Circumpolar Deep Water located in the Bransfield Strait / Mar de la Flota (Fig. 6 in WGEMM-17/25 rev. 1), projected nursery areas by 2030 in Palmer Deep (see SC-CCAMLR-XXXVI); also echinoderms communities and diverse benthic environment types; Polynyas margins; Shelf incising canyon and part of the seamounts.

A major abundance hotspot of Adélie penguin identified in 2018 at Danger Islands off the northern tip of the Antarctic Peninsula was reported by Borowick and colleagues. Their survey reveals that Danger Islands host 751,527 breeding pairs of Adélie penguins, more than the rest of AP region combined, and include the third and fourth largest Adélie penguin colonies in the world. In contrast to what has been described for other areas of the Domain 1 such as the South Shetland islands (Trivelpiece *et al*. 2011), this region is likely to remain as an important hotspot for avian abundance under projected climate change scenarios (Borowick *et al*. 2018). Moreover, in this region there is another mega colony with 104,000 breeding pairs located at Hope Bay/Esperanza (Santos *et al*. 2018). This colony was established as a CEMP site in 1995 and its long-term monitoring will contribute to the monitoring of the MPA. In addition, the installation of a new network of monitoring cameras has been programmed close to Base O' Higgins, in Kopaitic Island (Antarctic Peninsula).

<u>Protection of important areas for top predators</u>

Due to the likely impact on predators populations the changes proposed, in pursuant of a compromise among interested Members, allow for the protection of a high percentage of breeding foraging range of chinstrap and fur seal populations (Table 1) without substantially displacing the fishing catch (Table 2). The proposed GPZs protect more than 40% and 60% of both population and breeding foraging range of Chinstrap penguins and Fur Seals respectively. Evidences of decline of Chinstrap Penguins in the Antarctic Peninsula are solid (Trivelpiece et *al*. 2011; Lynch et *al*. 2012; Casanovas et *al*. 2015), Chinstrap performance can increase with the establishment of MPA (SC-CAMLR-XXX VII BG/04).

Table 1. Percentage of populations and breeding foraging range of Chinstrap Penguins and Fur Seals inside each of the sectors of the proposed D1MPA.

Species	Sector	Population	%	Area	%
Chinstrap Penguin	GPZ-NWAP*	205805	12.93	107825	42.61
	GPZ-SOI	558595	35.08	5434.40	2.15
	GPZ-SWAP	2	0.00	0.00	0.00
	KFZ-NWAP	826939	51.93	139234.45	55.03
	KFZ-SOI	1000	0.06	532.45	0.21
	Total GPZ	764402	48.00	113259.40	44.76
Fur Seal	GPZ-NWAP*	4996	75.62	19698.42	22.2
	GPZ-SOI	900*	13.62	34911.04	39.35
	GPZ-SWAP	0	0.00	0.00	0.00
	KFZ-NWAP	711	10.76	28857.64	32.53
	KFZ-SOI	0	0.00	5253.68	5.92
	Total GPZ	4996	89.24	54609.46	61.55

*Includes three polygons named Joinville, Anvers and Livingston

Table 2. Mean krill fishery catch inside each of the sectors of the proposed D1MPA for the period 2013-2019.

Sector	**Fishing catch (t)**	**%**
GPZ-NWAP*	56926.7	36.9
KFZ-NWAP	95609.8	63.1
GPZ-SOI	4405.3	6.8
KFZ-SOI	69464.7	93.2

*Includes three polygons named Joinville, Anvers and Livingston

Important areas for krill

The Western Antarctic Peninsula and Scotia Arc is the zone where the global biomass of Krill is higher (Atkinson et al. 2009; Atkinson et al. 2017). Antarctic krill has a complex life cycle with descending and ascending states depending of the stage of life (Hofmann et al. 1992). Recent efforts on mapping the whole life cycle of krill in the Antarctic Peninsula (Perry et al. 2019) showed that both horizontal and vertical distribution of krill varies along the year depending on its life stage.

The distribution of eggs, larvae, furcilia, calytope and juveniles have a different distribution on the spatial and on the water column, where during the late part of the austral season juvenile distribution move from ocean to shelf, opposite to the adult direction (Perry et al. 2019). Perry et al. (2019) found that the distribution of egs, nauplii and metanauplii of Antacrtic krill are most intense over the shelf and slope, which contrasts with the distribution of calyptope and furcilia larve which are more concentrated futher offshore. Important concentration of eggs was found in southeast South Georgia, the northern tip of the Antarctic Peninsula and the western Bransfield Basin throughout the Gerlache Strait. The occurrence of naupli and metanaupli was also high in the Western Bransfield Basin and Gerlache Strait, while calyptopes and furcilia larvae concentrated north off Elephant Islands and Orkney Islands, with a smaller area of concentration in open water west off Marguerite Bay. Bransfield Strait and South Georgia had higher densities of adults early in the season, which displaced to more open waters in the scotia arc late in the season, while juveniles presented an inverted pattern of distribution.

The transport pathways in the Bransfield Strait is linked to the Coastal and the Bransfield currents on a clockwise pathway. Simulation of Langranian particles release have estimated that the transportation of krill can reach 760 km between 48 to 110 days (WG-EMM.2019/22). (Piñones et al. 2013;2017; Piñones and Fedorov 2016) simulated movement of Langranian particles on the Western Antarctic Peninsula and identified nursery zones at Marguerite Bay, Anvers Island and Crystal sound (Palmer Deep). The circulation pathways projected under climate change scenarios resulted in enhanced advection of krill larvae from nursery areas into the inner shelf, increasing the importance of the Gerlache Strait and the area between Anvers and Renaud Islands for occurrence of nurseries under climate change. Increased advection of CDW into the inner shelf may also support a successful descend-ascend cycle and enhance krill early development.

Density of adult krill in the northern range fringes presented a sharp decline in the last century, while south 65°S adult density was stable or slightly increased. That followed a tendency for increased adult size while the number of recruiting individuals decreased abruptly (Perry et al. 2019). This suggests a substantial reduction on recruitment, which has been verified before (Trivelpiece et al. 2011) and a shift of adult biomass towards south (Piñones and Fedorov 2016; Perry et al. 2019). Taking all of this in account, first: (i) under climate change, krill may lose its northern range and or increase density towards south therefore protection in key climatic stable areas is necessary to avoid increased impacts from fisheries; (ii) early developmental stages and juveniles are at greater risk, therefore zones of high importance for early stages and juveniles also should be closed to guarantee recruitment of the stocks, like Gerlache Strait, areas south of Marguerite Bay and Anvers Island, and the tip of the Antarctic Peninsula. This support the full protection of the proposed NWAP GPZs and the fusion of the SWAP into a single unity, guaranteeing protection and connectivity along the whole area. It is noteworthy mention that eggs, naups and metanaups were very abundant in the Gerlache Strait, were fisheries increased consistently in the last years (WG-EMM-2019/41). As there still a lot to know about flux and recruitment and how fisheries affect it, the precautionary approach should be adopted.

B) Krill Fishery zone (KFZ): included the previous SFMZ, part of the previous KFRZs, part of the previous GPZ at South Shetland Islands, and integrally the GPZ at Elephant Island.

Rationale:
As previously mentioned, the model has been simplified excluding Krill fishery Reference zones (KFRZ) and also reducing the GPZ in the South Shetlands Islands, therefore increasing the KFZ-NWAP. The increased KFZ allows for redistribution of catch allocation, minimizing the potential for further spatial and temporal concentration of the krill fishery (Figure 1), hence reducing the risk for predators. Furthermore, the current model provides opportunities to implement an experimental approach comparing fished vs no-fished areas, once the preferred management option of krill is adopted. The implementation and development of the preferred management option will allow the Scientific Committee to agree on the most appropriate experimental approach that may include krill reference zones that could be implemented within the KFZ as part of the Research and Monitoring Plan of the MPA.

C. In SOI the previous SFMZ and KFRZ were merged into a KFZ (KFZ-SOI) Note that the catch limits in KFZs remain as in CM 51-07 or the CM(s) that replace it. The previous GPZ remains unchanged
D. A new objective was included: xi) to ensure a sustainable development of the Antarctic krill fishery in a manner consistent with the objectives in Article II of the Convention.

An ecosystem-based management encompassed the interconnectedness of natural systems and recognized "that management is essentially the management of human behavior associated with extraction of human benefits, and that in using the resources of the ocean there will always be conflicting interests that need to be resolved". The purpose of this objective is to incorporate this activity within D1MPA proposal. A sustainable development of this activity and its monitoring could be incorporated into the Research and Monitoring Plan.

Protection in the 2019-D1MPA model

Similar to the analysis run for the preliminary proposal introduced in 2017 (SC-CAMLR-XXXVI/BG/21) and the 2018-model (SC-CAMLR-XXXVII/BG/07), the level of protection for the 2019-D1MPA model was analyzed (Annex A). In general terms, the current model still achieves the high level of protection agreed by the international community for Domain 1, including most of the important areas for the life cycles of zooplankton, fishes, birds and mammals. The increase in the area protected in the southwest Antarctic Peninsula favored the protection of almost all conservation objectives (with the exception of number 8 – rare or unique habitats). In particular, there is more representation of some examples of benthic habitats, biopelagic regions, benthic processes including ice-shelves and canyons, large-scale pelagic ecosystem processes such as high Chl-a production and polynyas, important areas for zooplankton including adult krill, non-breeding distribution of mammals, specially cetaceans (such as minke whales, humpback whales and killer whales), inshore and offshore areas important for the life-cycles of fishes, and krill nurseries particularly those associated with the Bellingshausen Sea.

Considering the South Shetland Islands, the buffers around Livingston, Deception, Smith and Low islands have been designed to adequately protect, chinstrap penguins' colonies and Fur seals reproductive distribution as their colonies are well documented to occur at Cape Shirreff in Livingston Island (South Shetland islands). While the post reproductive dispersion of fur seals does not reach the agreed target (20% of the 50%), it is worth to mention that there is a potential underrepresentation since tracking data has only been available for the colonies at Cape Shirreff. Fur seals breeding outside the Domain 1 (e.g. subarea 48.3) are known to use intensively the Gerlache Strait for their non-breeding dispersion (Arthur et al. 2017), increasing the importance of the GPZ in the Antarctic Peninsula for this species. Also, targets for non-breeding foraging distribution of Adélies and chinstrap penguins are not entirely achieved at NWAP, although their wider dispersion during this period is well represented in the D1MPA model including within its GPZ (Annex A). Inshore waters important for early life stages of some species of fishes reduce their protection (45% instead of 80%) although its protection is increased by a 2.5 factor in the south due to the bigger extension of the GPZ.

Balance of interests

The outstanding issues of two members were addressed. It is worth noting that at the Scientific Committee XXXVII meeting, Argentina and Chile encouraged all Members, especially those with outstanding issues, to engage on intersessions, and noted three possible mechanisms: the D1MPA Expert Group, the workshop on management of the krill fishery in 2019 and by submitting papers documenting any concerns of scientific nature to WG-EMM-19 (SC 37-para 6.48 and 6.58). Also, at the WG-EMM 2019, Argentina and Chile informed that during this intersessional period the D1MPA proponents have been working with Members to progress the development of a D1MPA proposal in line with a comprehensive krill fisheries management approach, including bilateral meetings and an exercise shared with the D1MPA Expert Group, participation in krill fishery management discussions during Working Group meeting and at the Workshop on Krill Fishery Management (WG-EMM-2019/25 Rev. 1). At that point, in order to progress towards a revised version of the proposal, Argentina and Chile invited Members with outstanding issues to provide their comments to the proponents (WG-EMM para 6.25) and no country raised any concern.

Fishery for *Dissostichus*

The Antarctic continental shelf on depths until 550 m holds nursery habitat for Antarctic toothfish. As toothfish grows up, it shifts habitats towards deep pelagic areas. Maturity is assumed to be reached when fishes reach 75-80 cm for males and 95-110 cm for females, what corresponds to ages between 5 and 7 years for males and 8 to 12 years for females (Horn 2002). First spawning is estimated to occur at ages of

12.8 years for males 16 years for females (Parker and Grimes 2010). Therefore, protecting habitat used by younger fish, in order to avoid fishes being caught before their first spawning, is of extreme importance for the management of fishing stocks.

Söffker *et al*. (2018; SC-CAMLR-XXXVII/01) compiled all the information available about distribution of Antarctic toothfish life stages distribution, and proposed that Domain 1 holds several zones of nursery, matching a significant proportion of the proposed MPA in the north Antarctic Peninsula, South Shetlands and South Orkney Islands (Fig. 6). Therefore, the D1MPA is expected to provide protection to Antarctic toothfish important habitats during a critical stage of their life cycle (Fig. 6). On the other hand, the known zones of spawning within domain seem to be associated to the areas of research fisheries (48.2N and 48.2S, Fig. 6), which is probably a result from sampling bias. More effort should be made in order to detect zones of spawning in the Domain 1.

Research fisheries for Dissostichus

As mentioned in SC-CCAMLR-XXXVII/BG/09, direct fishing of Dissostichus spp. is prohibited in Domain 1, however, following CM 24-01 and CM 24-05 several research fishing programs have been developed in recent years (See Table 4), focused on Research blocks, which are areas where catch limits are smaller than those on statistical areas.

Table 4. Summary of research fisheries of *Dissostichus* spp. within Domain 1. Antarctic toothfish *D. mawsoni* (TOA) and Patagonian toothfish *D. eleginoides* (TOP).

Document	Species	Member	Status	Subarea	Period
WG-FSA-05/53	TOA	NZ	Finished	88.3	2005
WG-FSA-12, WG-FSA-12/32	TOA, TOP	Russia	Finished	88.3	2011-2012
WG-FSA-16, WG-FSA-15/65	TOA	Korea	Finished	883_4, 883_3	2016-2017
WG-FSA-17, WG-SAM-19/02	TOA	Korea/NZ/ Ukraine	Ongoing	883_3,883_4, 883_5, P6-10	2017-2019/2020
WG-FSA-18, WG-SAM-19/28	TOA, TOP	Ukraine	Ongoing	48.1	2019-2021
WG-FSA-17, WG-SAM-18/26	TOA, TOP	Chile	Finished	48.2	2018
WG-FSA-18, WG-SAM-19/29	TOA, TOP	UKraine	Finished	48.2	2017-2019
WG-FSA-18, WG-SAM-18/52	TOA, TOP	UK	Finished	48.2	2015-2019

WG-SAM-19/02: Proposal to continue research of the joint research proposal by Korea and New Zealand that now includes Ukraine

WG-SAM-19/28: Proposal as new submission to continue the research

A research program in Subarea 48.1 for data collection on stock structure and genetics was conducted in 2019 and has been proposed for one further year (WG-SAM-19/28 for further detail). However, there are concerns regarding the repeated accessibility of the area due to sea ice (see WG-SAM-19 report, Table 2). Multi-tagging programs have been carried out in Subarea 88.3 providing a good overlap between release locations and subsequent recaptures (See WG-SAM-19/02 for further detail). The new research program proposed by South Korea, New Zealand and Ukraine in subarea 88.3 aim to determine the distribution and abundance as well as to obtain and understanding of the stock structure following what was hypothesized by Parker et al. (2014). As a prospecting phase, some new blocks have been proposed in WG-SAM-19/02, aiming to determine toothfish abundance on representative parts of the shelf to obtain information on size and age composition of toothfish for studies on stock structure. As stated by the proponents, the prospecting phase will be effort limited/focused on the specific questions and once it has been completed and evaluated, it would be discussed and integrated with the D1MPA proposal, in order to ensure the proposed research and questions are linked to the RMP.

Research activities for *Dissostichus* within D1MPA proposal

Most of the habitat used by younger fish (depths below 550 m) is protected by the proposed MPA (conservation of important areas for life cycle of fishes, Annex Figure A2), and is closed for directed fishing. However, research fishing is allowed in specific blocks, with some of them overlapping with the MPA and important habitats for juvenile fishes (Figure 6). Considering there are areas where the fishing blocks matches the proposed MPA in subarea 88.3 (Figure 6), and following CM 24-05 for research activities in closed areas, we propose to maintain a low catch in the overlapping areas, in comparison with the areas of the fishing blocks outside the D1MPA where a higher catch could be allowed (under CM 24-05). The appropriate catch limit and specific location within D1MPA should be decided by the Commission based on the advice of the Scientific Committee and its Working Groups, and depending on the specific question/objectives agreed for a determined area. In addition, considering the needs to provide information because the data-poor situation of this resource in the area 48.1 and that proposed research block overlaps with the GPZ-NWAP GPZ at the northern tip of the Peninsula and GPZ-SWAP, we believe that as stated by the proponents, further hypothesis and research activities should be proposed to support question and objectives, including: a) develop surveys for dedicated collection and monitoring on the distribution and abundance of early life stages and spawning of toothfish; b) focused surveys on testing stocks hypothesis developed by CCAMLR for area 48; c) surveys for comparing slope habitats with and without fishing to assess the effects of fishing on toothfish and demersal fishes in subarea 88.3; d) compare benthic habitats in areas with and without fishing to study the effects of longline fishing on benthic habitats and ecosystems.

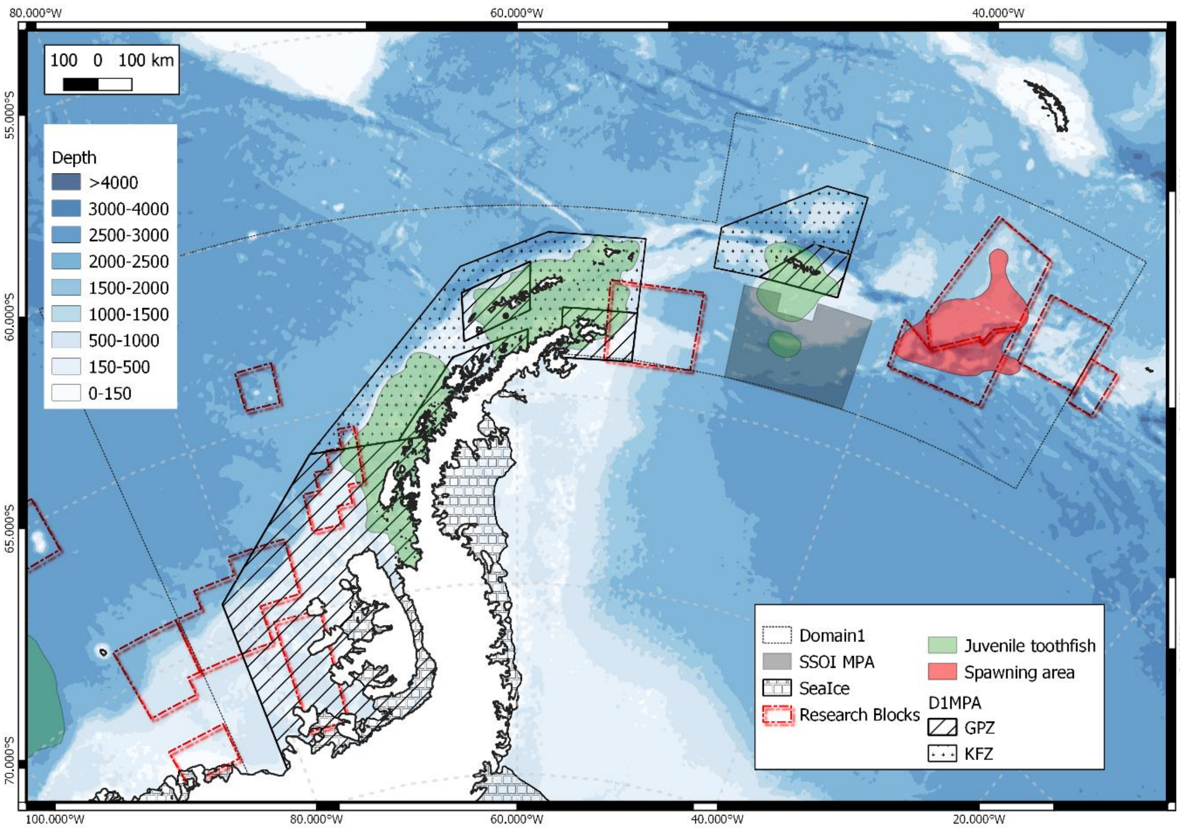

Figure 6. Proposed distribution of different stages of Antarctic Toothfish (*Dissostichus mawsoni*) life-cycle (Nursery – small juveniles – and spawning areas) within Domain 1 (from Söffker et al. 2018; SC-CAMLR-XXXVII/01) overlapped with the proposed D1MPA, and toothfish research blocks.

Craboid fishery

At present, fishery for crabs in the CCAMLR Convention Area is absent. For the first time, there is a proposal to establish a new crabs fishery in area 88.2 and 88.3 (WG-SAM-19/21). However, during the first year of the crabs research program (WG-SAM-19/31) there was a significant number of juvenile toothfish by-caught (WG-SAM-19 paraph. 6,102), 45 pots were losses (potential ghost fishing, WG-SAM-19 paraph. 6.104) and the requirement to use monitoring cameras on the pots was not fulfilled, which is essential to assess any impact on the benthic ecosystem. Further analysis is necessary to demonstrate that the establishment of a craboid fishery will not have negative implications on the ecosystem. It is also necessary to generate a database of greater temporal extension that allows identifying possible variations in population abundance.

The D1MPA is a largely discussed proposal where new fishery activities and resources needs to be thoroughly analyzed before approval. In this case, the GPZ-SWAP zone overlap with the area considered by the proposal of fishery for crab (Figure 7). This proposal for a new fishery and any other shall demonstrate that its activity and practices will not involve both negative effects on benthic habitats and significant benthic bycatch rates.

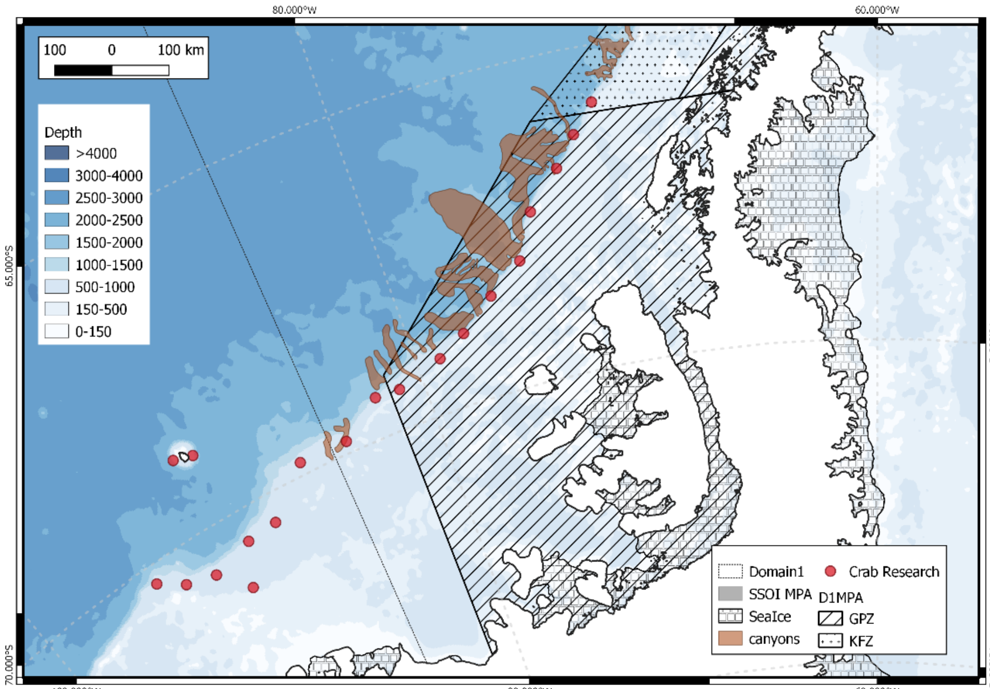

Figure 7. Location of crabs research during 2019 overlapped with the GPZ-SWAP of the proposed D1MPA.

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WG-EMM-2019/41. Exploring trends of the krill fishery indicators among the NWAP D1MPA zones in the Subarea 48.1F. Santa Cruz, L. Krüger, L. Rebolledo and C. Cárdenas

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WG-SAM-19/02. Integrated research proposal for Dissostichus spp. in Subarea 88.3by the Republic of Korea, New Zealand and Ukraine

WG-SAM-19/21. Proposal on establishment of a new fishery for craboids (Anomura,Decapoda) in the Subareas 88.2 and 88.3

WG-SAM-19/28. Ukraine proposes to continue a scientific survey of Dissostichusspp. by bottom longline in the eastern part of Subarea 48.1 in aseason 2019/20

WG-SAM-19/31. Report on implementation of research program for study of speciescomposition, biology and resource potential of craboids (Anomura,Decapoda) in the Antarctic Pacific in 2019

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WG-EMM-2017/25 rev1 Domain 1 Marine Protected Area Preliminary Proposal – PART C: Biodiversity Analysis by MPA zones Delegations of Argentina and Chile

WG-EMM-2019/25 REV1 Report from the Workshop on Krill-fishery Management for Subareas 48.1 and 48.2 G. Watters and P. Trathan

Annex A- coverage of conservation objectives

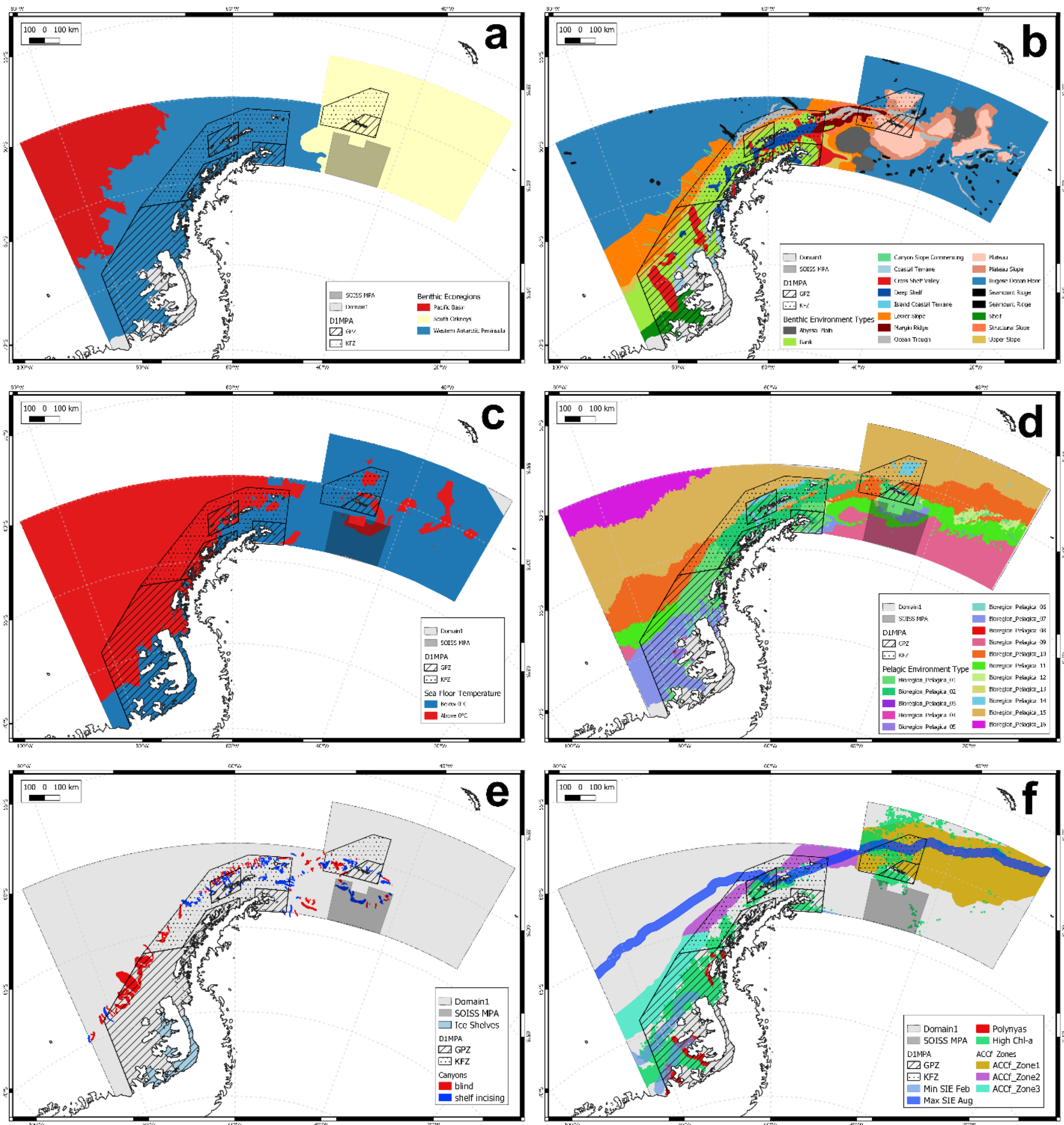

Figure A1. Distribution of benthic ecoregions (a), benthic environment types (b), sea floor temperature gradients (c), pelagic environment types (d), ice-shelves and canyons (e), zones of limits ofsea ice extent (SIE), zones of high productivity, polynias and different sectors of the Antarctic Circumpolar Current front ACCf (f) covered by the D1MPA proposal.

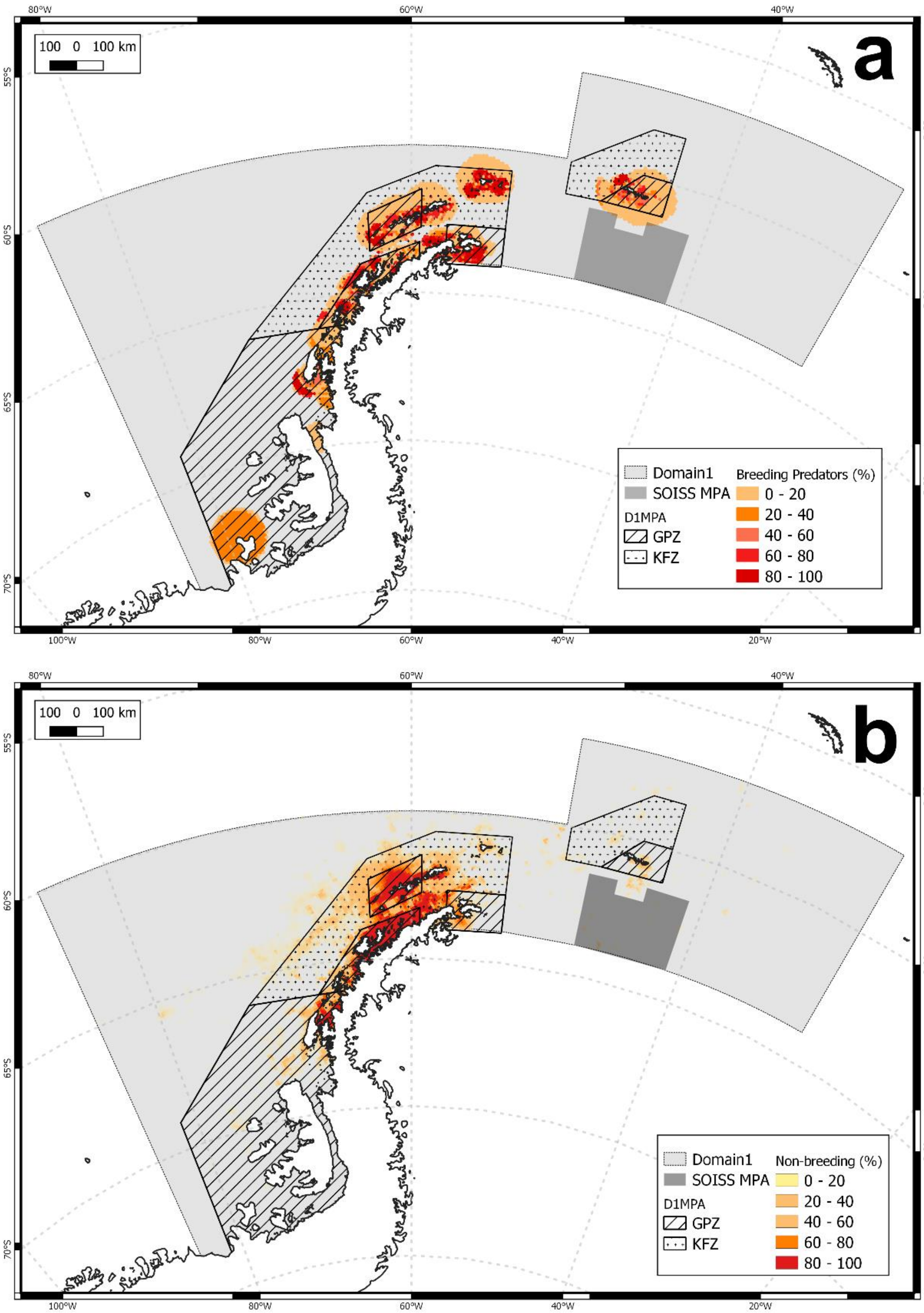

Figure A2. Breeding (a) and non-breeding (b) foraging range of mammals and seabirds covered by the D1MPA proposal.

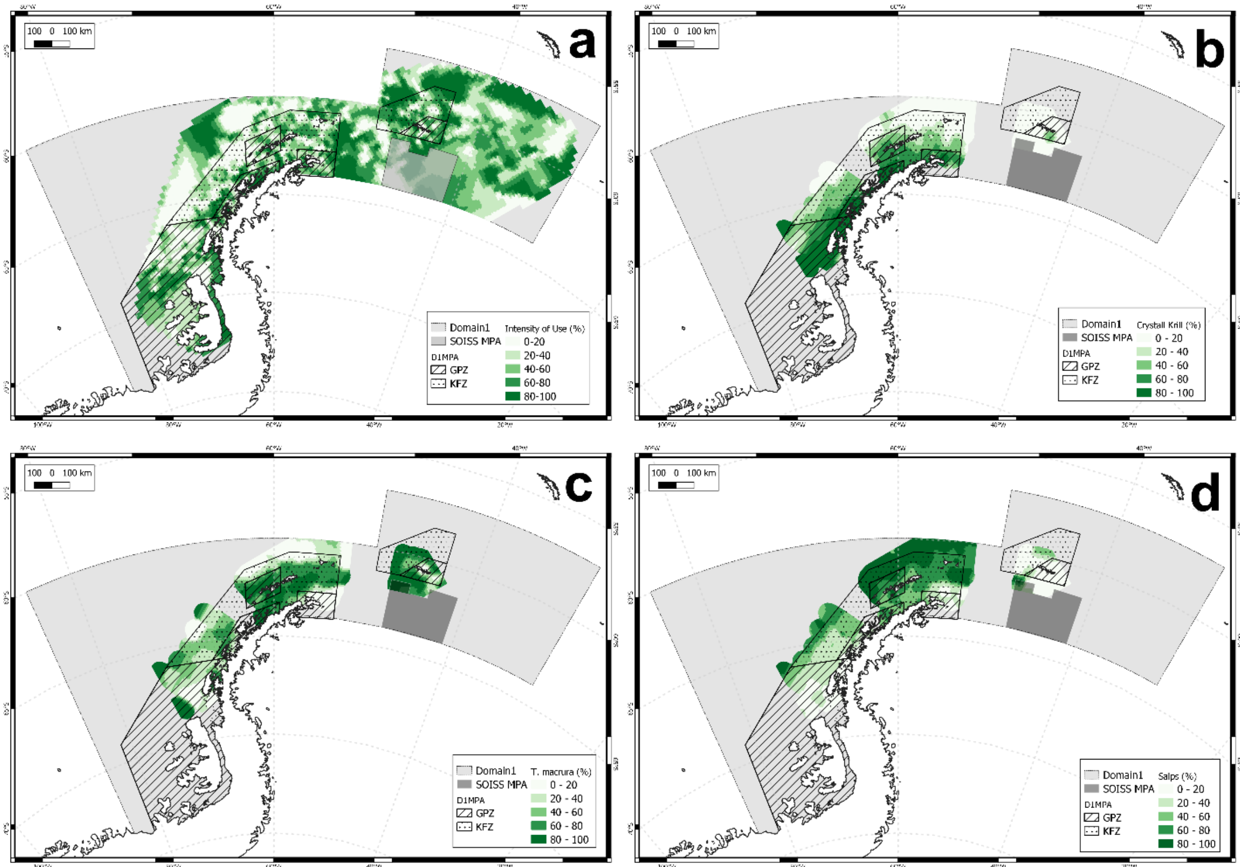

Figure A3. Distribution of main crustaceans *Euphausia superba* (a), *E. crystalorophyas* (b), *Thysanoessa macrura* (c) and salps *Salpa thompsoni* (d) covered by the D1MPA proposal.

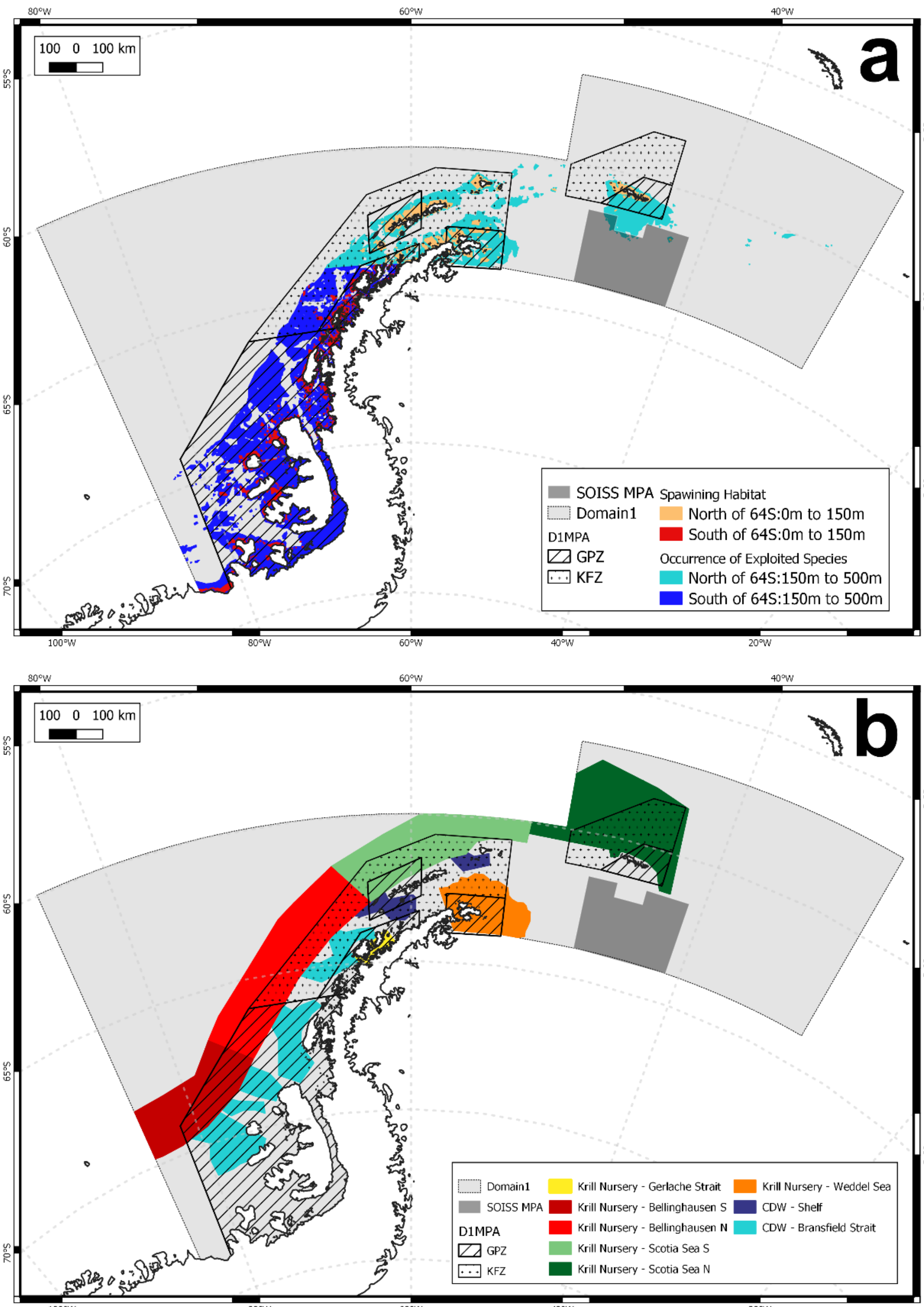

Figure A2. Distribution of important spawning habitat for fishes (a) and Antarctic krill *Euphausia superba* (b) covered by the D1MPA proposal.

Annex B- Indicators

indicators	parameter	area	Country
Adélie Penguins Chinstrap penguins Gentoo penguins	Breeding population size	GPZ-SWAP	CEMP CEMP
		GPZ NWAP	
		KFZ-NWAP	
		GPZ-SOI	
		KFZ-SOI	
		All regions	MAAAPD
	Breeding success	GPZ-SWAP	CEMP
		GPZ-NWAP	
		KFZ-NWAP	
		GPZ-SOI	
		KFZ-SOI	
	Foraging trips during breeding season	GPZ-SWAP	CEMP Funds, CEMP
		GPZ SSI	
		GPZ-AP	
		KFZ-NWAP	
		GPZ-SOI	
		KFZ-SOI	
	Foraging dispersal	GPZ-SWAP	
		GPZ SSI	
		GPZ-AP	
		KFZ-NWAP	
		GPZ-SOI	
		KFZ-SOI	
Fur Seals Elephant seals Weddell seals Crabeaters seals Leopard seals Humpback whales Killer Whales	population census	GPZ-SWAP	ARG; CHI; USA; UK; NORWAY; BRA; GER
		GPZ-NWAP	
		GPZ-AP	
		KFZ-NWAP	
		GPZ-SOI	
		KFZ-SOI	
	Foraging distribution during breeding and non-breeding season	GPZ-SWAP	ARG; CHI; USA; UK; NORWAY; BRA; GER
		GPZ SSI	
		GPZ-AP	
		KFZ-NWAP	
		GPZ-SOI	
		KFZ-SOI	