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Updated background paper (2018) on the Domain 1 MPA. Part A: Domain 1 MPA Model

Delegations of Argentina and Chile

EN

Updated background paper (2018) for the Proposal for the Establishment of a Marine Protected Area in the Western Antarctic Peninsula- South Scotia Arc (Domain 1)

Part A: Domain 1 MPA Model

Delegations of Argentina and Chile

Abstract

The present paper reflects on a series of documents, comments and suggestions made during the intersessional discussions since the D1MPA preliminary proposal was introduced by Argentina and Chile in 2017 at CCAMLR XXXVI. It also includes the suggestions and reviews (WG-EMM, Buenos Aires, 2017; Scientific Committee, Hobart, 2017) proposed by the Expert Group and the information provided for papers discussed during the recent workshop on Spatial management held in Cambridge, 2018. Thus, this document provides detailed information about the rationalization carried out to each suggestion made during the meetings detailed above, and includes new information about the identification of krill areas, scientific references areas, and other research activities such as those focused on *Dissostichus* spp. The changes included since the preliminary proposal of the D1MPA model are discussed in PART B.

Background

The objectives of the Commission in relation to the establishment of a representative network of Marine Protected Areas (MPAs) in the Convention Area, include the need to find a balance between the protection of ecological function and allowance for, and impact on, harvesting (CC-CAMLR-XXX paragraph 7.3). In this regard, at CCAMLR 36 in 2017, Argentina and Chile introduced a preliminary proposal to establish an MPA in the planning domain of the Western Antarctic Peninsula- South Scotia Arc (Domain 1) (hereafter D1MPA; SCCAMLR-XXXVI/17, SC-CAMLR-XXXVI/18, SC-CAMLR-XXXVI/19, SC-CAMLR-XXXVI-BG/21 SC-CAMLR-XXXVI-BG/22). The proposal aimed to provide an opportunity to all interested members to analyze, test and validate the model. Further in the process, an Expert Group (EG), formed by members interested as well as non-governmental organizations (NGOs) and krill fishing industry, was established to advance on specific topics during the intersessional period.

In 2018, after one year of considerations and exchange of views, and understanding that the process needs to move forward for formal consideration, Argentina and Chile are introducing a proposal on a Conservation Measure establishing a Marine Protected Area in the Domain 1 (Western Antarctic Peninsula-South Scotia Arc, CAMLR-XXXVII/31). for Members' consideration.

In order to provide detailed information in relation to the proposal on the Conservation Measure, we introduce this background paper which is organized in two parts:

PART A: D1MPA model, describes the new model and provides information supporting the modifications made from the preliminary proposal

PART B: Rationale of the changes regarding recommendations made by WG-EMM, Scientific Committee, Commission and WS-SM

PART A: D1MPA model

One of the most productive areas of the Southern Oceans is the Southwest Atlantic sector, from the Antarctic Peninsula to the Antarctic Convergence and the Scotia Arc. During the last decades, the region has experienced significant changes in air and seawater temperature, contributing to major modification to the environment, resulting in a highly complex scenario that is likely to increase the impacts in the Antarctic. The area is also the focus of the largest Antarctic krill (*Euphausia superba*) harvesting operation, and considering how these projected changes will affect the area, it is critical to assess the potential impacts of fisheries and the effects of climate change.

The new D1MPA model has an extension of 466,000 km^2 comprising three different zones: General Protection Zone (GPZ); Krill Fishery Research Zone (KFRZ) and Special Fishery Management Zone (SFMZ). These zones contemplate: the conservation of different objectives; the need for a better understanding of the krill fishery activity and it also contemplates current fishery management strategy (CM 51-07).

Domain 1 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. This domain comprises Subareas 48.1 and 48.2, and 88.3 for management purposes. Considering the krill fishery management, 48.1 and 48.2 are the most relevant subareas.

Therefore, the three different zones (GPZ, KFRZ, and SFMZ) have been replicated, as far as possible, in each of these three ecoregions. We have identified (Table 1, figure 1):

3 GPZs in the SWAP, (Emperor, Alexander Is. and Marguerite Bay), 2 GPZs in the NWAP (Antarctic Peninsula and South Shetland Is.) and 1 GPZ in the South Orkney Is.

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

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

Figure 1: D1MPA Model. General Protection zones (GPZ), Krill Fishery Research Zones (KFRZ) and Special Fishery Management Zones (SFMZ).

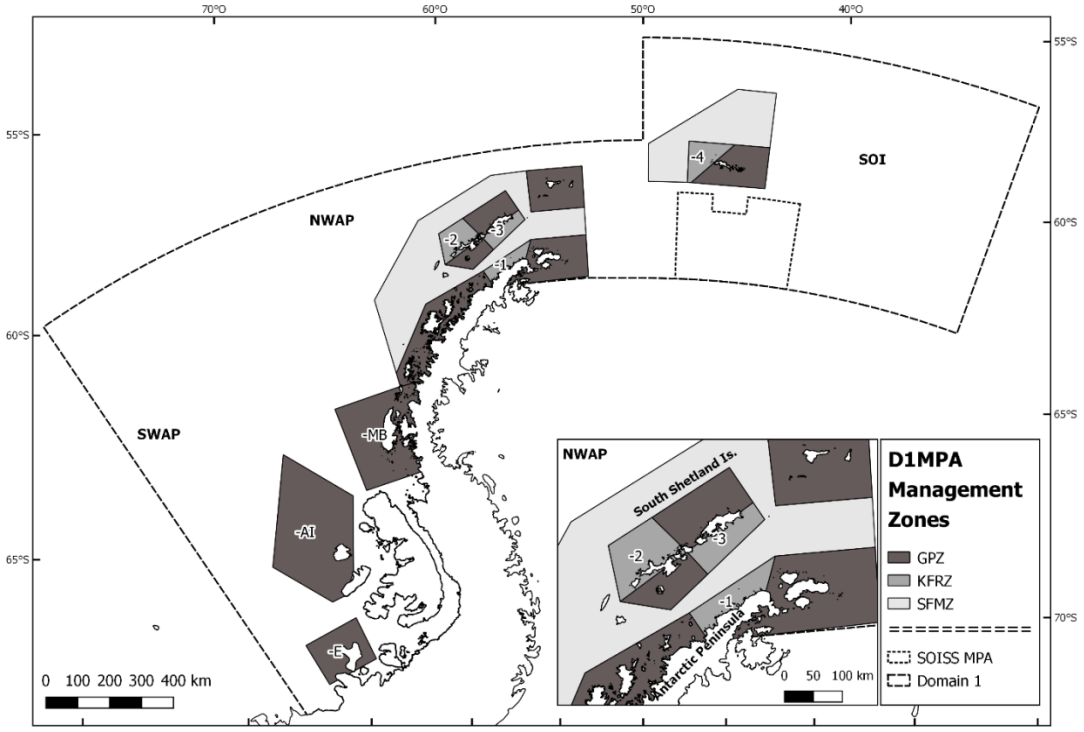

Table 1: D1MPA zones in the three ecoregions: Southwest and Northwest Antarctic Peninsula, and South Orkney Is.

Zone	Ecoregion	Geographic location	Code
General Protection Zone (GPZ)	South West Antarctic Peninsula (SWAP)	Emperor (Smiley Is.)	GPZ-EI
		Alexander I Is.	GPZ-AI
		Marguerite Bay	GPZ-MB
	North West Antarctic Peninsula (NWAP)	Antarctic Peninsula	GPZ-AP
		South Shetlands Is.	GPZ-SSI
	South Orkney Is. (SOI)	South Orkney Is.	GPZ-SOI
Krill Fishery Research Zone (KFRZ)	North West Antarctic Peninsula	Antarctic Peninsula	KFRZ-1
		South Shetlands Is.	KFRZ-2 and -3
	South Orkney Is.	South Orkney Is.	KFRZ-4
Special Fishery Management Zone (SFMZ)	North West Antarctic Peninsula	North West Antarctic Peninsula	SFMZ-NWAP
	South Orkney Is.	South Orkney Is.	SFMZ-SOI

Regarding the preliminary model introduced in 2017, different comments were provided by Members during the intersessional period. These comments, in conjunction with new peer-reviewed literature were considered for the final model (Fig. 1). In some cases, the publications supported the preliminary model introduced in 2017, in some others, the model was modified based on discussions and recommendations agreed in the Workshop on Spatial Management (Cambridge, 2018). These changes are listed and described below.

A) Reinforcement of MPA preliminary model

Discovery of Adélie penguin mega-colonies on Danger Islands and identification of this area as a seabird hotspot (Borowick *et al*. 2018)

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).

As an important seabird hotspot, and although this information was not published by the time the preliminary proposal was submitted, it is worth noting that the preliminary model included that area as a priority for conservation and therefore buffers around these islands were considered (Fig. 1). Thus, this publication reinforces the importance of protecting this area, in particular for a species that has experienced an important decline in the region (Trivelpiece *et al*. 2011, Juáres *et al*. 2015).

Simulating nursery areas for Antarctic krill along the western Antarctic Peninsula with relevance for the Domain 1 MPA Planning process (SC-CAMLR XXXVI-BG/12)

The aim of this study was to estimate favorable nursery areas for Antarctic krill and to assess how environmental conditions (stronger winds, enhanced transport of Circumpolar Deep Water (CDW) and higher ocean temperatures) may alter their distribution along the western Antarctic Peninsula (WAP) shelf (See SC-CAMLR XXXVI-BG/12 for details).

Projected circulation pathways may enhance advection of krill larvae from nursery areas into the inner shelf to regions such as the Gerlache Strait and the area between Anvers and Renaud Islands. Increased advection of CDW into the inner shelf may also support a successful descend-ascend cycle and enhance krill early development. Their results suggest that by 2030, projected nursery areas will be found along the mid (e.g. Crystal Sound and Palmer Deep) and inner shelf of the Gerlache Strait between Anvers and Renaud Islands and Marguerite Bay consistent with topographic features like bathymetric depressions, here the local circulation will help retention of krill larvae and may enhance the advection into inner shelf regions, being these zones important for conservation of Antarctic krill; this reinforces the preliminary model of MPA proposed for Domain 1 (SC-CAMLR XXXVI/18).

Evaluating MPA scenarios for the Western Antarctic Peninsula using a dynamic food-web model (SC-CAMLR-XXXVII- BG/04)

A spatially and temporally dynamic food-web model (Ecospace) of the region surrounding the WAP was used to evaluate the potential impacts of D1MPA (SC-CAMLR-XXXVII- BG/04, Delegation of USA). This model allows to evaluate the impacts of environmental drivers (such as sea ice conditions) on fisheries management strategies, including marine protected areas (Christensen & Walters 2004). The model was run considering two seaice conditions scenarios and three fishing effort scenarios (for further details see document SC-CAMLR XXXVII-BG/04). Their results show that as fishing pressure increases, so too does the utility of protecting the areas of krill concentration. In particular, by protecting the southern part of the region, the model showed that the concentration of krill within an MPA increased the biomasses of krill, Adélie and chinstrap penguins. This is striking because these species experienced declines in abundance during the model calibration period (Krill: Atkinson et al. 2004, Adélie and chinstrap penguins: Lynch et al. 2012). The authors also found that D1MPA model provides protection to chinstrap and gentoo feeding foraging areas around Elephant Island and in the Bransfield Strait/Mar de la Flota; however, under the highest evaluated fishing pressure, protection of these foraging areas needed to be supplemented with protection of the southern area of krill concentration to maintain MPA effectiveness.

*Buffers around predators' colonies (*WS-SM 18/P03)

The abundance of some predators may be sensitive to changes in krill availability or biomass (Trivelpiece *et al.* 2011, Constable *et al.* 2014), therefore the spatiotemporal overlap of fishing and foraging may be elevated and constitute a risk for predators. WS-SM 18/P03 explored risks associated with D1MPA and resulting fishery displacement in the Scotia Sea. While further discussions about the cost of fishery displacement and their tradeoff can be found later in this document, it worth noting that a 30-km buffer may sufficiently mitigate the risks of displaced fishing exacerbating depletion of penguins in all but one SSMU (SSMU 10 South Orkney West). Also, D1MPA, the model projected low depletion risks for whales and fish populations. Furthermore, preliminary analysis of tracking studies of gentoo and chinstrap penguins at Deception Island (December 2016 and January 2017) (WG-EMM 18/40), showed similar results to those reported by Hinke *et al*. (2017), further supporting the 30 km-buffers around the penguin colonies.

Representativeness

In 2009, the Commission endorsed the work program of the Scientific Committee to develop a representative system of Marine Protected Areas (RSMPA) by 2012 (CAMLR XXVIII, paragraph 7.19). Since then, progress was made with the adoption of SOISS MPA (CM 91-03) and Ross Sea MPA (CM 91-05). While several benthic and pelagic bioregions are still underrepresented (WS-SM-18 report, paragraph 2.8) the designation of the current proposed MPAs (East Antarctica MPA, Weddell Sea MPA and D1MPA) can substantially contribute to achieve a representative system of MPAs (WS-SM-18 report, paragraph 2.9).

Regarding benthic ecoregions, MPA proposals in the East Antarctic, Weddell Sea and Domain 1 would cover an additional nine benthic ecoregions. This would bring the total to 22 of the 23 benthic ecoregions included, at least partially, within protected areas (WS-SM-18/12 rev 1). In terms of pelagic representation, these 3 MPA proposals in the East Antarctic, Weddell Sea and Domain 1, will increase pelagic representation of almost every cluster type increases (for details see WS-SM-18/12 rev 1).

Representativeness is one important objective of CCAMLR MPAs, but other factors such as protection of vulnerable and rare species and unique features, adequacy, connectivity and replication should be considered (WS-SM-18 report paragraph 2.5). Within the D1MPA proposal, these factors have been considered by: providing protection to overexploited fish species and dependent predators species with declining population trends, by considering connectivity between D1MPA and adjacent current and proposed MPAs (i.e SOISS MPA and Weddell Sea MPA) and by considering as far as possible, General Protection Zones, Krill Fishery Research Zones and Spatial Fishery Management Zones along the different ecoregions within Domain 1.

B) Modifications in the MPA Model

The modifications in the model include the boundaries design and extension, and the inclusion of research reference areas.

Boundary modifications

From 2017 to 2018, D1MPA boundaries have experimented changes (Fig. 1). These changes are related to ecological considerations (*i.e.* effective protection of the unique Antarctic fur seal colony in Domain 1; reduction of predators' risk in the SOI) and fishery considerations (*i.e* Krill Fishery Research Zones). Boundaries have also been simplified to polygons (*e.g.* straight-line borders) for practical reasons as that allows for clear marking and enforcement of boundaries, and also simple shapes (*i.e.* shapes with low perimeter-to-surface area ratio) are preferred over highly convoluted boundaries (Friedlander *et al***.** 2003).

Buffers extension in the northern part of the South Shetland and South Orkney islands based on the analysis of displacement of fishing and catch effort (WS-SM-18/P03)

A principle 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 risks and costs inherent to the implementation of D1MPA, and resulting fishery displacement in the Scotia Sea. The authors employed 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. Hinke *et al.* (2017) illustrate that fur seals breeding in Cape Shirreff (South Shetland Islands) spend significant amounts of time in waters where the bottom depth is shallower than 2000 m. Since the 2000-m isobath in SSMU 3 (Drake Passage West) is about 40-60 km from the coastline, extending the buffer to 60 km in this area may reduce the risks of the D1MPA exacerbating the depletion of seals.

As the areas around the western part the South Orkney Islands (SSMU 10) are important penguin habitats and there is a considerable amount of fishing activity in the area, there are two ways to improve the D1MPA. Firstly, increasing the size of the coastal buffer in SSMU 10 may decrease the risks of exacerbating the depletion of penguins by protecting more of their foraging habitat. Alternatively, decreasing the size of the buffer, or removing it entirely, may decrease these risks by lessening the

displacement of krill fishing. In the new model, the second alternative (open to fishery) was chosen as it would be less costly for the fishery. It is also supported that the risks of exacerbating penguin depletion in this SSMU remain low, if this area was completely opened to fishing and displaced vessels from other areas self-sorted into it.

Managing the costs of displaced fishing involves trade-offs. By protecting 80% of the foraging habitats used by krill-dependent predators, MPAs can mitigate exacerbating depletion. However, protecting 80% of the foraging habitats used by krill predators will be costly if fishing vessels are displaced to areas where it is more difficult to catch krill. In this sense, it is worth noting that, not only buffer zone extensions were established but also KFRZs in Bransfield Strait/Mar de la Flota and South Orkney Is. are proposed to remain open for fishing activities.

Based on this document, the changes established in the MPA model are (Fig. 1):

- NWPA: Extension of protection buffer around Antarctic fur seal colony from 30 to 60 km, in South Shetland Islands in front of Drake Passage (SSMU 3 and SSMU 4);
- SOI: Extension of protection buffer around penguins' colonies from 30 to 50 km, in accordance with the larger use distribution of top predators in this zone (See SC-CCAMLR-XXXVI-BG/22: conservation objective 5, Table 1);
- SOI: In the northwest part (similar to SSMU 10), modification of GPZ into Krill Fishery Research Zone (KFRZ-4, for further details see below Krill Fishery Research Zones), providing a solution less costly to both the fishery and the risks of exacerbating penguin depletion.

Importance of scientific reference areas in MPA processes

One of the key objectives for MPAs set out in CM 91-04 is the establishment of scientific reference areas for monitoring natural variability and long-term change, or for monitoring the effects of harvesting and other human activities on Antarctic marine living resources and on the ecosystems of which they form part. Thus, establishing scientific reference areas in an MPA requires consideration of a range of objectives, including their capacity to provide a means to:

1) assess the potential impact of fisheries on dependent species,

2) study the effects of climate change in the absence of human activities,

3) assess the state of a broad range of marine features related to MPA conservation objectives, and thus contribute to monitoring the effectiveness of MPAs over time.

Identification of Krill Fishery Research Zones

We also recognized the need to consider reference areas for understanding the impacts of the krill fishery within the D1MPA (WS-SM-18 report, paragraph 3.26). In this sense, WS-SM-17/18 identified potential reference areas upstream and downstream of fishing grounds in the SWAP, NWAP and SOI as a combination of fished and non-fished reference areas. WS-SM-18/05 proposed an experimental approach aimed to improve the scientific basis for management of krill fishery, following the support for such an approach by the Scientific Committee (SC-CAMLR-XXXVI, paragraphs 3.17 to 3.22). The Workshop recognized the importance of this approach, its potential contribution to the feedback management (FBM) process, the risk assessment framework for krill and the D1MPA proposal, as all of these initiatives include the use of reference areas. In this regard, and following discussions held during the WS-SM, the MPA

proposal now considers modifications including reference areas to assess the potential impact of krill fisheries on dependent species.

The development of krill reference areas would need to take into account the operational and logistic capacity required to undertake relevant research and monitoring, as well as analysis of results (WS-SM-18 report 3. 29). Therefore, four Krill Fishery Research Zones (KFRZ) have been established in the D1MPA considering three components: the availability of scientific information, spatiotemporal variability of harvesting activities, and the existence of scientific long-term monitoring programs or study sites. The specific boundaries were designed taking into account the comparison in the achievement of conservation objectives (fished vs unfished areas), the harvesting activity and as far as possible, the areas proposed in WS-SM- 18/05. To further simplify the areas, to the extent possible, the boundaries matched those of the associated SSMUs. Thus, the size and boundaries of the areas were considered using the SSMU boundaries (north-south oriented) and the coastal buffer extensions. KFRZ 1 is placed in the Antarctic Peninsula, KFRZ 2 and 3 are placed in the South Shetland Is, and KFRZ 4 is placed in the South Orkney Is (Fig. 1).

The KFRZ are design as follows (Figure 1, Table 1):

- 2 KFRZs in the South Shetland Islands (KFRZ-2, -3, open- close every ten years)
- 1 KFRZ in the Antarctic Peninsula (KFRZ-1)
- 1 KFRZ in the SOI (KFRZ-4)

The majority of predator monitoring data available for addressing questions related to predators have been collected under CEMP, and mostly relates to penguin population processes (WS-SM-18 report 3.21) but also includes the Antarctic fur seal colony. Since the monitoring technology, particularly for predators, is changing, CEMP might usefully include any monitoring data that are used in management advice. It worth noting that there is a need to ensure congruence of monitoring metrics in order to address some key questions in relation to fishery–predator ecosystem interactions, though it is recognized also that some CEMP indices can be used as leading or trailing indicators (WS-SM-18 report 3.23).

Besides the KFRZs, it has been discussed the worth of developing an experimental approach for advancing the management of the krill fishery. For the development of an experimental approach within the KFRZs, a number of issues required attention, all of which could be included in the Scientific Research and Monitoring Plan (WS-SM-18 report 3.19). Among other issues, it would need to consider: the feasibility of defining one or more practical and trackable questions, the time scale, the operational and logistic capacity required as well as analysis of results, the indicators that will be required to achieve a comprehensive analysis of available data from the fishery, including acoustic survey data, environmental sampling and CEMP data. The development of candidate hypothesis should be done in the framework of the Scientific Research and Monitoring Plan and following recommendation provided by the Scientific Committee. It will also be necessary to increase synergies and cooperation between national programs as well as observers such as the fishing industry, SCAR and NGOs.

The management of the KFRZs contemplates mobile catch limits, and in some cases, temporal clauses (see CCAMLR-XXXVII/31 (CM)), to assess the potential impacts of the fishery on dependent predators. The catch limits inside the KFRZs were calculated using the median value of annual catches taken during the 2009-2016 fishing seasons (replicating the temporal period in WS-SM-18/P03 and WS-SM-18/05). The selection of a 10-year period for KFRZ-2 and -3 is explained by the need of sampling at least 9 years of the breeding population sizes of selected indicator species. This period would also include

at least one krill life-cycle (between 5 to 7 years, Atkinson et al 2004) and is likely to include some particular natural environmental event such as El Niño, La Niña/Southern Oscillation.

It will also include 5 years after the implementation, a revision of the Scientific Research and Monitoring Plan providing the opportunity to prevent changes or minimize the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades.

Conclusion: the D1MPA proposal includes Krill Fishery Research Zones for understanding the potential effects of fishery on the ecosystem. The proposed zones have been designed considering not only the fishery but also, the achievement of the conservation objectives. In this regard, temporary KFRZ 2 and 3, are proposed to be opened and closed, alternatively, every 10 years, in order to minimize any potential effect on the life cycle of predators, in particular Antarctic fur seals.

Krill fishery displacement in the current D1MPA model

The D1MPA process considered the krill fishery displacement by calculating the annual catches taken in each management zone during the 2009-2016 fishing seasons. Total displacement of the fishery is obtained subtracting from this quantity the total catch allowed in the KFRZs. For Subarea 48.1, this yields a total displacement of the fishery of 34% when the catch in the KFRZs (-1, -2 and -3) reaches 30000 metric tons. Near 70% of the displacement occurs in the GPZ in the Antarctic Peninsula while around 25% is displaced from the GPZs in the South Shetland Is. For Subarea 48.2, the total displacement of the fishery is of 30% when the catch in the KFRZ-4 reaches 33500 metric tons. In the case of the South Orkney Is. region, less than 10% of the catch is displaced from the GPZ.

Protection in the current D1MPA model

After modifications made to the model, the D1MPA still reaches the level of protection the international community agreed for Domain 1. Taking into account the protection already given by the SOISS MPA, the D1MPA achieves over 90% of conservation objects. In particular, the GPZ in SWAP and NWAP (AP and SSI) and SOI includes the protection for most of the areas considered to be important for zooplankton, fishes, birds, and mammals. However, the opening of certain zones to fishing (KFRZs), even when they are proposed as reference areas to evaluate the potential impacts of this activity, has associated a decrease in the protection of some important areas for certain predators, like the Antarctic fur seals colony in the KFRZ-2 (please see above for further details). Similar to the preliminary proposal, some conservation objects are not fully covered by the new model (SC-CAMLR-XXXVI/BG/21). In particular, seamounts (within conservation objective 8) are not entirely protected by the D1MPA, although some specific ones (depths over 2000 m) are already protected by the SOISS MPA, as well as seamounts with depths between 1000 and 2000 mts located in the SFMZ in SOI. Thus, a restriction of no fishing below 250 mts will contribute to their protection. While ice shelves (within conservation objective 8) are also underrepresented by the D1MPA, their protection can be considered within the provisions of Conservation Measure 24-04.

Selection of other scientific reference areas (Integration with other initiatives)

Since GPZs included in the D1MPA model could act as scientific reference areas (WS-SM-18 report paragraph 3.18), they can be useful for studying the effects of climate change in the absence of human activities as well as for assessing the state of conservation objectives. As such, reference areas can also provide useful locations where research and monitoring efforts in the context of the MPA Scientific Research and Monitoring Plan can be developed, also facilitating coordination and cooperation among

Members. Moreover, several programs are described below that could contribute to the selection of these areas.

The Integrating Climate and Ecosystem Dynamics in the Southern Ocean

The Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) programme is undertaking integrated circumpolar analyses to improve understanding of change and the implications for Southern Ocean ecosystems and for management of human impacts (WG-EMM-17/36; WG-EMM-18/09).

ICED research is focused on understanding the structure and functioning of Southern Ocean ecosystems, their variability and response to change across a range of spatial and temporal scales, on key species - from Antarctic krill to whales, and the structure of food webs (WG-EMM-16/22). As previously noted, the region is subject to a high level of variability and as such presents a unique opportunity to study, monitor and compare the effects of change by establishing a set of reference areas that experience a range of different climatologies. Due to the recognized difficulty in extracting regional-scale changes from existing global climate models (Cavanagh et al. 2017), ground-truthed observations from reference areas will also help to better understand and predict likely changes at the scale of CCAMLR statistical reporting areas.

ICED and CCAMLR are developing collaborative studies to consider the impacts of current and future change in Southern Ocean ecosystems and the implications for conservation and management. These collaborative activities are initially being focused on the Antarctic Peninsula and Scotia Sea region (CCAMLR Area 48), and include consideration of the development of the Scientific Research and Monitoring Plan. Outcomes from those activities (WG-EMM-18/09) are of direct relevance to the development of this plan. The analyses and observations being developed through the Scientific Research and Monitoring Plan will also be important to work being developed by ICED. In particular, ICED is developing ecological models for the region that can inform ecological and analyses and development of spatial management procedures. Such modelling studies will draw on analyses developed through the Scientific Research and Monitoring Plan.

Scientists involved in developing the Scientific Research and Monitoring Plan are already activity involved in these joint between ICED and CCAMLR. Further activities planned for the next 2 years aimed at developing and refining projections of change in Area 48 will be important in the development of the Scientific Research and Monitoring Plan and further development of collaborative links between the groups are encouraged.

Southern Ocean Observing System

The Southern Ocean Observing System (SOOS), is an international initiative of the Scientific Committee on Antarctic Research (SCAR) and the Scientific Committee on Oceanic Research (SCOR) that was established in 2001. Its mission is to facilitate the collection and delivery of essential observation on dynamics and changes of the Southern Ocean, where the stakeholders are: researchers, governments and non-government bodies, including the fishing industry. Since its establishment, SOOS has played a relevant role interacting with the Scientific Committee on how it can assist in co-ordinating the acquisition of data that may contribute to important topics including ecosystem monitoring and observation, spatial management of impacts on the Antarctic ecosystem, climate change and in support of managing and accessing these data. It has been noted the importance of this initiative for the monitoring program and research activities performing in the framework of the D1MPA (SC-CAMLR-XXXV, paragraph 10.22). Thus, the involvement of SOOS will be relevant in providing the foundations for measuring long-term

changes in the region, including for determining the effects of climate change. Since SOOS has several working Groups that operate in different zones of CCAMLR areas, we identified a clear connection with the West Antarctic Peninsula Working Group (SOOS-WAP-WG). This group is formed by 13 countries (Korea, Argentina, Chile, Brazil, UK, USA, Norway, Germany, Spain, India, Netherland, Italy, Belgium).

Thus, for the Scientific Research and Monitoring Plan of D1MPA, SOOS could be another valuable organization to facilitate the availability and exchange of information between experts of each country and helping with the development of strategies to collaborate in the design of oceanographic campaigns, meteorological observation, krill surveys, and sharing information with the purpose of joining forces and avoiding duplication of this work.

The Palmer (LTER) Program

The Palmer long-term ecological Program (LTER), is a multidisciplinary program established in 1981, whose main goal is to study the polar marine ecosystem of West Antarctica. Palmer-LTER generates important information about the water column, nutrients, oceanography, phytoplankton and krill distribution, with a multiproxy approach. The information generated by this program can provide important data for D1MPA Scientific Research and Monitoring Plan about the changes and trends in oceanographic variables and biological observations associated with the climate change.

Wilhelm Archipelago area, Antarctic Peninsula

Research developed by Ukraine in the Wilhelm Archipelago area (WAP), can also constitute a significant contribution to characterize potential climate change impacts across latitudinal clines. These studies include underwater and acoustic surveys, chemical analyses of bottom sediments and soils of nearshore areas. Importantly, Ukraine has been undertaking research on Adélie and Gentoo penguins at the same area since 2003, including the establishment of remote cameras in 2016, as part of the CEMP camera network (WG-EMM-18/P13 and 18/26) (WG-EMM-18 report paragraph. 7.8).

In relation to this, WG-EMM recalled the advice of Scientific Committee (SC-CAMLR-XXXVI, paragraphs 5.36 and 5.37) that it may be useful to coordinate spatial planning efforts in the Wilhelm Archipelago area around the Argentine Islands with those efforts supporting development of the D1MPA (WG-EMM-18 report para.7.9). Therefore, this site could form one of the potential reference areas for assessing the effects of climate change on benthic communities and penguin populations and distribution within the D1MPA proposal.

Mapping Application for Penguin Populations and Projected Dynamics

The Mapping Application for Penguin Populations and Projected Dynamics (MAPPPD) is an open access decision support tool designed as a comprehensive database and search tool for community-contributed and published data on the population status and population trends of Antarctic penguins. It is worth noting that this application has improved considerably over the past years, and that it could be a useful tool for the Scientific Committee and its working groups (SC-CAMLR-XXXVI. paragraph 8.17). In this regard, the Scientific Committee also noted that if results from MAPPPD were to be used for management advice, the application should be reviewed by WG-SAM (SC-CAMLR-XXXVI. paragraph 8.17) to ensure that the model assumptions and input data are consistent with CCAMLR policy and procedures on best available science.

All these initiatives should be encouraged to share data on biological-ecological and oceanographic systems, mooring-systems, sea-ice dynamics, all necessary to improve our understanding of the changes occurring along Domain 1. It is also fundamental and necessary to engage governments and industries as stakeholders and encourage them to work together to provide currently available and future information for monitoring the D1MPA.

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Annex 1 - Spatial distribution of conservation objectives and objects overlapped with the D1MPA. Further technical details on methods, variables and metadata can be found in Data Forms for each objective uploaded to the Domain 1 MPA e-group, and in the SC-CAMLR-XXXVI/BG/22.

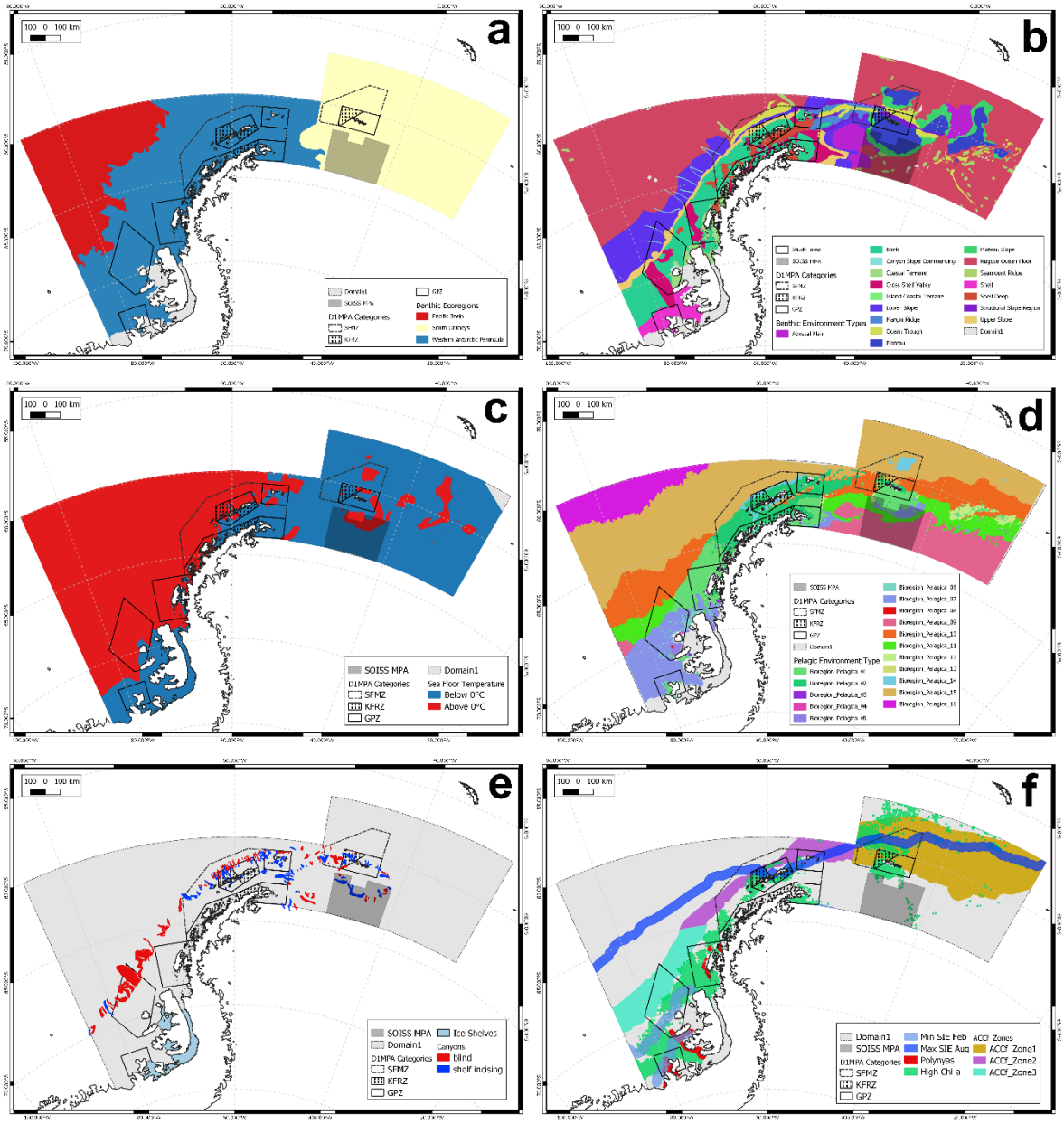

Figure 1. Representative examples of: benthic habitats (a-c); pelagic habitats (d); benthic ecosystem processes (e) and; large-scale pelagic ecosystem processes (f).

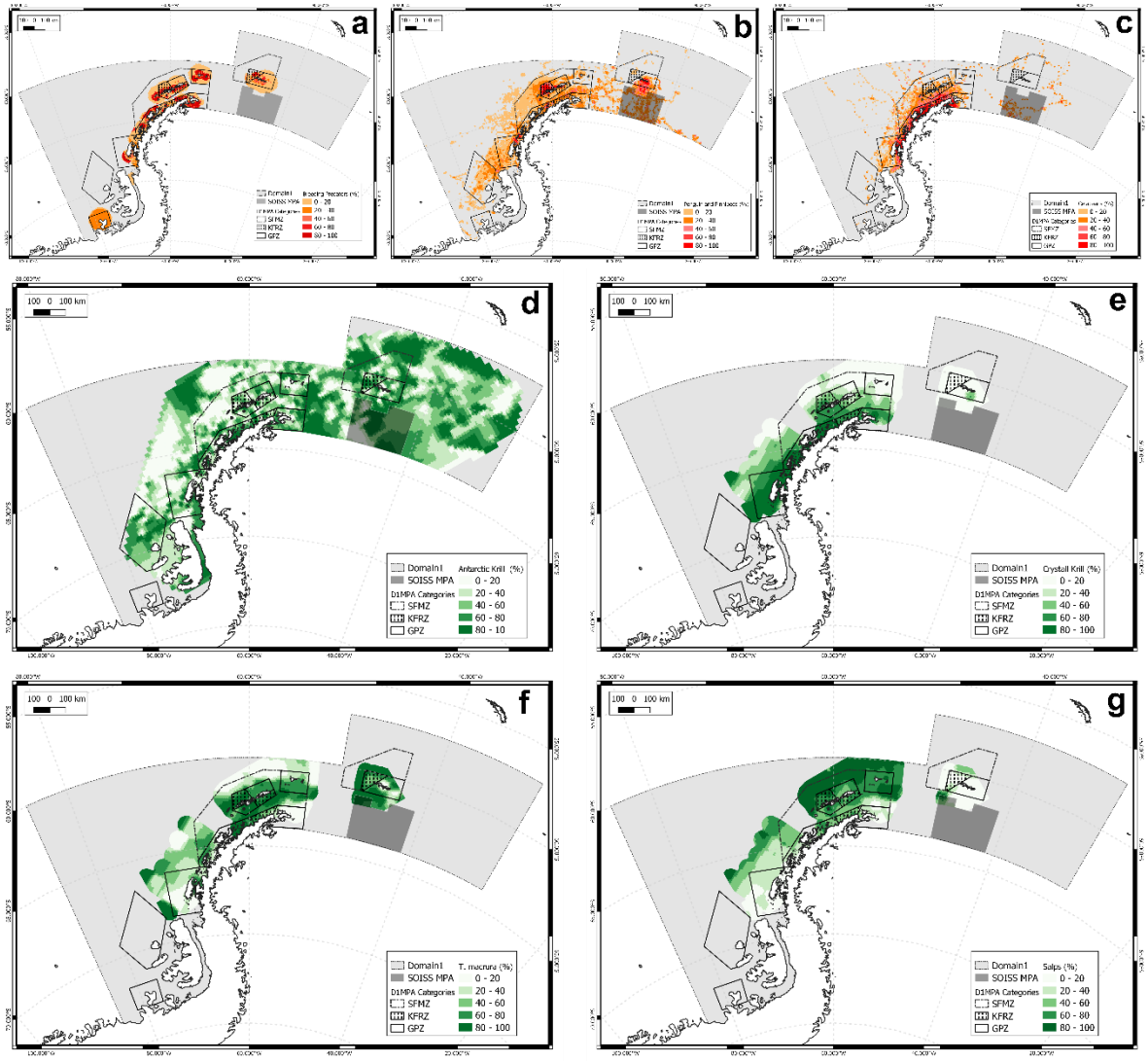

Figure 2. Percentage of usage of: all top-predators during breeding period (a); penguins and pinnipeds during non-breeding period (b); cetaceans during non-breeding period (c); and principal pelagic prey (d-f).

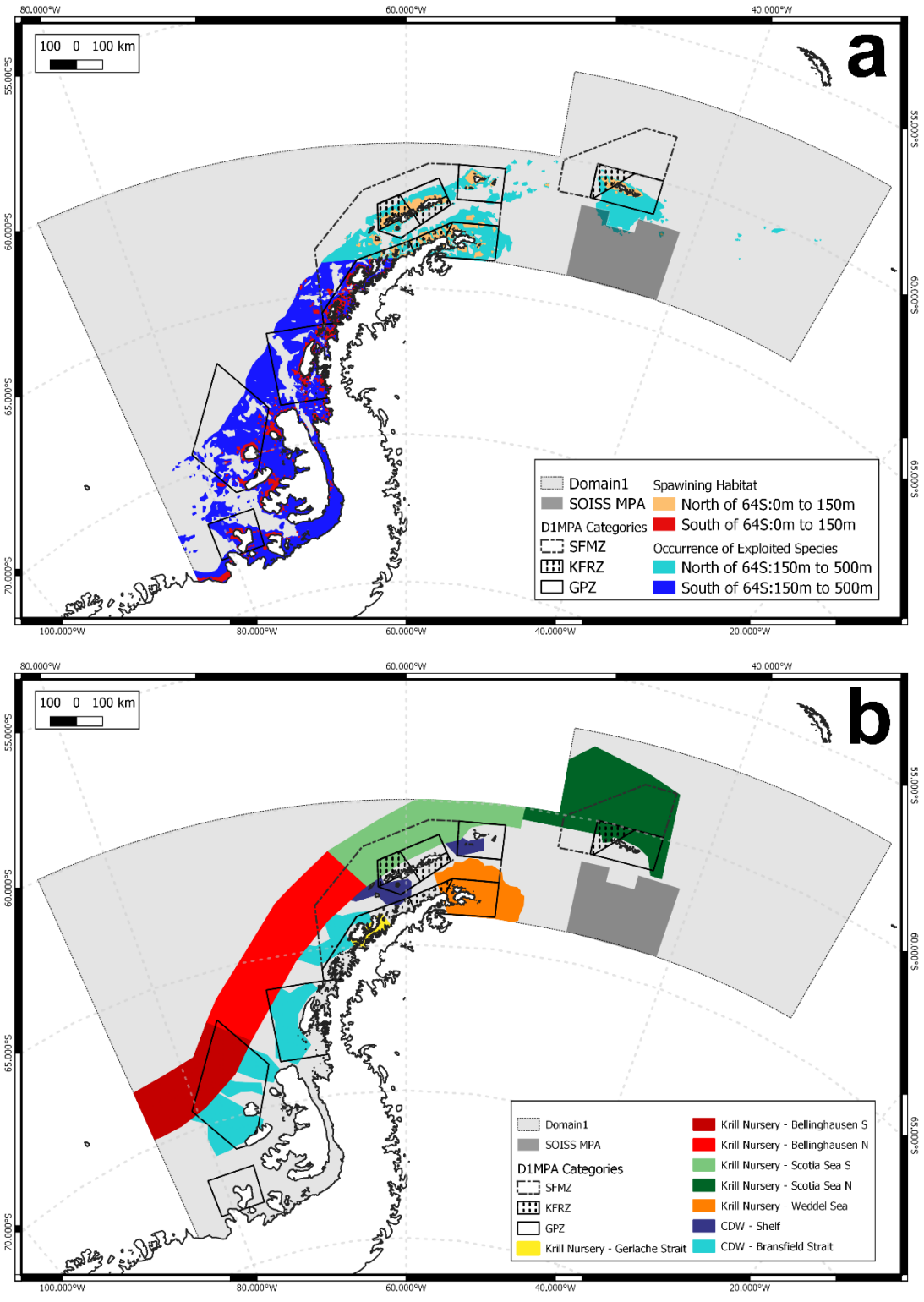

Figure 3. Important (spatially constrained / predictable) areas for: fish life cycles (a) and; zooplankton life cycles (b).

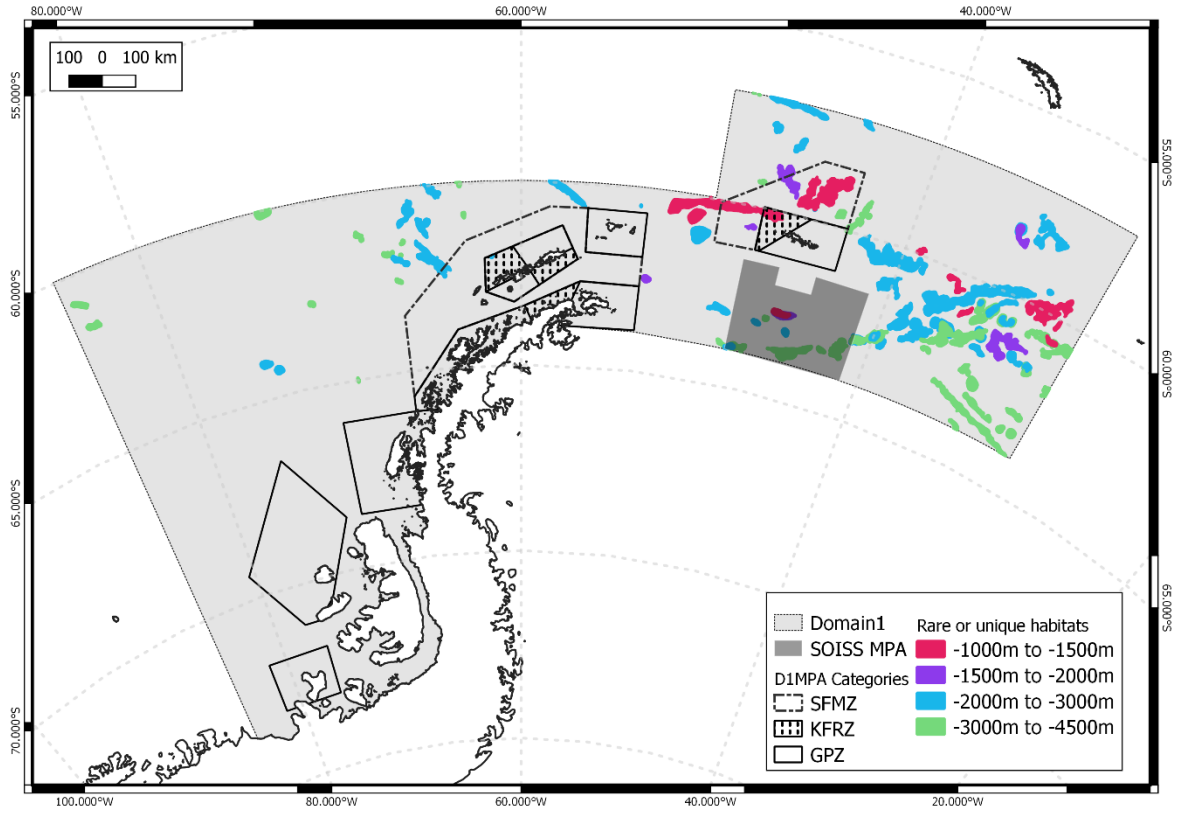

Figure 4. Distribution of rare or unique habitats.