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Updated background paper (2018) on the Domain 1 MPA. Part B: rationale of changes

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 B: Rationale of the changes made from Recommendations from WG-EMM, Scientific Committee, Commission and WS-Spatial Management

Delegations of Argentina and Chile

Abstract

The present document 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. In particular, 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 specific changes made to the D1MPA model since the preliminary proposal are discussed in PART A.

Introduction

With respect to the preliminary D1MPA proposal, the Commission recognized that (SC-CAMLR-XXXVI, paragraph 5.26):

(i) the proposal was developed in an inclusive and transparent manner
(ii) the scientific background for the proposal was comprehensive and appropriate
(iii) the 'Priority Areas for Conservation' (PACs) identified from MARXAN analyses undertaken by the proponents were justified by data and appropriate
(iv) in the context of climate change, it is important to have PACs along the latitudinal gradient with a duplication of ecoregional features between them integrating the different environmental gradients

It also recognized that further considerations were needed for (SC-CAMLR-XXXVI paragraph. 5.27 and 5.29):

A) fishing activities - e.g. either by applying a cost layer in MARXAN sharing the experiences with other users (SC-CAMLR-XXXVI, Annex 6, paragraph 5.12), or by evaluating the potential displacement of fishing effort, or by identifying areas where displaced fishing activities might otherwise occur (SC-CAMLR-XXXVI, Annex 6, paragraph 4.8);

B) consultation with industry experts and non-governmental organization (NGO) representatives would likely improve the proposal;

C) rationalizing the size of the proposed MPA with achievement of its specific conservation objectives and Members' other interests such as fishing;

D) estimating the contemporary distribution and biomass of krill throughout Planning Domain 1;

E) providing additional evidence that the proposed MPA can mitigate the effects of climate change or that the proposed MPA includes reference areas that are useful to study such effects;

F) providing additional evidence that the proposed MPA could decrease the risks of krill fishing having a negative impact on the ecosystem;

G) considering further data layers and conservation targets related to fishes;

H) developing priorities for a research and monitoring plan to accompany the proposed MPA.

This document aims to reflect the modifications incorporated into the proposal according to i) recommendations provided by WG-EMM, Scientific Committee and Commission during 2017; ii) the intersessional work carried out in the Expert Group (EG), and iii) recommendations provided by the workshop on spatial management 2018 (WS-SM-18).

a) Further information in relation to krill fisheries in the D1MPA process

In 2017, during the D1MPA presentation and discussions, some members raised concerns regarding that krill fishing was not included in the cost layer of MARXAN analysis (WG-EMM-17 report, paragraph 4.8 and 4.9. See also WG-EMM-17/22 and WG-EMM- 16 Report, paragraph 3.15 and 3.17). The Scientific Committee noted that further consideration of fishing activities could be achieved by either applying a cost layer in MARXAN sharing the experiences with other users (SC-CAMLR-XXXVI Annex 6, paragraph 5.12); by evaluating the potential displacement of fishing effort; or by identifying areas where displaced fishing activities might otherwise occur (SC-CAMLR-XXXVI Annex 6, 4.8).

In 2018, at the WS-SM-18, Argentina with contributions from the EG, introduced a document which aimed to provide further clarifications by sharing complementary analyses that were used to support the decisions taken in the D1MPA preliminary proposal (WS-SM-18/18). It provided a wide range of MARXAN scenarios, considering several cost layers with different krill fishing periods and dynamic ranges, noting the limitations of using fishery cost layers to represent the high spatial–temporal variability of the krill fishery in Domain 1. While for some scenarios its use produces none or minimal changes in the final reserve system, for other scenarios its inclusion could increase the overall size of the reserve system. In addition, some scenarios could potentially exclude some fishing grounds, although caution should be taken in their interpretation, as other factors such as the potential displacement of fishing and risk to predators should also be considered. It concluded that using fishery cost layers was not the most effective means of considering the fishery in the D1MPA preliminary proposal and that other methods, for example, fishery displacement, could be more appropriate to deal with the krill fishery dynamics (for a more detailed explanation, please see WS-SM-18/18).

The Workshop recognized that, given the spatial and temporal variation observed in the environment and in the krill fishery, it was not possible to generate a meaningful cost layer given available data in Domain 1, as discussed during Scientific Committee (SC-CAMLR-XXXVI, Annex 6, paragraph 5.12), and noted that consideration of the fishery displacement could be a better approach (WS-SM-18 report, paragraph 3.42).

While managing risks to krill predators may inevitably present novel risks and increase the costs of fishing, profiling these effects can facilitate decision-making (WS-SM-18/P03). WS-SM-18/P03 (Displacement of fishing and catch effort), introduced by US, assessed the risks and costs inherent in implementing an MPA within Domain 1. The authors explored risks associated with the MPA scenario and resulting fishery displacement in the Scotia Sea. They 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 workshop on spatial management (WS-SM 2018 report, par. 3.45). Both approaches reached similar conclusions; their results revealed that fishing displaced by the MPA could exacerbate depletion of krill predator populations unless closed areas protected ca. 80% of predator foraging distributions.

It is worth noting that, the exclusion of a (MARXAN) cost layer is explained by the fact that it does not properly reflect the fishing activity due to the high spatial and temporal variability and therefore analysis outputs would not be adequate for a proper management of the fishing activity. Thus, the fishery activity was incorporated into the model, using one of the approaches recommended by the Scientific Committee (krill fishery displacement). This approach generated a preliminary model that included a zonation process where different management provisions coexist, also considering the risks and costs inherent to the implementation of the D1MPA (WS-SM-18/P03), and subject to the constraint that as far as it does not jeopardize important conservation objectives (such as the protection of important feeding areas for predators). Thus, the D1MPA model also takes into account important fishing grounds around the South Orkney Is. and in the Bransfield Strait / Mar de la Flota (such as around de Astrolabe Is.), which are proposed to remain open for the fishery to allow for the establishment of Krill Fishery Research Zones (KFRZs).

b) Further consultation with industry experts and non-governmental organization (NGO) representatives would likely improve the proposal

Previously, in 2011 the Commission agreed that "given the scale of the CCAMLR region and of the proposed MPAs system, while it may be the responsibility of the proponent to articulate the broad aims of the proposal, there is a clear need for a process that allows wider engagement in the process of determining and implementing management arrangements for each MPA." (CCAMLR-XXX paragraph 7.6). Understanding that a broader engagement is important in relation to the implementation of the management plan and also in other stages of the process such as during the development of the research and monitoring plan, an EG was established to facilitate discussions between Members and interested observers such as the fishing industry, non-governmental organizations (NGOs) and other experts (CCAMLR-XXXVI, paragraph 5.67). The EG is composed by 28 representatives, including 11 Members, NGOs, Fishing industry and expert observers. In this sense, the spatial management workshop (held in Cambridge 2018) noted that work by different participants had been shared through this group, indicating the value of engagement, and highlighting the contribution of the EG to a revised D1MPA proposal (WS-SM 18 report, paragraph 3.49).

In particular, during the intersessional period, and according to the discussion at WG-EMM, the Scientific Committee and the Commission in 2017, the EG had further considerations on:

(i) <u>Fishing activities</u> (SC-CAMLR-XXXVI, paragraph 5.27): including the use of a krill cost layer (WS-SM-18/18) and potential displacement of fishing effort in relation to the D1MPA preliminary proposal (WS-SM-18/P03).

(ii) Mitigation of the effects of climate change and the risks of krill fishing having a negative impact on the ecosystem (SC-CAMLR-XXXVI, paragraph 5.29): which have been considered using reference areas (WS-SM-18/05 and WS-SM 18/17).

The results of these discussions are part of sections a) krill fishery considerations and e-f) MPAs and climate change.

c) **Rationalizing the size of the proposed MPA with achievement of its specific conservation objectives and Members' other interests such as fishing**

The size of an MPA should be determined by the specific management objectives for each MPA and the species and habitats targeted for protection. Therefore, their size must be large enough to protect ecological habitat and processes that take place within their boundaries, including movement patterns of mobile species (McLeod *et al.* 2009). Similar to the information provided last year (SC-CAMLR-XXXVI/BG/21), and in relation to the changes made to the model (SC-CAMLR-XXXVII/BG-XX; PART A D1MPA model), the D1MPA reaches the level of protection the international community agreed for Domain 1. Taking into account the protection already granted by the SOISS MPA, the D1MPA achieves over 90% of conservation objectives. The General Protection Zones (GPZs) in the North Western Antarctic Peninsula (NWAP) and South Orkney Is. (SOI) include the protection for most of the areas considered as important for birds, mammals, fishes and zooplankton. However, the opening of certain zones to fishing (Krill Fishery Research Zones, KFRZs), even when they are proposed as reference areas to evaluate the potential impacts of this activity, has an associated decrease in the protection of some important areas for some predators. For this reason, the KFRZs need to be carefully designed. For instance, such is the case for the Antarctic fur seals, which are known to be susceptible to fishing activities (Thompson *et al.* 2000). Since one of the KFRZ (KFRZ-2) proposed to be in the South Shetland Is. hosts the only known colony of this species within Domain 1, a temporary closure for the KFRZ for 10-years is proposed to be implemented to avoid any potential impacts that are not reversible within 2-3 decades (Article II of the convention)."

Considerations on fisheries were not included at the stage of definition of objectives to maintain the transparency of the process, also bearing in mind that the precautionary principle does not require demonstration of potential impacts in order to be applied. It is worth noting that, after the identification of the objectives, other interests such as fishing have been considered since the preliminary model developed in 2017. This is reflected in the MPA design. While the D1MPA model encompasses mostly all PACs and comprise approximately 20% of the Domain 1, the GPZs – where only research fishing is allowed - account for 11.3% of the Domain. In addition, KFRZs and SFMZs – where directed fishing is allowed - account for 1.3% and 7.1% of the Domain 1, respectively. When only considering the extension of the D1MPA, GPZs comprise approximately 57.4%, while KFRZs and SFMZs represent 6.7% and 35.9% of the entire model, respectively.

d) Estimating the contemporary distribution and biomass of krill throughout Planning Domain 1

A planned multinational large-scale krill survey that will be undertaken in area 48 in summer 2019 will provide important information for risk assessment, FBM and also spatial management in Doman 1. It is also expected to provide important information on abundance, distribution and biomass of krill as well as relevant information about environmental conditions on the distribution patterns (WG-EMM-18 paragraph 3.19).

e) Providing additional evidence that the proposed MPA can mitigate the effects of climate change or that the proposed MPA includes reference areas that are useful to study such impacts

f) Providing additional evidence that the proposed MPA could decrease the risks of krill fishing having a negative impact on the ecosystem

Marine Protected Areas: adaptation and mitigation to climate change impacts

Marine ecosystems are changing and will continue to do so increasingly. According to current projections of future climate change scenarios; species distribution and biomass are expected to be redistributed in the future, consequently food webs and ecosystem services will be altered (Henson *et al*. 2017). In 2009, the Commission considered that an effective global response by United Nations Framework Convention on Climate Change (UNFCCC) was urgently needed to address the challenge of climate change in order to protect and preserve the Southern Ocean ecosystems (Res 30 XXVIII). In this scenario of variability, Marine Protected Areas (MPAs) can play a role in mitigation and adaptation to climate change (Henson *et al*. 2017). Effective protection of biodiversity in the future relies on MPAs that accommodate potential climate change impacts

MPAs, 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 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). Additionally, the Southern Ocean and its key marine habitats can act as important zones for atmospheric carbon sequestration (Watson *et al*. 2014, Landschützer *et al*. 2015); the loss of those habitats would mean higher concentrations of atmospheric carbon and even release of carbons stored in the ocean (van Heuven *et al*. 2014; Rintoul 2018).

D1MPA has been designed based on contemporary data, providing the PACs in the Western Antarctic Peninsula (WAP). The Scientific Committee and the Commission requested to provide additional evidence that the proposed MPA can mitigate the effects of climate change and that it could decrease the risks of krill fishing having a negative impact on the ecosystem under effects of climate change (SC-CAMLR-XXXVI, paragraph 5.29, SC-CCAMLR-XXXVI, paragraph 5.65). Below we highlight how MPAs in Antarctica can act as effective tools to guarantee species and habitats resilience to climate change and to guarantee ecosystems ability to maintain the carbon cycle balance, as a mitigation measure against global warming.

<u>Marine protected areas and resilience</u>

Ecosystem resilience refers to the ability of an ecosystem to maintain key functions and processes in the face of stresses or pressures, either by resisting or adapting to change (Holling 1973, his original definition is: "the magnitude of the disturbance that a system can absorb without fundamentally changing"). One way to increase the capacity of habitats and biological communities to adapt to climate change is by reducing pressure generated by human activities (IPCC, 2014). Reduction of anthropogenic pressures in MPAs may maintain a favorable ecological status and a greater resilience.

Along the WAP, continued warming and sea-ice loss may, in the future, alter species patterns of distribution and abundance and the location of certain ecosystem processes and functions. Simulation models for habitat krill-based on RCP 8.5 scenarios, considering an increased in 30% wind for the year 2030, suggest that nursery areas may be displaced from the mid and inner-shelf (consistent with bathymetric depressions and biological hotspots, e.g. Crystal Sound and Palmer Deep) into the inner shelf towards regions such as the Gerlache Strait and the area between Anvers and Renaud Island (SC-CAMLR-XXXVI-BG/12).

The effective future protection of biodiversity relies on MPAs that accommodate potential climate change impacts. Thus, although climate change is likely to have significant impacts on the distribution of biodiversity across the Convention Area, the current and proposed MPAs in East Antarctica, Weddell Sea and Domain 1 are likely to encompass representative thermal habitats for decades into the future, and hence have the potential to contribute substantially to the resilience of all biota and ecological processes in the Convention area in the face of this threat (WS-SM 18/14).

Sea-ice conditions vary spatially and temporally year to year in the WAP. The highest sea-ice growth occurs in June to July, with the maximum extension in August, followed by a slow retreat during spring and a minimum extent in March (Masson and Stammerjohn, 2010). The seasonal sea-ice duration is strongly sensitive to atmospheric circulation variability associated to the Southern Annular Mode (SAM) and the El Niño Southern Oscillation (Yuan *et al*., 2004). In order to facilitate development of the D1MPA and assess whether it may achieve its objectives, the background paper SC-CAMLR-XXXVII-BG/04 (Delegation of USA) used a dynamic modelling approach to explicitly consider changing environmental conditions. It presented scenarios related to sea-ice conditions, fishing and 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 regard to resilience, 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. Their results indicated that krill and Adélie penguins benefitted from protecting a large portion of the southern area of krill concentration while chinstrap and gentoo penguins benefittted from protecting the foraging grounds near Elephant Island and inside the Bransfield Strait/Mar de la Flota.

Marine protected areas and mitigation

The Southern Ocean plays a critical role in the sequestration of atmospheric carbon concentrations (Landschützer *et al*. 2015, Barnes *et al*. 2018). Any changes in the ability of the Southern Ocean to take up carbon dioxide would have substantial effects in carbon cycles and climate at global scales (Watson *et al*. 2014; van Heuven *et al.* 2014; Rintoul 2018).

Recent studies have highlighted the strength of pelagic-benthic coupling and its importance on the structure of benthic communities in zones dominated by suspension and deposit feeders (Jansen *et al*. 2018), which plays critical roles for the ecosystem by providing habitats and food for a wide range of organisms (Griffiths 2010; Gutt *et al*. 2017). High-latitude benthos is globally important in terms of accumulation and storage of ocean carbon (Barnes and Sands 2017; Barnes *et al*. 2018). MPAs can contribute effectively to the increased storage of carbon by marine ecosystems by protecting those benthic habitats and species known to be important in storing carbon but are vulnerable to climate change and human impacts (Brooks *et al.* 2016). For instance, limiting the use of bottom fishing gear within vulnerable areas may prevent the loss of those habitats and the potential resulting consequences, such as re-suspending sediments and releasing carbon storage (Pusceddu *et al.* 2014).

On the other hand, the active transport of organic carbon to the sea bed is mainly carried out by the zooplankton populations. For instance, in the Southern Ocean, Antarctic krill, in addition to the important biomass that they represent, produce significant amounts of dead organic matter and faeces which drops rapidly into the depths assuring a long-term carbon storage (Bodungen *et al*. 1987; Atkinson *et al*. 2012; Belcher *et al*. 2017). Antarctic krill are also a major prey item in the Southern Ocean, and play a key role in the transfer of iron to large marine animals (Le-Fevre *et al*., 1998; Ratnarajah and Bowi 2016). Therefore, the protection of a significant proportion of pelagic habitat is not only critical to protect a fundamental element of the marine food webs (for instance, krill), but also to maintain a healthy balance of the carbon cycles. That could be achieved by creating MPAs with a significant reduction of fishing effort, which would allow an increased carbon sequestration in the long term (Roberts *et al.* 2017).

Furthermore, sea-ice plays an important role in the krill life cycle (Saba *et al*. 2014). Immature krill feed on algae growing below the ice cap. Those algae are highly dependent on the thickness of the ice, which, consequently, may substantially affect krill recruitment in the following summer (Flores *et al.* 2012; Piñones and Federov 2016; Meyer *et al*. 2017). A significant reduction in sea-ice extension and duration has been recorded in the last decades (Stammerjohn *et al*. 2008, Paolo *et al*. 2015) and areas in the south of the WAP that have remained naturally closed to the krill fishery can now be explored (Nicol *et al*. 2012, Reiss *et al*. 2017). MPAs in those sensible areas could "substitute" the sea ice as a barrier to the fisheries protecting krill biomass from extraction and guaranteeing the maintenance of the local carbon sequestration.

Climate change and Research and Monitoring plan

Scientific reference areas are a key tool in understanding the relative impacts of climate change and other human activities. Information on the potential impacts of climate change on species, habitats and ecosystems is important for the development of effective measures to conserve such features as part of a system of marine protected areas. In addition, such information will be critical in monitoring the achievement of MPA objectives, particularly where protected species or habitats undergo change or are no longer present within a designated area.

MPAs also provide the framework to focus research and monitoring efforts to observe climate trends. D1MPA has assessed this issue by identifying potential reference areas for climate change (SC-CAMLR-XXXVII-BG-XX PART A: D1MPA model) and by including this topic in the Scientific Research and Monitoring Plan (CCAMLR-XXXVII/31, Annex C). The development of a research and monitoring plan for Domain 1 includes specific research activities ensuring adequate comparison between fished and un-fished areas in different ecoregions.

In synchrony with the development of efforts to detect and monitor the effect of climate change, information of particular relevance includes (see Annex C, in in CCAMLR-XXXVII/31):

- Population status, trends, vulnerability and distribution of key Antarctic species;
- Effects of climate change on species at risk, including critical thresholds that would give irreversible impacts;
- Framework for monitoring to ensure the effects on key species are identified;
- Relationship between species and climate change impacts in important locations, especially range extensions;
- Systematic changes to community structure, including e.g. mesopelagic community structure;

- Plausible scenarios for changes in Antarctic marine living resource populations over the next 2 to 3 decades;
- Changes in accessibility of fishing areas due changes in the extent of seasonal sea ice;
- The magnitude of change in Antarctic marine living resources and food webs that could be agreed to have occurred using current data sources.

DIMPA model was designed with contemporary data and adjusted based on future projections, regarding sea-ice conditions (SC-CAMLR-XXXVII-BG/04), ocean circulation model (SC-CAMLR-XXXVI-BG/12) and fishery activity (WS-SM-18/18). Furthermore, in the review of CCAMLR MPAs, it will be valuable in elaborating specific elements and projects for MPA research and monitoring plans, and in designing appropriate review processes to ensure that MPAs can adapt to future change. In this sense, research groups as ICED, SOOS and SCAR, may provide valuable input in future projections for a flexible MPA.

g) Considering further data layers and conservation targets related to fishes

Although the preliminary MPA model included zones of protection for breeding areas and early life stages of notothenoids (*Notothenia rossi*, *Gobionotothen gibberifrons*) and icefish (*Chaenocephalus aceratus*) and protection of areas of geographic distribution of commercially exploited fish, recommendation on the inclusion of further data layers and conservation targets related to fishes, were received. Considering the information on toothfish species is still relatively scarce and probably presents a considerable bias since most information was provided from research fishing that has been carried out in specific blocks at subareas 48.2 and 88.3, the inclusion of a data layer for toothfish could be considered unrealistic. Having said that, it is worth noting that the proposal now includes background information on this topic, including an important amount of information provided by the recent workshop for the development of a *D. mawsoni* Population Hypothesis for Area 48 (WSDmPH) carried out in Berlin, in February 2018. Research fisheries activities on toothfish have been especially considered in the current proposal by providing a series of question and activities that have been included in the proposed Research and Monitoring plan.

Background

Patagonian (*Dissostichus eleginoides*) and Antarctic (*Dissostichus mawsoni*) toothfish are important resources within the Convention Area and both occur within Domain 1; however, direct fishing of these species is currently prohibited within Domain 1 (Subareas 48.1; 48.2 and 88.3; CM 32-02). This prohibition does not apply to the taking of *Dissostichus* spp. for the purpose of scientific research under CM 24-01 and CM 24-05.

Patagonian toothfish distribution extends to the north of the Antarctic Convergence (AC) into subantarctic islands of the Atlantic, Pacific and Indian Oceans. In contrast, Antarctic toothfish, is endemic for the seas of Antarctica with a circumpolar distribution, it is generally found south of the AC (Collin *et al.*, 2010). According to literature, toothfishes are long-lived fishes, which can reach the age of 48 years, and can grow to more than 1.7 metres in length and 135 kg in weight. Antarctic toothfish take a long time to mature; males take 13 years and females take 17 years. Spawning of Antarctic toothfish occurs during winter (Parker and Grimes 2010).

For subareas 48.1 and 48.2 there are not enough data available on growth rates for *D. mawsoni*, only minor research about otolith increments in *Dissostichus* larvae off the Southern Shetland Islands (La Mesa, 2007). Studies on growth and age of toothfish (based on otoliths) caught in area 48.2 resulted in fishes aged between 10 and 32, with an average age of 20 years old (WS-DmPH-18/11).

D. mawsoni are distributed across a broad bathymetric range throughout their life cycle (Dewit *et al.*, 1990). Pelagic larvae are occasionally recovered close to the surface, while adults are more abundant over continental slopes (DeWitt *et al.*, 1990; Hanchet *et al.*, 2003; Stevens *et al.*, 2014). Juveniles of Antarctic toothfish shift habitat from pelagic-planktonic to coastal-benthic at the Antarctic Continental Shelf as they grow, forming nurseries (Hanchet *et al.*, 2008). At a certain size, the juveniles have no buoyancy, what explains the dramatic change in habitat (Near *et al*., 2003). Research conducted by Collins *et al*. (2007), reported the presence of high numbers of small fish (< 30 cm TL) at South Orkney, South Shetland, and Elephant Islands, as important nursery habitats. As they reach maturity, adult Antarctic toothfish reach neutral buoyancy (Near *et al.*, 2003) and return to deep pelagic waters in the northern banks, where there is evidence of spawning (Söffker et al., 2018; SC-CAMLR-XXXVII/01). In addition, recent modelling on habitat for *D. mawsoni* developed by Molloy *et al*. (2018), predicted that 90% of *D. mawsoni* area found between 550 and 2100 m.

A recent workshop for the development of a *D. mawsoni* "Population Hypothesis for Area 48 (WSDmPH)" carried out in Berlin, February 2018 (see SC-CAMLR-XXXVII/01), provided a comprehensive compilation of studies about the biology, reproductive stages, eggs' and larvae's distribution, and hypotheses about the stocks. The workshop following the presentations and discussions of the available data resulted in the proposition of three hypotheses for the stock for *D. mawsoni* in the Atlantic and adjacent regions in the Southern Ocean 1) Single Atlantic population, 2) two Atlantic populations, 3) several interconnected populations. The workshop also identified some key gaps for area 48 related to: limited information available for distribution 2D/3D of *D. mawsoni* eggs and larvae for the area 48; evidence and verification of spawning locations, investigation of spawning seasons and potential nursery areas; the limited knowledge about life stages of *D. mawsoni*, age and diet data.

Thus, the comprehension of these issues and future research about the spawning of *D. mawsoni*, biology, maturity index, tagging, distribution off eggs and larvae, parasites and genetics for the stock hypothesis, are very important and relevant for the implementation of conservation measures in the framework of the D1MPA.

Research fisheries of *Dissostichus*

As mentioned previously, direct fishing of *Dissostichus* spp. is prohibited in Domain 1, however, following CM 24-01 and CM 24-05, a number of research programs have been developed and several others are currently in development or have been proposed for evaluation to the Scientific Committee (See Table 1) in subareas 48.1, 48.2 and 88.3. The management of research fisheries for *Dissostichus* is based on research blocks, which are areas where catch limits are smaller than those on statistical areas.

Research fisheries for *Dissostichus* spp. in subarea 48.2 were carried out for the first time by Chile in 1998 (Arana & Vega 1999). Later on, in 2014 Ukraine proposed research fishing (2015-2017), with the artisanal longline, for sampling the eastern part of Subarea 48.2 (SC-CAMLR-XXXII, Annex 7, paragraph 5.48). The results of the 2017 fisheries (WG-FSA 17/42) indicated estimations of stocks of 946t in area 48.2E, 2,569t in area 48.2N, 1,173t in area 48.2S, 1,589t in area 88.3-4 and 265t in area 88.3-

5. Some research fishing programs have also been developed in subarea 88.3, firstly by New Zealand and others have been developed or proposed in recent years (Table 1).

Table 1. 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-18/26	TOA, TOP	Chile	Finished	48.2	2018
WG-FSA-17, WG-SAM-18/05	TOA	Korea/NZ	Ongoing	883_4, 883_5	2017-2019
WG-FSA-17, WG-SAM-18/13	TOA, TOP	UK	Ongoing	48.2	2015-2020
WG-SAM-18/11	TOA, TOP	Ukraine	Proposed	48.1	2019-2021
WG-SAM-18/12	TOA, TOP	Ukraine	Proposed	883_4, 883_5	2019-2021
WG-FSA-16, WG-FSA-16/40Rev1	TOA, TOP	UKraine	Ongoing	48.2	2017-2019

Söffker *et al*. (2018; SC-CAMLR-XXXVII/01) compiled all the information available about Antarctic toothfish life stage 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 Is. (Fig. 1). Therefore, the D1MPA is expected to provide protection to Antarctic toothfish important habitats during a critical stage of their life cycle (Fig. 1). On the other hand, the known zones of spawning within the domain seem to be associated with the areas of research fisheries (48.2N and 48.2S, fig. 1), which is probably a result from sampling bias. More effort should be made in order to detect zones of spawning in Domain 1.

Dissostichus Research Activities for the Scientific Research and Monitoring Plan

As stressed out previously, the Antarctic continental shelf at depths of up to 550 m holds nursery habitats for Antarctic toothfish. As toothfish grows up, they shift 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, which corresponds with ages of between 5 and 7 years for males and 8 and 12 years for females (Horn 2002). First spawning is estimated to occur at ages of 12.8 years for males and 16 years for females (Parker and Grimes 2010). Therefore, protecting habitats 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.

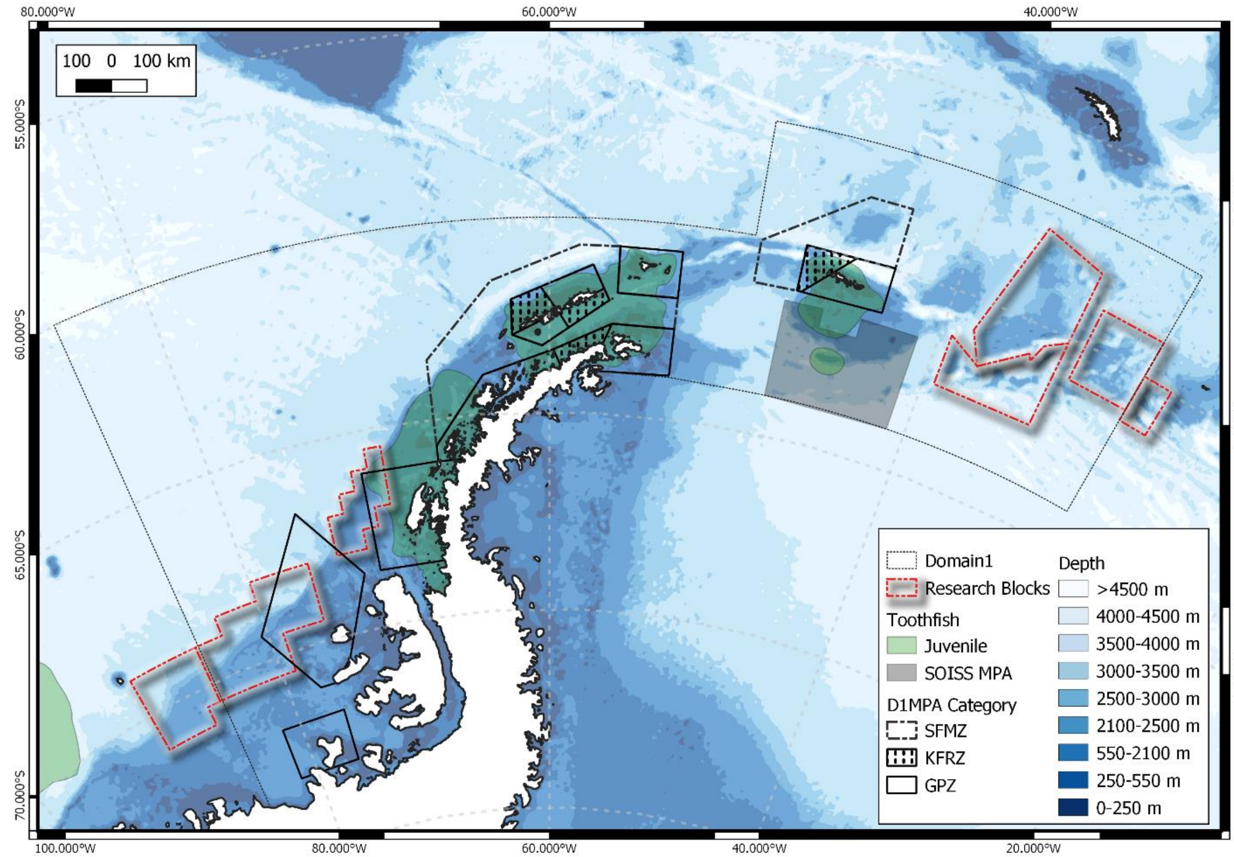

Figure 1. Proposed distribution of Antarctic Toothfish (*Dissostichus mawsoni*) juveniles (light green areas) and priority habitat for juveniles (0-550 m) and adults (550-2100 m) within Domain 1 (from Söffker et al. 2018; SC-CAMLR-XXXVII/01) overlapped with the proposed D1MPA, and toothfish research fishing blocks.

Most of the habitat used by younger fish (depths below 550 m) is protected by the proposed MPA (conservation objective N6, important areas for life cycle of fishes, SC-CAMLR-XXXVI-BG/22 Annex 1, Figure 6), 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 immature fishes (Fig. 2). Considering there are areas where the fishing blocks match the proposed MPA (GPZ AI and GPZ MB) in subarea 88.3 (Fig. 2), 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).

Research activities could be focused on: a) development of 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. The appropriate catch limit and specific location 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. depending on the specific question/objectives agreed for a determined area.

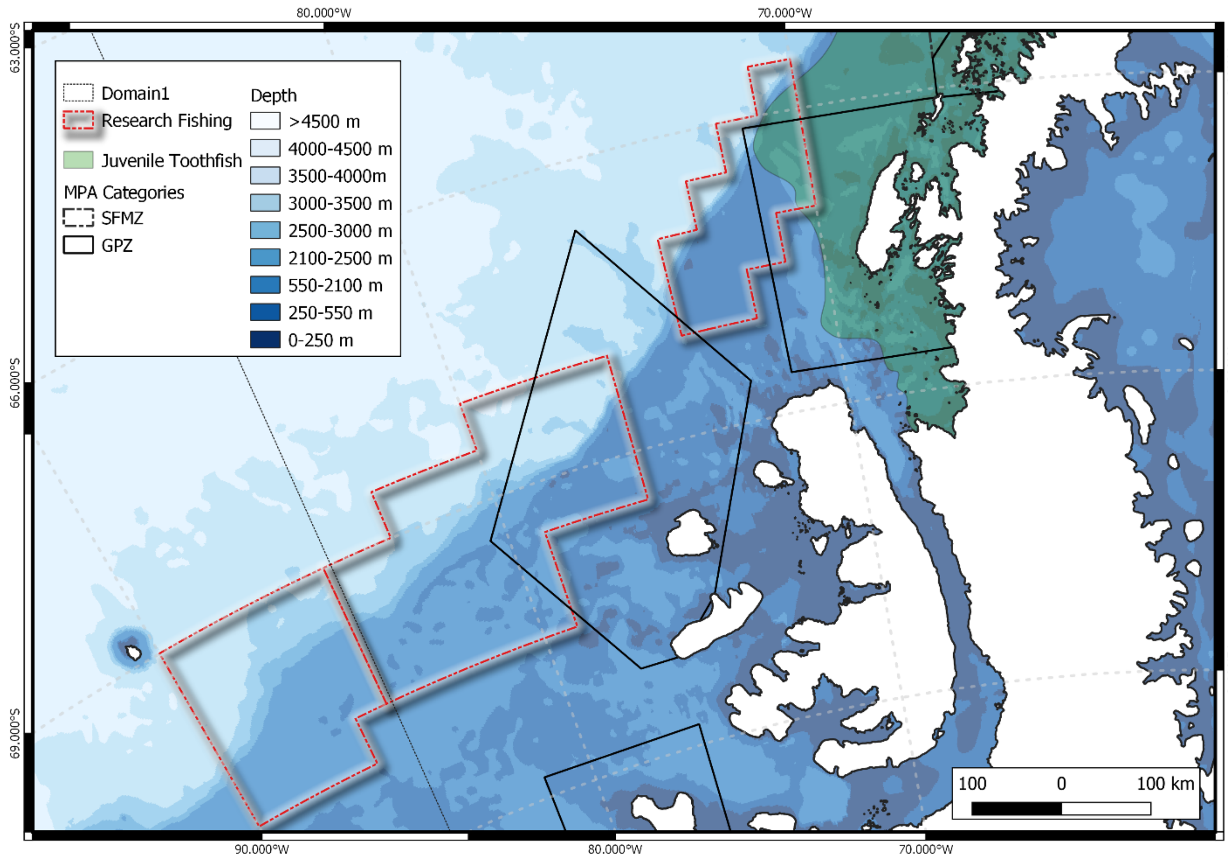

Figure 2. Detail on the western part of area 48.1 and area 88.3 (SWAP) where current Research fishing blocks overlap with the general protection zones of the MPA.

h) Developing priorities for a research and monitoring plan to accompany the proposed MPA

In order to ensure that the general and specific objectives of this Conservation Measure are being met, we have identified priority elements for scientific research and monitoring for Domain 1 MPA. Priority elements were grouped within broad research areas including ecosystem, oceanography, fisheries and climate change. The priority elements of the Research and Monitoring Plan to support the management of D1MPA are detailed in Annex C.

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