CCAMLR

Commission for the Conservation of Antarctic Marine Living Resources
Commission pour la conservation de la faune et la flore marines de l'Antarctique
Комиссия по сохранению морских живых ресурсов Антарктики
Comisión para la Conservación de los Recursos Vivos Marinos Antárticos

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WG-SAM

Research plan for the 2018/19 exploratory longline fishery of D. mawsoni in Subarea 48.6 by Spain

Delegation of Spain

EN

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Abstract

The Subarea 48.6 is considered a data-poor fishery after the acknowledgement that commercial fishing by itself had resulted in too few data to develop a full assessment of the targeted stocks. The management of these data-poor fisheries has been a major focus of attention in CCAMLR in recent years and CCAMLR has developed a framework for designing and undertaking research fishing designed to lead to an assessment of these toothfish stocks in the short to medium term.

Since 2004, licensed longline vessels have fished in Subarea 48.6 for *Dissostichus* spp, but it has been in 2013 that research fishing is focused in 5 research blocks.

The key building blocks towards developing a stock hypothesis are understanding distribution, reproduction, behaviour and movement. These will then allow answering key questions relating to formative life history stages, such as where toothfish spawn, where eggs and larvae are distributed to, where juvenile, sub-adult and adult toothfish are, and how toothfish move to and from spawning grounds (Soeffker et al, 2018).

South Africa and Japan have proposed the first joint research plan in 2016 in the SAM-WG when the working group recommended:

- ✓ research fishing in Subarea 48.6 should be targeted towards *D. mawsoni* (Antarctic toothfish, TOA) as a greater amount of data derived from research fishing is available compared to D. eleginoides (Patagonian toothfish, TOP).
- ✓ research blocks 48.6_2, _3 and _4 should be considered priority areas for research fishing as they are consistently free of sea-ice at the time of the research fishing and represent a diverse range of likely toothfish habitat, and
- ✓ the use of pop-up satellite archival tags (PSATs) is encouraged in the priority research blocks to provide data on fish movement within and outside these areas (WG-SAM-16 report, paragraph 3.40, 2016).

The SC in 2016 welcomed the progress made on the development of a hypothetical life cycle for *D. mawsoni* in Subarea 48.6 and also on the development of a preliminary integrated assessment for research block 486_2 (Annex 5, paragraph 3.24 and Annex 7, paragraphs 4.87 to 4.89). However, it noted that it was difficult to forecast the time required to achieve a full stock assessment of the subarea and that the Commission should have a realistic expectation about how long this might take. It further noted that this needs to be taken into account when considering uncertainty and setting precautionary catch limits in these areas.

In the SC-2017 report, the Scientific Committee noted that, based on a revised proposal, **the future inclusion of an ice strengthened vessel, in an expanded research plan for this area, would address the capacity issues that the research conducted by Japan and South Africa**

were experiencing (parag 3.109) and recommended that research in this subarea should continue, focussing on *D. mawsoni* in research blocks 486_2 to 486_5 (parag 3.112).

Taking into account the above recommendations made by CCAMLR WGs and SC and in order to speed up the acquisition and data analysis, Spain proposes their collaboration with the former proponents namely ZAF and JAP to achieve a fully integrated assessments of the *D.mawsoni* stock in the Subarea 48.6. The proposed Spanish vessel "TRONIO", with extensive experience in fisheries in CCAMLR area, is an ice strengthened vessel that could highly contribute to achieve the catch limit by research blocks, especially those with more difficult access due to difficult ice condition, and therefore increase the acquisition of data necessary to achieve a fully stock assessment in the subarea in the scheduled time.

1. Main objective

According to the latest proposal made by JAP and ZAF (WG-FSA-17/10), the main objective of the research plan is to provide the data required for:

1. An assessment of the stock status of *Dissostichus mawsoni*,
2. Improving the knowledge about growth of *Dissostichus mawsoni*,
3. Improving the knowledge about population structure of *Dissostichus mawsoni*
4. Investigating ecological traits of *Dissostichus mawsoni*
5. Revealing spatio-temporal pattern of bycatch species distribution,
6. Improving the knowledge about Antarctic marine ecosystems, and
7. Investigating effects of depredation by marine mammals

Detailed description of how the proposed research will meet the objectives, including annual research goals

Contribution from Spain to the multi-member research plan will address specifically the following objectives from the 2017 joint proposal between ZAF and JAP (WG-FSA-17/10):

Objective 1

An assessment of the stock status of *Dissostichus mawsoni*

Catch, effort, and tagged-recaptured data will be updated and used for estimation of toothfish stock status. Analysis of ancillary data will also be conducted to improve the understanding of stock hypothesis that will form the basis of integrated stock assessments to be conducted in subarea 48.6

Standard catch, fishing effort, tagging and biological data will be collected under Conservation Measure 41–04 to inform an assessment of the status and productivity of toothfish stocks in subarea 48.6. Annual milestones include updated reports on research activity and collected data, ageing of collected toothfish otoliths and updated estimation of biological parameters.

Objective 2

Improving the knowledge about growth of *Dissostichus mawsoni.*

Measured length and weight of toothfish and aging data obtained by processing otoliths will be used for updating age-length and length-weight relationship.

Contribution to the age estimation using otoliths readings will be made by Spain, that could serve in the meantime as calibration to previous lectures in the subarea.

Objective 3

Improving the knowledge about population structure of *Dissostichus mawsoni.*

Environmental information as well as conventional tagged-recaptured data, PSATs data, and improved knowledge about reproduction of toothfish (obtained from O4) are crucial for updating population structure hypothesis.

Dynamics of water mass and currents are essential to understand the life history and migration of *D.mawsoni*. For this it is necessary to know the oceanographic characteristics. However, there is a lack of oceanographic data especially collected in-situ in the 48.6 Subarea. We propose to collect and analyze satellite data as well as in-situ data acquired from a CTD..

Vertical profiles of temperature and salinity from the CTD will provide information on the geostrophic current but also the water mass. This information will help to refine the knowledge about the potential habitat of *D. mawsoni*.

To correct scientific oceanographic data of 48.6, using satellite data and other oceanographic databases (such as World Ocean Database, NOAA) of sea temperature and salinity at depth to understand how the dynamics of water current could affect the life history of *D. mawsoni* in 48.6 and the evaluation of the Dr. Taki hypothesis (on the large scale migration in whole 48.6 and 58.4).

To study the movement of *D. mawsoni* in the southern part of 48.6 (middle scale), a CTD (Micro CAT, SBE37SMP) will be used to analyzing water current data at depth in order to evaluate the geostrophic currentby means of salinity and sea temperature. A numerical model data (HYCOM) will be used.

In-situ data will be made to evaluate the ice concentration and sea surface temperature using satellite data and numerical model (Hycom). It has been observed that a dynamical change to a warmer phase since 2016 occurs. Block 5 has been free of ice in Jan-Mar and the catch allocation of block 5 has been taken both in 2017 and 2018.

Spain also proposes to deploy a few pop-up tags in 48.6_4 and 5 research blocks. However, we suggest to work with other member with experience in the deployment and analysis of pop-up tags to try to improve results, taking in account the various difficulties.

Objective 4

Investigating ecological traits of *Dissostichus mawsoni*

Conventional tagged-recaptured data, biological measurement such as length, weight, sexual maturity, stomach contents, and aging data derived from processing otoliths are considered

essential to investigating ecological traits of toothfish (e.g. growth, movement and reproduction).

Objective 5

Revealing spatio-temporal pattern of bycatch species distribution

Comprehensive bycatch data collected in accordance with relevant Conservation Measures (33-03, 41-01 and 41-06) will help to reveal the spatio-temporal pattern of distribution and relative abundance of the main bycatch species.

Objective 6

Improving the knowledge about Antarctic marine ecosystems,

Bycatch records under scientific observer scheme and collecting specimens of benthic invertebrateswill improve knowledge of macrobenthic species composition and distribution. Interactions between predators (e.g., seabirds and marine mammals) and fishing vessels are recorded under scientific observer scheme.

Objective 7

Investigating effects of depredation by marine mammals

Toothfish depredation records and additional observations of marine mammals around fishing vessels will contribute to understand their distribution and to estimate potential depredation.

In Table 1 we show the scheme of milestones presented in the 2017/18 proposal under the mentioned objectives. We highlight the milestones where Spain could contribute (in bold letters) within the proposal. This is made assuming that ZAF and JAP agree on that.

Table 1. Scheme of milestones under the mentioned objectives, specifying the role that Spain could contribute (in bold letters) taking into account that ZAF and JAP agree on that.

Meetings	Milestones corresponding each object	Role sharing
WG-SAM-18	Local abundance estimates with latest data [O1]	JPN *
	Annual report of survey cruise in fishing season 2016/17 [O1–O7]	JPN
	Improving the knowledge about growth, population structure, movement, and reproduction of toothfish with latest data [O2–O4]	JPN / ZAF
	Analysis of sea-ice dynamics using updated data [O6]	JPN
WG-FSA-18	Revised local abundance estimates referring to previous meeting's advices [O1]	JPN *
	Preliminary integrated assessment model with considering IUU catch [O1]	JPN / ZAF
	Summary of bycatch analysis (sample sizes, catch composition, spatial distribution of catches) [O5]	JPN
	Preliminary results of macrobenthos bycatch analysis [O6]	JPN
WG-SAM-19	Local abundance estimates with latest data [O1]	JPN *
	Annual report of survey cruise in fishing season 2017/18 [O1–O7]	JPN/**ESP**
	Improving the knowledge about growth, population structure, movement, and reproduction of toothfish with latest data [O2–O4]	JPN / ZAF/**ESP**
	Analysis of sea-ice dynamics using updated data [O6]	JPN/**ESP**
WG-FSA-19	Revised local abundance estimates referring to previous meeting's advices [O1]	JPN *

	Revised integrated assessment model referring to previous meeting's advices [O1]	JPN / ZAF/**ESP**
	Summary of bycatch analysis (sample sizes, catch composition, spatial distribution of catches) [O5]	JPN/**ESP**
	Summary of macrobenthos bycatch analysis [O6]	JPN
	Preliminary results of marine mammal's records analysis [O7]	JPN
WG-SAM-20	Local abundance estimates with latest data [O1]	JPN *
	Annual report of survey cruise in fishing season 2018/19 [O1–O7]	JPN
	Improving the knowledge about growth, population structure, movement, and reproduction of toothfish with latest data [O2–O4]	JPN / ZAF
	Analysis of sea-ice dynamics using updated data [O6]	JPN
WG-FSA-20	Revised local abundance estimates referring to previous meeting's advices [O1]	JPN *
	Revised integrated assessment model referring to previous meeting's advices [O1]	JPN / ZAF/**ESP**
	Summary of bycatch analysis (sample sizes, catch composition, spatial distribution of catches) [O5]	JPN
	Summary of marine mammal's records analysis [O7]	JPN
	Determination of population structure [O3]	JPN / ZAF/**ESP**
WG-SAM-21	Local abundance estimates with latest data [O1]	JPN *
	Annual report of survey cruise in fishing season 2018/19 [O1–O7]	JPN/**ESP**
	Improving the knowledge about growth, population structure, movement, and reproduction of toothfish with latest data [O2–O4]	JPN / ZAF/**ESP**
	Analysis of sea-ice dynamics using updated data [O6]	JPN/**ESP**
WG-FSA-21	Revised local abundance estimates referring to previous meeting's advices [O1]	JPN *
	Establishment of integrated assessment model [O1]	JPN / ZAF/**ESP**
	Summary of bycatch analysis (sample sizes, catch composition, spatial distribution of catches) [O5]	JPN

We acknowledge the results of the research cooperation between Japan and South Africa for the last years. The proposal for Spain to join the current research should help with filling the gaps and to speed up the achievements of the objectives.

It is expected that Spain could develop the cooperation with Japan and South Africa into a more detailed and practical level summarizing a unique proposal between the three-members before 2018 FSA-WG.

Rationale for research, including relevant existing information on the target species from this region, and information from other fisheries in the region or similar fisheries elsewhere

There have been no integrated toothfish stock assessments in subarea 48.6 so far. Here, biomass estimation, e.g. through tag-based methods and a better understanding of stock structure are research priorities.

From the beginning of the research proposals in the Subarea 48.6, the catch allowed to get enough data to achieve the objectives of the proposal has never been taken (although the ratio from the last season has been the highest). It has been due to various reasons of which the most frequent is the accessibility to some research blocks due to the ice concentration.

Table 2 shows the ratio (reported catch*100/catch limit) of the catch during the research proposals (from 2013) while the reported catch and ratio for research block in 2016 is shown in Table 3.

Table 2: Catch and ratio from the reported catch vs catch limit in Subarea 48.6 from 2013.

Season	Catch limit (tonnes)	Reported catch (tonnes)			
		D. mawsoni	*D. eleginoides*	Total	Ratio
2013	400	275	15	291	72,8
2014	538	145	9	154	28,6
2015	538	189	1	190	35,3
2016	538	232	8	240	44,6
2017	552	460*		460	83,3

*Preliminary

Table 3: Catch by research block in the 2016/17 season for *Dissostichus* spp. in Subarea 48.6.

Research blocks	Species	Catch (% of catch limit)
486_1 and 486_2	*D. eleginoides*	8 tonnes (29%)
486_2	*D. mawsoni*	83 tonnes (49%)
486_3	*D. mawsoni*	50 tonnes (100 %)
486_4	*D. mawsoni*	99 tonnes (99%)
486_5	*D. mawsoni*	0 tonnes. (0%)

The SC-2017 report noted that a future inclusion of an ice strengthened vessel, in an expanded research plan for this area, would address the capacity issues that the research conducted by Japan and South Africa were experiencing (parag 3.109) and recommended that research in this subarea should continue, focussing on *D. mawsoni* in research blocks 486_2 to 486_5 (parag 3.112).

The proposed Spanish vessel "TRONIO" is an ice strengthened vessel that could highly contribute to achieve the catch limit by research blocks and help to address the capacity issues noted by the SC.

At the recent CCAMLR Workshop for the Development of an Antarctic toothfish Population Hypothesis for Area 48 in Germany (WS-DmPH), Japan presented a document "Stock hypothesis in region for Subarea 48.6 and Divisions 58.4.2 and 58.4." which suggested that the region west of the Prydz Bay(specifically 50-70°E; SSRUs 58.4.2C and D) seems to be an important nursery ground. Juveniles in these areas would migrate to east- and west-ward and become important resources for the populations in the shelf areas of adjacent subareas and divisions.

Based on the annual average of geostrophic current at the depth of 150m (Okuda et al 2018), the Antarctic Circumpolar Current(ACC) diverges into some sub-gyres which flow southwards towards the Antarctic continental shelf around at 50-70°E (Fig. 1). Okuda et al. mentioned that the water movement is highly consistent with the stock structure hypothesis presented in WG-

FSA-16/32 Rev.1 and 17/10 and it may facilitate the transport of *D. mawsoni* larvae from off-shore areas, including sea mountain grounds towards the shelf areas in areas 48 and 58.

Toothfish tag released in 48.6_4 were recaptured in the 48.6_5 block and also a specimens released in 5842_1 were recaptured in 48.6_4. This migration could support the hypothesis of the stock structure and recruitment where *D. mawsoni* moves westward along the coast in 58.4 and 48.6 towards their nursery and feeding grounds.

Life history of and migration related with currents.

The life history of *D. mawsoni* and understanding of the migration patterns along the ACC and sub-gyres of early life phases is critical information to understand the stock dynamics The physical factors, such as the water current and sea temperature, must affect the migration to a large extent, especially those of eggs and larvae.

The main subgyre diverges from the clockwise ACC at 50-70°E going southwards. When the current reaches the continental shelf (coast) it changes both eastwards and westwards. Around the continental shelf areas, the currents flow in complicated directions because some peninsulas and
thick surface ice probably complicates the coastal currents to a large extent.

The geostrophic current at a depth of 150m indicates that the coastal current around the continental shelf weakens because of less wind and thick ice. The westward currents may change southwestwards around the Ataka bay area at 0°W 70°S. However, in contrast to the ACC around 40-60°S where the strong eastward wind drives the current, the current around 48.6_5 block is rather weak.

Life history with water mass in sub-layer depths.

Both the knowledge of the sea temperature in the sub-layer depths (such as at depths 150-200m) as well those at the sea surface temperature and of the water dynamics is also critical information contributing to a better understanding of the life history of Toothfish as eggs and larvae must float or flow with the current in the sub-layer at depth or near the sea surface.

There exist cold water masses are present around the sublayer at 150-200m depth, in the eastern part of block 5 (Fig. 4). This suggests that a northward flowing cold current may exist at depths of 150-200m. The currents flow westward along the coast and the currents diverge northwestward around research block 5 in the Ataka bay region. According to the geostrophic currents at depths of 150m, the south westward current is dominant along the coast. However, the area must has have some small gyres there around the Akta Bay area, as in research block 4 there seems to be none of the significant water masses in the sublayer like in block 5. The SST of the eastern part is colder than that of in the western part, so this would suggest that the geostrophic current must flow northwards.

Spain proposes to conduct an oceanographic study by using CTD equipment to assist the stock assessment of Antarctic toothfish. In our proposal, 20 stations have been allocated where there will be deployments of the CDT equipment along the longitude in area 48.6 research blocks 4 and block 5 to study the water movement. The resulting data will be compared with the Hybrid Coordinate Ocean Model (HYCOM) (https://hycom.org), which provides global daily temperature, salinity at depth etc. for the globe including for the Antarctic. We already compared the HYCOM model with real-time data of ice concentration, to verify that they are comparable with each other on a scientifically reliable level. The CTD equipment to be

purchased and deployed is suggested to be either a Seabird profiler (www.seabird.com) for which a specific whinch will need to be installed on the ship, or a Valeport CDT profiler (www.valeport.co.uk), which could potentially be deployed on the anchor line of the fishing gear.

Dynamics of ice concentration in 48. 6 (Weddell Sea)

Especially in the Antarctic continental shelf area, the success of the fishery for *D. mawsoni* is dictated largely by the ice condition.

According to the ice concentrations during Dec-Mar (Austral summer) for the last 5 years (2013/14-2017/18) and the Sea Surface Temperature (SST) anomaly, during Jan to Mar (Austral summer) in the 2016/17 and the 2017/18 seasons, ice concentration has been very low and probably allowing fishing vessels from conducting fishing operation .(see Fig.2) By comparison, in the seasons 2013/14 through to 2015/2016, the ice concentration had been higher so that vessels could not operate in research 48.6 block 5, which coincidentally has the largest catch limit allocated (228t in 2017/18
season).

As the sea surface temperature became warmer since 2016, the ice concentration has become lower from 2016 to 2017. Block 486_5 was not covered thoroughly by ice until the middle of April in 2018 even though it did become colder. It is a very extraordinary ice phenomenon. Namba (WG-FSA-17/08) reported that the ice concentration is highly correlated with the Sea Surface Temperature (anomaly). The positive spikes (like a small mountain shape) of SST are consistent with lesser concentrations of ice (Fig.2).

In 2018 a positive spike of SST also took place in Dec.-Mar. followed by the much reduced ice concentration during Jan.-Mar. 2018. This warming phase started in 2016 with a small increase, but from 2017 to 2018 gradually the positive increase accelerated, which means it became warmer from 2016 to 2018. The plot of ice concentration (0-100%) during Jan.-Mar. for 2014-2018 in 48.6 block 4 and block 5 show how much the ice concentration in 2017 and 2018 was reduced compared to 2014 to 2016 (Fig. 3). The ice concentration in 2018 in the research block 5 was lower than in block 4. The reduction in ice concentration seems to start in 2016 and to continue.

Pop-up tags for the life history studies

SeaTag-MOD (Desert Star Systems) and MiniPAT-348A(Wild Life) popup tags were deployed under an NZ and US project (FSA- 16-57), whereas Korea deployed 5 Mini-PAT in 2016 (SAM - 16-28). Japan also plans to deploy 4 MiniPAT-348A in 2018. Spain also proposes to deploy a few popup tags in this proposal.

We understand that analysis of the data provided by electronic tags is difficult to interpret because of the unique environment of the Antarctic toothfish habitat. Methodologies to estimate the location at high depths are improving, and a contribution to that is expected from Spain.

Marine Protected Area (MPA)

Germany recently hosted a Workshop about the Development of an Antarctic toothfish (*D. mawsoni*) Population Hypothesis for Area 48. To develop the Weddell Sea MPA, scientists pay attention to environmental changes in the Weddell Sea. According to the FSA-2017

(SC_CCAMLR- XXXVI/BG/2), it is predicted that the ice concentration in the Weddell Sea could be much higher than in 2017 during Austral summer season. In fact the very opposite to their prediction occurred, and the ice concentration of Jan.-Mar 2018 was the lowest level for the last 10 years.

A SST analysis using satellite data in the Weddell Sea (Fig.5) indicates that the SST is approximately consistent with the ice concentration. The proposed oceanographic study can contribute to help predict the ice condition not only for the exploratory fishing but also to better understand the mechanisms of the ecosystem in the Weddell Sea and shedding further light on the understanding of the early life phases of Antarctic toothfish.

2. Fishery operations

(a) Fishing Members

Spain.

It is expected to join the Japan and South Africa proposal in a unique collaborative proposal for the WG-FSA 2018.

(b) Vessels to be used

Table 4. Fishing vessel of Spain

Vessel name	*Tronio*
Information	www.ccamlr.org/en/node/75760
Vessel owner	Pesquerías Georgia S.L.
Vessel type	Commercial bottom longline fishing vessel
Registration port/number	Cillero/ 3GC-1-2-05
Radio call sign	ECJF
Overall length and tonnage	55 m, 1058 tonnes (GRT)
Equipment for determining position	VMS-c
Fishing processing/storage capacity	42.7t / 635.3 m^3
Subarea	48.6

c) Target species

Dissostichus mawsoni and *Dissostichus eleginoides*. Antarctic toothfish (*Dissostichus mawsoni*) will be the primary species caught.

(d) Fishing or acoustic gear to be used

Longline type

Spain will employ a Spanish longline system. Full descriptions of gear configurations and deployment are located in the CCAMLR Fishing Gear Library at http://www.ccamlr.org/en/publications/fishing-gear-library.

Other sampling gear

- CTD loggers
- Archival tags (MiniPAT), depending on results of pop-up tags by NZ, Korea and Japan and the CCAMLR WGs suggestions

(e) Fishing regions (divisions, subareas and SSRUs) and geographical boundaries

This research plan proposes all research blocks in Subarea 48.6 following the SC criteria.

(f) Estimated dates of entering and leaving the CCAMLR Area

Table 5. Estimated months of operation during the 2018/19 season (shaded red) in the CCAMLR 48.6 Subarea

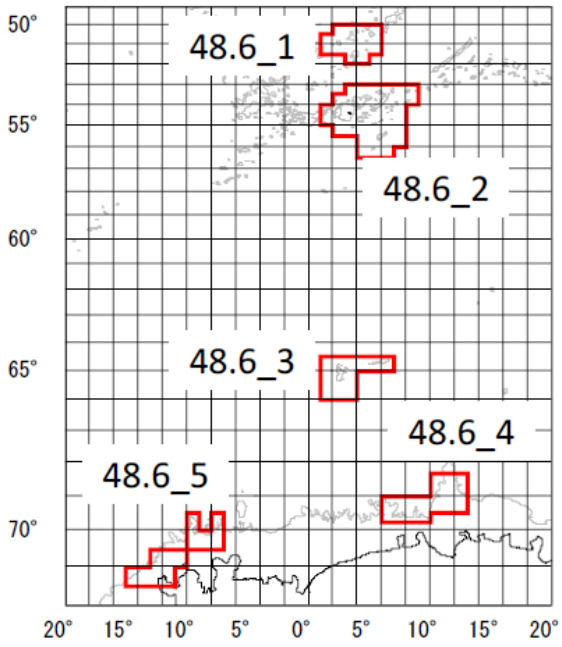
Notifying Member	2018	2019											
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
Spain													

3) Research survey/fishing design (description and rationale)

3a) Existing research area

We will follow the previous scheme proposed by ZAF and JAP. Research will be focused in research blocks 48.6_2,3,4 and 5, where higher probability of tagging recapture success is expected

Research blocks are shown in the figure below. Black and gray contours show 1 000 m and 2000 m isobaths, respectively. Note that the research in block 48.6_1 will be suspended from the 2018/19 season (WG-SAM-16 report, paragraph 3.40, 2016).



Other requirements
CTD loggers will be deployed with the line.

3.b) Data collection

Data collection and bycatch mitigation will be following the CMs in line with the previous proposal made by ZAF and JAP.

3.b.1) Tagging

The tagging performance will take place fully complying with paragraph (2) of Conservation Measure 41-01 Annex 41-01/C (Conservation Measure 41-01, 2016), such that; a) only fish suitable for tagging , in accordance with the suitability criteria in the CCAMLR Tagging Protocol, shall be tagged and released; b) the length frequency of tagged fish will reflect the length frequency of the catch; c) the vessel will achieve a minimum tag overlap statistic of 60%; and d) in regions where both toothfish species occur such as in the north of 48.6, the tagging rate will be in proportion to the species and lengths of each *Dissostichus* spp. present in the catches. In addition, toothfish will be tagged at a rate of at least five fish per ton green weight caught (seven fish per ton when operating in the optional areas) complying with Conservation Measure 41-04 (Conservation Measure 41-04, 2016).

According to the recommendation of last WG-SAM to encourage the use of PSATs (WG-SAM-16 report, paragraph 3.40, 2016), we are planning to conduct PSAT survey for toothfish in 48.6 Subarea.

4. Estimates of current biomass

Allocations of catch limits among members for the 2018/19 season (i.e. following a similar approach to that described in WG-FSA-15/54 and used in WG-FSA-17/18r1) will be discussed during the 2018 meetings in conjunction with the updated biomass estimates using the CPUE

by Analogy and Chapman index. The CCAMLR Secretariat will update the estimations with the latest available data.

4.a) Proposed catch limit

We propose to continue the current research operation for the next fishing season with the same survey design. The catch limit proposed for 2018 CCAMLR-WGs will be adopted.

4.b) Evaluation of the impact of the proposed catch on stock status

4.b.1) Rationale that proposed catch limits are consistent with Article II of the Convention

The proposed research is not expected to have an additional impact on stock status. The catch limits will be based on revised local abundance estimation discussed in WG-FSA-18, which are designated to provide reasonable assurances against negative impacts on stock status, consistent with the objectives of CCAMLR and a precautionary approach.

4.b.2) Evaluation of timescales involved in determining the responses of harvested, dependent and related populations to fishing activities

Preliminary results quantifying spatio-temporal variation in bycatch will be presented yearly. Conditional upon CCAMLR review, survey and tag-recovery fishing in 2016/2018 will provide information on the biomass present in fished areas, and estimated long-term population responses to fishing activities, further investigations are expected to compare especially fishing effort (CPUE) and gear selectivity (toothfish and bycatch), between South African/Japanese and Spanish flagged vessels in 48.6 Subarea.

4.b.3) Information on estimated removals, including IUU fishing activities, where available

IUU fishing activity was not recorded in Subarea 48.6 between 2006 and 2012, however, IUU gear was first reported in 2013 (CCAMLR-XXXII/BG/09). The first reported vessel sighting in Subarea 48.6 was in 2014 of the IUU-listed vessel Viking. There is compelling evidence of IUU activity in Subarea 48.6 with vessel sightings and vessel detection as well as recovery of gillnet by scientific observers reported annually from 2013 to 2016. The location of the gillnet recovery indicated that Maud Rise is a consistent target for IUU activity.

4.c) Details of dependent and related species and the likelihood of their being affected by the proposed fishery

The most common bycatch species group to be *Macrourus* spp. (GRV). Other bycatch species may include Crocodile icefishes (ICX: *Channichthyidae*) and *Antimora rostrata* (ANT).

The proposed research will maintain strict compliance with CCAMLR Conservation Measures regarding bycatch (CMs 41-01, 41-06 and 33-03) and the protection of seabirds and marine mammals (CMs 41-01, 41-06, 25-02 and 25-03). All registered and newly discovered vulnerable marine ecosystems (VMEs) are avoided during fishing operations in accordance with Conservation Measure 22-07. VME-related data are collected and notified in accordance with Conservation Measure 22-06.

5. Research capability

(a) Name(s) and address of the chief scientist(s), research institute or authority responsible for planning and coordinating the research

Spain:
Roberto Sarralde Vizuete and Luis J. López Abellán
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(b) Number of scientists and crew to be on board the vessel

The vessel will carry at least two scientific observers, one of whom shall be appointed in accordance with the CCAMLR Scheme of International Scientific Observation. The other will be an observer appointed by fisheries management body/s of the Members participating in this research.

(c) Is there opportunity for inviting scientists from other Members? If so, indicate a number of such scientists

There is no space available for scientists from other Members aboard the fishing vessels.

(d) Commitment that the proposed fishing vessel(s) and nominated research provider(s) have the resources and capability to fulfil all obligations of the proposed Research Plan

The nominated vessels and on-board scientific observers have the resources and capability to fulfill all obligations of the proposed research plan. For example, the vessels are equipped with the fishing gear and all other facilities required for conducting this research in accordance with relevant conservation measures; as well as communication systems that allow direct telephone, fax, email and internet communication between the vessel and observer coordinators and fishery scientists. The nominated vessel and fishing company is experienced operating in CCAMLR fisheries, including in Divisions 58.4.1 and 58.4.2.

The fishing vessel Tronio (Spain) has conducted exploratory fishing in Divisions 58.4.1 and 58.4.2 in five seasons since 2012/13. It has fished in Division 58.4.1 from 2006, always in compliance with conservation measures. Researchers of the Spanish Institute of Oceanography (IEO) have collaborated with CCAMLR since 1986 when a Spanish Scientific Survey was conducted on the Scotia Arc and Antarctic Peninsula. Currently a program on otolith aging is underway.

6. Reporting for evaluation and review

(a) List of dates by which specific actions will be completed and reported to CCAMLR. If the research is a stand-alone survey, Members shall commit to providing a progress report to WG-FSA and/or WG-EMM for review and comment and a final report within 12 months of completion of the research to the Scientific Committee

A list of dates by which specific actions will be completed and reported to CCAMLR is provided in Table 1. A final report will be provided to WG-FSA in 2021, which will contain a comprehensive evaluation of existing management arrangements and updated advice on precautionary catch limits as appropriate.

(b) If research is multi-annual, Members shall commit to providing annual research reviews to be submitted to WG-FSA and/or WG-EMM, including review of progress towards meeting research objectives and associated proposed time lines in initial proposal, and proposals for adjustments to the research proposal if required

Following each season of data collection, a progress report will be submitted to WG-SAM and WG-FSA that addresses how the research is achieving the research objectives and whether any changes are required to research plans.

References

Delegation of Japan and South Africa. 2016. Revised research plan for the 2016/17 exploratory longline fishery of Dissostichus spp. in Subarea 48.6 by South Africa and Japan. WG-FSA-16/32 Rev.1.

Delegation of Japan and South Africa. 2016. Revised research plan for the 2017/18 exploratory longline fishery of *D. mawsoni* in Subarea 48.6 by South Africa and Japan. WG-FSA-17/10.

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Namba T., T. Ichii and T. Okuda,2017,Correlation of sea-surface temperature in Ross Sea, Weddell Sea and the sea off Peru for the ice analysis,WGFSA-17/08

Soeffker M., A. Riley, M. Belchier, K. Teschke, H. Pahlke, J. Graham, S. Somhlaba, T. Namba, C. Darby. Towards the development of a stock hypothesis for Antarctic toothfish (*Dissostichus mawsoni*) in Subarea 48.6 in the context of Area 48. WS-DmPH-18/14, 2018.

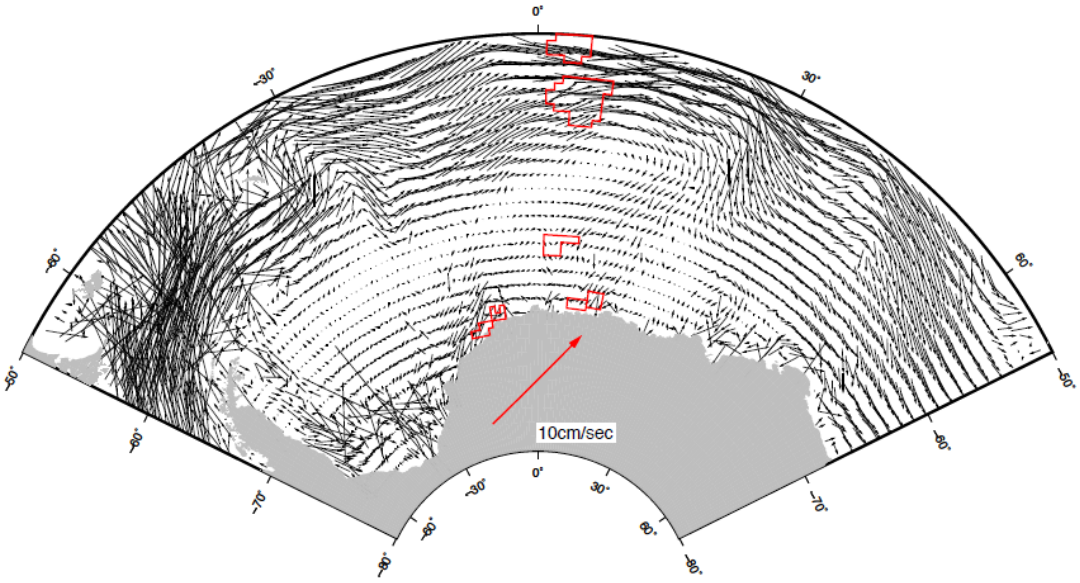

Figure 1. Geostrophic water current at 150m depth averaged over years calculated using World Ocean Database 2013, (NOAA).

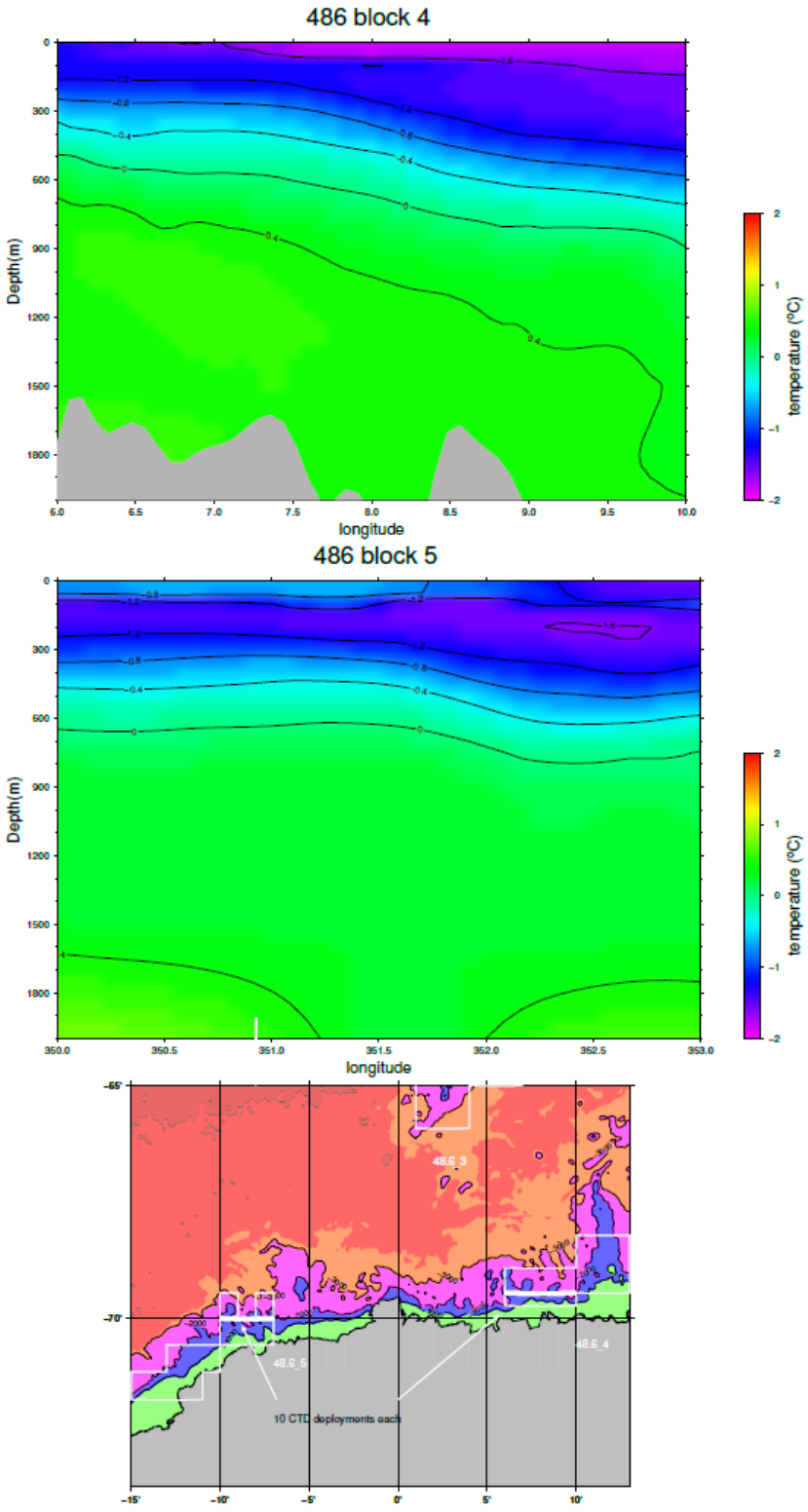

Figure 2. Vertical profiles of sea temperature of research block 4 and block 5 dated 18th May. block 4 and block 5 are along 69.5S 6.0E-10.0E and 70.0S 10.0W-7.0W respectively. (Data source is HYCOM.)

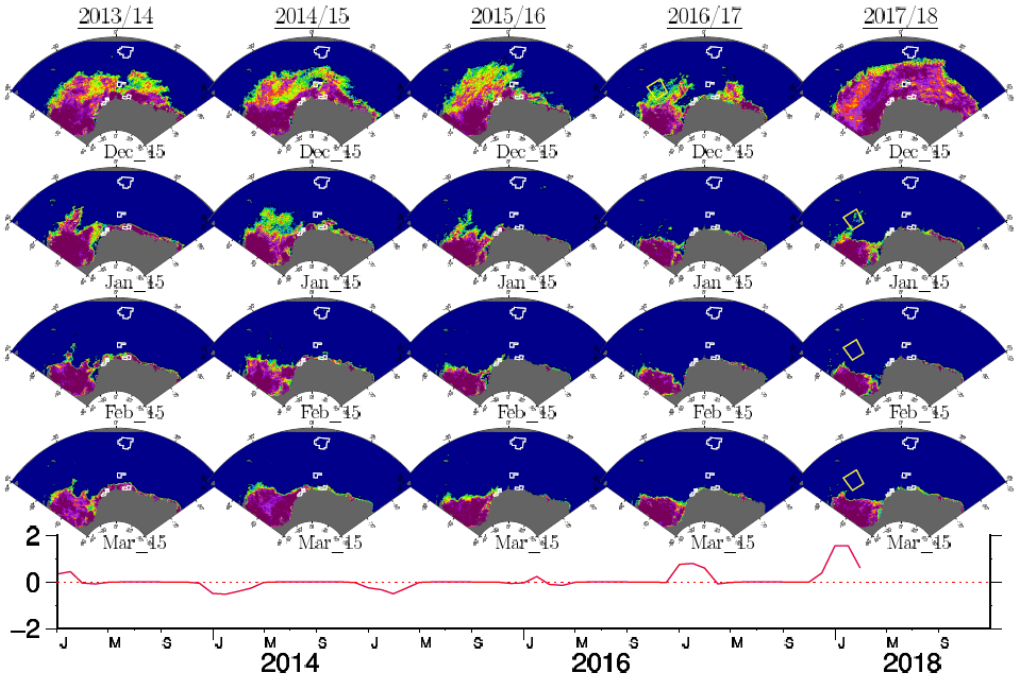

Figure 3. 15th of Dec-Mar. of ice concentration distribution of Weddell Sea(including 486) for 2013-2018. (Data source: Bremen University, Daily AMSR-E Sea Ice Map, http://www.iup.uni-bremen.de/seaice/amsr/ with satellite "Shizuku" (GCOM-W1))

Lower plot is SST anomaly for 2013-2018. In SST anomaly plot, the flat line of 0 means covered by ice thoroughly. (Data source: https://coastwatch.pfeg.noaa.gov/erddap/griddap/jplMURSST41anommday)

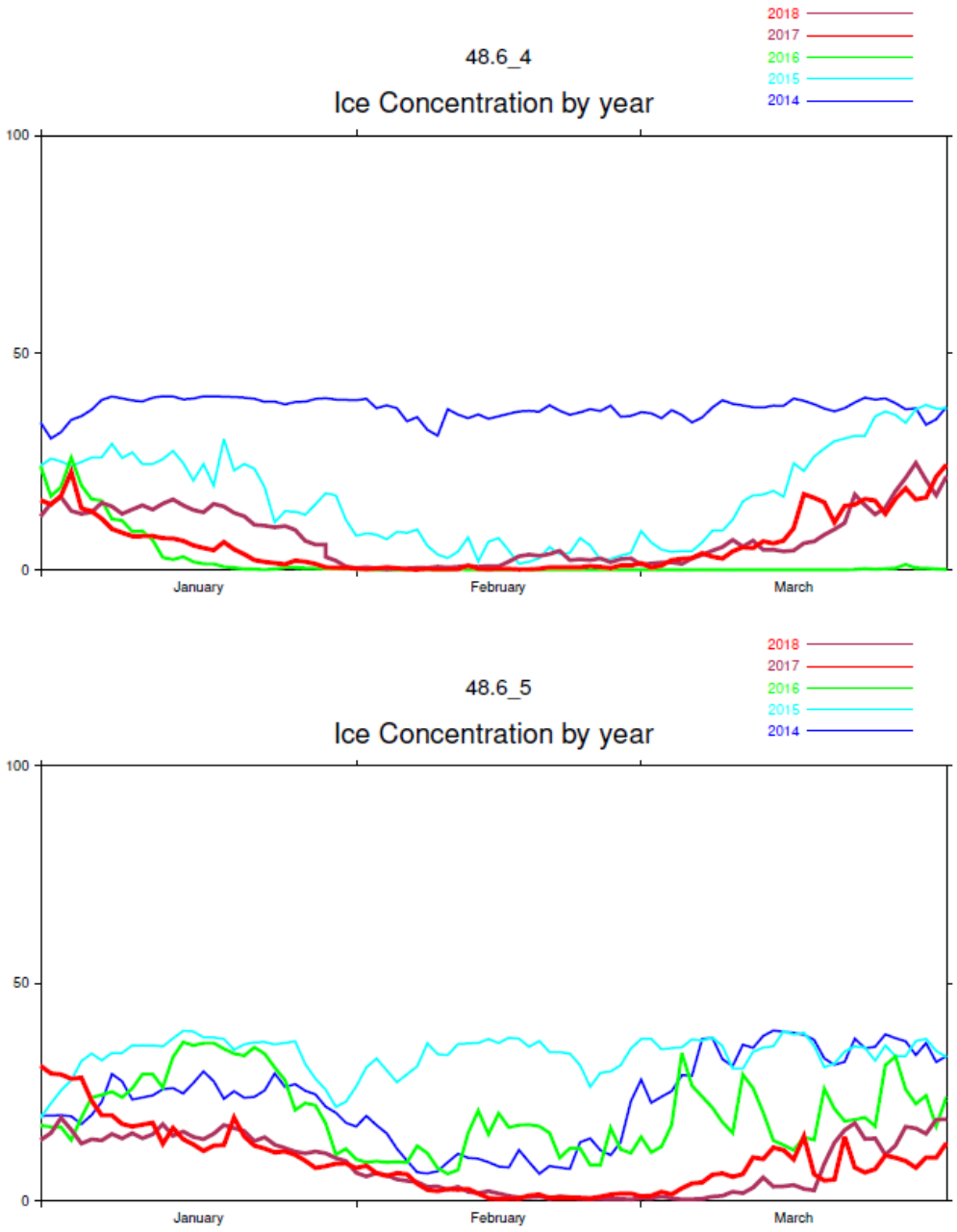

Figure 4. Plots of ice concentration(0-100%) of Jan.-Mar. in research block 4(upper) and block 5(lower).

(Data source is Bremen Univ, Daily AMSR-E Sea Ice Map, http://www.iup.unibremen.de/seaice/amsr/.)

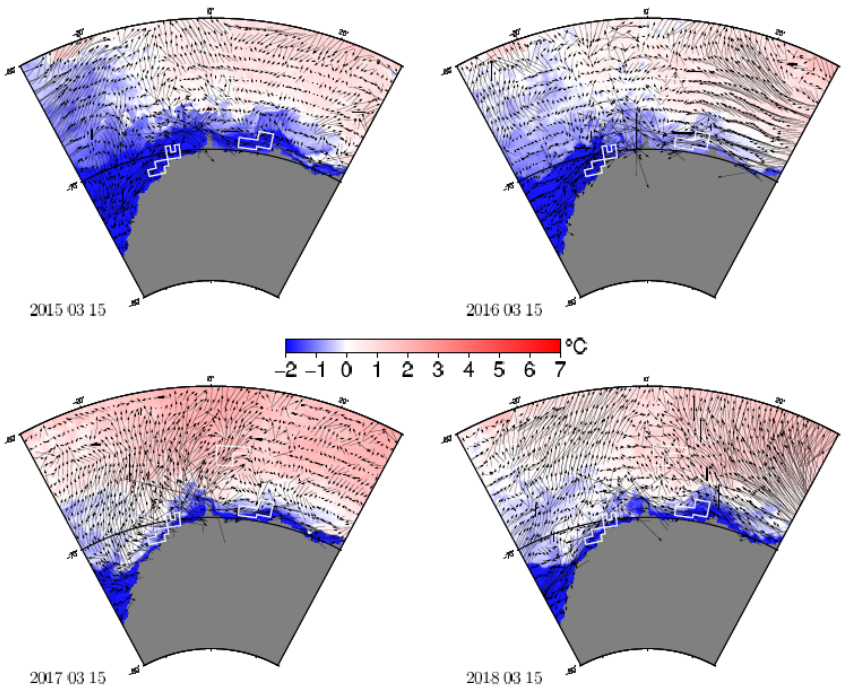

Figure 5. Sea Surface Temperature of 15th March for the latest 4 years of 2015-2017 with current.

(data source is HYCOM)