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Commission pour la conservation de la faune et la flore marines de l'Antarctique
Комиссия по сохранению морских живых ресурсов Антарктики
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# Continuation in the 2015/16 season of the research plan initiated in 2012/13 for stocks of Dissostichus spp. in Divisions 58.4.1 and 58.4.2

Delegation of Spain

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**Continuation in the 2015/16 season of the research plan initiated in 2012/13 for stocks of *Dissostichus* spp. in divisions 58.4.1 and 58.4.2**

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Abstract

In the 2012/13 fishing season Spain began implementing a multi-annual Research Plan for Divisions 58.4.1 and 58.4.2 in order to estimate local biomass of *Dissostichus* spp. by means of two methods: depletion and tagging. In 2014/15 the vessel was unable to conduct the proposed research experience due to problems with a blade of the propeller, During the season 2015/16 is intended to make the same proposed research with some minor changes, always subject to the ice conditions, fulfilling Spain's commitment to return to the same fishing areas in order to study inter-annual variability and maximize tag recovery, as well as, to progress research in these SSRUs (58.4.1H, G, D and C). Two research surveys have been already implemented in Division 58.4.1 and preliminary estimates of local biomass using Leslie depletion analyses have been obtained. Some recoveries of tagged toothfish have been made, both within-season and between-seasons recaptures and a preliminary Age-Length Key of *Dissostichus mawsoni* has been built after otholits reading from 58.4.1 division specimens. All these data will allow a robust stock assessment attempt by the end of this multiyear research survey.

**Continuation in the 2015/16 season of the research plan initiated in 2012/13 for stocks of *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2**

*Spain*

## 1. MAIN OBJECTIVE

*a) Objectives for the research and why it is a priority for CCAMLR*

In the 2012/13 fishing season Spain began to implement a multi-annual Research Plan for Divisions 58.4.1 and 58.4.2 in order to estimate local biomass of *Dissostichus* spp by means of two methods: local depletion and tagging-recapture.

The main objectives are:

i. To estimate local abundance of toothfish, mainly of *Dissostichus mawsoni*, implementing the use of depletion models in the specified local areas.

ii. To estimate the local abundance of *Dissostichus mawsoni* using a tag-recapture simple Petersen model.

iii. Comparison of local abundance estimates by these two methods.

iv. To increase our understanding on the potential fish mixing populations in these Divisions with those in adjacent areas (Banzare Bank and Ross Sea), as well as, between fish populations in SSRUs with zero TAC and the populations in adjacent SSRUs that are open to exploratory fisheries.

v. Estimate biological parameters associated with productivity like maturity; length composition and mean length; and collect otholiths to age determination and growth studies.

The last 2014/15 season the vessel had to return to Montevideo due to technical problems and couldn't perform the proposed research fishing. Thus, we propose to continue the failed research in the next 2015/16 season, as far as the ice conditions allow for the vessel operations, fulfilling Spain's commitment to return to the same fishing areas in order to study the inter-annual variability and maximize the tag recovery, enabling comparison of local abundance estimates generated by two different methods and to progress research in these SSRUs (58.4.1H, G, D and C).

Exploratory fishing on *Dissostichus* spp. stocks in the slope of the east coast of the Antarctic continent began in the year 2003 (30°E–150°E; Divisions 58.4.1 and 58.4.2 of CCAMLR). Since the 2004/05 season, only few SSRUs have been open to fishing which causes a circle where there is a lack of harvesting activities resulting in a lack of data for some of these SSRUs (58.4.2 B-C-D and 58.4.1B-D-F-H) and undermine tag recovery. On that scenario a multi-year research survey have been proposed for these two divisions, with the aim of obtaining information to better understand the population dynamics of both species of

*Dissostichus* in areas of the Antarctic continental slope, close to the Ross Sea and Banzare Bank, implementing the use of both local depletion models and simple Petersen tag-recapture estimates within areas described so as to estimate local abundance, mainly of *Dissostichus mawsoni*.

The IEO has started the age determination of TOA using otoliths from specimens of these divisions, and a preliminary Age-Length Key is already built with the otoliths obtained in the 2012/13 experience. This work, especially for regions with data-limited fisheries, is a priority in order to input catch at age data into the expected assessment

Collaboration with other members presenting other research proposals in these SSRUs is a priority.

Up to now, eight documents have been presented to the WG-FSA and WG-SAM in 2012, 2013 and 2014 namely WG-FSA-14/35, WG-SAM-14/09, WG-SAM-14/12, WG-SAM-13/12, WG-SAM-13/30, WG-FSA-13/15, WG-FSA-12/69 and WG-SAM-12/13, describing the proposal and the results considering the advice of previous Working Groups, Scientific Committee and our own adaptation to new befallen situations.

*b) Detailed description of how the proposed research will meet the objectives, including annual research goals (where applicable).*

In 2012 ,2013 and 2014, the WG-SAM, WG_FSA and SC- CAMLR have made a huge effort to improve the initial proposal in order to achieve the objectives of the CCAMLR decision rules .

According to the recommendations from the last two SC-CCAMLR-XXXIII (paragraph 3.199) and XXXII (paragraph 2.29, and the ANNEX 41-01/B of the CM for the 2014/15 season, the proposal envisages

- the highest priority is to return to the same areas where the depletion experiment were conducted over the last two seasons (defined by a circle of 10nm of ∅) allowing to compare the effect of the depletion between years and to maximize the tag recoveries.

- lines should be set close together to ensure that variability in CPUE observed can be attributed to local depletion rather than variation in toothfish density across an area.

- to continue the prospection in other locations within these four SSRUs, trying to cover across a range of depths to improve area-based estimation of biomass within fishable depths at the SSRU scale.

- in the research activities conducted in 2015/16, 50% of research lines could be set with less than 3 n miles separation. Once the depletion phase was commenced in the research activities conducted, research lines would be set with less than 3 n miles separation.

- otoliths obtained are used to determine the age by length and sex at the IEO laboratory.

At this stage it is early to proceed with a revision of the results as recommended by the WG-SAM-14 (Paragraph 5.100) due to the impossibility of conducting the proposed research in the last season (2014/15). *Rationale for research*

In 2011, the Scientific Committee recalled its recommendation to give the highest priority to the evaluation of *Dissostichus* spp. in data-poor fisheries and pointed out that in recent years little progress had been made in the assessment regarding data-poor exploratory fisheries of *Dissostichus* spp. The XXX-WG-SAM agreed that areas under conditions of limited data should be prioritized, in such a way that the potential for an assessment of the area within a reasonable timeframe is maximized.

## 2. FISHERY OPERATIONS

a) *Fishing Member:* Spain

*Vessel to be used:*

- *Vessel name* B/P TRONIO
- *Vessel owner* Pesquera Canaria 2004 S.L.
- *Vessel type* Commercial vessel
- *Port of registration and registration number* 3GC-1-2-05
- *Radio call sign* ECJF
- *Overall length and tonnage* 55 m – 1058 GT
- *Equipment used for determining position* VMS-c
- *Fishing capacity* 632 $m^3$
- *Fishing processing and storage capacity* 340 t

b) *Target species*: <u>*Dissostichus*</u> spp.

*c) Fishing or acoustic gear to be used:* Bottom longline Spanish type

d) *Fishing regions (divisions, subareas and SSRUs) and geographical boundaries*:
Division 58.4.1, SSRUs 58.4.1 C, D, G y H between 80ºE-150ºE, depth stratum 550-2000 m

e) *Estimated dates of entering and leaving the CAMLR Convention Area*:
Entry: November 2015
Exit: March 2016

## 3. SURVEY DESIGN, DATA COLLECTION AND ANALYSIS

***a) Research survey/fishing design (description and rationale):***

A summary is detailed next, regarding the last season proposal (SAM-14/09) slightly modified from the initial plan that couldn't be performed. In Anex I is presented the protocol to be provided to the vessel, as established in the previous proposals and used on-board routinely while surveying.

*Summary of the revised Spanish research proposal for the 2015/16 season*

The only change to the previous proposal (WG-FSA-14/35) is the one that includes the suitability of setting to less than 3nm separation the setting of the lines when the depletion phase is started, as advised by SC-CCAMLR-XXXIII, Annex 7, paragraph 5.99 "*It further noted that lines should be set close together to ensure that the variability in CPUE observed can be attributed to local depletion rather than variation in toothfish density across an area*".

Research fishing shall be carried out subject to the operational capacity of the proposed Spanish vessels and ice conditions. The proposal will start once their activities in the exploratory fisheries in the Subareas 88.1 and 88.2 are finished.

The research fishing protocole is :

- Lines will be set within a depth interval of 550 and 2000 m. The deeper depth is not regulated. .
- Minimum duration (soaking time) of the set will be 6 hours
- A maximum number of 5 000 hooks per set.
- Depletion fishing shall start when the CPUE of the initial cluster of stes is greater than 0.3 kg/hook
- Tag rate of 5 toothfishes by retained ton and tag-size overlap greater than 60%.
- Catch limit established was 42t by SSRU.
- 50% of research lines could be set with less than 3 n miles separation. Once the depletion phase was commenced in the research activities conducted, research lines would be set with less than 3 n miles separation

- *Spatial arrangements or maps of stations/hauls*

Phases I, II, III y IV of the proposal (Figure 1) have been partially made in the 2012/13 and 2013/14 seasons.

The highest priority is to return to the same SSRU's already prospected in previous seasons. Adjacent areas within these SSRUs will be prospected trying to cover all depth strata. Both vessels will never work at the same time in the same SSRU because of the limited allowable catch This season there is not expectation to progress to the phase V and VI. The priority is to prospect the same SSRUs surveyed lately.

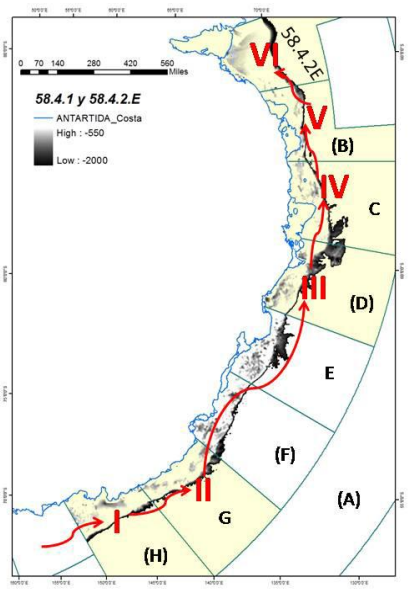
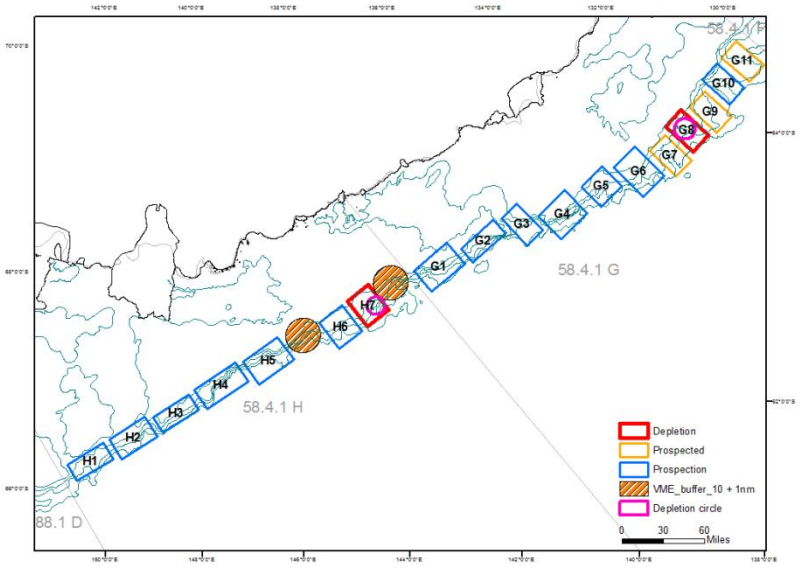



**Figure 1. Sequence of the multiyear proposal (I a VI).**

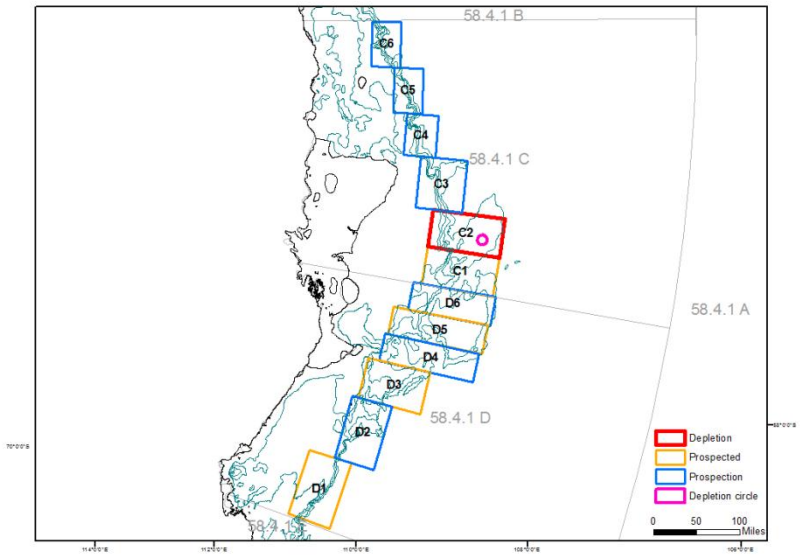
Figure 2 shows the maps with the planning of sets.The survey will start in the first available rectangle from the H1 (the ice extent prevented it in the two previous surveys). During the 2013/14 season, these plan had to be inverted due to the ice condition in this SSRU, but following with the commitment to return to this locations later in the research when the ice cover had decreased.

The priority is to survey the three locations where the depletion experiment was held previously (in rose), inside the compulsory research rectangles (red). It is expected to cover adjacents locations, as well as, shallower depths (between 550 y 800m). The minimum numbers of sets in these three priority areas will be 5, when the established catch threshold is not reached.

Depending on the ice extent, the survey will prospect the remaining rectangles in yellow (already prospected) and in blue (not prospected). The prospection phase consists of a cluster of sets (3-6) following the protocol outlined before.




a)




b)

**Figure 2. Prospection plan, SSRUs 58.4.1 H and G (a) and 58.4.1D and C (b).**

- *Stratification according to e.g. depth or fish density*

A special focus to conduct research fishing in shallower waters (550-800m), highlighted in Figure 3 will be made. Within SSRUs 58.4.1C and D we have not detected large fishing locations inside this shallower stratum, but those depths will be prospected when available.

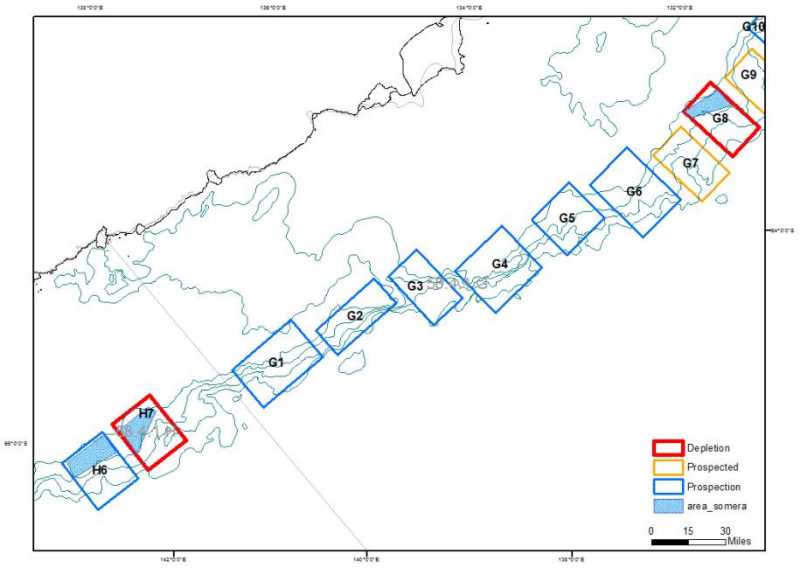



**Figure 3. Prospection rectangles in SSRUs 58.4.1H and G. Shallower location are highlighted.**

- *Calibration/standardisation of sampling gear*

The maximum number of hooks by set are 5000. All sets have the same length and configuration.

- *Proposed number and duration of stations/hauls*

It is intended to prospect as much rectangles as possible. The prospection phase is made by cluster of sets (3-6 sets). Once the mean CPUE is calculated, if it is greater than 0.3 k per hook, the depletion experiment will be held, otherwise a new cluster of prospecting sets will be made at a different location.

The end of the survey might be due to three reasons:

1. The maximum catch limit is reached in a given SSRU
2. The fuel is on the limit for the trip back.
3. The ice coverage prevented from continuing the research.

- *Tagging rates and other performance metrics such as tag overlap statistics for tagging programs*

The tagging rate is 5 individuals of *Dissostichus* spp per ton (green weight). All double tagged. The size overlap should be above 60%.

In the table below is a detail of the number of toothfish tagged during the two seasons researched and the recoveries made in 2013/14 season.

**Number of tags and recaptures by year and SSRU**

| *SSRU* | *Tagging year* | *Number tagged* | *Within-season recoveries* | *Between season recoveries* |
|---|---|---|---|---|
| 58.4.1C | 2014 | 281 | 2 | 1(other vessel) |
| 58.4.1D | 2014 | 29 | 0 | 0 |
| 58.4.1G | 2013 | 120 | 0 | 0 |
| | 2014 | 139 | 0 | 0 |
| 58.4.1H | 2013 | 111 | 0 | 0 |
| | 2014 | 85 | 0 | 3 |

Preliminary information about data-recoveries in the 2014/15 season in the 58.4.1 division seems that no fish tagged by the Tronio has been recaptured by any vessel.

Revisiting the same locations will allow more recaptures of tagged fishes, as far as the survey progress.

- *Other requirements.*

The IEO and the vessel will be in a permanent contact when the survey begins. Unexpected contingencies will be solved in a consensus according to the current conservation measures.

***b) Data collection: Types and sample size or quantities of catch, effort and related biological, ecological and environmental data***

The observer sampling requirements are the same detailed in the Observer Sampling Requirements (Conservation Measure 41-01, Annex 41-01/A)

**c) *Method for data analysis to achieve the objective in 1(a).***

This research design combines aspects of prospecting phase and also the tag-recapture phase, requiring that the vessel return to the locations that they fished before. The data collection and the methods to analyze are described in the WG-FSA-12/69 document.

Using the method of Leslie (Leslie and Davis, 1939), densities of *Dissostichus* spp. in the research survey areas will be estimated assuming a lineal correlation to CPUE. The application of this correlation to the total fished area in each SSRU would allow for the calculation of the total biomass for the species in the area surveyed.

The only direct experience before this, aimed to cause a localised reduction in fish abundance in CCAMLR management area, has been the one described in Parkes *et al*. (1996), performed in a CCAMLR experiment during the 1993/94 season. This experience was held during the season 1993/94 in Subarea 48.3 and it has been unsuccesful because local depletion did not regularly occur. Despite some doubt as to the general applicability of the depletion model to longline fisheries on the scale of single vessels operating in localised areas, they think that there are some variation between localities and it may be that there is greater potential for applying the method in some areas than others.

These models have been used in numerous occasions in CCAMLR areas mostly as an alternative assessment model for stocks of *Dissostichus* spp., where data or long-term time-

series are not available as well as outside CCAMLR convention area (Agnew et al.,2009; Agnew D. and Pierce J., 2004; McKinlay et al., 2008; Parkes et al., 1996).

***d) How and when will the data meet the objectives of the research (e.g. lead to a robust estimate of stock status and precautionary catch limits). Include evidence that the proposed methods are highly likely to be successful. .***

In a yearly base the local abundance of Antarctic toothfish will be estimated in every location where the depletion experiment has been held. The following years the data from the new revisited locations as well as the new prospected ones will be added to the results.

By the end of the 2015/16 survey, subject to the recoveries of tagged toothfish, estimates of local biomass by the simple Petersen model of tag-recapture will be applied.

The two implemented surveys have allowed the preliminary estimation of local biomass using the depletion model in three of the four prospected SSRUs (58.4.1H, G y C).

The main difficulties in the process have been:

1. The access to some areas due to the ice extent. Changes on dates have solved partially the problem as far as the ice coverage was lower by the end of the survey (even that strong winds present).

2. The IUU fishing in SSRU 58.4.1D. The Spanish presence in the area forced to flee the IUU vessel.

3. Duration of the survey and fuel consumption limiting the work.

All the unexpected problems were solved as far as possible and the data obtained are highly valuable for the use in the future assessment.

Due to the technical problems during the last season, the tentative schedule must to be run for one year. It is expected to have a robust stock assessment by the end of the 2017/18 season. To the present a preliminary Age-Length Key using otoliths from the first research survey (2012/13 season) has been built. Readings from the 2013/14 otoliths is in progress.

| | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | 2017/18 |
|---|---|---|---|---|---|---|
| Estimation of local abundance in SSRUs with Leslie's depletion method. | | | | | | |
| 58.4.1H | X | X | | X | X | X |
| 58.4.1G | X | X | | X | X | X |
| 58.4.1D | | X | | X | X | X |
| 58.4.1C | | X | | X | X | X |
| 58.4.1B | | | | X | X | X |
| 58.4.2E | | | | X | X | X |
| Estimation of local abundance in SSRUs with Petersen's simple estimator (tag/recapture data) | | | | | | |
| 58.4.1H | | | | | X | X |
| 58.4.1G | | | | | X | X |
| 58.4.1D | | | | | X | X |
| 58.4.1C | | | | | X | X |
| 58.4.1B | | | | | | X |
| 58.4.2E | | | | | | X |
| *D.mawsoni* age estimation of otoliths. Length-age keys | | | | | | |
| 58.4.1and 58.4.2 | | | X(Preliminary) | X | X | X |

## 4. PROPOSED CATCH LIMITS

*a) Proposed catch limits and justification*

The catch limits proposed is **42t** per proposed SSRU (SSRU 58.4.1H, G, D and C
In the SSRUs 58.4.1G y H is highly unlikely to be achieved this catch limit according to the previous experience (the maximum catch has been 24t in the SSRU 58.4.1G).

*b) Evaluation of the impact of the proposed catch on stock status*

It is considered that this catch level has no negative effect for the stock of *Dissostichus* spp., both locally and in general.

On the other hand, the high levels of IUU fishing notified for Division 58.4.1 in previous seasons and the sightings of a vessel and settled gillnets the last season is a matter of profound concern. The probability of detecting these vessels would increase with the number of legal vessels present, and would give an idea of the incidence of IUU activies in the area, likely discouraging them.

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

The fishing method proposed (Spanish bottom longline) has a low bycatch incidence in other species such as macrourids.

According to data from these Divisions, the main bycatch species or taxonomic groups are:

- *Macrourus* spp.

- *Antimora* rostrata
- Channichthyidae
- *Muraenolepis* sp.
- Notothenidae
- *Pogonophryne* spp.
- Rajiformes

It is thought that the low catch level proposed has no negative effect for the population of these species.

## 5. RESEARCH CAPABILITY

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

The planning, tracking and analysis of the obtained information will be made by the *Centro Oceanográfico de Canarias* of the *Instituto Español de Oceanografía* (IEO). Researchers in charge are: Roberto Sarralde Vizuete (IEO representative at WG-FSA) and Luis J. López Abellán (IEO representative at the CCAMLR-SC).

*b) Number of scientists and crew to be on board the vessel.*

Scientific duties will be made by the observers nominated for the exploratory fisheries in subareas 88.1 and 88.2. Spanish observers are experimented biologists.

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

There is not possibility to invite other scientists. The vessel will start the survey following the exploratory fishery in the 88.1 Subarea. There is not provided any port entry.

*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 vessel and the Spanish observer on board have a long experience in CCAMLR fisheries; and he has participated in the two previous researches in this Division.

## 6. REPORTING FOR EVALUATION AND REVIEW

Spain is committed to evaluate progress in relation to the objectives of the survey and the time frames mentioned in the original survey. Possible modifications to the work plan, as dictated by the ongoing experience, would be discussed at the annual meetings of WG-SAM and WG-FSA.

It is intended to prepare a report including the combined results of the two previous research cruises already conducted, including the request made by the SC-CCAMLR_XXXIII Annex 7, paragraph 5.100 to be presented to the WG-SAM-16.

The research plan would be subject to the operational needs of the vessel at all times.

## 7. REFERENCES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Parkes, G., C.A. Moreno, G. Pilling and Z. Young. 1996. Use of the Leslie stock depletion model for the assessment of local abundance of Patagonian toothfish (*Dissostichus eleginoides*). *CCAMLR Science*, 3: 55–77.

Sarralde R., L.J. López-Abellán and S. Barreiro, 2012. Revised research plan for the Spanish exploratory longline fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2: Fundamentals and procedures (this is a revision of WG-SAM-12/13). CCAMLR, WG-FSA-12/69.

ANNEX I

# PROTOCOLO DE TRABAJO EN LA DIVISIÓN 58.4.1. Temporada 2013/14

Probablemente la campaña de investigación de 2014 se inicie en las UIPEs 58.4.1D o 58.4.1C debido a la presencia de hielo en las UIPEs 58.4.1H y 58.4.1G .

En este caso, se han generado rectángulos en cada una de estas UIPEs (**Figura 1**). Los 4 vértices de cada rectángulo se detallan en la tabla inferior. En todos ellos habría que realizar lances de prospección, es decir, si la experiencia empieza en el rectángulo C2 y se quiere seguir hasta el C6, es imprescindible hacer al menos un conjunto de lances cortos de prospección (5 habitualmente) en cada uno de los rectángulos definidos (C3, C4 y C5). Igualmente al avanzar hacia las UIPEs 58.4.1G y 58.4.1H, habría que realizar lances en los D1, D2, D3…

La activación del **protocolo de agotamiento** es el mismo del año pasado:

El conjunto de los 5 lances cortos iniciales debe tener un CV aproximado o inferior al 30% y la captura media de los lances largados el mismo día tiene que ser superior a 0.3 Kg por anzuelo. Una vez activado el proceso de agotamiento se deberán hacer un mínimo de 10 lances y nunca se deberá abandonar la experiencia si el nivel de significación p no es menor de 0.05.

Hay que intentar realizar los subsiguientes lances lo más cercanos a este primer conjunto y sobre los mismos, a ser posible atravesándolos y **NO expandirse en paralelo** por todo el área **sin reincidir en la zona ya pescada**. Hay que tratar de cubrir el máximo de área, separando inicialmente los lances y a la vez reincidir posteriormente en las zonas ya pescadas.

Se debe intentar cubrir todo el rango de profundidades entre 550 y 2000 m. Si no puede ser de una sola vez, de dos o las que sean necesarias para cubrir todo el rango. Una opción sería afrontar las pescas por estratos (p.ej. 550-800 m y 800-2000 m) y trabajar en cada estrato de forma independiente. En círculos amarillos aparecen algunas áreas más someras (550-800 m) en las que es probable que se puedan realizar las pescas.

Una vez que se vaya abriendo el hielo, habrá que regresar a las UIPEs 58.4.1G y 58.4.1H para continuar con la experiencia del año pasado e intentar recuperar el máximo nº de marcas (**Figura 2**). Es obligatorio realizar pescas en los rectángulos en rojo (H7 y G8) y recomendable hacerlos en los que se visitaron el año anterior (G11, G9 y G7). Si este año el hielo lo permite, se deben seguir prospectando las áreas que el año pasado no se pudieron visitar debido a la presencia de hielo.

Se debe extremar la atención para la detección de marcas en los ejemplares capturados, tanto en el momento de captura como durante el procesado.

El marcado debe ser rápido, procurando minimizar el impacto en los ejemplares durante todo el proceso.

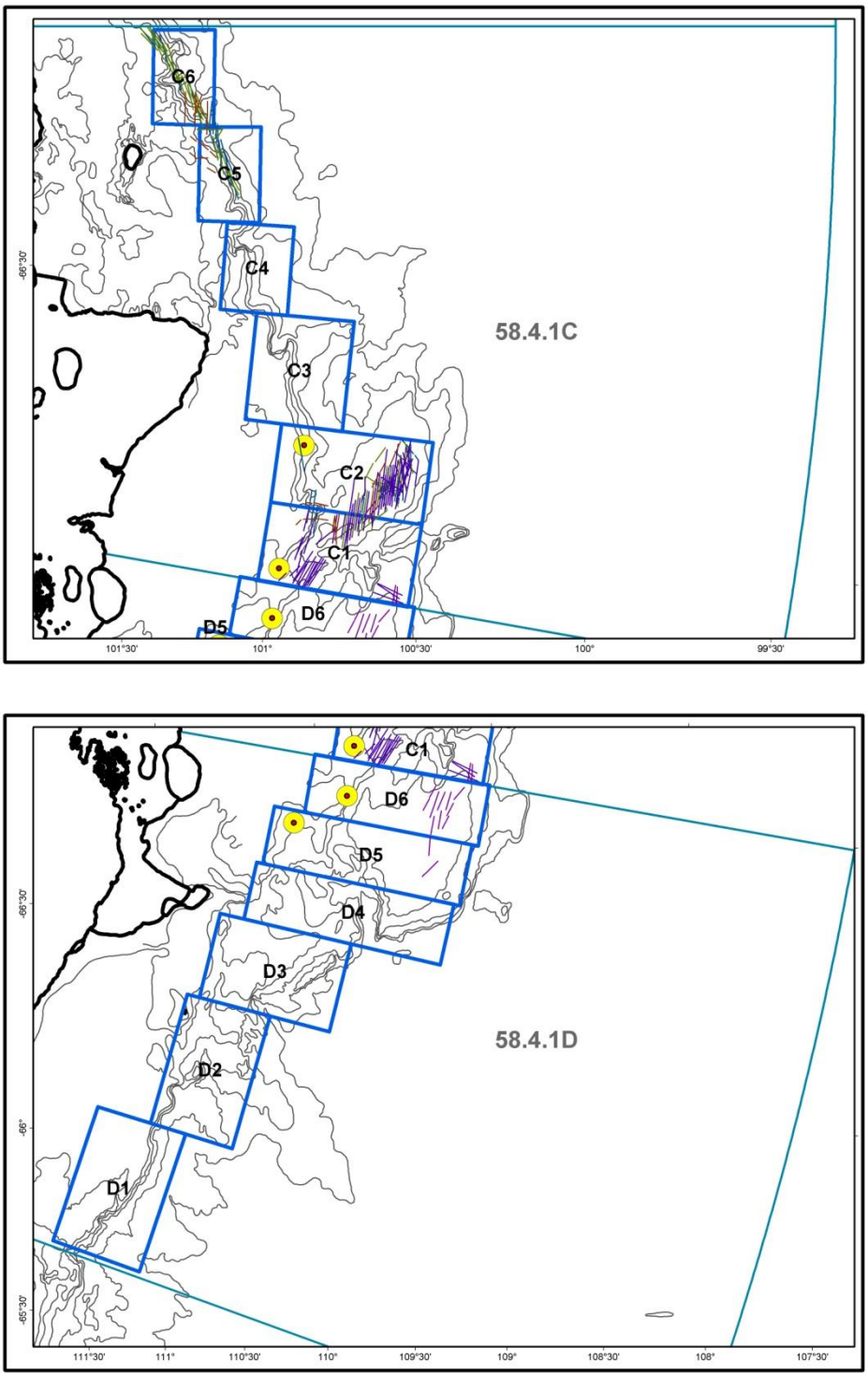


Figura 1.- Localización de los rectángulos en las UIPEs 58.4.1 D y C. Los círculos amarillos muestran las posibles localizaciones en las que se pueden realizar lances más someros. Se incluyen también los lances históricos de buques españoles en la zona.

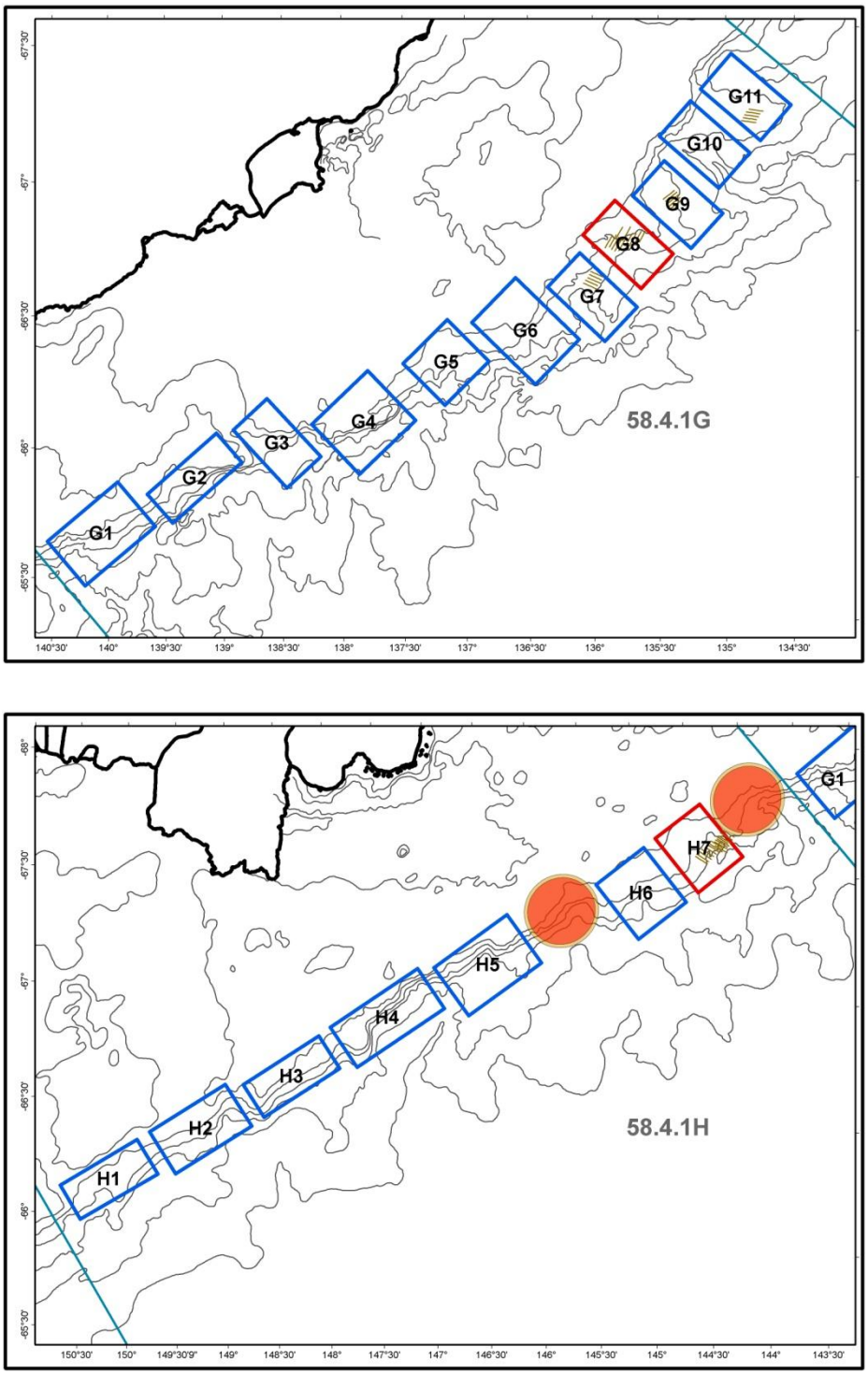


Figura 2.- Localización de los rectángulos en las UIPEs 58.4.1G y H. En la UIPE H hay dos áreas en las que está prohibida la pesca por presencia de Ecosistemas Marinos Vulnerables (círculos naranja). Se incluyen los lances realizados en la temporada 2012/13. Los rectángulos en rojo son de visita obligada.

| Vértices Rectangulos | V1 | V2 | V3 | V4 |
|---|---|---|---|---|
| D1 | 109°53'20.463"E 65°33'1.944"S | 109°53'16.902"E 64°48'2.849"S | 107°15'11.414"E 64°47'58.02"S | 107°14'22.759"E 65°33'3.859"S |
| D2 | 107°13'53.103"E 65°5'55.851"S | 107°14'11.116"E 64°24'0.814"S | 104°45'50.43"E 64°24'2.533"S | 104°45'28.099"E 65°5'59.233"S |
| D3 | 104°45'18.014"E 65°0'3.805"S | 104°45'33.528"E 63°53'45.65"S | 103°9'46.561"E 63°54'1.208"S | 103°10'17.987"E 64°59'54.882"S |
| D4 | 103°10'5.453"E 64°48'2.822"S | 103°10'26.865"E 63°8'46.73"S | 102°6'44.253"E 63°9'1.476"S | 102°6'37.293"E 64°47'59.304"S |
| D5 | 102°6'0.546"E 64°44'50.351"S | 102°6'9.705"E 63°5'51.85"S | 101°2'44.051"E 63°5'55.626"S | 101°2'44.702"E 64°45'2.781"S |
| D6 | 101°2'23.394"E 64°29'53.538"S | 101°2'20.071"E 63°2'53.429"S | 99°58'44.344"E 63°3'4.881"S | 99°59'19.656"E 64°30'0.508"S |
| C1 | 99°58'52.11"E 64°21'16.809"S | 99°58'45.101"E 63°6'8.621"S | 98°34'3.506"E 63°5'59.303"S | 98°33'51.12"E 64°20'58.788"S |
| C2 | 98°33'48.556"E 64°20'51.027"S | 98°33'31.008"E 63°6'1.647"S | 97°8'57.507"E 63°6'11.084"S | 97°9'1.686"E 64°21'9.944"S |
| C3 | 97°8'41.13"E 64°38'50.756"S | 97°8'47.376"E 63°50'50.427"S | 95°12'9.222"E 63°51'2.71"S | 95°12'14.861"E 64°39'7.644"S |
| C4 | 95°12'4.101"E 64°56'58.923"S | 95°11'32.356"E 64°24'3.389"S | 93°36'39.128"E 64°23'58.102"S | 93°36'19.826"E 64°56'59.129"S |
| C5 | 93°36'34.119"E 65°11'6.812"S | 93°33'47.528"E 64°40'57.045"S | 91°49'26.819"E 64°42'38.044"S | 91°51'37.172"E 65°12'40.033"S |
| C6 | 91°49'44.204"E 65°35'48.544"S | 91°49'37.539"E 65°5'38.386"S | 90°3'34.121"E 65°5'53.361"S | 90°3'38.419"E 65°35'47.017"S |
| G1 | 139°49'20.422"E 65°35'57.562"S | 139°49'22.049"E 65°18'19.757"S | 138°45'47.056"E 65°18'5.761"S | 138°44'59.326"E 65°35'37.212"S |
| G2 | 138°35'9.771"E 65°27'0.973"S | 138°35'7.742"E 65°15'14.775"S | 137°31'32.531"E 65°15'2.05"S | 137°30'57.189"E 65°26'45.196"S |
| G3 | 137°20'37.61"E 65°23'54.124"S | 137°20'16.781"E 64°59'58.375"S | 136°48'54.252"E 65°0'3.909"S | 136°48'51.933"E 65°23'56.489"S |
| G4 | 136°38'18.924"E 65°8'52.297"S | 136°37'40.512"E 64°48'2.322"S | 135°44'59.634"E 64°48'3.821"S | 135°45'1.744"E 65°8'56.961"S |
| G5 | 135°23'47.203"E 65°3'0.683"S | 135°23'23.636"E 64°45'0.778"S | 134°41'17.642"E 64°45'1.55"S | 134°41'11.364"E 65°3'1.503"S |
| G6 | 134°30'35.865"E 64°57'0.637"S | 134°30'18.594"E 64°30'1.54"S | 133°48'16.205"E 64°30'0.166"S | 133°48'3.185"E 64°56'53.18"S |
| G7 | 133°37'38.248"E 64°47'54.516"S | 133°37'18.309"E 64°24'3.369"S | 133°5'34.743"E 64°48'0.831"S | 133°5'28.062"E 64°47'57.635"S |
| G8 | 132°55'11.059"E 64°51'3.124"S | 132°54'56.181"E 64°27'8.474"S | 132°23'31.992"E 64°27'4.428"S | 132°23'3.7"E 64°50'58.799"S |
| G9 | 132°12'38.668"E 64°47'55.198"S | 132°12'28.526"E 64°24'2.757"S | 131°40'53.255"E 64°24'0.164"S | 131°40'47.01"E 64°47'59.126"S |
| G10 | 131°30'1.944"E 64°54'0.186"S | 131°29'50.023"E 64°30'6.969"S | 130°58'20.369"E 64°30'0.283"S | 130°58'9.284"E 64°53'56.798"S |
| G11 | 130°47'29.305"E 64°53'54.865"S | 130°47'30.283"E 64°29'54.6"S | 130°16'3.046"E 64°30'5.407"S | 130°15'48.647"E 64°53'53.774"S |
| H1 | 149°44'5.945"E 66°2'59.449"S | 149°44'1.171"E 65°51'2.124"S | 148°40'32.704"E 65°50'45.621"S | 148°40'27.41"E 66°2'59.089"S |
| H2 | 148°29'48.69"E 66°2'57.744"S | 148°29'46.291"E 65°48'1.719"S | 147°26'0.74"E 65°48'2.573"S | 147°26'4.695"E 66°3'1.312"S |
| H3 | 147°15'22.358"E 65°59'58.116"S | 147°15'26.467"E 65°48'13.874"S | 146°11'44.874"E 65°48'2.197"S | 146°11'16.131"E 65°59'42.469"S |
| H4 | 146°1'7.752"E 65°59'56.839"S | 146°1'1.744"E 65°45'24.281"S | 144°46'47.397"E 65°45'2.097"S | 144°46'9.152"E 65°59'34.516"S |
| H5 | 144°36'11.801"E 65°56'56.744"S | 144°35'47.092"E 65°38'59.781"S | 143°32'26.024"E 65°39'3.205"S | 143°32'7.416"E 65°56'58.328"S |
| H6 | 142°28'43.659"E 65°48'0.36"S | 142°28'19.368"E 65°27'4.816"S | 141°46'16.638"E 65°27'4.348"S | 141°46'5.165"E 65°47'59.926"S |
| H7 | 141°35'41.931"E 65°47'53.07"S | 141°35'30.704"E 65°27'0.136"S | 140°55'39.455"E 65°26'59.356"S | 140°56'4.722"E 65°47'40.812"S |

| Centro Circulos Amarillos | Zonas más someras |
|---|---|
| D5 | 101°16'19.552"E 64°34'11.424"S |
| D6 | 100°38'12.758"E 64°10'56.857"S |
| C1 | 99°42'41.248"E 64°11'58.806"S |
| C2 | 97°30'13.496"E 64°8'51.161"S |