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Southern Indian Ocean Fisheries Agreement
Accord relatif aux Pêches dans le Sud de l'Océan Indien

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Characterization of the European Union and French Overseas Territories toothfish fishery on Del Cano and the Southern SW Indian ridge in SIOFA statistical area 3-b

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Abstract	
This report includes a characterization of the Del Cano and the Southern SW Indian ridge toothfish fisheries from the EU Member States (Spain) and French Overseas Territories (FR-OT) active in SIOFA during the period 2000-2022.	

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1. Introduction

The part of the del Cano Rise located in the SIOFA convention area (statistical area 3-b) is bounded between -44°S and -45°S, and the adjacent EEZ to the east of the French Exclusive Economic Zones (EEZ) at Crozet Islands (CI) and to the west of African exclusive economic zone (EEZ) at the Prince Edward Islands (PEI, CMM 2021/15). On the Crozet Plateau, one fishery for TOP is located in CCAMLR Division 58.6 covering the CI shelf slope and in the Eastern part on the del Cano Rise³. On the PEI Plateau, the TOP fishery is located in CCAMLR divisions 58.7, 58.4.4a and in the Western part on the del Cano⁴.

The del Cano Rise area has been subject to intermittent fishing effort targeting TOP since 2003. While the fishing activity in the area was very limited in the first years, the area has known two episodes of more intense fishing between 2009-2013 mainly from Korean fishing vessels and 2017-2019 from EU-Spain. FR-OT and Japan have also an historical activity this area (Sarralde et al. 2020).

Management measures were put in place in response to the fishing activity in 2017-2019 in CMM 2019/15 and have since largely remained unchanged (CMM 2021/15). The measures include catch limits as well as data collection requirements:

- The total annual toothfish catch limit is 55 tonnes;
- Longlines shall not exceed 3000 hooks per line and shall be set at minimum 3 nautical miles from each other;
- Toothfish need to be tagged and released at a rate of at least 5 fish per tonne green weight caught, with a minimum size overlap statistic of at least 60% once 30 or more toothfish have been caught;
- Each vessel participating in the fishery needs to have at least one scientific observer on board throughout all fishing activities, with a target of observing 25% of hooks hauled per line over the duration of the fishing deployment;
- Vessels are encouraged to not haul longlines in the presence of killer whales (*Orcinus orca*) and are discouraged from hauling longlines in presence of any odontocete (toothed) whales to mitigate depredation.

The Project Stock structure of Patagonian toothfish (*Dissostichus eleginoides*) SER2022-TOP2 funded under an EU Grant agreement with SIOFA aims at providing advice to the SIOFA Scientific Committee on the stock structure of Patagonian toothfish in the SIOFA Area and on appropriate spatial management units for SIOFA to use in future monitoring and stock assessments of Patagonian toothfish. Data presented in this report should be considered as a partial input to this project as it does not reflect the whole Patagonian toothfish fishery in the SIOFA area.

This report includes a characterization of the del Cano Rise and the Southern SW Indian ridge toothfish fisheries from the EU Member States (Spain) and French Overseas Territories (FR-OT) active in SIOFA during the period 2000-2022.

³ For details see [Fishery Report 2021: *Dissostichus eleginoides* at Crozet Island French EEZ \(Subarea 58.6\) \(ccamlr.org\)](#)

⁴ For details see [Fishery Report 2021: *Dissostichus eleginoides* at Prince Edward Islands South African EEZ \(Subarea 58.7 and part of Area 51\) \(ccamlr.org\)](#)

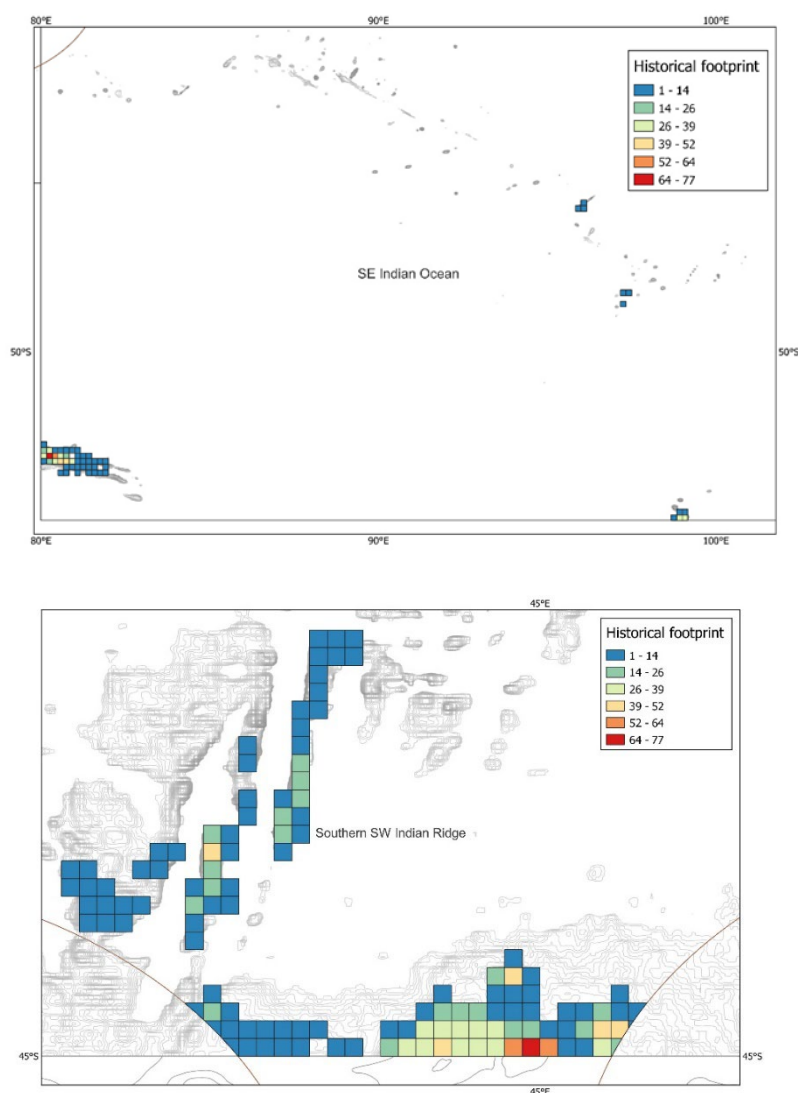
1.1 Description of fisheries

EU-Spain Fishery⁵

The first evidence that we have of Spanish fishing for Patagonian toothfish (*Dissostichus eleginoides*) in the southern part of the SIOFA convention area was an experimental fishery that took place from 28 June to 27 July 2003, in the Del Cano Rise. Results of this experience were presented in a CCAMLR Science document (López-Abellán, 2005). In 2004 and 2007, some minor fishing activity also occurred in this area.

From April 2015 to the present the main gear system is the Mustad autoline, that is used every year by the only operating vessel in the area except 2018 when a second vessel has participated using the bottom longline Spanish system (Figure 1).

Since 2017, the Spanish fishing activity targeting toothfish in the Del Cano Rise increased and a new fishing ground was prospected in the SIOFA Area (Williams Ridge), near the Kerguelen Plateau. A SIOFA working document presenting a preliminary Patagonian toothfish population analysis to the Stock Assessment and Ecological Risk Assessment Working Group was presented at SERAWG1 in 2019 (Sarralde & Barreiro, 2019) and SERAWG2 in 2020 (Sarralde et al. 2020).



⁵ Further information can be found in the EU-Spain annual National Reports and the BFIA document.

Figure 1 Spanish footprint area 7 (top) and 3b (bottom).

The approximate fishing area in Del Cano (and North) is about 10455km².

Description of the Mustad Autoline system:

The gear has a GPS beacon and flashing light. There are four or five buoys in each tip and each buoy has reflective strips. The downline, which is the vertical section of line buoyed at the surface, is connected to a weight or a number of weights such as chains or grapnels at the beginning or end of the backbone that drives them to the bottom. The length of the downline is usually determined by the fishing depth, the weather or the local current strength.

The mainline or backbone is the main section, which extends horizontally along the bottom and is where the snoods and the hooks are attached. The backbone has an integrated weighted line (IWL) that has lead embedded in the core to assist sinking as a seabird mortality mitigation measure.

A magazine is the unit of line measurement, generally comprising six or seven segments of the backbone (between 700 and 1000 hooks). These magazines are stored in an aluminium line, holding the hooks, snoods and backbone. The snoods are about 47 cm long and are made of nylon. Between the hook and the braid there is a string of wire of about 13 cm long, making the snood more resistant.

When the main line is released, it is automatically baited. Hooks on magazines or segments are baited alternately with the two bait species, mackerel, and squid. The hauling time to get the line to the surface depends on the depth. When targeting TOP it is usually around one hour.

The mean setting time is about 1.3 hours and the hauling time 7 hours. In the water there are usually between 3 and 4 lines simultaneously, but it depends on the sea conditions. The minimum soak time is about 12 h.

FR-OT Fishery⁶

A limited number of FR-OT vessels active in the Eastern part of the del Cano Rise situated in the French EEZ operate in the Del Cano area each year and participate also in the SIOFA fishery (Table 1, Figure 2). The only exceptions are the years 2016 and 2018, in which no FR-OT vessels participated in the SIOFA fishery.

In the recent years, catches have fluctuated from a maximum of 11.62 t in 2022 to a minimum of 4.97 t in 2021, in part due to the introduced catch limits and high removals in the 2017-2019 period.

Fishing activity occurs primarily in sufficiently shallow habitats along the del Cano Rise and seamounts, although activity on the Southern SW Indian Ridge seamounts stopped in 2014.

⁶ Further information can be found in the FR-OT annual National Reports and the BFIA document.

Table 1 Fishing season, toothfish catch limits, and toothfish catch, number of hauls, number of active fishing vessels, and deployed fishing gear type on del Cano Rise.

Season	Catch limit (t) del Cano Rise	Toothfish catch (t) del Cano Rise	Effort Nb. Hauls	Toothfish catch (t) outside del Cano Rise	Effort Nb. Hauls outside del Cano Rise	Nb. Longline vessels	Fishing gear
2022	55	11.620	80	—	—	1	Autoline
2021	55	4.497	54	—	—	1	Autoline
2020	55	5.220	46	—	—	2	Autoline
2019	—	9.638	41	—	—	1	Autoline
2018	—	—	—	—	—	0	Autoline
2017	—	7.610	26	0	7	2	Autoline
2016	—	—	—	—	—	0	Autoline
2015	—	17.800	68	—	—	2	Autoline
2014	—	12.144	71	1.365	32	1	Autoline
2013	—	14.859	86	1.121	40	2	Autoline
2012	—	18.913	67	15.624	100	2	Autoline
2011	—	19.130	68	2.956	12	2	Autoline
2010	—	9.498	31	1.655	11	2	Autoline

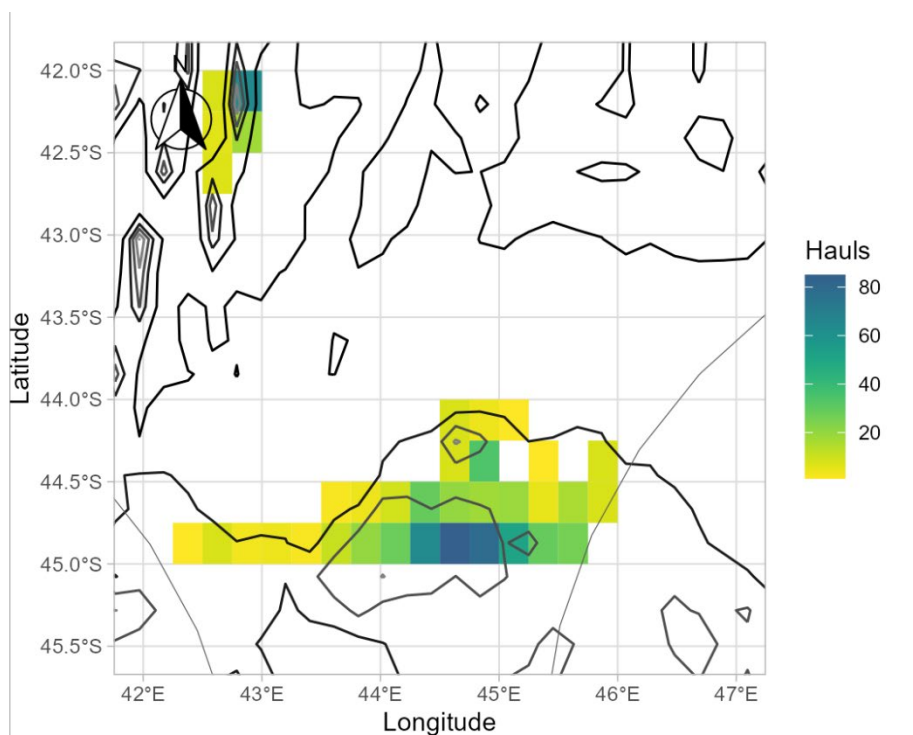


Figure 2 Spatial distribution of fishing activity in Del Cano Rise in SIOFA Statistical Area 3b since 2010. Resolution 25'x25' cells.

2. Data and methods

2.1 EU-Spain Fishery

Scientific observers on board trained by the Spanish Institute of Oceanography (IEO) have collected samples and biological data. The observer tasks followed the same protocol as that used by the observers of the CCAMLR scientific information system. Before the SIOFA agreement was in place, these activities were reported to CCAMLR in 2005. After the entry into force of the SIOFA agreement in 2012, reports have been submitted to both SIOFA and CCAMLR.

The scientific observers (Biologist or Marine Science degree) are trained at the *Instituto Español de Oceanografía*, specific training is also adapted for all fleets that are monitored.

Since the entry into force the CMM 2020/15, scientific observers are deployed throughout all fishing activities targeting TOP. Reports on the scientific observations and information on toothfish recaptures were prepared and provided to SIOFA Secretariat.

Table 2 Summary of Observer data provided to the SIOFA Secretariat

Sp	Scientific_name	year	Num	min	max	mean
TOP	Dissostichus eleginoides	2017	2413	36	187	80.1
TOP	Dissostichus eleginoides	2018	4096	36	188	92.2
TOP	Dissostichus eleginoides	2019	4596	41	187	85.5
TOP	Dissostichus eleginoides	2020	4882	38	180	88.1
TOP	Dissostichus eleginoides	2021	2258	39	156	80.4
TOP	Dissostichus eleginoides	2022	2870	38	160	83.8

Data from the EU-Spain fleet are reviewed searching for outliers on catch and effort data; species names; and fishing set position errors. In the periods where scientific observation is available, data from the vessels are contrasted with the observer's data.

Vessels are also controlled through VMS positioning system.

2.1 FR-OT Fishery⁷

Scientific observers are present on all fishing activities targeting TOP in the SIOFA area following the protocols used by the observers in the CI EEZ that are consistent with SIOFA and CCAMLR scientific information system.

The following analysis is based on FR-OT operational and observer data collected from 2011 to 2022.

The operational data included 842 records of hauls and trip identifiers; gear type (demersal longline); set start date latitude and longitude; haul start date latitude and longitude; start and end fishing depth; longline hook numbers; and toothfish catch weight and numbers.

Observer collected data included 2715 records of specimen and haul identifier; set start date latitude and longitude; haul start date latitude and longitude; longline hook numbers and length; and specimen length, weight, sex and maturity.

⁷ Further information can be found in the following document:

<https://siofa.org/sites/default/files/documents/meetings/WHOP1-INFO-06-French-Observer-program.pdf>

Following CMM 2021/15, a fishing season is defined as starting on December 1st and ending on November 30th of the following year.

3. Catch trends and distribution

3.1 EU-Spain Fishery

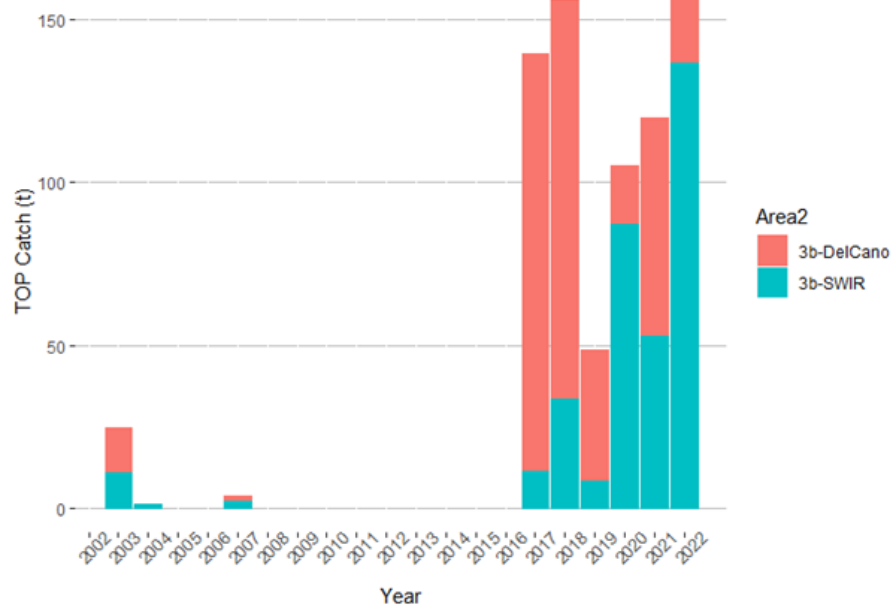


Figure 3 Catch of Patagonian toothfish between 2003 and 2022 in DelCano and SWIR.

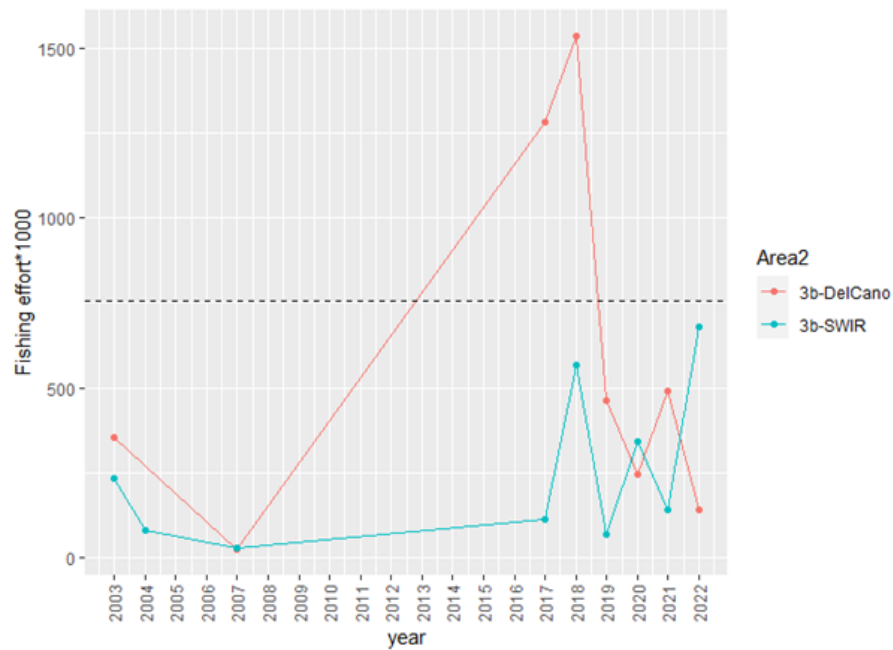


Figure 4 Fishing effort (*1000 hooks) of Patagonian toothfish between 2003 and 2022 in DelCano and SWIR.

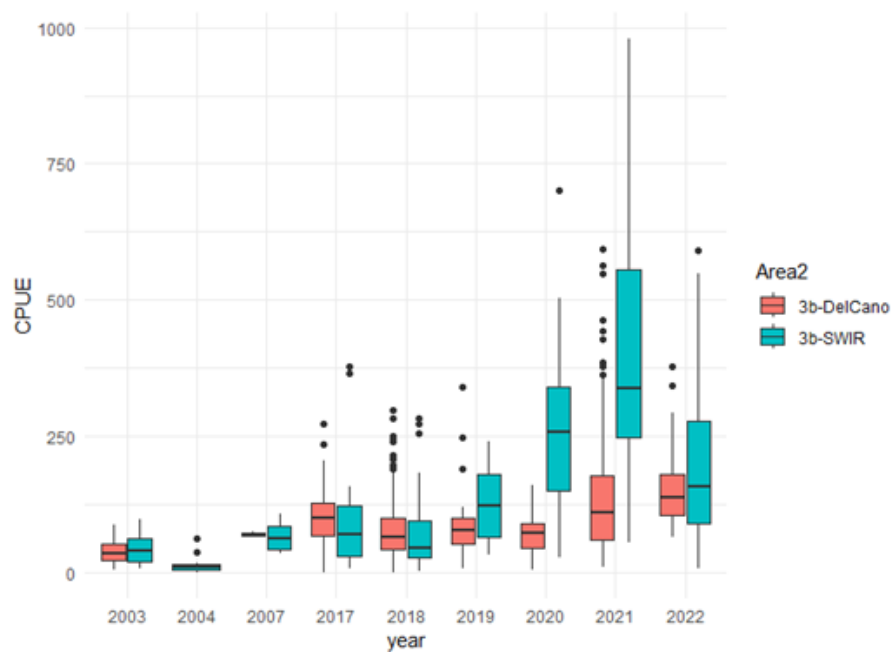


Figure 5 CPUE (k/1000hook) of Patagonian toothfish between 2003 and 2022 in DelCano and SWIR.

3.2 FR-OT Fishery

With the shift from two active fishing vessels to one vessel over the 2019-2022 period, fishing effort and catch has been cut in half from over 400 000 hooks for a catch of 15 t to 171 500 hooks for a catch of 7.7t.

Fishing operations are characterised by a mean soak time of 29h and line of 4520 hooks for a mean length of 4.7 km. Since 2019 and the introduction of the 55t catch limits (CMM 2019/15), number of hooks have been limited to 3000 hooks per line with mean number of 2700 hooks for a length of 1.8 km and a soak time remain unchanged with a mean of 30.9 h. During the same period, catch rates have been relatively stable with an increase in 2022.

Soak time is calculated as the time between set start date and haul start date. Catch rates for all hauls are calculated as the catch (kg) divided by the number of hooks.

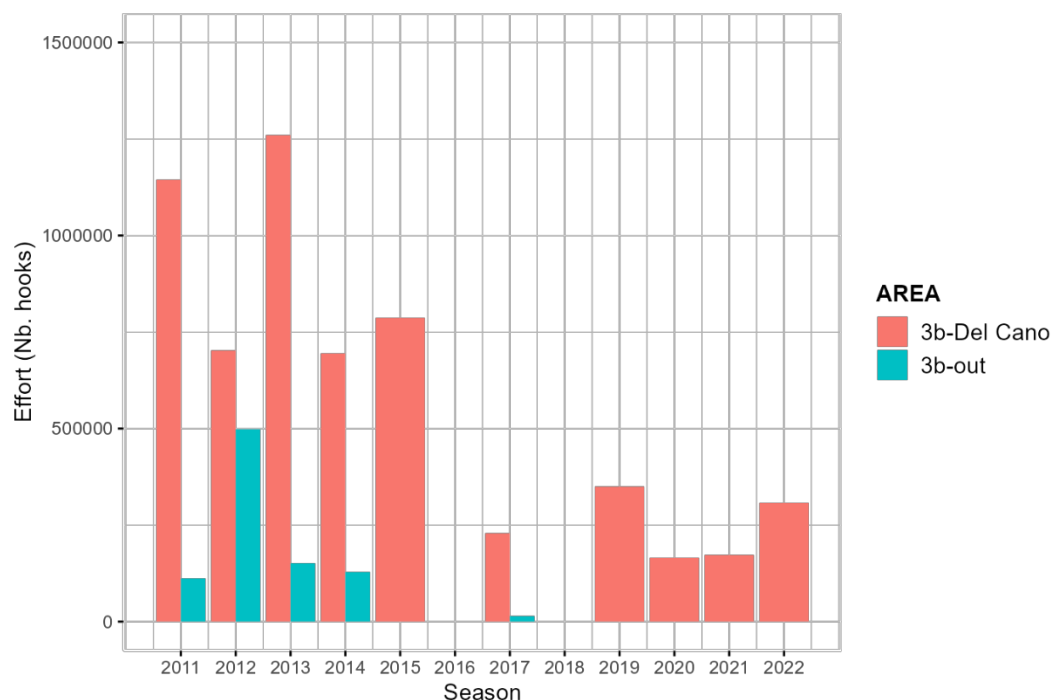


Figure 6 Effort (nb. Hooks) for the 2011 to 2022 fishing seasons.

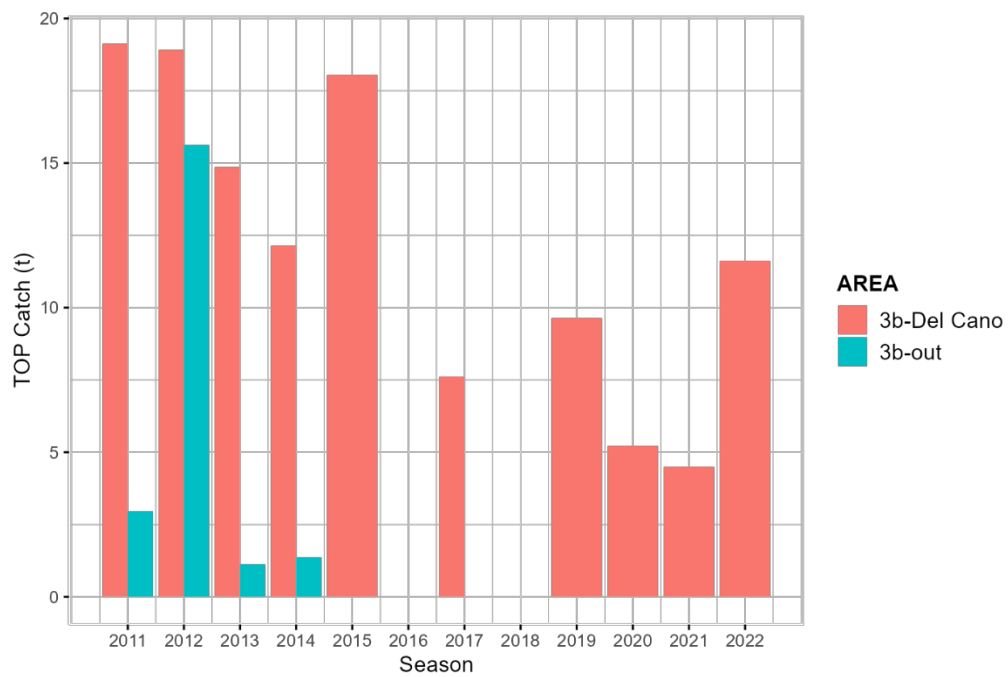


Figure 7 TOP catch (t) for the 2011 to 2022 fishing seasons.

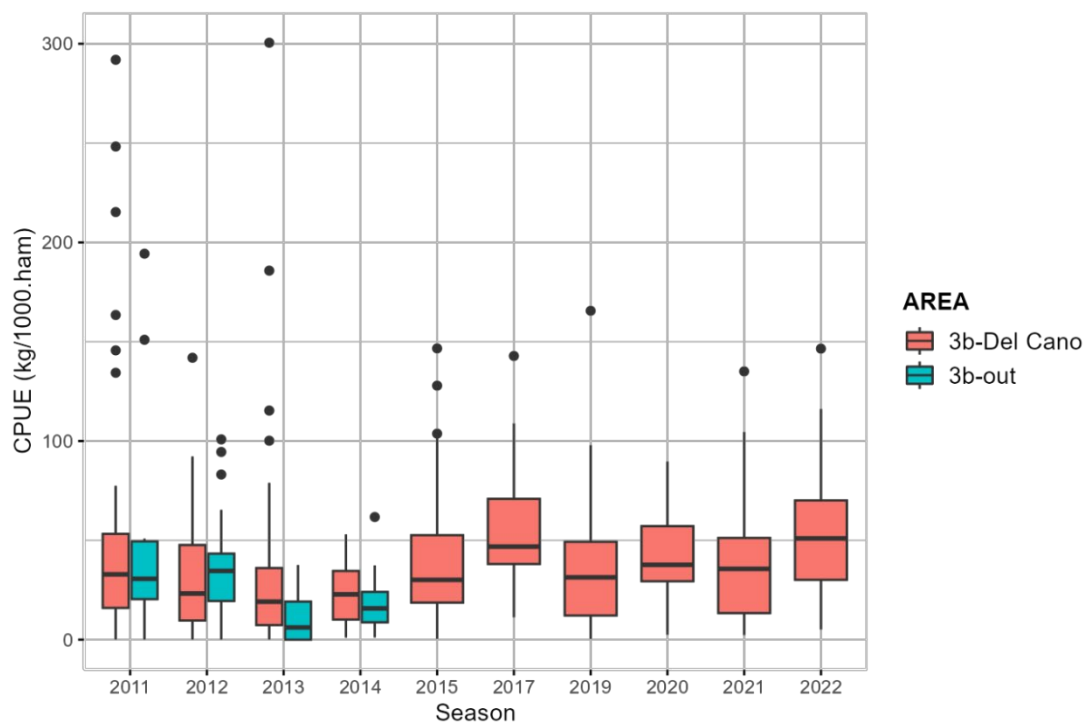


Figure 8 CPUE for the 2011 to 2022 fishing seasons. Boxes show median, 25th and 75th percentile values and whiskers refer to 5th and 95th percentile values.

4. Catch composition

4.1 EU-Spain Fishery

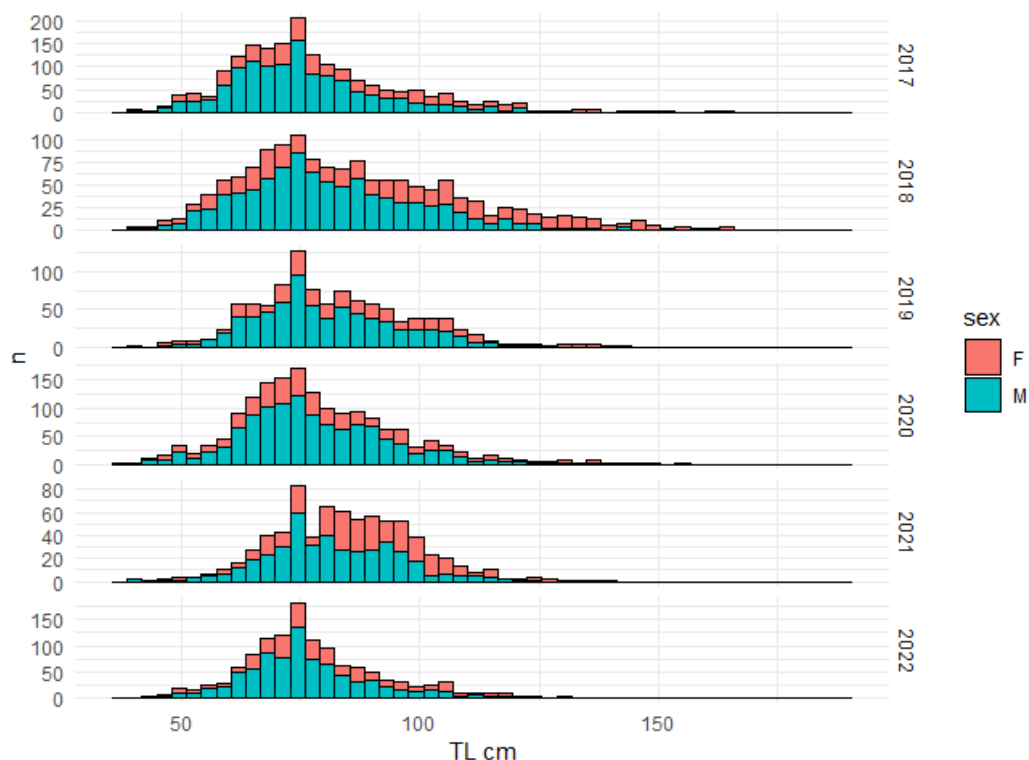


Figure 9 Catch length-frequencies by sex from 2017 to 2022 for the 3-b Del Cano area. n is the number of sampled TOP.

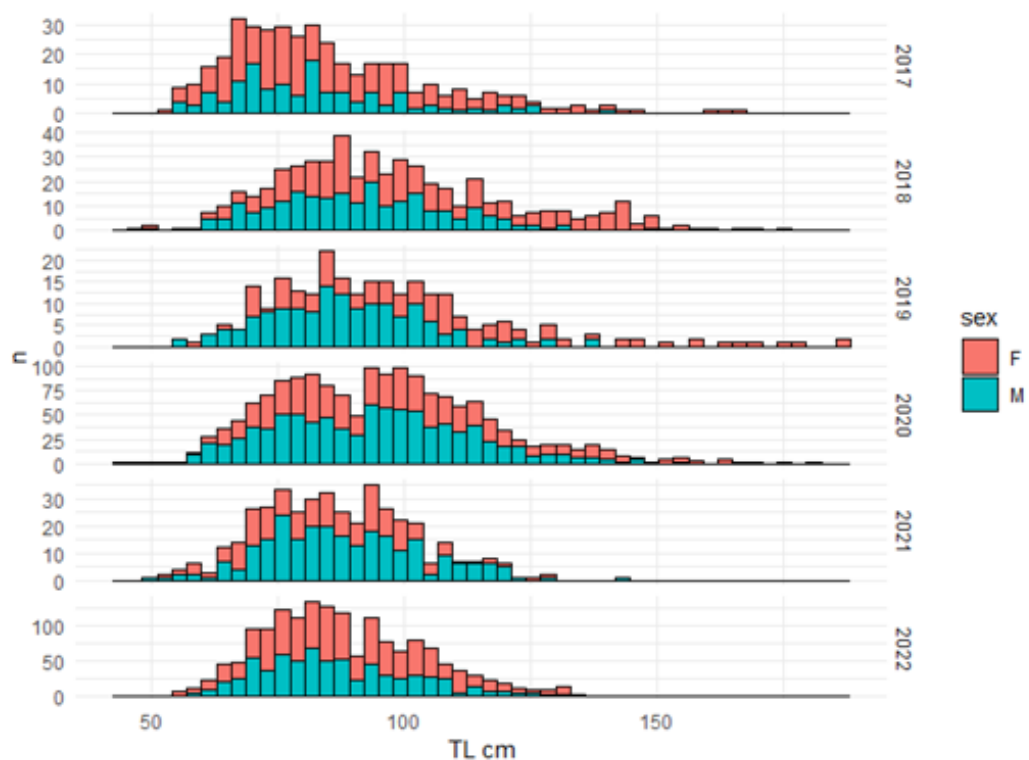


Figure 10 Catch length-frequencies by sex from 2017 to 2022 for the 3-b SWIR area. n is the number of sampled TOP.

4.2 FR-OT

The length of toothfish caught ranged from 37 to 190 cm, with a mode at around 70-75 cm.

The sex ratio of measured fish was skewed towards males, with 61-76% of all fish measured in the 2014 to 2022 fishing seasons being males.

A total of 147 otolith samples from 2014 to 2022 seasons have been collected. None of these fish otoliths have been aged so far, therefore no information about catch-at-age has been available.

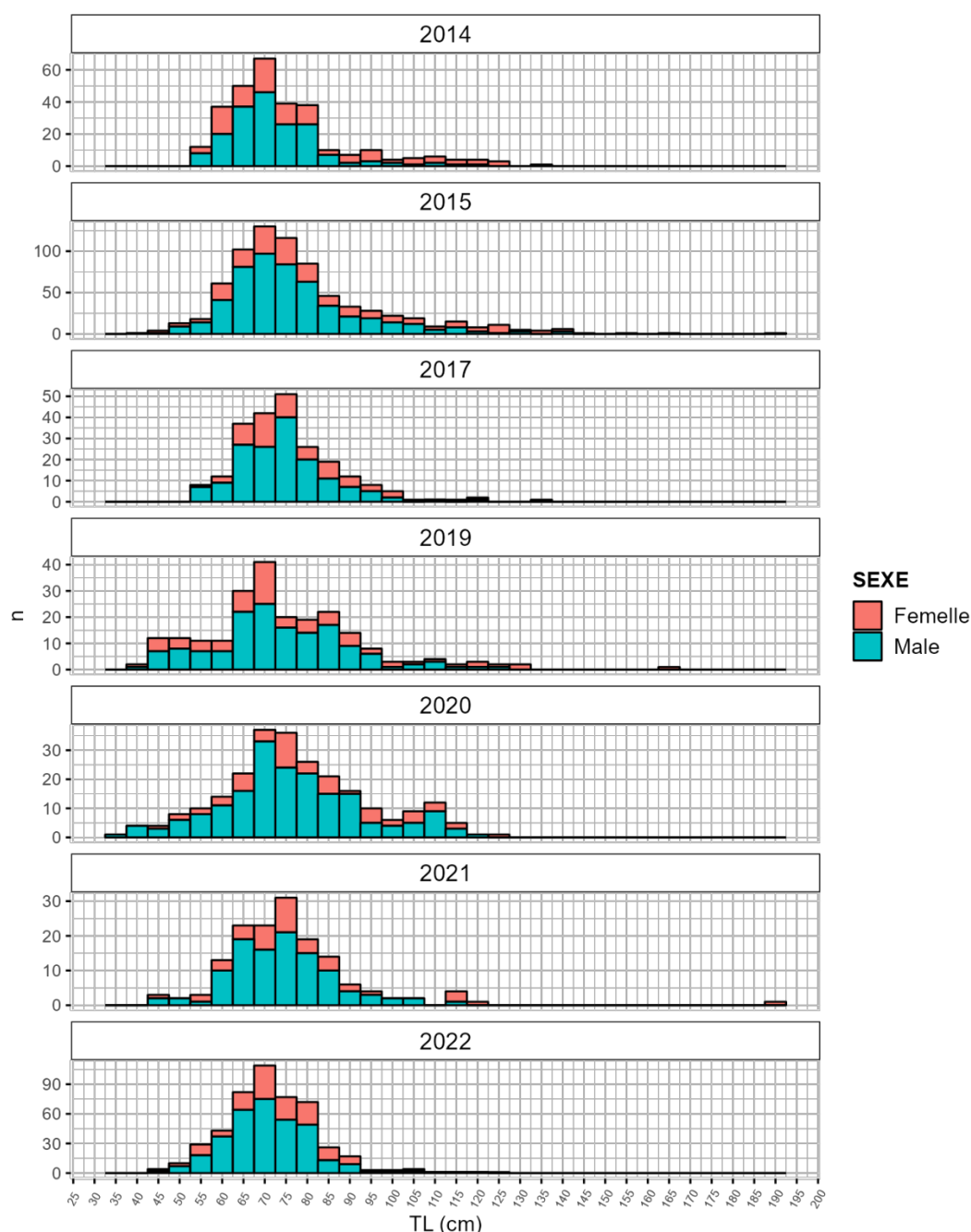


Figure 11 Catch length-frequencies for the 2019 to 2022 seasons for the 3-b Del Cano area. *n* is the number of sampled TOP.

5. Toothfish tagging/recaptures

5.1 EU-Spain Fishery

In 2018, information on tag recovery within the SIOFA convention area from toothfish tagged in CCAMLR was presented to the CCAMLR-FSA working group (Sarralde & Barreiro, 2018) after coordination between both organizations and the sharing the information on fish tagged and recaptured.

In 2022 started the tagging of *Dissostichus spp* specimens caught in accordance with CMM 2021/15.

The tagging is made by the scientific observer with the help of the crew when needed. The tagging protocol is described in the National Report of the European Union presented to SIOFA SC in 2022, SC-07-16.

Recaptures

In 2022, five TOP specimens were recaptured in Area 3b. Two of the recaptures were tagged in a previous survey from the same vessel (342 and 368 days at sea and 6.1 and 29.8 km respectively). From the three remaining recaptures, two had the Australia label and one a French one.

5.2 FR-OT Fishery

Between 2020 and 2022, a total of 121 tagged fish have been marked on del Cano Rise (Table 3). Only 2 tagged fish have been recaptured, one released in the CI EEZ, and the last one released on del Cano Rise. Details of the fish recaptured can be found in Table 4.

Table 3 Summaries of tag-release and recapture from FR-OT vessels.

Year	Release Numbers	Tagging rates	Recaptures from SIOFA releases	Recaptures from CCAMLR releases	Recaptures from Crozet
2019	0	0	0	0	1
2020	29	0.029	0	0	0
2021	30	0.031	0	0	0
2022	62	0.022	1	0	0
Total	121	–	1	0	1

Table 4 Details of TOP released and recaptured on del Cano Rise in the SIOFA area.

Release			Recapture				
Area	Date	Length (cm)	Area	Date	Length (cm)	Time at liberty (days)	Distance travelled (km)
ZEE Crozet	18-07-2018	70.6	SIOFA 3-b Del Cano	25-02-2019	72.0	222	–
SIOFA 3-b Del Cano	11-02-2020	72.0	SIOFA 3-b Del Cano	27-02-2022	75.6	747	4.11

6. Marine mammal interaction – Depredation

Killer whale and sperm whale depredation interactions with toothfish longlines have been documented as a severe issue in the CI EEZ since the late 1990's. These interactions have been extensively monitored and studied through long-term observation and photoidentification, consistently collected by fishery observers during fishing operations involving depredation events.

Based on data collected on del Cano Rise, Gasco et al. (2020) provided a first quantification of marine mammal removals and established the link with the populations present in CI EEZ and PEI EEZ.

Since 2021, the requirements of CMM-2021/02 (unchanged in the latest version of CMM-2022/02) to systematically report the presence of whales, conduct photographic identification, estimate the number of individuals in the vicinity of fishing gear should provide useful data in the future to understand the dynamics of whales interacting with TOP fisheries.

6.1 EU-Spain interaction

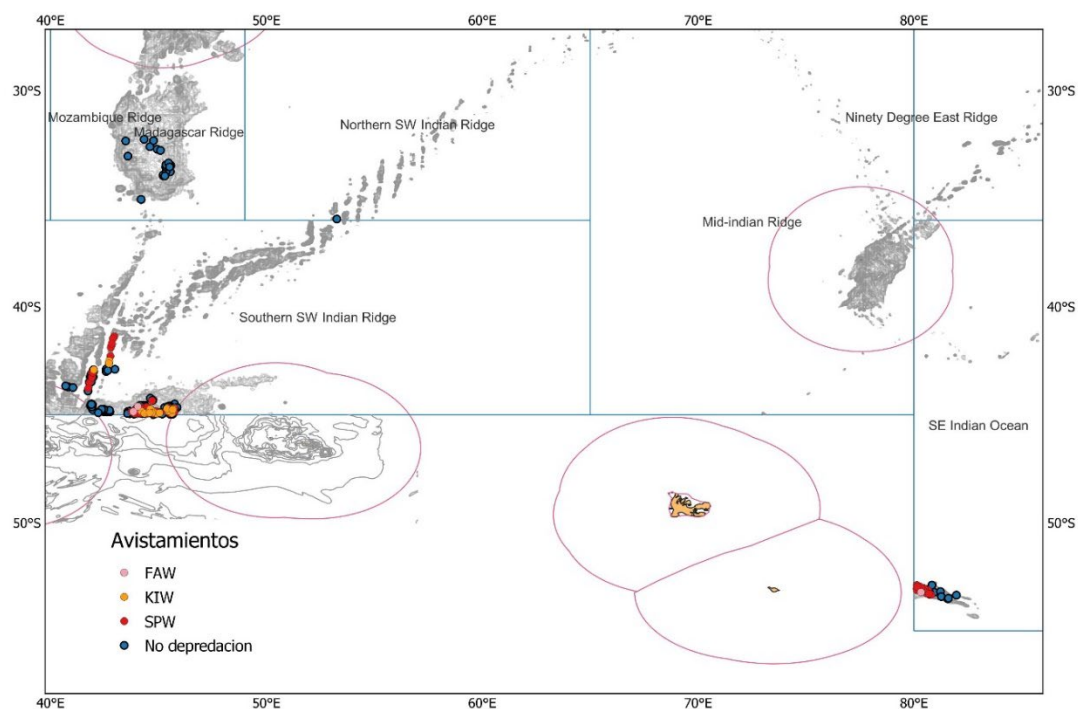


Figure 12 MM sightings by MM species from 2017-2022. In blue are MMs not related with predation.

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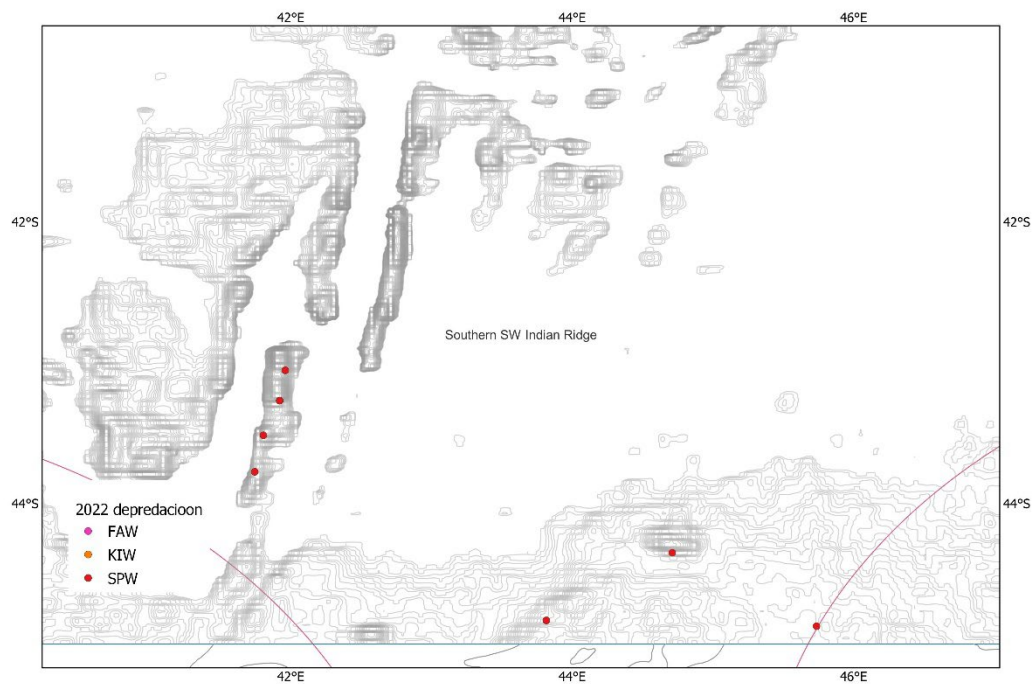


Figure 13 Reported depredation by MM species in 2022.

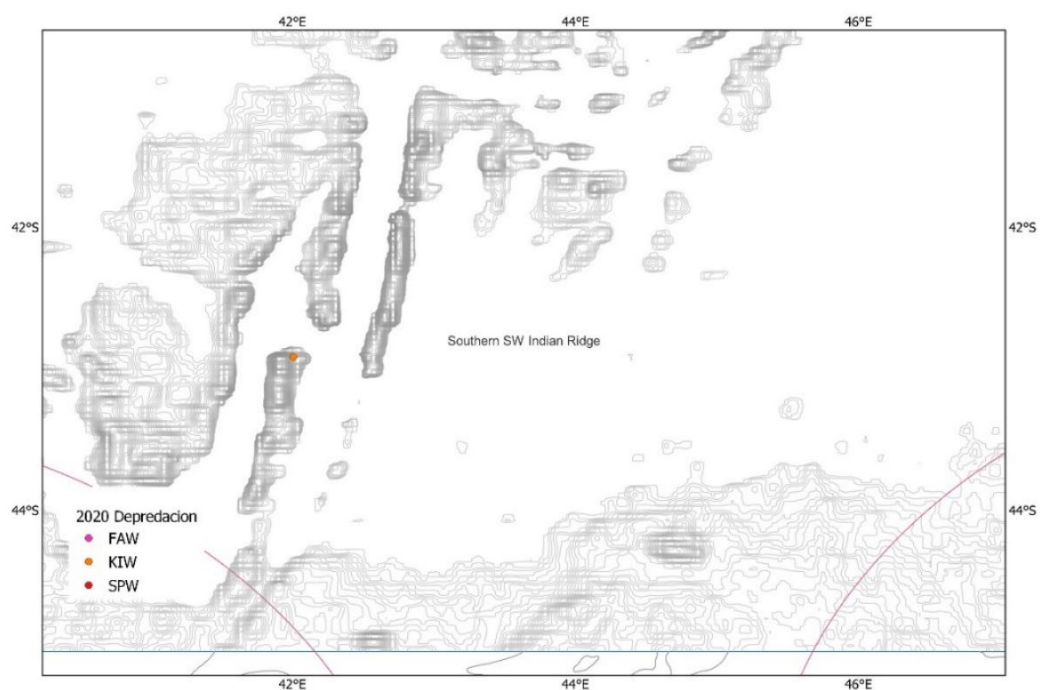


Figure 14 Reported depredation by MM species in 2020.

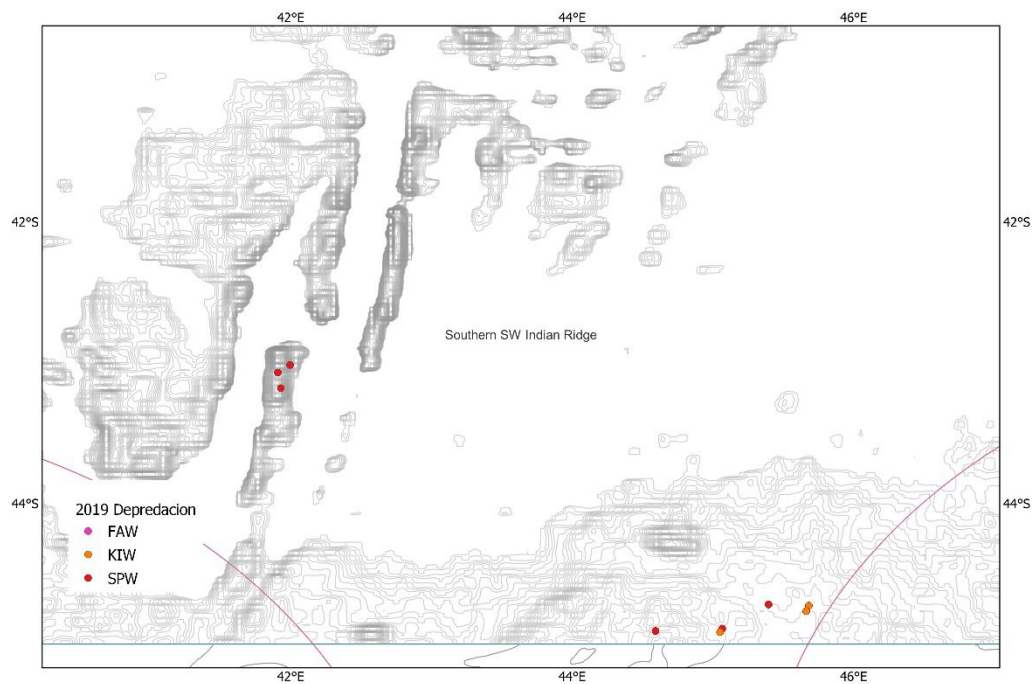


Figure 15 Reported depredation by MM species in 2019.

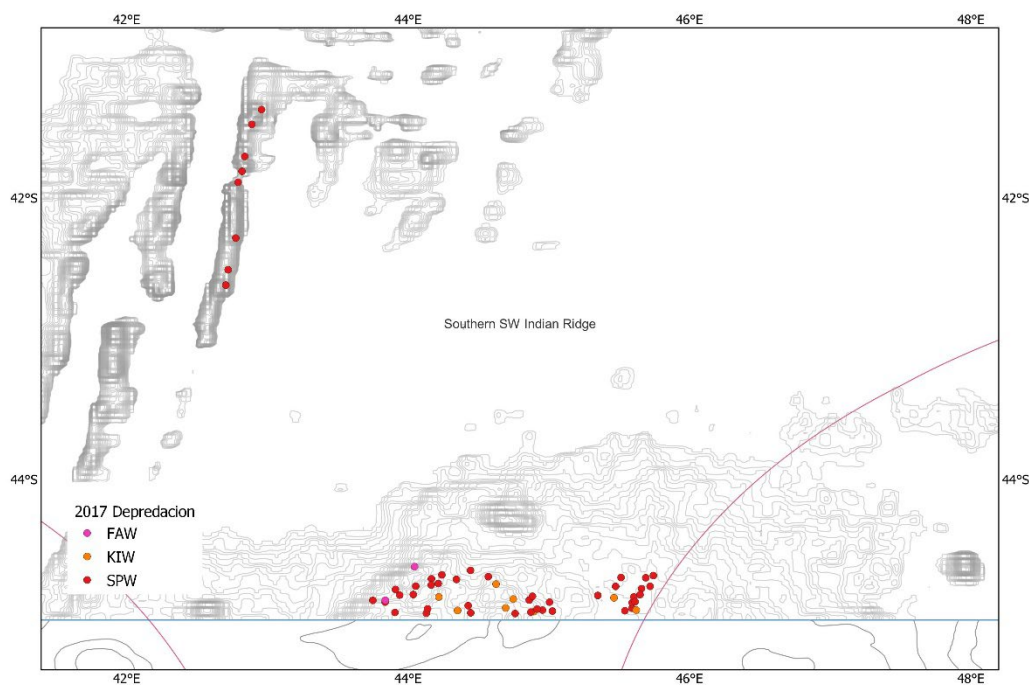


Figure 16 Reported depredation by MM species in 2017.

6.1 FR-OT interaction

A total of 187 interactions between whales and FR-OT vessels have been recorded since 2011. Depending on the year, interactions are dominated by sperm whales (SPW) or killer whales (KIW).

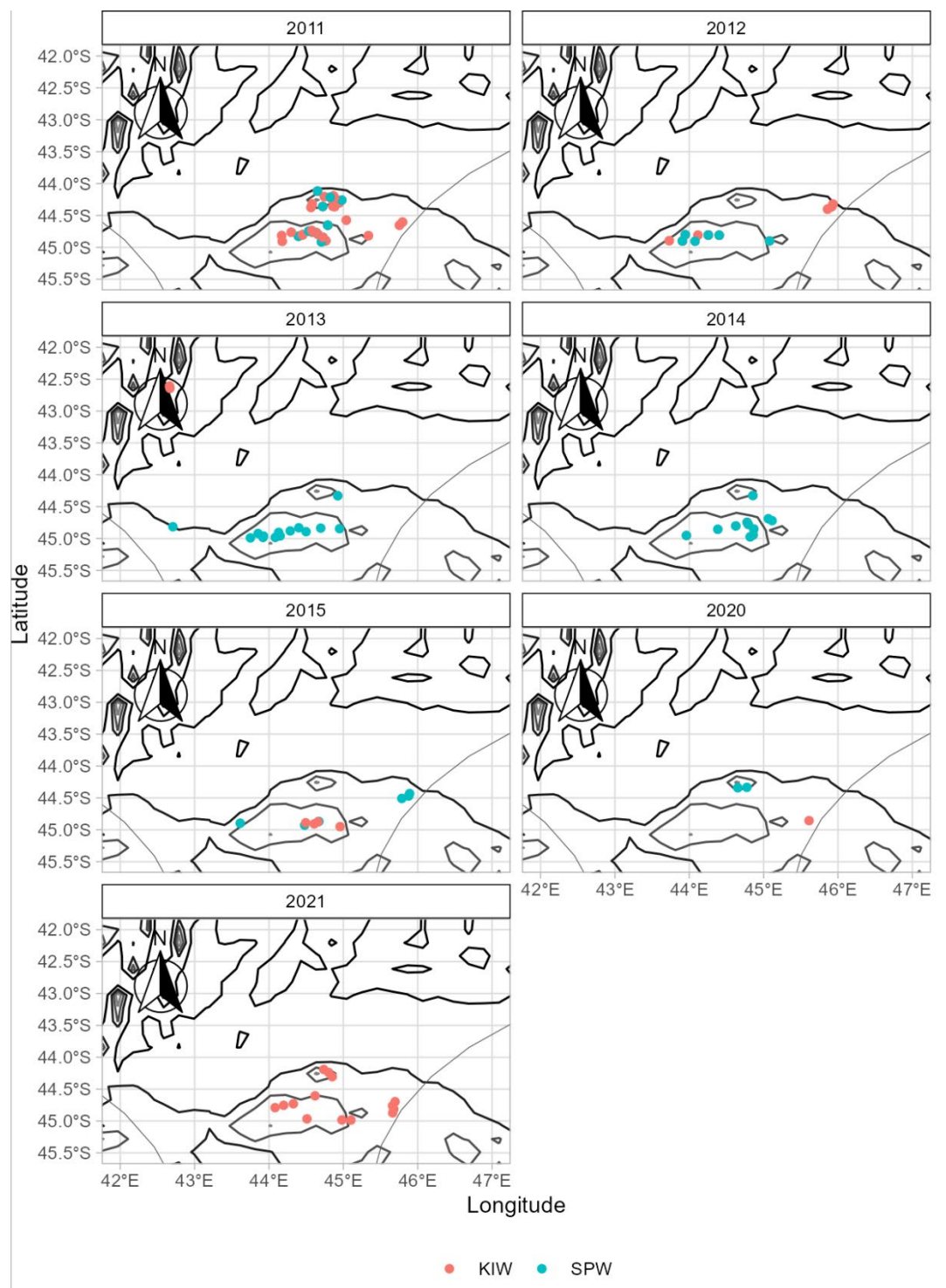


Figure 17 Reported whales interactions from 2011-2022. In blue are sperm whales (SPW) and in red killer whales (KIW).

7. Discussion

There is a clear distinction of the catch history and catch rates trends for the two fisheries.

Data limitations, especially in term of spatial extension and the application of the tag-recapture program and observation of depredation is a constraint to address a robust stock characterization.

While some fish tagged in the French and in the Australian EEZ have been recaptured in the Del Cano SIOFA area proving inward migration from these areas to date not a single toothfish has been recovered from the South African EEZ. Indeed, the northward distribution of *D. eleginoides* is closely related to the extension of the Sub-Antarctic Front, and especially the intermediate layer of sub-Antarctic water masses, which defines the habitat of *D. eleginoides* toothfish. Del-Cano SIOFA could be at the northern edge of the global distribution area of *D. eleginoides* concentration, in which a residual recruitment effect persists (López-Abellán, 2005). The toothfish tagging protocol which is in force in the SIOFA convention area since 2020 (CMM 2019/15) will provide insights on the connectivity between this area and the close by fisheries of the South African EEZ and the French EEZ as potential future recapture of tagged fished in Del Cano SIOFA in EEZs would allow to assess the migration components. Project SER2022-TOP2 will necessarily help to better understand the migration dynamics of *D. eleginoides* in the SIOFA area.

CCAMLR decision rules applied in adjacent area is defined by precautionary sets of reference points based on the long-term spawning stock biomass of toothfish at or above 50% of the initial unexploited biomass (target biological reference point (BRP) of $0.5 \times B_0$) and the probability of a decline of the spawning biomass below 20% of the initial biomass should be less than 10%. However, in a data limited situation such as the Del Cano and the SW Indian Ridge where data are insufficient for integrated long-term stock assessments, precautionary catch limits should be applied and updated accordingly to the availability of the new data.

Following a simple set of rules, a maximum catch level could be determined based on an exploitation rate that can increase catches or decrease based on the trend local biomass estimates over available time, either estimated through tag-recaptures or through CPUE over a given seabed area. Annex 1 provides the detail on this approach. This method allows for continued exploration and associated data collection towards longer-term assessment models, while at the same time annually adjusting the exploitation rate to local estimates.

8. Recommendations

1. Recommend setting two different management units to manage toothfish fisheries of Del Cano and Southern SW Indian Ocean Ridge. A holistic approach to toothfish management for all SIOFA toothfish fisheries should be encouraged.
2. Recommend adopting precautionary reference points and a biomass trend analysis rules methodology and calculation of catch limits in data poor toothfish fisheries.
3. Recommend setting rules to ensure that fishing effort is enough spread spatially and stratified across depth over as large a range as possible for the Del Cano region to obtain the information necessary to determine the potential for this fishery, avoid over-concentration of catch and effort, and attain representative toothfish biological data for biomass estimation and population characteristics.

9. References

López Abellán, L.J. 2005. Patagonian toothfish in international waters of the Southwest Indian ocean (statistical area 51). CCAMLR Science, 12: 207–214.

Sarralde, R. and S. Barreiro. 2019. Patagonian toothfish population analysis with data from two Spanish vessels fishing in the South of the Indian Ocean (SIOFA CA) between 2017 and 2018. SIOFA SERAWG-01-INFO-04.

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Gasco, N., Tixier, P., Massiot-Granier, F., Péron, C., Selles, J., Sarralde, R. & Soeffker, M. (2020). No boundaries for whales interacting with fishing activities targeting Patagonian toothfish. 2nd Meeting of the Stock and Ecological Risk Assessment Working Group (SERAWG2). SERAWG2-02-11, 21pp.

10. Annex

Trend analysis of local biomass estimates are used for cases when it was not possible to estimate longer-term stock projection or in data-poor fisheries⁸. In these instances, local biomass estimates available derived from either tag-recapture based methods (Chapman, Petersen), or by scaling CPUE over a defined seabed area⁹ are commonly used to determine catch limits. Biomass estimates from the Chapman method are preferably used if considered reliable, otherwise the CPUE method estimates are used. Additional constraint can be imposed to avoid large annual change of catch limits.

Trend analysis:

Apply a 4% exploitation rate to the Chapman and/or CPUE by seabed area biomass estimates, including up to the most recent season (B4%):

_ IF the trend was stable:

- if adequate recaptures, use the B4% from the most recent Chapman estimate - *otherwise* use the B4% from the most recent CPUE by seabed area estimate

_ IF the trend was declining:

- use the current catch limit $\times 0.8$ (regardless of adequate recaptures or not)

_ IF the trend was increasing:

- if adequate recaptures, use the B4% from the most recent Chapman estimate - *otherwise* use the B4% from the most recent CPUE by seabed area estimate.

_ IF the trend was too short, too variable, or trends between abundance indices are in conflict

- if adequate recaptures, use the B4% from the most recent Chapman estimate - *otherwise* use the B4% from the most recent CPUE by seabed area estimate

_ AND constraining any changes in the proposed catch limit to be not more than a 20% increase or decrease from the current catch limit.

⁸ https://fishdocs.ccamlr.org/TrendAnalysis_2020.pdf

⁹ This might be an issue depending on the size of the area and the accuracy of the bathymetric chart.