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

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SIOFA Ecosystem Summary 2024

The SIOFA Secretariat

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Abstract

This paper presents the SIOFA Ecosystem Summary 2024.
The first draft of this document was originally prepared by the SIOFA Secretariat and presented during PAEWG4 and at SC7. SC8 further reviewed and endorsed this document, recommending its publication to MoP10, and the Summary was first published in 2023.
This new version of the Ecosystem Summary includes figures with data updated to 2022.
Please note that this document does not contain sections with confidential data. If elements with confidential data are identified by the SC they will not be included in the published version of this Summary.

[1] Restricted documents may contain confidential information. Please do not distribute restricted documents in any form without the explicit permission of the SIOFA Secretariat and the data owner(s)/provider(s).
[2] Documents available only to members invited to closed sessions.

Recommendations

The SIOFA Secretariat recommends that the SC9:

- **notes** the work done by the Secretariat in preparing the SIOFA Ecosystem Summary 2024.
- **identifies** any elements in this summary that are confidential and should therefore be withheld from the published version.
- **provides** any comments or edits to the SIOFA Ecosystem Summary 2024 during the meeting.
- **endorses** the SIOFA Ecosystem Summary 2024 and **recommends** its publication to the MoP.

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SIOFA Ecosystem Summary 2024

Restricted Version 2.0 Date 25.01.2024 | Revised by SC9 | Endorsed by SC9

Next review date: 2025

Restricted sections are identified with yellow highlights in this version

Prepared by the SIOFA Secretariat

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Contents

1. Purpose of this document

The SIOFA Ecosystem Summary describes the main known effects of SIOFA fisheries on ecosystems and species in the SIOFA Area (Figure 1) and summarizes the available data with an emphasis on the most recent five years. This document is targeted at the general public, institutions, and countries wanting to better understand SIOFA fisheries. It also describes SIOFA data available on SIOFA ecosystems and species that could be used by scientists and consultants for scientific research.

The SIOFA Fisheries Summaries provide more detailed information on target species of SIOFA fisheries, and their biology and ecology. The SIOFA Fisheries Overview further integrates this summary and illustrates broad temporal trends in the main fisheries in the SIOFA Area.

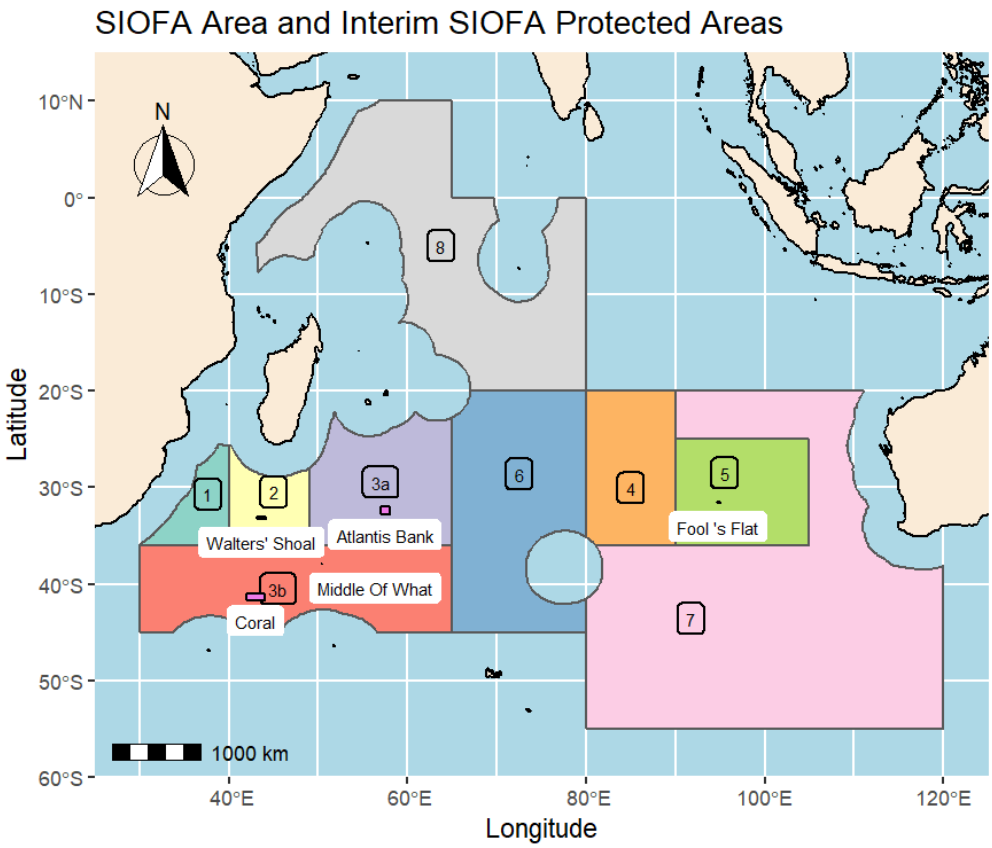


Figure 1 – The SIOFA Area and Subareas (source: SIOFA Spatial database). The Subarea numbers and colour codes are used consistently throughout this summary to identify Subareas. The map highlights SIOFA Interim Protection Areas (in magenta) as defined in CMM 01(2023) (Annex 3). All the interim protection areas have been labelled by name for easier recognition.

2. Data sources and analysis code

2.1 Data availability

There are thirteen CCPs that are members of SIOFA. The SIOFA Secretariat receives data from CCPs pertaining to their fishing activities, biological sampling, and Scientific Observer reports as per CMM 02(2023) (Data Standards). The SIOFA Secretariat acts as custodian for these data on behalf of its members. Request to release or publish these data (e.g., for scientific purposes) are regulated under CMM 03(2016) (Data Confidentiality). Data requests can be made through the SIOFA Secretariat (secretariat@siofa.org).

The main SIOFA databases are:

- AggregatedCatchEffort, which contains catch (and sometimes effort) aggregated at different spatial resolutions, varying from the whole SIOFA Area to 20' squares, from 2000 to 2019.
- HBHCatchEffort, which contains haul-by-haul catch and effort at a spatial accuracy varying from degrees to seconds, from 1998 to 2022.
- Observer, which contains Scientific Observer collected biological sampling, observer reported catches, and observed operations data, from 2012 to 2022.

The SIOFA databases are supported by other data assets such as:

- Spatial layers, which contains all the GIS spatial layers available to the Secretariat (e.g., boundaries of SIOFA Subareas, Assessment Areas)
- Codes, including countries, gear, and species codes etc.

These have been described in the outputs of project SEC2021-05 (see SC-07-08, restricted access), where it was noted that the data was repeated (i.e., overlaps) across the first two databases. A suggestion has been made to further develop the three databases as three 'subject areas' that form part of a single SIOFA Fisheries Database in the future.

Further data (e.g., on active vessels) is available from Annual National Reports (2015–2022) that SIOFA CCPs submit to the Scientific Committee every year, which are made publicly available on the SIOFA website (https://siofa.org/meetings/groups/Scientific%20Committee%20Meeting).

2.2 Missing/incomplete/problematic data for the purposes of this report

2023 Catch, Effort and Scientific Observer data are scheduled to be submitted to the Secretariat at the end of May in 2024. Any data more recent than 2022 should be thus considered as draft, potentially incomplete and subject to further revisions, and has therefore been excluded from this overview. Inconsistencies between tows times and positions have been detected in the 2021 and 2022 data submitted by the Cook Islands. These data were included in the Overview, but caution should be exercised when interpreting positional data at a fine scale.

2.3 Data used in this report

A SIOFA database extract was delivered on 15 September 2023 and used in this document.

The information presented in this summary was extracted from different sources, depending on the type of data required. To minimize the confusion that can arise from having to interpret multiple data sources, explicit references to data sources have been made in each table/figure caption in the summary.

The summary is intended to cover the last five years of available data (at a minimum) but note that the data used covers the 2013–2022 period (10 years of data), and that the period covered varies across the different sections as detailed below.

i. Active fleet composition (2015–2022) and Main fisheries (2000–2022): annual National Reports 2022 (submitted to Scientific Committee in 2023).
ii. Total catches per CCP (2013–2022): SIOFA AggregatedCatchEffort database, combined with SIOFA HBHCatchEffort database.
iii. Catch, Effort (including per Subarea) and discards (2013–2022): SIOFA HBHCatchEffort, SIOFA AggregatedCatchEffort database and spatial layers (this does not include non-fish catch, see Sections 6 and 6.2 for definitions of target catch).
iv. VMEs (2003–2022): SIOFA Observer and HBHCatchEffort databases.
v. Fishing in Interim Protected Areas (2013–2022): SIOFA HBHCatchEffort and Spatial databases
vi. Biological sampling (2022): SIOFA Observer database.
vii. Observer-reported catches (2022): SIOFA Observer database.

2.4 Analysis code

The code that produces all analyses presented in this report is publicly available at https://github.com/SIOFASecretariat/SIOFA_SC_Reports_code

3. Ecoregions of the Southern Indian Ocean

The PAE2021-01 project (SIOFA Bioregionalization and VMEs) produced maps of biogeographical regions of the Southern Indian Ocean based on VME indicator taxa using two complementary predictive modelling approaches ("predict first, then group" and "group first, then predict").

This work detected three biogeographical regions at the first hierarchical level, which broadly represented the upper and lower bathyal, the abyssal and the Southern Ocean (Figure 2). At the second hierarchical level, eight nested biogeographical regions were detected, displaying distinct geographical and bathymetric differences across the region (Figure 3).

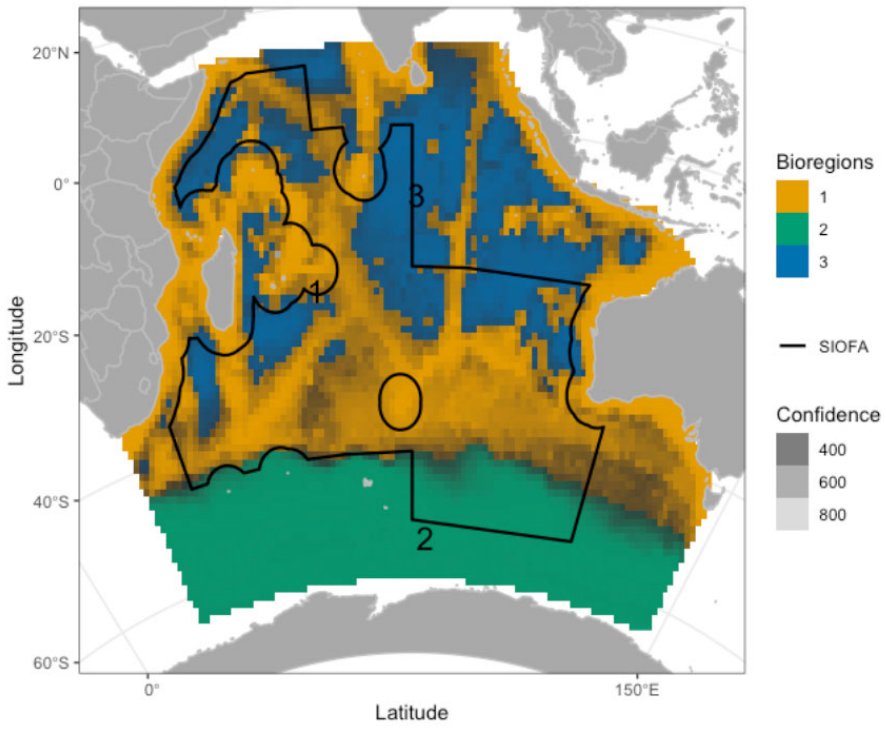


Figure 2 – Predicted biogeographical regions of VME indicator taxa in the Southern Indian Ocean at the first level of the hierarchy. Areas with low confidence in the prediction are shown in darker shades of grey.

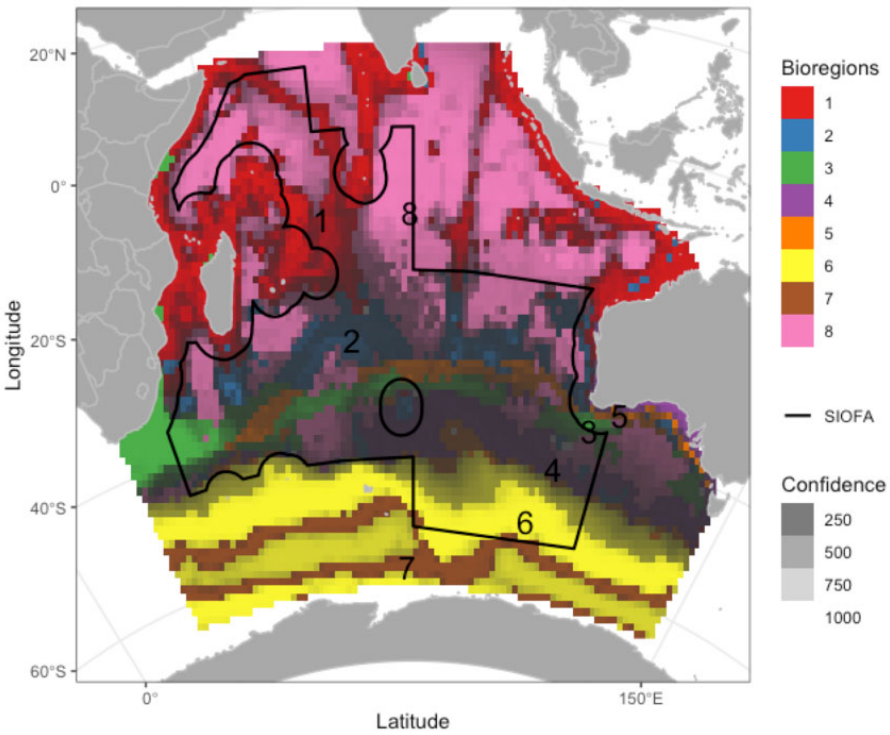


Figure 3 – Predicted biogeographical regions of VME indicator taxa in the Southern Indian Ocean at the second hierarchical level. Areas with low confidence in the prediction are shown in darker shades of grey. Note that, because of the low number of data points, we cannot reliably evaluate these predictions. Bioregion labels: 1: cluster 1.1; 2: cluster 1.2; 3: cluster 1.3; 4: cluster 1.5; 5: cluster 1.7; 6: cluster 2.1; 7: cluster 2.4; 8: cluster 3.1.

Bioregions at the first hierarchical level are the result of taxa distributions spatial clustering, while bioregions at the second hierarchical level reflect limits in dispersal likely driven by the circulation of the water masses in the area. The bioregions, in both predictive approaches, were entirely encompassed within the SIOFA Area. These maps suggest that the SIOFA has a great diversity of bioregions.

4. Main fisheries operating in the SIOFA Area

In the SIOFA Area, a few fisheries account for the majority of the total catch. Table 1 summarises the main SIOFA fisheries by target species and provides information about the fishing method and gear employed, which CCPs engaged in the fishery, and the main Subareas where these fisheries occurred.

Table 1 – The main fisheries and target species in the SIOFA Area. The table also provides information on fishing methods and gear used, which CCPs engaged in each fishery, and the main Subareas where each fishery occurred.

Target species/fisheries	**Fishing method and gear type**	**Participants (from National Reports between 2000 and 2019)**	**Subareas and focal locations**
Patagonian toothfish	Set longline Traps	Australia, EU (Spain), France (Overseas Territories), Japan, Korea	SIOFA Subareas 3b, 7
Orange roughy	Bottom trawl	Australia, Cook Islands, China (2000-02), Namibia, Mauritius	Underwater topographic features in SIOFA Subareas 1, 2, 3a and 3b
Alfonsino	Midwater trawl	Australia, Cook Islands, Japan, Korea, Namibia	Underwater topographic features in SIOFA Subarea 1, 2, 3a and 3b
Saurida and scads	Trawl (nei), Single boat otter board trawl	Thailand	SIOFA Subarea 8 (mainly Saya de Malha Bank)
Shallow-water (<200m) snappers, emperors and groupers	Set longline, Hook and line (handlines) Bottom trawl Traps	EU (France), Mauritius, Thailand, Comoros	SIOFA Subarea 8 (mainly Saya de Malha Bank)
Deeper water snappers, lutjanids, Hapuka	Set longline Dropline	Australia China EU (Spain)	
Oilfish	Pelagic longline	Chinese Taipei	South-west Indian Ocean

5. Scientific Observer coverage

Scientific Observer coverage is very challenging to assess in SIOFA because of the current lack of linkages between the Observer and CatchEffort databases, which once established would enable more meaningful analyses. This linkage is currently being addressed by the SIOFA Secretariat and will likely be available only for the 2025 edition of this Summary.

Data challenges have been identified with aggregated CatchEffort data (up to 2019) not allowing a direct comparison with Observer data reported on a haul-by-haul basis and making it difficult to calculate coherent numbers of fishing events. Further, some gear codes (Demersal longlines, Mechanized lines and pole-and-lines, Traps (nei)) are recorded only in the CatchEffort database but not in the Scientific Observer database and in general gear codes mismatches across the databases are another potential source of confusion.

As an interim presentation, SC9 agreed to showcase the data currently available in the Observer database (Table 2~~Table 2~~), recognizing its limitations, especially regarding estimates of observer coverage for pelagic fisheries, which are unrealistically high.

SC9 further recommended that this table be revised for the next edition of this Summary.

~~Scientific Observer coverage varies across years and fisheries, with highest observation rates in bottom fisheries, as prescribed by CMM 01(2023), and high rates even in pelagic fisheries, where no prescriptions are in force (Table 2). Some gear codes (Demersal longlines, Mechanized lines and pole-and-lines, Traps (nei)) are recorded only in the CatchEffort database but not in the Scientific Observer database and are thus not reported in this section to avoid confusion.~~

Table 2 – Total fishing events recorded in the Observer database and observer coverage ratio in SIOFA fisheries by gear types (source: Observer database 2018–2022). Events were recorded on a set level, except for handlines and hand operated pole-and-lines where they were recorded on a daily basis, and the Scientific Observer coverage is ratio between the number of events observed and the total events recorded in the Observer database. Please note that the Observer database does not record the totality of fishing events, and further work is in progress to address the lack of linkages between the Observer and CatchEffort databases, which would enable more meaningful analyses.~~Total fishing events and observer coverage ratio in SIOFA fisheries by gear types (source: Observer database 2018–2022). Events were recorded on a set level, except for handlines and hand operated pole-and-lines where they were recorded on a daily basis, and the Scientific Observer coverage is ratio between the number of events observed and the total events.~~

Year	Fishing gear	Total events recorded in the Observer database	Observed events	% observed
2018	Bottom trawls (nei)	575	356	61.91
2019	Bottom trawls (nei)	161	144	89.44
2022	Bottom trawls (nei)	995	995	100
2022	Demersal longlines	20	20	100
2021	Drifting longlines	405	405	100
2022	Drifting longlines	274	274	100
2018	Dropline	46	46	100
2019	Handlines and hand-operated pole-and-lines	103	0	0

2020	Handlines and hand-operated pole-and-lines	134	134	100
2021	Handlines and hand-operated pole-and-lines	52	52	100
2022	Handlines and hand-operated pole-and-lines	49	49	100
2018	Midwater trawls (nei)	1156	698	60.38
2019	Midwater trawls (nei)	545	506	92.84
2020	Midwater trawls (nei)	199	199	100
2021	Midwater trawls (nei)	287	287	100
2022	Midwater trawls (nei)	428	428	100
2021	Pots	19	19	100
2018	Set longlines	32	32	100
2019	Set longlines	445	432	97.08
2020	Set longlines	595	470	78.99
2021	Set longlines	457	334	73.09
2022	Set longlines	358	303	84.64
2020	Single boat bottom otter trawls	464	464	100
2021	Single boat bottom otter trawls	1017	1017	100
2018	Trawls (nei)	2	2	100
2019	Trawls (nei)	1611	1279	79.39
2020	Trawls (nei)	1216	1034	85.03
2022	Trawls (nei)	811	326	40.2
2018	Vertical lines	9	0	0
2019	Vertical lines	12	0	0
2020	Vertical lines	8	8	100

6. Target ~~C~~catch and bycatch

A wide variety of fish species are targeted in the SIOFA Area~~ (Appendix A)~~. All fish species not in the list of species identified by the SIOFA SC as primary and secondary species in SIOFA fisheries, and considered as target species for the purposes of this overview (Appendix A) were considered bycatch.~~The list of target fish species was extracted from CCP declared targets as per CMM 02(2023), and as contained in the SIOFA HBHCatchEffort database. For the purposes of this summary, bycatch was defined as all fish species that were not declared as a target.~~

Target catch was taken mainly in SIOFA Subareas 1 and 3b (Figure 4a). Bycatch in 2020 was mostly taken in SIOFA Subareas 8 and 2 (Figure 4b). In absolute terms, bycatch is highly variable between years. Bycatch constituted >50% of the total fish catch by weight in 2015 and 2016 (Figure 4a) but has otherwise been around or below 25% of the total catch in other years (Figure 4a). In 2015-2016, when bycatch was highest, the majority of the bycatch came from Subarea 8 (Figure 4b).

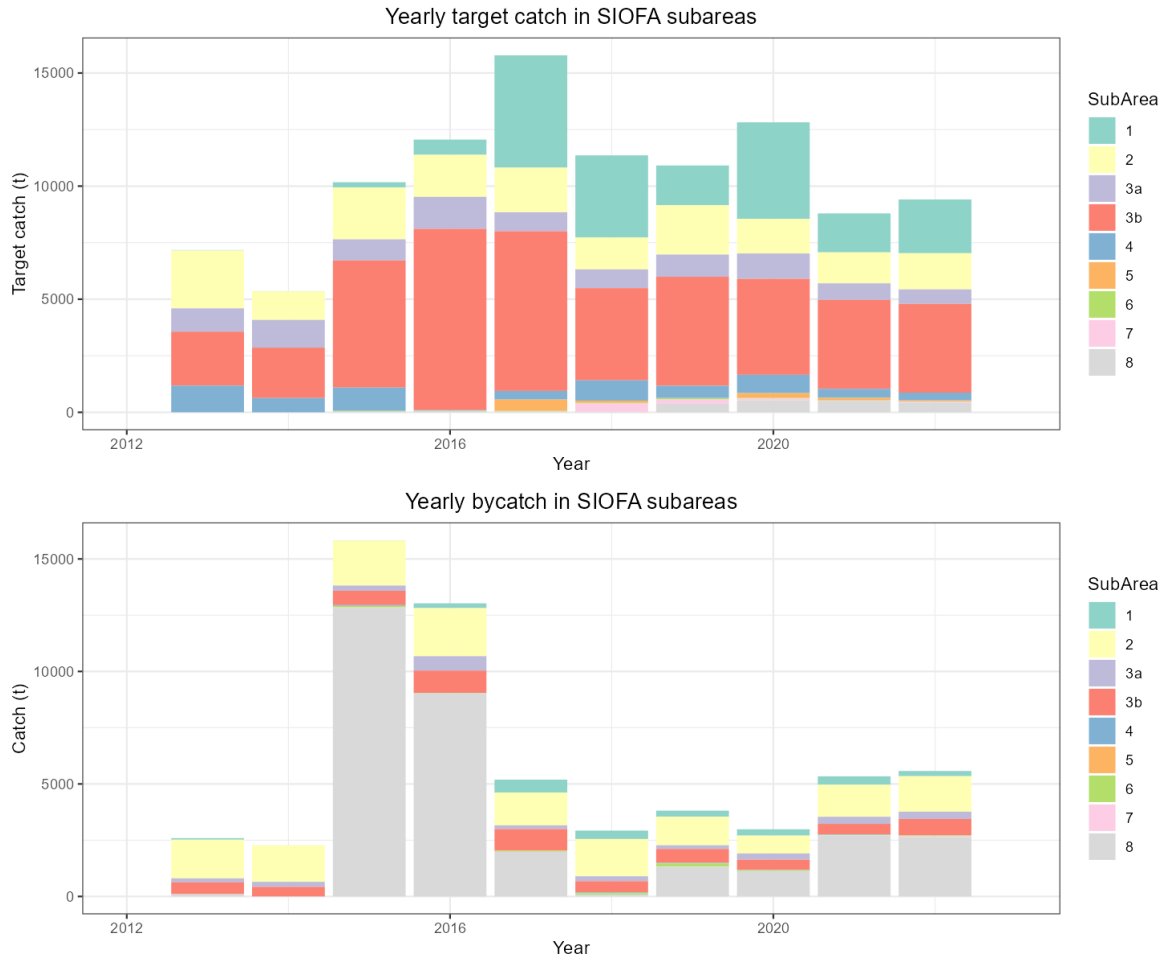


Figure 4a and b – Target catch (upper panel, a) and bycatch (lower panel, b) fish catch by weight in different SIOFA Subareas (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2022). Catches reported without spatial information are not included. See Table D.2 in Appendix D for the values associates with this figure.

The bycatch figures below (Figure 5) show the proportion of 'sharks' in the reported catch. The broad definition of 'sharks' used here includes Chondrichthyans in general (i.e., including rays and chimaeras). In this section, a list of all Chondrichthyan taxa captured in SIOFA fisheries and reported in the HBHCatchEffort database 2013–2022 was extracted and used to define 'sharks'. The full list of shark taxa reported as captured by SIOFA fisheries is shown in Appendix B.

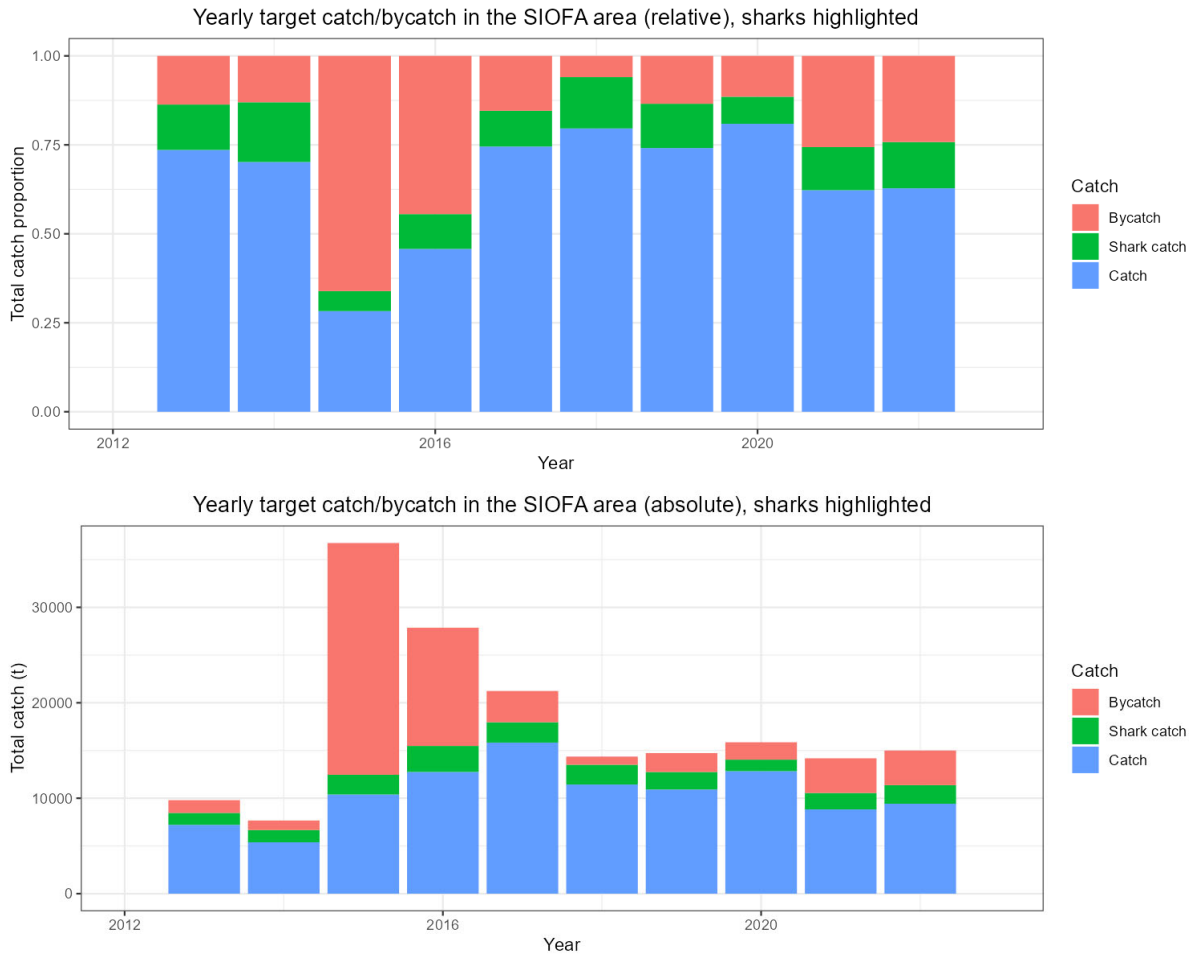


Figure 5a and b – Target catch and bycatch in the SIOFA Area summarised as relative proportions (upper panel, a) and absolute weights (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2022). Catches reported without spatial information are not included. The portion of catch composed by sharks (as defined in Appendix B) is highlighted. Sharks were targeted in the SIOFA Area until the entry into force of CMM 2019/12 (binding from October 10, 2019), which prohibited targeting any deep-sea shark species listed in its Annex 1. Following the entry into force of CMM 2019/12, all sharks are considered as bycatch for the purpose of this summary. See Table E.1 in Appendix E for the values associates with this figure.

7. Catch of sharks

Sharks were targeted in the SIOFA Area until the introduction of CMM 2019/12, which prohibited targeting the deep-sea shark species listed in its Annex 1 after October 10, 2019. Following the entry into force of CMM 2019/12, all deepwater sharks are considered as bycatch for the purpose of this summary.

Reported catch of sharks (as defined in Appendix B) increased between 2013 and 2016 but has decreased thereafter (Figure 6a). In most years shark catches were dominated by Portuguese dogfish (CYO) and a substantial proportion of unidentified 'other shark species' (including rays, skates, etc. coded SKX). Other prominent shark catch taxa include kitefin shark (SCK), birdbeak dogfish (DCA) and gulper shark (GUP).

The vast majority of shark catches in the SIOFA Area occurred in Subarea 2 (Figure 6b).

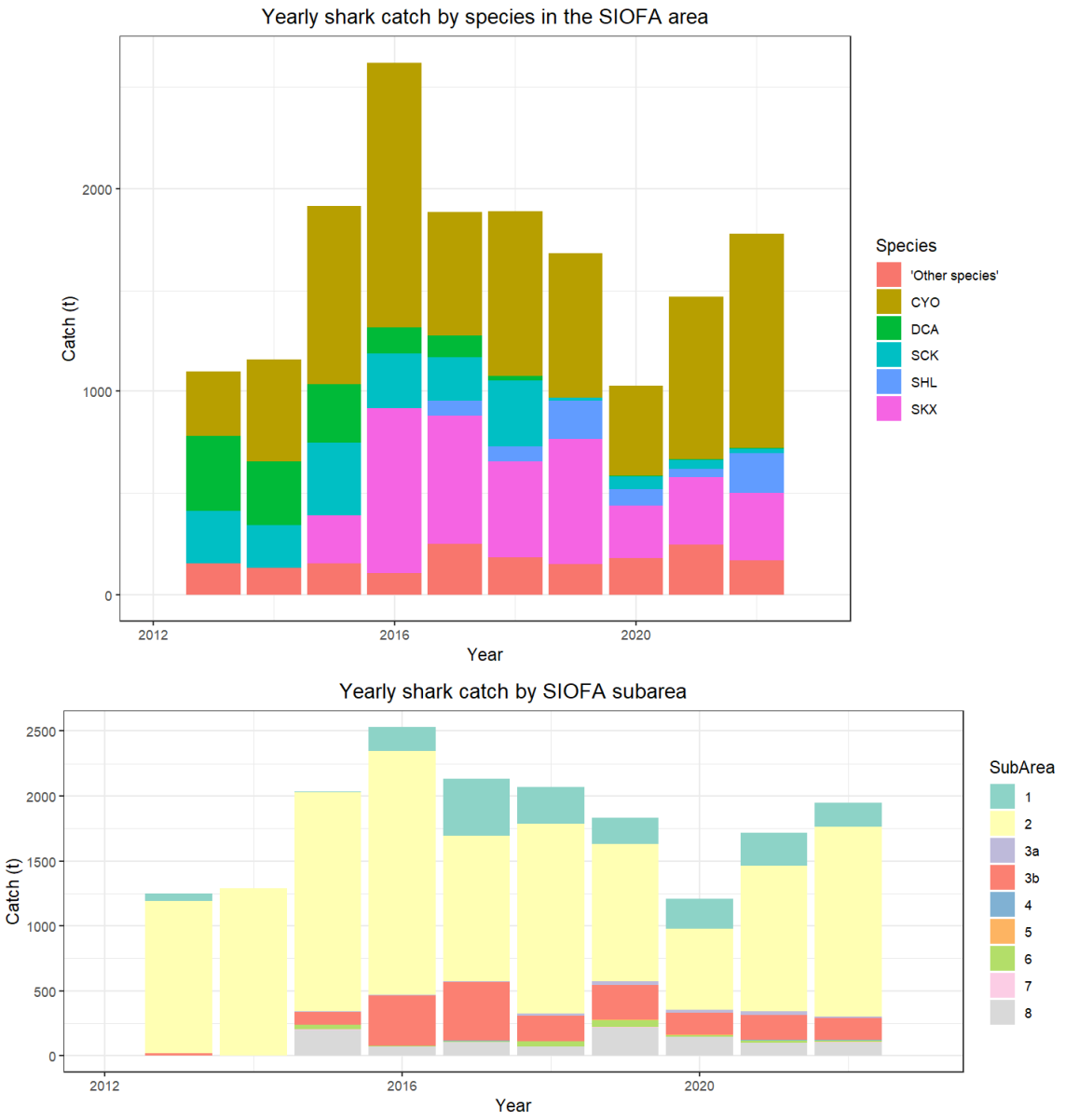


Figure 6 a and b – Yearly catch of sharks in the SIOFA Area by taxon (upper panel, a) and by SIOFA Subarea (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2022). Only the top 5 species by weight (cumulatively in the full database) are shown individually (identified by their FAO species code, see Appendix B). All other species are grouped under 'other species. ~~Figure~~ Table D.~~1~~5 in Appendix D provides a full list of species caught. See Table D.3 in Appendix D for the values associated with the lower panel figure.

Sharks are caught using several different fishing methods and gears. Historically, a larger proportion of sharks reported captured in SIOFA were caught using gillnets, but in recent years sharks have been mainly caught with longlines (Figure 7~~Figure 7~~).

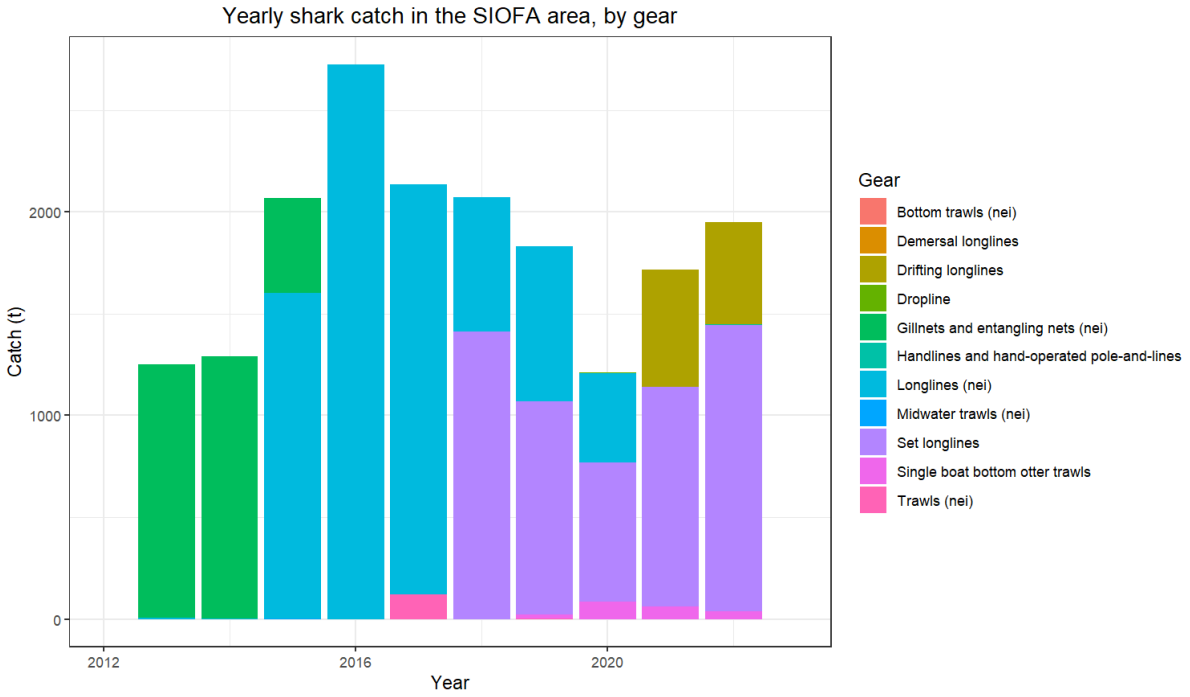


Figure 7 – Yearly catch of sharks in the SIOFA Area by gear type (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2022).

At its 8th annual meeting in 2023, the SIOFA Scientific Committee When reviewing the ecosystem summary, the SC noted that some shark bycatch data appeared to be missing from some of the figures of the Ecosystem Summary 2023 and requested the Secretariat t to resolve this issue when preparing the ecosystem summary for 2024. The Secretariat identified that the issue arose from the non-inclusion of observer-reported catches in the 2022 extract, and therefore also not in the Secretariat reports.

These data were extracted and released to the Science Officer in 2023, and are now included as Figure 8, so as not to lump them with the other types of data. Please note that observer-reported catches might overlap with catches recorded in the Aggregated and HBHCatchEffort databases.

Observer-reported shark (as defined in Appendix B) catches were first recorded in 2013, but were not consistently reported until 2018 (Figure 8~~Figure 8~~a). In most years shark catches were dominated by Portuguese dogfish (CYO), leafscale gulper shark (GUQ), and a substantial proportion of kitefin shark (SCK). The vast majority of observer-reported shark catches in the SIOFA Area occurred in Subarea 2 (Figure 8~~Figure 8~~b).

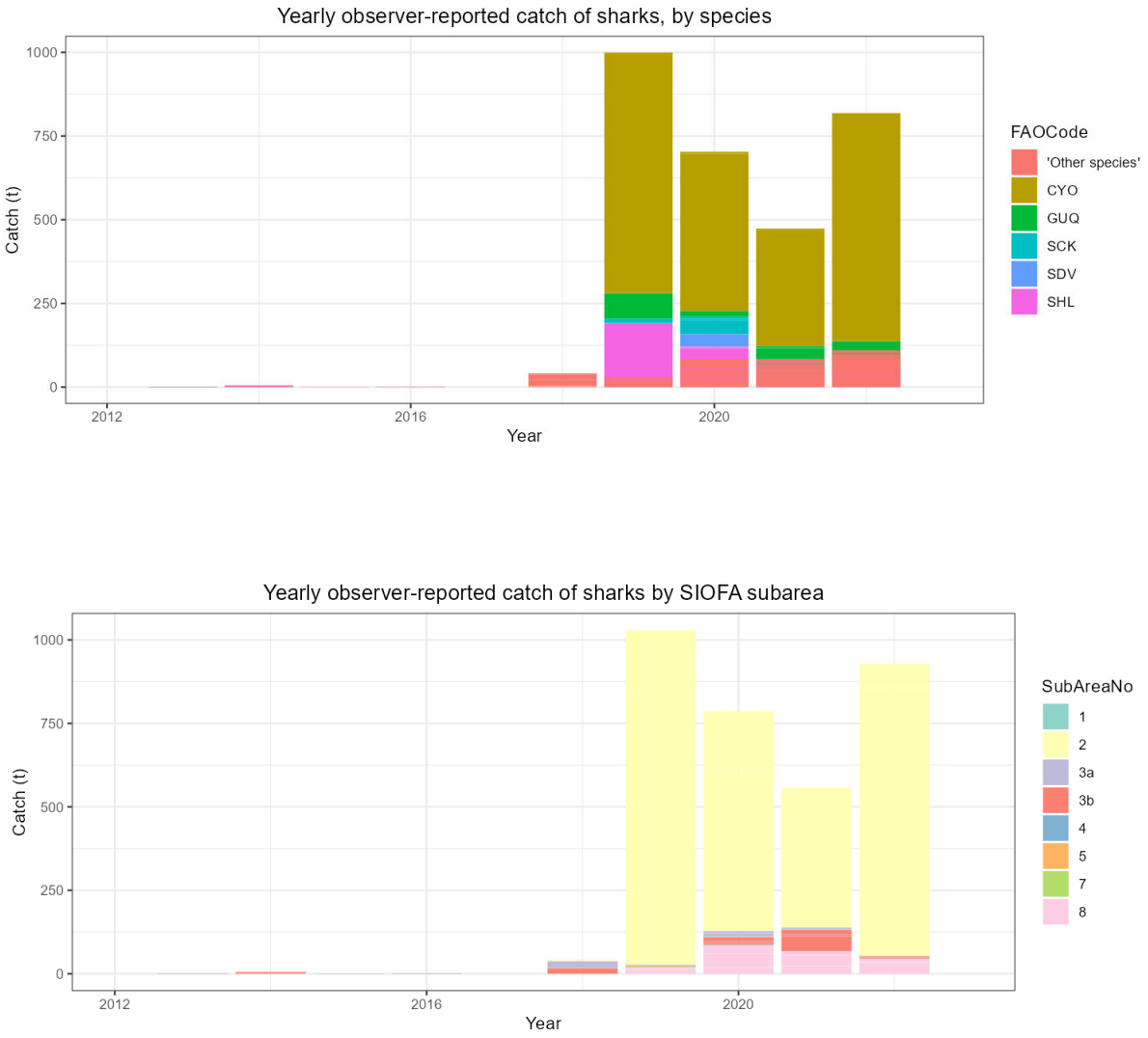


Figure 8a and b – Yearly observer-reported catch of sharks in the SIOFA Area by taxon (upper panel, a) and by SIOFA Subarea (lower panel, b) (source: SIOFA Observer databases 2012–2022). Only the top 5 species by weight (cumulatively in the full database) are shown individually (identified by their FAO species code, see Appendix B). All other species are grouped under 'other species.

A list of deep sea sharks considered to be at "high risk" and/or "of concern" is included in Annex 1 of SIOFA CMM 12(2023) (Conservation and Management Measure for Sharks). The following figures refer to the sharks listed in CMM 12(2023). This list is reproduced below in Table 3~~Table 3~~.

Table 3– Deep-sea shark taxa considered to be at "high risk" and/or "of concern" , as listed in Annex 1 of SIOFA CMM 12(2023) (Conservation and Management Measure for Sharks). Species considered to be at "high risk" are highlighted in bold.

FAO code	English common name	French common name	Scientific name
APD	Smallbelly catshark	Holbiche artouca	*Apristurus indicus*
BZL	Narrowhead catshark		*Bythaelurus tenuicephalus*
BZO	**Bach's catshark**		***Bythaelurus bachi***
CYO	Portuguese dogfish	Pailona commun	*Centroscymnus coelolepis*
CYP	**Longnose velvet dogfish**	**Pailona à long nez**	***Centroselachus crepidater***
CYU	**Plunket shark**	**Pailona austral**	***Scymnodon plunketi***
DCA	**Birdbeak dogfish**	**Squale savate**	***Deania calceus***
DWG	**Cristina's skate**		***Bathyraja tunae***
ETP	Smooth lanternshark	Sagre nain	*Etmopterus pusillus*
EZT	**Blue-eye lanternshark**		***Etmopterus viator***
EZU	Whitecheek lanternshark		*Etmopterus alphus*
ETB	**Blurred smooth lantern shark**		***Etmopterus bigelowi***
GUP	**Gulper shark**	**Squale-chagrin commun**	***Centrophorus granulosus***
GUQ	**Leafscale gulper shark**	**Squale-chagrin de l'Atlantique**	***Centrophorus squamosus***
CPU	**Little gulper shark**	**Petit squale-chagrin**	***Centrophorus uyato***
HCR	Pacific longnose chimaera	Chimère à nez rigide	*Harriotta raleighana*
HXC	**Frilled shark**	**Requin lézard**	***Chlamydoselachus anguineus***
HXN	Bigeyed sixgill shark	Requin-vache	*Hexanchus nakamurai*
LMO	**Goblin shark**	**Requin lutin**	***Mitsukurina owstoni***
QUK	**Shortspine spurdog**	**Aiguillat épinette**	***Squalus mitsukurii***
SDQ	**Longsnout dogfish**	**Squale-savate à long nez**	***Deania quadrispinosa***
SDU	**Arrowhead dogfish**	**Squale-savate lutin**	**Deania profundorum**
SCK	**Kitefin shark**	**Squale liche**	***Dalatias licha***
SSQ	**Velvet dogfish**		***Zameus squamulosus***
RFI	**Paddlenose chimaera**		***Rhinochimaera africana***
RZZ	**Southern sleeper shark**		***Somniosus antarcticus***
ZZC	**Dark-mouth chimaera**		***Chimaera buccanigella***
ZZD	**Falkor chimaera**		***Chimaera didierae***
ZZE	**Seafarer's ghost shark**		***Chimaera willwatchi***

Note that the CMM 2019/12 listed the scientific name of *Somniosus antarcticus* (FAO code RZZ) under the FAO code for *Somniosus pacificus* (SON), but only SON was recorded in the data, and likely represents a nomenclature discrepancy in CMM 2019/12. In CMM 12(2023), the *antarcticus* species code was updated to RZZ.

Please be advised that the nomenclature of Plunket's shark (*Centroscymnus plunketi*, CYU) has been officially revised in 2023 to largespine velvet dogfish (*Scymnodon macracanthus*, YSM). This change is not reflected in this report, which follows the nomenclature of CMM 12(2023), but the SIOFA Scientific Committee might want to recommend updating the nomenclature of the CMM and thus further updates of this report will reflect that change.

Please be advised that, following a request by SIOFA SC8, the Secretariat obtained FAO common names for Cristina's skate and paddlenose chimaera in early July 2023 and provided them to the CCPs in time for inclusion in the SIOFA CMM 12 revision at MoP10. However, FAO codes for these two species were obtained only in September 2023, and were thus not included in the Annex of the revised In CMM 12(2023). Note that these codes, included in Table 3, should be considered for a future inclusion in Annex 1 of SIOFA CMM 12.

Given the recent changes in shark species codes, combined with the changes in the list of species included in SIOFA CMM 12 Annex 1, the Secretariat further noted that there is a risk that some species data could be missed in the analyses, as the database contains obsolete or even contradictory codes. For the purpose of composing the following figures in a comprehensive way, all FAO codes of species included in Annex 1 of CMM 12 through its different iterations (2019, 2022, and 2023) were retained but this could create some confusion in reporting, thus supplementary figures have also been prepared to illustrate the differences in using the different Annexes of CMM 12. A revision and upgrade of the shark codes between the database and the CMM could solve this issue, and the SIOFA SC would be best placed to set up a consistent framework for this revision.

Catch of shark species considered to be at “high risk” and/or “of concern” (as defined in CMM 12(2023)) increased between 2013 and 2016 but has been decreasing thereafter (Figure 9~~Figure 9~~a). In most years Portuguese dogfish (CYO) was the most commonly caught species on this list, with a significant presence of kitefin shark (SCK) until 2019 (Figure 9~~Figure 9~~a). The vast majority of catches of shark at “high risk” and/or “of concern” in the SIOFA Area came from Subarea 2 (Figure 9~~Figure 9~~b).

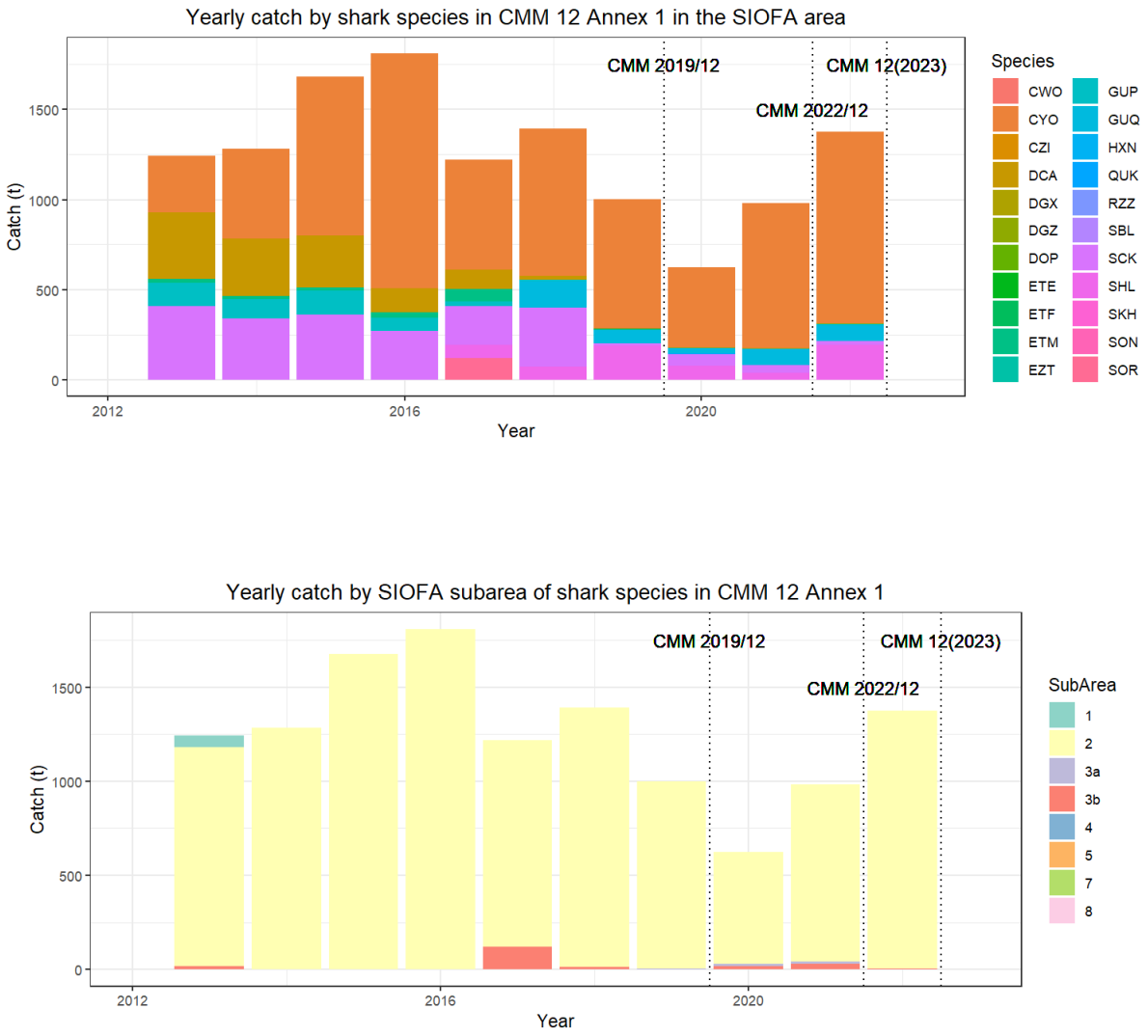


Figure 9a and b – Yearly catch in the SIOFA Area of sharks considered to be at "high risk" and/or "of concern" as included in Annex 1 of SIOFA CMM 12 (Conservation and Management Measure for Sharks). Catches are summarised by species (upper panel, a) and by SIOFA Subarea (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2022). Species are identified by their FAO species code (see Table 3 for disambiguation). Figures D.1~~2~~a and b in Appendix D provide information on species caught separating the different versions of the CMM.

8. Discards and bycatch

In SIOFA fisheries most of the catch (both target and bycatch) is retained and landed, with small proportion being discarded at sea. The SIOFA CatchEffort database records the fate of catch per species, aggregated at different levels, which enables an analysis of the proportion discarded.

Discards typically involve non-commercial species in the bycatch and undersized or damaged fish in the target catch.

Discards have historically been a very minor proportion of the total bycatch (Figure 10~~Figure 10~~a), and consequently an even smaller proportion of total catch. In absolute terms, only up to around 100 t of catch is discarded per year, but discards were much higher in 2015, when they were more than 1500 t (Figure 10~~Figure 10~~b). Note that, in this figure, discards also include sharks.

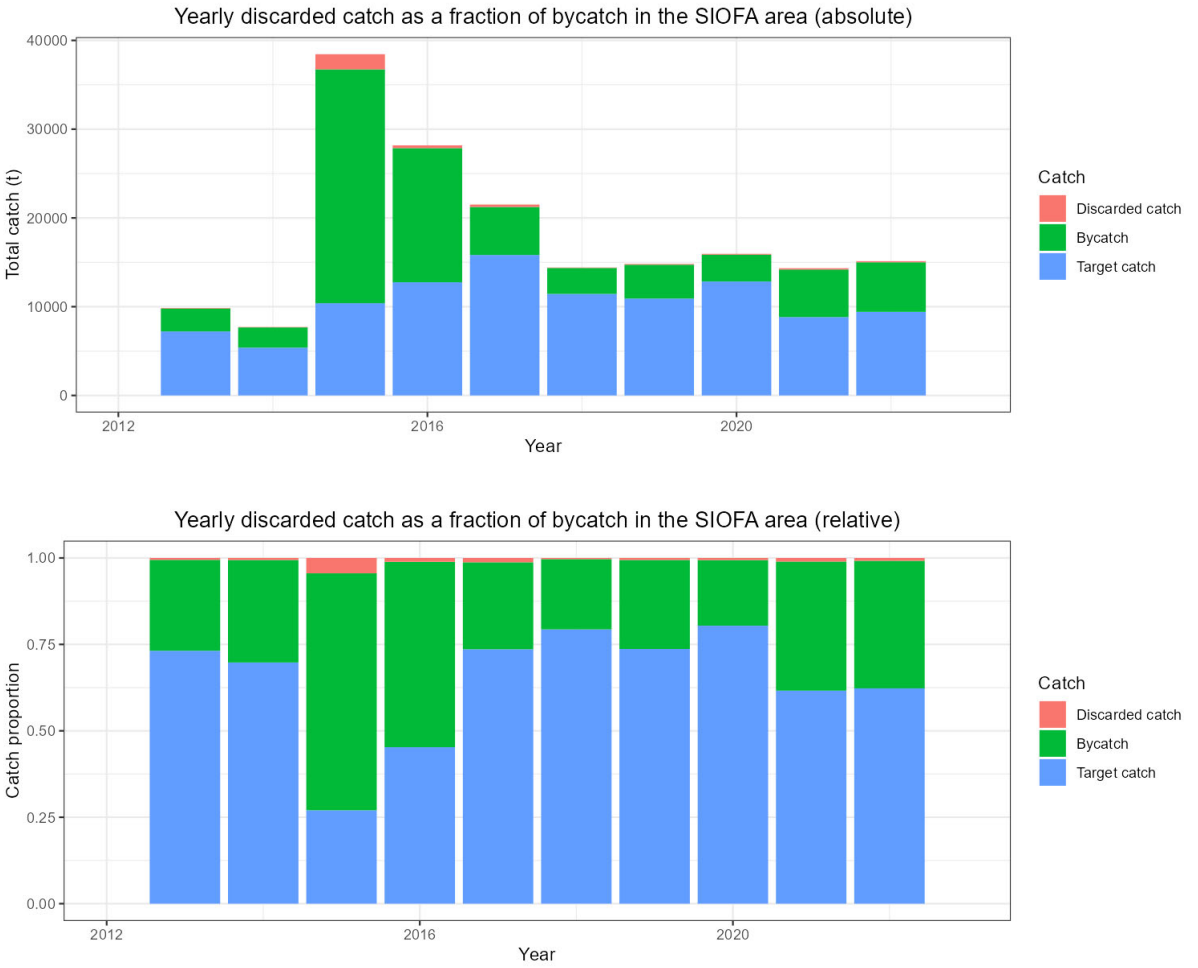


Figure 10a and b – Catch, bycatch and discards (including of sharks) as absolute weights (upper panel, a) and relative proportions (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2022). Catches reported without spatial information are not included.

Given the high number of species, and imperfect taxonomic reporting, estimates of discards by species was not easy to determine. The high discards recorded in 2015 were recorded as an 'unspecified marine species' (MZZ) which was also reported in 2016 and 2017 (Figure 11~~Figure 11~~). The most heavily discarded species that was identified to species level (in 2017) was little sleeper shark (SOR) (Figure 11~~Figure 11~~).

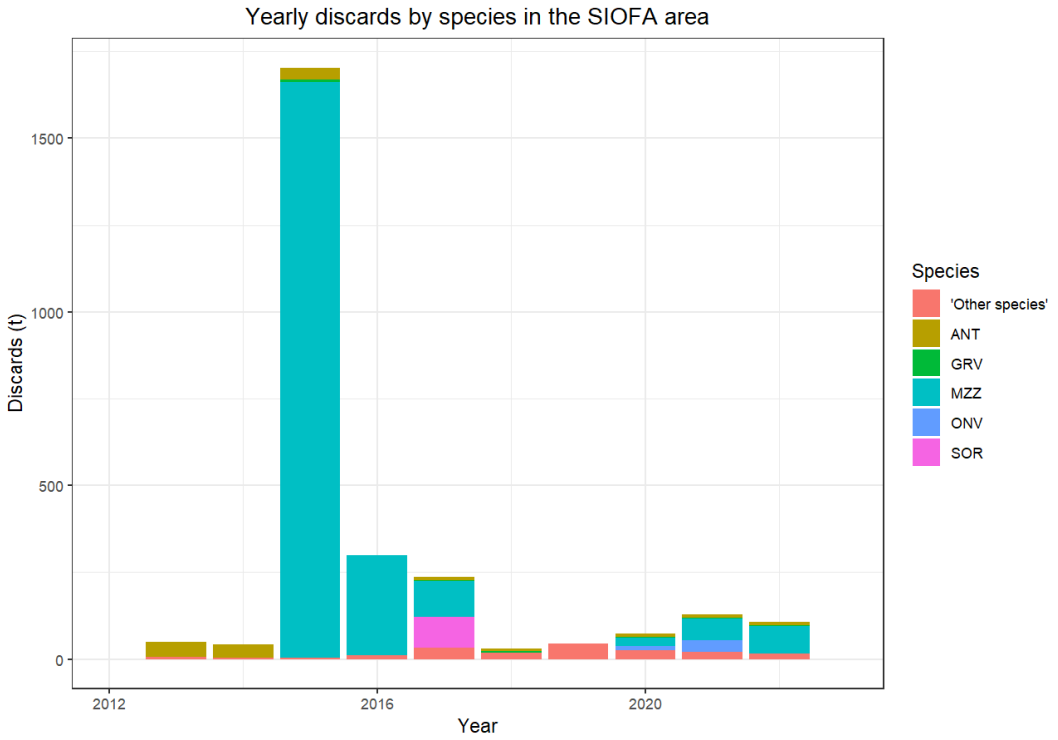


Figure 11 – Yearly discards in the SIOFA Area by species (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2020) Only the top 5 species by weight (cumulatively in the full database) are recorded (indicated by their FAO species code, see Appendix B). All other species are grouped and recorded as 'other species'. See ~~Figure~~ Table D.~~4~~7 in Appendix D for a full account of all discarded species.

9. Interactions with seabirds, marine mammals, turtles, and with sharks considered to be at high risk and/or of concern

Only incidental captures of seabirds, marine mammals, turtles, and sharks considered to be at high risk and/or concern are reported in the SIOFA Scientific Observer database, and the following sections have drawn from this database to explore the number and locations of these interactions.

Incidental captures of other species (e.g., of sharks) are also recorded in the SIOFA CatchEffort database but are not reported here. Note that 8 capture records contained wrong codes, these were excluded from further analysis for the time being, pending clarifications from one of the CCPs.

Figure 12 shows the reported locations of incidental captures (Figure 12~~Figure 12~~a) and observations (Figure 12~~Figure 12~~b) of seabirds, mammals, turtles and sharks considered to be at high risk and/or concern (i.e., included in SIOFA CMM 12) in the SIOFA Area as recorded by Scientific Observers.

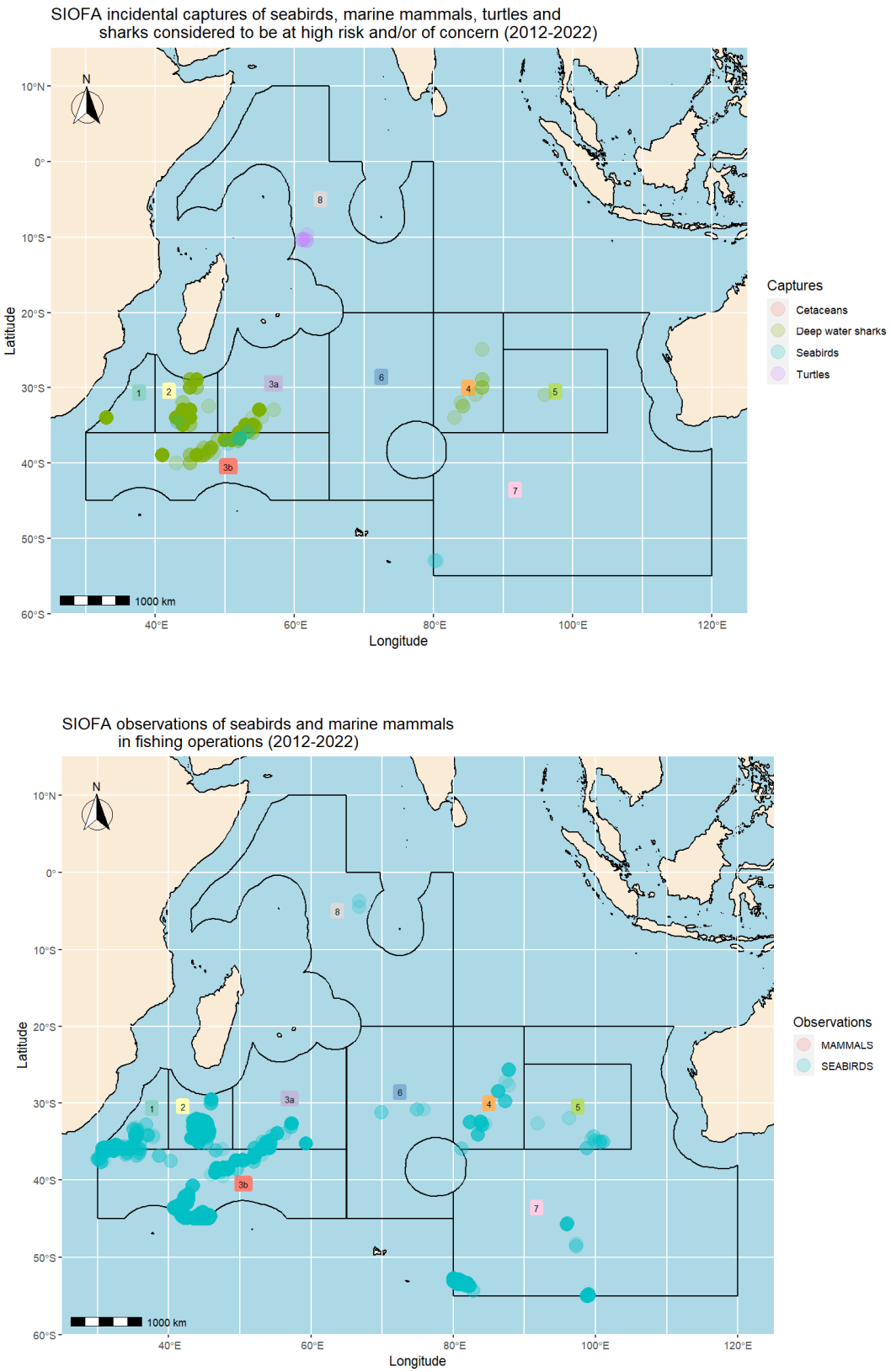


Figure 12a and b – Reported locations of incidental captures (a, upper) and observations (b, lower) of seabirds, mammals, turtles and sharks considered to be "at high risk" and/or "of concern", as defined in Annex 1 of CMM 12(2023), in the SIOFA Area, as recorded by SIOFA Scientific Observers (source: SIOFA Observer database 2012–2022).

9.1 Seabirds

This Summary uses official FAO taxonomic nomenclature (i.e. common and scientific names) for seabirds, but please note that this might not always correspond to the nomenclature used e.g. by ACAP.

9.1.1 Incidental captures

Only a small number of seabird captures have been reported in SIOFA fisheries, these numbers might be different than those submitted in national reports as the data has not been submitted to the SIOFA Secretariat.

From 2007-2022 there have been 15 seabird captures reported by Scientific Observers in the SIOFA Area as summarised below in Table 4~~Table 4~~.

Table 4 - Incidental captures of seabirds for which interactions have been reported (source: SIOFA Observer database 2012–2022).

Year	Common name	Scientific name	Captures	Status at release	Gear
2009	Wedge-tailed shearwater	*Puffinus pacificus*	1	Dead	Single boat midwater otter trawls
2012	Hall's giant petrel	*Macronectes halli*	1	Dead	Single boat bottom otter trawls
2013	White-chinned petrel	*Procellaria aequinoctialis*	1	Unknown	Single boat midwater otter trawls
2014	White-faced storm petrel	*Pelagodroma marina*	1	Alive	Single boat midwater otter trawls
2016	White-chinned petrel	*Procellaria aequinoctialis*	1	Unknown	Set longlines
2019	Antarctic giant petrel	*Macronectes giganteus*	2	Unknown	Set longlines
2020	Black-browed albatross	*Thalassarche melanophrys*	1	Dead	Set longlines
2020	White-chinned petrel	*Procellaria aequinoctialis*	2	Dead	Set longlines
2021	Black-browed albatross	*Thalassarche melanophrys*	1	Dead	Midwater trawls (nei)
2021	White-chinned petrel	*Procellaria aequinoctialis*	4	Unknown	Set longlines

9.1.2 Abundance observed around fishing operations

The abundance and species of seabirds around fishing operations has been recorded on individual fishing events by Scientific Observers starting from 2007. Table 5~~Table 5~~ shows the total numbers of seabirds recorded by Scientific Observers, per species, across all fishing events of each year.

Note that there are 2523 records of seabirds observations without any information on species names in the SIOFA Observers database 2019–2022. These represent observations of seabirds around fishing vessel without species identification and are therefore not listed in Table 5. This Summary uses official FAO taxonomic nomenclature (i.e. common and scientific names) for seabirds, but please note that this might not always correspond to the nomenclature used e.g. by ACAP.

Table 5 - Numbers of seabirds observed around fishing operations per species and year (source: SIOFA Observer database 2012–2022). Species nomenclature follows FAO ASFIS codes and might not correspond to other conventions (e.g. ACAP nomenclature).

Year	Common name	Scientific name	Fishing gear	Abundance
2007	Atlant. yellow-nosed albatross	*Thalassarche chlororhynchos*	Single boat bottom otter trawls	50
2007	Black-browed albatross	*Thalassarche melanophris*	Single boat bottom otter trawls	6
2007	Wandering albatross	*Diomedea exulans*	Single boat bottom otter trawls	26
2007	White-chinned petrel	*Procellaria aequinoctialis*	Single boat bottom otter trawls	536
2008	Albatrosses nei	*Diomedeidae*	Single boat bottom otter trawls	31
2008	Atlant. yellow-nosed albatross	*Thalassarche chlororhynchos*	Single boat bottom otter trawls	5
2008	B/W bellied storm petrels nei	*Fregetta spp*	Single boat bottom otter trawls	1
2008	Black-browed albatross	*Thalassarche melanophris*	Single boat bottom otter trawls	21
2008	Cape petrel	*Daption capense*	Single boat bottom otter trawls	35
2008	Giant petrels nei	*Macronectes spp*	Single boat bottom otter trawls	22
2008	Grey petrel	*Procellaria cinerea*	Single boat bottom otter trawls	4
2008	Light-mantled sooty albatross	*Phoebetria palpebrata*	Single boat bottom otter trawls	2
2008	Shy albatross	*Thalassarche cauta*	Single boat bottom otter trawls	21
2008	Sooty albatross	*Phoebetria fusca*	Single boat bottom otter trawls	1
2008	Wandering albatross	*Diomedea exulans*	Single boat bottom otter trawls	3

Year	Common name	Scientific name	Fishing gear	Abundance
2008	White-chinned petrel	*Procellaria aequinoctialis*	Single boat bottom otter trawls	8
2010	Albatrosses nei	*Diomedeidae*	Single boat bottom otter trawls	104
2010	Atlant. yellow-nosed albatross	*Thalassarche chlororhynchos*	Single boat bottom otter trawls	322
2010	Hall's giant petrel	*Macronectes halli*	Single boat bottom otter trawls	8
2010	Petrels nei	*Procellaria spp*	Single boat bottom otter trawls	6223
2010	Wandering albatross	*Diomedea exulans*	Single boat bottom otter trawls	113
2010	White-chinned petrel	*Procellaria aequinoctialis*	Single boat bottom otter trawls	1
2011	Albatrosses nei	*Diomedeidae*	Single boat bottom otter trawls	18
2011	Antarctic giant petrel	*Macronectes giganteus*	Single boat bottom otter trawls	12
2011	Atlant. yellow-nosed albatross	*Thalassarche chlororhynchos*	Single boat bottom otter trawls	44
2011	Cape petrel	*Daption capense*	Single boat bottom otter trawls	184
2011	Giant petrels nei	*Macronectes spp*	Single boat bottom otter trawls	82
2011	Grey petrel	*Procellaria cinerea*	Single boat bottom otter trawls	2
2011	Shy albatross	*Thalassarche cauta*	Single boat bottom otter trawls	82
2011	Wandering albatross	*Diomedea exulans*	Single boat bottom otter trawls	166
2011	White-chinned petrel	*Procellaria aequinoctialis*	Single boat bottom otter trawls	306
2011	Wilson's storm petrel	*Oceanites oceanicus*	Single boat bottom otter trawls	2
2019	Antarctic giant petrel	*Macronectes giganteus*	Set longlines	18570
2019	Black-browed albatross	*Thalassarche melanophris*	Set longlines	1140
2019	Cape petrel	*Daption capense*	Set longlines	15298
2019	Hall's giant petrel	*Macronectes halli*	Set longlines	1155
2019	Indian yellow-nosed albatross	*Thalassarche carteri*	Set longlines	34
2019	Prions nei	*Pachyptila spp*	Set longlines	3
2019	Seabirds nei		Set longlines	542
2019	Shy albatross	*Thalassarche cauta*	Set longlines	1956
2019	Southern royal albatross	*Diomedea epomophora*	Set longlines	1
2019	Wandering albatross	*Diomedea exulans*	Set longlines	4992
2019	White-chinned petrel	*Procellaria aequinoctialis*	Set longlines	2050
2019	Wilson's storm petrel	*Oceanites oceanicus*	Set longlines	8

Year	Common name	Scientific name	Fishing gear	Abundance
2020	Albatrosses nei	*Diomedeidae*	Set longlines	11
2020	Antarctic giant petrel	*Macronectes giganteus*	Set longlines	3953
2020	Antarctic petrel	*Thalassoica antarctica*	Set longlines	3
2020	Atlant. yellow-nosed albatross	*Thalassarche chlororhynchos*	Set longlines	2
2020	Black-bellied storm petrel	*Fregetta tropica*	Set longlines	568
2020	Black-browed albatross	*Thalassarche melanophris*	Set longlines	4633
2020	Brown skua	*Stercorarius antarcticus*	Set longlines	2
2020	Buller's albatross	*Thalassarche bulleri*	Vertical lines	4
2020	Cape petrel	*Daption capense*	Set longlines	5686
2020	Giant petrels nei	*Macronectes spp*	Set longlines	365
2020	Great shearwater	*Puffinus gravis*	Set longlines	1
2020	Great skua	*Catharacta skua*	Set longlines	2
2020	Grey-headed albatross	*Thalassarche chrysostoma*	Set longlines	1
2020	Grey petrel	*Procellaria cinerea*	Set longlines	156
2020	Hall's giant petrel	*Macronectes halli*	Set longlines	10295
2020	Indian yellow-nosed albatross	*Thalassarche carteri*	Set longlines	231
2020	Light-mantled sooty albatross	*Phoebetria palpebrata*	Set longlines	29
2020	Prions nei	*Pachyptila spp*	Set longlines	151
2020	Seabirds nei		Set longlines	315
2020	Seabirds nei		Trawls (nei)	6065
2020	Shy albatross	*Thalassarche cauta*	Set longlines	1893
2020	Sooty albatross	*Phoebetria fusca*	Set longlines	16
2020	Southern fulmar	*Fulmarus glacialoides*	Set longlines	5
2020	Wandering albatross	*Diomedea exulans*	Set longlines	10987
2020	Wandering albatross	*Diomedea exulans*	Vertical lines	9
2020	White-chinned petrel	*Procellaria aequinoctialis*	Set longlines	21429
2020	White-chinned petrel	*Procellaria aequinoctialis*	Vertical lines	19
2020	Wilson's storm petrel	*Oceanites oceanicus*	Set longlines	100
2021	Albatrosses nei	*Diomedeidae*	Set longlines	10

Year	Common name	Scientific name	Fishing gear	Abundance
2021	Albatrosses nei	*Diomedeidae*	Single boat bottom otter trawls	13
2021	Amsterdam Island albatross	*Diomedea amsterdamensis*	Set longlines	20
2021	Antarctic giant petrel	*Macronectes giganteus*	Drifting longlines	64
2021	Antarctic giant petrel	*Macronectes giganteus*	Set longlines	5655
2021	Atlant. yellow-nosed albatross	*Thalassarche chlororhynchos*	Single boat bottom otter trawls	37
2021	Black-browed albatross	*Thalassarche melanophris*	Set longlines	5602
2021	Black-browed albatross	*Thalassarche melanophris*	Single boat bottom otter trawls	26
2021	Blue petrel	*Halobaena caerulea*	Set longlines	16
2021	Buller's albatross	*Thalassarche bulleri*	Set longlines	21
2021	Cape petrel	*Daption capense*	Drifting longlines	382
2021	Cape petrel	*Daption capense*	Set longlines	145
2021	Fairy prion	*Pachyptila turtur*	Set longlines	4
2021	Giant petrels nei	*Macronectes spp*	Set longlines	176
2021	Grey-headed albatross	*Thalassarche chrysostoma*	Set longlines	2
2021	Hall's giant petrel	*Macronectes halli*	Set longlines	2630
2021	Indian yellow-nosed albatross	*Thalassarche carteri*	Drifting longlines	104
2021	Indian yellow-nosed albatross	*Thalassarche carteri*	Set longlines	3340
2021	Light-mantled sooty albatross	*Phoebetria palpebrata*	Drifting longlines	8
2021	Light-mantled sooty albatross	*Phoebetria palpebrata*	Set longlines	3
2021	Parkinson's petrel	*Procellaria parkinsoni*	Set longlines	380
2021	Seabirds nei		Set longlines	32
2021	Shy albatross	*Thalassarche cauta*	Set longlines	35
2021	Sooty albatross	*Phoebetria fusca*	Drifting longlines	9
2021	Sooty albatross	*Phoebetria fusca*	Set longlines	1
2021	Sooty shearwater	*Puffinus griseus*	Set longlines	8
2021	Southern royal albatross	*Diomedea epomophora*	Set longlines	2154
2021	Wandering albatross	*Diomedea exulans*	Drifting longlines	22
2021	Wandering albatross	*Diomedea exulans*	Set longlines	16352
2021	Wandering albatross	*Diomedea exulans*	Single boat bottom otter trawls	131

Year	Common name	Scientific name	Fishing gear	Abundance
2021	White-chinned petrel	*Procellaria aequinoctialis*	Drifting longlines	180
2021	White-chinned petrel	*Procellaria aequinoctialis*	Set longlines	25900
2021	White-chinned petrel	*Procellaria aequinoctialis*	Single boat bottom otter trawls	683
2021	Wilson's storm petrel	*Oceanites oceanicus*	Set longlines	1
2022	Antarctic giant petrel	*Macronectes giganteus*	Drifting longlines	5
2022	Antarctic giant petrel	*Macronectes giganteus*	Set longlines	23375
2022	Atlant. yellow-nosed albatross	*Thalassarche chlororhynchos*	Set longlines	1
2022	Black-browed albatross	*Thalassarche melanophris*	Demersal longlines	261
2022	Black-browed albatross	*Thalassarche melanophris*	Drifting longlines	15
2022	Black-browed albatross	*Thalassarche melanophris*	Set longlines	2482
2022	Boobies and gannets nei	*Sulidae*	Drifting longlines	4
2022	Cape petrel	*Daption capense*	Demersal longlines	199
2022	Cape petrel	*Daption capense*	Drifting longlines	343
2022	Cape petrel	*Daption capense*	Set longlines	3725
2022	Cape petrel	*Daption capense*	Trawls (nei)	53
2022	Flesh-footed shearwater	*Puffinus carneipes*	Drifting longlines	12
2022	Giant petrels nei	*Macronectes spp*	Demersal longlines	374
2022	Giant petrels nei	*Macronectes spp*	Set longlines	155
2022	Great-winged petrel	*Pterodroma macroptera*	Trawls (nei)	39
2022	Grey-headed albatross	*Thalassarche chrysostoma*	Demersal longlines	3
2022	Grey petrel	*Procellaria cinerea*	Set longlines	1
2022	Grey petrel	*Procellaria cinerea*	Trawls (nei)	79
2022	Hall's giant petrel	*Macronectes halli*	Set longlines	838
2022	Hall's giant petrel	*Macronectes halli*	Trawls (nei)	226
2022	Indian yellow-nosed albatross	*Thalassarche carteri*	Drifting longlines	718
2022	Indian yellow-nosed albatross	*Thalassarche carteri*	Set longlines	1620
2022	Indian yellow-nosed albatross	*Thalassarche carteri*	Trawls (nei)	4
2022	Leach's storm-petrel	*Oceanodroma leucorhoa*	Drifting longlines	1
2022	Light-mantled sooty albatross	*Phoebetria palpebrata*	Demersal longlines	23

Year	Common name	Scientific name	Fishing gear	Abundance
2022	Parkinson's petrel	*Procellaria parkinsoni*	Set longlines	79
2022	Prions nei	*Pachyptila spp*	Demersal longlines	79
2022	Prions nei	*Pachyptila spp*	Set longlines	77
2022	Prions nei	*Pachyptila spp*	Trawls (nei)	16
2022	Salvin's albatross	*Thalassarche salvini*	Drifting longlines	130
2022	Seabirds nei		Demersal longlines	8
2022	Seabirds nei		Set longlines	184
2022	Seabirds nei		Trawls (nei)	3103
2022	Shearwaters nei	*Puffinus spp*	Set longlines	425
2022	Shy albatross	*Thalassarche cauta*	Set longlines	1730
2022	Shy albatross	*Thalassarche cauta*	Trawls (nei)	130
2022	Sooty albatross	*Phoebetria fusca*	Drifting longlines	1
2022	Southern fulmar	*Fulmarus glacialoides*	Demersal longlines	13
2022	Southern royal albatross	*Diomedea epomophora*	Set longlines	1384
2022	Wandering albatross	*Diomedea exulans*	Demersal longlines	112
2022	Wandering albatross	*Diomedea exulans*	Drifting longlines	183
2022	Wandering albatross	*Diomedea exulans*	Set longlines	16492
2022	Wandering albatross	*Diomedea exulans*	Trawls (nei)	168
2022	White-capped albatross	*Thalassarche steadi*	Drifting longlines	6
2022	White-chinned petrel	*Procellaria aequinoctialis*	Demersal longlines	485
2022	White-chinned petrel	*Procellaria aequinoctialis*	Drifting longlines	1441
2022	White-chinned petrel	*Procellaria aequinoctialis*	Set longlines	25690

Table 6~~Table 6~~ summarizes the number of records where observers did not detect birds around fishing operations (0 detection events), grouped by type of fishing gear. Due to the missing linkages between the CatchEffort and the Observer database it is impossible to determine the share of fishing events observed for seabirds presence on the total of fishing events.

Table 6 - Records where observers did not detect birds around fishing operations (0 detection events) in 2020–2022, by gear (source: SIOFA Observer database 2012–2022).

Year	Fishing gear	Fishing events observed with no seabirds reported	Fishing events observed with seabirds reported	Share of events observed with no seabirds reported (%)
2020	Handlines and hand-operated pole-and-lines	134	0	100
2020	Set longlines	88	1475	5.6
2020	Single boat bottom otter trawls	464	0	100
2020	Trawls (nei)	0	294	0
2020	Vertical lines	6	6	50
2021	Drifting longlines	0	41	0
2021	Set longlines	65	876	6.9
2021	Single boat bottom otter trawls	3	28	9.7
2022	Bottom trawls (nei)	984	0	100
2022	Demersal longlines	0	125	0
2022	Drifting longlines	0	279	0
2022	Set longlines	8	1047	0.8
2022	Trawls (nei)	2	207	1

Not all fishing events were observed for seabirds presence, and Table 7~~Table 7~~ summarizes at least the total number of events that were not observed per each year. Due to the missing linkages between the CatchEffort and the Observer database it is impossible to determine the share of fishing events observed for seabirds presence on the total of fishing events.

Table 7 - Fishing events that were not observed for bird presence around fishing operations in 2020–2022 (source: SIOFA Observer database 2012–2022).

Year	Fishing gear	Fishing events not observed for seabirds presence
2020	Set longlines	68
2021	Set longlines	160
2022	Set longlines	91

9.2 Marine turtles

Four incidental captures of marine turtles have been reported in SIOFA fisheries, in 2019 and 2020 (Table 8~~Table 8~~).

Table 8 - Reported Incidental captures of marine turtles (source: SIOFA Observer database 2012–2022).

Year	Common name	Scientific name	Fishing gear	Captures	Status at release
2019	Hawksbill turtle	*Eretmochelys imbricata*	Handlines and hand-operated pole-and-lines	1	Unknown
2020	Leatherback turtle	*Dermochelys coriacea*	Single boat bottom otter trawls	3	Alive
2021	Leatherback turtle	*Dermochelys coriacea*	Single boat bottom otter trawls	1	Alive
2022	Leatherback turtle	*Dermochelys coriacea*	Bottom trawls (nei)	2	Unknown
2022	Leatherback turtle	*Dermochelys coriacea*	Single boat bottom otter trawls	2	Unknown

9.3 Marine mammals

9.3.1 Incidental captures

Only a single incidental capture of a marine mammal has been reported in SIOFA fisheries, in 2012 (Table 9~~Table 9~~).

Table 9 - Reported Incidental captures of marine mammals (source: SIOFA Observer database 2012–2022).

Year	Common Name	Scientific Name	Captures	Status at release	Fishing Gear
2012	Sperm whale	*Physeter macrocephalus*	1	Alive	Single boat bottom otter trawls

9.3.2 Abundance observed around fishing operations

Marine mammal presence around fishing operations were first recorded in 2021 and significantly increased in 2022 (Table 10~~Table 10~~).

Table 10 - Observations of marine mammals around fishing operations (source: SIOFA Observer database 2012–2022).

Year	Common name	Scientific name	Fishing gear	Abundance
2021	Antarctic minke whale	*Balaenoptera bonaerensis*	Set longlines	3
2022	Long-finned pilot whale	*Globicephala melas*	Set longlines	240

9.4 Shark captures of species considered to be at high risk and/or of concern

This summary reports captures of sharks considered to be "at high risk" and/or "of concern", as defined in Annex 1 of CMM 12(2023). However, these shark captures have only been occasionally recorded in the SIOFA Observer database, as shark captures were able to be targeted before 10 October 2019 and were reported in the CatchEffort database (summarised in Section 5.2 and Figure 7~~Figure 7~~ above) instead of in the Observer database. For completeness, shark captures recorded in the Observer database are shown in Table 11~~Table 11~~, but these data cannot be considered a reliable indicator of actual numbers of captures (e.g., see Figure 7~~Figure 7~~).

Note that discussions during the 8th meeting of the SIOFA Scientific Committee suggested the possibility of data from the Secretariat records being incomplete, in particular those of observer reported captures of sharks included in Annex 1 of CMM 12(2023). This issue has been resolved in the SIOFA Ecosystem Summary 2024.

Table 11 - Incidental captures of sharks considered to be "at high risk" and/or "of concern", as defined in Annex 1 of CMM 12(2023) for which interactions have been reported via the Observer database (source: SIOFA Observer database 2012–2022).

Year	Fishing gear	Common name	Scientific name	Captures
2016	Midwater trawls (nei)	Birdbeak dogfish	*Deania calcea*	1
2016	Midwater trawls (nei)	Kitefin shark	*Dalatias licha*	1
2017	Midwater trawls (nei)	Birdbeak dogfish	*Deania calcea*	2
2017	Midwater trawls (nei)	Kitefin shark	*Dalatias licha*	3
2017	Midwater trawls (nei)	Portuguese dogfish	*Centroscymnus coelolepis*	1
2018	Bottom trawls (nei)	Birdbeak dogfish	*Deania calcea*	297
2018	Bottom trawls (nei)	Frilled shark	*Chlamydoselachus anguineus*	1
2018	Bottom trawls (nei)	Goblin shark	*Mitsukurina owstoni*	2
2018	Bottom trawls (nei)	Gulper shark	*Centrophorus granulosus*	67
2018	Bottom trawls (nei)	Kitefin shark	*Dalatias licha*	120
2018	Bottom trawls (nei)	Longnose velvet dogfish	*Centroscymnus crepidater*	217
2018	Bottom trawls (nei)	Pacific longnose chimaera	*Harriotta raleighana*	30
2018	Bottom trawls (nei)	Plunket shark	*Centroscymnus plunketi*	76
2018	Bottom trawls (nei)	Portuguese dogfish	*Centroscymnus coelolepis*	34
2018	Bottom trawls (nei)	Southern lanternshark(Lucifer)	*Etmopterus granulosus*	4966
2018	Bottom trawls (nei)	Velvet dogfish	*Scymnodon squamulosus*	9
2018	Midwater trawls (nei)	Birdbeak dogfish	*Deania calcea*	53
2018	Midwater trawls (nei)	Gulper shark	*Centrophorus granulosus*	2
2018	Midwater trawls (nei)	Kitefin shark	*Dalatias licha*	47
2018	Midwater trawls (nei)	Longnose velvet dogfish	*Centroscymnus crepidater*	15
2018	Midwater trawls (nei)	Pacific sleeper shark	*Somniosus pacificus*	1
2018	Midwater trawls (nei)	Plunket shark	*Centroscymnus plunketi*	1
2018	Midwater trawls (nei)	Portuguese dogfish	*Centroscymnus coelolepis*	2
2018	Midwater trawls (nei)	Southern lanternshark(Lucifer)	*Etmopterus granulosus*	143
2018	Midwater trawls (nei)	Velvet dogfish	*Scymnodon squamulosus*	5
2019	Midwater trawls (nei)	Kitefin shark	*Dalatias licha*	9
2019	Midwater trawls (nei)	Leafscale gulper shark	*Centrophorus squamosus*	1

Year	Fishing gear	Common name	Scientific name	Captures
2019	Midwater trawls (nei)	Smooth lanternshark	*Etmopterus pusillus*	82
2019	Midwater trawls (nei)	Southern lanternshark(Lucifer)	*Etmopterus granulosus*	1
2019	Midwater trawls (nei)	Southern sleeper shark	*Somniosus antarcticus*	1
2020	Midwater trawls (nei)	Kitefin shark	*Dalatias licha*	4
2021	Midwater trawls (nei)	Kitefin shark	*Dalatias licha*	4
2021	Midwater trawls (nei)	Leafscale gulper shark	*Centrophorus squamosus*	2
2022	Midwater trawls (nei)	Leafscale gulper shark	*Centrophorus squamosus*	2
2022	Single boat bottom otter trawls	Bigeyed sixgill shark	*Hexanchus nakamurai*	7
2022	Trawls (nei)	Birdbeak dogfish	*Deania calcea*	2
2022	Trawls (nei)	Longnose velvet dogfish	*Centroscymnus crepidater*	4
2022	Trawls (nei)	Southern lanternshark(Lucifer)	*Etmopterus granulosus*	336

10. Interactions with the seafloor and benthic organisms

A particular focus in the work of the SIOFA Scientific Committee has been the interaction of fisheries with the seafloor and its benthic organisms. This followed a specific mandate included in CMM 01(2023), which required the Scientific Committee to develop and provide advice and recommendations to the Meeting of the Parties to define the maximum extent of an appropriate SIOFA bottom fishing footprint (i.e., a map of the spatial extent of historical bottom fishing in the Agreement Area, for all vessels flagged to all CCPs). Furthermore, VME presence in the SIOFA Area is being investigated, and the SIOFA Scientific Committee is planning to elaborate its scientific advice on management of VMEs for the Meeting of the Parties to consider.

10.1 SIOFA bottom fishing footprint

The 7th meeting of the SIOFA Scientific Committee endorsed a map of the spatial extent of historical bottom fishing in the SIOFA Area, as presented at PAEWG4 (Figure 13~~Figure 13~~, para 180 of the SC7 Report). The footprint shown in this figure includes midwater trawling fishing activities. The Scientific Committee also recommended that further work was needed to clarify whether national data was properly accounted for in the PAEWG4 footprint shown here and that heatmaps of fishing activity be developed.

The 9th Meeting of the Parties of SIOFA (MoP9) noted that there was still outstanding work on the footprint recommended by 7th meeting of the Scientific Committee but recommended that this estimate of the footprint be adopted on an interim basis until the Scientific Committee can update it (para 113 of the MoP9 Report). However, MoP9 also decided that midwater trawling was not to be considered bottom fishing for the purposes of defining the footprint (Annex I of the MoP9 Report).

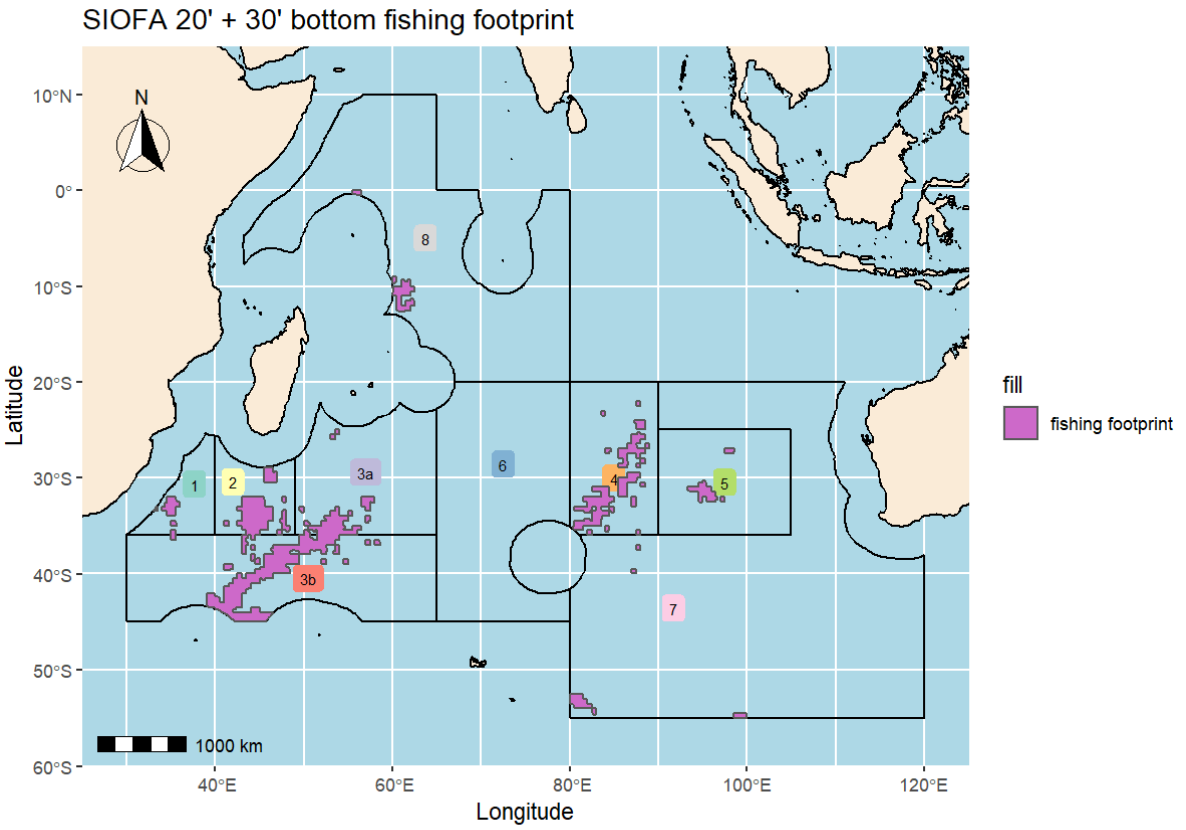


Figure 13 – SIOFA bottom fishing interim footprint map derived from recent (2016–2020) set level and aggregated historical (1998–2015) fishing data, at a hybrid 20' x 30' square resolution (sources: SIOFA HBHCatchEffort 1998–2020, and SIOFA spatial layers, edited from the SC7 final report and PAEWG-04-12 versions

for clarity). Note that because actual fishing events are narrower than the spatial resolution at which the data are summarised, the combined area of the cells will exceed the area of the actual fishery footprint.

After removing midwater trawls, and accounting for the national data provided by SIOFA CCPs for the purpose of updating the mapped footprint, the Interim Footprint map endorsed at MoP9 was revised (Figure 14~~Figure 14~~) and the overall footprint area increased marginally (6%) and shifted in its relative position.

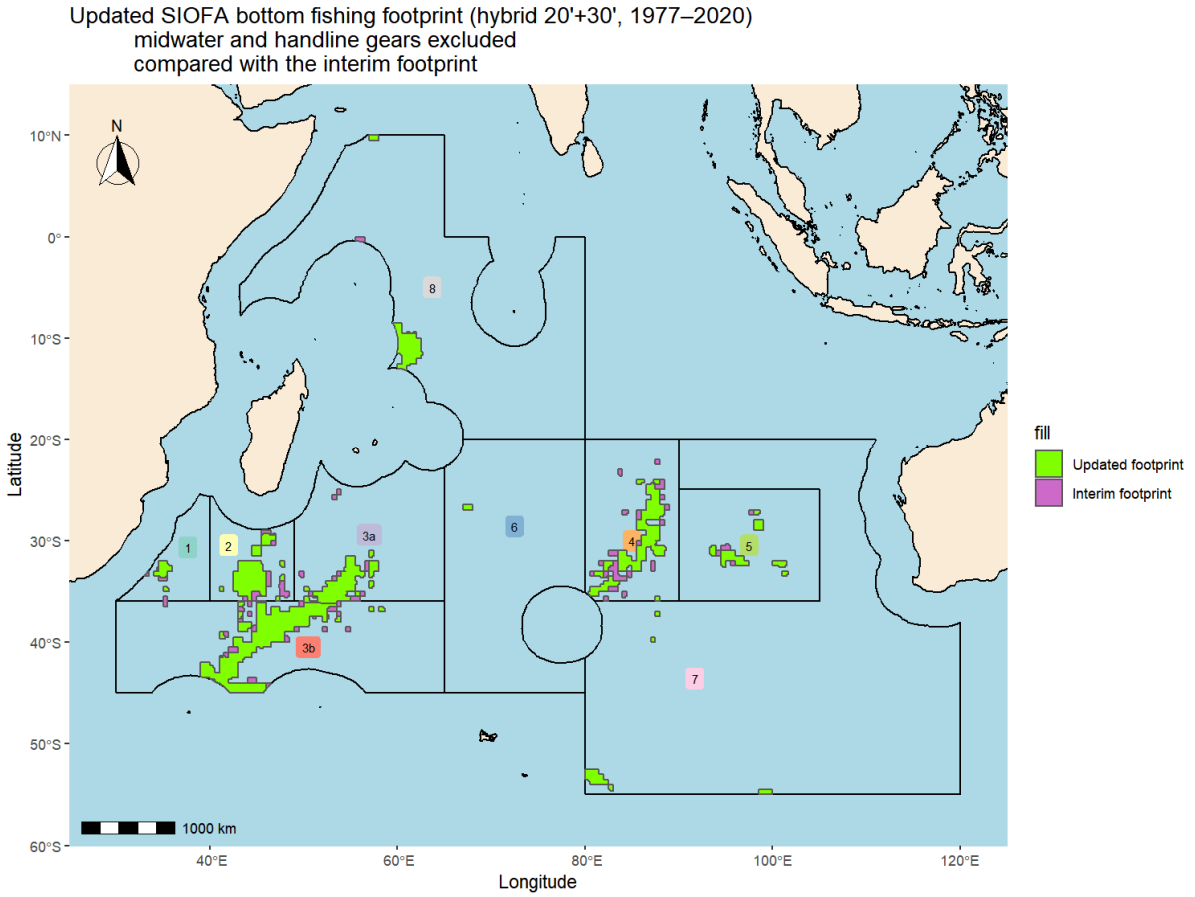


Figure 14 – Revised SIOFA bottom fishing footprint map derived from recent set level and historical fishing data from 1977–2020, at a hybrid 20' x 30' square resolution (sources: SIOFA HBHCatchEffort 1998–2020, national data, and SIOFA spatial layers). The footprint shown in this map does not include midwater trawling or handlining, and includes additional data provided by SIOFA CCPs for the purpose of updating the footprint map. Note that because actual fishing events are narrower than the spatial resolution at which the data are summarised, the combined area of the cells will exceed the area of the actual fishery footprint.

The revised SIOFA Bottom Fishing footprint (Figure 14~~Figure 14~~) was adopted by the SIOFA Meeting of the Parties in 2023 (Para 113-114 MoP10 report) and was made available as a shapefile through the SIOFA GitHub (https://github.com/SIOFASecretariat/SIOFA_SC_Spatial_layers).

The total surface area of the updated footprint is (approximately) 1 131 244 km^2.

The total surface area of the SIOFA area is (approximately) 27 162 002 km^2. Therefore, the updated footprint area is (approximately) 4.16% of the total SIOFA area.

Within the SIOFA area, the total area with depths shallower than 2000m is (approximately) 834 497 km^2 (3.1% of the total SIOFA area). The updated footprint overlaps with this area for (approximately) 646 236 km^2 (77.4% of the total area), leaving (approximately) 188 261 km^2 outside of the footprint (22.6% of the total area).

For the draft heatmap of bottom fishing activities, the number of bottom fishing events (all gears combined) was calculated for each of the 30' cells in the SIOFA Area (Figure 15~~Figure 15~~). WS2022-SUM1 suggested that further developments of this heatmap could consider representing different metrics of fishing effort (e.g., number of hooks or length of trawls), but doing so would require the production of separate maps for different gears, as these measures are not directly comparable.

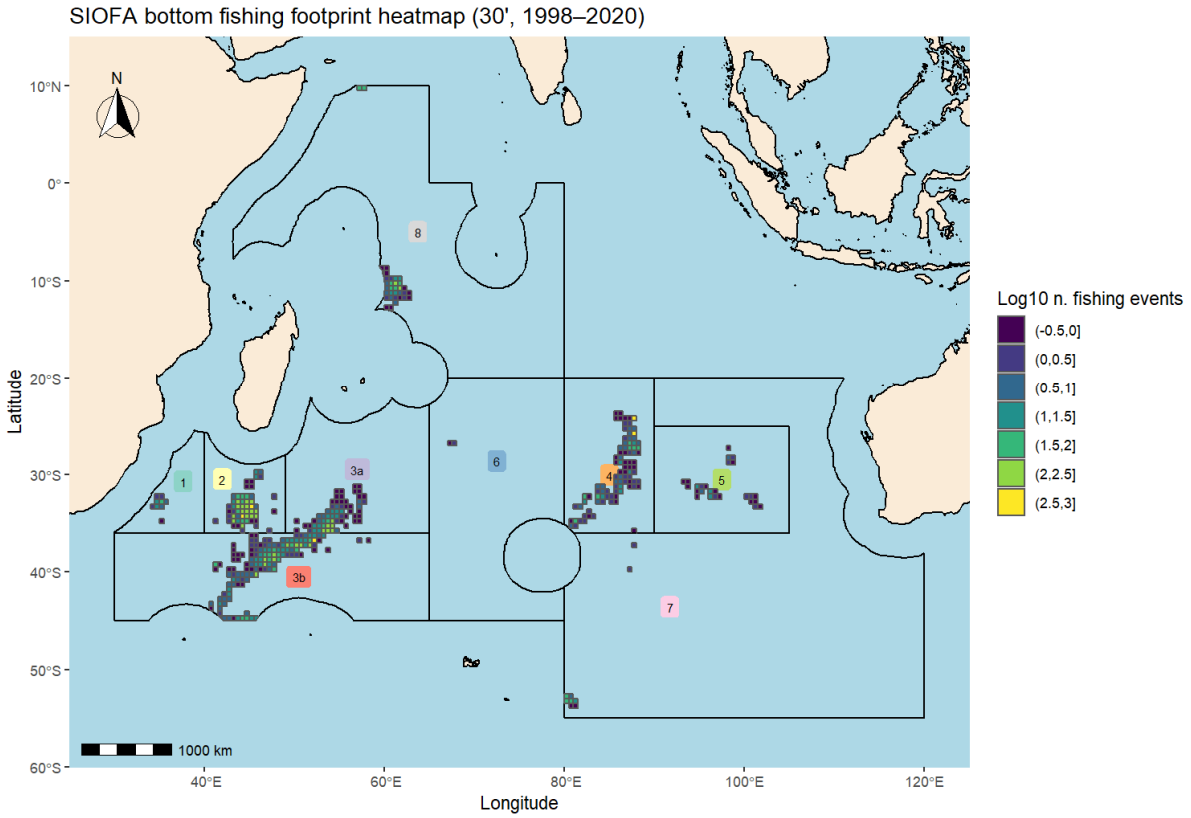


Figure 15 – Heatmap of bottom fishing effort levels in the SIOFA area, derived from recent set level and historical fishing data from 1998–2020, at 30' square resolution (sources: SIOFA HBHCatchEffort 1998–2020, and SIOFA spatial layers). The footprint shown in this map does not include midwater trawling or handlining, and includes additional data provided by SIOFA CCPs for the purpose of updating the footprint map. Note that because actual fishing events are narrower than the spatial resolution at which the data are summarised, the combined area of the cells will exceed the area of the actual fishery footprint.

~~The SIOFA Bottom Fishing footprint was adopted by the SIOFA Meeting of the Parties in 2023 (Para 113-114 MoP10 report) and was made available as a shapefile through the SIOFA GitHub (https://github.com/SIOFASecretariat/SIOFA_SC_Spatial_layers).~~

10.2 Revised bottom fishing footprint by gear

The revised bottom fishing footprint was disaggregated to produce gear-specific maps of bottom fishing effort distribution. Gear-specific maps of bottom fishing effort distribution included longlines (including Demersal longlines, Dropline, Set longlines, and Vertical lines), trawls (including Bottom trawls (nei), Trawls (nei), and Single boat bottom otter trawls), gillnets and entangling nets (nei), and traps (nei).

These maps are summarised in Figure 16~~Figure 16~~ to Figure 19~~Figure 19~~, shown at a coarser spatial resolution (5 x 5 degree squares) as recommended by WS2022-SUM1.

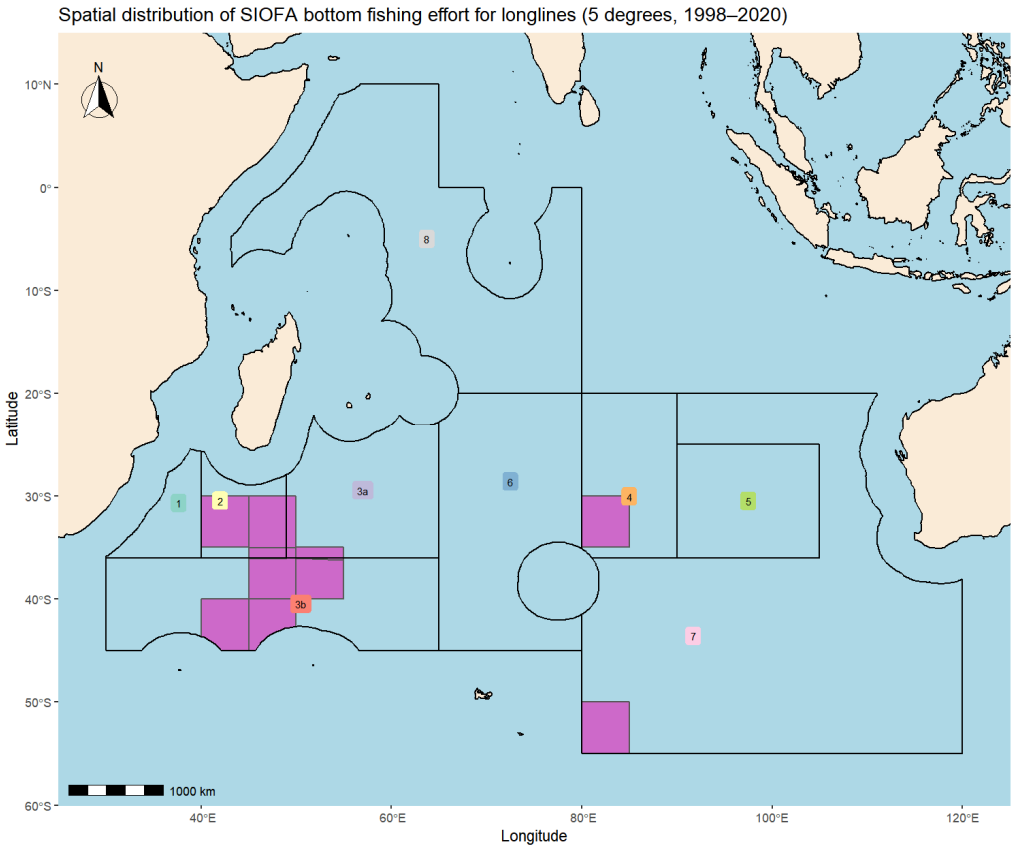


Figure 16 – Spatial distribution of SIOFA bottom fishing effort for longlines (including Demersal longlines, Dropline, Set longlines, and Vertical lines) derived from recent set level and historical fishing data from 1998–2020, at a 5 degrees square resolution (sources: SIOFA HBHCatchEffort 1998–2020, and SIOFA spatial layers). Note that due to the coarse spatial resolution of these data, the area of the non-zero-effort cells will greatly exceed the actual area of the fishing footprint.

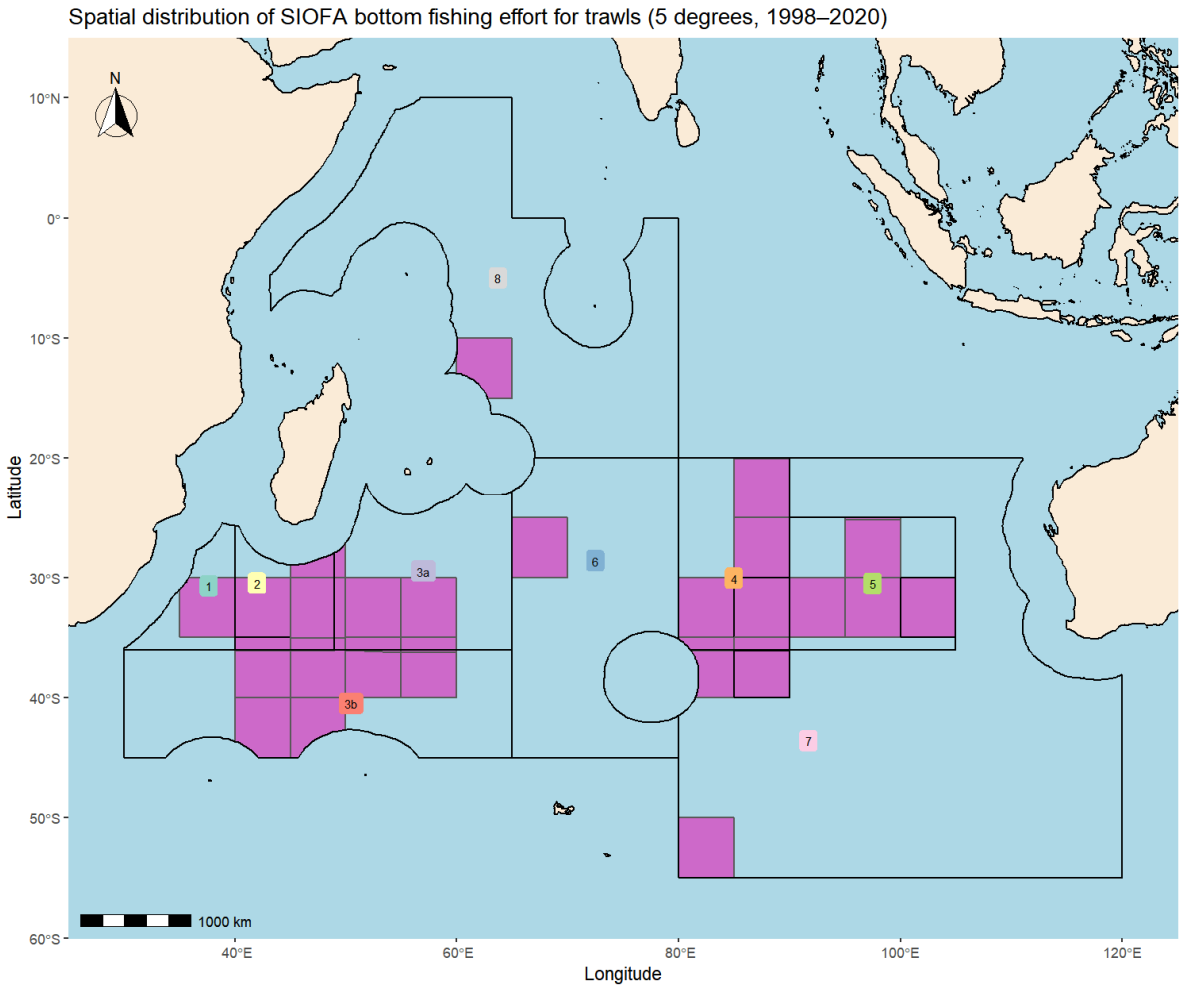


Figure 17 – Spatial distribution of SIOFA bottom fishing effort for trawls (including Bottom trawls (nei), Trawls (nei), and Single boat bottom otter trawls) derived from recent set level and historical fishing data from 1998–2020, at a 5 degrees square resolution (sources: SIOFA HBHCatchEffort 1998–2020, and SIOFA spatial layers). Note that due to the coarse spatial resolution of these data, the area of the non-zero-effort cells will greatly exceed the actual area of the fishing footprint.

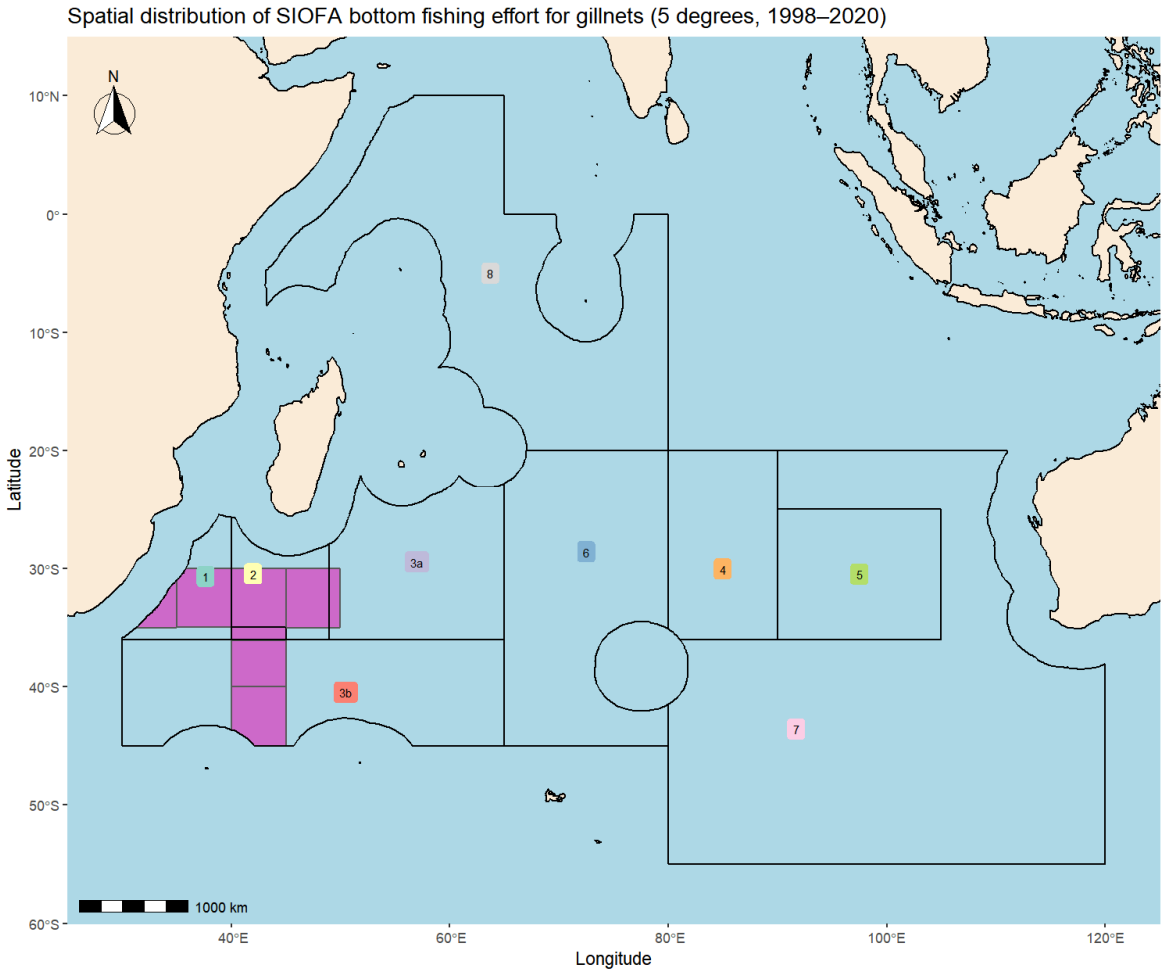


Figure 18 – Spatial distribution of SIOFA bottom fishing effort for gillnets and entangling nets (nei) derived from recent set level and historical fishing data from 1998–2020, at a 5 degrees square resolution (sources: SIOFA HBHCatchEffort 1998–2020, and SIOFA spatial layers). Note that due to the coarse spatial resolution of these data, the area of the non-zero-effort cells will greatly exceed the actual area of the fishing footprint.

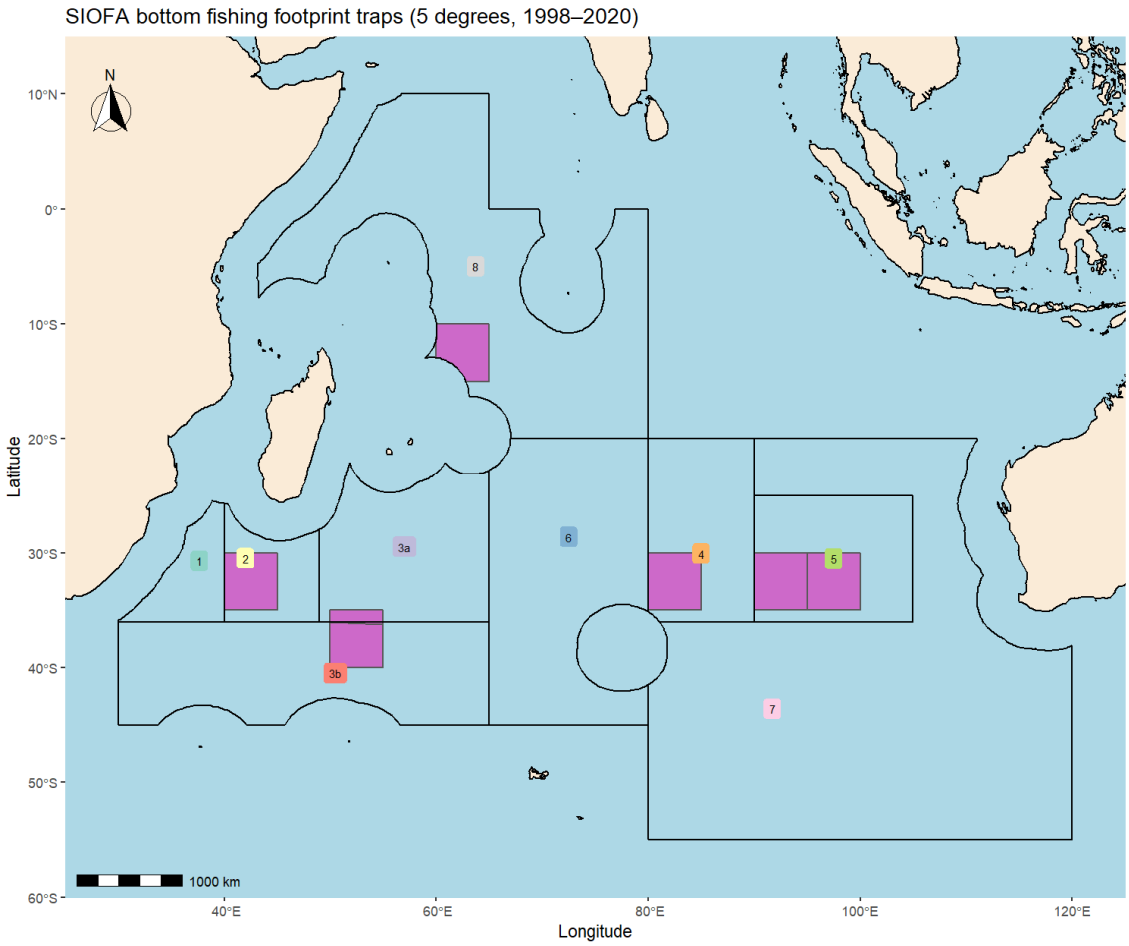
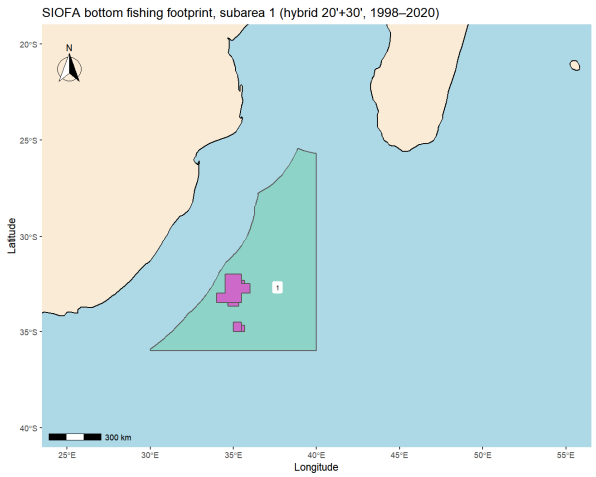
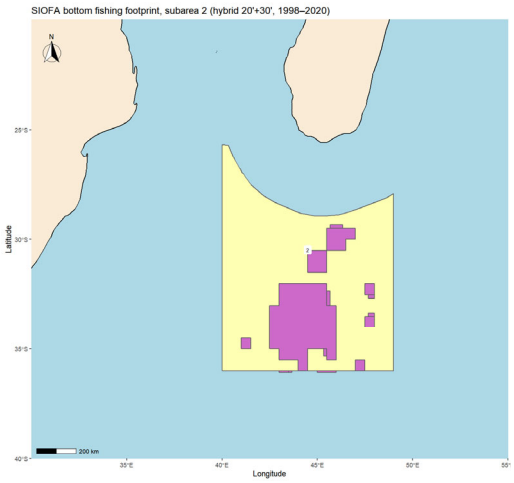


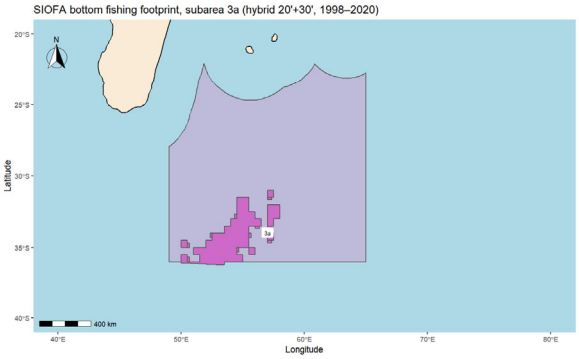
Figure 19 – Spatial distribution of SIOFA bottom fishing effort for traps (nei) derived from recent set level and historical fishing data from 1998–2020, at a 5 degrees square resolution (sources: SIOFA HBHCatchEffort 1998–2020, and SIOFA spatial layers). Note that due to the coarse spatial resolution of these data, the area of the non-zero-effort cells will greatly exceed the actual area of the fishing footprint.

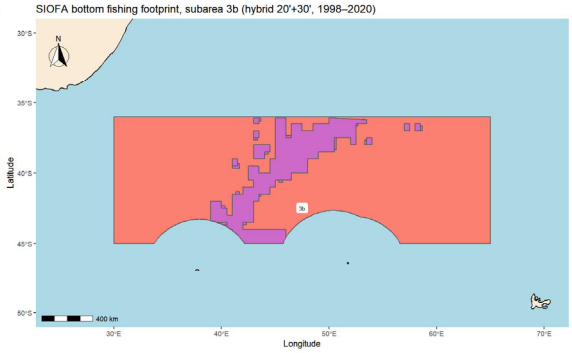
10.3 Bottom fishing footprint by Subarea

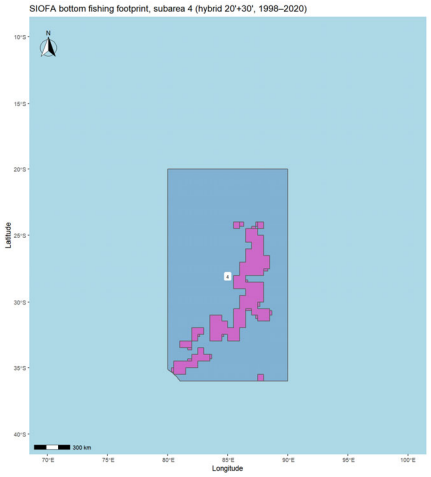
The revised bottom fishing footprint was disaggregated to produce Subarea-specific maps of bottom fishing. Figure 20~~Figure 20~~ details the revised combined-method fisheries footprint (at 20'+30' resolution), for each of the SIOFA Subareas.

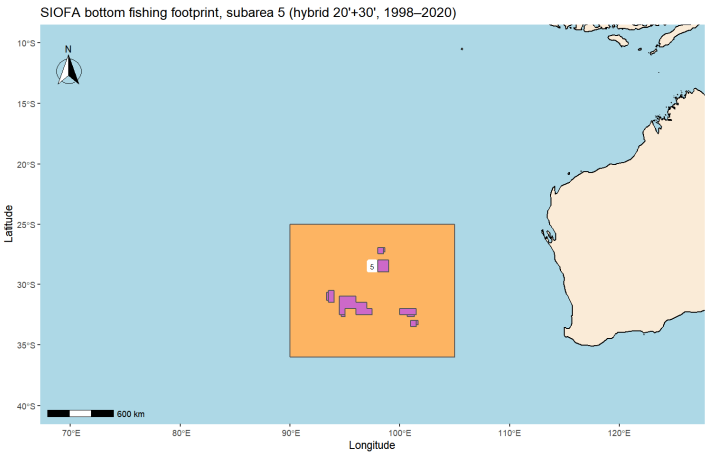

SIOFA bottom fishing footprint, subarea 1 (hybrid 20'+30', 1998–2020)
Latitude
Longitude
300 km


SIOFA bottom fishing footprint, subarea 2 (hybrid 20'+30', 1998–2020)
Latitude
Longitude
200 km


SIOFA bottom fishing footprint, subarea 3a (hybrid 20'+30', 1998–2020)
Latitude
Longitude
400 km


SIOFA bottom fishing footprint, subarea 3b (hybrid 20'+30', 1998–2020)
Latitude
Longitude
400 km


SIOFA bottom fishing footprint, subarea 4 (hybrid 20'+30', 1998–2020)
Latitude
Longitude


SIOFA bottom fishing footprint, subarea 5 (hybrid 20'+30', 1998–2020)
Latitude
Longitude
600 km

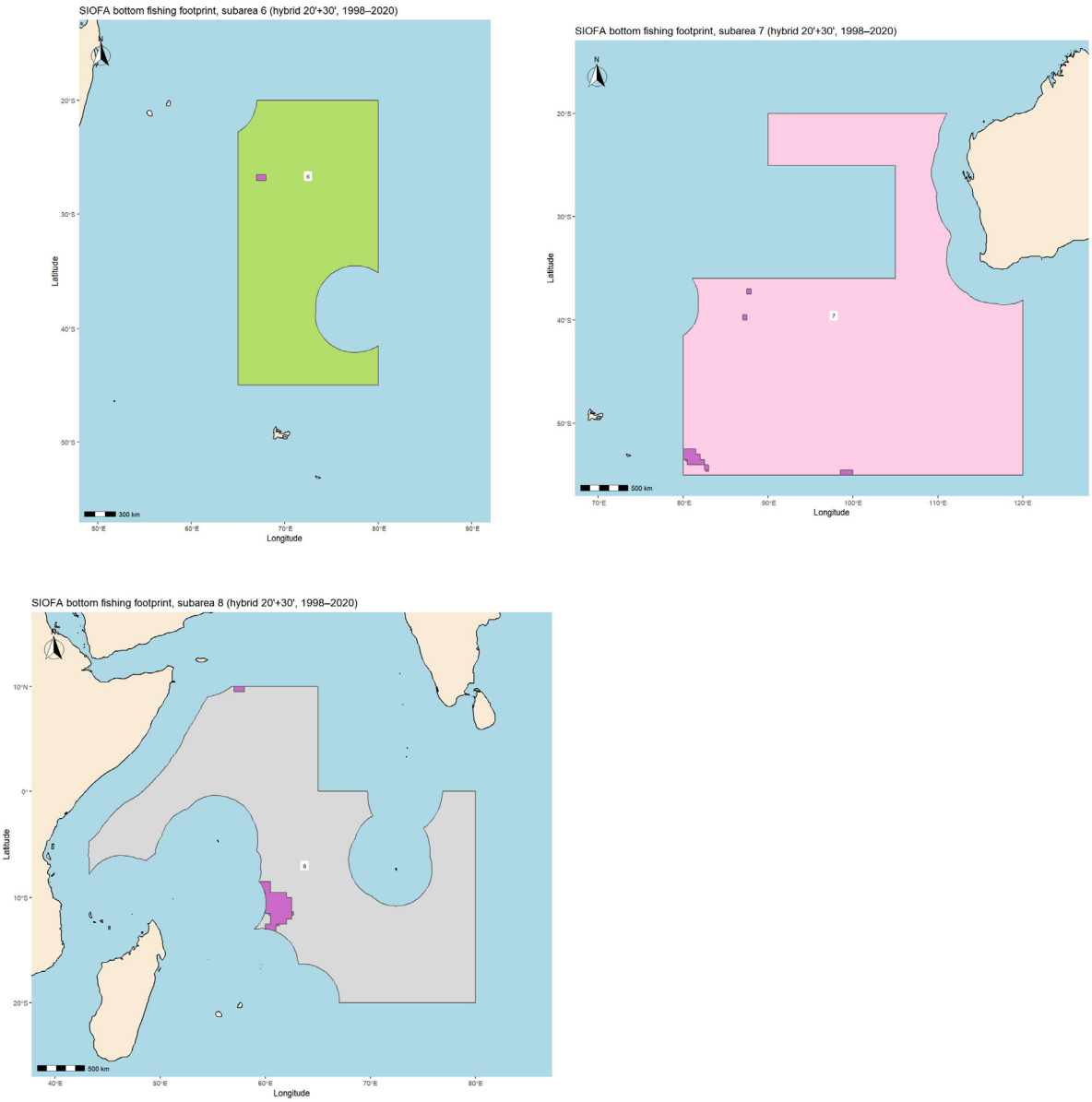


Figure 20 – Bottom fishing footprint by each SIOFA Subarea. These are the same as Figure 14~~Figure 14~~ above (i.e., not including midwater trawling or handlining, and using updated data since adoption of the interim footprint in Figure 13~~Figure 13~~) but represented at the scale of individual SIOFA Subareas. Cell sizes are at a hybrid 20' x 30' square resolution. As for other figures, because actual fishing events are narrower than the spatial resolution at which the data are summarised, the combined area of the cells will exceed the area of the actual fishery footprint.

10.4 Bottom Fishing Impact Assessment

In 2022, SIOFA adopted its first Bottom Fishing Impact Assessment (BFIA) (Mormede 2022), as required by CMM2020/01 (Conservation and Management Measure for the Interim Management of Bottom Fishing in the Agreement Area).

A bottom fishing impact assessment method was developed and applied for trawl and longline gears including all reported effort in 1998–2020 in the SIOFA Area. Summary statistics show the proportion of cells that were fished by at least one fishing event at the designated spatial scale.

To quantify impact and status, a relative benthic status (RBS) method was used, which considered both the actual width of the fished footprint (i.e., the area contacted by fishing gear, independent of

cell size), and the fragility to damage of benthic organisms inside the footprint, and their potential for recovery.

When considering only cells within the fishable area (i.e., to 2000 m depth) at the 0.1° cell resolution, 48% of cells in Subarea 3b and 45% of cells in Subarea 2 have had at least one fishing event (including both trawl and/or longline gears) since 1998). At fishable depths in the 1° cell resolution, 88% of cells in Subarea 8 have been fished at least once. At both scales, the number of fished cells has expanded between 1998 and 2020.

Because the size of cells used in the analysis were larger than the actual width of the fishing events, these 'proportional area fished' summary statistics overestimated the size of the actual fished footprint and were sensitive to the size of the cell used in the calculation. In contrast, impact assessment methods such as RBS estimate proportional impact per cell as a function of actual footprint width and the fragility of the benthic taxa contacted by fishing gear inside the footprint. Because the total area of the footprint and the area of the assessed domain did not depend on cell size, estimates of cumulative impact and VME taxon status under the RBS method were relatively insensitive to the use of different cell sizes.

The final BFIA calculation in Mormede (2022) was carried out at a 0.1° resolution south of 20° S (SIOFA Subareas 1 to 7) and 1° resolution north (SIOFA Subarea 8) for both trawl and bottom longline gears. The analysis estimated that the cumulative bottom fishing impact of trawl and longline gears on stony corals, *Demospongiae* and *Hexactinellida,* and on *Anthiparia* in the assessed area ranged from 0.4% to 1% in different Subareas (i.e., the intact status of each taxon per Subarea ranged 99%-99.6%) in 2020.

The distribution of this impact was not uniform within each Subarea. Summarised per Subarea, mean impact varied from 0.4–1%, but impact in the most heavily impacted cell in each Subarea ranged from 0.7–12.7%. When considering only fishable depths (< 2000 m), mean impact ranged from 0.5–3.5% in the different Subareas, and impact in the most heavily impacted cell per Subarea ranged 1.4–100%.

The Subareas most impacted was Subarea 2 followed by Subareas 3a, 3b and 4 (Figure 21~~Figure 21~~).

Sensitivity analyses showed that in the estimation of relative benthic status (which combined both impact and recovery), biological characteristics of the VME taxa were the most influential parameters (i.e., steepness of the stock-recruit curve and recovery parameters), followed by factors affecting uncertainty about impact (i.e., VME fragility and the width of the bottom impact associated with individual fishing events).

In 2022, SIOFA adopted its first Bottom Fishing Impact Assessment (BFIA) (Mormede 2022), as provided for in its Conservation and Management Measure for the Interim Management of Bottom Fishing in the Agreement Area (CMM 01).

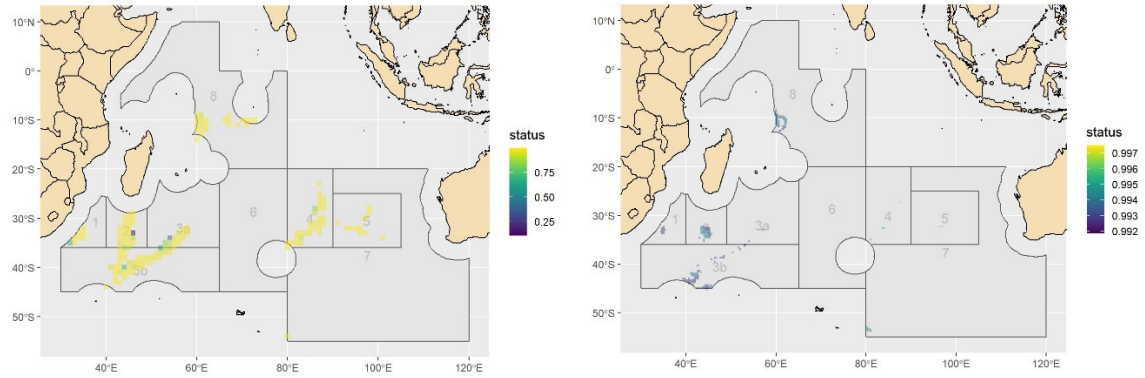


Figure 21 – Relative benthic status as affected by cumulative bottom trawl (left panel) and bottom longline (right panel) impacts within the SIOFA Area. Note unimpacted cells are at 100% status by definition, but these values are not shown. Reproduced from Mormede (2022).

10.5 Bottom fisheries interaction with VME indicator taxa

The incidental capture of VME indicator taxa during fishing operations were recorded by Scientific Observers on board of vessels and reported by SIOFA CCPs in their annual data submissions. Additionally, the Observer database also includes VME taxa captures that have been recorded occasionally in the Catch and Effort database.

While fishing operations and effort have not significantly changed, reporting of incidental captures of VME indicator taxa has been inconsistent over this period, with reports being supplied at the beginning and at the end of the time series but missing from several years in the middle (Figure 22~~Figure 22~~). The species that were most reported (by weight) include precious corals nei (COR), hard corals, madrepores nei (CSS), Demospongiae (DMO), Porifera (PFR) and Spongiidae (SPO).

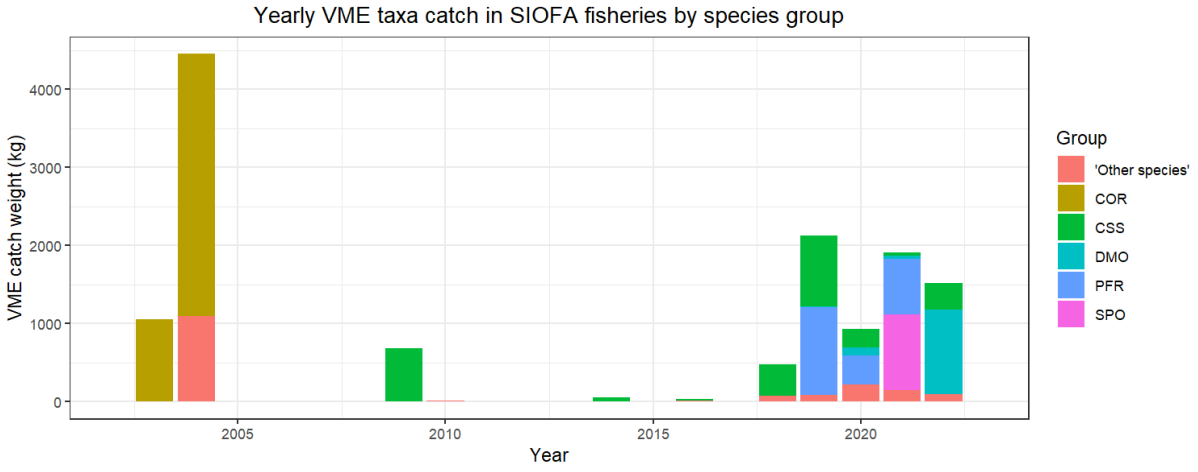


Figure 22 – Yearly incidental catch of VME indicator taxa in the SIOFA Area by taxa group (source: SIOFA Observer and HBHCatchEffort databases 2003–2020). Only the top 5 taxa by weight (cumulatively in the full database) are represented, indicated by their FAO species code (see Appendix C) and all other taxa are grouped in a separate category. ~~Figure~~ Table D.~~8~~6 in Appendix D provides a full account of taxa caught.

Incidental captures of VME indicator taxa were reported predominantly in trawls (Figure 23~~Figure 23~~) and especially in bottom trawls, with occasional records being reported for midwater trawls.

Occurrences of captures are reported for line fishing gear, but usually these had small weights compared to those reported in trawls. Table D.4 in Appendix D gives the results by taxon, weight and gear.

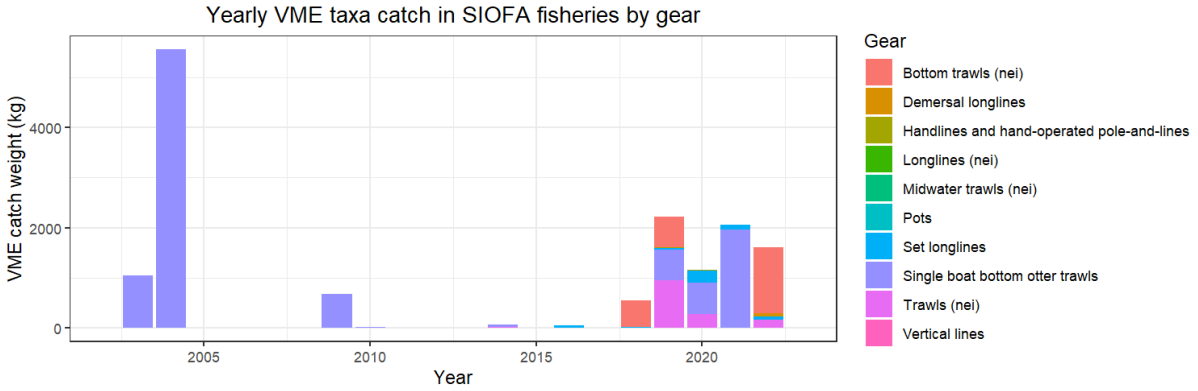


Figure 23 – Yearly incidental catch of VME indicator taxa in the SIOFA Area by fishing method and gear (source: SIOFA Observer and HBHCatchEffort databases 2013–2022).

Hard corals (*Scleractinia*) were commonly caught by fisheries operating at higher latitudes, while sponges *(Porifera*) were caught by fisheries operating throughout the SIOFA Area (Figure 24~~Figure 24~~).

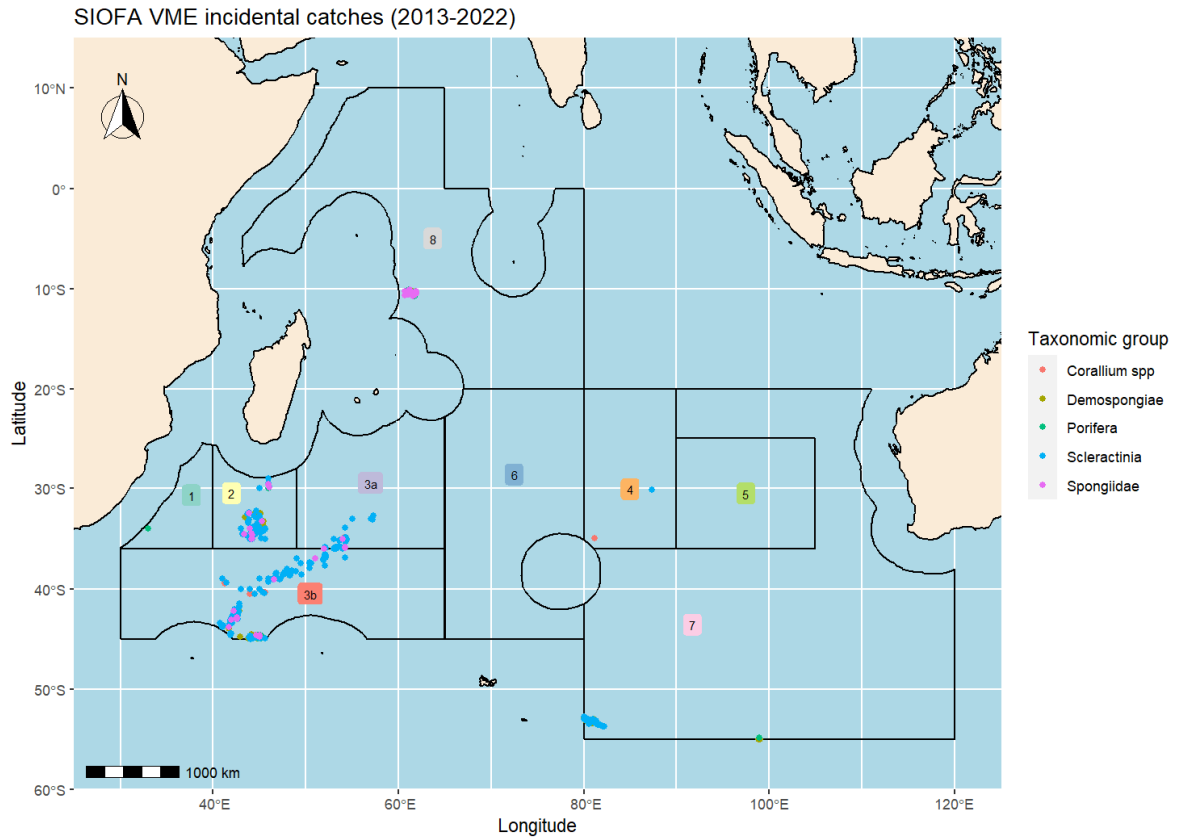


Figure 24 – Reported incidental catch of VME taxa in the SIOFA Area, mapped by taxonomic group (source: SIOFA Observer and HBHCatchEffort databases 2013–2022). Only the top 5 taxa by weight (cumulatively in the full database) are represented in this map. Figure D.~~5~~2 in Appendix D provides a more detailed map at the highest taxonomic resolution.

11. Habitats of significance

This section has been left empty, pending discussions by the SIOFA Scientific Committee on habitats of significance.

12. Fishing activities in Interim Protected Areas (CMM 01(2023))

Annex 3 of SIOFA CMM 01(2023) lists five Interim Protected Areas (IPAs) and their coordinates (Figure 25). These areas were first instituted in 2018 through SIOFA CMM2018/01 and entered into force on 10 August 2018. CCPs are provisionally required to abide by the specified fisheries restrictions to fisheries inside these areas until the adoption of a dedicated research and management plan, referred to in paragraph 6 e, SIOFA CMM 01(2023).

Current restrictions to fisheries in IPAs include a prohibition for CCPs to engage in bottom fishing, exclusion of line and trap fishing, and an obligation to have a Scientific Observer onboard at all times while fishing in those areas.

According to SIOFA CMM 01(2023), when the Meeting of the Parties adopts a revised SIOFA protocol for protected area designation after advice from the Scientific Committee arising from its review referred to in paragraph 6 d., the Meeting of the Parties shall also review Annex 3 of CMM 01(2023), taking into account advice of the Scientific Committee.

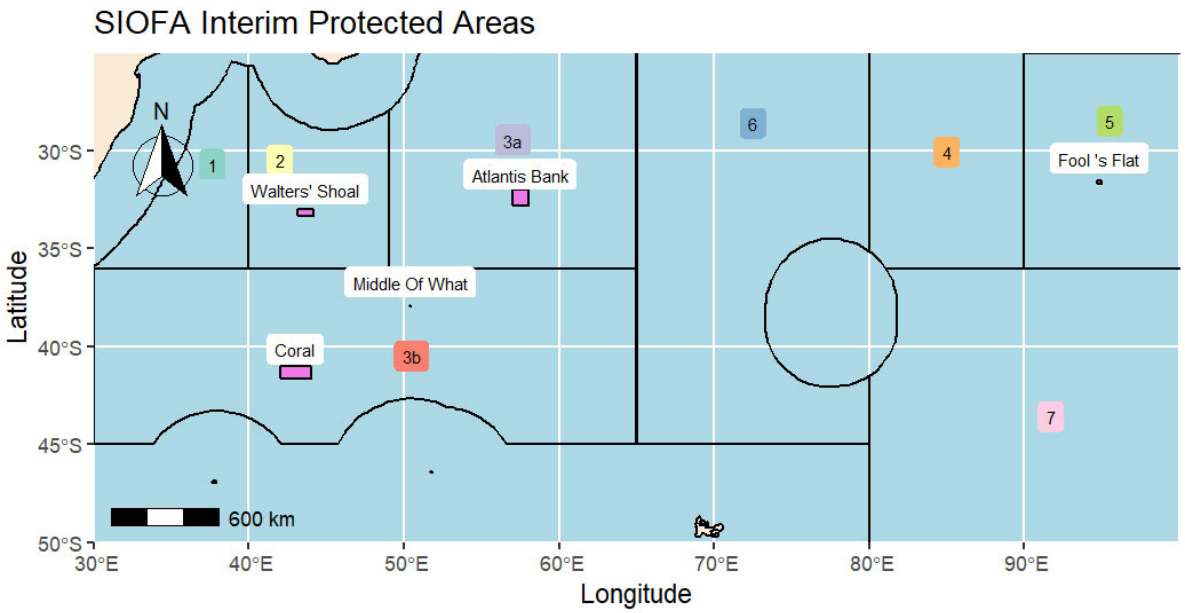


Figure 25 – Map of the SIOFA Interim Protection Areas (in magenta) as defined in CMM 01(2023) (Source: Annex 3 of SIOFA CMM 01(2023)). Each area has been labelled by name for easier recognition, as some are barely visible on a map of this large scale.

A total of 125 fishing events have been recorded to occur in SIOFA IPAs in 2013–2022, but the number of fishing events significantly decreased after the institution of the IPAs in late 2018 (Figure 26~~Figure 26~~). Before the institution of the IPAs multiple gear types were used, but after adoption of the IPAs in 2018 only lines were used, consistent with the gear restrictions in CMM 01(2023) (Figure 27~~Figure 27~~). No fishing was recorded within IPAs in 2022.

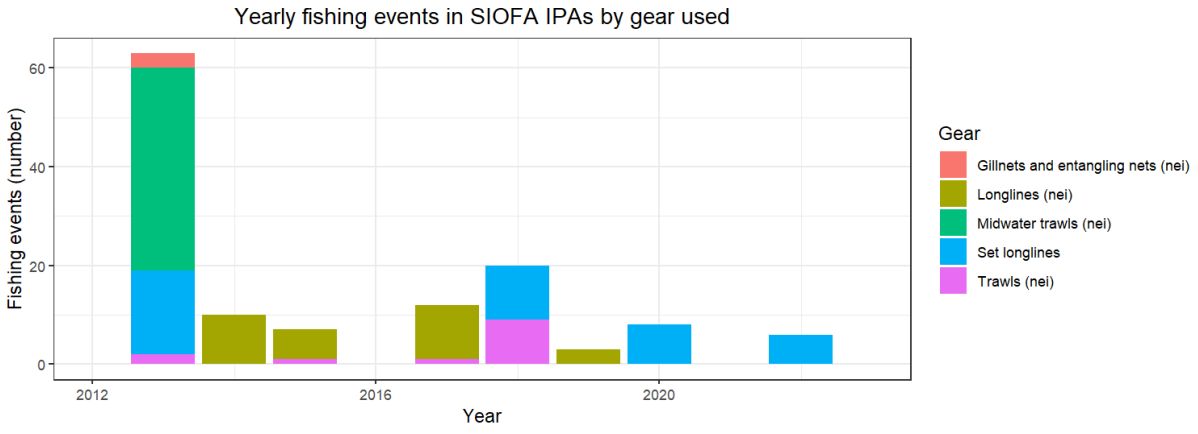


Figure 26 – Number of fishing events by gear in Interim Protected Areas (IPAs) per year (including from years before the IPAs were implemented) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2022).

These events caught a range of species, but total catch weights in these locations have been relatively low (Figure 27~~Figure 27~~). Splendid alfonsino (BYS) and kitefin shark (SCK) were the species that made

the largest contribution to total catches in years when catch in IPAs was highest (2013, 2017 and 2018, Figure 27~~Figure 27~~). No fishing was recorded within IPAs in 2021.

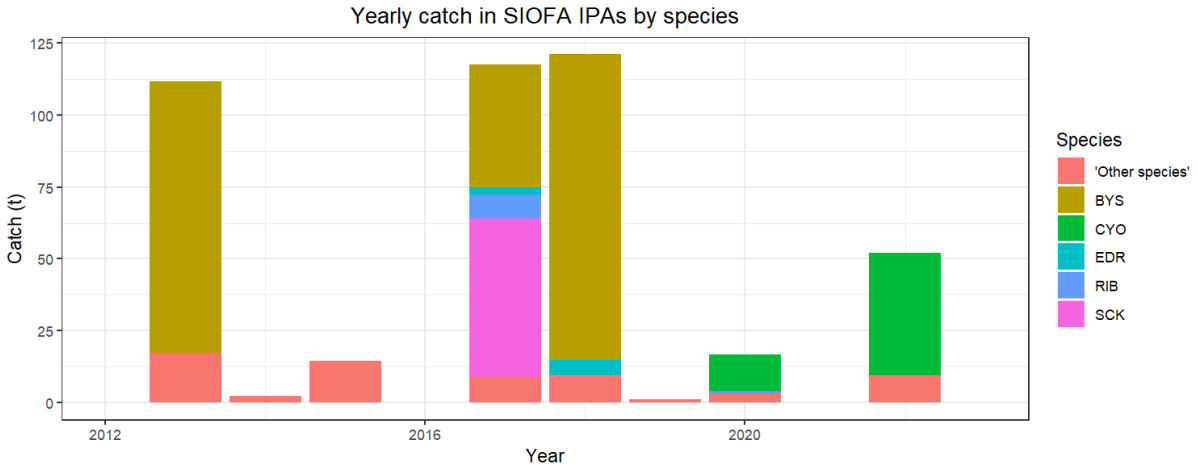


Figure 27 – Total catch (t) by species in Interim Protected Areas (IPAs) per year (including in years before the IPAs were implemented) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2022). Only the top 5 species by weight (cumulatively over the history of the fisheries) are shown, indicated by their FAO species code (see Appendix C); other taxa are grouped and collectively labelled 'other species'. ~~Figure~~ Table D.~~3~~6 in Appendix D provides a more detailed account of other species caught.

13. Interactions with larger ecosystem processes

13.1 Climate change and environmental variability

No information is currently available on the impacts of climate change or environmental variability on SIOFA fisheries.

13.2 Trophic and ecosystem level effects

No information is currently available on the trophic interactions or other larger ecosystem effects of SIOFA fisheries.

14. References

Mormede, S. 2022. Calculating bottom fishing impact for trawl and longline gears in SIOFA. Pages 1–22.

15. Appendix A – List of species identified by the SIOFA SC as primary and secondary species in SIOFA fisheries and considered as target species for the purposes of this overview ~~Target fish species reported in SIOFA fisheries and included among target species referred to in this summary~~

FAO Code	Common name	*Scientific name*
BYS	Splendid alfonsino	*Beryx splendens*
ORY	Orange roughy	*Hoplostethus atlanticus*
CDL	Cardinal fishes	*Epigonus spp*
OIL	Oilfish	*Ruvettus pretiosus*
HAU	Hapuka	*Polyprion spp*
LIB	Brushtooth lizardfish	*Saurida undosquamis*
RUS	Indian scad	*Decapterus russelli*
KZJ	Thredfin bream	*Nemipterus bipunctatus*
UPM	Goldfin goatfish	*Upeneus moluccensis*
DCC	Shortfin scad	*Decapterus macrosoma*
LTQ	Sky emperor	*Lethrinus mahsena*
TOP	Toothfish	*Dissostichus eleginoides*
NGU	Yellow spotted trevally	*Carangoides fulvoguttatus*
NGY	Bludger	*Carangoides gymnostethus*
NGX	Carangoides species	*Carangoides spp*
LEC	Escolar	*Lepidocybium flavobrunneum*
BYS	Splendid alfonsino	*Beryx splendens*
SSO	Smooth oreo dory	*Pseudocyttus maculatus*
BIS	Bigeye scad	*Selar crumenophthalmus*
YBS	bigeye barracuda	*Sphyraena forsteri*
EMN	Marbled coral groper	*Plectropomus punctatus*
LTQ	Sky emperor	*Lethrinus mahsena*
LUB	Emperor red snapper	*Lutjanus sebae*
LJB	Two-spot red snapper	*Lutjanus bohar*
BOE	Black oreo	*Allocyttus niger*
ORD	Oreos nei	*Oreosomatidae*
GRV	Macrourids	*Macrourus spp*

FAO Code	Common name	*Scientific name*
ANT	Violet cod	*Antimora rostrata*
BIL	Billfish*	*Istiophoridae*
TUN	Tuna *	*Thunnini*
YFT	Yellowfin tuna	*Thunnus albacares*

~~FAO Code~~	~~Scientific name~~	~~Common name~~
~~AVR~~	~~Aprion virescens~~	~~Green jobfish~~
~~BWA~~	~~Hyperoglyphe antarctica~~	~~Bluenose warehou~~
~~BYS~~	~~Beryx splendens~~	~~Splendid alfonsino~~
~~CDL~~	~~Epigonus spp~~	~~Cardinal fishes nei~~
~~DPX~~	~~Perciformes~~	~~Demersal percomorphs nei~~
~~EDR~~	~~Pseudopentaceros richardsoni~~	~~Pelagic armourhead~~
~~EMP~~	~~Lethrinidae~~	~~Emperors(=Scavengers) nei~~
~~EPI~~	~~Epigonus telescopus~~	~~Black cardinal fish~~
~~GPX~~	~~Epinephelus spp~~	~~Groupers nei~~
~~GRO~~	~~Actinopterygii~~	~~Groundfishes nei~~
~~HAU~~	~~Polyprion spp~~	~~Hapuka~~
~~LEC~~	~~Lepidocybium flavobrunneum~~	~~Escolar~~
~~LHN~~	~~Lethrinus nebulosus~~	~~Spangled emperor~~
~~LUB~~	~~Lutjanus sebae~~	~~Emperor red snapper~~
~~LZX~~	~~Lethrinus spp~~	
~~NGX~~	~~Carangoides spp~~	
~~OIL~~	~~Ruvettus pretiosus~~	~~Oilfish~~
~~ORY~~	~~Hoplostethus atlanticus~~	~~Orange roughy~~
~~QXR~~	~~Polysteganus baissaci~~	~~Frenchman seabream~~
~~RYG~~	~~Plagiogeneion rubiginosum~~	~~Rubyfish~~
~~SDX~~	~~Decapterus spp~~	~~Scads nei~~
~~SEY~~	~~Schedophilus velaini~~	~~Violet warehou~~
~~SNA~~	~~Lutjanus spp~~	~~Snappers nei~~
~~SNX~~	~~Lutjanidae~~	~~Snappers, jobfishes nei~~
~~SSO~~	~~Pseudocyttus maculatus~~	~~Smooth oreo dory~~
~~SZX~~	~~Saurida spp~~	
~~TOP~~	~~Dissostichus eleginoides~~	~~Patagonian toothfish~~
~~TUN~~	~~Thunnini~~	~~Tunas nei~~
~~UHW~~	~~Sepioteuthis spp~~	~~Reef squids nei~~
~~WRF~~	~~Polyprion americanus~~	~~Wreckfish~~

16. Appendix B – Common names, FAO species codes, and scientific names of sharks, referred to in this summary

FAO code	FAO common name	Scientific name
ALS	Silvertip shark	*Carcharhinus albimarginatus*
ASK	Angelsharks, sand devils nei	*Squatinidae*
BHY	Bathyraja rays nei	*Bathyraja spp*
BSH	Blue shark	*Prionace glauca*
BYR	Kerguelen sandpaper skate	*Bathyraja irrasa*
CAR	Cartilaginous fishes nei	*Chondrichthyes*
CLD	Sliteye shark	*Loxodon macrorhinus*
CVX	Ground sharks	*Carcharhiniformes*
CWM	Ghost sharks	*Chimaera spp*
CWO	Gulper sharks nei	*Centrophorus spp*
CWZ	Carcharhinus sharks nei	*Carcharhinus spp*
CYO	Portuguese dogfish	*Centroscymnus coelolepis*
CZI		*Centroscymnus spp*
DCA	Birdbeak dogfish	*Deania calcea*
DGX	Dogfish sharks nei	*Squalidae*
DGZ	Dogfishes nei	*Squalus spp*
DOP	Shortnose spurdog	*Squalus megalops*
ETE		*Etmopterus compagnoi*
ETF	Blackbelly lanternshark	*Etmopterus lucifer*
ETM	Southern lanternshark(Lucifer)	*Etmopterus granulosus*
GTF	Guitarfishes, etc. nei	*Rhinobatidae*
GUP	Gulper shark	*Centrophorus granulosus*
GUQ	Leafscale gulper shark	*Centrophorus squamosus*
HAG	Mud catshark	*Halaelurus lutarius*
HCM	Hooktooth shark	*Chaenogaleus macrostoma*
HOL	Chimaeras, etc. nei	*Chimaeriformes*
HXT	Sharpnose sevengill shark	*Heptranchias perlo*
JFB	Bigmouth skate	*Raja robertsi*
NTC	Broadnose sevengill shark	*Notorynchus cepedianus*
ORZ	Tawny nurse shark	*Nebrius ferrugineus*
PTM	False catshark	*Pseudotriakis microdon*
QUK	Shortspine spurdog	*Squalus mitsukurii*
RAJ	Rays and skates nei	*Rajidae*
RBI		*Rhinobatos irvinei*
RBY	Butterfly rays nei	*Gymnura spp*
RFA	Whiteleg skate	*Amblyraja taaf*
RME	Longhorned mobula	*Mobula eregoodootenkee*
RMV	Mobula nei	*Mobula spp*
RRY	Bowmouth guitarfish	*Rhina ancylostoma*
RSK	Requiem sharks nei	*Carcharhinidae*
RTE	Round ribbontail ray	*Taeniura meyeni*
RYE	Ornate eagle ray	*Aetomylaeus vespertilio*

FAO code	FAO common name	Scientific name
RZZ	Southern sleeper shark	*Somniosus antarcticus*
SBL	Bluntnose sixgill shark	*Hexanchus griseus*
SCK	Kitefin shark	*Dalatias licha*
SDV	Smooth-hounds nei	*Mustelus spp*
SHL	Lanternsharks nei	*Etmopterus spp*
SKA	Raja rays nei	*Raja spp*
SKH	Various sharks nei	*Selachimorpha (Pleurotremata)*
SKX	Sharks, rays, skates, etc. nei	*Elasmobranchii*
SMA	Shortfin mako	*Isurus oxyrinchus*
SON	Pacific sleeper shark	*Somniosus pacificus*
SOR	Little sleeper shark	*Somniosus rostratus*
SPK	Great hammerhead	*Sphyrna mokarran*
SPN	Hammerhead sharks nei	*Sphyrna spp*
SRX	Rays, stingrays, mantas nei	*Rajiformes*
SUN	Ocellated angelshark	*Squatina tergocellatoides*
TIG	Tiger shark	*Galeocerdo cuvier*

17. Appendix C – Common names, FAO species codes, and scientific names of VME taxa reported as incidental captures in SIOFA fisheries

FAO code	FAO common name	Scientific name
ADQ	Black coral	*Antipathes dichotoma*
AJZ	Soft corals	*Alcyonacea*
AQZ	Black corals and thorny corals	*Antipatharia*
ATX	Sea anemones	*Actiniaria*
AXT	Hydrocorals	*Stylasteridae*
AZN	Hydroids, hydromedusae	*Anthoathecata*
BVH	Brachiopods, lamp shells	*Brachiopoda*
BWV		*Paragorgiidae*
BWY		*Bathylasmatidae*
BZN	Bryozoans	*Bryozoa*
CNI	Cnidarians nei	*Cnidaria*
COR	Precious corals nei	*Corallium spp*
CSS	Hard corals, madrepores nei	*Scleractinia*
CVD	Pencil urchins	*Cidaridae*
CWD	Feather stars and sea lilies	*Crinoidea*
DMO	Siliceous sponges	*Demospongiae*
GGW	Gorgonians	*Gorgoniidae*
HQZ	Hydrozoans	*Hydrozoa*
HXY	Glass sponges	*Hexactinellida*
IQO		*Isididae*
KRH	Wire coral	*Cirrhipathes spp*
NTW	Sea pens	*Pennatulacea*
NYZ	0	*Nephtheidae*
OEQ	Basket stars	*Euryalida*
PFR		*Porifera*
QFY		*Chrysogorgiidae*
SPO	Sponges	*Spongiidae*
SSX	Sea squirts nei	*Ascidiacea*
SZS	Serpulid tube worms	*Serpulidae*
ZOT	Zoanthids	*Zoantharia*

18. Appendix D – Data included in figures and additional figures

Table D.1 – Total annual target and bycatch weight (t) in the SIOFA Area (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021~~1~~2)

Year	Catch (t)	Shark catch (target/non-target, t)	Bycatch (t)
2013	7589.3	1249.9	961.7
2014	5825.6	1286.8	553.1
2015	23014.7	2067.5	11656.8
2016	20913.8	2724	4227.3
2017	17403.6	2134.1	1697.8
2018	11788.7	2071.5	503.7
2019	11993.3	1832.6	902.9
2020	13737.1	1207.2	917.2
2021	10612.3	1717.2	1853.5
2022	11810.4	1949	1240.3

Table D.2 – Total annual target catch weight (t) in the SIOFA Area, by Subarea. (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021~~1~~)

Year	1	2	3a	3b	4	5	6	7	8
2013	23.8	2898.3	1098.7	2336.1	1178.8				15.5
2014	12.7	1371.4	1356.7	2424.1	630.4				0.4
2015	231.2	2450.9	1036.8	5896.3	1057.7		30.9	3.6	6200
2016	673.2	2051.2	1977	8300.5	29.7		13.2		6003.9
2017	4965.3	2220.7	950.1	7116.7	382.6	500.2	18.1		1093
2018	3634.8	1539.6	952.6	4171.5	914.5	100.6	28.4	347.2	23.4
2019	1758.2	2353.5	1040.5	4837.6	556.4	0.9	62	184.7	1196.4
2020	4269.7	1646.3	1318.6	4325.4	812.8	214.9	29.4	77.8	985.2
2021	1721.4	1549.4	979.5	3968.8	400.8	103.5	23.6	30	1787.4
2022	2376.7	1629.4	929.4	4371.2	343.9	49.4	11.3	31.4	2055.5

Table D.3: Total catch of sharks (t) per year and Subarea (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Total catch includes both target catch and bycatch of all species.

Year	1	2	3a	3b	4	5	6	7	8
2013	61.4	1167.7	0	20.6	0	0	0	0	0.2
2014	0	1282.9	0	3.9	0	0	0	0	0
2015	7.5	1685.4	10.5	95.7	2.7	0	32.2	3	200.2
2016	184.4	1878.1	3.2	387.8	1.1	0	5	0	70.4
2017	436.1	1121.7	5.2	453.9	1.4	0.4	9.8	0	102.8
2018	286.7	1456.1	18	199.9	0	0	38.2	0.2	71
2019	204.4	1055.3	28	263.5	1.2	5	51.5	9.2	213.9
2020	231.9	619.6	23.7	166	5.1	1.2	15.1	0.5	143.4
2021	252.5	1120	27.9	193.9	4.4	0	14.8	0.4	100.1
2022	186.5	1460	13.5	168.3	2.4	2.9	9.5	8.8	96.5

Table D.4 – Total incidental catch (in kg) of VME taxa by fishing method and gear (source: SIOFA Observer and HBHCatchEffort databases 2013–2021).

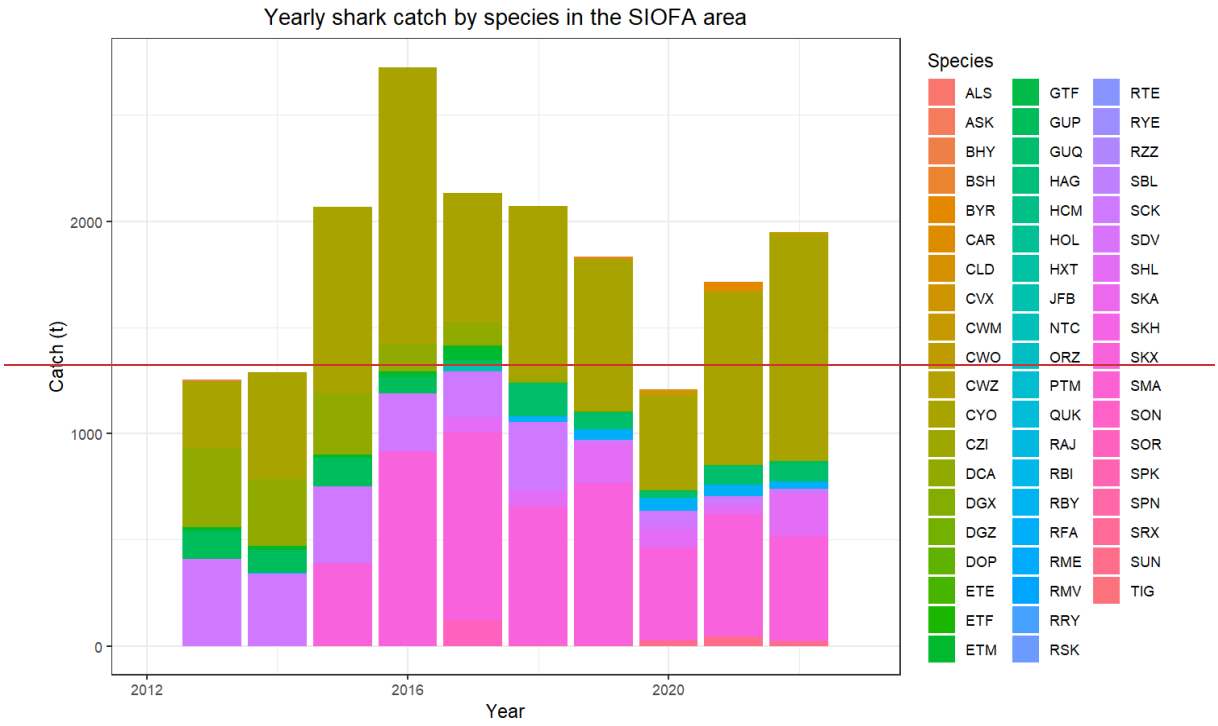
Taxon	Bottom trawls (nei)	Demersal longlines	Handlines and hand-operated pole-and-lines	Longlines (nei)	Midwater trawls (nei)	Pots	Set longlines	Single boat bottom otter trawls	Trawls (nei)	Vertical lines
Actiniaria	0.84	4.79					26.467	1.45		
Anthoathecatae	9						0.377	1	1	
Antipatharia	3.572						11.515	45.9	7.91	
Antipathes dichotoma	1.3							0.02	31.66	
Asteroidea	0.14							12.66	0.5	
Brisingidae	0.025									
Chrysogorgiidae	0.055									
Cidaridae	4.2	0.76					0.035			
Cirrhipathes spp	0.1									
Cnidaria	5	3.04	22.8				2.64	28.97		
Crinoidea	0.005						4.62			
Demospongiae	1152.32	14.82		0.645			34.476	117	1.08	
Echinodermata	0.4						9.025001			
Gorgoniidae	1.5						103.4083	69.57	13.84	
Hexactinellida	25.63	5.76		0.03			13.53		2.85	
Hydrozoa	10.322							2	0.77	
Isididae	15.57			0.49					51.37	
Nephtheidae	0.1									
Ophiurida	4	2.55					2.211001	1		

Taxon	Bottom trawls (nei)	Demersal longlines	Handlines and hand-operated pole-and-lines	Longlines (nei)	Midwater trawls (nei)	Pots	Set longlines	Single boat bottom otter trawls	Trawls (nei)	Vertical lines
Paragorgiidae	0.09								2.215	
Pennatulacea	3.66	0.66					5.595001	0.05	0.05	
Porifera	625.67	1.8			0.5		5.89	1848.7	6	
Rhopilema spp	1.65				5.2			14.4		
Scleractinia	577.57	14.2		0.15	3.8	0.2	181.239	751.93	1210.537	
Spongiidae	5.5						6.19	1112.35	61.99	
Stylasteridae	3.325			0.41			25.404	7	5	0.6
Bryozoa		3.13					6.44			
Euryalida		3.8		0.155			9.032			
Acropora formosa			22.2							
Heliopora coerulea			4.5							
Alcyonacea				0.041			24.32	1.12	1.005	
Animalia							0.01	1000		
Ascidiacea							2.325			
Bathylasmatidae							0.21			
Brachiopoda							0.28			
Crustacea							0.271			
Echinoidea							0.05	15.31	3.15	
Galatea spp							0.04			
Holothuria spp							0.4			
Invertebrata							6.43			0.9
Lithodidae							1.52			
Pycnogonida							0.07			
Serpulidae							1.14			

Taxon	Bottom trawls (nei)	Demersal longlines	Handlines and hand-operated pole-and-lines	Longlines (nei)	Midwater trawls (nei)	Pots	Set longlines	Single boat bottom otter trawls	Trawls (nei)	Vertical lines
Zoanthidea							2.905			
Corallium spp								5509.35		
Gorgonocephalus spp								2.83		
Ophiuroidea								1.51		

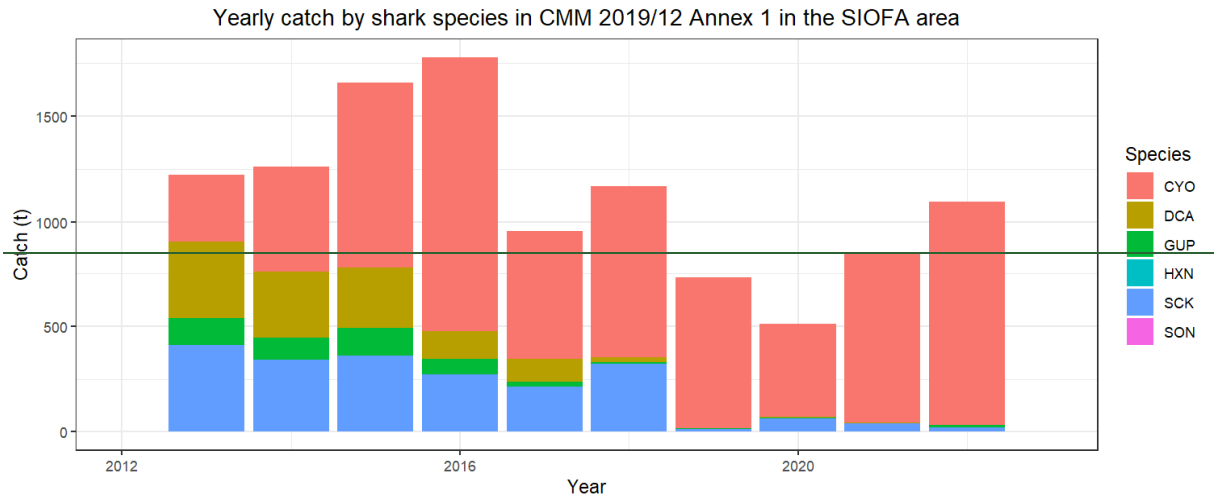
Table D.5 – Total catch of sharks in the SIOFA Area by species (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2020~~2~~2). Species are indicated by their FAO species code (see Appendix B).

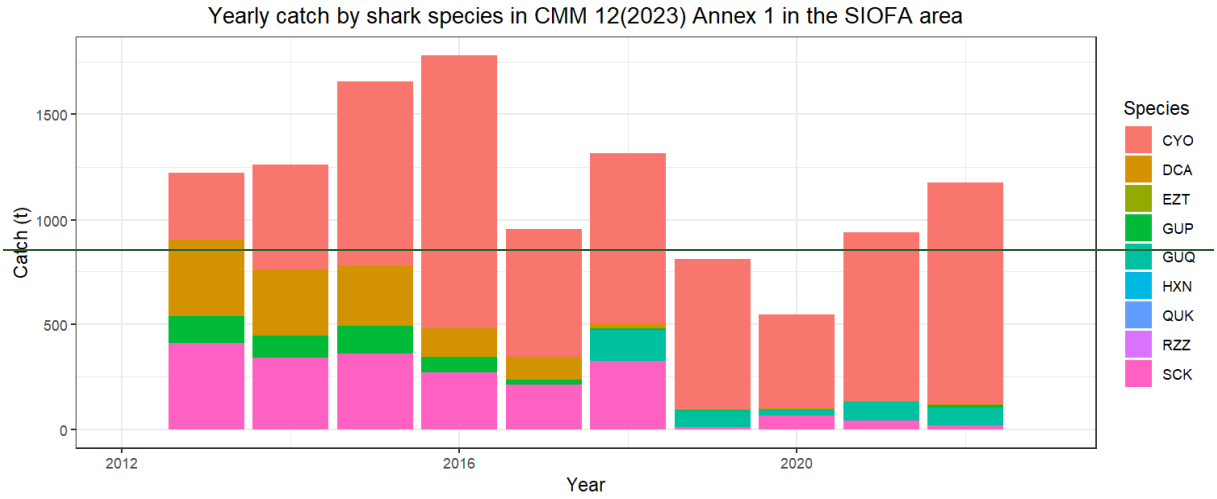
Species	Total weight (t)	Species	Total weight (t)	Species	Total weight (t)
ALS	0	HXT	0.3	SOR	120.8
ASK	2	JFB	32.7	SPK	0
BHY	5.2	NTC	1.4	SPN	2
BSH	0	ORZ	2.5	SRX	4.1
BYR	42.3	PTM	0.2	SUN	83.6
CAR	3.1	QUK	1.5	TIG	0.1
CLD	0.3	RAJ	0.2		
CVX	38.1	RBI	0.8		
CWM	0	RBY	1		
CWO	0	RFA	218.4		
CWZ	35.9	RME	0.1		
CYO	7450.2	RMV	0		
CZI	0	RRY	0.9		
DCA	1241.8	RSK	0		
DGX	0.5	RTE	0		
DGZ	0.7	RYE	0.2		
DOP	1.5	RZZ	0.4		
ETE	3.7	SBL	0		
ETF	0.5	SCK	2057.9		
ETM	155.4	SDV	30.1		
GTF	6.6	SHL	654.7		
GUP	486.4	SKA	0.2		
GUQ	427.2	SKH	0.1		
HAG	0	SKX	5121.4		
HCM	0	SMA	0.2		
HOL	1.2	SON	1.1		



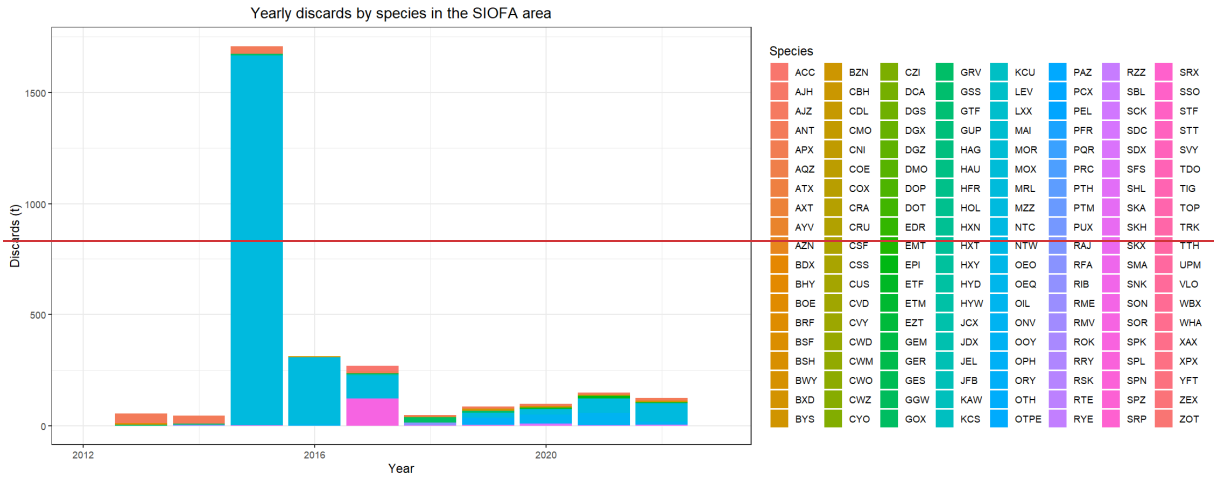
~~*Figure D.1 – Yearly catch of sharks in the SIOFA Area by species (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2020). Species are indicated by their FAO species code (see Appendix B).*~~

Figure D.1 – Yearly catch of sharks in the SIOFA Area by species (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2020). Species are indicated by their FAO species code (see Appendix B).



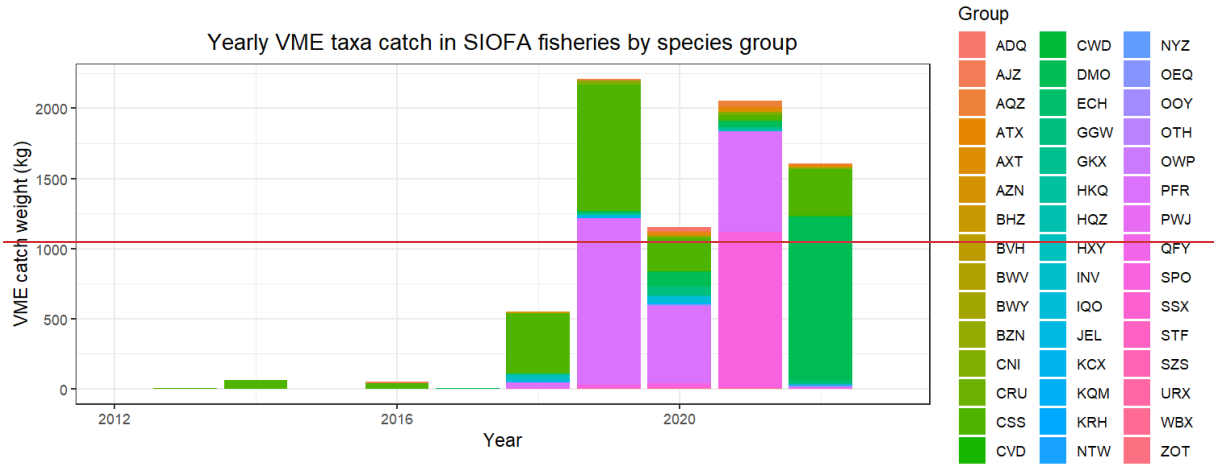


~~*Figure D.2a and b – Yearly catch in the SIOFA Area of sharks considered to be at "high risk" and/or "of concern" as included in Annex 1 of SIOFA CMM 12 (Conservation and Management Measure for Sharks). Catches are summarised by species in different versions of the CMM Annex 1, 2019/2022 (upper panel, a) and 2023 (lower panel, b) (source: SIOFA_AggregatedCatchEffort and HBHCatchEffort databases 2013–2022). Species are identified by their FAO species code (see Table 3 for disambiguation).*~~



~~Figure~~ Table D.~~36~~ – ~~Yearly~~ Total discards in the SIOFA Area by species (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2022~~0~~). Species are indicated by their FAO species code.

Species	Total weight (t)	Species	Total weight (t)	Species	Total weight (t)	Species	Total weight (t)	Species	Total weight (t)	Species	Total weight (t)
ACC	25	CRA	0	GEM	0	LXX	0	RAJ	0	SPN	2
AJH	0	CRU	0	GER	0	MAI	0	RFA	17.9	SPZ	0
AJZ	0	CSF	0	GES	0	MOR	0	RIB	0.1	SRP	0
ANT	172.7	CSS	0	GGW	0	MOX	0	RME	0.1	SRX	0.4
APX	0	CUS	0	GOX	0.4	MRL	0	RMV	0	SSO	0.2
AQZ	0	CVD	0	GRV	53.1	MZZ	2254.7	ROK	0	STF	0
ATX	0	CVY	0	GSS	0	NTC	1.4	RRY	0.9	STT	0.1
AXT	0	CWD	0	GTF	0	NTW	0	RSK	0	SVY	0.1
AYV	0	CWM	0	GUP	0.2	OEO	1	RTE	0	TDO	0
AZN	0	CWO	0	HAG	0	OEQ	0	RYE	0.1	TIG	0.1
BDX	0	CWZ	0	HAU	0	OIL	8.7	RZZ	0.4	TOP	0.1
BHY	5.2	CYO	0	HFR	1.7	ONV	109.4	SBL	0	TRK	0
BOE	0.2	CZI	0	HOL	1.2	OOY	0	SCK	0.1	TTH	0
BRF	1.6	DCA	0	HXN	0	OPH	0.2	SDC	0.1	UPM	0.1
BSF	2.1	DGS	0	HXT	0.3	ORY	24	SDX	14.8	VLO	0
BSH	0	DGX	0.5	HXY	0	OTH	3.7	SFS	2	WBX	0
BWY	0	DGZ	0.4	HYD	0.2	OTPE	0	SHL	0.3	WHA	0
BXD	0.1	DMO	0	HYW	0	PAZ	0	SKA	0.2	XAX	0.4
BYS	21.9	DOP	1.5	JCX	0	PCX	0.2	SKH	0.1	XPX	0
BZN	0	DOT	0	JDX	0	PEL	0	SKX	2.2	YFT	0
CBH	0	EDR	1.5	JEL	0	PFR	1.6	SMA	0.2	ZEX	0.5
CDL	4.3	EMT	0.1	JFB	5.1	PQR	0	SNK	0.1	ZOT	0
CMO	1.7	EPI	19.2	KAW	0.2	PRC	0	SON	1.1		
CNI	0.1	ETF	0.5	KCS	0	PTH	0.1	SOR	120.8		
COE	0	ETM	0	KCU	0	PTM	0.2	SPK	0		
COX	1.2	EZT	0	LEV	0.5	PUX	0.1	SPL	0		



~~Figure~~Table D.7~~4~~ – ~~Yearly~~Total incidental catch of VME taxa in the SIOFA Area by species group (source: SIOFA Observer and HBHCatchEffort databases 2013–202~~0~~2). Species are indicated by their FAO species code.

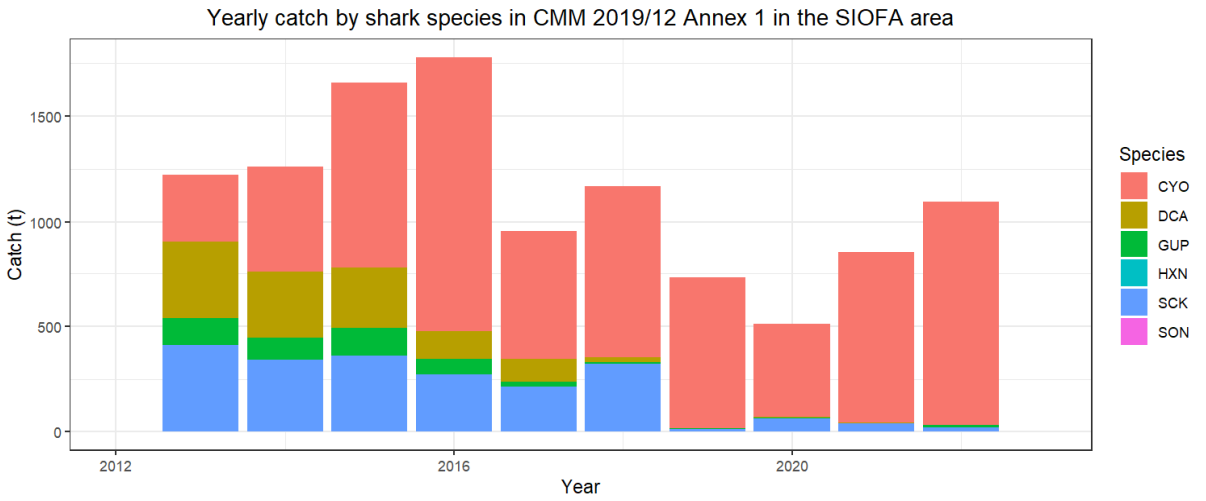
Taxon	Total weight (kg)	Taxon	Total weight (kg)
ADQ	32.98	INV	7.33
AJZ	26.49	IQO	67.43
AQZ	68.9	JEL	21.25
ATX	33.55	KCX	1.52
AXT	41.74	KQM	22.2
AZN	11.38	KRH	0.1
BHZ	0.03	NTW	10.02
BVH	0.28	NYZ	0.1
BWV	2.3	OEQ	12.99
BWY	0.21	OOY	9.76
BZN	9.57	OTH	1000.01
CNI	62.45	OWP	1.51
COR	5509.35	PFR	2488.56
CRU	0.27	PWJ	0.07
CSS	2739.63	QCX	2.83
CVD	5	QFY	0.06
CWD	4.62	SPO	1186.03

DMO	1320.34	SSX	2.33
ECH	9.43	STF	13.3
GGW	188.32	SZS	1.14
GKX	0.04	URX	18.51
HKQ	4.5	WBX	0.4
HQZ	13.09	ZOT	2.91
HXY	47.8		

Table D.8 – Total fish catch (t) by species in Interim Protected Areas (IPAs) (including years before the IPAs were implemented) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2020~~2~~2).

Species	Total weight (t)	Species	Total weight (t)
ANF	1.7	JEL	0
ANT	0.4	KCS	0
AXT	0	KCU	0
BWA	0.1	LEV	0.5
BXD	0	OIL	2.5
BYS	255.3	ORY	0.2
BZN	0	PEL	7.6
COX	0	RFA	0.4
CSS	0	RIB	17
CYO	58.3	ROK	0
DCA	6.6	SCK	71.7
DMO	0	SEY	4.7
EDR	21.1	SHL	3.4
EPI	7.3	SKA	0.1
GGW	0	SKX	5.4
GRV	0.9	SRX	0
GUP	3.4	TOP	12

GUQ	5.8	WRF	2.4
HOL	0.3		



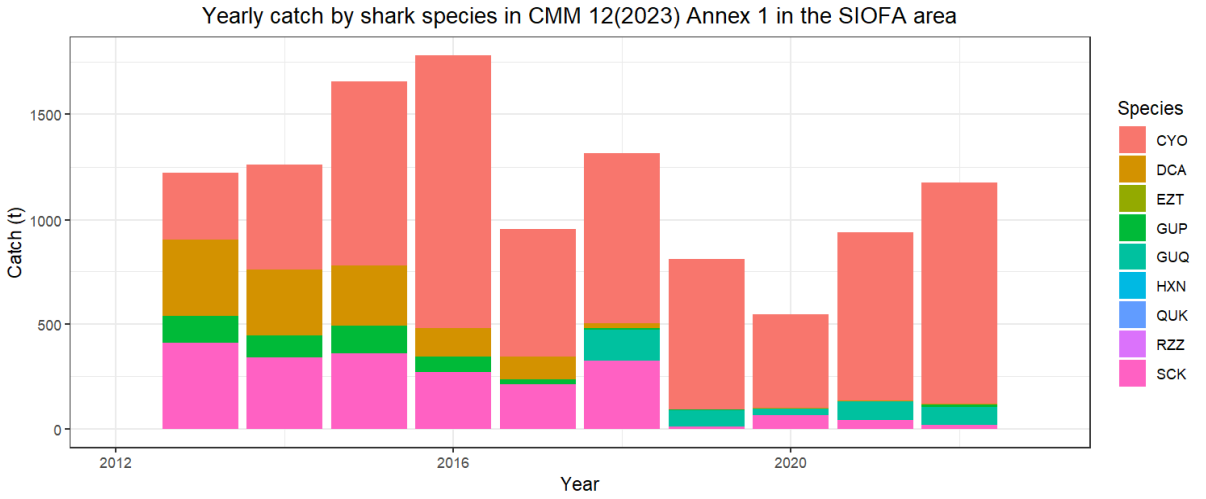


Figure D.1~~2~~a and b – Yearly catch in the SIOFA Area of sharks considered to be at "high risk" and/or "of concern" as included in Annex 1 of SIOFA CMM 12 (Conservation and Management Measure for Sharks). Catches are summarised by species in different versions of the CMM Annex 1, 2019/2022 (upper panel, a) and 2023 (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2022). Species are identified by their FAO species code (see Table 3 for disambiguation).

~~*Figure D.4 – Yearly incidental catch of VME taxa in the SIOFA Area by species group (source: SIOFA Observer and HBHCatchEffort databases 2013–2020). Species are indicated by their FAO species code.*~~

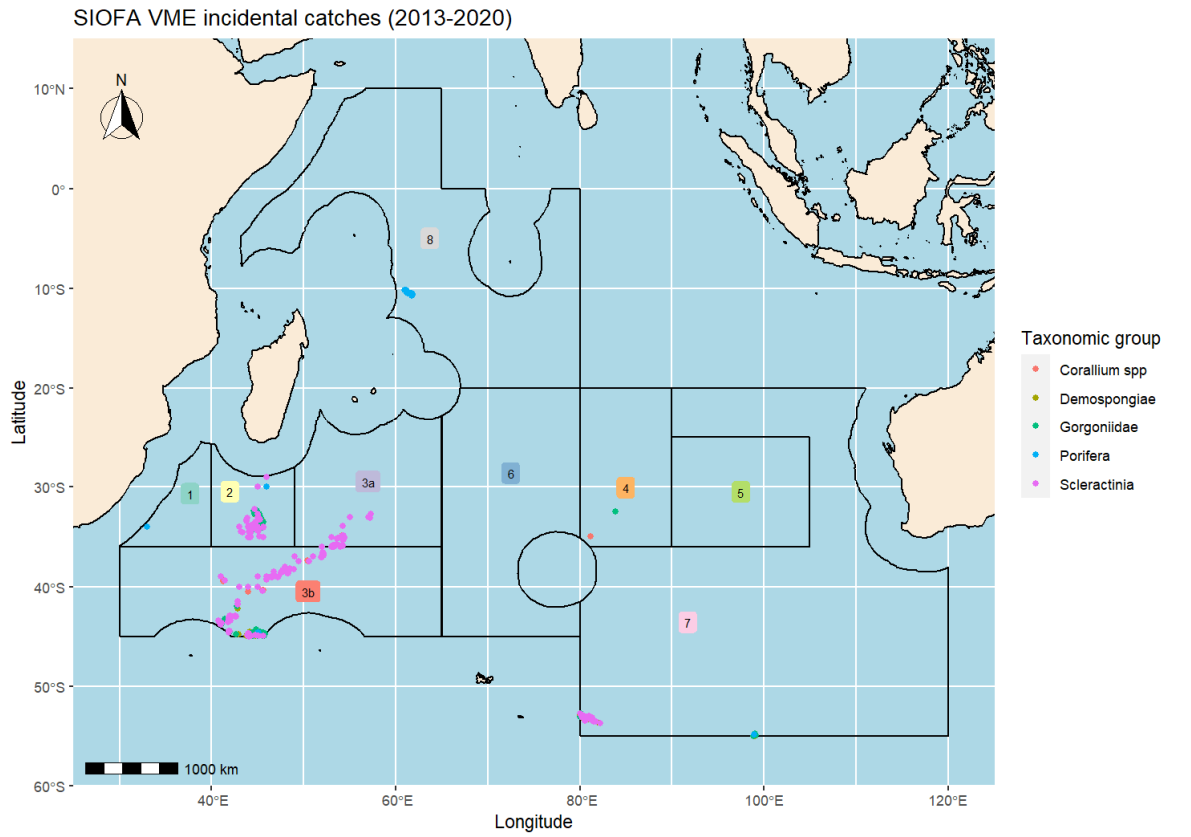
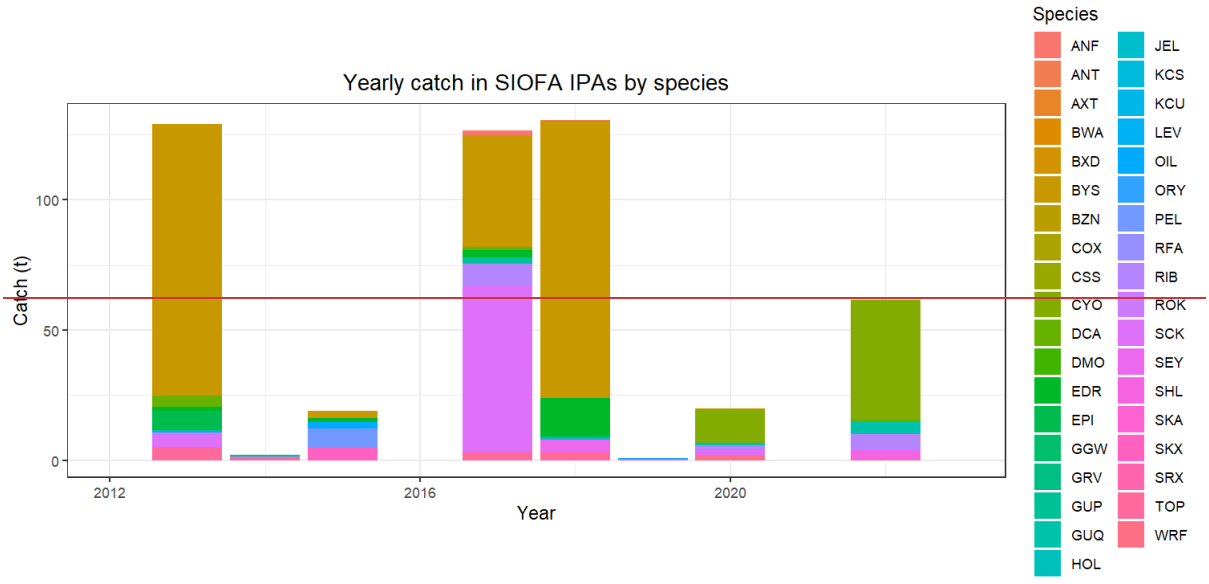


Figure D.~~5~~2 – Incidental catch of VME taxa reported in the SIOFA Area, mapped by taxonomic group (source: SIOFA Observer and HBHCatchEffort databases 2013–202~~0~~2).



~~*Figure D.6 – Total fish catch (t) by species in Interim Protected Areas (IPAs) per year (including in years before the IPAs were implemented) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2020).*~~