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

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Overview of SIOFA Fisheries 2023

Workshop Conveners

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Abstract

This paper presents the Overview of SIOFA Fisheries 2023.
This previous version of this document, including data up to 2020, was originally prepared by the SIOFA Secretariat, endorsed by SC7 and MoP9, and published in 2022.
The current version of this document has been produced during the SC8 meeting, by a specific workgroup within the meeting, and has been subsequently approved for publication at the MoP10 meeting. The published version includes figures with data updated to 2021.

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[2] Documents available only to members invited to closed sessions.

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Overview of SIOFA Fisheries 2023

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Contributing authors: Marco Milardi, Stephen Brouwer, Alistair Dunn, Pierre Peries, Patrice Pruvost, Sebastian Rodriguez Alfaro, Trent Timmiss.

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Contents

1. Purpose of this document

The SIOFA Fisheries Overview is a public document that aims to summarize, at a minimum, the last 5 years of available data, as well as illustrate broad temporal trends in the main fisheries within the SIOFA Area (Figure 1). Its target audience is the general public, as well as institutions and countries wanting to better understand SIOFA fisheries. It also serves as a description of data available on SIOFA fisheries, which can be used by scientists and consultants alike when evaluating research involving this data.

Fisheries Summaries (e.g. the orange roughy fisheries summary, with others currently being developed for a number of species of interest) integrate this overview by providing further details on single species ecology/biology and their fisheries and are a useful resource for exploring specific knowledge. An interim list of the species declared as a target of fisheries by SIOFA CCPs (Contracting Parties (CP), Cooperating non Contracting Parties (CNCP) and Participating Fishing Entities (PFE)) as per CMM 02-2021, including their FAO codes, is provided in Appendix A. The SIOFA Ecosystem Summary https://siofa.org/sites/default/files/files/SIOFA-Ecosystem-Summary-2023.pdf supplements this overview by describing the main areas of work on ecosystems and species conservation within the SIOFA Area.

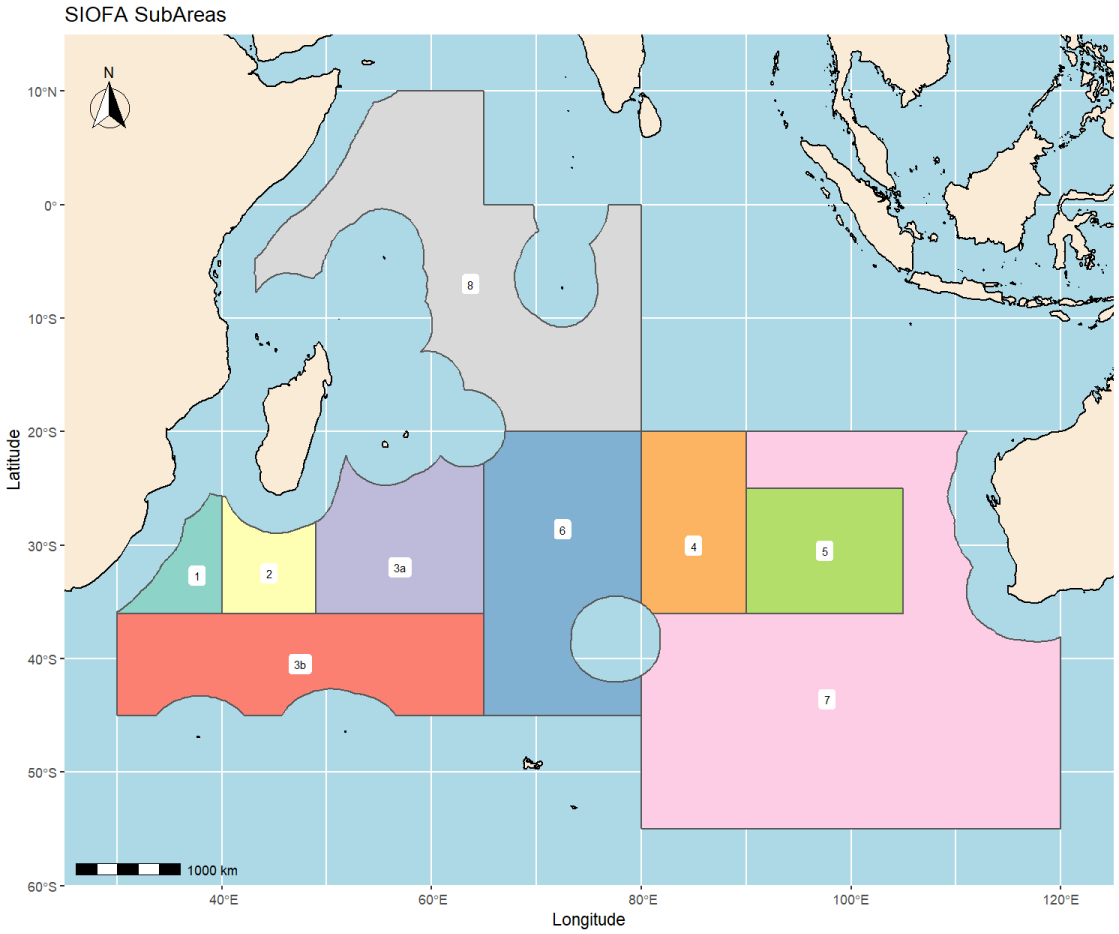


Figure 1 – The SIOFA Area and its subareas highlighted with different colours (source: SIOFA Spatial database). The subarea colour code is used consistently to identify subareas throughout this overview.

2. Data sources

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 02-2021 (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 2021.
- Observer, which contains Scientific Observer collected biological sampling and operational data, from 2012 to 2021.

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 (e.g., SC-07-08), 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 (2015–2021) 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).

Finally, some spatial data layers have been made publicly available on a GitHub repository (https://github.com/SIOFASecretariat/SIOFA_SC_Spatial_layers).

Missing data for the purposes of this overview

Final 2022 catch, effort and Scientific Observer data were scheduled to be submitted by 31 May 2023 and were thus only partly available for this overview. Any data from 2022 should be considered as draft and potentially incomplete and subject to further revisions, and has been excluded from this overview.

Data used in this overview

The information presented in this overview has been 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 have been made to data sources have been made in each table/figure in the overview.

The Overview was originally meant to cover the last five years of available data (at a minimum), but note that the data used covers the 2013–2021 period (9 years of data), and that the period covered varies across the different sections as detailed below.

i. Active fleet composition (2015–2021) and Main fisheries (2000–2019): National Reports submitted to Scientific Committee.
ii. Total catches per CCP (2013–2021): SIOFA AggregatedCatchEffort database, combined with SIOFA HBHCatchEffort database.
iii. Catch, Effort (including per subarea) and discards (2013–2021): 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 (2003–2021): SIOFA Observer and HBHCatchEffort databases.
v. Fishing in Interim Protected Areas (2013–2021): SIOFA HBHCatchEffort and Spatial databases
vi. Biological sampling (2021): SIOFA Observer database.

3. Active Fleet Composition

In the SIOFA Area, eight CCPs were fished over the last three years. Table 1 summarises the number of vessels engaged in fisheries in the SIOFA Area by type of gear employed.

Table 1 – Historical summary of active vessels by CCP and gear in the SIOFA Area (source: Annual National Reports 2015–2021). The Thailand fleet was mainly composed of small tonnage vessels. The Chinese Taipei fleet was composed mainly of longliners fishing for tuna and oilfish. Korea has had no vessels active in the SIOFA Area since 2014 and Seychelles since 2015.

		Year						
CCP*	**Gear**	2015	2016	2017	2018	2019	2020	2021
AUS	Multipurpose	1	1	0	0	1	1	1
	Longlines	0	0	0	1	0	0	2
	Trawls	0	0	0	0	0	0	0
CHN	Longlines	0	0	0	0	0	0	0
	Seine nets	6	8	5	0	0	0	0
COK	Trawls	2	2	2	2	2	2	2
COM	Handlines	-	-	-	2	1	1	0
EU(France)	Longlines	0	1	1	0	0	0	0
EU(Spain)	Gillnets	1	0	0	0	0	0	0
	Longlines	1	1	1	2	1	1	1
FR-OT	Pots/Traps	0	1	0	1	0	0	0
	Longlines	2	0	2	0	1	2	1
JPN	Longlines	0	0	1	0	0	0	0
	Trawls	2	2	2	1	1	1	1
KOR	Longlines	0	0	0	0	0	0	0
	Trawls	0	0	0	0	0	0	0
MUS		-	-	-	7	9	6	4
SYC		0	0	0	0	0	0	0
TPE	Pel. Longlines	21	40	45	35	42	51	49
THA	Pots/Traps	1	2	0	0	0	0	0
	Multipurpose (trawl/handline)	56	60	13	0	2	3	3
	Totals	93	118	72	51	60	68	65

*CCP stands for Contracting Parties, Cooperating Non-Contracting Parties and Participating Fishing Entities
- indicates years where no information provided.

4. Main fisheries operating in the SIOFA Area

In the SIOFA Area, only a few fisheries account for the majority of the total catch. Table 2 summarises these fisheries by target species and provides information about the gear employed, the CCPs engaged in the fishery, and the main Subareas where these fisheries were targeted.

Table 2 – Target species/fisheries in the SIOFA Area. The table also provides information on gear employed, the CCPs engaged in the fishery, and the main Subareas where these fisheries were targeted.

Target species/fisheries	Fishing gear	Participants (reported in National Reports between 2000 and 2019)	Subareas
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 b
Alfonsino	Midwater trawl	Australia, Cook Islands, Japan, Korea, Namibia	Underwater topographic features in SIOFA Subareas 1, 2, 3a and b
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. Fishing Effort

Table 3 summarises fishing effort in the SIOFA Area by CCPs. Effort was variable across years and gears. Note that different gears also have had different units of measure for their effort.

Table 3 – Summary of fishing effort by each CCP, main gear and year (source: SIOFA National Reports 2015–2021). 2021 fishing efforts are incomplete as some information has not yet been provided by 2 CCPs. Handline effort was not reported by hooks number but by fishing day.

			Year						
Flag	Gear	Effort unit	2015	2016	2017	2018	2019	2020	2021
AUS	Trawl	hours	15	26	0	0	0	0	0
	Longline/Vertical line	x1000 hooks	2	40	0	28	54.2	173	109.7
CHN	Seine net	hours	10000	4000	300	0	0	0	0
	Longline	x1000 hooks	0	0	0	0	0	0	0
COK	Trawl (mid)	shots	2050	1409	1534	897	1026	1549	1084
	Trawl (Bottom)	shots	679	565	451	672	589	381	336
EU-ESP	Gillnet	Km	1200	0	0	0	0	0	
	Longline	x1000 hooks	2300	3200	3200	5432	3435	2551	2691
EU-FRA	Longline	x1000 hooks	0	np	np	0	0	0	0
FR-OT	Longline/Vertical line	sets	66	13	33	30	40	46	54
	Longline	x1000 hooks	443.5	1.2	150.7	2.6	200	127	145
	Pot/Trap	number		40		50	0	0	0
JPN	Trawl	hours	2250	2500	3250	1091	1512	689	-
	Longline	x1000 hooks			64	0	0	0	0
KOR	Longline	hooks	0	0	0	0	0	0	0
	Trawl	hours	0	0	0	0	0	0	0
MUS			-	-	-	-	-	-	-
SYC	*no fishing*		0	0	0	0	0	0	0
CT	Longline	x1000 hooks	11501	22083	26557	20773	23145	21830	19506
THA	Trawl	shots	4090	4552	795	0	176	464	1003
	Handline	days					110	133	52
	Pot/Trap	number	0	8	10	0	0	0	0
COM	Handline	days	-	-	-	-	-	64	0
TOTAL	longline *	hooks (x1000)	14244	25324	29940	26204	26840	24683	22451
	trawl	shots	9084	9063	6275	1667	1644	464	[2373]
		hours	2265	2526	3250		1512	689	

* does not include potential hooks number from sets
- no information provided to date.

6. Fish catch in the SIOFA Area

6.1 Total fish catches

Total fish catches in the SIOFA Area are composed by a wide variety of species. The species targeted in the SIOFA Area are listed (along with their FAO species codes) in Appendix A. The list of target fish species was extracted from CCP declared targets as per CMM 02-2021, and as listed in the SIOFA HBHCatchEffort database, for the purposes of this Overview.

The total fish catch in the SIOFA Area sharply increased in 2015 and then decreased to lower levels (but still higher than 2013-2014) in recent years (Figure 2).

The increase in reported catch since 2015 was contributed to by the catch from Thailand (THA) (Thailand National report 2015-17) and Chinese Taipei (CT) catches. Thailand catches were mostly made from scads (*Decapterus sp*.) and lizardfish (*Saurida sp.*) and Chinese Taipei catches were oilfish from its tuna fishery.

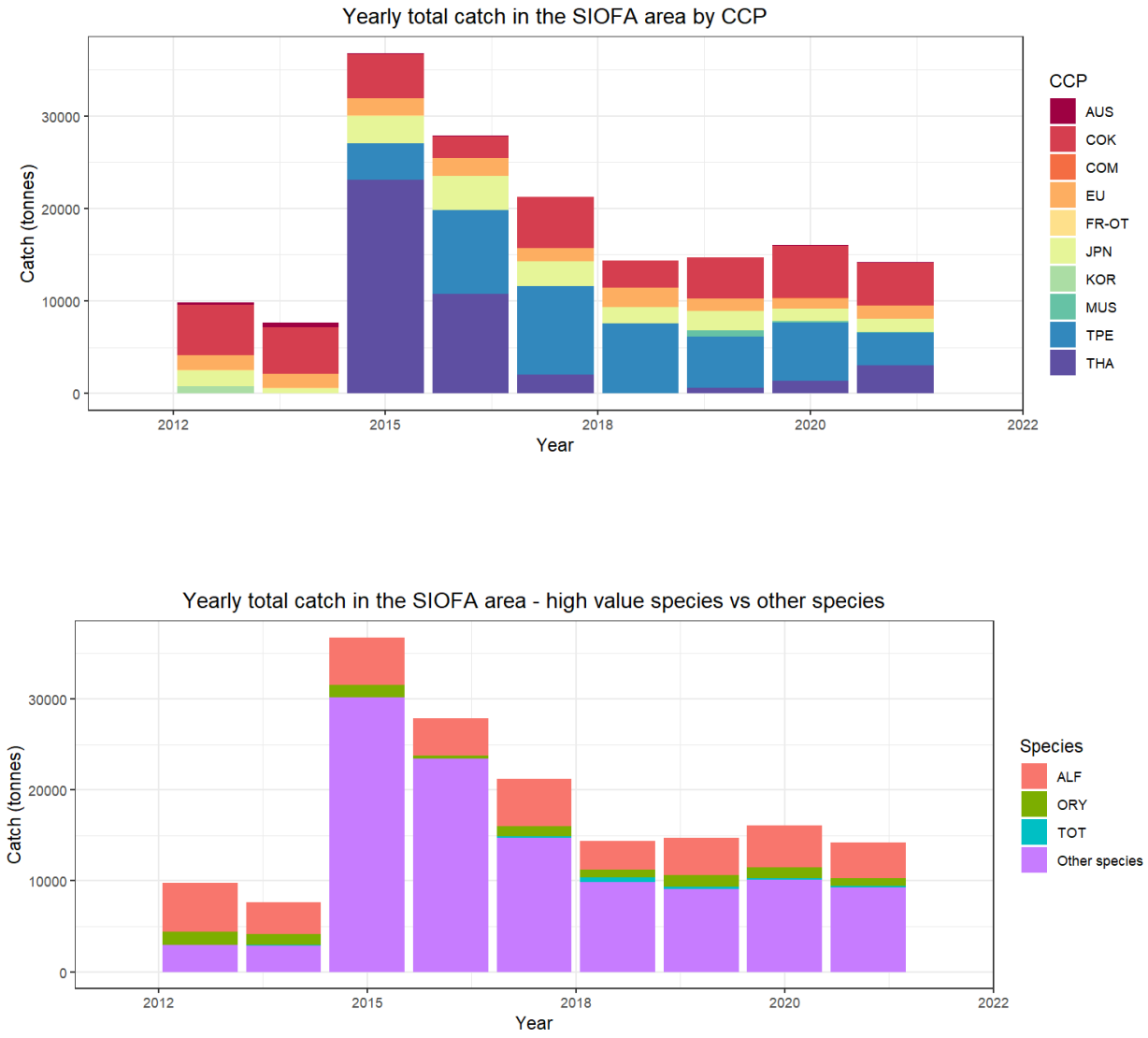


Figure 2a and b – Yearly total catch (t) in the SIOFA Area (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021) by SIOFA CCP (panel a) and by species (panel b) highlighting the primary species as opposed to all other species. All catch included, even without spatial information.

Total catch in 2021 was mostly taken in SIOFA Subareas 3b, 1 and 2, but in 2015-2016 a larger portion of the catch came from subarea 8 (Figure 3).

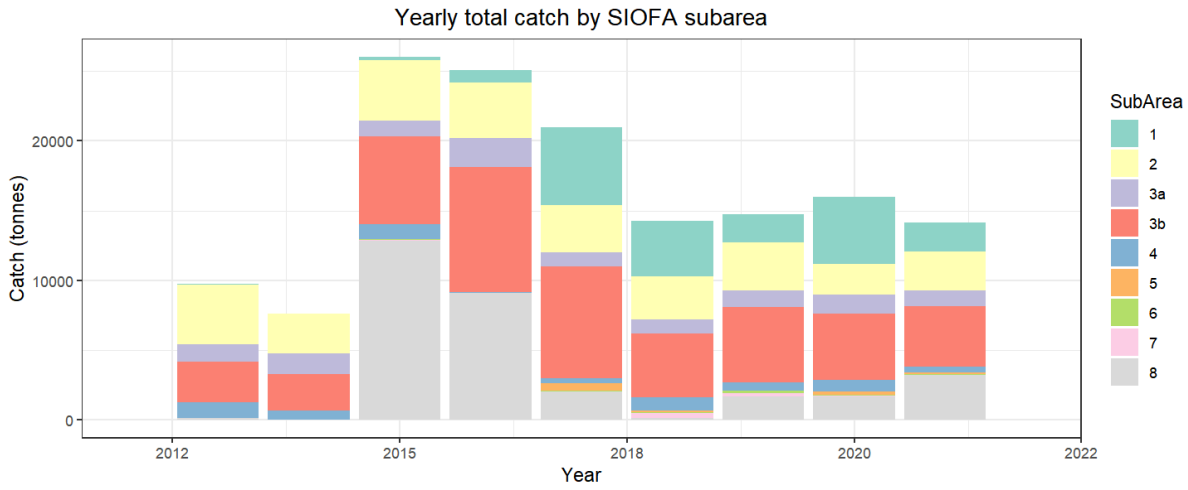


Figure 3 – Total catch reported by SIOFA Subareas (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included.

6.2 Target fish catch and bycatch

Fish bycatch commonly refers to the capture of all fish species that were not intended as a target in a given fishing event or, more broadly, in a fishery. All fish species not declared as targets as per CMM 02-2021 were considered bycatch.

6.2.1 Global fish catch/bycatch

Bycatch constituted a predominant proportion (>50%) of the total catch in 2015 and 2016 (Figure 4a) but has otherwise been around or below 25% of the total catch in other years (Figure 4a). In absolute terms, bycatch was extremely variable across years (Figure 4b).

The figures on bycatch highlight the proportion of “sharks” in the catch.

Broad definitions of sharks include Chondrichthyans in general in the “shark” category (e.g., rays and chimaeras). For the purpose of this chapter, a list of all Chondrichthyans taxa captured in SIOFA fisheries and reported in the HBHCatchEffort database 2013–2021 was extracted and used to define “sharks”. The full list of shark taxa captured in SIOFA fisheries is provided in Appendix B.

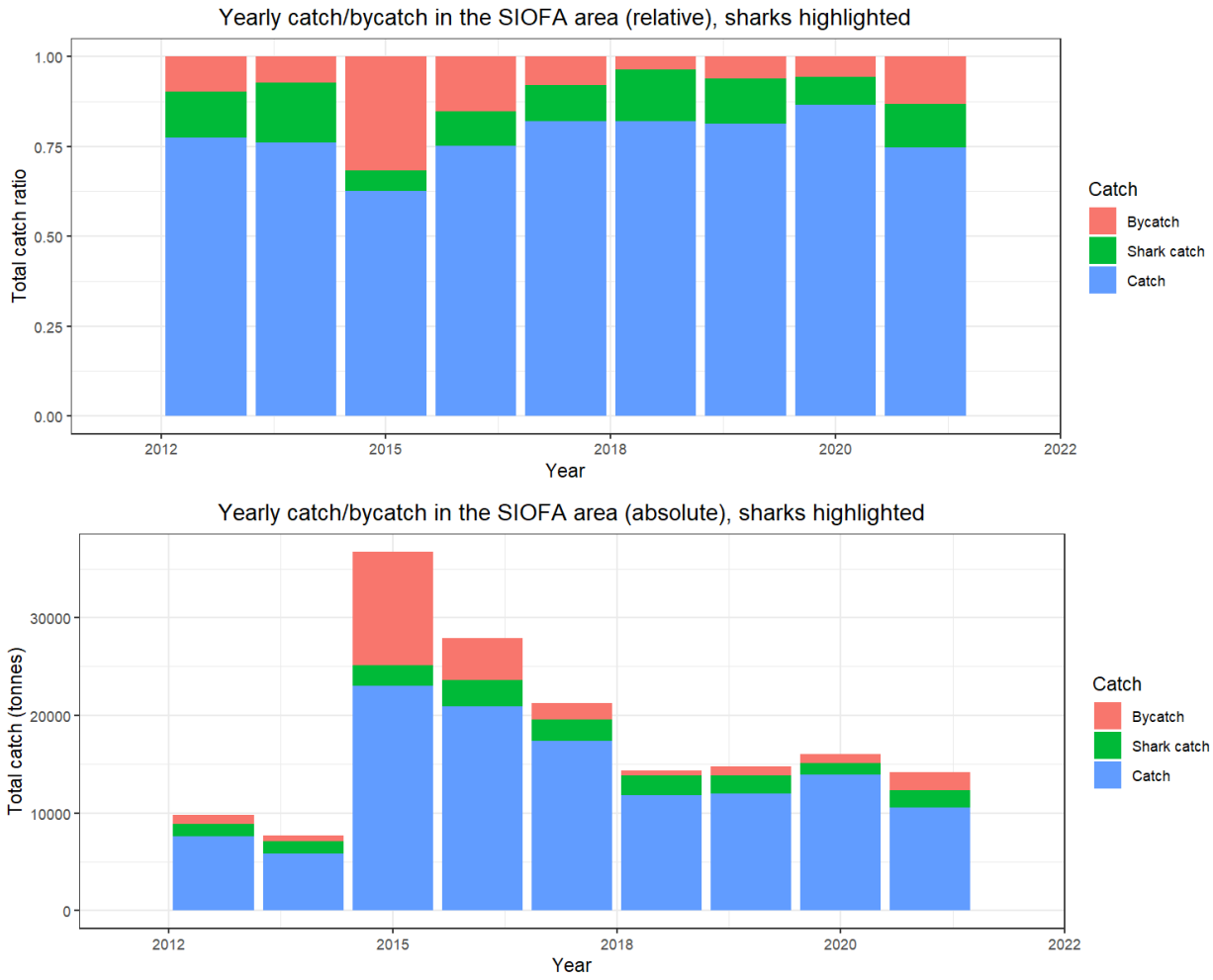


Figure 4a and b – Catch and bycatch as relative values (upper panel, a) and absolute values (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included, and the portion of bycatch composed by sharks (as defined in Appendix B) is highlighted.

6.2.2 Catch and bycatch in SIOFA Subareas

Catch of target species was taken mainly in SIOFA Subareas 1 and 3b (Figure 5a). Bycatch in 2021 was mostly taken in SIOFA Subareas 8, and 2 (Figure 5b). In 2015-2016 a larger portion of the bycatch came from subarea 8 (Figure 5b).

Figure 5a and b – Catch (upper panel, a) and bycatch (lower panel, b) in different SIOFA Subareas (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included.

6.2.3 Catch of sharks

This section presents further details on the sharks catches in SIOFA, which were noted in section 6.2.1. Sharks are caught with different gears, in the past they were caught with both gillnets and longlines, but in recent years they are mainly caught with longlines.

Sharks were targeted in the SIOFA Area until the entry into force of CMM 12-2019 (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 12-2019, all sharks are considered simply as catch for the purpose of this Overview.

Catch of sharks (as defined in Appendix B) increased between 2013 and 2016 but has decreased since (Figure 6a). Catch of sharks was dominated by Portuguese dogfish (CYO), with a significant presence of kitefin shark (SCK) until 2019 (Figure 6a). Subarea 2 was the origin of most of the shark catches in the SIOFA Area (Figure 6b).

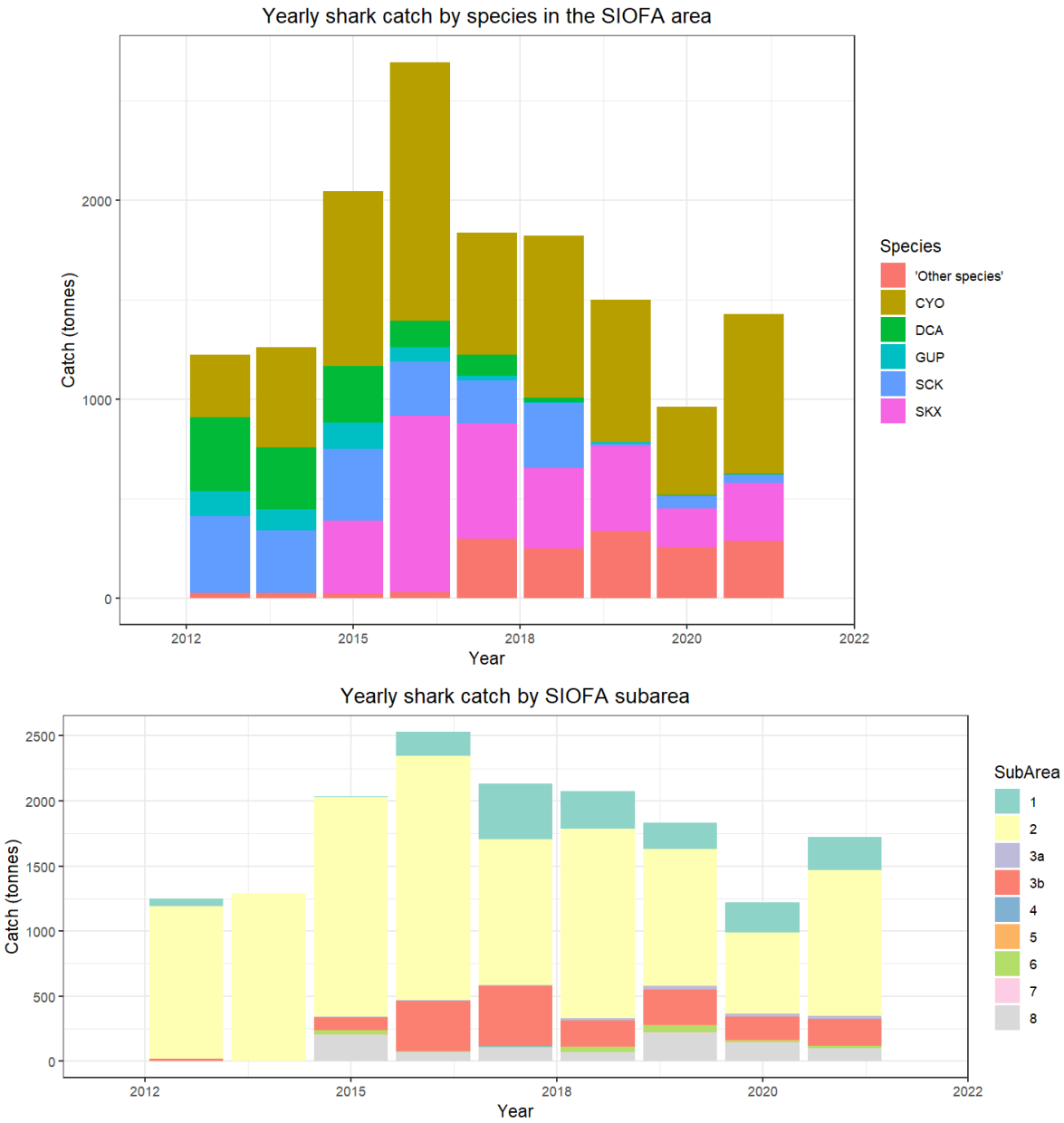


Figure 6a and b – Yearly catch of sharks in the SIOFA Area by species (upper panel, a) and by SIOFA subarea (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Species are indicated by their 3-letter FAO code, see Appendix B for disambiguation.

Table 4 - Total catch of sharks (in t) per year and subarea (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Total catch includes both target and bycatch for all species.

Year	1	2	3a	3b	4	5	6	7	8
2013	61.4	1167.7		20.6					0.2
2014		1282.9		3.9					

2015	7.5	1685.4	10.5	95.7	2.7		32.2	3	200.2
2016	184.4	1878.1	3.2	387.8	1.1		5		70.4
2017	436.1	1121.7	5.2	453.9	1.4	0.4	9.8		102.8
2018	286.7	1456.1	18	199.9			38.2	0.2	71
2019	204.4	1055.3	28	263.5	1.2	5	51.5	9.2	213.9
2020	235.9	624	23.7	167.8	5.1	1.2	15.1	0.5	143.5
2021	252.5	1120	27.9	193.5	4.4		14.8	0.4	100.1

A list of deep sea sharks considered to be at “high risk” and “of concern” is included in Annex 1 of SIOFA CMM 12-2019 (Conservation and Management Measure for Sharks) and was derived from Georgeson et al. (2020). The following figures refer to this subset of sharks as defined in CMM 12-2019, which is reported here in Appendix C for easier reference.

Catch of sharks at “high risk” and “of concern” (as defined in CMM 12-2019) increased between 2013 and 2016 but has decreased since (Figure 7a). Catch of sharks at “high risk” and “of concern” was dominated by Portuguese dogfish (CYO), with a significant presence of Kitefin shark (SCK) until 2019 (Figure 7a). The vast majority of catches of shark at “high risk” and “of concern” in the SIOFA Area came from Subarea 2 (Figure 7b).

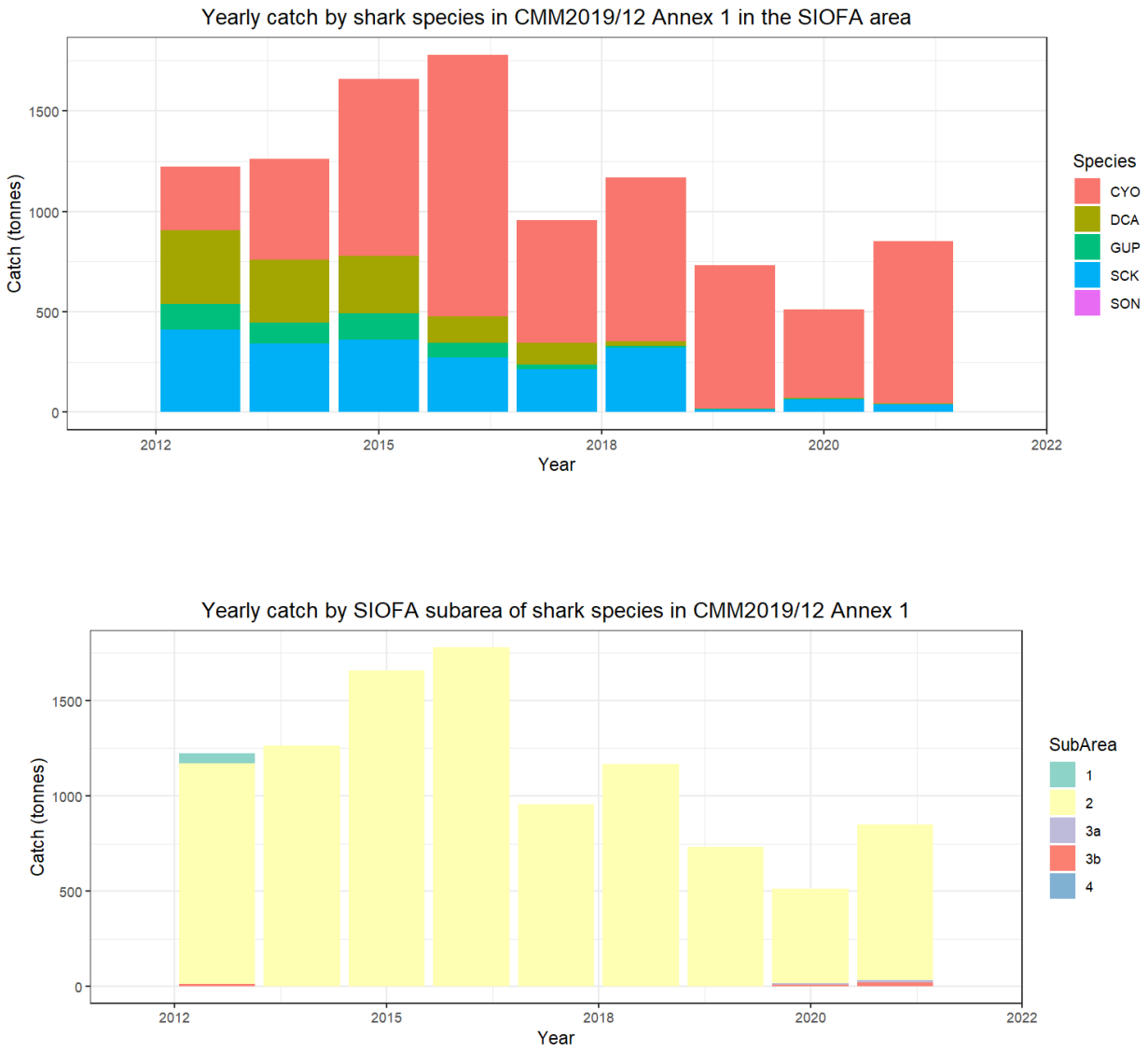


Figure 7a and b – Yearly catch of sharks considered to be at "high risk" and "of concern" as included in Annex 1 of SIOFA CMM 12-2019 (Conservation and Management Measure for Sharks) in the SIOFA Area. Figures by species (upper panel, a) and by SIOFA subarea (lower panel, b) are presented (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Species are indicated by their FAO species code, see Appendix C for disambiguation.

6.2.4 Catch in SIOFA Assessment Areas for orange roughy and toothfish

Stock boundaries for orange roughy were defined and used in the stock assessments by Cordue (2018a, 2018b), and assumed that all catch would derive from within these boundaries. These stock boundaries have been historically referred to as "Management Units", even though SIOFA has not yet formally adopted these for orange roughy (Figure 8). Therefore, they should be referred to more appropriately as "Assessment Areas". Note that not all catch of orange roughy was taken inside those Assessment Areas.

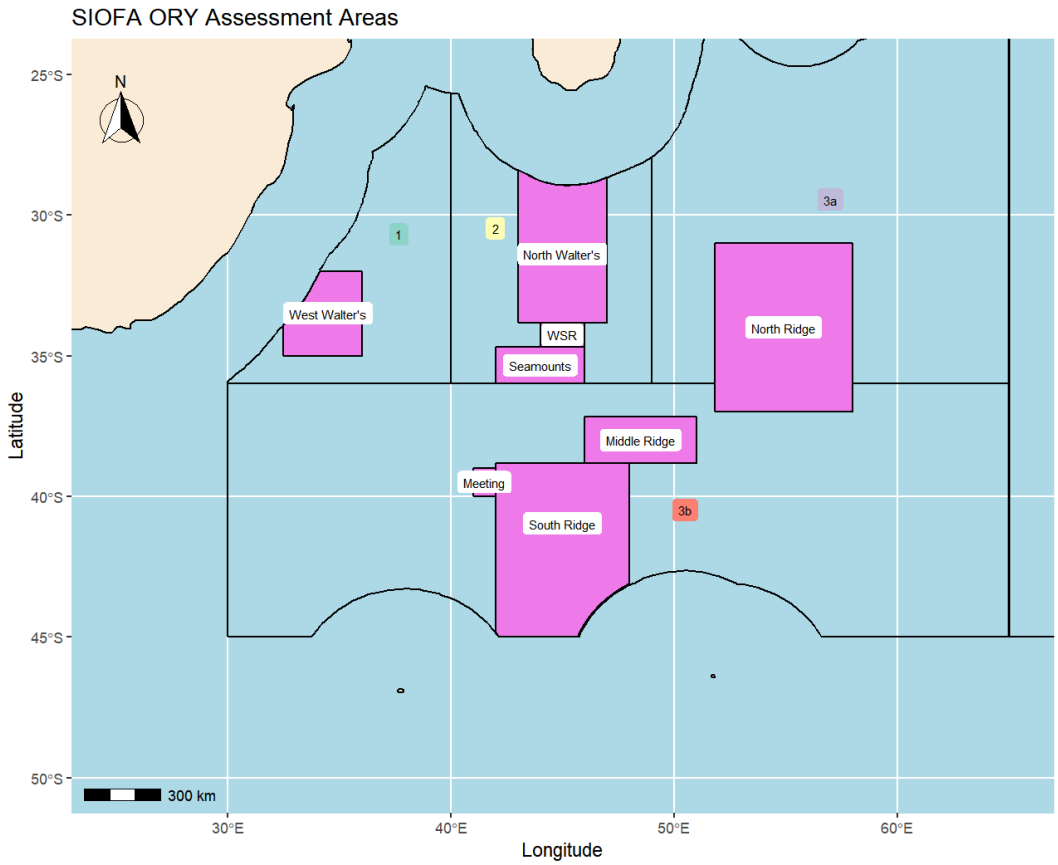


Figure 8 – Map of SIOFA Assessment Areas for orange roughy as defined by Cordue (2018a, 2018b) (source: SIOFA Spatial layers). Labels indicate names of each Assessment Area.

Toothfish Assessment Areas are defined within CMM 15-2021 (paragraphs 13 and 50), and include two areas, the Del Cano Rise and Williams Ridge (Figure 9). Note that not all catch of toothfish was taken inside those Assessment Areas.

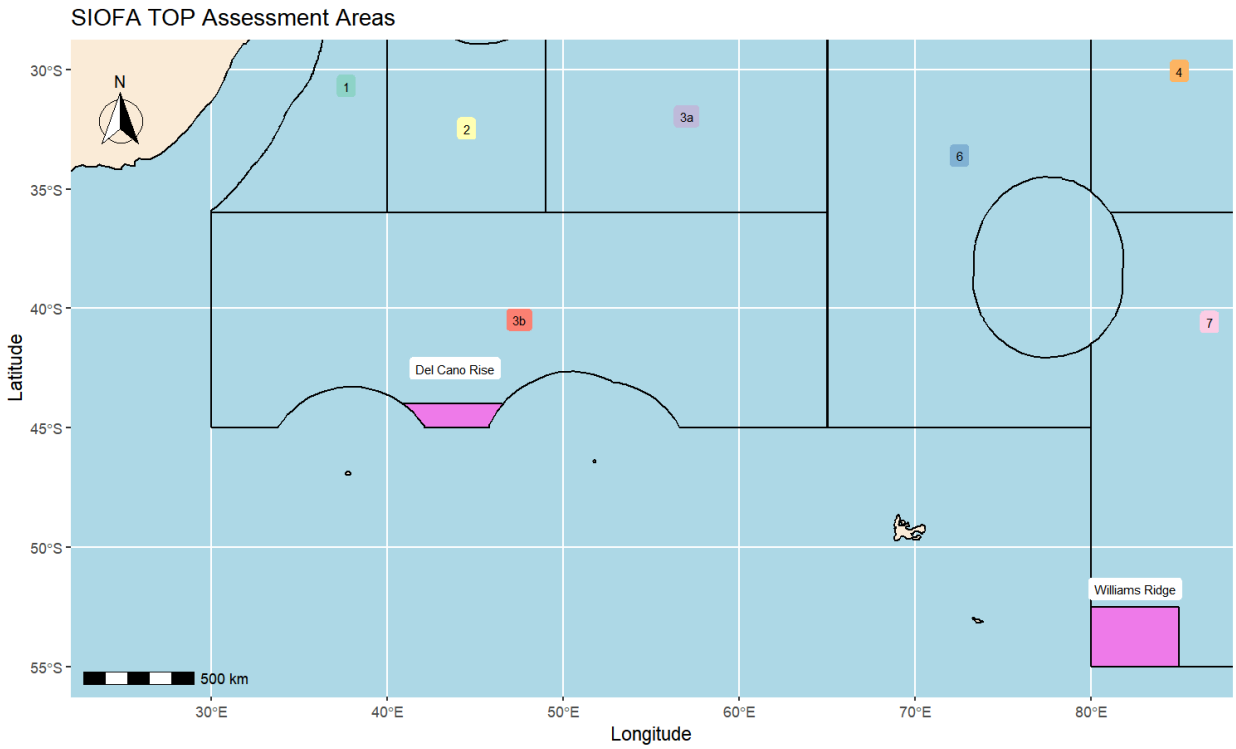
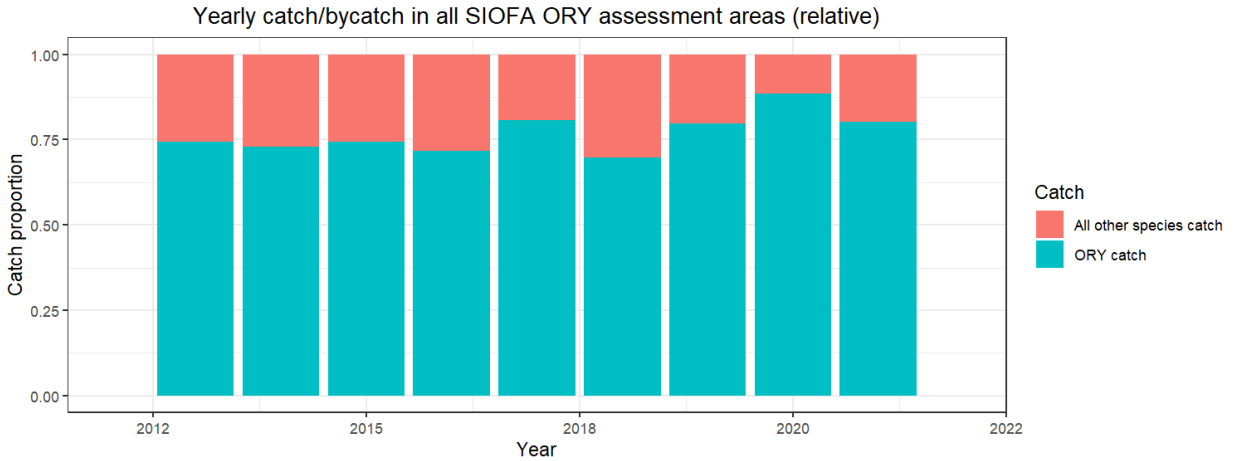


Figure 9 – Map of SIOFA Assessment Areas for toothfish as defined in CMM 15-2021 (source: SIOFA Spatial layers). Labels indicate names of each Assessment Area.

Some specific analyses of catch and effort within Assessment Areas included presentation of confidential data. These have been excluded from the public version.

Within the Assessment Areas for orange roughy, the proportion between target (as defined in Appendix A) and bycatch was relatively stable (around 25% of bycatch) from 2013 onwards (Figure 10a). Total (all species) catch was however variable across years (Figure 10b).



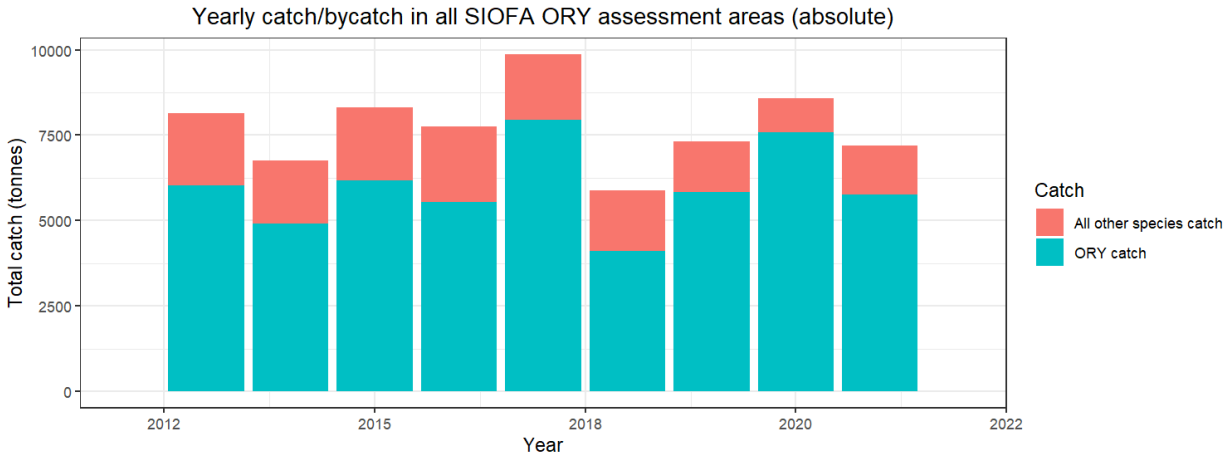


Figure 10a and b – Target catch (as defined in Appendix A) and bycatch as relative values (upper panel, a) and absolute values (lower panel, b) in all SIOFA Assessment Areas for orange roughy (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included.

Within the two Assessment Areas for toothfish, the proportion between catch and bycatch was relatively variable, with the proportion of bycatch close to 0.75 until 2015, and below 0.5 afterwards (Figure 11a). Total (all species combined) catch was however relatively variable across years, with a notable peak in 2018 (Figure 11b).

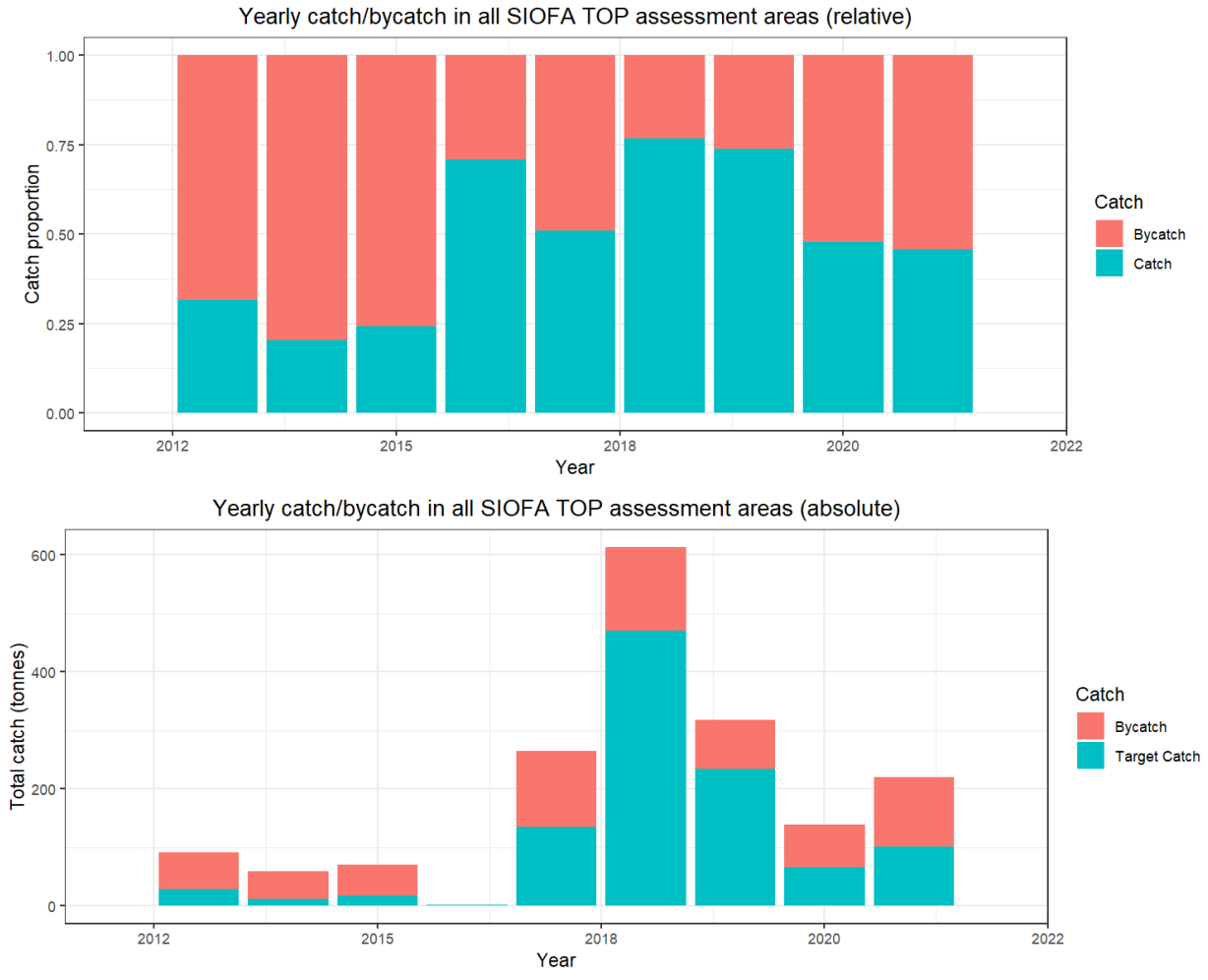


Figure 11a and b – Target catch (as defined in Appendix A) and bycatch as relative values (upper panel, a) and absolute values (lower panel, b) within the two SIOFA Assessment Areas for toothfish (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included.

Catch and bycatch in single Assessment Areas

[this section is not included in the public version of the manuscript, due to confidentiality limitations set out in CMM 03-2016]

6.2.5 Discards and bycatch

When dealing with bycatch, note that usually most of the bycatch was retained and landed, with only a small proportion of it being discarded at sea and not landed. Discards might also involve target catch (e.g., undersized or damaged fish), but typically to a lesser extent. SIOFA catch and effort databases contain the fate of catch per species, aggregated at different levels, which enables analyses on discards.

Discards have historically been a small proportion of the bycatch (Figure 14a), and consequently an even smaller proportion of the total catch. In absolute terms, they were typically around or below 100 t per year but were much higher in 2015, when they were more than 1500 t (Figure 14b).

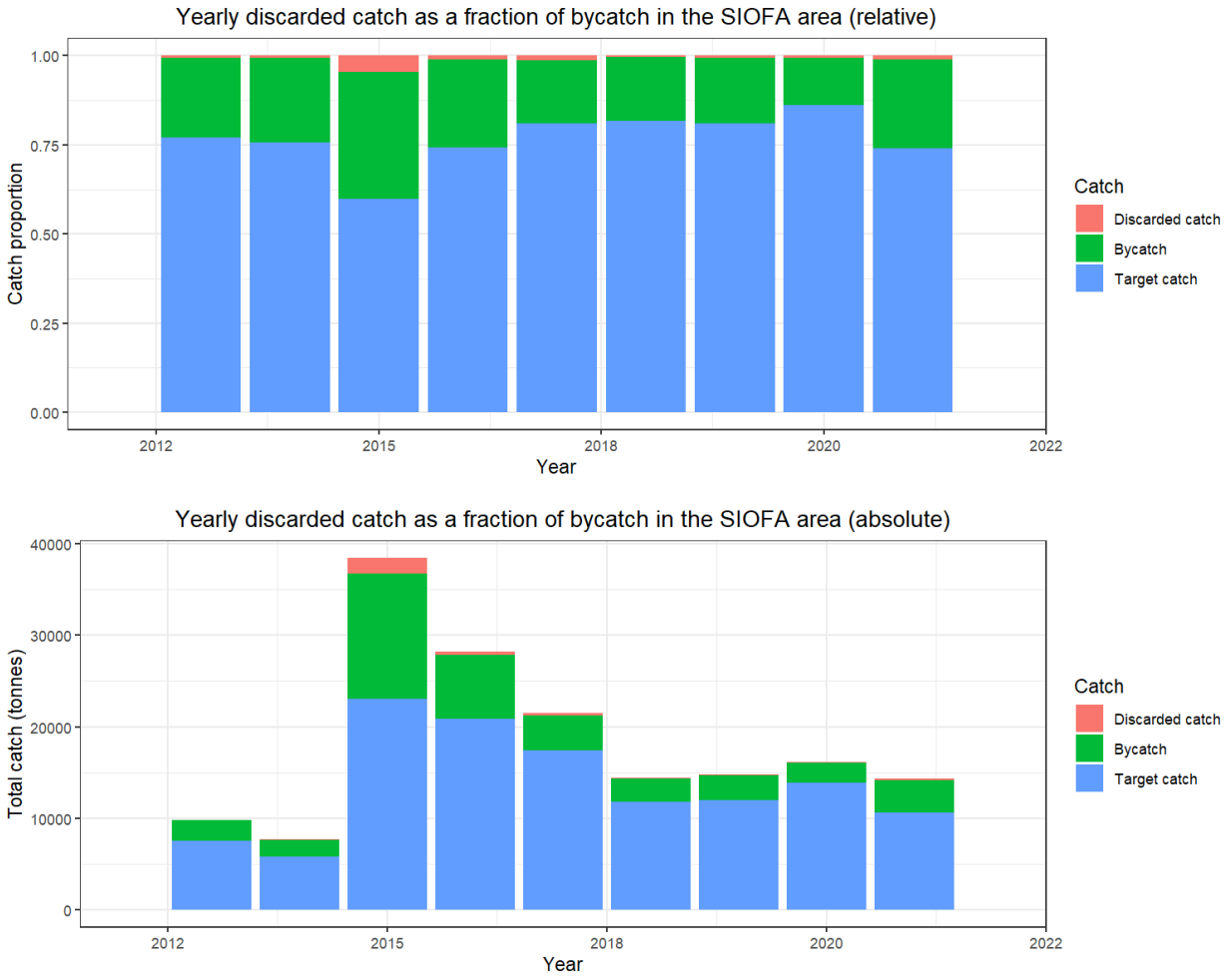


Figure 14a and b –Target catch, bycatch and discards as relative values (upper panel, a) and absolute values (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included.

Discards are often considered in the perspective of bycatch, even though also target species (e.g. undersized or damaged) are also discarded. A total of 113 different species/taxa were discarded in SIOFA fisheries.

Given the high number of species, figures on discards by species are not easy to interpret and only the top five species (by weight) are fully displayed. The high discards recorded in 2015 were attributed to unspecified marine species (MZZ) which are still reported up to 2017 (Figure 15). Other high contributions to discards (e.g. in 2017) were due to little sleeper shark (SOR) (Figure 15).

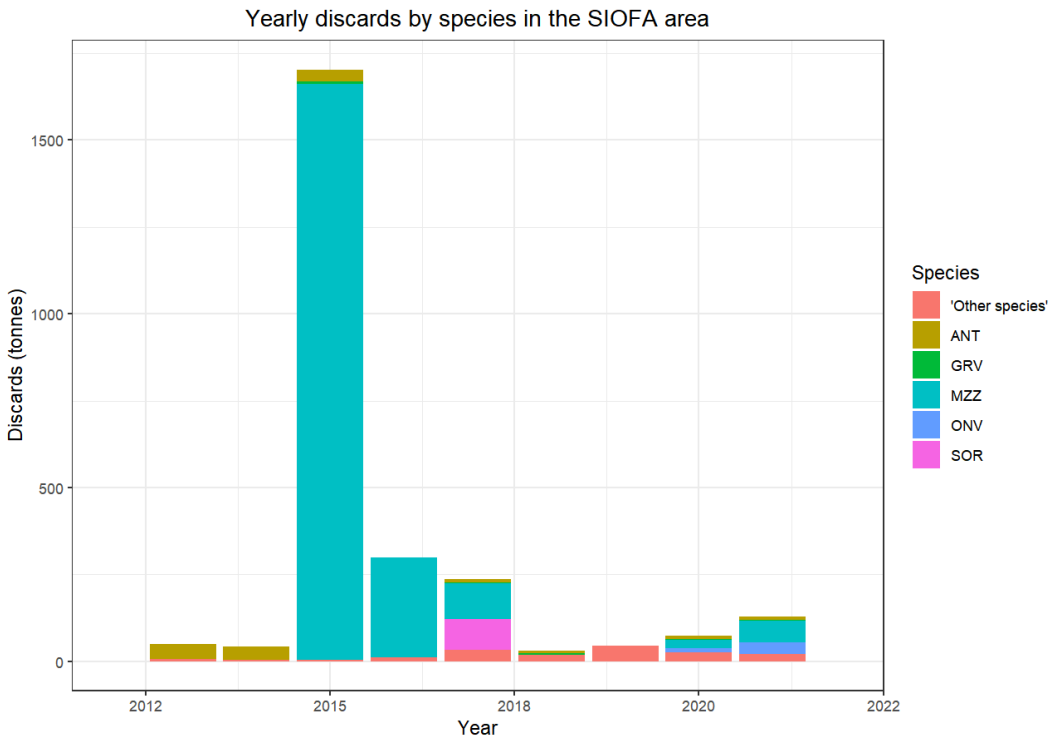


Figure 15 – Yearly discards in the SIOFA Area by species (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Only the top five species (by weight) are fully represented, while the other species have been grouped in a single category. Species are indicated by their 3-letter FAO code.

6.3 Main species catch and effort

The catch of trawl vessels was predominantly alfonsino (6.3.1) and orange roughy (6.3.2). Species also caught by trawling include pelagic armourhead, bluenose warehou, violet warehou, ocean blue-eye trevalla and oreo dories, cardinal fish, hapuku wreckfish.

The addition of Thailand's fishery added Lizardfish and scads as a major catch from small trawlers since 2015.

The catch of longline vessels differs between three groups. There are longline vessels (reported by EU, Japan, Korea and France Overseas Territories) that catch Patagonian toothfish (6.3.3) and associated

species, such as blue antimora. The second group catch hapuka (6.3.4), ocean blue-eye trevalla, pelagic armourhead, rubyfish, common mora and, historically, deep-water sharks. The third group was the Chinese Taipei tuna longline fleet that catch oilfish (6.3.5).

The catch of the historical gillnet fisheries was predominantly deep-water sharks (see 6.2.2). Large-scale pelagic driftnets and deepwater gillnets use in the SIOFA Area has been prohibited since October 2016, when CMM 05-2016 entered into force.

China's light seining fishery targeted mackerel and *Brama* species (such as *Brama japonica*) and its bottom longline fishery targeted ruby snapper and other species in the Lutjanid family.

6.3.1 Alfonsinos (ALF, *Beryx* spp.)

The most common species of alfonsinos caught in the SIOFA Area was splendid alfonsino (BYS, *Beryx splendens*), but sometimes catch of another species (alfonsino, BXD, *Beryx decadactylus*) or not identified to the species level (ALF, *Beryx* spp.) were also reported. The data on all alfonsinos has been aggregated, and is presented here, at the highest taxonomical resolution.

Alfonsinos are long-lived, late-maturing, benthopelagic fishes found at a depth range of 25–1300 m, but more commonly at 400–600 m. Alfonsinos have a global distribution, excluding the north-eastern Pacific and the Mediterranean, and are often aggregating around underwater topographic features (particularly during spawning). Further information on alfonsinos and their fishery in the SIOFA Area are provided in a relative Fisheries Summary.

Catches of alfonsino have been increasing over the last years but are overall within the historical average (Figure 16a). Effort has decreased in recent years, from higher values in 2013–2017 (Figure 16a). Alfonsinos are mostly caught in the western SIOFA Area, mainly Subareas 2, 3a, 3b and 4 (Figure 16b).

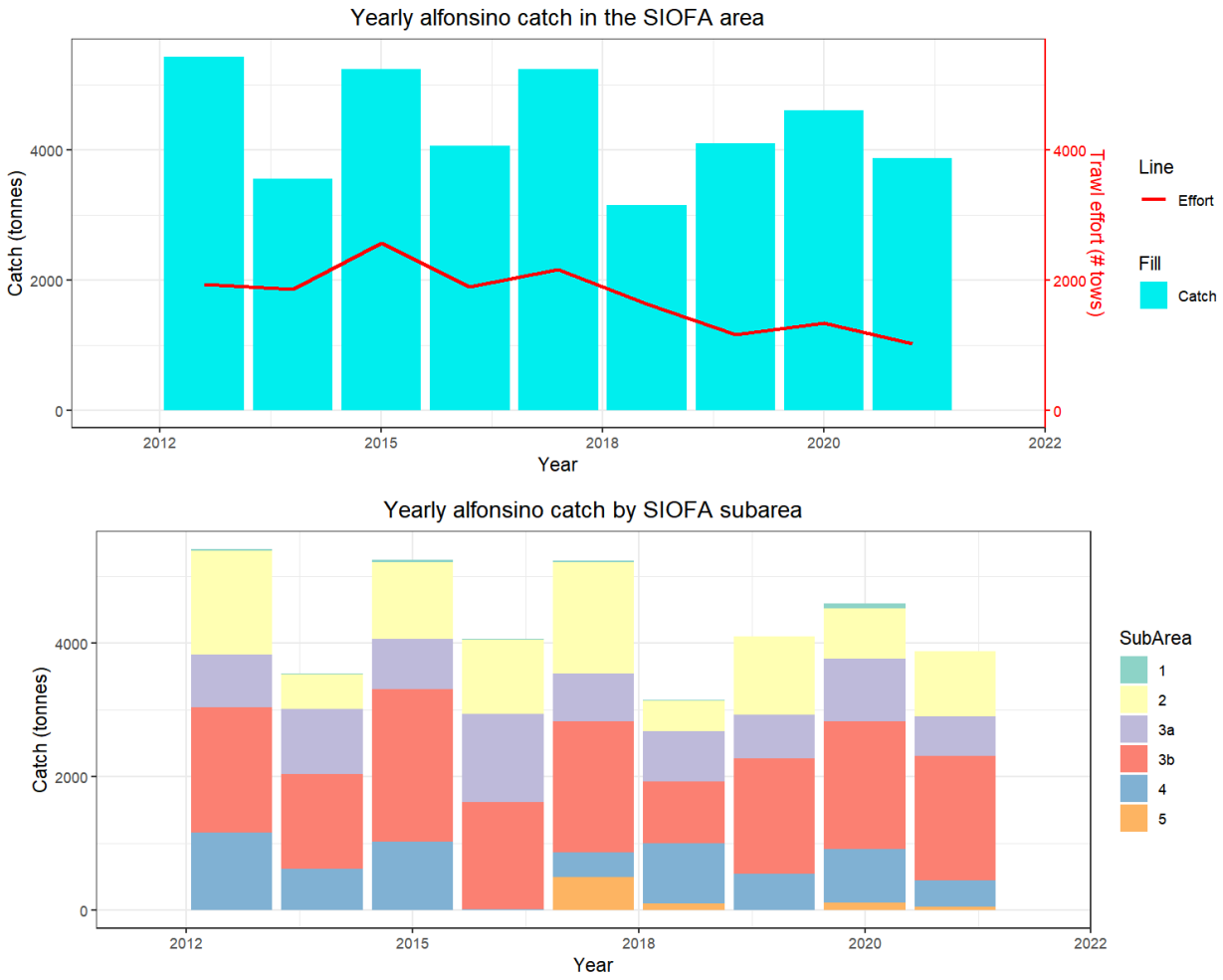


Figure 16a and b – Yearly alfonsino catch (t) and effort (number of trawls) in the SIOFA Area (upper panel, a) and in different SIOFA Subareas (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Recent years have seen lower levels of effort with higher catches (Figure 16a), so unstandardised catches per units of effort (CPUEs) have been rising correspondingly (Figure 17).

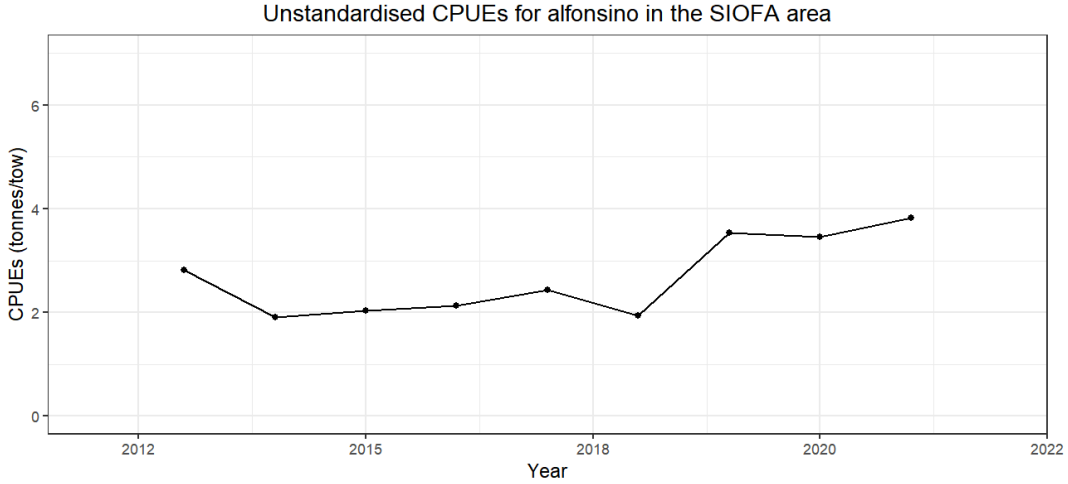


Figure 17 – Unstandardised catches per unit of effort (CPUEs) of alfonsino in the SIOFA Area (t/tow) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

6.3.2 Orange roughy (ORY, *Hoplostethus atlanticus*)

The only species of slimehead caught in the SIOFA Area was orange roughy (ORY, *Hoplostethus atlanticus*).

Orange roughy is a long-lived, late-maturing, bathypelagic species found at a depth range of 180–1809 m, but more commonly at 400–900 m. Orange roughy is present in all oceans and is often found both around underwater topographic features and plateaus. Spawning and non-spawning aggregations are known. Further information on orange roughy and its fishery in the SIOFA Area is provided in the orange roughy fisheries summary.

Catches of orange roughy have been increasing over the last years but are overall within the historical average (Figure 18a). Effort has decreased in recent years, from higher values in 2015–2018 (Figure 18a). Orange roughy was mostly caught in the western SIOFA Area, mainly Subareas 2 and 3a (Figure 18b).

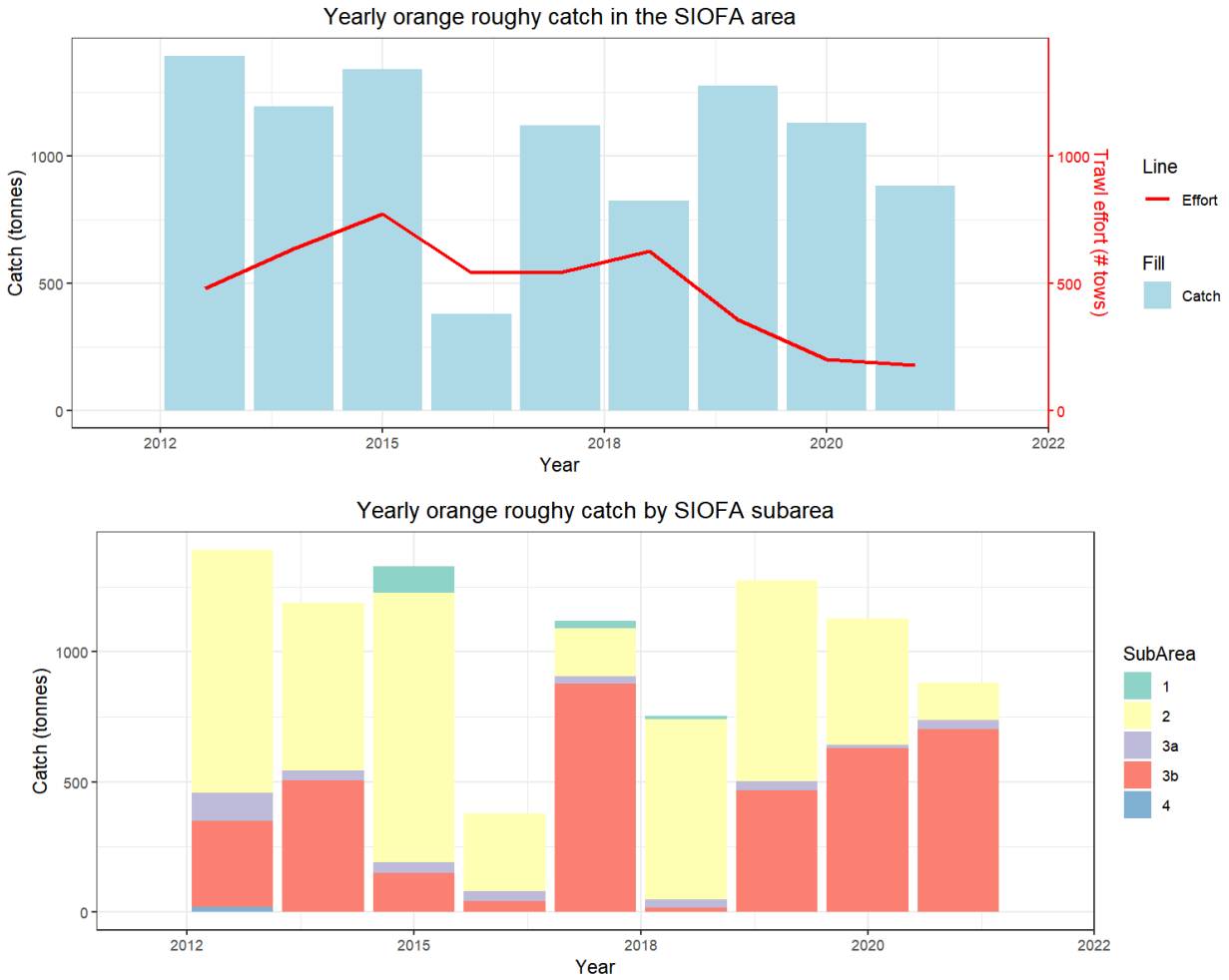


Figure 18a and b – Yearly orange roughy catch (t) and effort (number of trawls) in the SIOFA area (upper panel, a) and in different SIOFA Subareas (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Values of the figure in panel a are provided in Table A.1 and values of the figure in panel b are provided in Table A.2 (both in Appendix A).

Recent years have seen lower levels of effort with higher catches (Figure 18a), so unstandardised catches per units of effort (CPUEs) have been rising correspondingly (Figure 19).

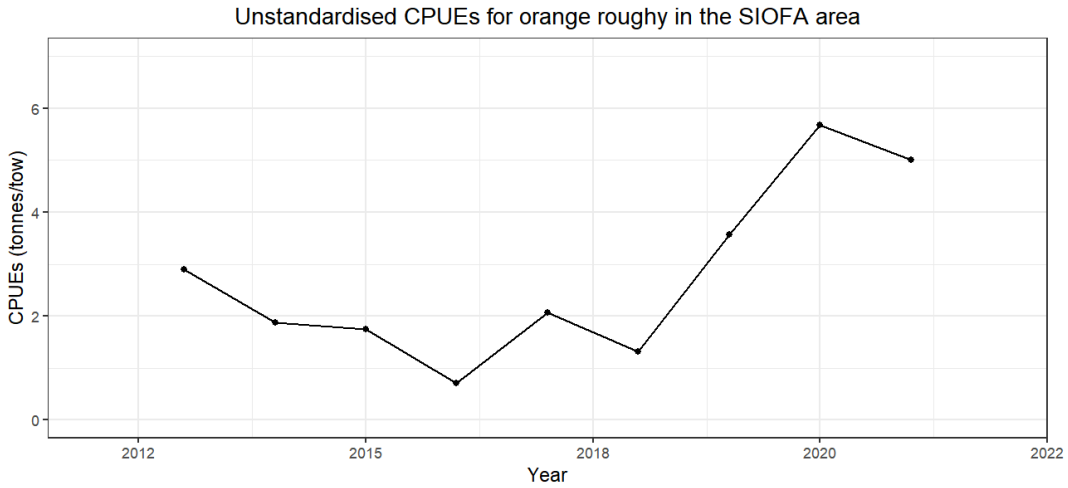


Figure 19 – Unstandardised catches per unit of effort (CPUEs) of orange roughy in the SIOFA area (t/tow) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

6.3.3 Toothfish (TOT, *Dissostichus eleginoides* and *Dissostichus mawsoni*)

Patagonian toothfish (TOP, *Dissostichus eleginoides*) was the main species of toothfish caught in the SIOFA area. However, few Antarctic toothfish (TOA, *Dissostichus mawsoni*) were caught in 2021.

Toothfish are long-lived, late-maturing, large demersal fishes often found at depths greater than 1000m. Patagonian toothfish is present in waters near the Antarctic, approximately east of southern America to New Zealand. Antarctic toothfish is present in waters near the Antarctic, approximately east of New Zealand to southern America.

Catches of toothfish have been decreasing over the last years, and effort has also decreased in recent years, from higher values in 2018 (Figure 20a). Catches of Antarctic toothfish come from the southern SIOFA area, mainly Subareas 7 and 3b (Figure 20b).

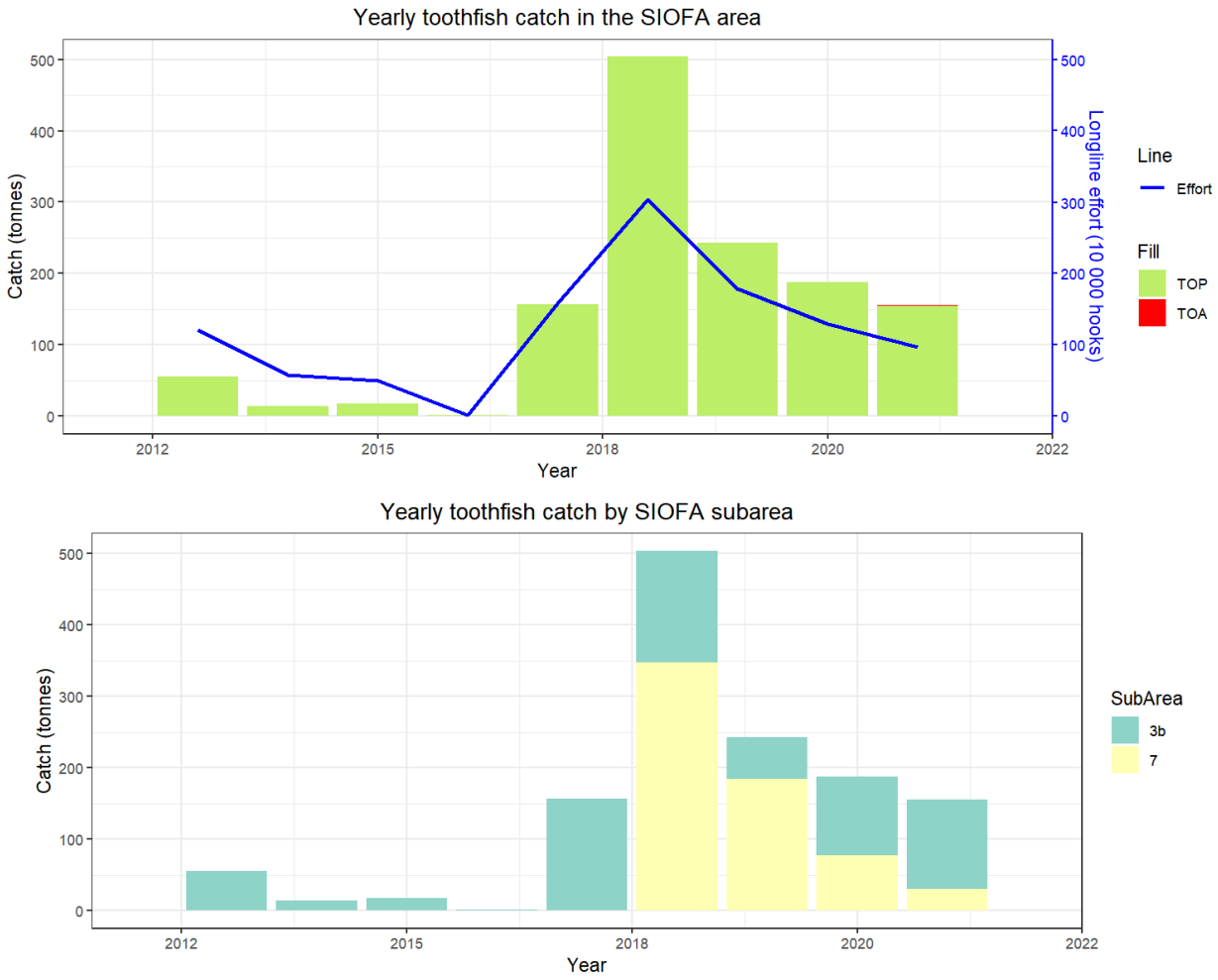


Figure 20a and b – Yearly toothfish catch (t) and effort (10 thousand hooks) in the SIOFA area (upper panel, a) and in different SIOFA Subareas (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Note that the Subareas are larger than the toothfish Assessment Areas.

Unstandardised catches per units of effort (CPUEs) have been slightly rising in recent years (Figure 21).

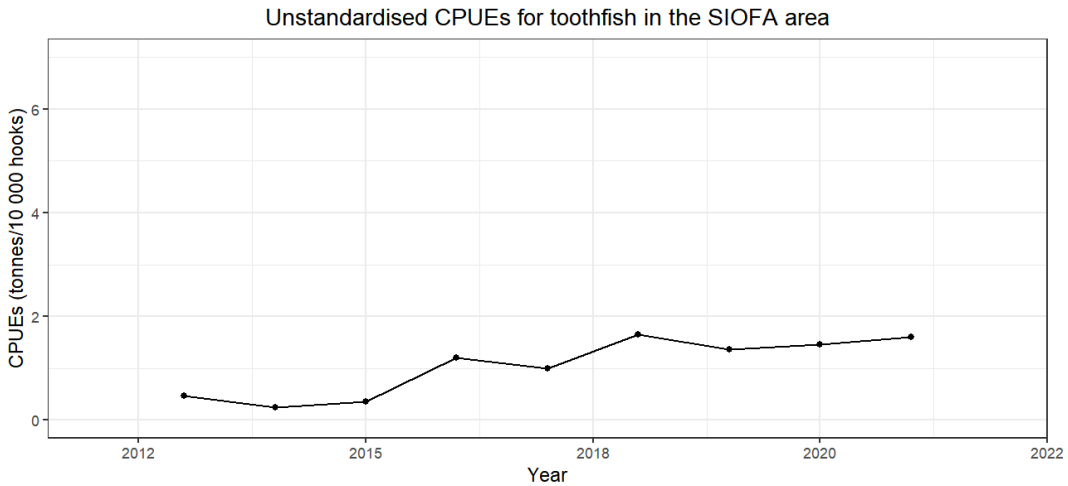


Figure 21 – Unstandardised catches per unit of effort (CPUEs) of toothfish in the SIOFA area (t/10 thousand hooks) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

6.3.4 Hapuka (HAU, *Polyprion* spp.)

Hapuka is a taxa of groupers that includes both the hapuku wreckfish (WHA, *Polyprion oxygeneios*) and wreckfish (WRF, *Polyprion americanus*) species, as well as catch not identified to the species level (HAU, *Polyprion* spp.). All three taxa have been recorded in catches from the SIOFA area.

Hapuka are large, long-lived, late-maturing, demersal groupers often found at depths of 50–854 m. Hapuka are found on rough grounds and seamounts off the shelf, with a circumglobal distribution in southern oceans. Further information on hapuka and their fishery in the SIOFA area are provided in a relative Fisheries Summary.

Catches of hapuka have significantly increased in 2019 and especially 2020, and effort has also correspondingly increased (Figure 19a). The yearly catch composition was relatively variable, but hapuku wreckfish was the most commonly caught species in the last years (Figure 22a). Hapuka are caught in the western SIOFA area, mainly Subareas 2, 3a and 3b (Figure 22b).

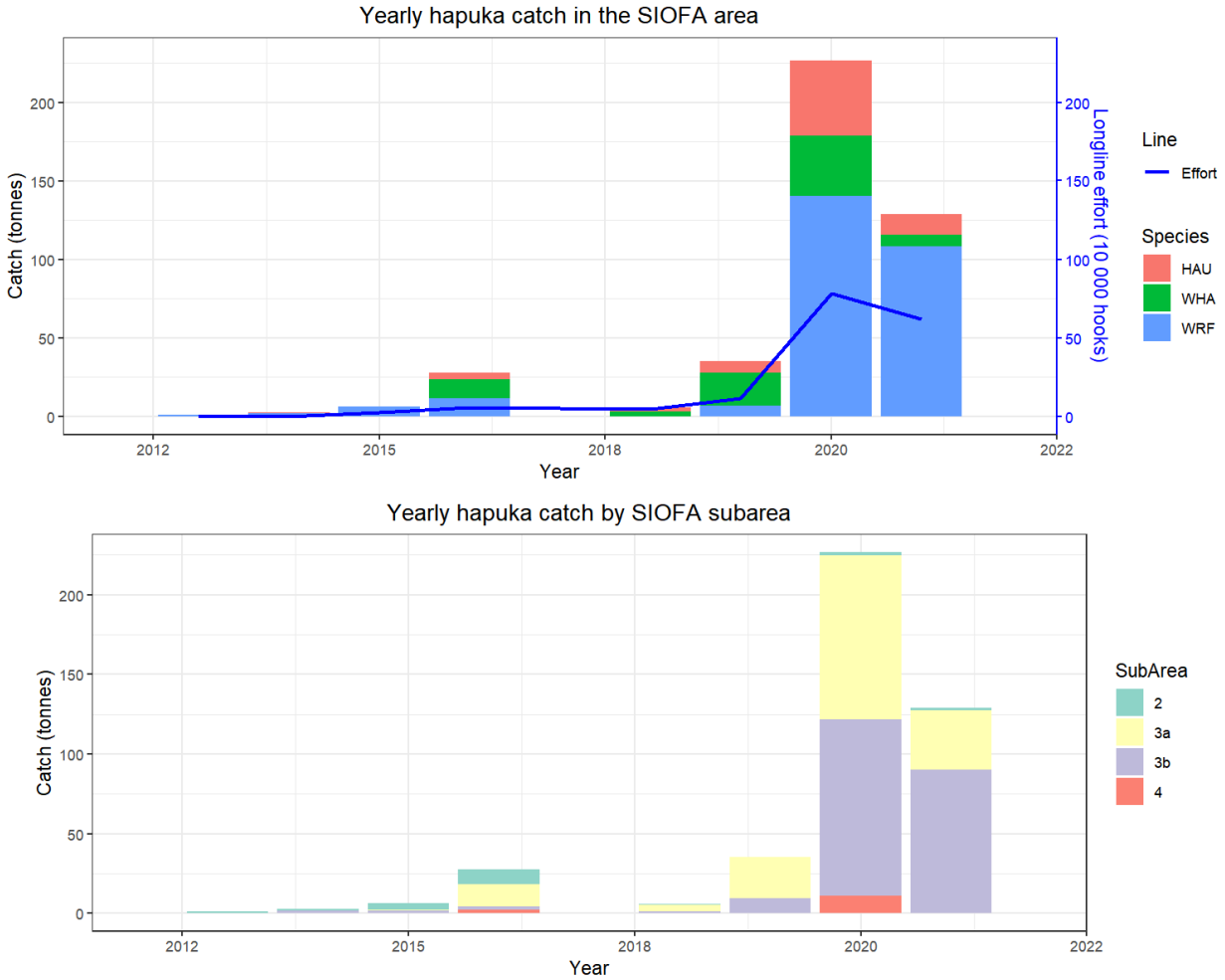


Figure 22a and b – Yearly hapuka catch (t) and effort (10 thousand hooks) in the SIOFA area (upper panel, a) and in different SIOFA Subareas (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Recent years have seen higher levels of effort with higher catches (Figure 22a), with unstandardised catches per units of effort (CPUEs) remaining relatively stable (Figure 23).

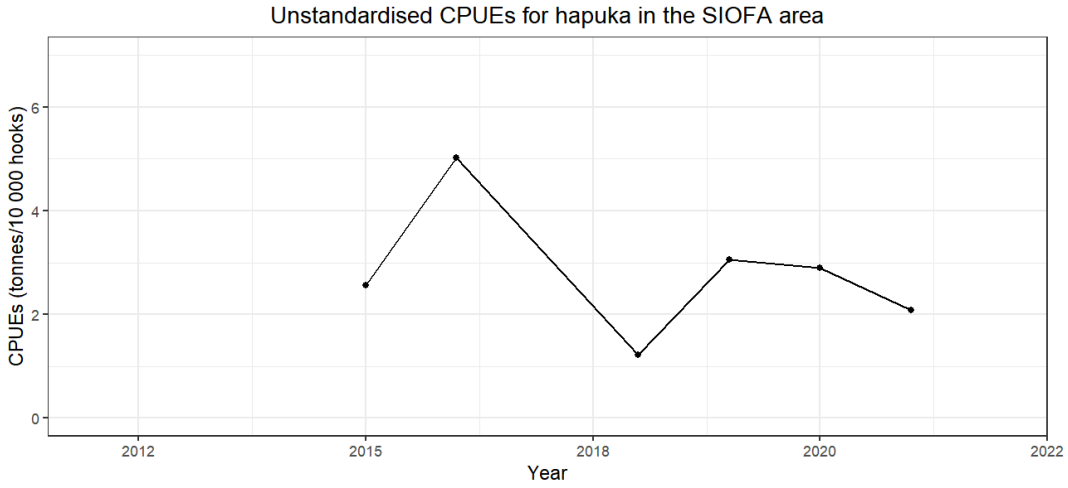


Figure 23 – Unstandardised catches per unit of effort (CPUEs) of hapuka in the SIOFA area (t/10 thousand hooks) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

6.3.5 Oilfish (OIL, *Ruvettus pretiosus* and LEC, *Lepidocybium flavobrunneum*)

Oilfish include both oilfish (OIL, *Ruvettus pretiosus*) and escolar (LEC, *Lepidocybium flavobrunneum*) two species of the Gempylidae family.

Oilfish are benthopelagic, found at a depth range of 100– 800 m in subtropical waters of all oceans, and mainly fished with longlines. Note that almost all catch and effort was by Chinese Taipei from its pelagic longline fishery, but a small amount of bycatch was also reported by other CCPs from other gears.

Both oilfish and escolar can grow to over 2 m in length and over 50 kg, but average sizes measured in the SIOFA area are around 27 kg (see section 10). Despite having very high levels of indigestible wax esters in their flesh (which is likely at the root of the ban on sales in countries like Japan or Italy), these species are sought after in several countries and fished in relatively significant amounts in the SIOFA area.

Catches of oilfish in the SIOFA area were first reported in 2013, but at very low levels (Figure 24a). Effort was only reported starting in 2015, and has progressively increased since, with catches increasing and then stabilizing at levels higher than the other main SIOFA species (Figure 24a). Oilfish are mainly caught in the western SIOFA area, particularly in Subareas 1 and 3b (Figure 24b).

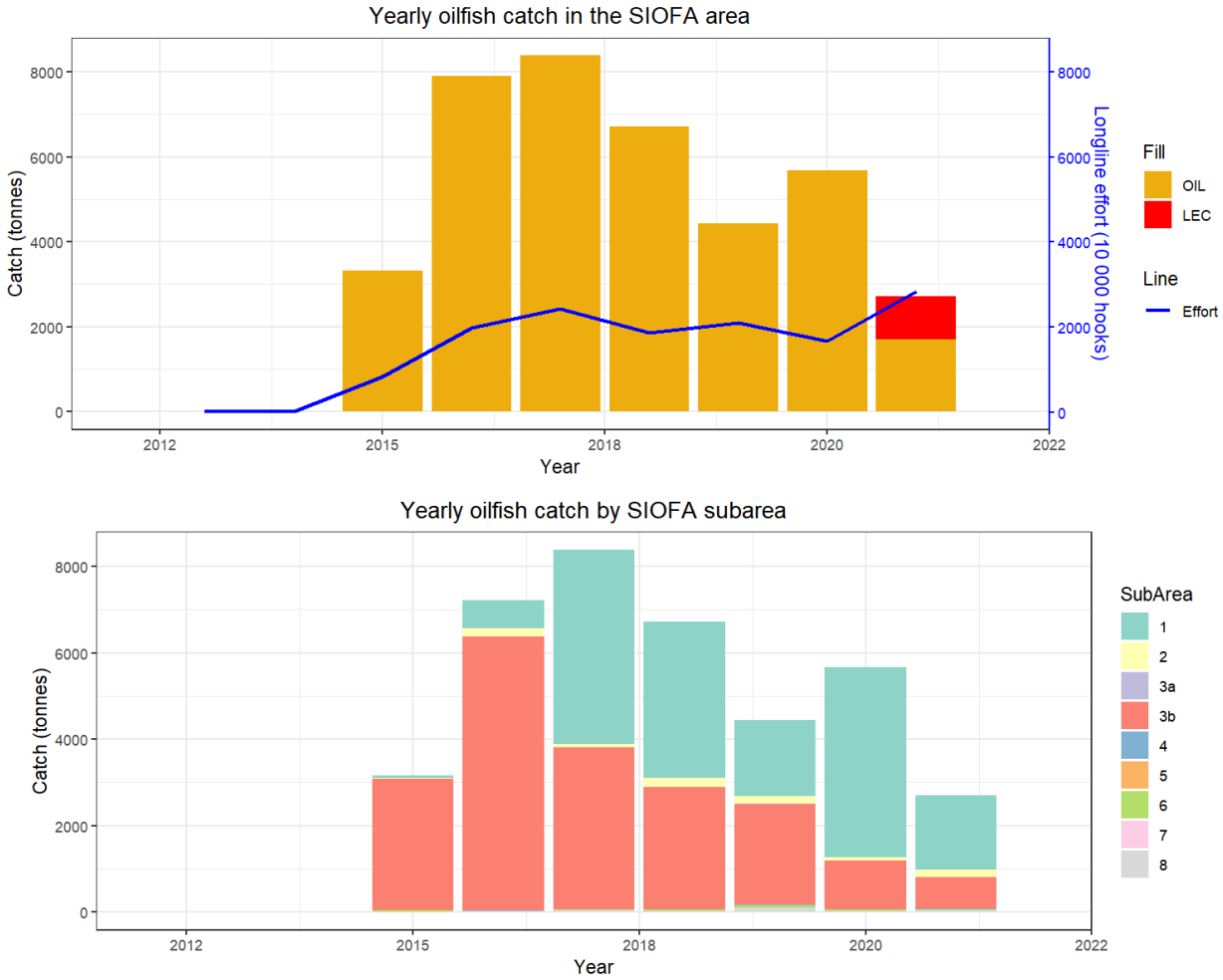


Figure 24a and b – Yearly oilfish catch (t) and effort (10 thousand hooks) in the SIOFA area (upper panel, a) and in different SIOFA Subareas (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Effort has been relatively stable in recent years, with slightly declining catches (Figure 24a), such that unstandardised catches per units of effort (CPUE) declined slightly (Figure 25). In 2021 effort increased and catches decreased, leading to a marked decline of CPUE.

Unstandardised CPUEs cannot be considered a reliable index of abundance. Standardised CPUEs have not been produced for these species.

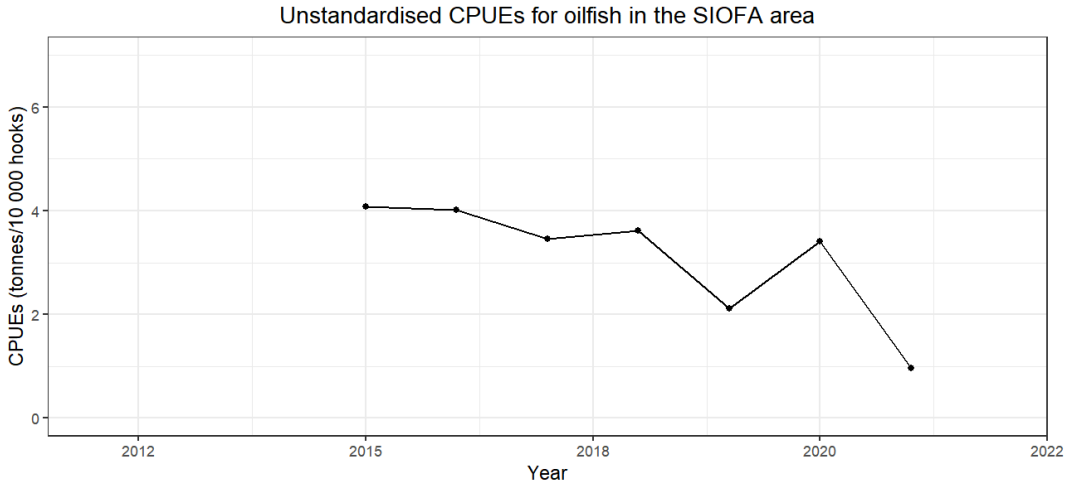


Figure 25 – Unstandardised catches per unit of effort (CPUEs) of oilfish in the SIOFA area (t/10 thousand hooks) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

7. Vulnerable Marine Ecosystems (VMEs)

Vulnerable Marine Ecosystems (VMEs) are marine ecosystems corresponding to the characteristics referred to in paragraph 42 of the Annex of the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (FAO 2009).

These characteristics are:

i. Uniqueness or rarity – an area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by similar areas or ecosystems. These include:
   - habitats that contain endemic species;
   - habitats of rare, threatened or endangered species that occur only in discrete areas; or
   - nurseries or discrete feeding, breeding, or spawning areas.

ii. Functional significance of the habitat – discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, particular life- 10 history stages (e.g., nursery grounds or rearing areas), or of rare, threatened or endangered marine species.

iii. Fragility – an ecosystem that is highly susceptible to degradation by anthropogenic activities.

iv. Life-history traits of component species that make recovery difficult – ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics:
   - slow growth rates;
   - late age of maturity;
   - low or unpredictable recruitment; or
   - long-lived.

v. Structural complexity – an ecosystem that is characterized by complex physical structures created by significant concentrations of biotic and abiotic features. In these ecosystems, ecological processes are usually highly dependent on these structured systems. Further, such ecosystems often have high diversity, which is dependent on the structuring organisms.

VMEs have not been fully identified in the SIOFA area, but scientific work is currently ongoing to identify and locate potential VMEs. In the interim, VME management measures are in place and invertebrate taxa bycatch is monitored and assessed on a regular basis.

7.1 Interim VME management measures

One of the management tools SIOFA implements to manage fishing impacts on Vulnerable Marine Ecosystems (VME) is the application of move-on rules. Move-on rules require the fishing vessel to move away a certain distance from the set area when quantities of VME indicator taxa exceeding set thresholds are hauled on board of a vessel. These measures are described in CMM 01-2020.

Table 4 summarises the thresholds and move-on rules applied by each CCP. No VME encounters were recorded in 2021.

Table 4 – Summary of thresholds used to define VME encounters, and management responses to be used in case of an encounter (source: SIOFA National Reports 2021). The last column details whether any encounters were recorded in 2021.

CCP	Thresholds	Management response	Encounter
AUS	Australian-flagged vessels observe the thresholds and move-on rules specified in CMM 01-2020. Australian-flagged vessels are required to record any evidence of a Vulnerable Marine Ecosystem (VME) such as coral or sponges encountered in a fishing shot in logbooks.	Australian-flagged vessels observe the thresholds and move-on rules specified in CMM 01-2019. Australian-flagged vessels are required to record any evidence of a Vulnerable Marine Ecosystem (VME) such as coral or sponges encountered in a fishing shot in logbooks.	No thresholds were triggered by any Australian-flagged vessels in 2021.
COK	In 2021, flagged vessels adhered to the VME encounter threshold established in CMM 01-2020 Interim Bottom Fishing Measures section 12(b)	In 2021, flagged vessels adhered to the VME encounter threshold established in CMM 01-2020 Interim Bottom Fishing Measures section 12(b)	No shots breached the VME threshold in 2021
EU	From 2019, the EU bottom longline fleet is applying the protocols adopted by SIOFA in the CMM 01-2019. Previously the fishing vessels followed the rules adopted by the Fishing Administration, similar to those applied in SEAFO and CCAMLR in the definition of the VME encounter and thresholds (see SC-06-21 for details).	From 2019, the EU bottom longline fleet is applying the protocols adopted by SIOFA in the CMM 01-2019.	The threshold of 10 or more VME indicator units by segment has never been reached
JPN	From the middle of 2019 fishing season, Japanese fishing vessels have applied Article 12, CMM 01-2019, which establishes thresholds for bycatches of VME indicator species and move-on-rule in the encounter protocol, i.e., for trawl fisheries, 60 kg of live corals and 300 kg of sponges and for bottom longline fisheries, 10 or more VME-indicator units.	If by-catch amount of VME indicator species reach the threshold level, Japanese fishing vessels will follow the protocols stipulated in Article 12 to 19, CMM 01-2019, i.e. fishing vessels move away 2 and 1 nm for trawl and longline fisheries respectively then report it to the Secretariat.	No VME bycatch in 2021
FR-OT	Crew must collect and retain all benthic organisms for each segment in numbered buckets, those buckets will be made available for observers. The observers record benthic organisms' composition and abundance for each set. This information is also recorded in a digital logbook and transferred to the MNHN fishing database "PECHEKER".	No VME indicator thresholds were triggered for the period 2011-2021. The move-on protocol didn't need to be applied.	No interactions with threatened, endangered and protected species were reported in 2021.
KOR	Korea established a procedure to protect Vulnerable Marine Ecosystems from bottom fishing in the high seas, in accordance with UNGA Resolution 61/105, adopted in 2006, and 64/72, adopted in 2009. Korean domestic laws request all Korean bottom fishing vessels clearly mark the start and end of each haul on each fishery, and monitor all hauls to record the quantity of VME indicator organisms recovered during that haul. The fishing vessel, during its operation, shall submit the information with regard to its operation (e.g. position, date) to NIFS if it was confirmed that the vessel encountered VMEs. The threshold of the encounter of VMEs is over 60kg of coral per set or over 800kg of sponges per set.	If the amount of VME that exceeds the weight specified in the criteria, the vessel shall apply a 2 nmiles move-on rule to resume its fishing operation. Furthermore, the vessel shall relocate its fishing position until it reaches a point where no VMEs are confirmed.	no fishing in 2021

CCP	Thresholds	Management response	Encounter
MUS	no information provided	no information provided	no information provided
SEY	no fishing in SIOFA area		no fishing in SIOFA area
TPE	no bottom fishing in SIOFA area		no bottom fishing in SIOFA area
THA	Trawls corals > 60 kg sponges > 300 kg Longlines corals or sponges > 10 units per 1,000 hooks or per mainline of 1,200 meters, whichever is the shorter Traps corals or sponges > more than thresholds to be assigned by SIOFA secretariat Other bottom fishing gears corals or sponges > more than thresholds to be assigned by SIOFA secretariat	Trawls: move at least 2 nautical miles area . Longlines: move at least 1 nautical mile. Traps: move at least 1 nautical mile. Other bottom fishing gears: move at least 1 nautical mile	

1.1 Benthic invertebrates bycatch summary

Observers are required to report the incidental catch of benthic invertebrates in bottom fisheries, and the corresponding data is submitted to the Observer database at the SIOFA Secretariat. The HBHCatchEffort database also contains information on benthic invertebrate taxa incidental catches.

Corals and sponges were the most caught (by weight) benthic invertebrates in SIOFA bottom fisheries (Table 5). Note that an exemption was in place for CCPs to have the required Scientific Observer coverage in their bottom fisheries during 2020 and 2021, due to the restrictions imposed by the COVID pandemic.

Table 5 – Invertebrate taxa recorded as incidental captures in SIOFA fisheries, presented in order of decreasing total weight and including the number of occurrences (source: SIOFA Observer and HBHCatchEffort databases, 2003–2022, with the 2022 data being largely incomplete). Highest taxonomic resolution.

FAO code	Scientific name	Total weight (kg)	Occurrences
COR	*Corallium* spp	5614.3	69
CSS	Scleractinia	2506.3	575
PFR	Porifera	2485.7	122
SPO	Spongiidae	1199.8	84
OTH	#N/A	1000	3
GGW	Gorgoniidae	171.5	292
DMO	Demospongiae	152.4	124
IQO	Isididae	67.7	112
AQZ	Antipatharia	63.6	53
CNI	Cnidaria	62.9	45
HXY	Hexactinellida	42.8	43
ADQ	*Antipathes dichotoma*	32.9	16
AXT	Stylasteridae	32.9	77
ATX	Actiniaria	27.4	61
AJZ	Alcyonacea	24.6	67
JEL	*Rhopilema* spp	22.5	35
KQM	*Acropora formosa*	22.2	4
URX	Echinoidea	18.5	51
STF	Asteroidea	13.3	19
HQZ	Hydrozoa	13.1	10
AZN	Anthoathecata	11.4	22
OEQ	Euryalida	9.4	65
INV	Invertebrata	7.6	23
BZN	Bryozoa	5.6	23
CWD	Crinoidea	4.8	24
HKQ	*Heliopora coerulea*	4.5	1
NTW	Pennatulacea	3.7	45
ZOT	Zoantharia	2.9	15
QCX	*Gorgonocephalus* spp	2.8	7

OOY	Ophiurida	2.6	21
BWV	Paragorgiidae	2.3	4
SSX	Ascidiacea	2.2	7
OWP	Ophiuroidea	1.5	3
ECH	Echinodermata	1.4	23
SZS	Serpulidae	1.1	1
KCX	Lithodidae		1
WBX	Holothuria spp	0.4	1
BVH	Brachiopoda	0.3	6
CRU	Crustacea	0.3	12
KRH	*Cirrhipathes* spp	0.1	1
NYZ	Nephtheidae	0.1	1
BWY	Bathylasmatidae	0.07	5
QFY	Chrysogorgiidae	0.055	3
CVD	Cidaridae	0.035	6
BHZ	Brisingidae	0.025	1

8. Fishing activities in Interim Protected Areas (CMM 01-2020)

Annex 3 of SIOFA CMM 01-2020 lists five Interim Protected Areas (IPAs) and their coordinates (Figure 26). These areas were first instituted in 2018 with SIOFA CMM 01-2018, which entered into force on the 10th of August 2018, and CCPs are provisionally required to apply the some restrictions to fisheries until the adoption of a dedicated research and management plan, referred to in paragraph 6 e of SIOFA CMM 01-2020.

According to SIOFA CMM 01-2020, 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 this CMM, taking into account advice of the Scientific Committee.

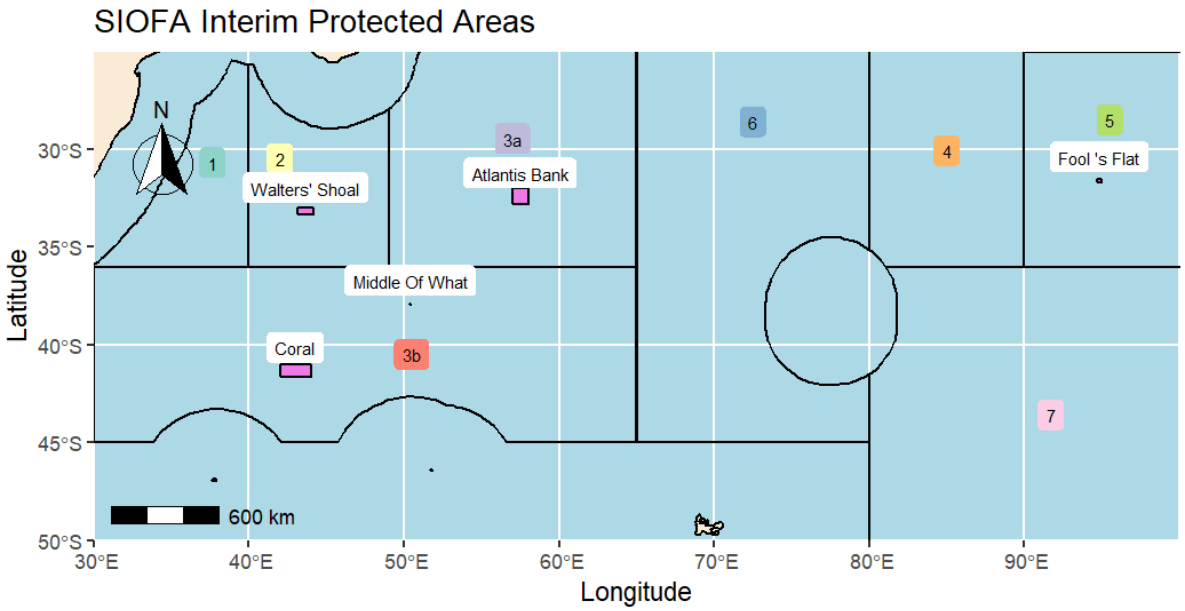


Figure 26 – Map of the SIOFA Interim Protection Areas (in magenta) as defined in CMM 01-2020 (Source: Annex 3 of SIOFA CMM 01-2020). All the areas have been labelled for easier recognition, as some are barely visible on the map due to their small size.

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

A total of 125 fishing events have been recorded to occur in SIOFA IPAs in 2013–2021, but the number of fishing events significantly decreased after the establishment of the IPAs in late 2018 (Figure 27). While before the institution of the IPAs multiple gear types were used, after 2018 only lines were used, as per the CMM restrictions (Figure 27). Data from 2021 showing midwater trawl operations likely contains an error.

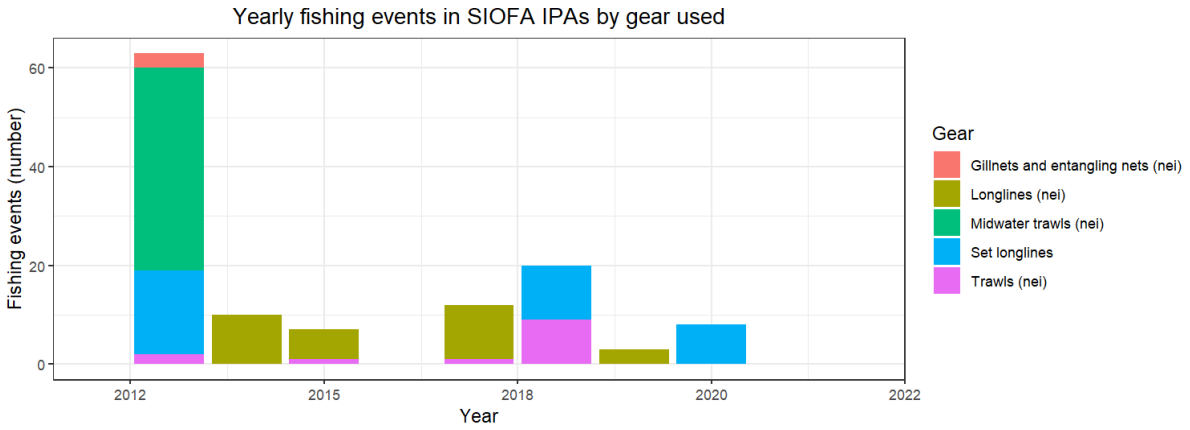


Figure 27 – Number of fishing events by gear in Interim Protected Areas (IPAs) per year (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

These events caught a large number of species, many with a relatively low tonnage (Figure 28). Splendid alfonsino (BYS) and kitefin shark (SCK) had a significant contribution to total catches in years when catch in IPAs was highest (2013, 2017 and 2018, Figure 28).

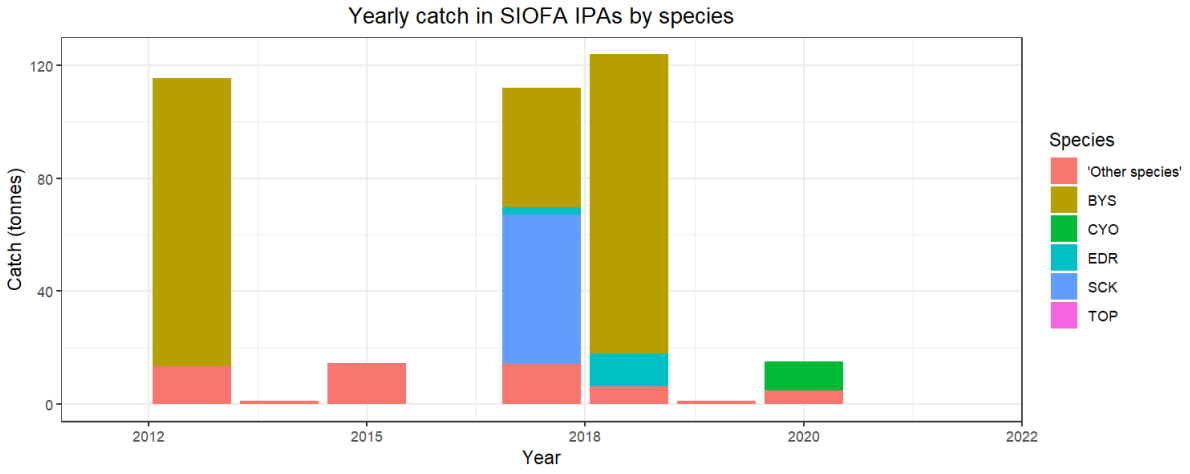


Figure 28 – Total catch (t) by species in Interim Protected Areas (IPAs) per year (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Only the top five species (by weight) are fully represented, while the other species have been grouped in a single category. Catches in 2021 were 0.1 t and thus are not visible in the graph.

9. Scientific Observer and port sampling programmes

CMM 01-2020 requires SIOFA CCPs to implement Scientific Observer programmes. Scientific Observer coverage of trawl fisheries in the SIOFA area was set at 100% (para. 39a of CMM 01-2020) and at 20% for any other bottom fishing gear type (para. 39b of CMM 01-2020).

In 2020, AUS, JPN, THA reported a 100% Scientific Observer coverage of their hauls. The EU and FR-OT reported 69.2% and 80.4% Scientific Observer coverage of their hauls, respectively. Note that an exemption was in place for CCPs to have the required Scientific Observer coverage in their bottom fisheries during 2020, due to the restrictions imposed by the COVID pandemic.

Table 6 provides a summary of the Scientific Observer programs implemented by each SIOFA CCP and information on port sampling.

Table 6 – Summary of Scientific Observer and Ports Sampling programs in 2021 (sources: SIOFA National Reports 2022).

Flag	Item	Description
Australia	Coverage	Since 2010, Australian permit conditions for bottom fishing in the SIOFA area have required 100% observer coverage on all vessels permitted to use trawl gear, with this coverage being expressed as the percentage of hauls observed. A target of 20% observer coverage is required for vessels using non-trawl fishing methods, with this coverage being expressed as the number of hooks observed. Observer coverage requirements were met in 2021.
	Training	AFMA recruits and trains the observers. Observers have a scientific background and/or experience in the fishing industry or other maritime industries and must demonstrate skills in collecting biological data at sea, fisheries research methodologies and collection of associated scientific data. Observers also hold a sea safety certificate and medical certificate and have completed an AFMA observer training course. Some observers hold a marine radio operator certificate of proficiency (or similar qualifications).
	Collection	Observers collect a range of data on vessel characteristics, fishing activity, catch composition, discarding and bycatch. Observer data are provided to the SIOFA Secretariat in accordance with CMM 02-2021.
	Port sampling	Australia does not have a port sampling program for vessels that fish in the SIOFA area. The landings are monitored through catch disposal records where the catch is verified by an AFMA-approved fish receiver.
China	Coverage	China did not conduct an observer program for demersal trawling from 2000 to 2002 in the Indian Ocean. Neither did China for Light seining fishery from 2014 to 2017. Since 2005 China has been conducting an observer program for bottom longlining.
	Training	
	Collection	
	Port sampling	China does not have a regular port sampling program for the vessels operating in the Indian Ocean except for tuna fishing. However, from 2015 to 2019, China has sampled the catch by light seining.
Comoros*		Since the Diego Star 2 is a mother boat, it is difficult to take an observer on board and to find reliable data. The small motorized boats carry out the fishing activities. The main difficulty arises in making observers available for each boat, of which there are 19 today.
Cook Islands	Coverage	In 2021, The Cook Islands National Observer Programme (CINOP) experienced issues and restrictions caused by COVID -19. As a result of the COVID-19 outbreak, CINOP was unable to maintain 100% observer trip coverage. and we continued to request an extension of the derogation of paragraph 39(A) of CMM 01-2020

Flag	Item	Description
		(interim Bottom Fishing Measures). The Cook Island has in addition, requested an extension of this derogation to March 2022.
	Training	In 2019 MMR had trained two additional Observers from the Pacific Islands Regional Fisheries Observers (PIRFO) Programme to carry out placements on Cook Island vessels.
	Collection	
	Port sampling	Cook Islands vessels unload in either Cape Town or Port Louis. Entry and unloading at port are governed by the relevant Port State authorities under their domestic legislation. The Cook Islands does not have a port sampling programme as sampling is conducted onboard the vessel by the observer.
EU France	Coverage	*No fishing in 2021*
	Training	
	Collection	
	Port sampling	The EU has no port sampling program for vessels fishing within the SIOFA CA.
EU Spain	Coverage	In 2021 a total of two trips out of three have been covered by an on-board observer corresponding 100% of the TOP targeted fishing days and 43% of the fishing days targeting other species from a total of 307 fishing days.
	Training	The Scientific Observers (Biologist or Marine Science degree) are trained at the Instituto Español de Oceanografía, specific training is also adapted for all fleets that are monitored.
	Collection	
	Port sampling	The EU has no port sampling program for vessels fishing within the SIOFA CA.
France Oversea Territories	Coverage	100% trip coverage (100% coverage within hauls, 25% coverage for birds)
	Training	The FR-OT observer program is described in info-paper (WHSOP1-INFO-06-French-Observer-program.pdf). This document describes the French observer program, current update is October 2021 according to the SIOFA's CMM. This report includes summary sections covering observer training, program design and coverage, and type of data collected. During the previous calendar year, no problems are encountered in the of the observer program implementation report. All the data collecting by the observer program are provide to the secretariat following the CMM 02-2021. Biological sampling and length composition of catches is provided to the secretariat through the annual data submission. No specific analyse is conduct in this report. The observation programme follows the guidelines in Annex 4, on 'Function and tasks of the Scientific Observer' and Annex 5, on 'Protocol for documenting whale interaction in deep-sea demersal longline fisheries.
	Collection	
	Port sampling	In order to keep track of the catch: species and area where the fish were caught are reported on every single box containing the fish to be landed for commercial purposes. An independent company of experts based in La Réunion island is tasked to weigh a second time (the first time being on the factory of the ship at sea) all the fish boxes and report the exact weight for each combination of area, species and product. Those data are then used to correct the weights collected at sea. For Patagonian toothfish, an official DCD (*Dissostichus* Catch Document) from CCAMLR is produced at the scale of each trip and contains all needed information on species, products and areas including SIOFA.
Japan	Training	In accordance with Article 30, CMM 01-2016 (SIOFA interim observer program), Japan started the observer program from January 2017 (for details, see National Report of Japan in 2017, SIOFA-2017-SC02-04 (05)). This program is based on the Japanese Scientific Observer program for bottom trawl fisheries in North Pacific
	Collection	

Flag	Item	Description
		Fisheries Commission (NPFC) CA. The Scientific Observers collect items listed in Annex B, CMM 02-2017, CMM 02-2018, CMM 02-2019, and CMM 02-2021, i.e., catch by species, effort, biological data, bycatch information by species including VME indicator species, non-target species (sharks, seabird, marine mammals, reptiles and other species of concern) and other requested information.
	Coverage	The observers are deployed to all operating vessels, and they cover all activities in fishing operations (100% coverage) since 2017.
	Port sampling	There are no port sampling programs in Japan.
Korea*	Training	Korean Scientific Observer program for distant water fisheries started in 2002. National Institute of Fisheries Science (NIFS) is responsible for implementing and developing the observer program. The qualification for a person to be an observer is: a person who is a college graduate whose major field is nature science, or else, a fisheries high school graduate who accompanies at least 2-year experience on board having a certificate of qualification to deck officer. Candidates for observer who have passed the paper review (including medical check-up) and oral interview have to take training programs for 3 weeks. Observer training programs include basic safety training for seafaring, operations of navigation devices, biological information training for target and non-target species and data collection method for fishing activities. During the training program they have two types of tests. One is the test on a technical term of fisheries and biology, and the other is the test on species identification. The person who scored above 70 in both tests and attended 100% of the course timetable can be qualified and deployed on board as a Scientific Observer. NIFS trains observers again before dispatching them to each RFMO area. The training includes the conservation and management measure of each RFMO, how to collect the data and sample, specific task needs to be done and more.
	Coverage	No fishing in 2021
Mauritius		*no information provided*
Seychelles		*no fishing*
Chinese Taipei	Training	For purposes of collecting fisheries data and bycatch data, Taiwan launched the pilot observer program in 2001 and deployed observers on vessels fishing in the Indian Ocean commenced in 2002. Our observer program had received interim authorization in 2009 and received full authorization after auditing in November 2011 and October 2017, respectively. The forms used in our observer program are fully conformed to the standards set by WCPFC which include the fishing activities, catch number and weight, species identification, bycatch species and status. In addition, length frequency of major species and the sighting and incidental catch of ecological species were recorded, and biological samplings were collected for biological research. To fulfil the obligation of distant waters fishing state, the observer data has been provided to t-RFMOs, including CCSBT, IATTC, ICCAT and WCPFC, per their requirements, and the trip reports of individual observer of the Indian Ocean has been submitted to IOTC per its resolution on regional observer program.
	Collection	
	Coverage	In 2021, there were 6 921 fishing day observed by 43 observers dispatched to Taiwanese tuna longline vessels operating in the Indian Ocean. The observer coverage rate of Taiwanese oilfish longline fishery from 2017 to 2021 were summarised in Table 6 which ranges between 5.94% to 15.49% and it should be noted that the observer coverage rate of 2021 is still in preliminary.
	Port sampling	A port sampling program has conducted in domestic ports to collect the size data of tuna and tuna-like species.
Thailand	Training	The training course for observer contained 11 modules of essential fisheries observer principle based on the FAO Guidelines for Developing an at Sea Fisheries

Flag	Item	Description
		Observer Program. These included the Basic Training of Seaman, Fisheries Management, Legal and Policy Framework, Health and Safety, Code of Conduct for Observers, Fishing Vessels and Gears, Data Collection, Recording Forms and Documents, Navigation, Radio Communication and Shipboard Training.
	Coverage	- Vessels using trawl gear must have onboard observer coverage for the entire duration of the trip (100% coverage). - Vessels using any other bottom fishing gear types must have onboard observer for 20% of operation in any calendar year. - 100% transhipment observer coverage.
	Collection	Duties of observer: - Observe and collect biological information, including catch composition sampling of the transhipped aquatic animal, and other activities such as sorting, processing, or observe several parts onboard the vessel, fish hold, wheelhouse and technology of fishing gears. - Record biological information or data related to the conduct of the conservation and management measures in the format defined by the Department of Fisheries, composition, number of bycatch or discard, type of fishing gear, mesh size, fishing logbook, transhipment, etc. as well as co-signing in the transhipment report by observer, fishing vessel and transhipment vessel
	Port sampling	Port inspector will inspect the documentation and physical checks on board for port in –port out permission and the video recorded by the EM will be inspected by port inspector prior to authorize to unloading. Besides, the Thai authorities will also carry out the catch landing inspection when porting in for reliability and accuracy of information on landed fish before entering the supply chain. During this process, catch weight is verified with landing declaration documents, such as fishing logbook, fishing gears and Marine Catch Transhipment Document (MCTD) in the case of transhipments.

*Sourced from the 2022 National Report

10. Summary of Scientific Observer biological sampling

The SIOFA Scientific Observer programme aims to cover as much of the fisheries operations as feasible under the operational and financial constraints of fishing in the high seas.

10.1 Length measurements for main target species

The length of some of the main target species of fisheries in the SIOFA area (see Appendix A) is measured by Scientific Observers and reported both in the SIOFA Observer database and in national reports. Table 7 summarizes the number of individuals of each species that were measured by the Scientific Observer programmes.

In order to provide an estimate of the fraction (%) of the catch that was measured in each year by the programme, average individual weights were calculated for each species where data was available. Total catch was then divided by this average weight to estimate the total number of individuals caught per each species. Finally, the fraction of the catch measured was obtained as the ratio of the number of measured individuals and the total number individuals caught.

Table 7 – Summary of the number of fish of SIOFA main target species measured by Scientific Observers in 2013–2020 for length, and their fraction of their total catch (sources: SIOFA Observer database 2013–2020, Cook Island 2020 data, and Chinese Taipei National Report 2020). The fraction of the catch measured (%, 2 decimals precision) was derived considering the average weight of an individual measured in every given year. N/A marks years/species for which a given measure or ratio was not available.

	Alfonsinos		Oilfish		Orange roughy		Toothfish	
Year	N. of individuals measured	% of catch measured	N. of individuals measured	% of catch measured	N. of individuals measured	% of catch measured	N. of individuals measured	% of catch measured
2013	990	0.02	N/A	N/A	32	0.00	N/A	N/A
2014	792	0.03	N/A	N/A	283	0.07	N/A	N/A
2015	500	0.02	14	0.01	N/A	N/A	N/A	N/A
2016	9608	0.33	10	0.00	N/A	N/A	N/A	N/A
2017	39863	N/A	12558	N/A	N/A	N/A	792	6.07
2018	24014	1.40	87933	N/A	9727	3.22	254	0.37
2019	32245	1.24	59919	12.56	9605	N/A	4955	15.06
2020	22923	0.80	75990	30.03	11626	N/A	5564	25.92
2021	14433	0.29	12399	2.78	42	0.00	3308	15.96

10.2 Length measurements of non-target species

Table 8 summarises the number of individuals measured for other non-target species of fish, when at least 40 measures had been recorded.

Table 8 – Summary of the number of fish of SIOFA non-target target species measured for length by Scientific Observers in 2013–2020. Only species where at least 40 individuals have been measured are included (sources: SIOFA Observer database 2013–2020, Chinese Taipei and Cook Islands National Reports 2020).

Species Code	English Name	Scientific Name	2013	2014	2015	2016	2017	2018	2019	2020	Total
ALL	Warty dory	*Allocyttus verrucosus*								12	80
ANT	Blue antimora	*Antimora rostrata*					316		658	1162	2648
AVR	Green jobfish	*Aprion virescens*							515	171	686
BAR	Barracudas nei	*Sphyraena spp*							73	4	77
BRF	Blackbelly rosefish	*Helicolenus dactylopterus*							105	350	455
BWA	Bluenose warehou	*Hyperoglyphe antarctica*	61	34		5		1	9	141	299
BYR	Kerguelen sandpaper skate	*Bathyraja irrasa*					6		22	18	468
CDL	Cardinal fishes nei	*Epigonus spp*									148
CGZ	Conger eels nei	*Conger spp*								292	292
COX	Conger eels, etc. nei	*Congridae*							99		111
CVY	Grenadiers, whiptails nei	*Coryphaenoides spp*							1	37	612
DCC	Shortfin scad	*Decapterus macrosoma*							3052	1014	4066
DCK	Redtail scad	*Decapterus kurroides*							606	109	715
DOP	Shortnose spurdog	*Squalus megalops*								81	81
EDR	Pelagic armourhead	*Pseudopentaceros richardsoni*	42	56		338	1650	13		87	2923
EMN	Marbled coralgrouper	*Plectropomus punctatus*							96	65	161
EMT	Bonnetmouths, rubyfishes nei	*Emmelichthyidae*								4	59
EPI	Black cardinal fish	*Epigonus telescopus*	68	210						16	666
FIT	Flutemouth	*Fistularia spp*							202	161	363
GEP	Snake mackerels, escolars nei	*Gempylidae*				50					50
GES	Snake mackerel	*Gempylus serpens*									522
GOX	Goatfishes	*Upeneus spp*							420		420
GRV	Grenadiers nei	*Macrourus spp*					279	27	12	517	1005
GUQ	Leafscale gulper shark	*Centrophorus squamosus*							272	346	795
HYD	Ratfishes nei	*Hydrolagus spp*							58	212	270

Species Code	English Name	Scientific Name	2013	2014	2015	2016	2017	2018	2019	2020	Total
IWX	Coralgroupers nei	*Plectropomus spp*							120	52	172
JAX	Jack and horse mackerels nei	*Trachurus spp*		110		50					160
KZJ	Delagoa threadfin bream	*Nemipterus bipunctatus*							5803	8558	14361
LEN	Smalltooth emperor	*Lethrinus microdon*								110	110
LIB	Brushtooth lizardfish	*Saurida undosquamis*							6056	5327	11383
LJB	Two-spot red snapper	*Lutjanus bohar*							205	225	430
LJG	Humpback red snapper	*Lutjanus gibbus*							198	259	457
LUB	Emperor red snapper	*Lutjanus sebae*							13	105	118
LZX	(blank)	*Lethrinus spp*							196	44	240
MAX	Mackerels nei	*Scombridae*									66
MCH	Bigeye grenadier	*Macrourus holotrachys*					150	60	1183	1339	3263
MOR	Moras nei	*Moridae*								6	67
MSN	Bathypelagic rattail	*Mesobius antipodum*									54
NGU	Yellowspotted trevally	*Carangoides fulvoguttatus*							231	3306	3537
NGX	(blank)	*Carangoides spp*							1851	490	2341
ONV	Spiky oreo	*Neocyttus rhomboidalis*	43	427							990
OPH	Cusk-eels, brotulas nei	*Ophidiidae*								107	111
QMC	Caml grenadier	*Macrourus caml*								63	63
QUK	Shortspine spurdog	*Squalus mitsukurii*							13	65	78
RIB	Common mora	*Mora moro*		51			20	8	687	701	2501
ROK	Rosefishes nei	*Helicolenus spp*					20	26	1	180	259
RUS	Indian scad	*Decapterus russelli*							8457	13511	21968
RYG	Rubyfish	*Plagiogeneion rubiginosum*	20	353		50			1		908
SDC	Basketwork eel	*Diastobranchus capensis*					73			3	91
SDU	Arrowhead dogfish	*Deania profundorum*								112	112
SEY	Violet warehou	*Schedophilus velaini*	616	560	89	519		1	59	160	2721
SFS	Silver scabbardfish	*Lepidopus caudatus*									126
SSO	Smooth oreo dory	*Pseudocyttus maculatus*		82							149

Species Code	English Name	Scientific Name	2013	2014	2015	2016	2017	2018	2019	2020	Total
SVY	Cutthroat eels nei	*Synaphobranchidae*							90	325	415
SYW	Variegated lizardfish	*Synodus variegatus*							101	85	186
TBE	Terebellum conch	*Terebellum terebellum*									68
WGR	Whitson's grenadier	*Macrourus whitsoni*								159	159
WHA	Hapuku wreckfish	*Polyprion oxygeneios*	10	6		136		10	24	527	820
WRF	Wreckfish	*Polyprion americanus*	1			96		32	111	1951	2195
YTC	Yellowtail amberjack	*Seriola lalandi*	8			20				23	66

10.3 Biological sampling of sharks

Other species of fish in the catch are also measured in the Scientific Observer programme. Table 9 provides a summary of the number of sharks (as defined in Appendix B for the purpose of this overview) individuals measured in recent years.

In the case of sharks, given the differences in body size across the different species measures within this broad category, it was not possible to reasonably estimate the fraction of total catch that was measured for length.

Table 9 – Summary of the number of fish of SIOFA sharks measured for length by Scientific Observers in 2013–2020 (sources: SIOFA Observer database 2012–2020, Cook Island 2020 data, and Chinese Taipei National Report 2020). See Appendix B for a list of sharks, defined for the purpose of this overview.

Year	N. of sharks measured
2013	12
2014	11
2015	
2016	
2017	189
2018	7
2019	8882
2020	6214

10.3.1 Biological sampling of deep-water sharks species at high risk and of concern

Table 10 focuses on the number of deep-water sharks at "high risk" and "of concern" (as defined in CMM 12-2019, and reported here in Appendix C for easier reference) that have been sampled in 2019 and 2020.

Table 10 – Number of deep-water sharks at "high risk" (in bold) and "of concern" (as defined in CMM 12-2019, and reported here in Appendix C for easier reference) that have been sampled by Scientific Observers in 2019 (top) and in 2020 (bottom) (source: SIOFA Observer database 2019-2020).

2019					
FAO code	**English Name**	**Scientific Name**	**Maturity (n)**	**Sex (n)**	**Weight (n)**
CYO	Portuguese dogfish	*Centroscymnus coelolepis*	4000	4000	3999
CYP	**Longnose velvet dogfish**	***Centroscymnus crepidater***	8	8	8
CYU	**Plunket shark**	***Centroscymnus plunketi***	1	1	1
DCA	**Birdbeak dogfish**	***Deania calcea***	27	27	27
ETM	Southern lanternshark (Lucifer)	*Etmopterus granulosus*	2399	2399	2399

2019					
FAO code	**English Name**	**Scientific Name**	**Maturity (n)**	**Sex (n)**	**Weight (n)**
GUP	Gulper shark	*Centrophorus granulosus*	162	162	162
HOL	Chimaeras, etc. nei	*Chimaeriformes*	42	42	42
RFA	Whiteleg skate	*Amblyraja taaf*	56	95	505
SCK	**Kitefin shark**	***Dalatias licha***	26	26	26
SHL	Lanternsharks nei	*Etmopterus spp*	1653	1654	1654
SKA	Raja rays nei	*Raja spp*			19
SSQ	Velvet dogfish	*Scymnodon squamulosus*	2	2	2
2020					
FAO code	**English Name**	**Scientific Name**	**Maturity (n)**	**Sex (n)**	**Weight (n)**
CYO	Portuguese dogfish	*Centroscymnus coelolepis*	2453	2454	2454
CYP	**Longnose velvet dogfish**	***Centroscymnus crepidater***	36	36	36
DCA	**Birdbeak dogfish**	***Deania calcea***	292	292	292
ETP	Smooth lanternshark	*Etmopterus pusillus*		1	1
GUP	Gulper shark	*Centrophorus granulosus*	197	197	197
RFA	Whiteleg skate	*Amblyraja taaf*		846	650
SCK	**Kitefin shark**	***Dalatias licha***	275	275	275
SHL	Lanternsharks nei	*Etmopterus spp*	1976	1976	1976
SKA	Raja rays nei	*Raja spp*		130	130
SOR	Little sleeper shark	*Somniosus rostratus*	5	5	5
SSQ	Velvet dogfish	*Scymnodon squamulosus*	2	2	2

10.4 Biological samplings performed in 2020

Besides length, other biological measures are taken in the SIOFA Scientific Observer programme. These include measures of maturity stage, sex and weight. Table 11 displays the number of individuals for which other biological records were conducted in 2020.

Table 11 – Summary of the number of fish that have been sampled for maturity, sex, and weight by Scientific Observers in 2020 (source SIOFA Observer database 2020). Other 95 species have been sampled but accounted for less than 10 individuals in total and thus were not reported in this table.

FAO code	Common Name	Scientific Name	Maturity (n)	Sex (n)	Weight (n)
ALL	Warty dory	*Allocyttus verrucosus*			12
ANT	Blue antimora	*Antimora rostrata*	5	285	763
API	Deep-water catsharks	*Apristurus spp*	14	14	16
AVR	Green jobfish	*Aprion virescens*			171
BEA	Eaton's skate	*Bathyraja eatonii*	4	12	12
BGX	(blank)	*Pomadasys spp*			21
BIG	Bigeyes nei	*Priacanthus spp*			21
BIS	Bigeye scad	*Selar crumenophthalmus*			88
BRF	Blackbelly rosefish	*Helicolenus dactylopterus*			350
BWA	Bluenose warehou	*Hyperoglyphe antarctica*		94	131
BXD	Alfonsino	*Beryx decadactylus*	16	60	398
BYR	Kerguelen sandpaper skate	*Bathyraja irrasa*	13	18	18
CGZ	Conger eels nei	*Conger spp*			292
CLD	Sliteye shark	*Loxodon macrorhinus*			22
COE	European conger	*Conger conger*			16
CRS	Portunus swimcrabs nei	*Portunus spp*			40

FAO code	Common Name	Scientific Name	Maturity (n)	Sex (n)	Weight (n)
CVY	Grenadiers, whiptails nei	*Coryphaenoides spp*	6	22	22
CWZ	Carcharhinus sharks nei	*Carcharhinus spp*	8	9	14
CYO	Portuguese dogfish	*Centroscymnus coelolepis*	2453	2454	2454
CYP	Longnose velvet dogfish	*Centroscymnus crepidater*	36	36	36
CZL	(blank)	*Coryphaenoides lecointei*	12	12	12
DCA	Birdbeak dogfish	*Deania calcea*	292	292	292
DGZ	Dogfishes nei	*Squalus spp*	26	26	26
DOP	Shortnose spurdog	*Squalus megalops*	81	81	81
EDR	Pelagic armourhead	*Pseudopentaceros richardsoni*		10	87
EMN	Marbled coralgrouper	*Plectropomus punctatus*			65
EMU	Roving coralgrouper	*Plectropomus pessuliferus*			12
ENE	Cape armourhead	*Pentaceros capensis*			19
EPI	Black cardinal fish	*Epigonus telescopus*			16
FIP	Red cornetfish	*Fistularia petimba*			23
FIT	Flutemouth	*Fistularia spp*			59
GER	Chaceon geryons nei	*Chaceon spp*		14	14
GOX	Goatfishes	*Upeneus spp*			49
GRV	Grenadiers nei	*Macrourus spp*	5	356	143
GUP	Gulper shark	*Centrophorus granulosus*	197	197	197
GUQ	Leafscale gulper shark	*Centrophorus squamosus*	346	346	346
GUX	Gurnards, searobins nei	*Triglidae*			16
HXT	Sharpnose sevengill shark	*Heptranchias perlo*	39	39	39
HYD	Ratfishes nei	*Hydrolagus spp*	188	212	212
IAX	Cuttlefishes nei	*Sepia spp*			17
IWX	Coralgroupers nei	*Plectropomus spp*			52
KCZ	King crabs nei	*Lithodes spp*	5	17	17
LEF	Lefteye flounders nei	*Bothidae*			31
LEN	Smalltooth emperor	*Lethrinus microdon*			112
LFX	(blank)	*Lagocephalus spp*			10
LHO	Longface emperor	*Lethrinus olivaceus*			23
LJB	Two-spot red snapper	*Lutjanus bohar*			225
LJG	Humpback red snapper	*Lutjanus gibbus*			259
LLV	Lunartail puffer	*Lagocephalus lunaris*			10
LUB	Emperor red snapper	*Lutjanus sebae*			108
LZX	(blank)	*Lethrinus spp*			54
MCH	Bigeye grenadier	*Macrourus holotrachys*	110	110	1339
NGU	Yellowspotted trevally	*Carangoides fulvoguttatus*			3309
NGX	(blank)	*Carangoides spp*			514
NGY	Bludger	*Carangoides gymnostethus*			49
OPH	Cusk-eels, brotulas nei	*Ophidiidae*			107
PQY	Purple-spotted bigeye	*Priacanthus tayenus*			68
PRP	Roudi escolar	*Promethichthys prometheus*			12
PUX	Puffers nei	*Tetraodontidae*			23
QMC	Caml grenadier	*Macrourus caml*	63	63	63
QUK	Shortspine spurdog	*Squalus mitsukurii*	65	65	65
RAG	Indian mackerel	*Rastrelliger kanagurta*			51
RFA	Whiteleg skate	*Amblyraja taaf*		846	650
RIB	Common mora	*Mora moro*			701
ROK	Rosefishes nei	*Helicolenus spp*		13	180
RUS	Indian scad	*Decapterus russelli*			19
SCK	Kitefin shark	*Dalatias licha*	275	275	275
SCO	Scorpionfishes nei	*Scorpaenidae*			15
SDU	Arrowhead dogfish	*Deania profundorum*	112	112	112
SEY	Violet warehou	*Schedophilus velaini*		89	125
SHL	Lanternsharks nei	*Etmopterus spp*	1976	1976	1976
SKA	Raja rays nei	*Raja spp*		130	130
SQZ	Inshore squids nei	*Loliginidae*			11
SVY	Cutthroat eels nei	*Synaphobranchidae*			325

FAO code	Common Name	Scientific Name	Maturity (n)	Sex (n)	Weight (n)
TOA	Antarctic toothfish	*Dissostichus mawsoni*	12	12	12
TOP	Patagonian toothfish	*Dissostichus eleginoides*	5422	5430	5307
UAZ	Thorny flathead	*Rogadius pristiger*			28
UPM	Goldband goatfish	*Upeneus moluccensis*			72
URA	Stargazers	*Uranoscopus spp*			27
VRL	Yellow-edged lyretail	*Variola louti*			11
WGR	Whitson's grenadier	*Macrourus whitsoni*	159	159	159
WHA	Hapuku wreckfish	*Polyprion oxygeneios*	94	321	435
WRF	Wreckfish	*Polyprion americanus*	777	1226	1865
YBS	Bigeye barracuda	*Sphyraena forsteri*			33
YRB	Obtuse barracuda	*Sphyraena obtusata*			46
YTC	Yellowtail amberjack	*Seriola lalandi*		20	13

10.5 Patagonian toothfish tags releases and recaptures

Two Spanish fishing vessels have been working in the SIOFA management area in 2017 and 2018. These vessels have released and recovered eleven Patagonian toothfish (*D. eleginoides*), but the release data from one of these toothfish is missing. The time elapsed between the release and recapture has been between 3 and 10 years, all fish were small at release (between 75-93 cm). The maximum increment in weight was 5 kg and 26 cm in length. Specimens recaptured have travelled (straight line distance) from 6 to ~1800km, with 6 out of 10 individuals showing a long-distance movement (exceeding 1000km). This information was provided to CCAMLR by Sarralde and Barreiro (2018).

Observers record the number of toothfish tags released and recaptured in the Patagonian toothfish fishery (Table 12). All recaptures in the SIOFA area were of fish originally released in the CCAMLR area.

Table 12 – Summary of Patagonian toothfish tag releases and recaptures in the SIOFA area (source: SIOFA Observer database 2019-2021). Data for 2022 is still preliminary.

Subarea	Year							
	2019		**2020**		**2021**		**2022***	
	Released	**Recaptured**	**Released**	**Recaptured**	**Released**	**Recaptured**	**Released**	**Recaptured**
Subarea 3b	-	-	-	3	687	6	108	
Subarea 7	-	1	175	1	4	3		

Toothfish recapture data was shared with CCAMLR to collect more information on release/recapture locations and fish conditions. Of the total 14 tagged individuals that were released in the CCAMLR area and recaptured in the SIOFA area, information could be matched only for 12. These individuals were recaptured in the Williams Ridge and Del Cano Rise toothfish Assessment Areas (figure 29).

[this figure is not included in the public version of the manuscript, due to confidentiality limitations]

Figure 29 – Releases (orange points) and recapture (black points) location of tagged toothfish recaptured in the SIOFA Area (source: SIOFA Observer database/CCAMLR database). Black lines represent the shortest distance between release and recapture locations.

Tagging data indicated that some fish had a negative growth in size between release and recapture, perhaps suggesting that further work would be needed to perfect the tag matching algorithms (Table 13). The longest distance between release and recapture locations was >2000 km, whereas the shortest distance was around 39 km (Table 13).

Table 13 – Biological and positional data available on releases and recaptures of tagged toothfish recaptured in the SIOFA Area (source: SIOFA Observer database/CCAMLR database).

[this table is not included in the public version of the manuscript, due to confidentiality limitations]

11. References

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Cordue, P. L. 2018b. Stock assessment of orange roughy in the Walter's Shoal Region. SIOFA, Saint-Denis, Reunion.

FAO. 2009. International Guidelines for the Management of Deep-sea Fisheries in the High Seas. Page 90. Rome, Italy.

Sarralde and Barreiro. 2018. Information about tagged Patagonian toothfish (*Dissostichus eleginoides*) tagged in the CCAMLR Convention Area and recovered in the SIOFA management area by two Spanish vessels in 2017/18. CCAMLR paper WG-FSA-18/53 Rev. 1

Appendix A – List of species reported as targets in SIOFA fisheries and considered as target species for the purposes of this overview

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

Appendix B – Common names, FAO species codes, and scientific names of sharks, defined for the purpose of this overview

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		*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*

Appendix C – List of deep-sea sharks considered to be at "high risk" and "of concern" is included in Annex 1 of SIOFA CMM 12-2019 (Conservation and Management Measure for Sharks)

Species considered to be at "high risk" are highlighted in bold.

FAO code	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**	***Centroscymnus crepidater***
CYU	**Plunket shark**	**Pailona austral**	***Centroscymnus plunketi***
DCA	**Birdbeak dogfish**	**Squale savate**	***Deania calcea***
ETP	Smooth lanternshark	Sagre nain	*Etmopterus pusillus*
EZU	Whitecheek lanternshark		*Etmopterus alphus*
GUP	Gulper shark	Squale-chagrin commun	*Centrophorus granulosus*
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*
SCK	**Kitefin shark**	**Squale liche**	***Dalatias licha***
SON	Pacific sleeper shark	Laimargue dormeur	*Somniosus pacificus*
SSQ	**Velvet dogfish**		***Zameus squamulosus***
ZZC	Dark-mouth chimaera		*Chimaera buccanigella*
ZZD	Falkor chimaera		*Chimaera didierae*
ZZE	Seafarer's ghost shark		*Chimaera willwatchi*

Appendix E – Data included in figures

Figure 4 – Yearly total catch (t) in the SIOFA area (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). All catch included, even without spatial information.

Year	TotalCatch
2013	9800.967
2014	7665.514
2015	36738.99
2016	27865.06
2017	21235.49
2018	14363.94
2019	14728.75
2020	16057.88
2021	14172.16

Figure 5 – Total catch reported by SIOFA Subareas (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included.

Year	SubArea	TotalCatch
2013	1	87.16897
2014	1	12.65214
2015	1	244.0379
2016	1	887.5886
2017	1	5542.67
2018	1	4008.41
2019	1	2025.859
2020	1	4789.025
2021	1	2094.522
2013	2	4275.793
2014	2	2881.515
2015	2	4293.592
2016	2	3994.63
2017	2	3398.214
2018	2	3062.497
2019	2	3449.125
2020	2	2232.698
2021	2	2792.819
2013	3a	1203.414
2014	3a	1447.749
2015	3a	1170.487
2016	3a	2054.513
2017	3a	1006.218
2018	3a	1045.87
2019	3a	1148.344

2020	3a	1381.862
2021	3a	1078.882
2013	3b	2914.002
2014	3b	2655.21
2015	3b	6254.438
2016	3b	9007.653
2017	3b	8005.051
2018	3b	4575.246
2019	3b	5433.065
2020	3b	4738.973
2021	3b	4373.717
2013	4	1179.227
2014	4	630.4962
2015	4	1069.587
2016	4	34.03907
2017	4	386.9707
2018	4	928.5816
2019	4	559.6967
2020	4	824.4903
2021	4	418.9532
2017	5	523.0365
2018	5	100.6148
2019	5	7.0368
2020	5	218.6876
2021	5	103.52
2015	6	96.964
2016	6	27.71337
2017	6	56.3174
2018	6	96.4996
2019	6	200.7715
2020	6	71.07661
2021	6	43.81253
2015	7	20.532
2018	7	362.6302
2019	7	203.2464
2020	7	82.20765
2021	7	35.8114
2013	8	103.3415
2014	8	7.858
2015	8	12853.35
2016	8	9079.027
2017	8	2028.383
2018	8	105.8707
2019	8	1697.828
2020	8	1650.662
2021	8	3194.637

Figure 4a and b – Catch and bycatch as relative values (upper panel, a) and absolute values (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included, and the portion of bycatch composed by sharks (as defined in Appendix B) is highlighted.

Figure 5a and b – Target catch (upper panel, a) and bycatch (lower panel, b) in different SIOFA Subareas (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included.

Figure 6a and b – Yearly catch of sharks in the SIOFA area by species (upper panel, a) and by SIOFA subarea (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Species are indicated by their 3-letter FAO code, see Appendix B for disambiguation.

Figure 7a and b – Yearly catch of sharks considered to be at "high risk" and "of concern" as included in Annex 1 of SIOFA CMM 12-2019 (Conservation and Management Measure for Sharks) in the SIOFA area. Figures by species (upper panel, a) and by SIOFA subarea (lower panel, b) are presented (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Species are indicated by their 3-letter FAO code, see Appendix C for disambiguation.

Figure 10a and b – Target catch (as defined in Appendix A) and bycatch as relative values (upper panel, a) and absolute values (lower panel, b) in all SIOFA Assessment Areas for orange roughy (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included.

Figure 11a and b – Target catch (as defined in Appendix A) and bycatch as relative values (upper panel, a) and absolute values (lower panel, b) within the two SIOFA Assessment Areas for toothfish (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included.

Figure 14a and b –Bycatch and discards as relative values (upper panel, a) and absolute values (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Catches without spatial information are not included.

Figure 15 – Yearly discards in the SIOFA area by species (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Only the top five species (by weight) are fully represented, while the other species have been grouped in a single category. Species are indicated by their 3-letter FAO code.

Figure 16a and b – Yearly alfonsino catch (t) and effort (number of trawls) in the SIOFA area (upper panel, a) and in different SIOFA Subareas (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Figure 17 – Unstandardised catches per unit of effort (CPUEs) of alfonsino in the SIOFA area (t/tow) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Year	CPUEs
2013	2.81598
2014	1.906733
2015	2.037894
2016	2.136271
2017	2.429722
2018	1.937629

2019	3.534825
2020	3.450295
2021	3.816471

Figure 18a and b – Yearly orange roughy catch (t) and effort (number of trawls) in the SIOFA area (upper panel, a) and in different SIOFA Subareas (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Values of the figure in panel a are provided in Table A.1 and values of the figure in panel b are provided in Table A.2 (both in Appendix A).

Figure 19 – Unstandardised catches per unit of effort (CPUEs) of orange roughy in the SIOFA area (t/tow) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Year	CPUEs
2013	2.901408
2014	1.878547
2015	1.737694
2016	0.701408
2017	2.067203
2018	1.318779
2019	3.571361
2020	5.676508
2021	5.004332

Figure 20a and b – Yearly toothfish catch (t) and effort (10 thousand hooks) in the SIOFA area (upper panel, a) and in different SIOFA Subareas (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Note that the Subareas are larger than the toothfish Assessment Areas.

Year	Total catch (t)	Effort (10 thousand hooks)
2013	55.7	120.9864
2014	13.5	57.4049
2015	17.2	49.1515
2016	1.2	1.0112
2017	157	158.1598
2018	503.7	304.1199
2019	242.5	178.6158
2020	188.1	128.8434
2021	155	96.9194

Year	3b	7
2013	55.7	
2014	13.5	
2015	17.2	
2016	1.2	
2017	156.2	
2018	156.5	347.2
2019	58.1	184.4
2020	110.3	77.8
2021	124.5	30.5

Figure 21 – Unstandardised catches per unit of effort (CPUEs) of toothfish in the SIOFA area (t/10 thousand hooks) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Year	CPUEs
2013	0.460305
2014	0.235343
2015	0.350716
2016	1.203521
2017	0.992556
2018	1.656293
2019	1.357461
2020	1.459913
2021	1.599068

Figure 22a and b – Yearly hapuka catch (t) and effort (10 thousand hooks) in the SIOFA area (upper panel, a) and in different SIOFA Subareas (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Figure 23 – Unstandardised catches per unit of effort (CPUEs) of hapuka in the SIOFA area (t/10 thousand hooks) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Figure 24a and b – Yearly oilfish catch (t) and effort (10 thousand hooks) in the SIOFA area (upper panel, a) and in different SIOFA Subareas (lower panel, b) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Year	Total catch (t)	Effort (10 thousand hooks)
2013	9.3	0
2014	0.2	0
2015	3329.2	816.2505
2016	7901	1967.303
2017	8387.5	2425.898
2018	6716.3	1856.838
2019	4437.4	2098.871
2020	5676.6	1667.027

2021	2713.8	2823.591

Figure 25 – Unstandardised catches per unit of effort (CPUEs) of oilfish in the SIOFA area (t/10 thousand hooks) (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Year	CPUEs
2015	4.078668
2016	4.016178
2017	3.457466
2018	3.617064
2019	2.114175
2020	3.40521
2021	0.961106

Figure 27 – Number of fishing events by gear in Interim Protected Areas (IPAs) per year (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021).

Figure 28 – Total catch (t) by species in Interim Protected Areas (IPAs) per year (source: SIOFA AggregatedCatchEffort and HBHCatchEffort databases 2013–2021). Only the top five species (by weight) are fully represented, while the other species have been grouped in a single category.