REVIEW OF THE STATISTICAL DATA AVAILABLE FOR INDIAN OCEAN INDO-PACIFIC SAILFISH (1950-2020)

Author: IOTC Secretariat

Abstract

The document provides an overview of the consolidated knowledge about fisheries catching Indo-Pacific sailfish (*Istiophorus platypterus*) in the Indian Ocean since the early 1950s based on a range of data sets collected by Contracting Parties and Cooperating Non-Contracting Parties (CPCs) of the IOTC and curated by the IOTC Secretariat. The available fisheries statistics indicate that Indo-Pacific sailfish are mostly caught by artisanal fisheries using gillnets and a combination of longlines, troll lines, and handlines operated in coastal areas. Total catches of Indo-Pacific sailfish have steadily increased since the 1980s to exceed 32,000 t during 2017-2018, before decreasing to 27,800 t in 2020. Information available on discarding practices of Indo-Pacific sailfish in industrial fisheries indicates that discard levels are small in large-scale longline and purse seine fisheries and individuals generally discarded dead at sea. Discarding in coastal fisheries interacting with the species is poorly known but considered to be small. Information available on the spatial distribution of catch and effort has substantially improved over the last decade but remains limited, half of the total catch lacking accurate data on fishing grounds in 2020. Catches of Indo-Pacific sailfish are mainly located along the coasts of I.R. Iran, Pakistan, Oman, India, Sri Lanka and Tanzania, although the catch levels for this latter CPC are largely unknown. The reporting of size-frequency data has also improved over the last decade but remains very limited for most fisheries.

Keywords: billfish | Indo-Pacific sailfish | Indian Ocean | tuna fisheries

Introduction

The overarching objective of this paper is to provide participants in the 20th Session of the IOTC Working Party on Billfish (WPB20) with a review of the status of the information available on Indian Ocean Indo-Pacific sailfish (*Istiophorus platypterus*) through the analysis of temporal and spatial trends in catches and their main recent features, as well as an assessment of the reporting quality of the data sets. A full description of the data collated and curated by the Secretariat is available in IOTC (2022).

Nominal catch

Historical trends (1950-2020)

Overall, total reported catches of Indo-Pacific sailfish show a marked increase from the early 1980s until today (**Fig. 1a**), with a peak in annual catches recorded in 2018 at around 34,000 t and slightly decreasing catches reported for 2019 and 2020.

Historical trends of Indo-Pacific sailfish catches indicate the species as predominant in its group (together with swordfish) with a contribution to over 30% of total billfish catches in the Indian Ocean. Furthermore, due to the tendency of the species to inhabit shallower waters (Nakamura 1985), the fraction of catches reported by artisanal fisheries is consistently higher than what reported for other billfish species (**Fig. 1b**). Nevertheless, the development of longline fisheries in the mid-1950s increased catches of billfish species in general, and sailfish in particular, as did the drastic development of gillnet fisheries from the 1980s onward (**Table 1**) in several coastal countries (Maldeniya et al. 1995, Hornby et al. 2014).

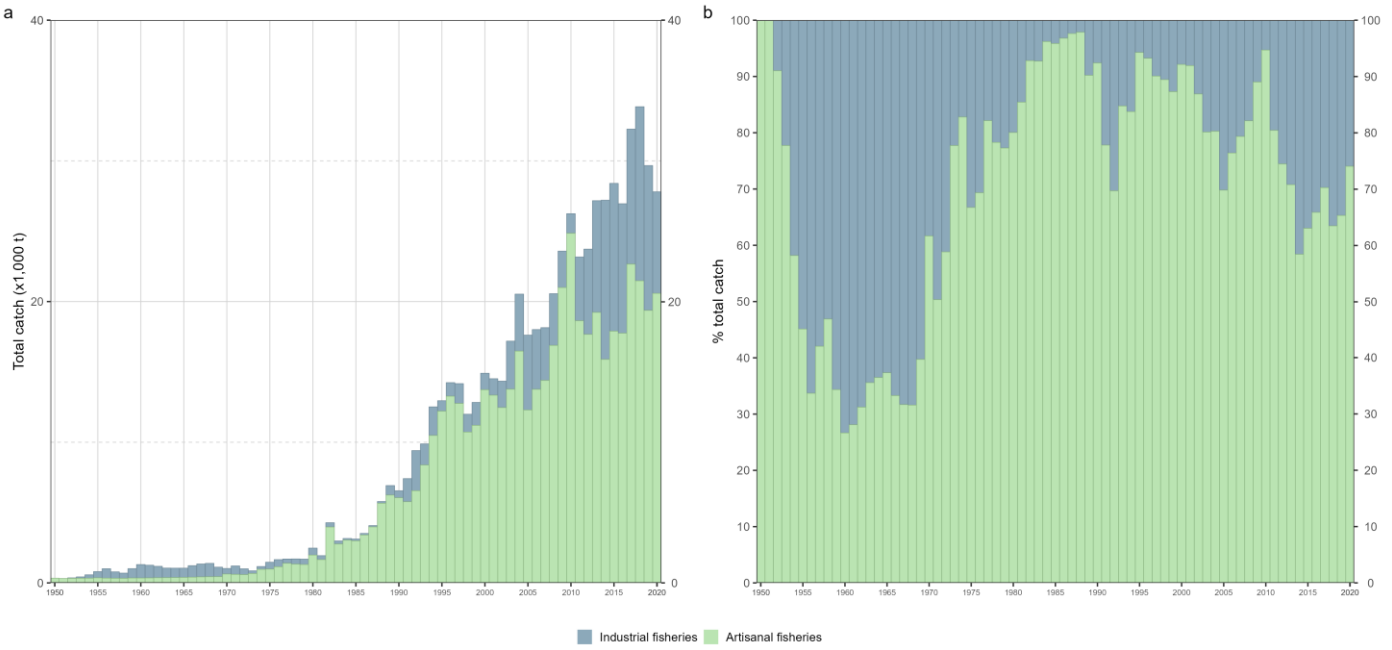

Figure 1: Annual time series of cumulative nominal absolute (a) and relative (b) catches (metric tons; t) of Indo-Pacific sailfish by type of fishery for the period 1950-2020. Data source: best scientific estimate of nominal catches

The relative proportions of catches of Indo-Pacific sailfish by fishery changed over the years, with both artisanal and industrial gillnets contributing the highest proportion from 1980s onward (reaching around 70% of total catches in recent years), line fisheries (coastal longline, trolling and handline) increasing their contribution between mid-1970s and mid-1990s before stabilizing to around 25% of total reported catches in recent years, and proportions from longline fisheries strongly declining between 1970 and 1990, when catches of the species caught by swordfish-targeting longliners began to increase again (**Fig. 2b** and **Table 1**). There are also reports of Indo-Pacific sailfish catches from purse seine (1980-2020) and baitboat fisheries (1970-1974 and 2015-2020), although very low in absolute terms at less than 100 t per year in the periods concerned.

Table 1: Best scientific estimates of average annual nominal catches (metric tons; t) of Indo-Pacific sailfish by decade and fishery for the period 1950-2019. The background intensity color of each cell is directly proportional to the catch level. Data source: best scientific estimate of nominal catches

Fishery	1950s	1960s	1970s	1980s	1990s	2000s	2010s
Purse seine | Other	0	0	2	23	40	81	204
Longline | Other	0	0	0	19	488	1,127	517
Longline | Fresh	0	0	17	69	711	990	636
Longline | Deep-freezing	297	804	368	183	613	345	383
Line | Coastal longline	63	62	68	376	694	1,532	3,467
Line | Trolling	79	122	217	560	1,092	1,650	1,528
Line | Handline	29	29	142	491	705	766	1,288
Baitboat	0	0	29	0	0	0	34
Gillnet	165	181	504	2,082	6,851	11,445	19,795
Other	0	0	2	22	2	4	14
Total	633	1,197	1,348	3,826	11,195	17,940	27,866

Table 2: Best scientific estimates of annual nominal catches (metric tons; t) of Indo-Pacific sailfish by fishery for the period 2011-2020. The background intensity color of each cell is directly proportional to the catch level. Data source: best scientific estimate of nominal catches

Fishery	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Purse seine | Other	173	171	269	183	178	170	378	170	184	273
Longline | Other	1,328	931	1,061	236	67	110	69	56	58	30
Longline | Fresh	27	412	944	1,010	545	504	714	822	1,194	625
Longline | Deep-freezing	202	387	122	283	510	1,160	297	377	305	243
Line | Coastal longline	2,710	2,222	2,269	2,925	4,381	3,215	5,483	4,695	3,706	2,475
Line | Trolling	1,355	1,286	1,328	1,376	1,481	2,285	1,613	1,384	1,599	2,508
Line | Handline	1,419	1,555	1,933	390	779	1,293	1,454	1,057	1,617	1,875
Baitboat	0	0	81	0	131	48	26	11	41	32
Gillnet	15,945	16,756	19,155	20,795	20,320	18,162	22,207	25,232	20,952	19,712
Other	10	9	9	8	8	8	18	46	13	28
Total	23,171	23,729	27,171	27,206	28,401	26,955	32,260	33,852	29,668	27,802

Industrial longline (deep-freezing) and coastal fisheries are known to be catching Indo-Pacific sailfish since the 1950s, with the Japanese fleet operating in the western Indian Ocean being the major contributor to the former component (since the mid-1950s) and Omani, Malagasy, and Indian fisheries being the major contributors to the latter, starting from the 1970s.

It is also assumed that vessels from Taiwan,China operating in the western Indian Ocean during the 1980s had substantial catches of sailfish, although these were reported to the IOTC as aggregates of billfish species (Campbell &

Tuck 1998), therefore explaining the low catches of sailfish recorded during a period of time that saw substantial increases in the number of active longline vessels.

Indo-Pacific sailfish catches were also influenced by the development of gillnet fisheries in Sri Lanka (Maldeniya et al. 1995) and Pakistan (Hornby et al. 2014) during the 1980s. Moreover, the contribution of coastal longline fisheries to Indo-Pacific sailfish catches gradually increased from the 2000s, with average annual catches almost doubling between the 2000s and 2010s (**Fig. 3** and **Table 1**).

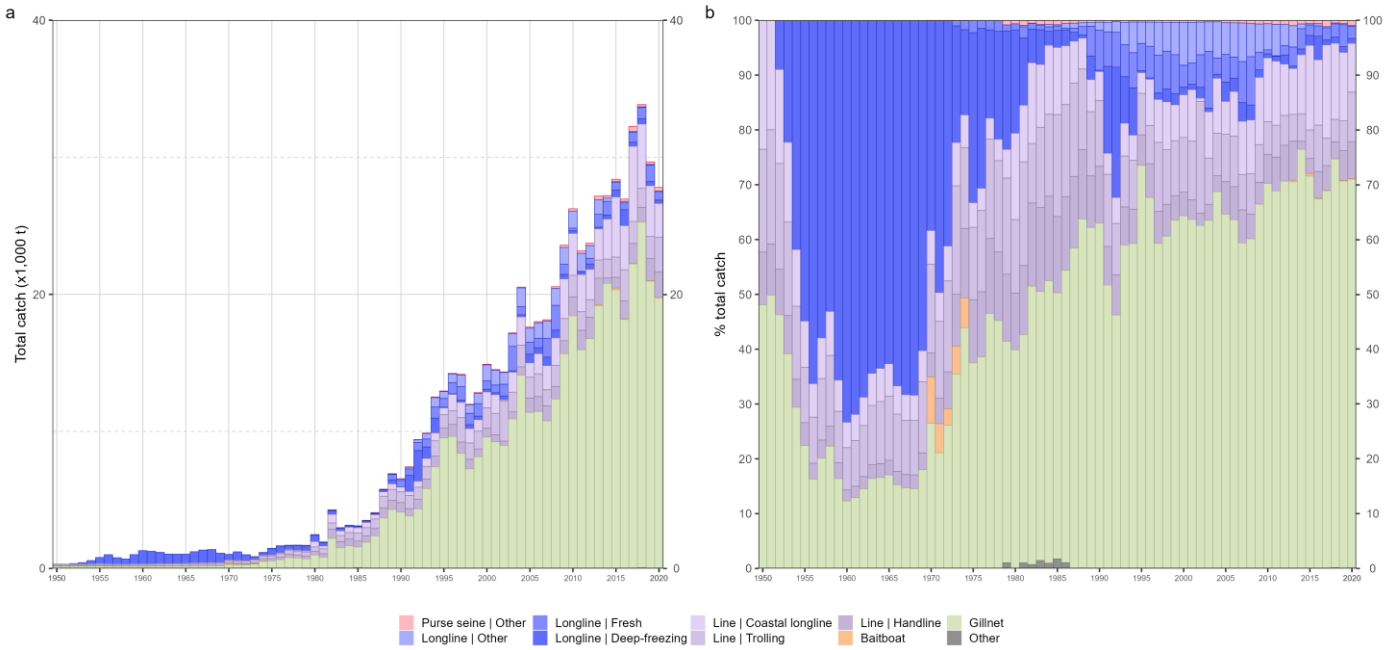

Figure 2: Annual time series of cumulative nominal absolute (a) and relative (b) catches (metric tons; t) of Indo-Pacific sailfish by fishery for the period 1950-2020. Data source: best scientific estimate of nominal catches

In 2017 Pakistan fully revised their time series of gillnet catches for the period 1987-2016 based on information collected through the WWF crew-based data collection programme, although without major improvements on the species composition of billfish catches (IOTC 2019, Moazzam 2019). This required the IOTC Secretariat to post-process all catches of aggregated billfish species from the gillnet fisheries of Pakistan, which in the years between mid-1980s and mid-1990s were in turn all assigned to Indo-Pacific sailfish (*Istiophorus platypterus*).

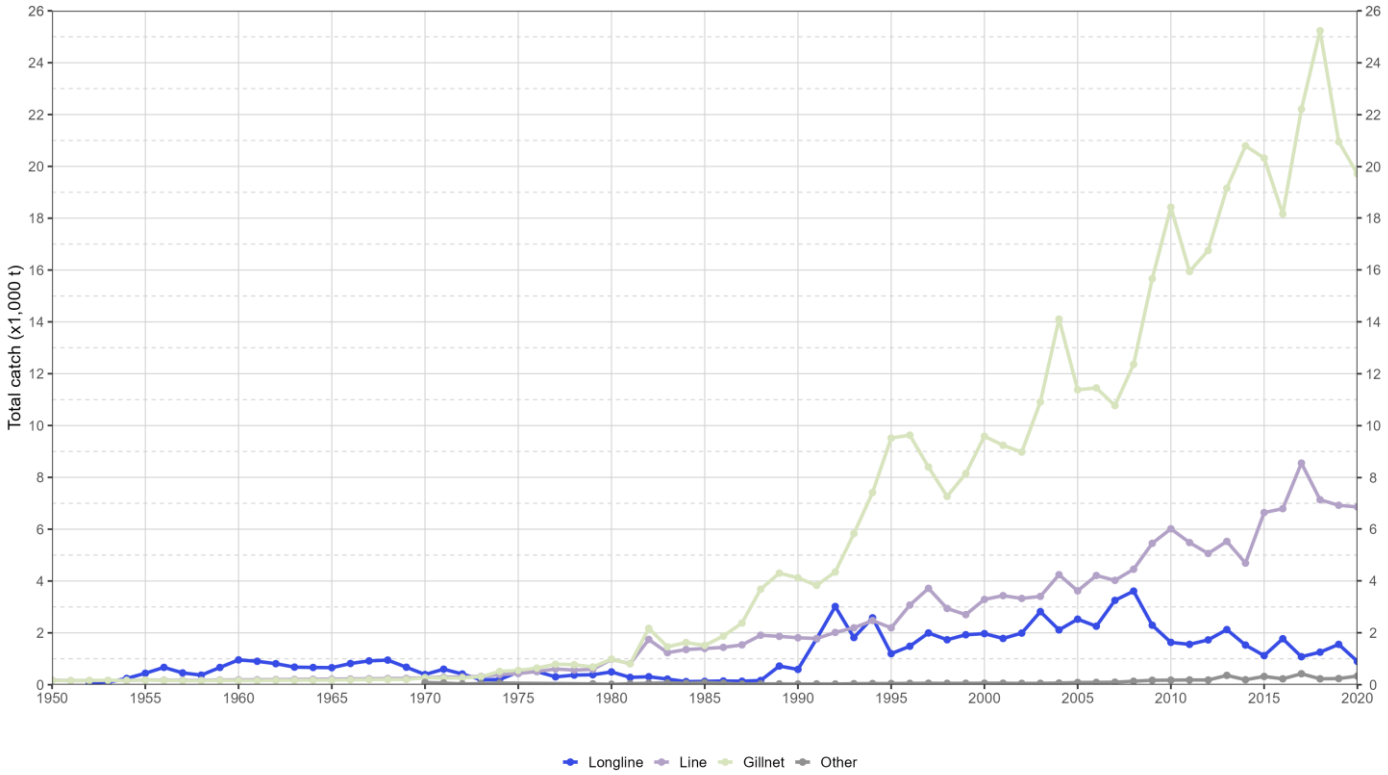

Figure 3: Annual time series of nominal catches (metric tons; t) of Indo-Pacific sailfish by fishery group for the period 1950-2020. Data source: best scientific estimate of nominal catches

Main fishery features (2016-2020)

In recent years (2016-2020), gillnet fisheries contributed to 70.6% of Indo-Pacific sailfish catch, followed by *coastal* line fisheries (combining coastal longline, troll line and handline fisheries) with 24%, fresh-tuna longline fisheries with 2.6%, deep-freezing longline fisheries with 1.6% and purse seine fisheries with 0.8% (**Table 3**).

With regards to purse seine fisheries, the vast majority of catches of Indo-Pacific sailfish is reported by the coastal purse seiners of Indonesia and by the ringnets of Sri Lanka, although the latter reached non-negligible levels only in 2017 when approximately 200 t of the species were recorded, in total, for the fishery.

Very limited information on retained catches of Indo-Pacific sailfish for industrial purse seine fisheries has been reported to the Secretariat through the nominal catch data form (1-RC) while information from the ROS indicates that some Indo-Pacific sailfish may be caught in these fisheries and retained or discarded at sea (see section Discard levels).

Table 3: Mean annual catches (metric tons; t) of Indo-Pacific sailfish by fishery between 2016 and 2020. Data source: best scientific estimate of nominal catches

Fishery	Fishery code	Catch	Percentage
Gillnet	GN	21,253	70.6
Line | Coastal longline	LIC	3,915	13.0
Line | Trolling	LIT	1,878	6.2
Line | Handline	LIH	1,459	4.8
Longline | Fresh	LLF	772	2.6
Longline | Deep-freezing	LLD	476	1.6
Purse seine | Other	PSOT	235	0.8
Longline | Other	LLO	65	0.2
Baitboat	BB	32	0.1
Other	OT	23	0.1

Catches of Indo-Pacific sailfish are highly concentrated, as it takes just five countries to reach ~85% of the average 2016-2020 total annual catch levels (**Fig. 4**). In particular, the gillnet fisheries of I.R. Iran account for 34% of the total Indo-Pacific sailfish catches, of which 80% are reported by I.R. Iran as caught by larger vessels that can operate in areas beyond national jurisdiction. India, Tanzania, Sri Lanka and Pakistan also reported substantial amounts of Indo-Pacific sailfish caught with a variety of coastal and offshore fisheries that include gillnet, line, and longline, contributing to 48% of the total catch reported between 2016 and 2020 (**Fig. 4**).

Besides Sri Lanka, the other major longline fleet reporting significant average catches of Indo-Pacific sailfish in recent years is the one from Taiwan,China (including both fresh and deep-freezing longliners) which contributed to around 1.4% of average annual catches for the species.

Finally, it is important to recall that catch levels of Indo-Pacific sailfish reported by Pakistan for years prior to 2018 are the result of the disaggregation process adopted by the IOTC Secretariat to break down catches originally reported by the CPC as a generic aggregate of billfish species.

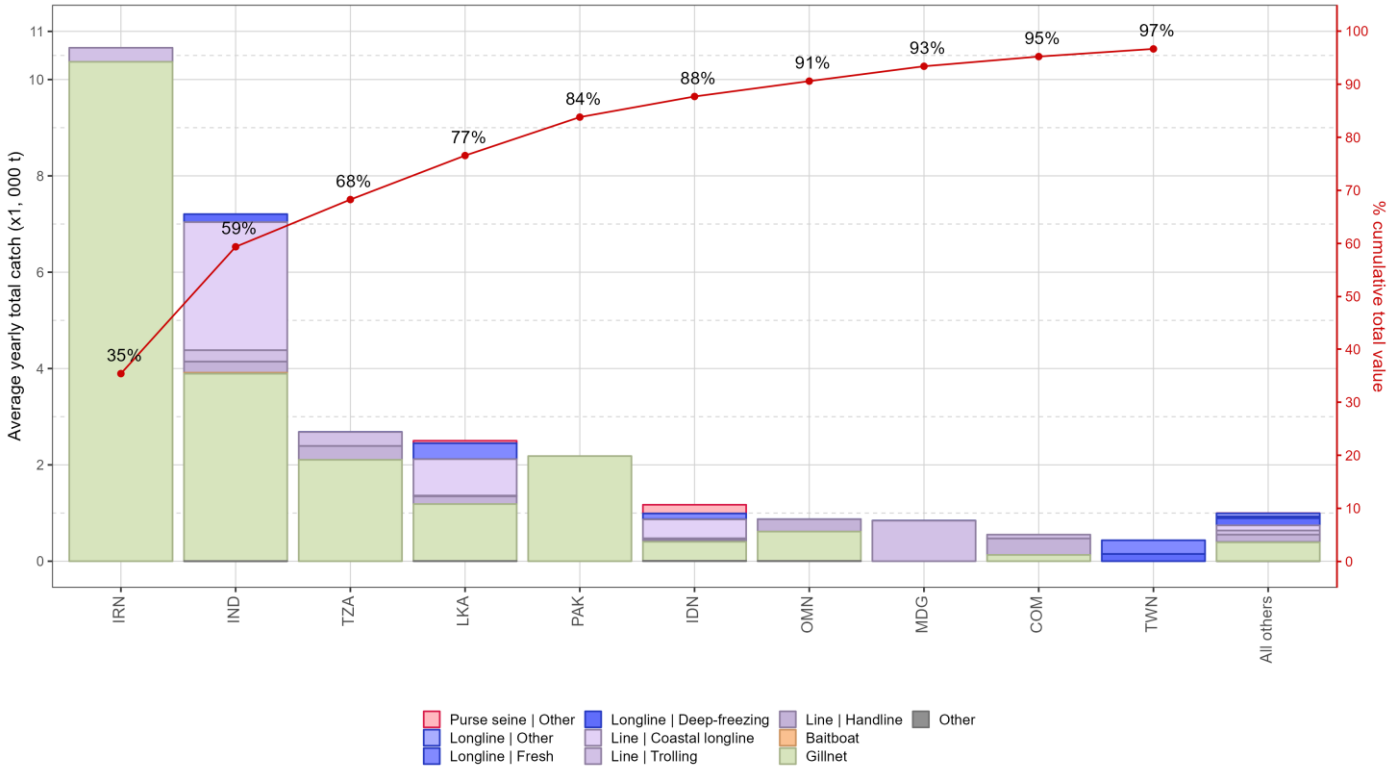

Figure 4: Mean annual catches (metric tons; t) of Indo-Pacific sailfish by fleet and fishery between 2016 and 2020, with indication of cumulative catches by fleet. Data source: best scientific estimate of nominal catches

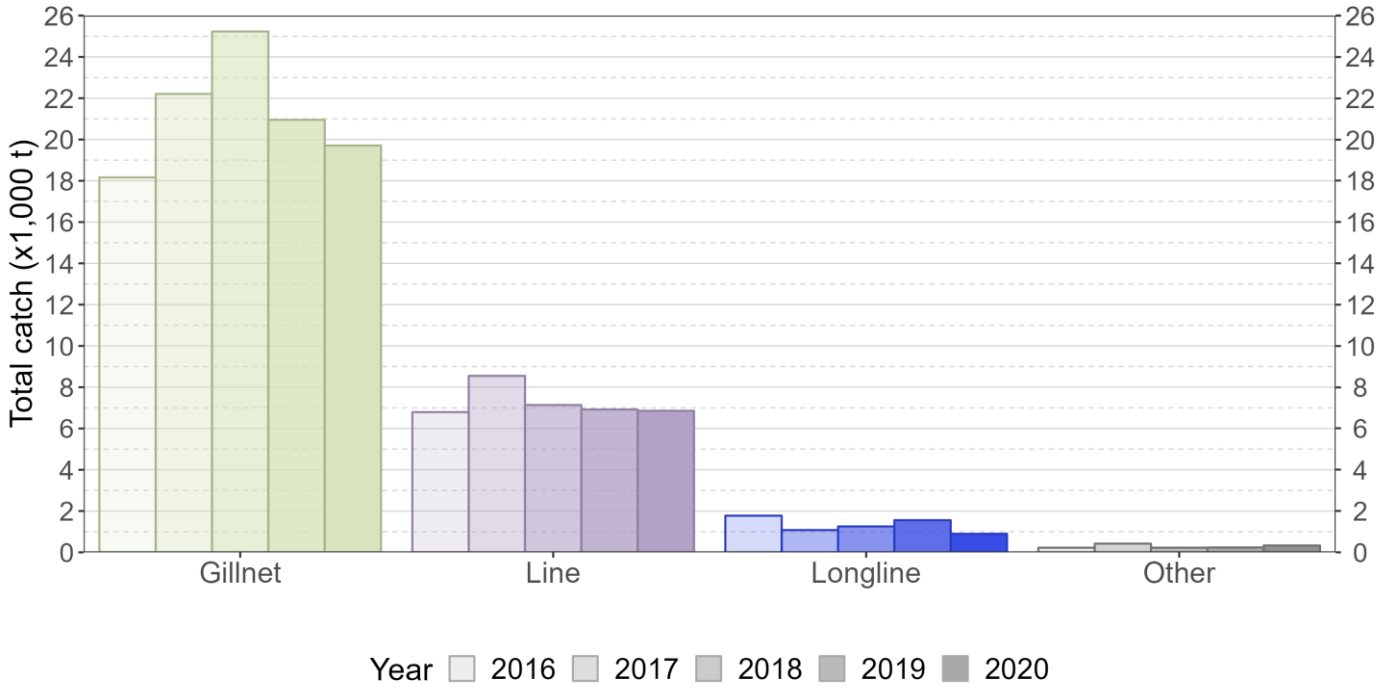

Figure 5: Annual catch (metric tons; t) trends of Indo-Pacific sailfish by fishery group between 2016 and 2020. Data source: best scientific estimate of nominal catches

Annual catches of Indo-Pacific sailfish by fishery group show that *line*, *longline* and *other* fisheries reported stable catches since 2016, as opposed to *gillnet* fisheries which recorded an overall increase between 2016 and 2018 followed by a decrease in 2019 and 2020, which brought catches back to levels comparable to those of 2016 (**Fig. 5**). Catches from industrial longline fisheries are generally declining after a period of relative stability, when not of increasing catch trends, as is the case of Sri Lanka until 2019 (**Fig. 6b**).

On a fishery-specific basis, gillnet catches are prominently accounted for by gillnetters from I.R. Iran, followed by India, Pakistan and Tanzania. India also dominates catches of Indo-Pacific sailfish from line-related fisheries, although the overall trend is decreasing in recent years, and Indonesia appears as the major source of catches for the species reported by fisheries of *other* types (**Fig. 5**). A few outliers exist, and concern in particular catches reported in 2016 by the *other* fisheries of Sri Lanka and by the industrial longliners of India (the latter only available in 2016), and in 2019 by the *other* fisheries of Indonesia, which show particularly high catches of the species compared to other years in the same period (**Fig. 6a-b**).

It is important to recall that the relative stability of catches from *gillnet* and *line* fisheries is a direct consequence of the repetition in annual catch levels for Tanzania (**Fig. 6c-d**) and Madagascar (**Fig. 6c**) due to non-reporting of catches for these fleet segments by the concerned CPCs, which adds significant uncertainties in overall catch levels for the species. Additional uncertainties are introduced by significant reporting of aggregated billfish and marlin catches by several fisheries of India in 2019 and 2020, which required explicit disaggregation of catch records by the Secretariat in order to produce species-specific catches (including Indo-Pacific sailfish) for these two years.

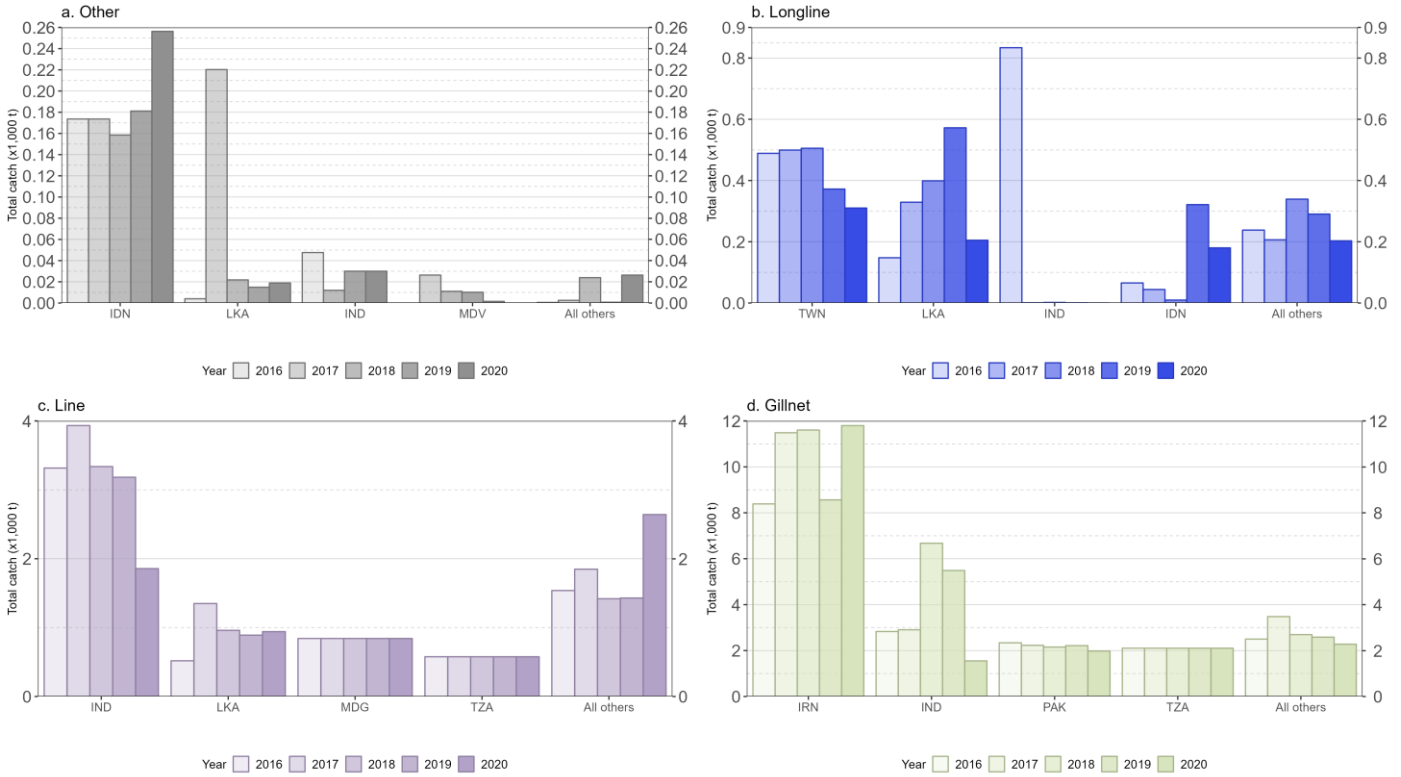

Figure 6: Annual catch (metric tons; t) trends of Indo-Pacific sailfish by fishery group and fleet between 2016 and 2020. Data source: best scientific estimate of nominal catches

Changes from previous Working Party

There was no significant data revision between the Working Parties on Billfish held in 2021 (WPB19) and 2022 (WPB20) which could impact the historical catch trend of Indo-Pacific sailfish. However, the disaggregation of marlin and billfish aggregated catches, which relies on proxy fleets and years, slightly altered past data estimated for Indo-Pacific sailfish (**Fig. 7**). In particular, catches from Pakistan and Jordan changed to reflect the latest catch breakdown of aggregated billfish species reported in recent years (see Appendix I for additional details on the most important changes in nominal catches recorded in recent years).

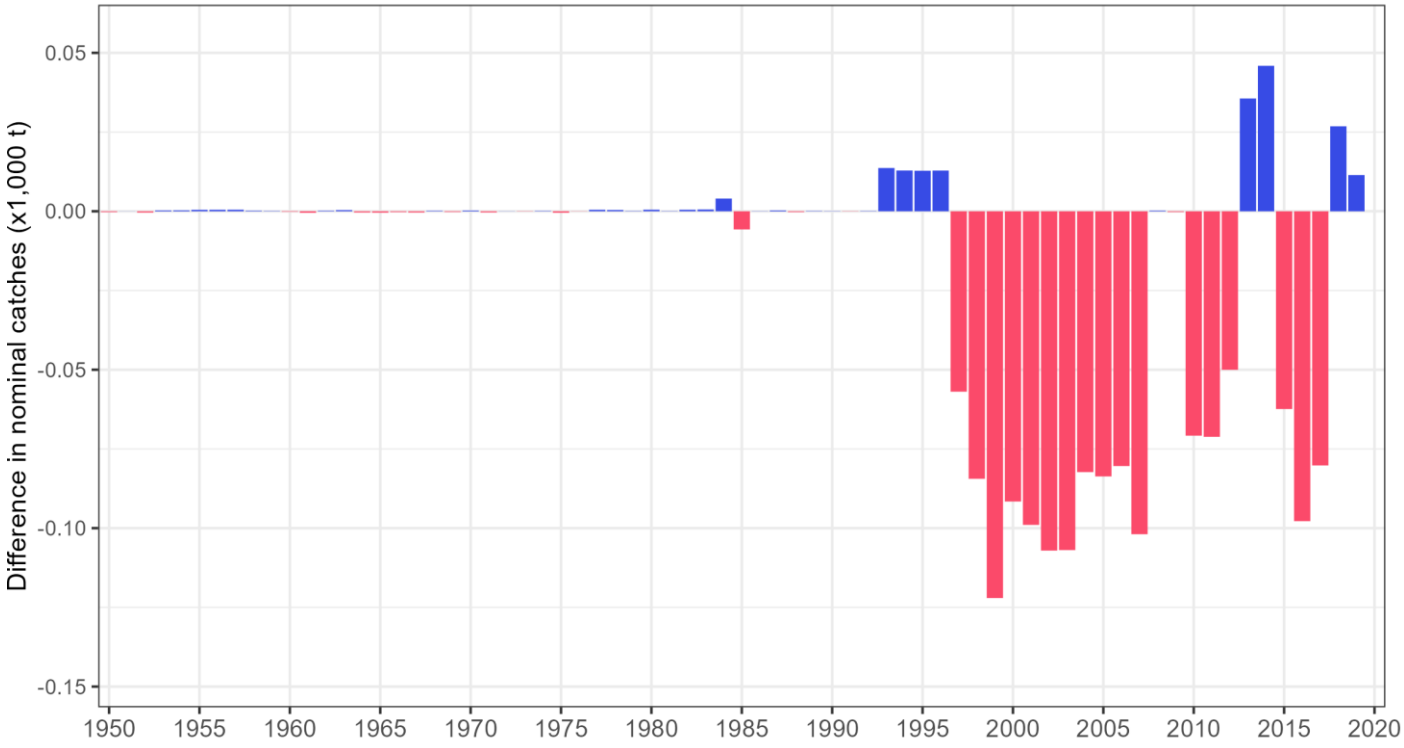

Figure 7: Differences in the available best scientific estimates of nominal catches (metric tons; t) of Indo-Pacific sailfish between this WPB and its previous session (WPB19 meeting held in September 2021)

Uncertainties in nominal catch data

Uncertainties in Indo-Pacific sailfish catches are generally more relevant than with other billfish species, due to the higher proportion of catches originating from coastal fisheries for which the species is thought to have been often under-reported in the past.

The quality of nominal catches is quite variable, with a marked drop starting in 1970 before reaching satisfactory levels again in 2010, when important coastal fisheries such as those from I.R. Iran and Sri Lanka started improving the quality of the data by providing detailed catches of billfish species for their major fisheries.

Overall there are marked uncertainties in the catch of industrial fisheries, as in the 1990s several industrial longline fisheries (mostly those operating fresh tuna longliners) were not reporting catch data to the IOTC Secretariat. Hence, most of the catches were estimated using proxy fleets and recorded as *not elsewhere identified* (NEI) (Herrera 2002) therefore explaining the very low quality scores of industrial fisheries for the period, which were often below the estimated quality level of artisanal fisheries. Furthermore, the lack of information at species level reduced the accuracy of the data available for Indo-Pacific sailfish (**Fig. 8**).

Around 20% of nominal catches of Indo-Pacific sailfish is considered uncertain in 2020 (**Fig. 8**), and it predominantly consists of re-estimated catches for coastal fisheries, including non-reporting ones (e.g., line fisheries of Madagascar and Tanzania, gillnet fisheries of Tanzania).

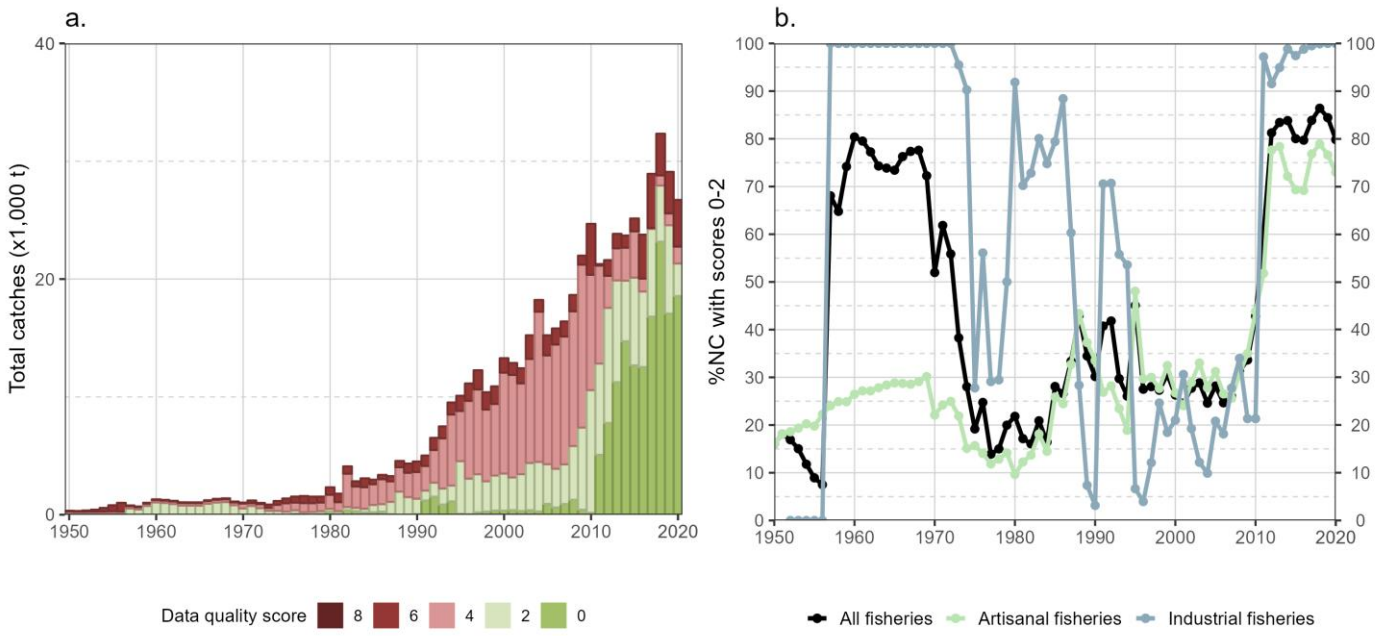

Figure 8: (a) Annual nominal catches (metric tons; t) of Indo-Pacific sailfish estimated by quality score and (b) percentage of nominal catch fully/partially reported to the IOTC Secretariat for all fisheries and by type of fishery, in the period 1950-2020

Discard levels

Information collected from scientific observers at sea through the ROS suggests that Indo-Pacific sailfish is more often discarded in large-scale purse seine than longline fisheries. The size composition of the catch shows that the species may be discarded at all sizes in purse seine fisheries, while little-to-no size data for discarded Indo-Pacific sailfish are available from longline fisheries (**Fig. 9**).

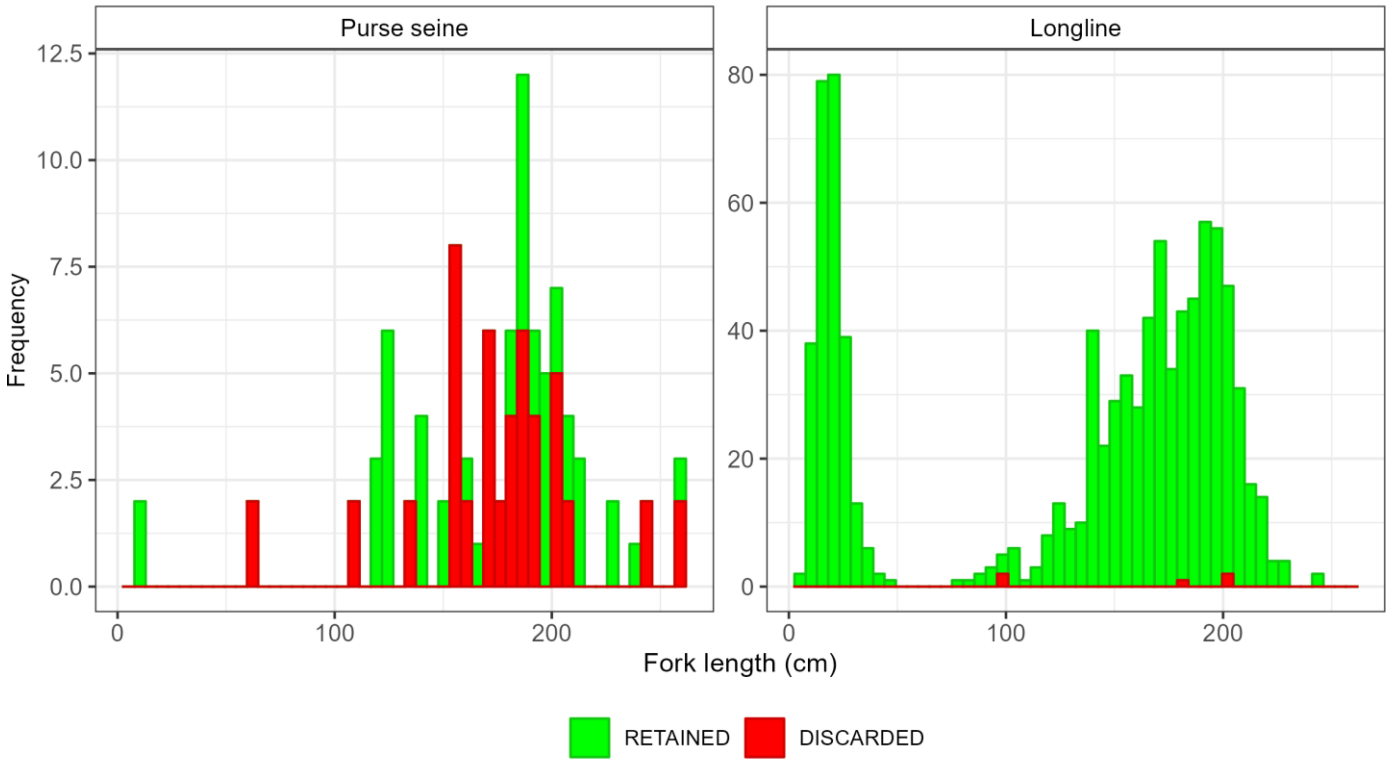

Figure 9: Size (fork length; cm) frequency distribution of Indo-Pacific sailfish retained and discarded at sea in purse seine and longline fisheries as available in the ROS regional database

Information collected on the condition (i.e., individual released *dead* or *alive*) suggests that the very large majority of the fish do not survive when discarded at sea, whatever the fishery group or fishing ground.

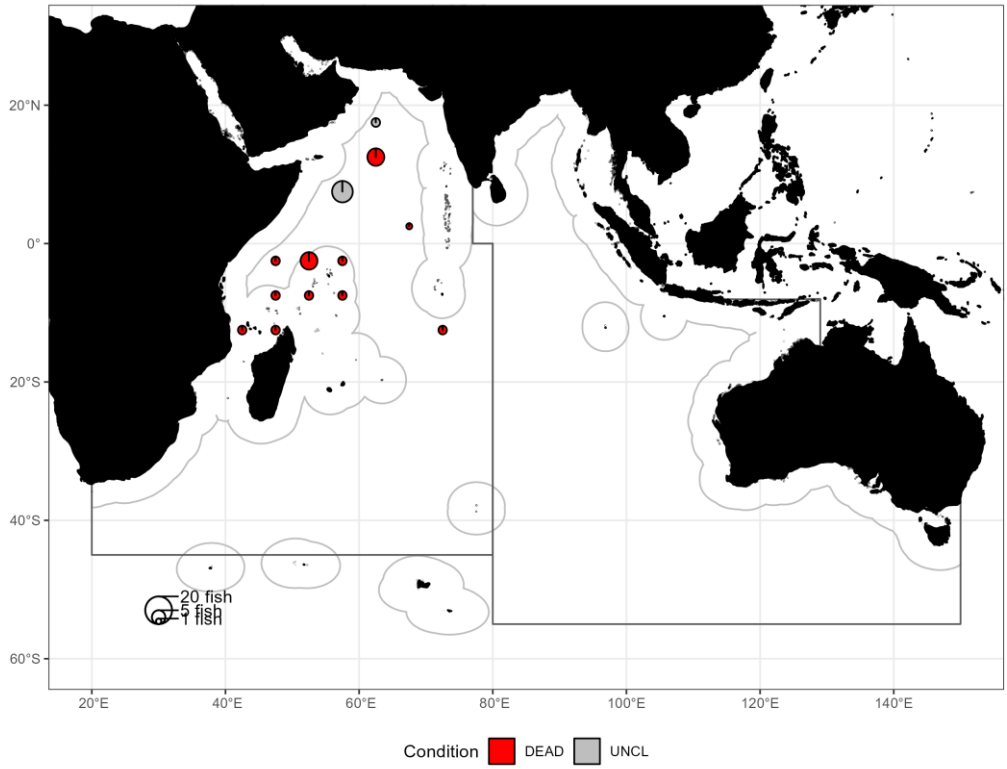

Figure 10: Distribution of Indo-Pacific sailfish discarded at sea in the western Indian Ocean purse seine fisheries with information on condition as available in the ROS regional database

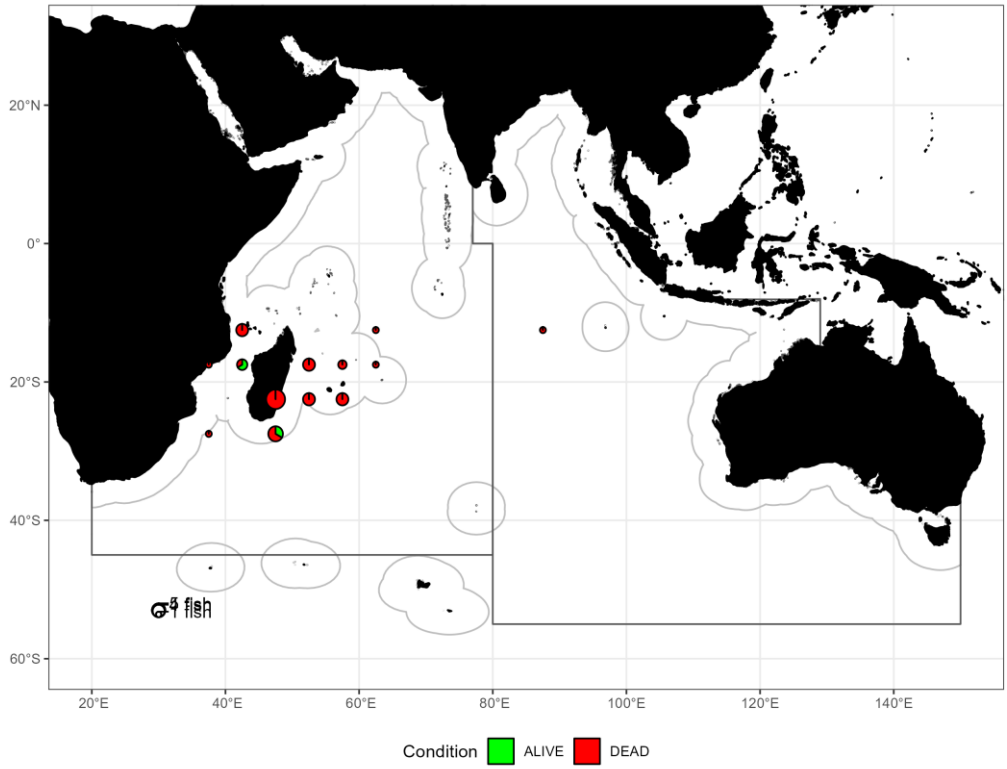

Figure 11: Distribution of Indo-Pacific sailfish discarded at sea in the Indian Ocean longline fisheries with information on condition as available in the ROS regional database

Geo-referenced catch

Spatial distribution of catches

Geo-referenced catches by fishery and decade (1950-2009)

In the past, geo-referenced catches of Indo-Pacific sailfish were generally available for the major industrial longline fisheries operating in the Indian Ocean. The distribution of the catch indicates that - from the 1970s to the 1990s - these were mostly occurring in equatorial waters both in the western and eastern Indian Ocean, as well as in the bay of Bengal (**Fig. 12a-b**). Starting with the 2000s, evidence of increased catches from longline vessels begun to appear in the Southwest Indian Ocean and in the Mozambique channel in particular (**Fig. 12c-d**). Between 1970 and 1989 most of the available geo-referenced catches of Indo-Pacific sailfish originated from Korean longliners, with Japanese longliners becoming predominant between 1990 and 2009. In the 2010s, longline catches appear to be more concentrated in the southwest Indian Ocean and Mozambique channel, with information from Seychellois and Chinese longliners beginning to be reported in tropical areas of the western Indian Ocean, mostly south of the equatorial line.

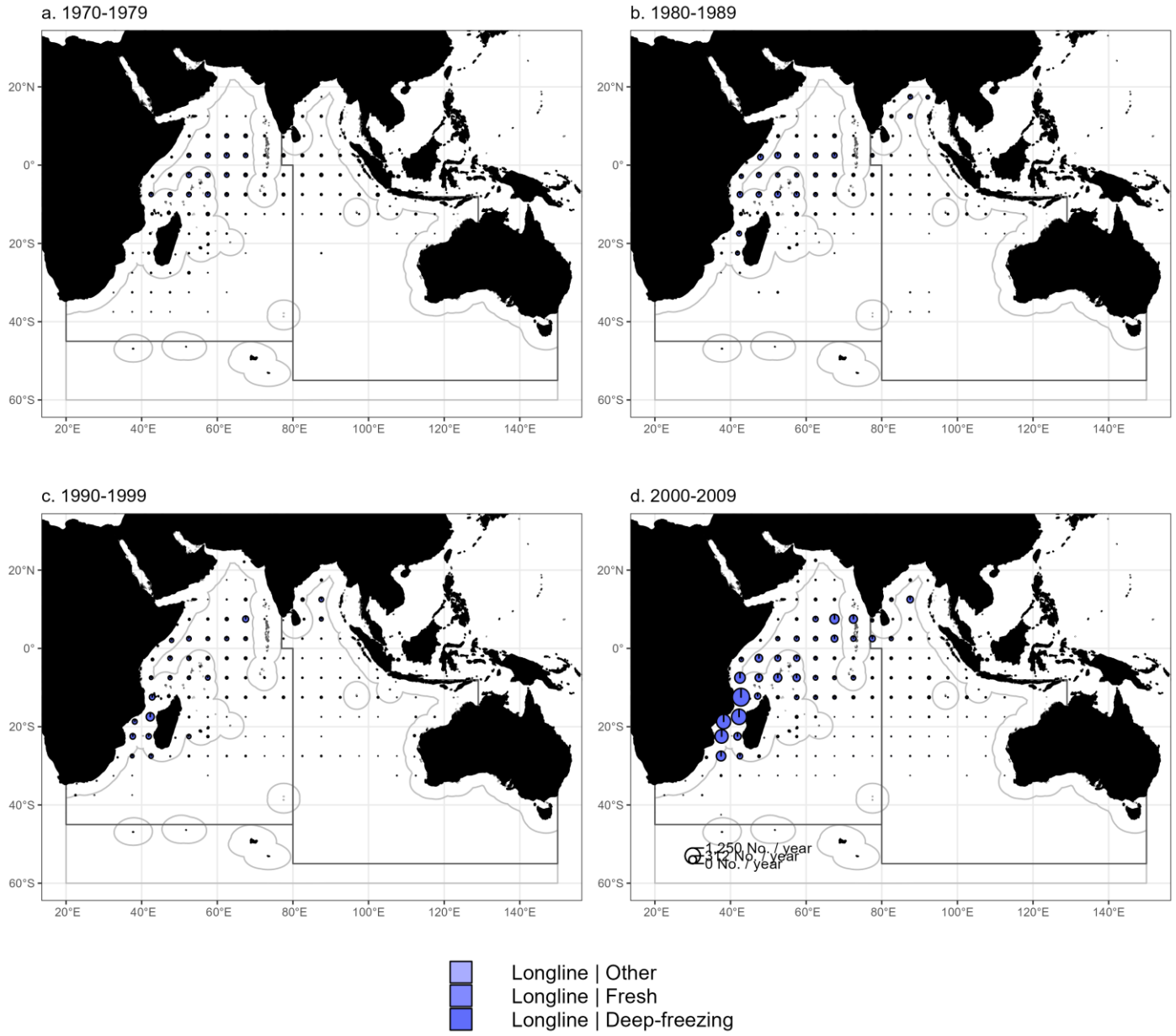

Figure 12: Mean annual time-area catches in numbers of Indo-Pacific sailfish, by decade, 5x5 grid, and fishery. Data source: time-area catches

Geo-referenced catches by fishery, last years (2016-2020) and decade (2010-2019)

The quality of the geo-referenced catches reported to the Secretariat has substantially improved in recent years, and spatial information on fishing activities is now available for most industrial and coastal fisheries. Geo-referenced catches in weight indicate high catch levels in the northern Arabian sea, in the areas of national jurisdiction of Sri Lanka and in the Mozambique channel for both line and gillnet fisheries (**Fig. 13**), while catches from longline fisheries (in number) remain high in the western Indian Ocean (particularly in the Mozambique Channel) and in temperate waters of both the eastern and western Indian Ocean (**Fig. 14**).

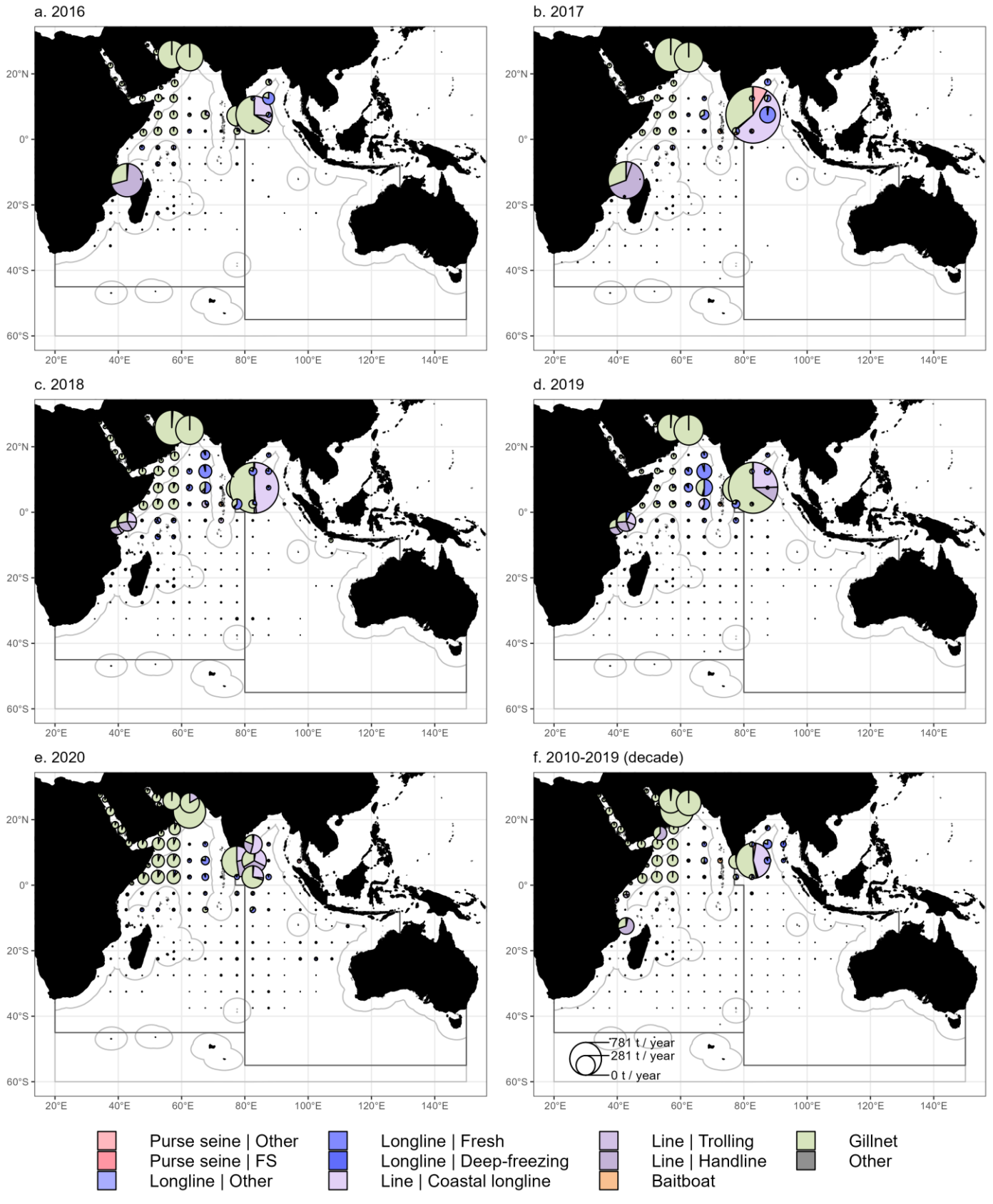

Figure 13: Mean annual time-area catches in weight (metric tons; t) of Indo-Pacific sailfish, by year / decade, 5x5 grid, and fishery. Data source: time-area catches

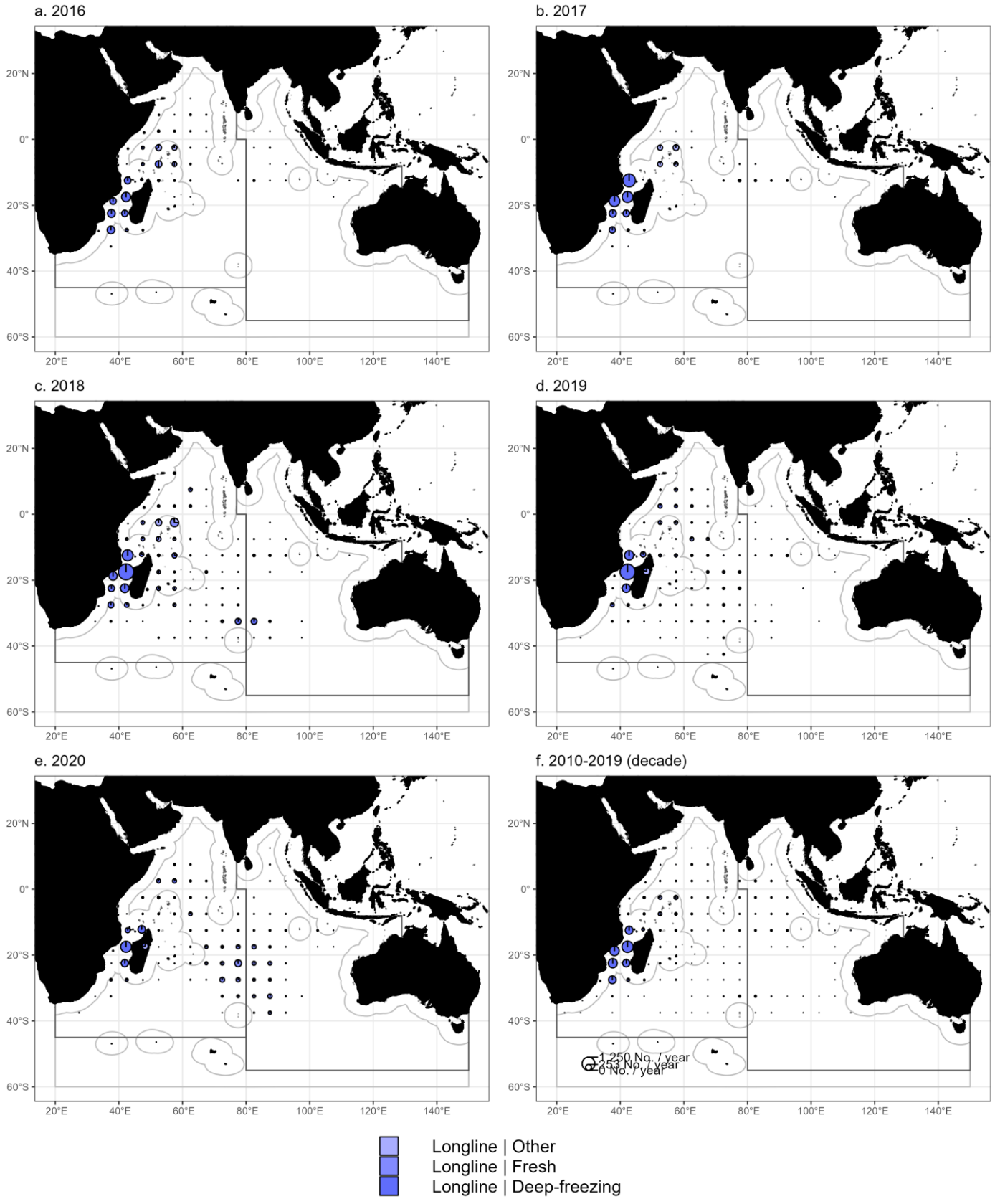

Figure 14: Mean annual time-area catches in numbers of Indo-Pacific sailfish, by year / decade, 5x5 grid, and fishery. Data source: time-area catches

Uncertainties in catch and effort data

Uncertainties in geo-referenced catch and effort data of Indo-Pacific sailfish are higher than those for nominal catch data, as catch and effort data for artisanal fisheries were only available from Sri Lanka prior to 2007 and the quality and completeness of data reported from industrial longline fleets is generally mediocre and extremely variable for the years between 1975 and 2010 (**Fig. 15**). Besides the limited extent of the data reported to the Secretariat, additional issues have been identified for the catch and effort records available for the species:

- data from Iranian fisheries have only become available since 2007, although not fully reported by IOTC standard;
- data for the main fisheries of Indonesia are not available prior to 2018, and appear characterized by a low coverage for all fisheries;
- data for the longline fisheries of China are not available prior to 2018;
- no data available for the longline fisheries of Taiwan,China;
- most industrial longline fisheries report catch and effort in numbers, although these appear to be low in the period 1970s to 2000s.

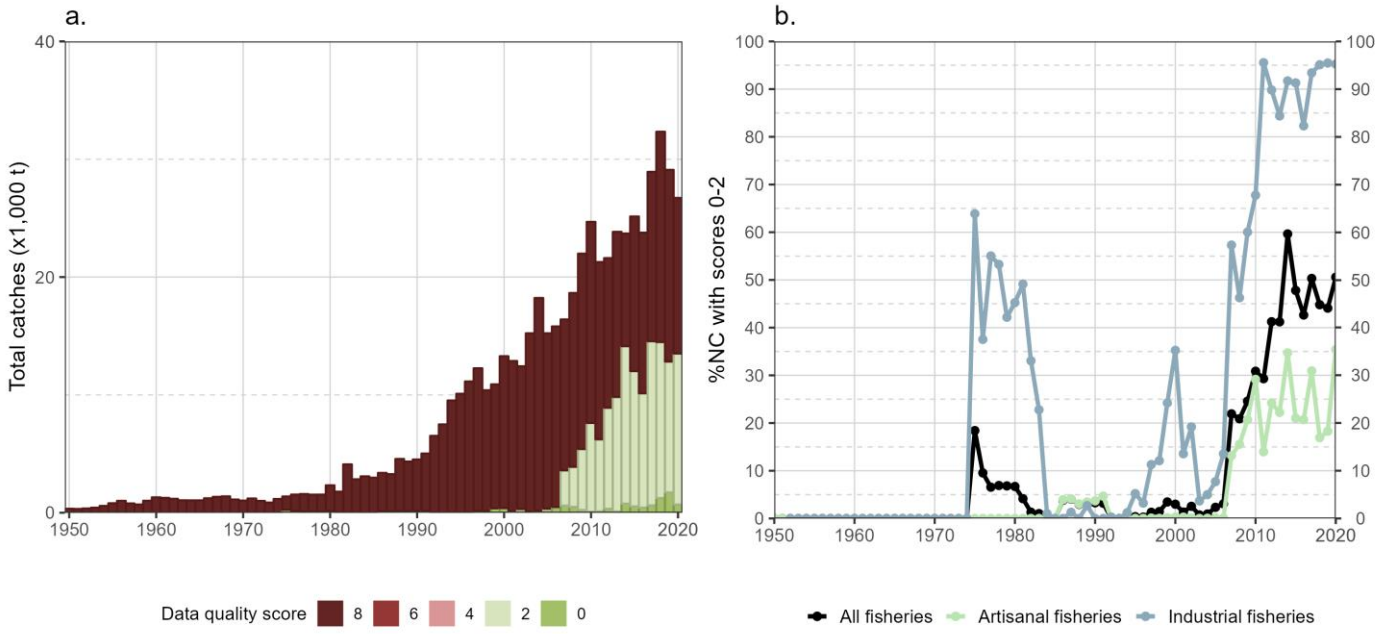

Figure 15: (a) Annual nominal catches (metric tons; t) of Indo-Pacific sailfish estimated by quality score and (b) percentage of nominal catch for which geo-referenced catches were reported to the IOTC Secretariat in agreement with the requirements of Res. 15/02 for all fisheries and by type of fishery in the period 1950-2020

Size composition of the catch

Samples availability

By fishery group

The availability of size-frequency samples for Indo-Pacific sailfish varies greatly over time and between fishery groups and fleets. A significant number of samples is available for the industrial longline fisheries, mainly recorded by Japanese vessels between 1960 and 1985 and from 2010 onwards (**Fig. 16**). A large number of size samples for Indo-Pacific sailfish was also collected by the gillnet fishery of Sri Lanka through the IPTP sampling programme conducted between 1988 and 2005. In recent years, however, size samples of Indo-Pacific sailfish are predominantly reported by longline fisheries (and namely those from Taiwan,China, Japan, EU,Portugal, and Sri Lanka), by gillnet fisheries (Sri Lanka) and to a lesser extent by line fisheries (Sri Lanka and Indonesia).

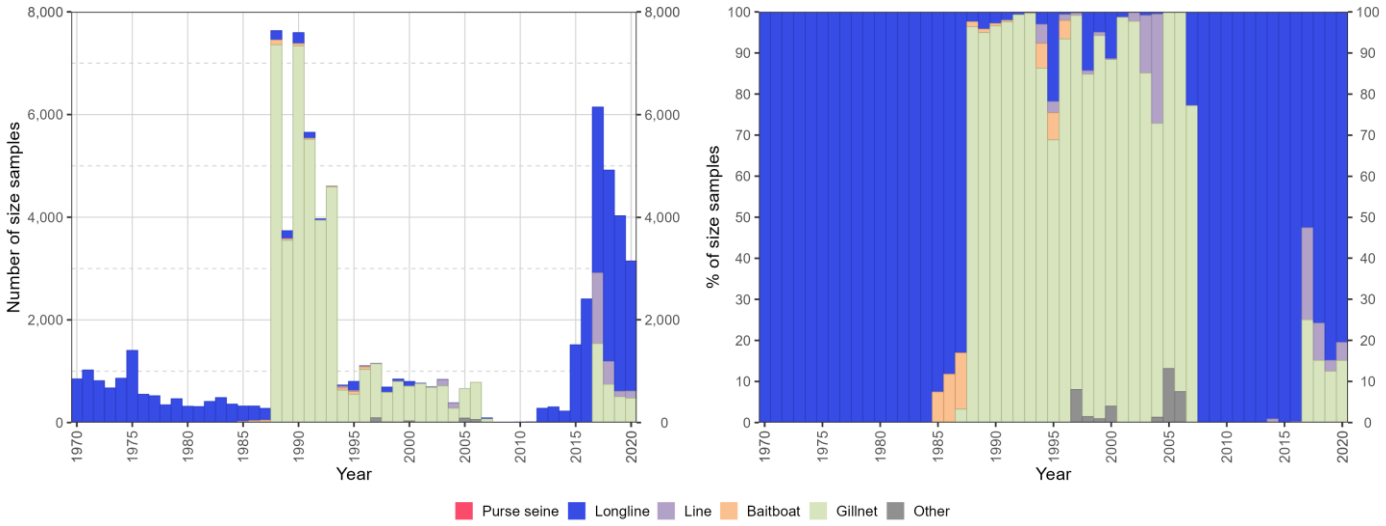

Figure 16: Availability of Indo-Pacific sailfish size-frequency data as absolute number of samples (left) and relative number of samples (right) per year and fishery group. Data source: standardized size-frequency dataset

Purse seine fisheries

Overall, only a negligible fraction of the size samples of Indo-Pacific sailfish available at the Secretariat has been collected from purse seine fisheries. The spatial extent of the size samples available for these fisheries in recent years is extremely limited (**Fig. 17**) with additional size samples that have been collected for both retained and discarded individuals by scientific observers onboard large-scale purse seiners (see section Discards).

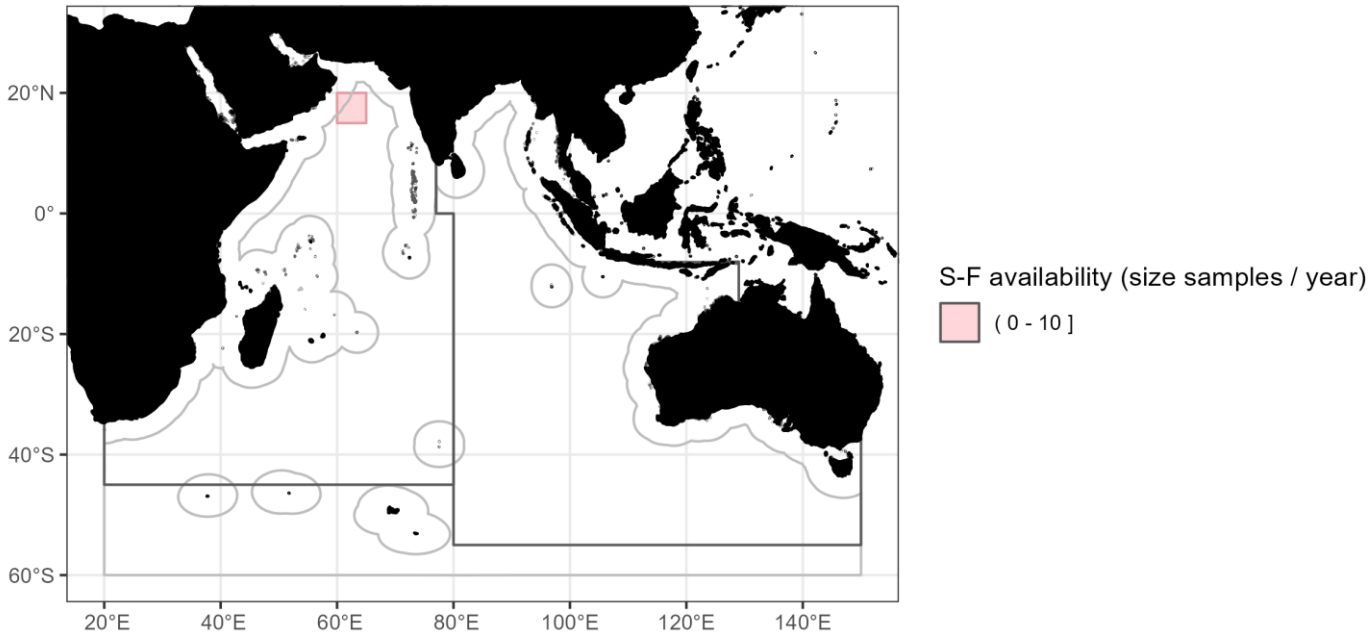

Figure 17: Spatial distribution (average number of samples per grid per year) of available Indo-Pacific sailfish size-frequency data for purse seine fisheries in the period 2016-2020. Data source: standardized size-frequency dataset

Longline fisheries

Longline fisheries provide a large number of Indo-Pacific sailfish samples, which are of particular interest considering the decline in catches for these fisheries recorded in recent years. Longliners from Taiwan,China sampled on average 2,500 fish per year between 2016 and 2020, followed by longliners from Japan, with an average of 200 sampled individuals, and although at low numbers, samples of the species are continuously reported by the longline fisheries of Korea and EU,Portugal. Data for Sri Lankan industrial longliners are also available from 2019 onwards. Overall, size-frequency data are generally collected by fishermen, recorded in the logbook, and additionally by scientific observers on board.

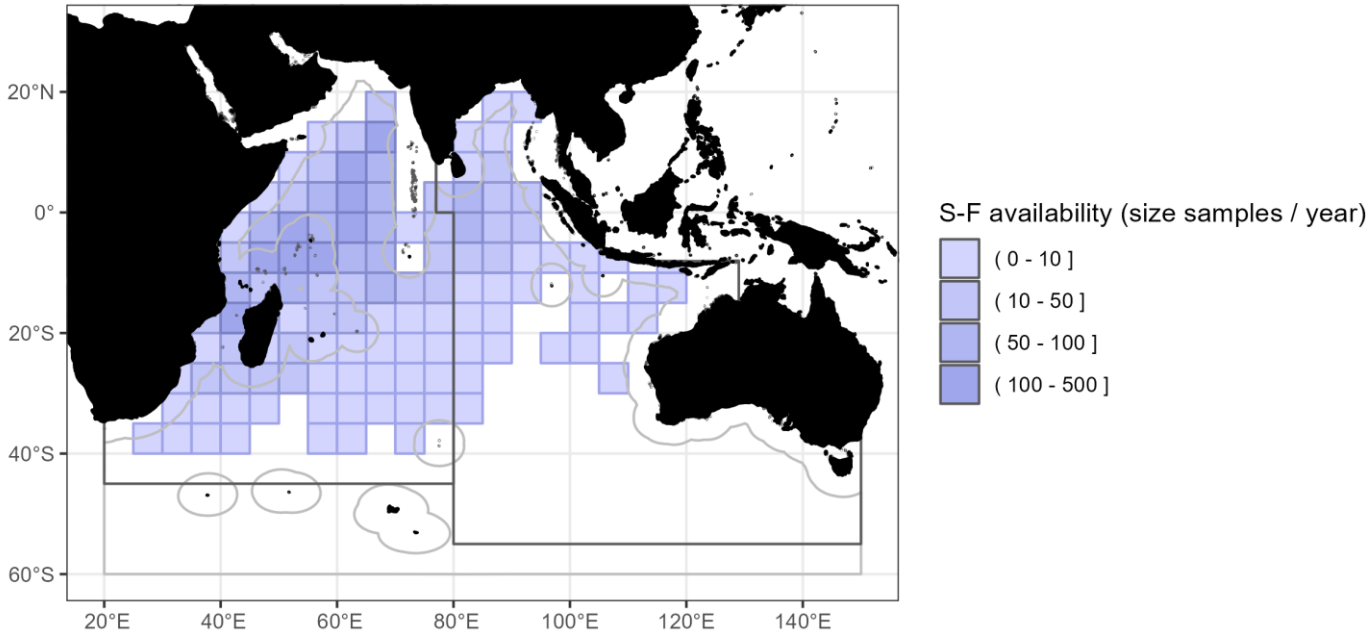

Figure 18: Spatial distribution (average number of samples per grid per year) of available Indo-Pacific sailfish size-frequency data for longline fisheries in the period 2016-2020. Data source: standardized size-frequency dataset

Gillnet fisheries

Gillnet fisheries collected substantial samples of Indo-Pacific sailfish during the years of activity of the IPTP sampling programme (1988-2003). In recent years (2017-2020), and notwithstanding the large amount of catches regularly reported for the species by the gillnet fisheries of several IOTC coastal states, size samples of Indo-Pacific sailfish are only available from the gillnet fishery of Sri Lanka.

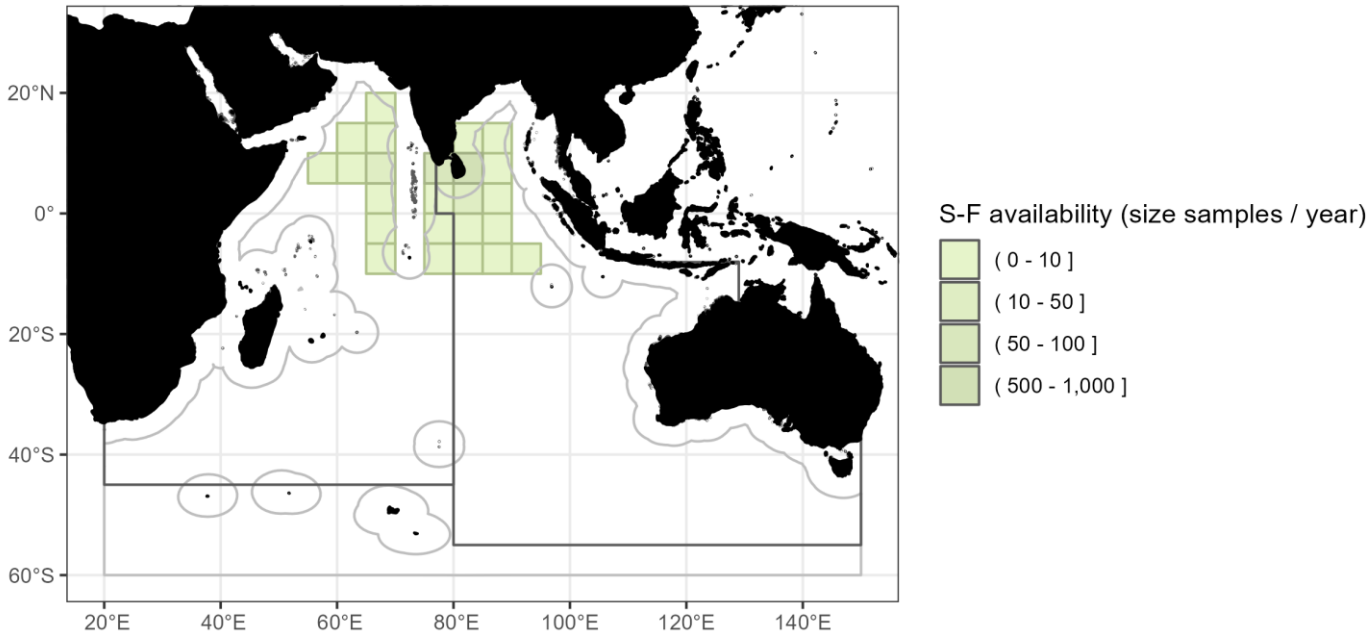

Figure 19: Spatial distribution (average number of samples per grid per year) of available Indo-Pacific sailfish size-frequency data for gillnet fisheries in the period 2016-2020. Data source: standardized size-frequency dataset

Line fisheries

Indo-Pacific sailfish are increasingly caught by line fisheries, including those operating with coastal longlines which represent the source of the majority of samples available for the *line* fishery group. In recent years, sample of Indo-Pacific sailfish from line fisheries become available in most fishing areas, such as the areas of national jurisdiction of Sri Lanka, Reunion island, Mozambique, and also in the eastern Indian Ocean, collected in Indonesian coastal line fisheries.

It is assumed that size samples for the species are regularly collected in the context of recreational fisheries, especially in the western Indian Ocean, although this information is seldom made available to the Secretariat. Most of the Indo-Pacific sailfish interacted with by these fisheries are caught on a tag-and-release basis (Billfish foundation).

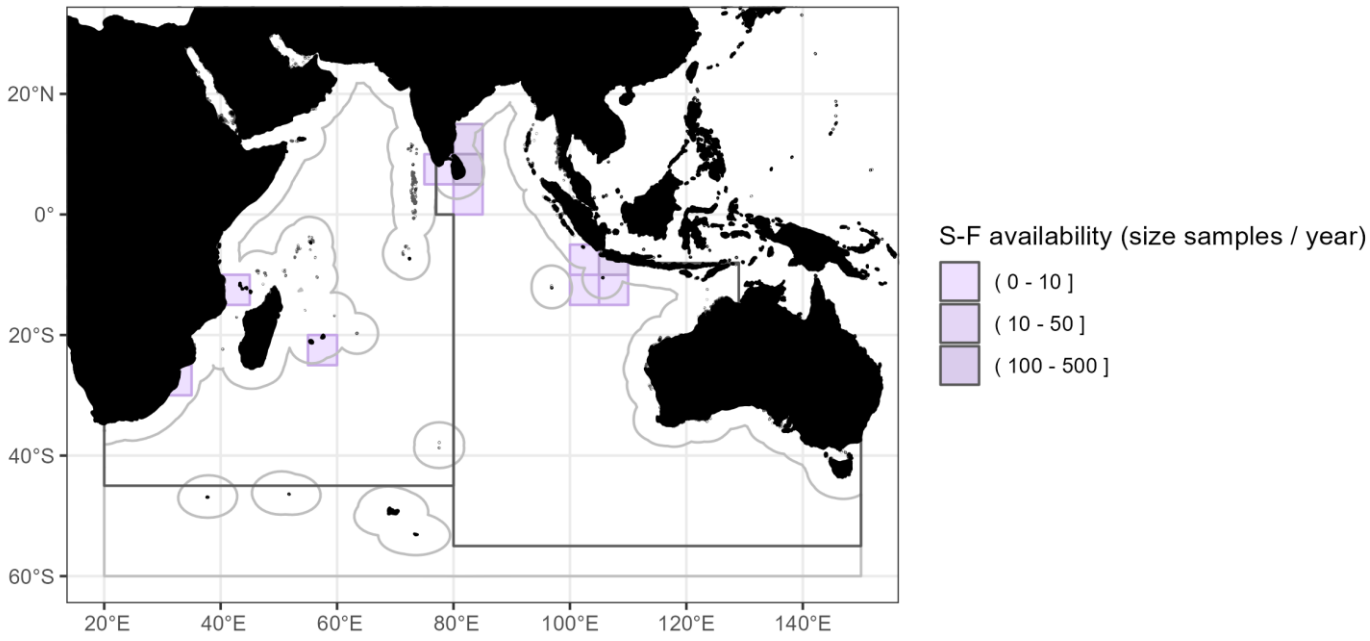

Figure 20: Spatial distribution (average number of samples per grid per year) of available Indo-Pacific sailfish size-frequency data for line fisheries in the period 2016-2020. Data source: standardized size-frequency dataset

By fishery

Longline fisheries

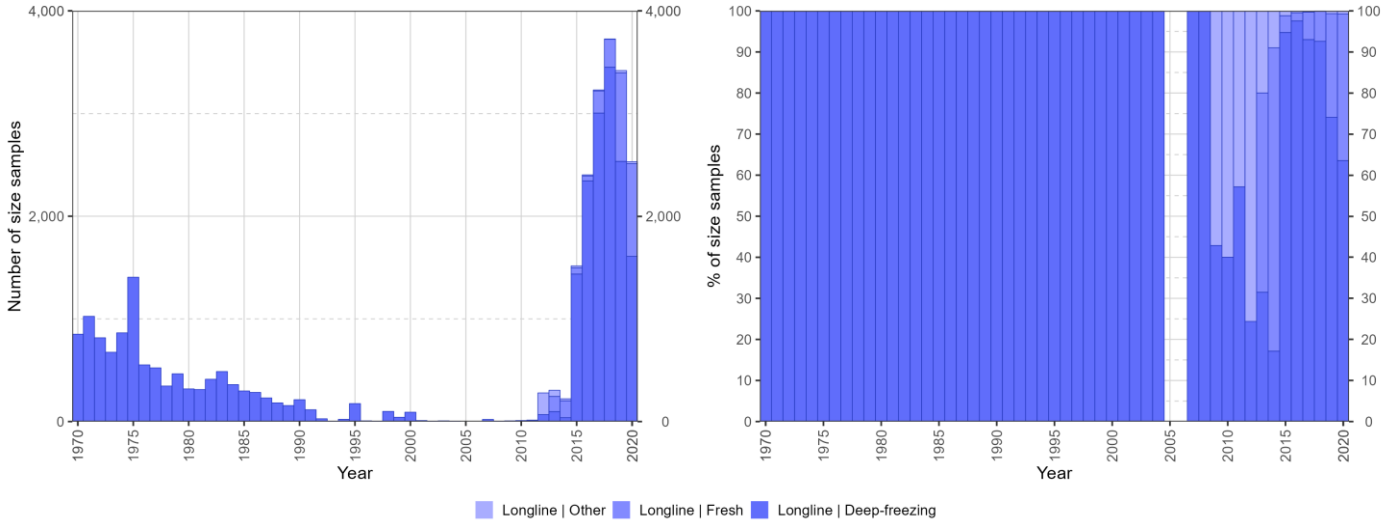

Figure 21: Availability of Indo-Pacific sailfish size-frequency data as absolute number of samples per year in longline fisheries. Data source: standardized size-frequency dataset

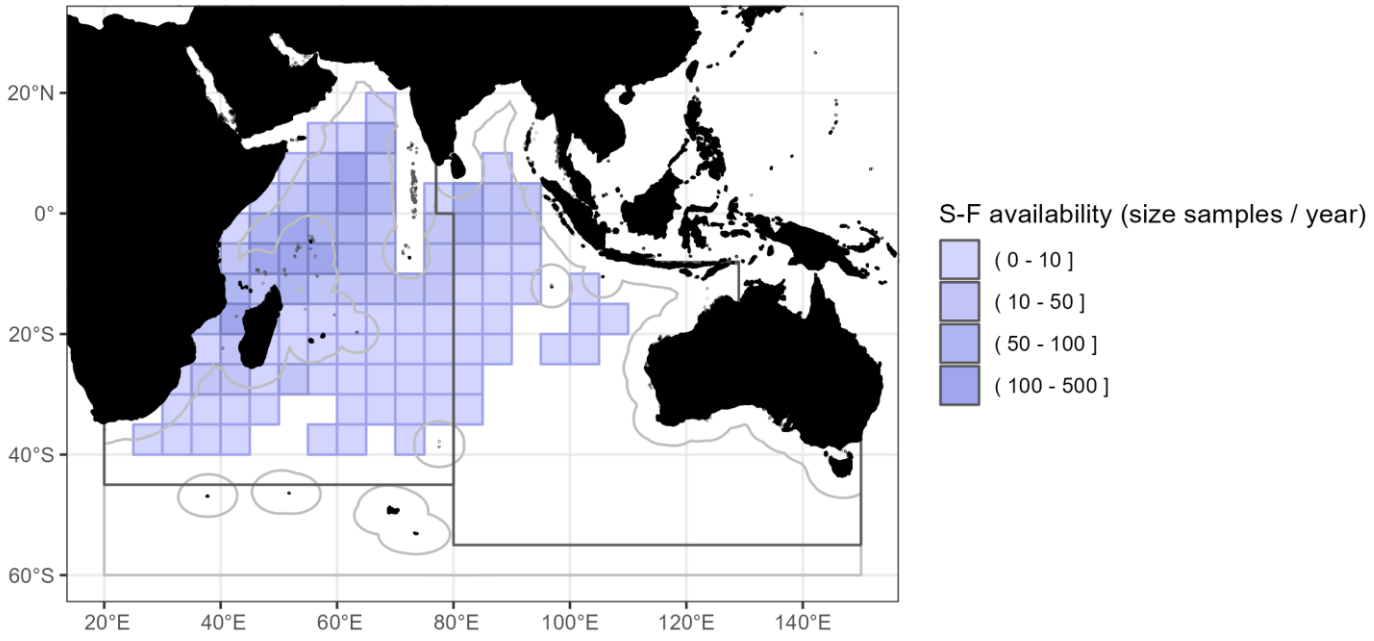

Figure 22: Spatial distribution (average number of samples per grid per year) of available Indo-Pacific sailfish size-frequency data by longline (deep-freezing longline) fisheries in the period 2016-2020. Data source: standardized size-frequency dataset

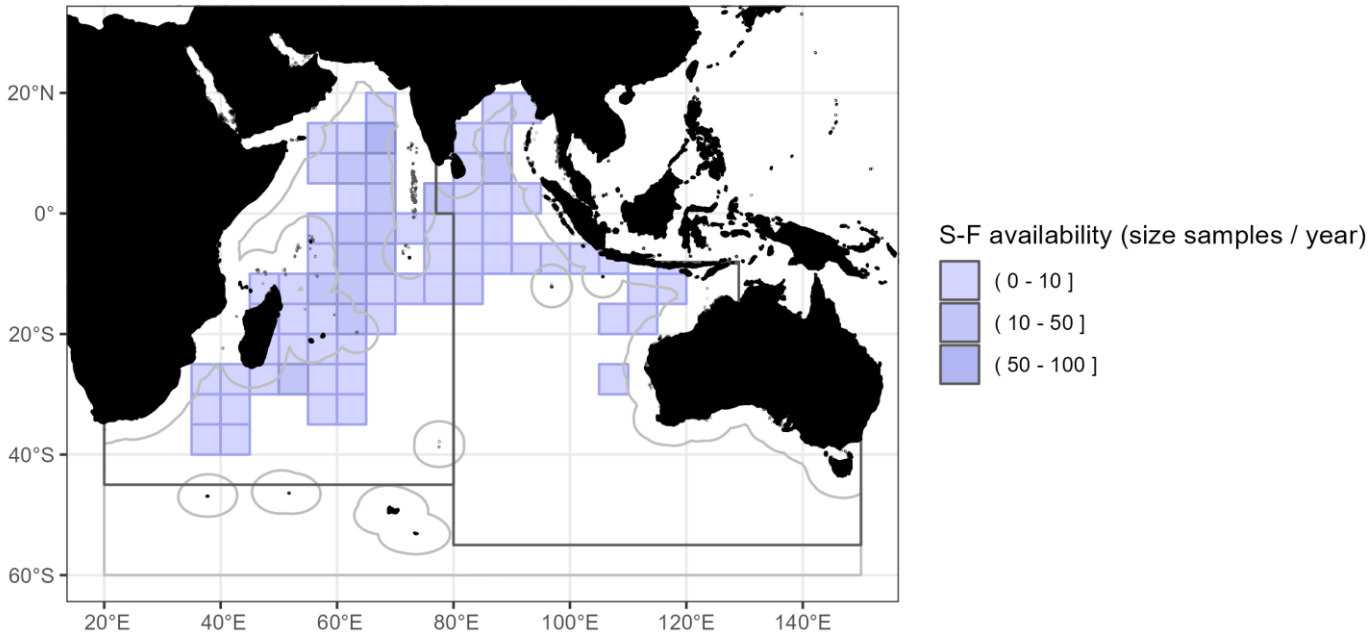

Figure 23: Spatial distribution (average number of samples per grid per year) of available Indo-Pacific sailfish size-frequency data by longline (fresh longline) fisheries in the period 2016-2020. Data source: standardized size-frequency dataset

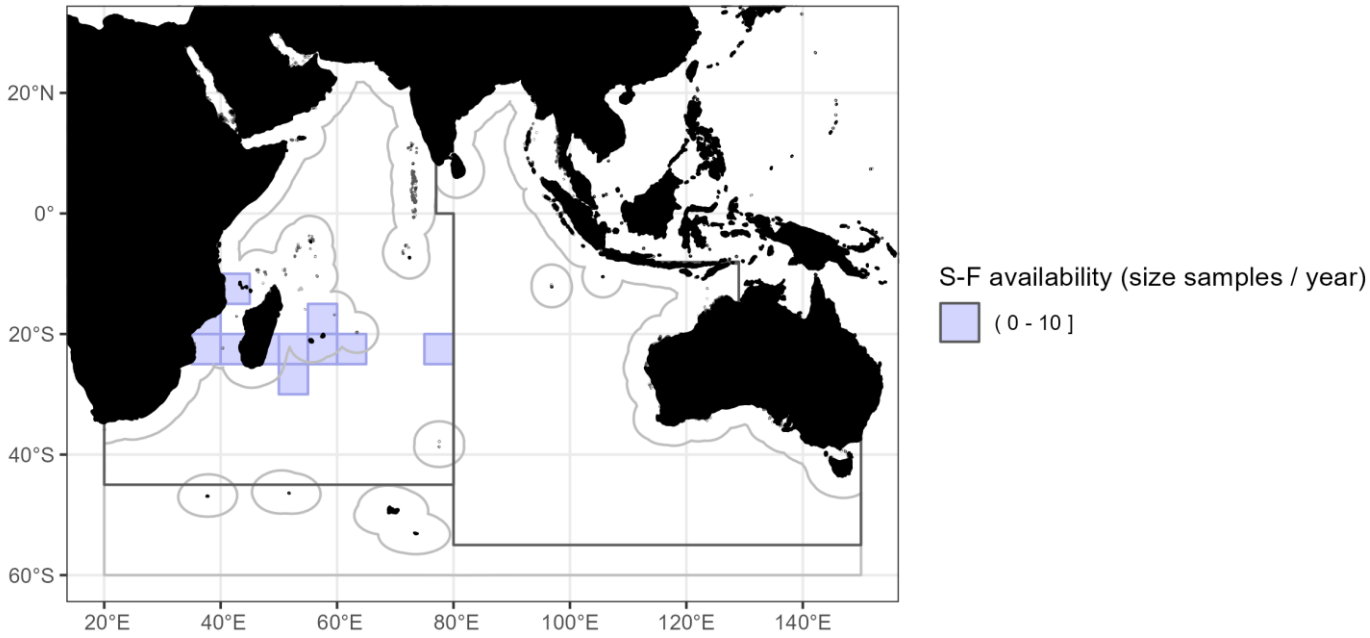

Figure 24: Spatial distribution (average number of samples per grid per year) of available Indo-Pacific sailfish size-frequency data by longline (other longline) fisheries in the period 2016-2020. Data source: standardized size-frequency dataset

Gillnet fisheries

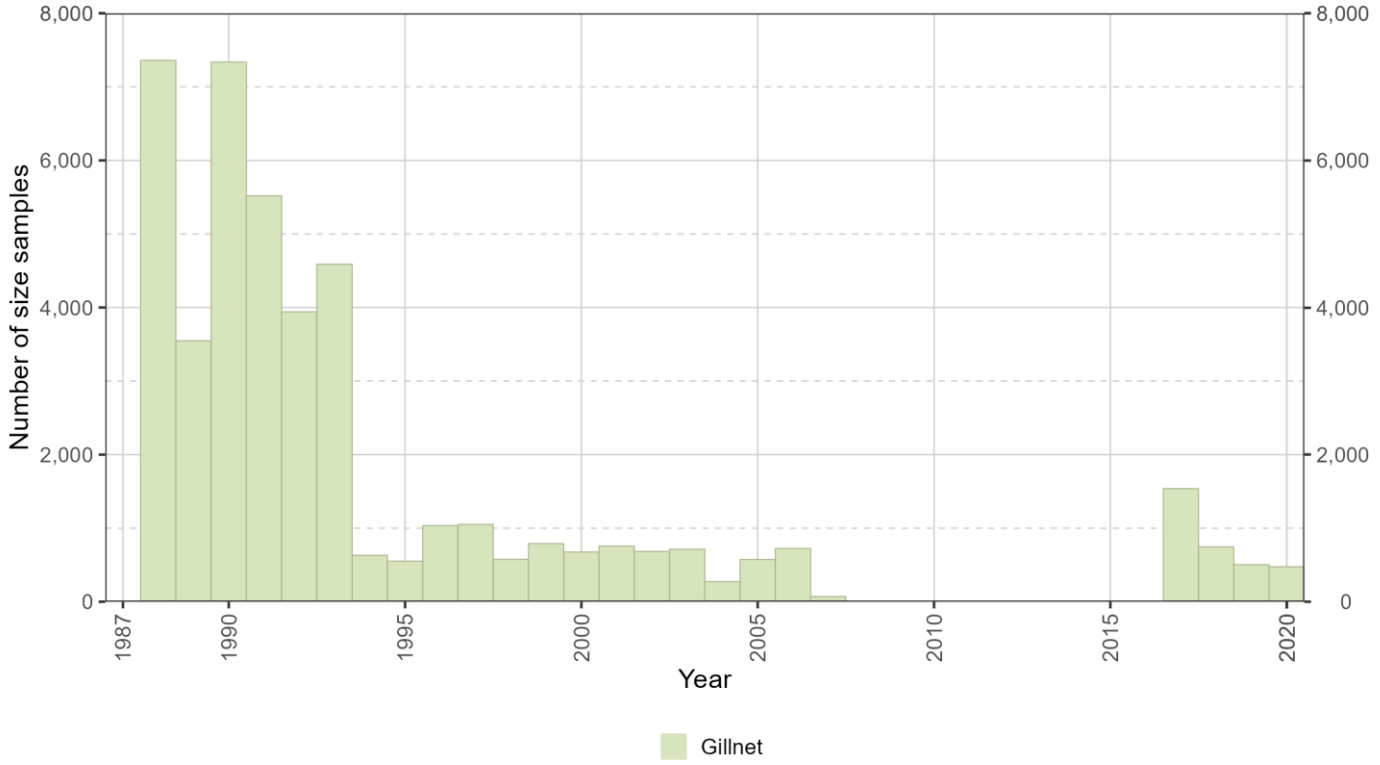

Figure 25: Availability of Indo-Pacific sailfish size-frequency data as absolute number of samples per year in gillnet fisheries. Data source: standardized size-frequency dataset

Line fisheries

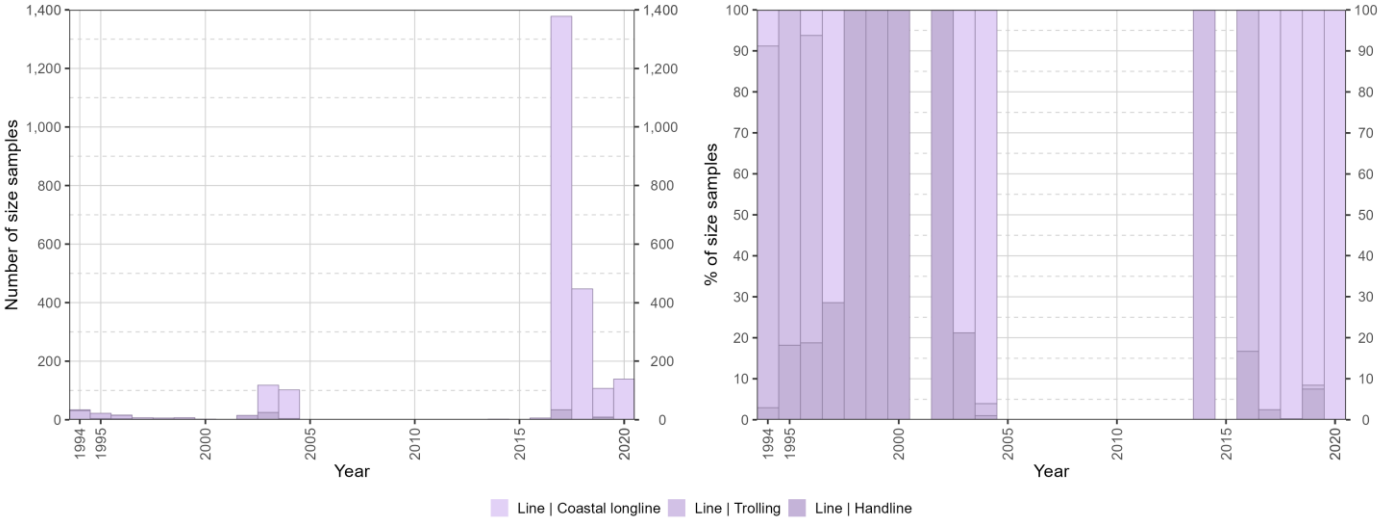

Figure 26: Availability of Indo-Pacific sailfish size-frequency data as absolute number of samples (left) and relative number of samples (right) per year and line fishery type. Data source: standardized size-frequency dataset

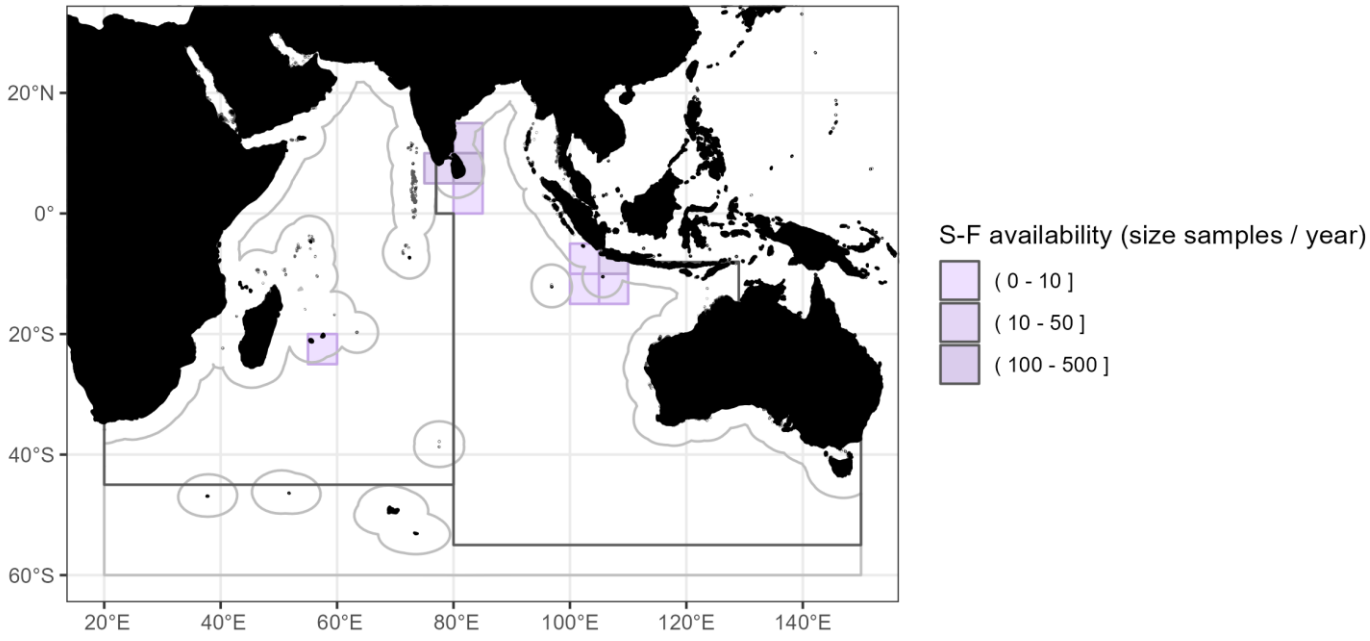

Figure 27: Spatial distribution (average number of samples per grid per year) of available Indo-Pacific sailfish size-frequency data by line (coastal longline) fisheries in the period 2016-2020. Data source: standardized size-frequency dataset

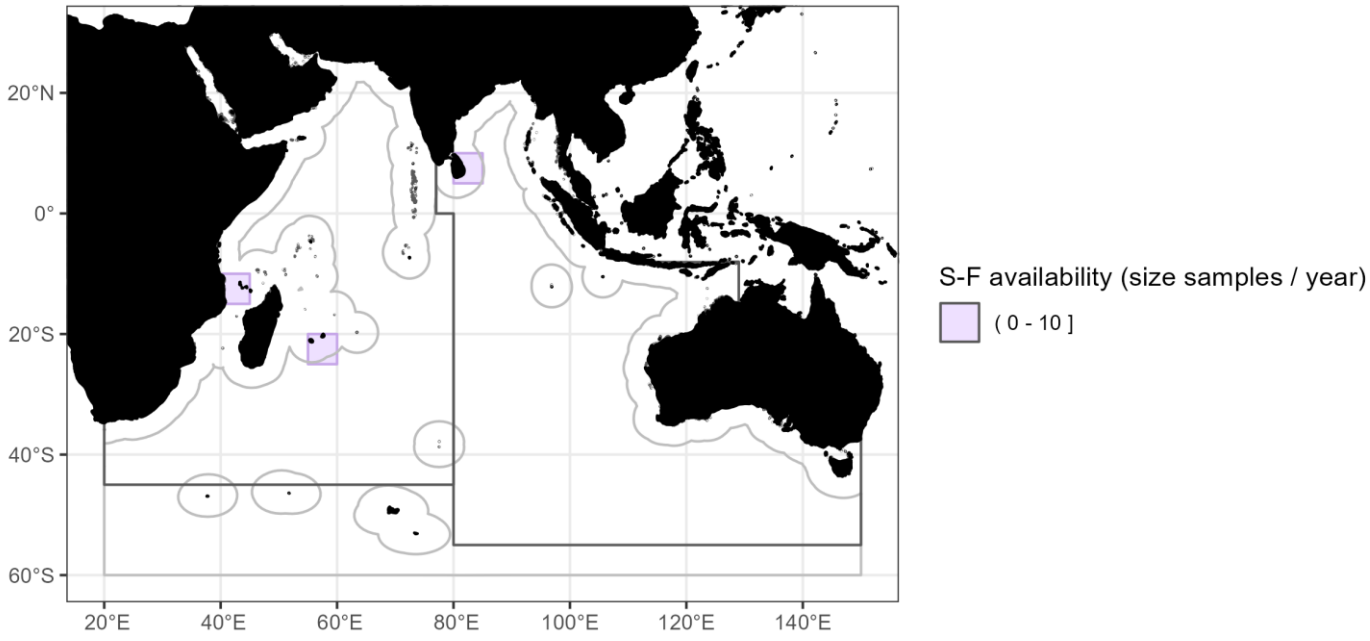

Figure 28: Spatial distribution (average number of samples per grid per year) of available Indo-Pacific sailfish size-frequency data by line (handline) fisheries in the period 2016-2020. Data source: standardized size-frequency dataset

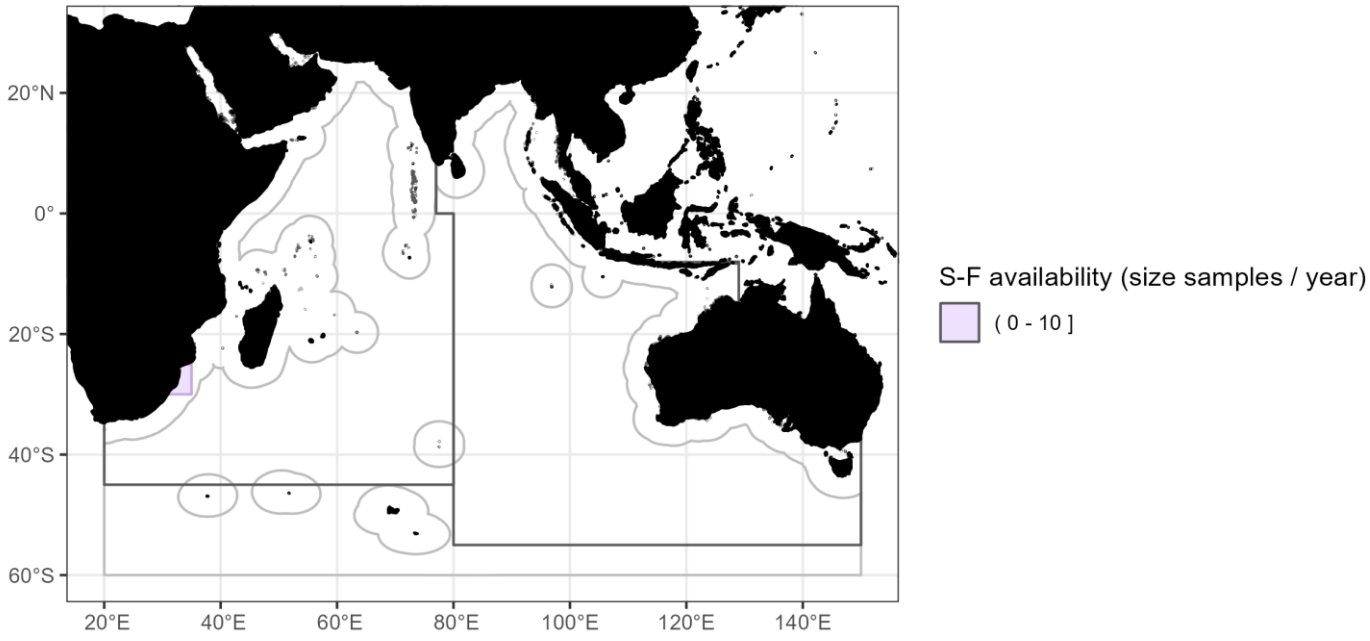

Figure 29: Spatial distribution (average number of samples per grid per year) of available Indo-Pacific sailfish size-frequency data by line (trolling) fisheries in the period 2016-2020. Data source: standardized size-frequency dataset

Other fisheries

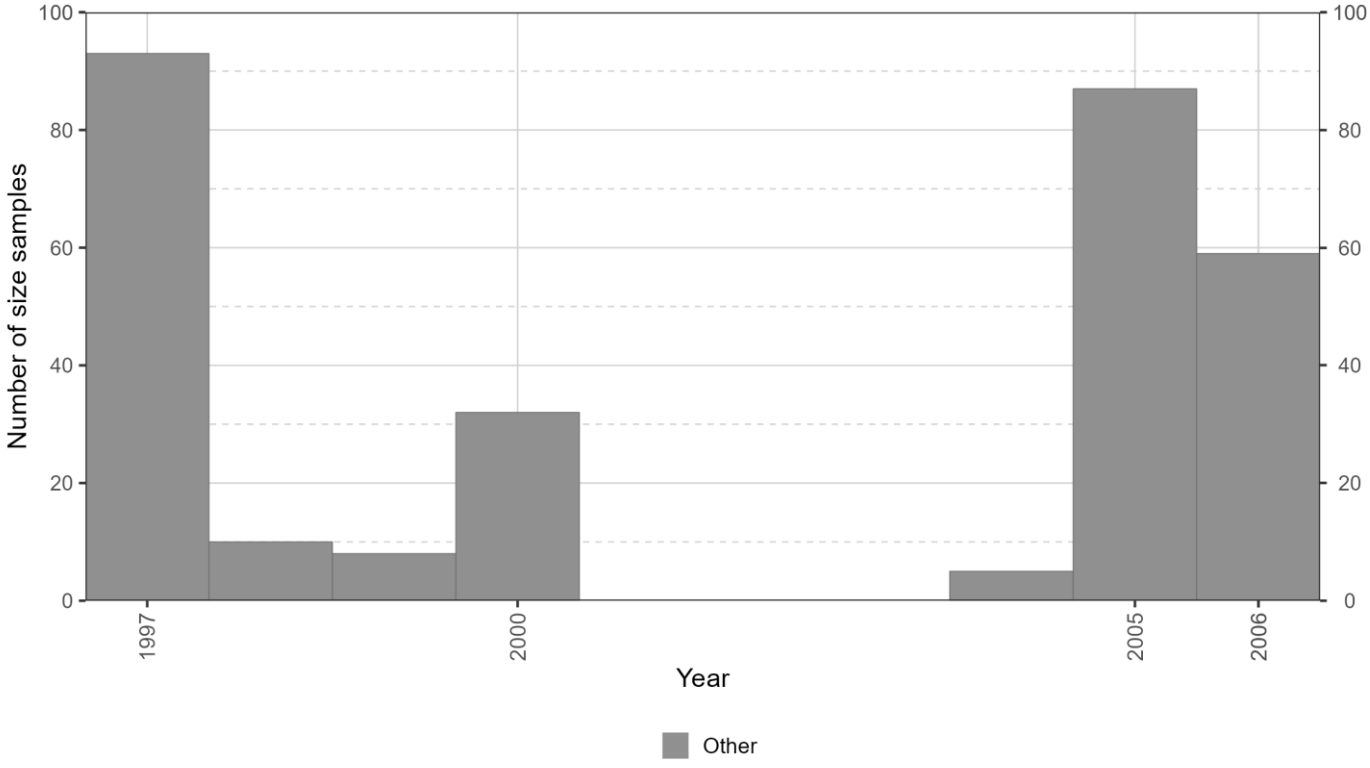

Figure 30: Availability of Indo-Pacific sailfish size-frequency data as absolute number of samples (left) and relative number of samples (right) per year and 'other' fishery type. Data source: standardized size-frequency dataset

Temporal patterns and trends in size distributions

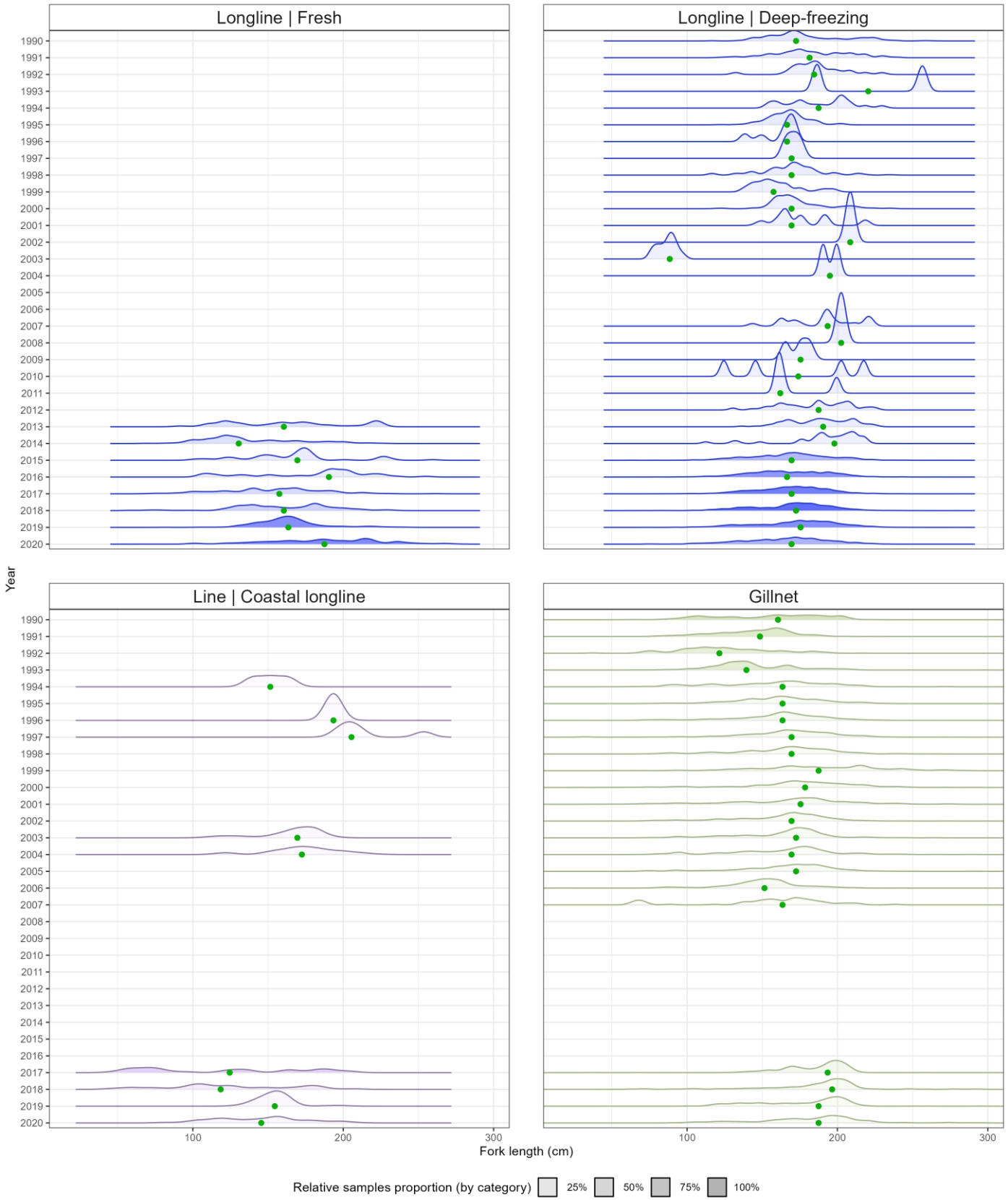

Figure 31: Relative size distribution (fork length; cm) of Indo-Pacific sailfish caught in purse seine (Other) and gillnet fisheries. Other = no information provided on school association. Fill intensity is proportional to the number of samples recorded for the year, while the green dot corresponds to the median value. Data source: standardized size-frequency dataset

Size distribution by fishery and fleet

Longline fisheries

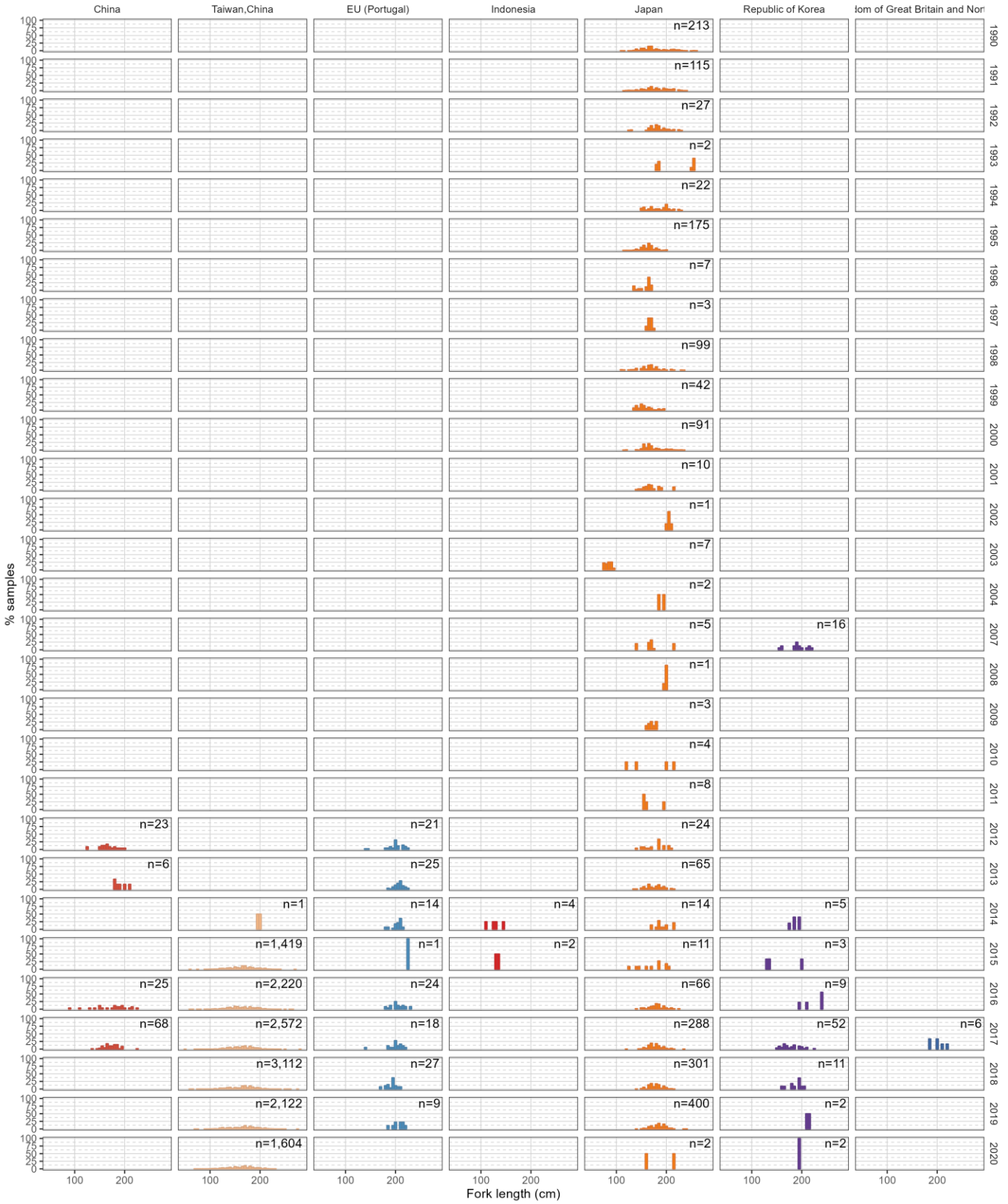

Figure 32: Relative size distribution of Indo-Pacific sailfish (fork length; cm) recorded for deep-freezing longline fisheries by year and main fleet. Data source: standardized size-frequency dataset

Figure 33: Relative size distribution of Indo-Pacific sailfish (fork length; cm) recorded for fresh longline fisheries by year and main fleet. Data source: standardized size-frequency dataset

Gillnet fisheries

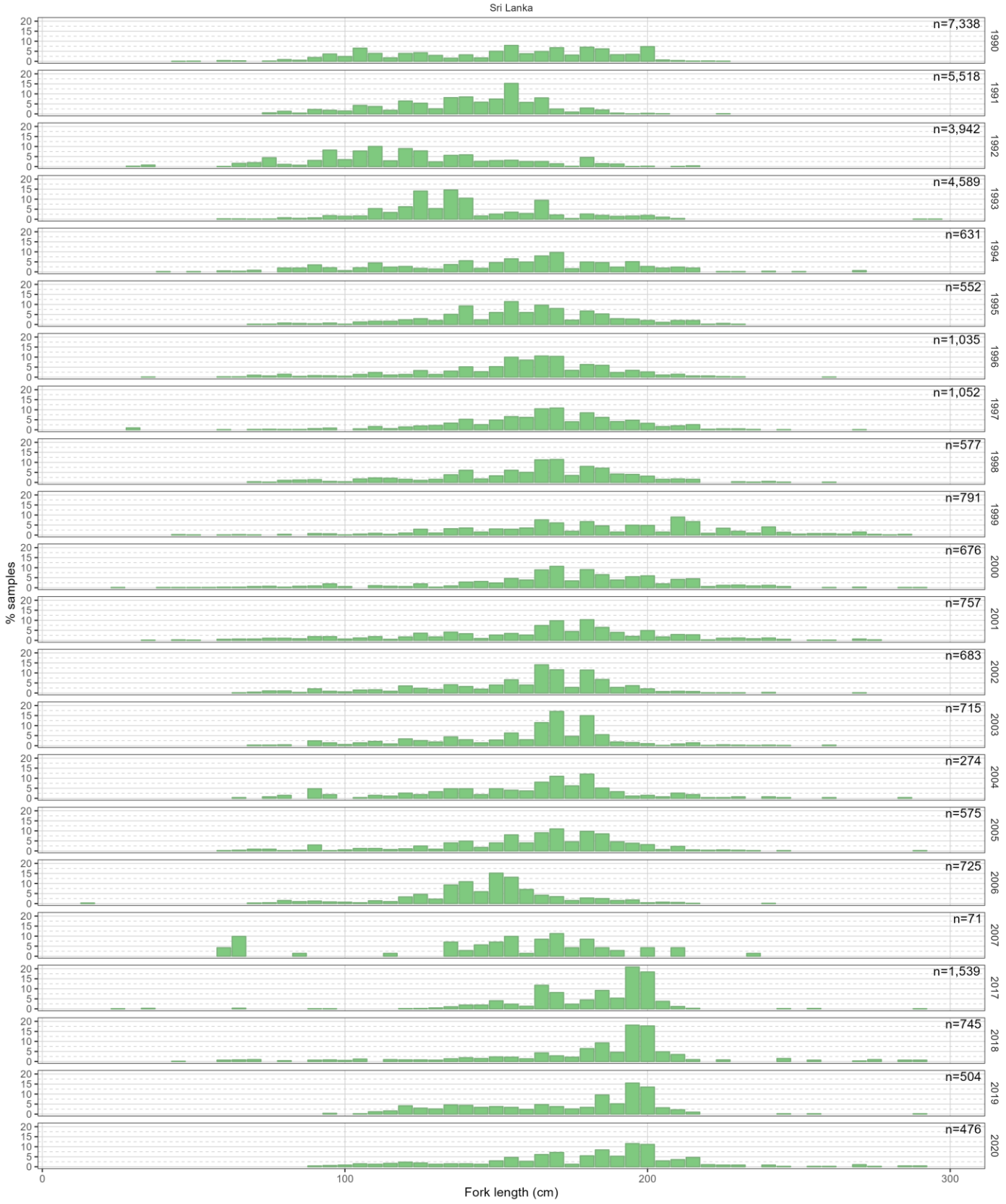

Figure 34: Relative size distribution of Indo-Pacific sailfish (fork length; cm) recorded for gillnet fisheries by year and main fleet. Data source: standardized size-frequency dataset

Line fisheries

Figure 35: Relative size distribution of Indo-Pacific sailfish (fork length; cm) recorded for line fisheries (coastal longline) by year and main fleet. Data source: standardized size-frequency dataset

Uncertainties in size-frequency data

Size frequency data are characterized by the lowest quality among the primary data sets that have to be reported to the Secretariat. As previously indicated (see section Size composition of the catch) few size data are available for Indo-

Pacific sailfish overall, and while nominal catch data are already available since the mid-1950s size-frequency data have only become available from the 1970s for industrial longline fisheries.

Contrarily to what happens in the case of other billfish species, the increase in longline fishing activities from the 1980s did not result in an increase in sampling of size data for Indo-Pacific sailfish, which in the period 1988-2006 was mostly measured in the context of gillnet fisheries initially under the supervision of the IPTP sampling programme. Notwithstanding this, the overall quality of size-frequency data recorded for Indo-Pacific sailfish by the gillnet fisheries operating in this period is still low due to the non-standard reporting of the geospatial information for the samples, which is an issue also affecting the overall quality of longline fisheries sampling data at the beginning of the available time series.

The quality of size data from industrial fisheries further declined between 1990 and 2007 when some fleets stopped collecting size data, and in particular some non reporting fleets or fleets operating with both fresh and deep-freezing longline vessels (**Fig. 36**).

Overall, there is little-to-no size-frequency sample of Indo-Pacific sailfish that is deemed to be of good quality until 2007, when strata covering around 10% of total reported catches for the species begun to be sampled regularly and according to IOTC standards (**Fig. 36b**). In recent years, Sri Lanka, Indonesia and Reunion improved the quality of the size frequency data submitted to the Secretariat, as did some industrial longline fisheries that benefited from on-board scientific observers to collect samples of the species (e.g., Taiwan,China).

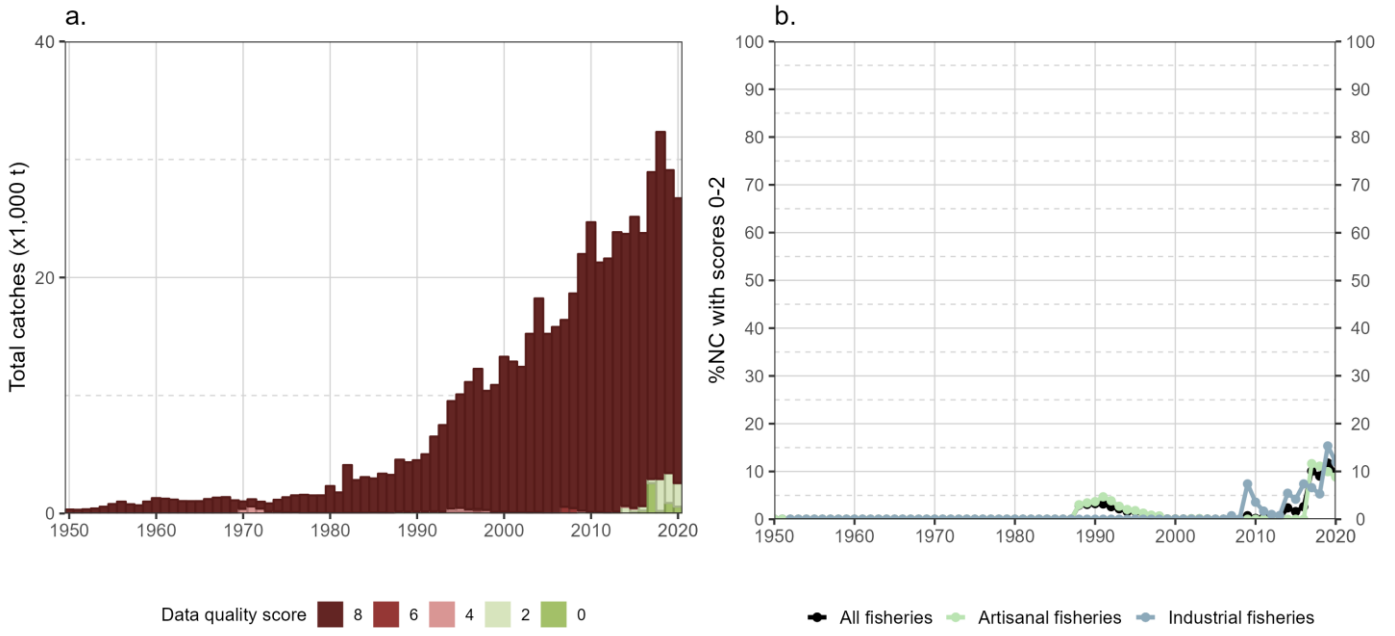

Figure 36: (a) Annual nominal catches (metric tons; t) of Indo-Pacific sailfish estimated by quality score and percentage of nominal catch for which geo-referenced size-frequency data were reported to the IOTC Secretariat in agreement with the requirements of Res. 15/02 (lines with dots) for all fisheries and by type of fishery in the period 1950–2020

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Appendix

Appendix I: Changes in best scientific estimates of nominal catches from previous WPB

Indo-Pacific sailfish catches show limited variation between WPB19 (2021) and WPB20 (2022) as only minimal updates to past data occurred in the meantime. In particular, Seychelles updated their historical (1998-2019) time series of catches for line and longline fisheries (coastal, deep-freezing, and fresh longliners) due to a gradual switch in target species from swordfish to tunas, with catches from longline targeting swordfish reassigned to coastal longline from 1998 onwards, and the eventual disappearance of swordfish longliners in 2015.

Changes recorded for other fleets (**Table 4**) and specifically Sri Lanka, Pakistan and Jordan, reflect the consequence of new data affecting the results of catch disaggregation for IOTC species aggregates (e.g., BILL) regularly performed by the IOTC Secretariat as part of the process producing the IOTC best scientific estimates. Similarly, changes recorded in catches of United Arab Emirates fisheries are a consequence of revisions of historical catch data directly reported to FAO (as the country is neither an IOTC Contracting Party nor a Cooperating non-Contracting party).

Zero-sum changes in historical catches for Sri Lankan fisheries reflect recent revisions of the original geo-spatial catch data that are now reported for the correct Indian Ocean area.

Table 4: Changes in best scientific estimates of average annual nominal catches (metric tons; t) of Indo-Pacific sailfish by year, fleet, fishery group and main Indian Ocean area between 2016 and 2019, limited to absolute values higher than 10 t

Year	Fleet	Fishery group	Area	Current (t)	Previous (t)	Difference (t)
2019	ARE	Gillnet	Western Indian Ocean	49	61	-12
	JOR	Gillnet	Western Indian Ocean	28	0	28
		Line	Western Indian Ocean	11	0	11
	LKA	Gillnet	Eastern Indian Ocean	1,568	1,264	304
		Gillnet	Western Indian Ocean	112	416	-304
		Line	Eastern Indian Ocean	890	647	243
		Line	Western Indian Ocean	0	243	-243
		Longline	Eastern Indian Ocean	86	53	33
		Longline	Western Indian Ocean	486	519	-33
	MOZ	Line	Western Indian Ocean	6	24	-18
2018	ARE	Gillnet	Western Indian Ocean	43	61	-18
	JOR	Gillnet	Western Indian Ocean	40	0	40
		Line	Western Indian Ocean	12	0	12
	LKA	Gillnet	Eastern Indian Ocean	1,315	980	335
		Gillnet	Western Indian Ocean	37	373	-335
		Line	Eastern Indian Ocean	960	931	30
		Line	Western Indian Ocean	0	30	-30
		Longline	Eastern Indian Ocean	137	92	45
		Longline	Western Indian Ocean	262	307	-45
2017	EUFRA	Line	Western Indian Ocean	0	12	-12
	EUMYT	Line	Western Indian Ocean	12	0	12
	JOR	Gillnet	Western Indian Ocean	41	0	41
		Line	Western Indian Ocean	11	0	11
	PAK	Gillnet	Western Indian Ocean	2,229	2,356	-127
	SYC	Longline	Western Indian Ocean	43	57	-14
2016	JOR	Gillnet	Western Indian Ocean	22	0	22
		Line	Western Indian Ocean	13	0	13
	PAK	Gillnet	Western Indian Ocean	2,338	2,472	-133
	SYC	Line	Western Indian Ocean	16	0	16
		Longline	Western Indian Ocean	24	39	-16