REVIEW OF THE STATISTICAL DATA AVAILABLE FOR INDIAN OCEAN BILLFISH (1950-2020)

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Abstract
The document provides an overview of the consolidated knowledge about fisheries catching billfish in the Indian Ocean since the early 1950s based on a range of data sets collected by the Contracting Parties and Cooperating Non-Contracting Parties (CPCs) of the IOTC and curated by the IOTC Secretariat. Additional details on the five billfish species under IOTC management mandate are provided in separate documents prepared for this meeting.

Keywords: billfish | Indian Ocean | tuna fisheries

Introduction

Information available from the four tuna Regional Fisheries Management Organizations (RFMOs) indicates that the annual catches of the ten billfish species exploited worldwide exceeded 200,0000 metric tons (t) in recent years (**Fig. 1**). Fisheries data (1950-2019) collated and harmonized through the FAO Global Tuna Atlas also show that the main fishing grounds for billfish are located in the Indian Ocean, whose contribution to the global production continuously increasing from the mid-1960s to reach about 45% of total billfish catches between 2016 and 2019, representing a mean annual catch of around 90,000 t (**Fig. 1**).

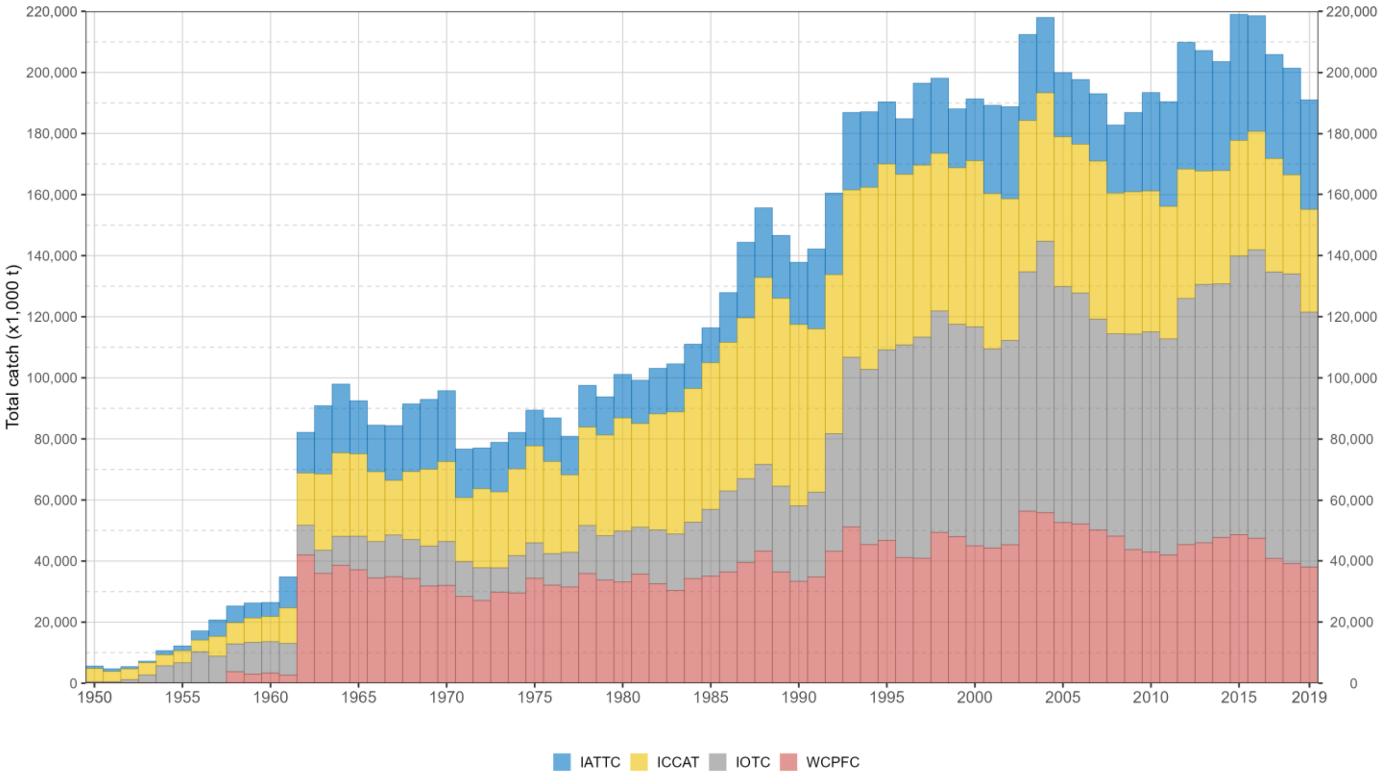

Figure 1: Annual time series of cumulative nominal catches (metric tons; t) of billfish by tuna Regional Fisheries Management Organisation, 1950-2019. IATTC = Inter-American Tropical Tuna Commission; ICCAT = International Commission of the Conservation of Atlantic Tunas; IOTC = Indian Ocean Tuna Commission; WCPFC = Western-Central Pacific Commission. Source: Global Tuna Atlas

Five billfish species are currently under the management of the Indian Ocean Tuna Commission (IOTC), i.e., black marlin (*Istiompax indica*), blue marlin (*Makaira nigricans*), striped marlin (*Kajikia audax*), Indo-Pacific sailfish (*Istiophorus platypterus*), and swordfish (*Xiphias gladius*), with shortbill spearfish (*Tetrapturus angustirostris*) having been considered, in several occasions, for further inclusion under the IOTC agreement.

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 these five species. The document provides an overview of the data sets available to the IOTC Secretariat as of August 2022, the methods used for processing and assessing the reporting quality of the main data sets, and a description of the main trends and features of Indian Ocean billfish fisheries over the last seven decades.

Materials

Several fisheries data sets shall be reported to the IOTC Secretariat by the Contracting Parties and Cooperating Non-Contracting Parties (CPCs) as per the IOTC Conservation and Management Measures (CMMs) and following the standards and formats defined in the IOTC Reporting guidelines. Although not mandatory, the use of the IOTC forms is recommended to report the data to the Secretariat as they facilitate data curation and management.

Nominal catch data

Nominal catches correspond to the total retained catches (in live weight) per year, Indian Ocean major area, fleet, and fishing gear (IOTC Res. 15/02) and can be reported through IOTC form 1RC. In addition, in order to support the monitoring of the catch limits implemented by some industrial fisheries for the CPCs having objected to IOTC Resolution 21/01 as part of the interim plan for rebuilding the yellowfin tuna stock, IOTC Res. 19/01 requests CPCs to submit their catches of yellowfin tuna from 2019 explicitly disaggregated by vessel length and area of operation (i.e., for vessel of 24 m overall length and over, and for those under 24 m if they fish outside the Exclusive Economic Zone (EEZ) of the flag state) (IOTC Form 1RC-YFT).

Changes in the IOTC consolidated data sets of nominal catches (i.e., raw and best scientific estimates) may be required as a result of:

i. updates received by December 30th each year, of the preliminary data for longline fleets submitted by June 30th of the same year (IOTC Res. 15.02);

ii. revisions of historical data by CPCs following corrections of errors, addition of missing data, changes in data processing, etc.

iii. changes in the estimation process performed by the Secretariat based on evidence of improved methods and/or assumptions (e.g., selection of proxy fleets, updated morphometric relationships) and upon endorsement by the Scientific Committee.

Geo-referenced catch and effort data

Catch and effort data refer to finer-scale data, usually from logbooks, reported in aggregated format and stratified per year, month, grid, fleet, gear, type of school, and species (IOTC Res. 15/02). The IOTC forms designed for reporting geo-referenced catch and effort data vary according to the nature of the fishing gear (e.g., surface, longline, and coastal gears). In addition, information on the use of fish aggregating devices (FADs) and activity of the support vessels that assist industrial purse seiners also has to be collected and reported to the Secretariat through IOTC forms 3FA and 3SU.

Discard data

The IOTC follows the definition of discards adopted by FAO in previous reports (Alverson et al. 1994, Kelleher 2005) which considers all non-retained catch, including individuals released alive or discarded dead. Estimates of total annual discard levels in live weight (or number) by Indian Ocean major area, species and type of fishery shall be reported to the Secretariat as per IOTC Res. 15/02. The IOTC form 1DI has been designed for the reporting of discards and the data contained shall be extrapolated at the source to represent the total level of discards for the year, gear, fleet, Indian Ocean major area, and species concerned, including turtles, cetaceans, and seabirds.

Nevertheless, discard data reported to the Secretariat with IOTC Form 1DI are generally scarce, not raised, and not complying with all IOTC reporting standards. For these reasons, the most accurate information available on discards comes from the IOTC Regional Observer Scheme (IOTC Res. 11/04) that aims to collects detailed information (e.g., exact location in space and time of the sets and interactions, including the fate of observed individuals) on discards of IOTC and bycatch species for industrial fisheries (see below).

Size frequency data

The size composition of catches may be derived from the data set of individual body lengths or weights collected at sea and during the unloading of fishing vessels. The IOTC Form 4SF provides all fields requested for a complete reporting of size frequency data to the stratification by fleet, year, gear, type of school, month, grid and species as required by IOTC Res. 15/02. While the great majority of size data reported through IOTC Form 4SF are for retained catches, CPCs can also use the same form to report size data of discarded individuals. Furthermore, additional size data (including those for individuals discarded at sea) may be collected through onboard observer programs and reported to the Secretariat as part of the ROS (see below).

Socio-economic data

Little information is available on the socio-economic dimension of fisheries catching billfish in the Indian Ocean. The IOTC Form 7PR has been designed to voluntarily report prices of fish per type of product and market but little data have been received so far at the Secretariat with the notable exception of time series of monthly prices by species, fishing gear, and region reported by Oman since 2015 (Appendix I), and Malaysia since 2018.

Regional Observer Scheme

Resolution 11/04 on the ROS makes provision for the development and implementation of national observer schemes among the IOTC CPCs starting from July 2010 with the overarching objective of collecting *"verified catch data and other scientific data related to the fisheries for tuna and tuna-like species in the IOTC area of competence"*. The ROS aims to cover *"at least 5% of the number of operations/sets for each gear type by the fleet of each CPC while fishing in the IOTC Area of competence of 24 meters overall length and over, and under 24 meters if they fish outside their EEZs shall be covered by this observer scheme"*. Observer data collected as part of the ROS include: (i) fishing activities and vessel positions, (ii) catch estimates with a view to identifying catch composition and monitoring discards, bycatch, and size frequency, (iii) gear type, mesh size and attachments employed by the master, and (iv) information to enable the cross-checking of entries made to the logbooks (i.e., species composition and quantities, live and processed weight and location). In addition, the ROS database includes morphometric data (i.e., lengths and weights) collected at sea by fisheries observers which are of particular interest for deriving morphometric relationships. A full description of the ROS data requirements for each fishing gear is provided in IOTC (2021a).

A comprehensive description of the status, coverage, and data collected as part of the ROS is provided in IOTC (2021b). Although incomplete and characterized by a large variability in coverage between fisheries and over space and time, observer data include information on the fate of the catches (i.e., retained or discarded at sea) as well as on the condition of the discards. Observer data are also the main source of spatial information on interactions between IOTC fisheries and seabirds, marine turtles, cetaceans, as well as any other species encountered.

To date, the ROS regional database contains information for a total of 1,583 commercial fishing trips (886 from purse seine vessels and 697 from longline vessels of various types) made during the period 2005-2020 from 7 fleets: Japan, EU,France and Sri Lanka for longline fisheries and EU,Spain, EU,France, Japan, Korea, Mauritius, and Seychelles for purse seine fisheries. In addition, some observer reports have been submitted to the Secretariat by some CPCs (e.g., Taiwan,China) but data sets were not provided in electronic format at the operational level following the ROS standards, *de facto* preventing the entry of these data in the ROS regional database.

Morphometric data

The current length-length and length-weight IOTC reference relationships for Indian Ocean billfish mostly come from historical data collected in the eastern Pacific Ocean (Uchiyama & Kazama 2003). However, several morphometric data sets have been collected for billfish through different research and monitoring programs conducted over the last decades, including measurements taken at sea and on land (Setyadji et al. 2016, Bonhommeau et al. 2019). Hence, different morphometric relationships have been established for billfish based on data that may cover different size ranges as well as different areas and time periods (**Appendix I**).

Methods

The release of the curated public-domain data sets for bllfish species is done following some processing data steps which are briefly summarized below.

Data processing

First, standard controls and checks are performed to ensure that metadata and data submitted to the Secretariat are consistent and include all mandatory fields (e.g., dimensions of the strata, etc.). The controls depend on each data set and may require the submission of revised data from CPCs if the original ones are found to be incomplete.

Second, a series of processing steps is applied to derive the best scientific estimates of nominal catches for the 16 IOTC species (see **Appendix V** of IOTC (2014)), by implementing the following rules:

a. When nominal catches are not reported by a CPC, catch data from the previous year may be repeated or catches may be derived from a range of sources, e.g., partial catch and effort data, the FAO FishStat database, data on imports of tropical tunas from processing factories collaborating with the International Seafood Sustainability Foundation, etc.;

b. For some specific fisheries characterized by well-known, outstanding issues in terms of data quality, a process of re-estimation of species and/or gear composition may be performed based on data available from other years or areas, or by using proxy fleets, i.e., fleets occurring in the same strata which are assumed to have a very similar catch composition, e.g., Moreno et al. (2012) and IOTC (2018);

c. Finally, a disaggregation process is performed to break down the catches by species and gear when they are reported as aggregates (IOTC 2016). Briefly, the process derives the catch proportion of each IOTC species of an aggregate in a given stratum from past reports of catches where the species and gears were reported separately following a substitution scheme.

A total of 8 species aggregates including IOTC billfish species have been used by some CPCs for reporting nominal catch data between 1950 and 2020 (**Table 1**).

Table 1: Species groups including billfish species used for reporting nominal catches to the IOTC Secretariat

Species code	Species name	BLM	BUM	MLS	SFA	SWO
AG01	Black marlin and striped marlin	✓		✓		
AG02	Indo-Pacific sailfish and shortbill spearfish				✓	
AG03	Marlins nei	✓	✓	✓		
AG14	Billfish nei	✓	✓	✓	✓	✓
BIL	Marlins,sailfishes,etc. nei	✓	✓	✓	✓	
BXQ	Marlins nei	✓	✓			
SAI	Atlantic sailfish				✓	
TUX	Tuna-like fishes nei	✓	✓	✓	✓	✓

A total of 5 gear aggregates including IOTC billfish species have been used by CPCs to report nominal catch data of any billfish species between 1950 and 2020 (**Table 2**).

Table 2: List of gear aggregates with their component gear codes (limited to gear aggregates that have reported catches of billfish species)

Aggr. code	Gear aggregate	Category	BB	GILL	HAND	LIFT	LL	LLCO	PS	PSS	RR	SPOR	TRAW	TROL
GIHT	Gillnet and hand line and troll line	Gillnet		✓	✓									✓
HATR	Hand line and Troll line	Trolling			✓									✓
HOOK	Hook and line	Trolling			✓			✓						✓
LLTR	Coastal Longline and Troll line combination	Longline						✓						✓
UNCL	Unclassified	Other	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Details on the results of the estimation process used to produce the 2020 best scientific estimates and changes in time series of nominal catches relative to the previous Working Party on Billfish are provided in Appendix II and Appendix III, respectively.

Third, and applying to all 16 IOTC species plus the most common shark species, filtering and conversions are applied to the size-frequency data in order to harmonize their format and structure and remove data which are non compliant (at the source) with IOTC standards, e.g., because provided with size bins exceeding the maximum width considered meaningful for the species (IOTC 2020).

Fourth, and applying to all 16 IOTC species plus the most common shark species defined in the appendices of IOTC Resolution 15/01, filtering and conversions are applied to the size-frequency data in order to harmonize their format and structure and remove data which are non-compliant with IOTC standards, e.g., when provided with size bins exceeding the maximum width considered meaningful for the species (IOTC 2020). The standard length measurements considered at IOTC are the eye fork length (EFL; straight distance from the orbit of the eye to the fork of the tail) for black and blue marlins and the fork length (FL; straight distance from the tip of the lower jaw to the fork of the tail) for all other species subject to mandatory size measurements (IOTC 2020). All size samples collected using other types of measurements are converted into FL and EFL by using the IOTC equations, considering size range and intervals that may vary with species. If no IOTC-endorsed equations exist to convert from a given length measurement for a species to the standard FL and EFL measurements, the original size data are not disseminated but kept within the IOTC databases for future reference.

Data quality

A scoring system has been devised to assess the reporting quality of nominal catch, catch-effort, and size-frequency data submitted to the Secretariat for all IOTC species. The determination of the score varies according to each type of data set and aims to account for reporting coverage and compliance with IOTC reporting standards (**Table** 3). Overall, the lower the score, the better the quality. It is to note that the quality scoring does not account for sources of uncertainty affecting the data such as issues in sampling and processing as well as under- or misreporting.

Table 3: Key to IOTC quality scoring system

Data set	Criterion	By species	By gear
Nominal catch	Fully available	0	0
	Partially available	2	2
	Fully estimated	4	4
Catch and effort	Available according to standards	0	0
	Not available according to standards	2	2
	Low coverage (<30% logbooks)	2	
	Not available	8	
Size frequency	Available according to standards	0	0
	Not available according to standards	2	2
	Low coverage (<1 fish per ton caught)	2	
	Not available	8	

Results

Nominal catches & discards

The best scientific estimates of nominal catches provide an annual view on the history of the fisheries catching billfish species in the Indian Ocean. These species are caught with a large diversity of fishing gears all over the region generally as incidental catches while swordfish is the main target of some longline fisheries,

Historical trends (1950-2020)

The contribution of catches of billfish to the total catches of IOTC species has remained fairly stable over the last decades, oscillating between 4-5% from the mid-1950s onwards (**Fig. 2**). In recent years, the five species of billfish under IOTC mandate represented 5.1% of the total catches of the 16 IOTC species.

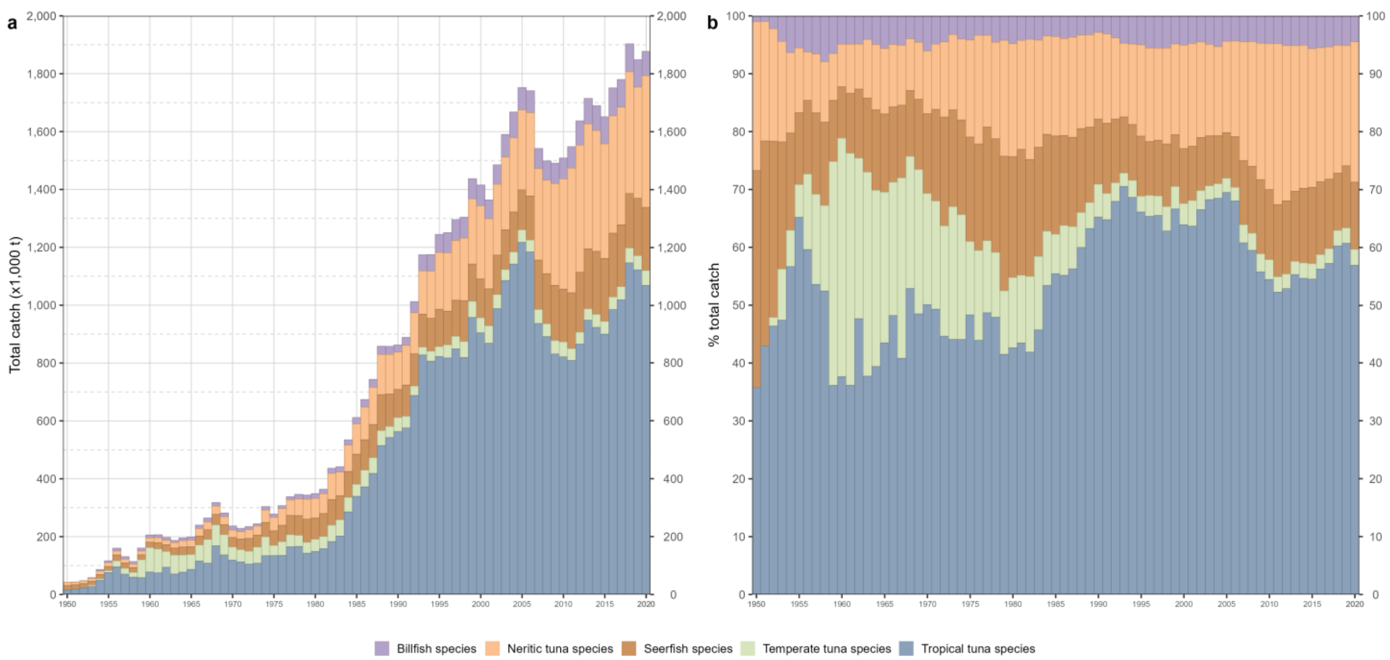

Figure 2: Annual time series of cumulative nominal absolute (a) and relative (b) catches (metric tons; t) of all IOTC tuna and tuna-like species by species category for the period 1950-2020

Billfish are mainly caught by industrial fisheries in offshore areas using longlines and gillnets, but they are also taken with purse seines and some artisanal gears such as troll and hand lines in more coastal fishing grounds. The total nominal catches of the IOTC billfish species showed a major increase over the last seven decades, from an average of 5,500 t per year in the 1950s to an average of 88,200 t per year in the 2010s (**Table 4**). The marked increase in annual catches of billfish species caught by industrial fisheries recoirded between the 1990s and the 2000s was mainly driven by the longline fisheries from Taiwan,China (**Fig. 3a**). Since then, industrial catches showed large variations between a maximum of 58,700 t in 2004 and a minimum of 32,500 t in 2010. Catches from artisanal fisheries have steadily increased over time, with their contribution to the total catch of billfish increasing from less than 10% prior to the 1970s to more than 50% in recent years (**Fig. 3b**).

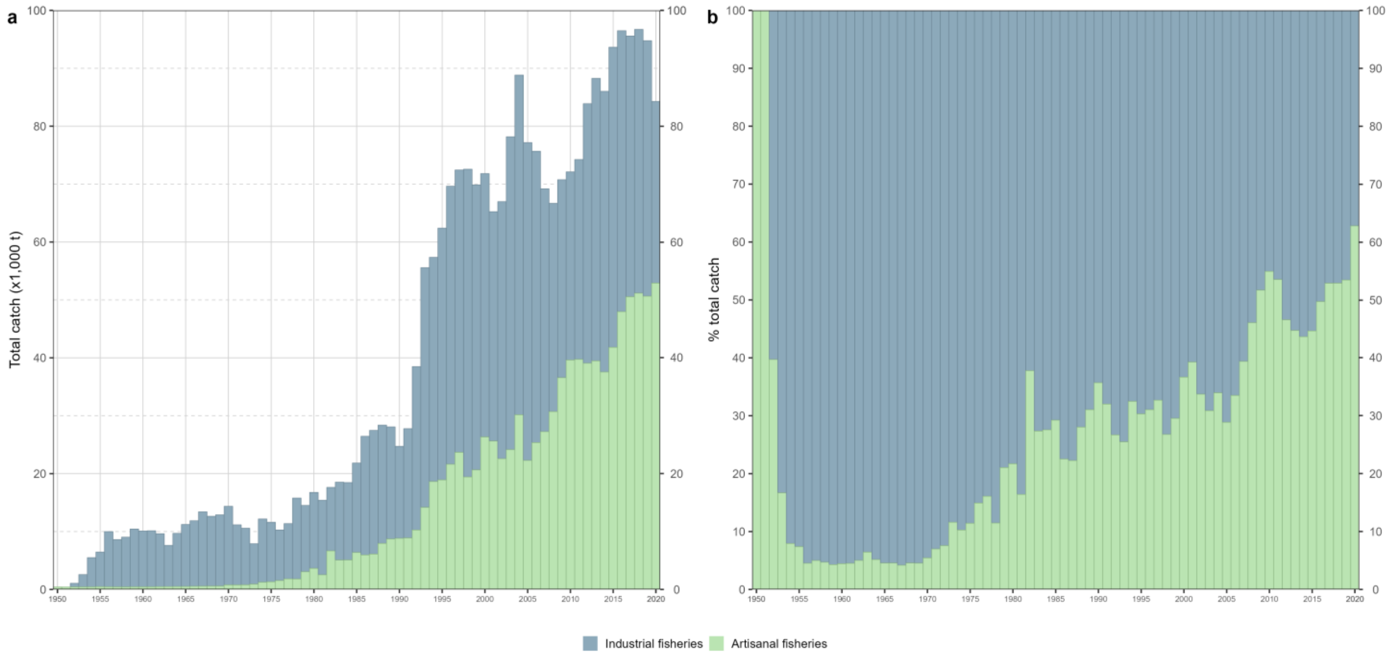

Figure 3: Annual time series of cumulative nominal absolute (a) and relative (b) catches (metric tons; t) of IOTC billfish by fishery type for the period 1950-2020

The composition of the fisheries catching billfish varies over time and between species. While billfish have mainly been reported to be caught by longliners until the early 1990s, the contribution of gillnet and coastal line fisheries has substantially increased over the last two decades (**Table 4 & Fig. 4**). In particular, gillnet catches of billfish have steadily increased since the early 1980s to reach about 36,000 t in 2020, representing 43% of the total catches of billfish in that year.

Table 4: Best scientific estimates of nominal catches (metric tons; t) of the IOTC billfish species by decade and fishery for the period 1950-2019

Fishery	1950s	1960s	1970s	1980s	1990s	2000s	2010s
Purse seine | Other	0	0	7	107	166	337	1,030
Longline | Other	0	0	0	115	4,503	15,433	9,224
Longline | Fresh	0	0	112	569	6,326	9,040	10,904
Longline | Deep-freezing	5,015	10,404	10,451	15,360	30,031	22,227	13,730
Line | Coastal longline	88	87	107	724	1,437	3,089	12,423
Line | Trolling	96	149	272	625	1,236	1,891	2,274
Line | Handline	40	39	277	1,253	1,784	1,431	3,001
Baitboat	0	0	29	0	0	0	35
Gillnet	213	241	713	3,091	9,576	19,559	35,450
Other	0	0	4	56	23	45	102
Total	5,451	10,920	11,972	21,900	55,083	73,052	88,173

Total catches of billfish reported for line fisheries showed a marked increase from the early 2010s (**Fig. 4**) reflecting in particular the increased reporting of billfish species caught by the coastal longline fishery of Sri Lanka, that went from 37 t in 2013 to 4,426 t in 2014. This sharp increase is thought to be mainly due to an improvement in the fisheries statistics of Sri Lanka starting with the early 2010s, when a closer monitoring of the catches in multi-gear fisheries (e.g., gillnet and longline operated during the same trip) was combined with a better break-down of longline fisheries data (i.e., separation between coastal and offshore components) (Herath & Maldeniya 2013). In parallel, the catches of billfish taken by coastal longliners operating in the Indian areas of national jurisdiction have doubled over the last decade, increasing from 3,388 t in 2013 to 5,190 t in 2020.

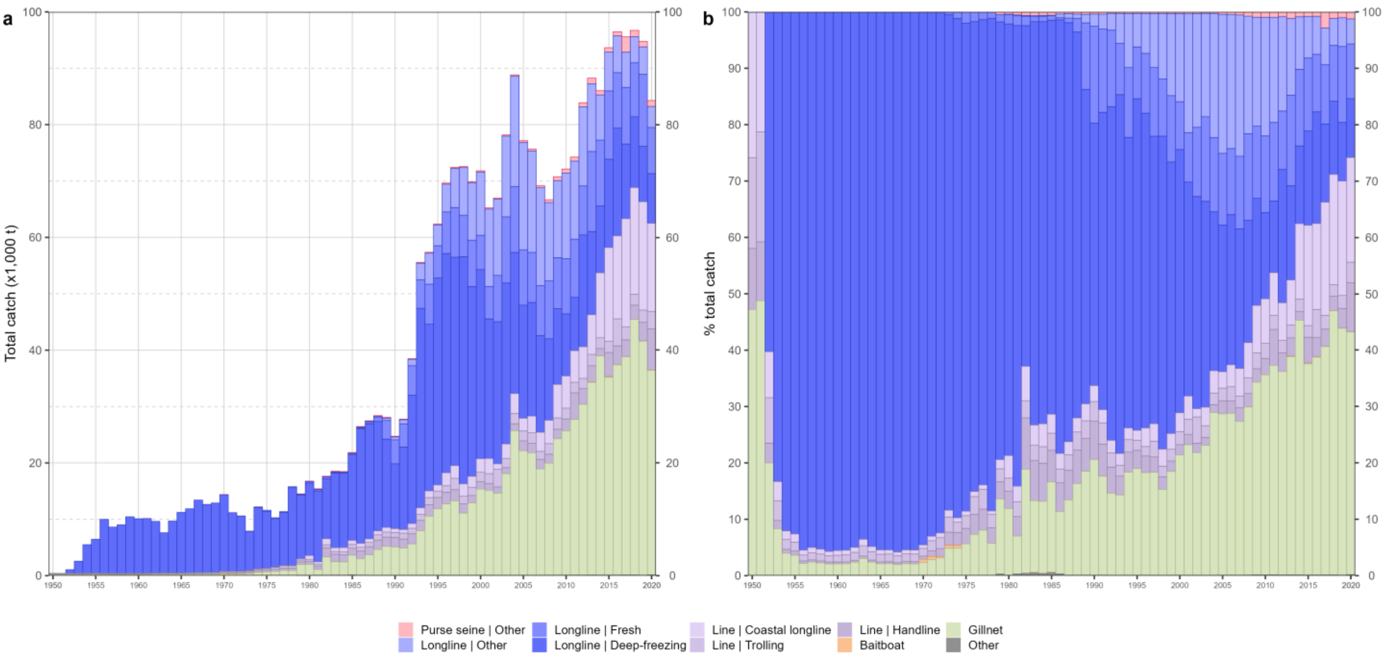

Figure 4: Annual time series of cumulative nominal absolute (a) and relative (b) catches (metric tons; t) of IOTC billfish by fishery for the period 1950-2020

The five IOTC billfish species show different catch levels and trends over time, with a total of 2.7 million metric tons of billfish reported to have been caught in the Indian Ocean since the 1950s. In terms of total catches, swordfish (SWO) represents the main billfish species, contributing to 37% of the cumulative catches of billfish available in the IOTC database, followed by Indo-Pacific sailfish (SFA) with a contribution of 24% (**Fig. 5**). Blue marlin (BUM) and black marlin (BLM) contributed about equally with cumulative catches of about 408,000 t, roughly corresponding to 15% of total billfish catches taken during that period. Striped marlin (MLS) appears to be less abundant in the catches of IOTC billfish with a maximum annual catch of 8,730 t observed between 1950 and 2020 and a total cumulative catch of about 260,000 t reported as caught over that period.

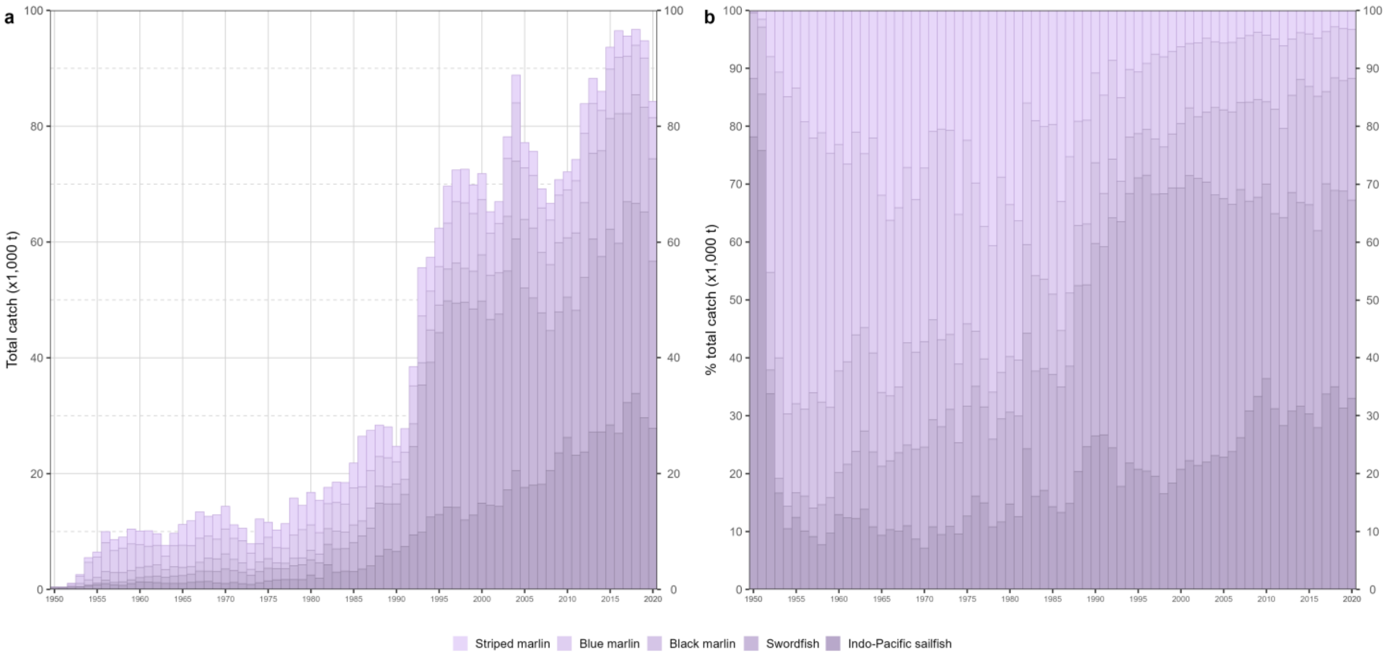

Figure 5: Annual time series of cumulative nominal absolute (a) and relative (b) catches (metric tons; t) of IOTC billfish by species for the period 1950-2020

Black marlin (BLM) shows an increasing trend, which brought catches of the species from 3,000 t in 1991 to around 13,000 t in 2004, partly due to the development of the mixed longline-gillnet fishery in Sri Lanka (IOTC 2022a). Catches sharply increased from around 10,000 t in 2010 to over 22,000 t in 2016 – the highest catches recorded in the Indian Ocean for the species – largely due to increases reported by the offshore gillnet fisheries of I.R. Iran. Catches decreased again to 15,000 t in 2017 and re-increased to about 18,000 t in 2020.

Blue marlin (BUM) shows a two-phases increase, with an average catch of about 4,000 t per year between 1955 and 1990 and about 9,000 t per year between 1995 and 2020 (IOTC 2022b). Some of the highest catches of blue marlin reported by longliners in recent years have been recorded between 2012 and 2016, and are likely to be the consequence of higher catch rates by some longline fleets which resumed operations in the western tropical Indian Ocean following a reduction in piracy threats. Overall, catches of blue marlin are mostly dominated by longline fisheries although the contribution of line and gillnet fisheries in recent years became more marked (IOTC 2022b).

Striped marlin (MLS) shows some strong interannual variability in the nominal catches between 1950 and 2020, with a progressive increase from the 1950s to the 1990s followed by a decreasing trend from a high catch of about 8,000 t of fish in 1993 to 3,000 t in 2020. Catch trends range from 2,000 t to 8,000 t per year, which may reflect the level of reporting and the status of striped marlin as a non-target species rather than actual catches. In particular, catches reported under drifting longlines are highly variable, with lower catch levels between and 2011 largely due to declining catches reported by deep-freezing and fresh-tuna longliners from Taiwan,China. Since 2012, catches of striped marlin have fluctuated between 3,000 t – 5,000 t per year (IOTC 2022d).

Similar to black marlin, Indo-Pacific sailfish (SFA) shows a continuous increasing trend between 1950 and 2020, driven by the gillnet fisheries that represent the large majority of the catches for this species over the entire period, with catches increasing from about 6,500 t in 1990 to 27,800 t in 2020 (IOTC 2022c).

With regards to swordfish (SWO), after a period of slow increase between 1950 and the early 1990s, catches of the species showed a massive increase from about 8,000 t in 1990 to about 35,000 t per year between 1995 and 2005, to decrease again to 25,000 t in 2011 before re-increasing over the last decade and reach 29,000 t in 2020 (IOTC 2022e).

Recent fishery features (2016-2020)

In recent years (2016-2020), total nominal catches of all IOTC billfish species combined were about 93,600 t per year, with gillnet, longline, and line fisheries contributing to 42.6%, 29.9%, and 25.9% of all catches, respectively (**Table 5**).

Table 5: Mean annual nominal catches (metric tons; t) of the IOTC billfish species by fishery and contribution (%) to the total catches of all IOTC billfish species between 2016 and 2020

Fishery	Fishery code	Catch	Percentage
Gillnet	GN	39,827	42.6
Line | Coastal longline	LIC	17,542	18.7
Longline | Deep-freezing	LLD	12,715	13.6
Longline | Fresh	LLF	10,074	10.8
Longline | Other	LLO	5,200	5.6
Line | Handline	LIH	3,869	4.1
Line | Trolling	LIT	2,864	3.1
Purse seine | Other	PSOT	1,329	1.4
Other	OT	114	0.1
Baitboat	BB	33	0.0

Between 2016 and 2020, the mean annual catches of IOTC billfish have been dominated by a few CPCs, to the point that about two thirds of all catches were accounted for by four distinct fleets: I.R. Iran (mostly composed of gillnet fisheries), Sri Lanka and India (described by a large diversity of fisheries and gears), and Taiwan,China (composed of an equal mix of fresh and deep-freezing longliners) (**Fig. 6**).

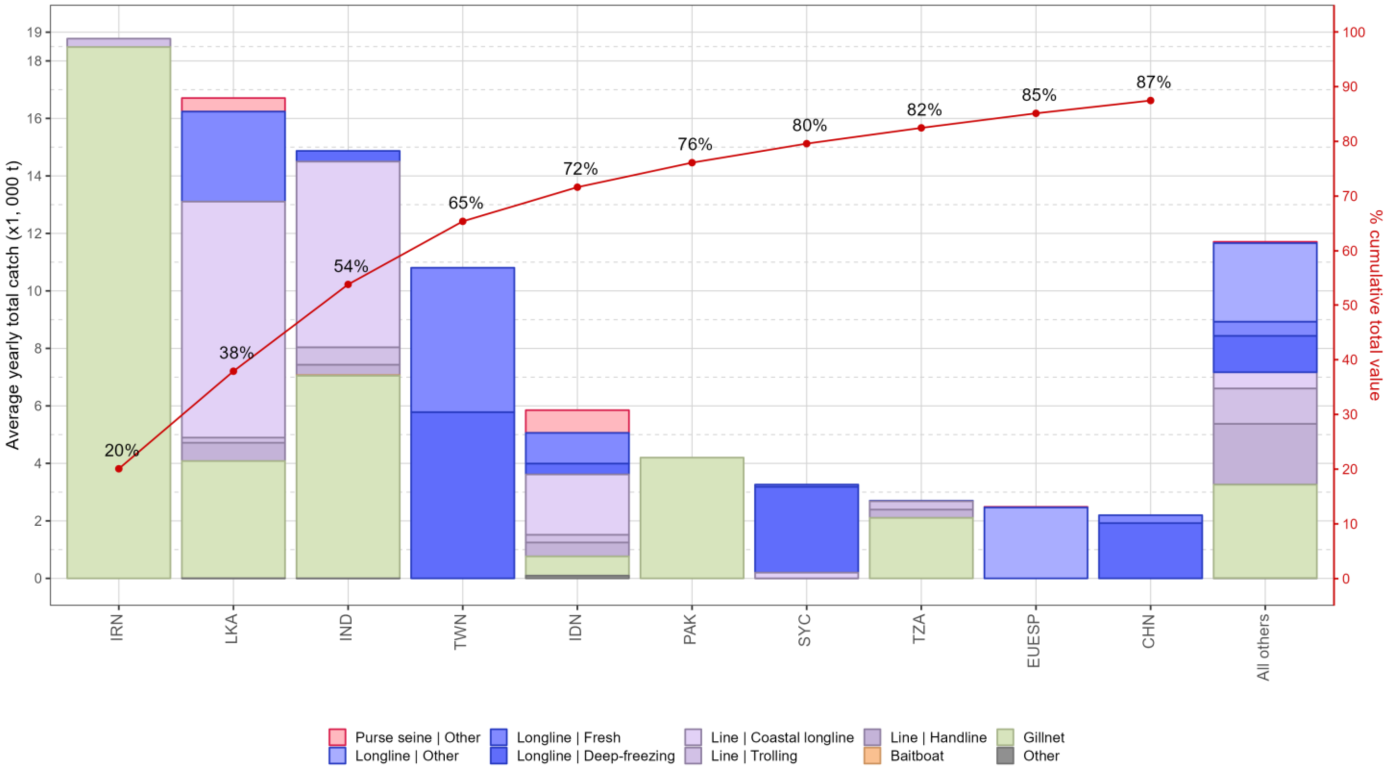

Figure 6: Mean annual catches of IOTC billfish species by fleet and fishery (metric tons; t) between 2016 and 2020 with indication of cumulative catches by fleet

Over the last five years of the time series (2016-2020), gillnet catches of billfish species showed an increase followed by a decrease when catches reported by longline fisheries substantially decreased and line catches showed a regular increasing trend (**Fig. 7**). Meanwhile, catches from the other fishery groups (i.e., purse seine, baitboat, and other fisheries) were small or negligible. Between 2016 and 2020, the catches of billfish taken by line fisheries increased from 22,800 t to 26,000 t, while catches of billfish taken by longline fisheries decreased from 35,500 t to 20,700 t (**Fig. 7**).

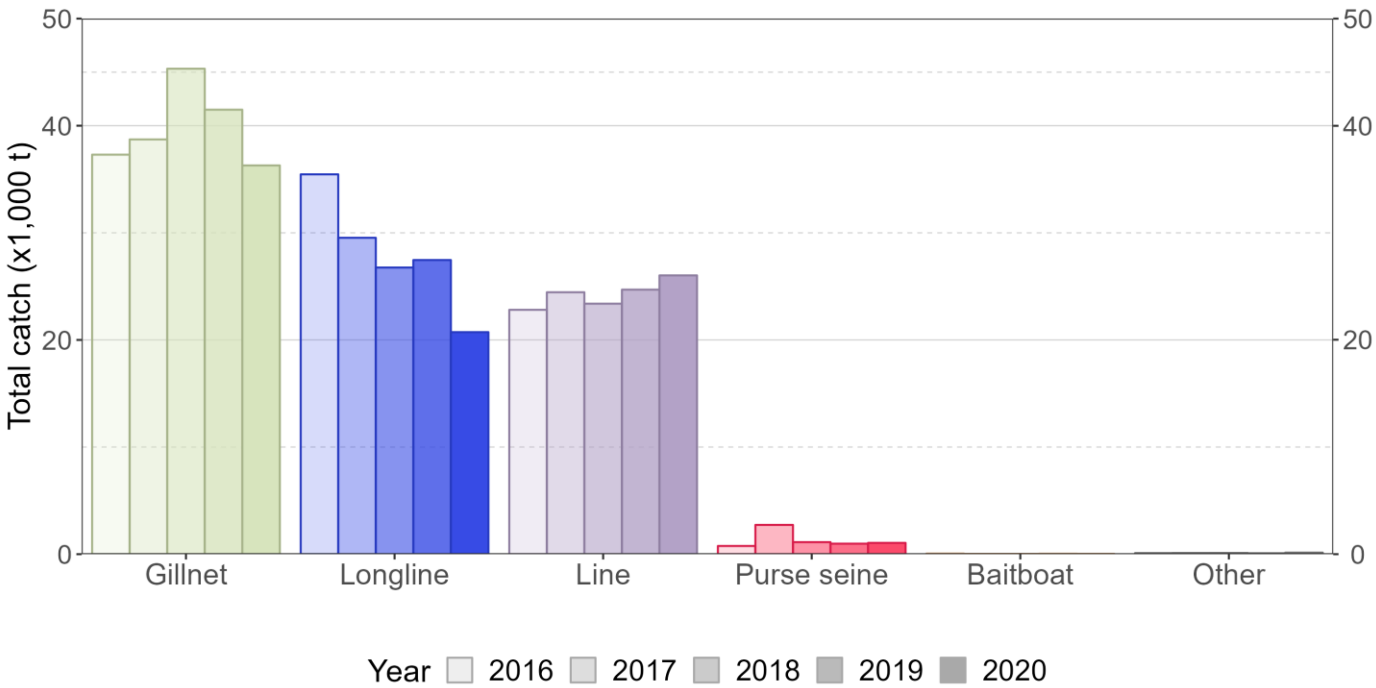

Figure 7: Annual catch (metric tons; t) trends of IOTC billfish species by fishery group between 2016 and 2020

Annual trends observed in the catches of billfish in recent years vary between fleets and fishery groups. The initial increase in gillnet catches was mainly driven by the fisheries of I.R. Iran, India, and Sri Lanka with the subsequent generalized stability in catches from the Indian gillnet fisheries (2014-2020) affecting the trend of billfish species accordingly. Catches from Pakistan also showed some inter-annual variability (2016-2020) although without any apparent underlying trend (**Fig. 8a**). Furthermore, the decrease in longline catches of billfish can be explained by the decrease in the catches of the fisheries of Taiwan,China, Seychelles, EU,Spain, and all longline fisheries other than Sri Lanka (**Fig. 8c**).

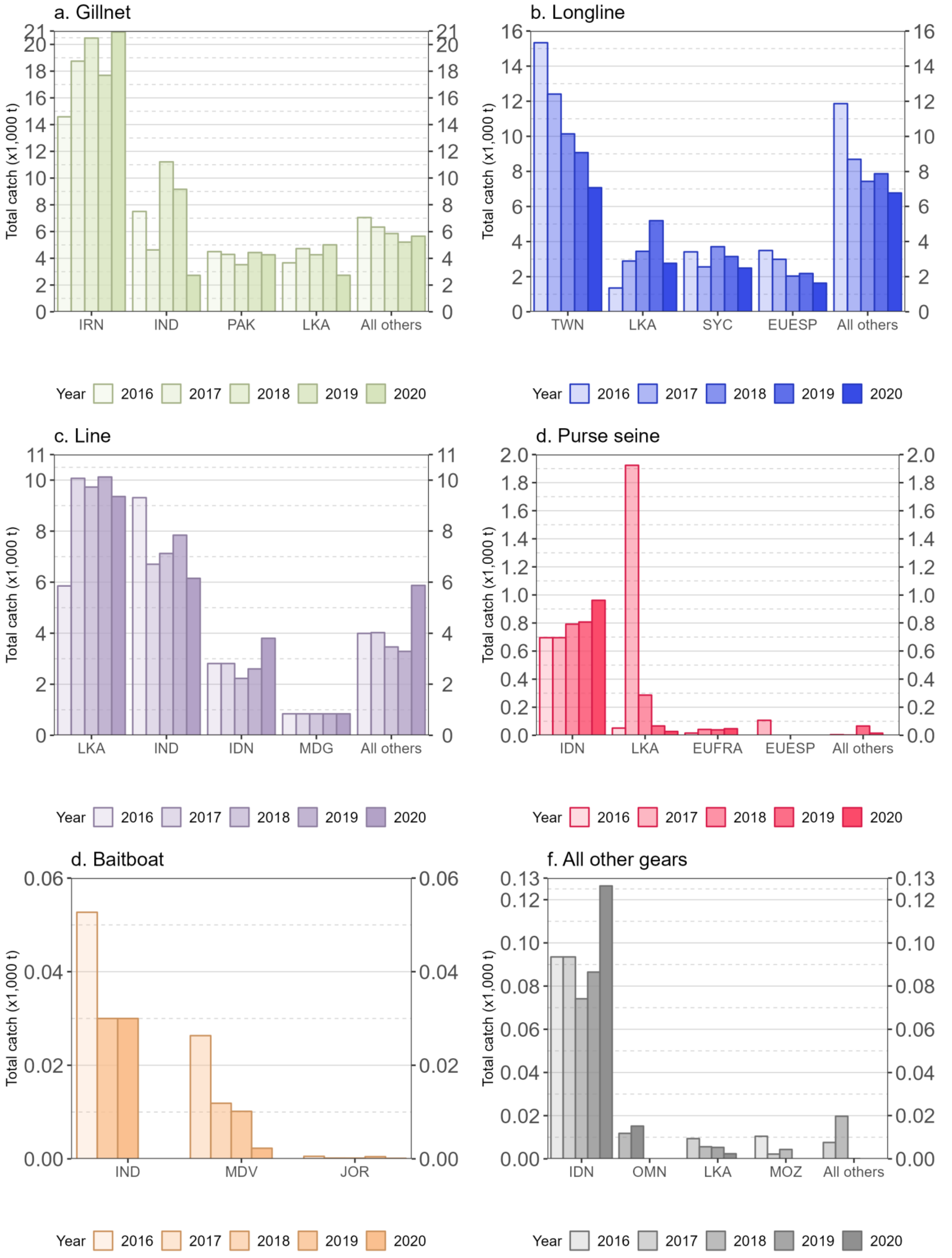

Figure 8: Annual catch (metric tons; t) trends of IOTC billfish species by fishery group and fleet between 2016 and 2020

Changes from previous Working Party

Some changes occurred in the catch time series of the IOTC billfish species since the release of the data set of best scientific estimates of nominal catches produced for the 19th session of the Working Party on Billfish (WPB19) held in 2021. The changes concern the last decade and represent an additional catch of about 2,600 t per year on average between 2011 and 2019 (**Fig. 9**). These changes are mostly due a major revision of the time series of total catches of Yemen fisheries made in the FAO global capture production database and used in absence of data reported to the Secretariat (see details provided in Appendix III).

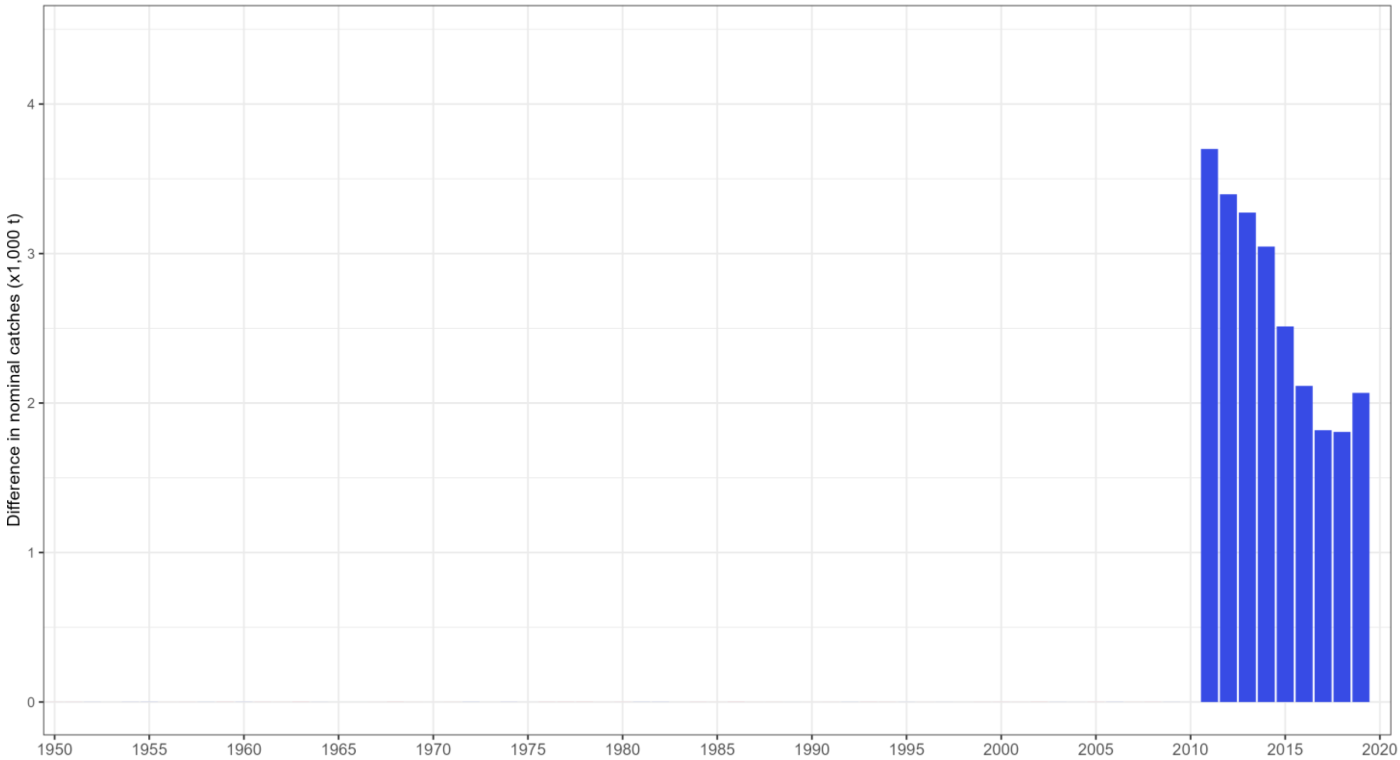

Figure 9: Differences in the available best scientific estimates of nominal catches (metric tons; t) of billfish between the 19th and 20th sessions of the IOTC Working Parties on Billfish

Uncertainties in nominal catch data

Different processes may affect the quality of the statistical data reported to the IOTC Secretariat, depending on the complexity of the fisheries and the systems in place to collect, process, and manage the data at national level. The accuracy and precision of the catches may be affected by under-reporting or misreporting, low sampling coverage, poor data resolution (e.g., due to mis-identification of species), and errors in processing and reporting.

The overall quality of nominal catches for the five IOTC billfish species with regards to IOTC reporting standards has strongly varied between 1950 and 2020, and improved substantially over the last decade. The percentage of nominal catches fully or partially reported to the Secretariat i.e., scores between 0 and 2; **Table 3**) showed large variations over time, decreasing from more than 90% prior to the 1970s, when the catches were dominated by industrial longline fisheries, to less than 40% in the late 2000s (**Fig. 10**). Since then, the reporting quality improved for both industrial and artisanal fisheries with the overall percentage of data fully or partially reported to the Secretariat reaching 87% in 2020 (**Fig. 10**). The reporting quality of nominal catch data varies between species and over time and information on quality is available on a species-specific basis from the data review papers on black marlin (IOTC 2022a), blue marlin (IOTC 2022b), striped marlin (IOTC 2022d), Indo-Pacific sailfish (IOTC 2022c), and swordfish (IOTC 2022e).

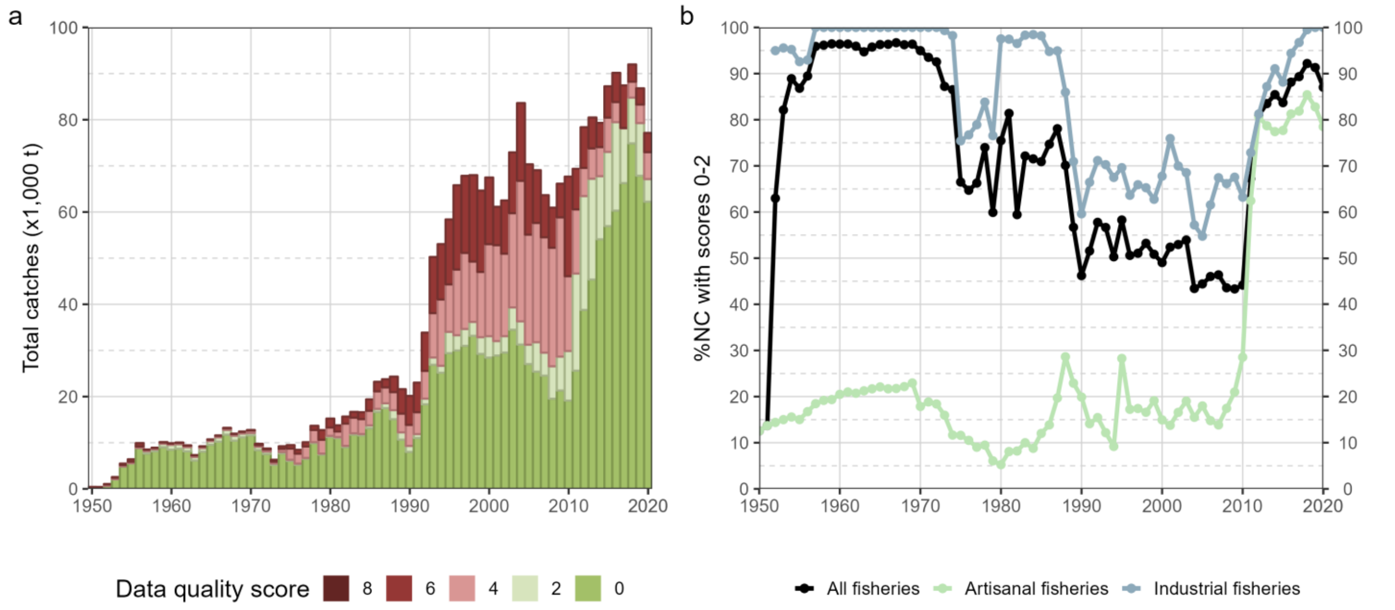

Figure 10: (a) Annual nominal catches (metric tons; t) of IOTC billfish species estimated by quality score and (b) percentage of nominal catches fully or partially reported to the IOTC Secretariat for all fisheries and by type of fishery, in the period 1950-2020

In 2020, 81% of the nominal catches of billfish were fully reported to the Secretariat while the rest had to be partially or fully estimated. Part of the nominal catches was derived from alternative sources of catch data for both non-IOTC members and IOTC CPCs that have not reported data to the Secretariat (Appendix I - Table 8). In addition, a re-estimation process was applied to the catches from the artisanal fisheries of India and Indonesia, which are known to be affected by data quality issues, in particular regarding the reporting of catch data for species and gear aggregates (Appendix I).

In addition to the reporting issues, several other key elements of concern emerge from the available nominal catches of some CPCs, that need to be noted and addressed to improve the fisheries statistics of the five IOTC billfish species:

- Artisanal fisheries (including sport fisheries)
  - Billfish catches for Indonesian artisanal fisheries have been estimated at very high levels in the last decade, reaching around 15-19% of the total catches of billfish in the Indian Ocean. In 2012 the Secretariat revised the nominal catch dataset for Indonesia, using information from various sources, including official reports (Moreno et al. 2012). While Indonesia is implementing a number of improvements to the collection and validation of data for artisanal fisheries, such as electronic logbooks and complete enumeration of catches at key landing sites, catches are still considered to be uncertain for Indonesian small-scale fisheries;
  - Sport fisheries of Australia, France (La Réunion), India, Indonesia, Madagascar, Mauritius, Oman, Seychelles, Sri Lanka, Tanzania, Thailand and United Arab Emirates: data have either never been submitted, or are available for only a limited number of years for sport fisheries in each of the referred CPCs. Sport fisheries are known to catch billfish species, and are particularly important for catches of blue marlin, black marlin and Indo-Pacific sailfish. Although some data are available from sport fisheries in the region (e.g., Kenya, Mauritius, Mozambique, South Africa), the information cannot be used to estimate levels of catch for other fisheries. In 2017 the IOTC Secretariat commissioned a pilot project to develop tools and training materials for CPCs to improve the collection and reporting of catch-and-effort and size frequency from sport fisheries in the Western Indian Ocean (Pepperell et al. 2017). The project focused on trialling specifically-developed data collection tools on a small number of CPCs, including La Réunion, Kenya, Mauritius and Seychelles – however data reporting continues to be an on-going issue for sports and recreational fisheries.

- The gillnet fisheries of I.R. Iran and Pakistan are estimated to account for around 22,000 t of catches of billfish (equivalent to about 24% of the total billfish catches in the Indian Ocean). However, catches for these components remain uncertain for several reasons:
  - In recent years (from 2012 onwards) I.R. Iran has reported catches of marlins and swordfish for their gillnet fishery which significantly revises the catch-by-species previously estimated by the IOTC Secretariat. While the IOTC Secretariat has used the new catch reports to re-build the historical series for its offshore gillnet fishery (pre-2012), the resulting estimates are thought to be highly uncertain;
  - In 2019, the IOTC WPDCS and SC endorsed the revised catch series (from 1987 onwards) officially provided by the Pakistan government for its gillnet fleet, based on the results of the work from the data collection programme supported by WWF-Pakistan. These revised catch series introduce large differences in the reported catches of billfish species, in particular for swordfish, striped marlin and Indo-Pacific sailfish that are now far lower than what originally reported (IOTC 2019). As a consequence, current catch estimates for Pakistan account for around 6% of the total catches of billfish in the Indian Ocean, and still suffer from the lack of detailed per-species information for several years (in fact, until 2017 catches were reported as “generic” billfish species, with limited explicit records of Indo-Pacific sailfish appearing throughout the revised time series).
- Industrial longline fisheries
  - Following issues with the reliability of catch estimates of Indonesia’s fresh longline fleet in recent years, in 2018 the IOTC Secretariat developed in collaboration with Indonesia a new methodology of catch estimation that mostly affects Indonesia’s catches of swordfish, striped marlin, and blue marlin (Geehan 2018). The revised catches are significantly lower for Indonesia’s fresh longline fleet in recent years, compared to previous IOTC estimates, while total catches across all fleets have also been revised downwards by as much as 30% for each species as a consequence of the new estimation methodology. The methodology was not applied to the catches for 2019;
  - Despite a decrease in the number of fresh-longline vessels from Taiwan,China by around 30% between 2013-2016, catches have remained at similar levels, or even marginally increased as average catches per vessel have risen from 100 t per vessel in 2013 to around 175 t per vessel in 2016. Over the same period, the proportion of swordfish reported by the fresh longline fleet from Taiwan,China has risen from around 8% to over 30% - due to improvements in the estimation of catches by species, according to official sources. Both these issues (i.e., the sharp increase in average catches per vessel and changes to the species composition) require further clarification to ensure that the recent increase in average catches is valid.
- Industrial purse seine fisheries
  - Catches of billfish recorded by all industrial purse seiners are thought to be a fraction of those retained on board. Due to the species being a bycatch, catches are seldom recorded in the logbooks although information collected through the ROS shows that some purse seine fleets do retain billfish for marketing.

Discard levels

The total amount of billfish species discarded at sea remains unknown for most fisheries and time periods despite the obligation to report these data as per IOTC Res. 15/02. Furthermore, the implementation of IOTC Res. 18/05 that bans the release of specimens of billfish smaller than 60 cm FL may have modified discarding practices in recent years. Despite the lack of information available, discarding of billfish species is overall considered to be limited in most coastal and industrial fisheries targeting tuna and tuna-like species in the IOTC area of competence.

Purse seine fisheries

In large-scale purse seine fisheries, part of the billfish has been shown to be discarded at sea despite the entry in force of IOTC Res. 19/05 that bans the discard of non-targeted species caught with purse seine. The levels of bycatch of billfish in Indian Ocean purse seine fisheries have been shown to be low and dominated by marlins, although sailfish may occasionally be caught (Romanov 2002, Ruiz et al. 2018). Based on a large data set of observations at sea collected during the period 2008-2017, the annual catch levels of billfish in the main component of the Indian Ocean purse seine fishery were estimated to vary between 100 and 400 t per year (Ruiz et al. 2018), providing an upper limit for the discard levels.

Information available in the ROS regional database for purse seine fisheries covers the period 2005-2020 and the whole fishing grounds of the purse seine fishery (**Fig. 11**). The discards are dominated by black and blue marlins while discards of sailfish and swordfish are very small, in line with the levels of bycatch for each species. Data show that 29% of all billfish for which the fate was known was discarded at sea, with the very large majority of the fish ending up dead (~97.5%). Interestingly, the data also show that the level of discarding of billfish in purse seine fisheries depends on the fleet, with an overall percentage of discarding of 42.6% for purse seiners from France and 10.7% and 14.1% for Seychelles and Spain, respectively. For the three fleets, the proportion of discards shows a decrease over time, indicating the growing tendency of the industry for marketing billfish species.

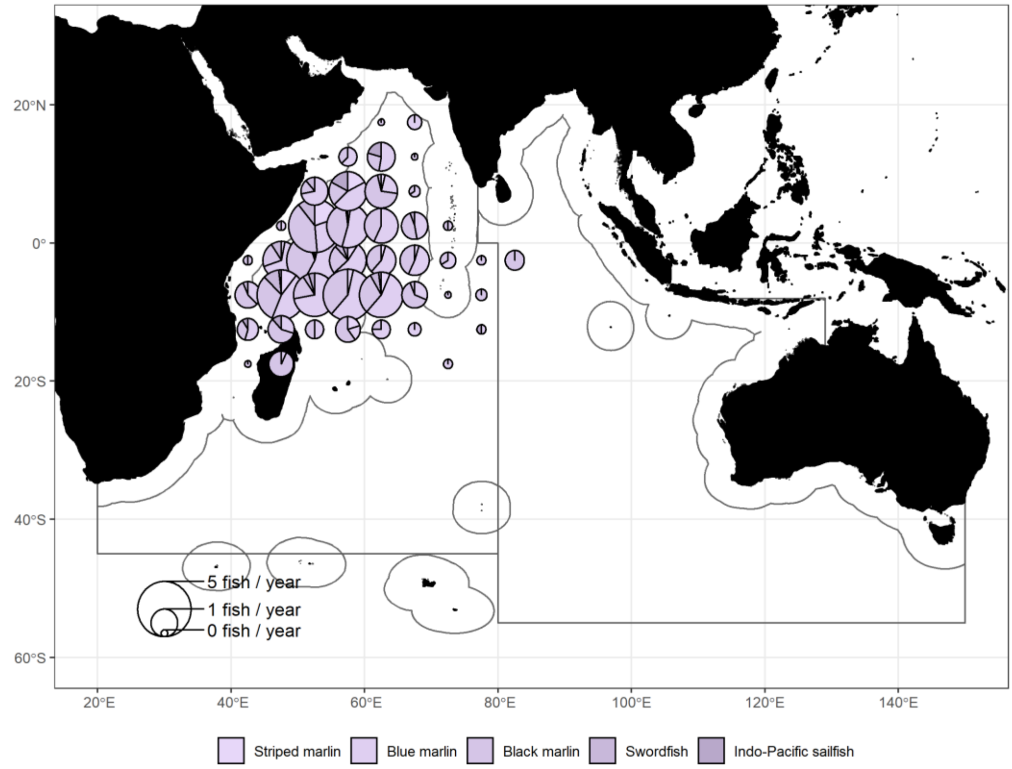

Figure 11: Distribution of all observations of billfish discarded at sea in the western Indian Ocean purse seine fishery with information on fate as available in the ROS regional database

Size data collected by observers at sea for billfish caught in the purse seine fishery show no significant difference between retained and discarded specimens (**Fig. 12**). The size of the three marlin species is very similar across species. The median fork length is about 215-230 cm, with the capture of the largest individuals showing larger sizes in black marlin (75% quantile = ~270 cm FL), followed by blue marlin (75% quantile ~250 cm FL), and striped marlin (75% quantile = ~235 cm FL). The median sizes of sailfish and swordfish are 183.5 cm FL and 200.5 cm FL, respectively.

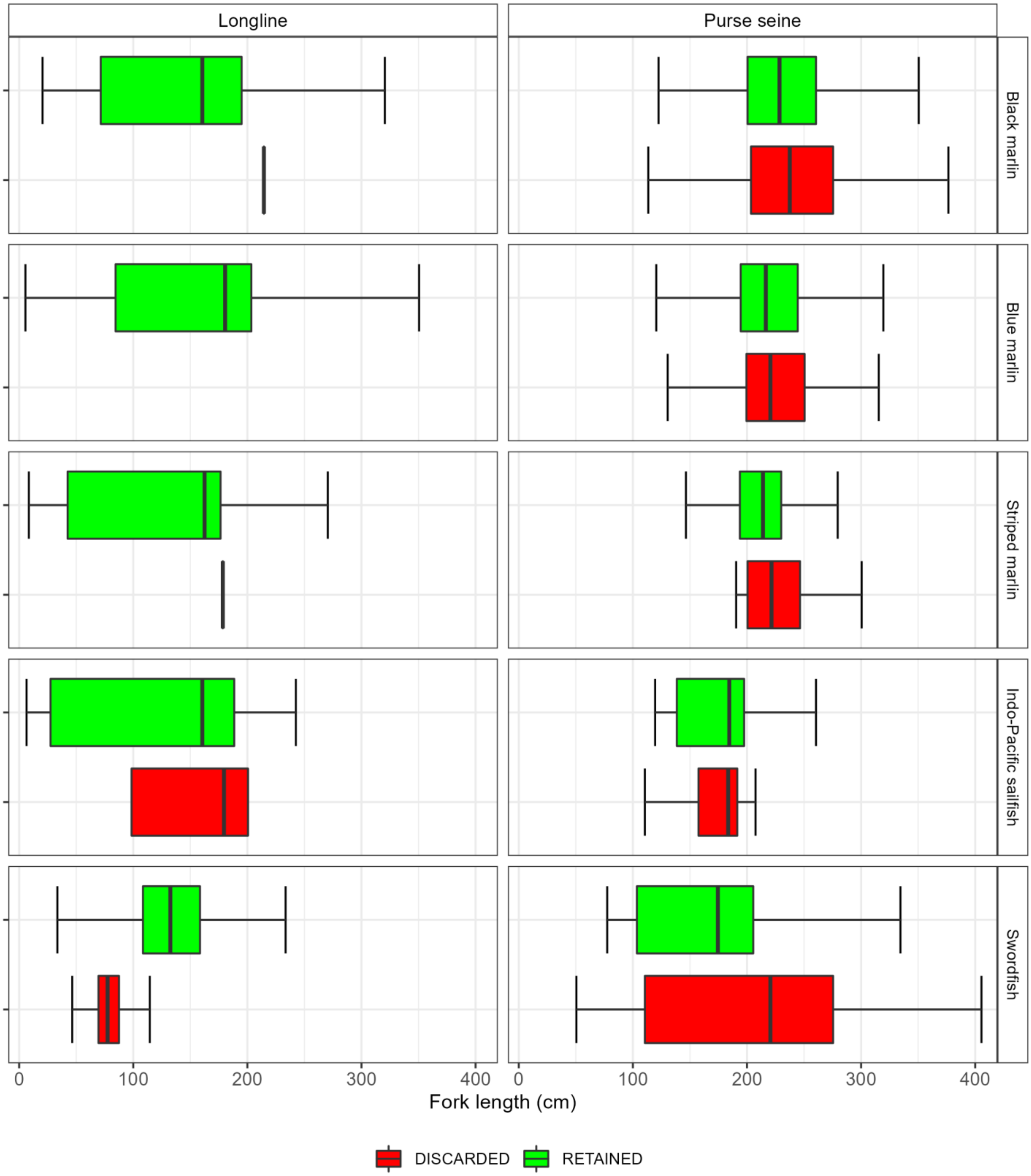

Figure 12: Boxplots of size measurements (fork length; cm) of billfish species caught and discarded at sea in purse seine and longline fisheries as available in the ROS regional database

Longline fisheries

Information from the literature indicates that levels of discards of billfish are low in Indian Ocean longline fisheries (Huang & Liu 2010, Gao & Dai 2016). Discarding is mainly due to under size, damaged condition, and depredation by whales and sharks that has been shown to be substantial in some longline fisheries of the western Indian Ocean (Munoz-Lechuga et al. 2016, Rabearisoa et al. 2018).

Information available in the ROS regional database for longline fisheries covers the period 2009-2020 and a small part of the longline fishing grounds as the data are limited to EU,France, Japan, and Sri Lanka. The discards of billfish in these fisheries appear to be low for billfishes and sailfish, i.e., from 0% discard in the longline fishery of Sri Lanka to a maximum of about 5% for blue marlin and swordfish in the longline fishery of Japan. Discarding appears to be the highest for swordfish in the swordfish-targeted longline of Reunion Island where the overall discarding rate during 2009-2019 was about 14.2%. This apparent high discard rate may be partly explained by the high levels of depredation observed in this fishery (Romanov et al. 2013, Rabearisoa et al. 2018). However, size data available in the ROS show a significant difference between the swordfish retained and discarded in the fishery, with the latter being ~60 cm smaller than the former, on average (**Fig. 12**). Further analysis accounting for the variability of discarding in space and time, differences in vessel attributes (e.g., size), etc. is required to accurately assess the extent of and causes of discarding in this fishery and other longline fisheries when data become available.

Gillnet fisheries

In absence of market value, marlins and swordfish have been assumed to be discarded in some gillnet fisheries such as in I.R. Iran although information available for this fishery suggests that billfish are retained and landed (Rajaei 2013, Shahifar et al. 2013).

Geo-referenced catch and effort

Time series of nominal effort

Some information is available on nominal effort for both artisanal and industrial fisheries having caught billfish species over the last seven decades. Nevertheless, the completeness and continuity of the time series of effort reported to the Secretariat greatly varies between fisheries and fleets. Furthermore, several different units of effort may have been used over time for some fisheries, and the spatial-temporal resolutions and reporting coverage for a given fleet may also vary between years (**Tables 6-7**).

Table 6: Geo-referenced data on artisanal fishing effort available at the IOTC Secretariat for each fishery group with information on the number of years and spatial fishing grounds used for teporting the data. FDAYS = Fishing days; FHOURS = fishing hours; MD = men-day

Fishery type	Fishery group	Unit	Years	Start year	End year	Fishing grounds
Artisanal fisheries	Purse seine	FDAYS	1	2020	2020	1
		TRIPS	8	1986	2020	5
	Line	BOATS	10	2001	2013	8
		DAYS	26	1985	2019	26
		FDAYS	21	2000	2020	94
		FHOURS	4	2012	2016	1
		HOOKS	26	1995	2020	322
		MD	1	2016	2016	1
		TRIPS	16	1985	2020	15
	Baitboat	FDAYS	7	2013	2020	29
		TRIPS	1	1987	1987	1
	Gillnet	BOATS	3	2011	2013	5
		DAYS	5	1979	2018	11
		FDAYS	5	1987	1991	1
		SETS	1	2019	2019	2
		TRIPS	34	1985	2020	19
	Other	BOATS	2	2011	2012	3
		DAYS	1	2002	2002	1
		TRIPS	30	1985	2020	7

Table 7: Geo-referenced data on industrial fishing effort available at the IOTC Secretariat for each fishery group with information on the number of years and spatial fishing grounds used for teporting the data. FDAYS = Fishing days

Fishery type	Fishery group	Unit	Years	Start year	End year	Fishing grounds
Industrial fisheries	Purse seine	SETS	6	2013	2020	68
		TRIPS	7	2014	2020	79
	Longline	BOATS	2	2010	2011	1
		DAYS	10	1998	2008	184
		FDAYS	16	1998	2015	631
		HOOKS	69	1952	2020	1,336
		SETS	5	2003	2008	37
		TRIPS	19	2001	2020	63
	Line	FDAYS	3	2018	2020	14
		TRIPS	3	2014	2016	9
	Baitboat	FDAYS	3	2018	2020	8
	Gillnet	NETS	6	1986	1991	76
		TRIPS	14	2007	2020	416

Information on fishing effort is generally missing for the main artisanal fisheries catching billfish in the areas of national jurisdiction of India, Indonesia, and Pakistan. Time series of effort data have been collected for and reported by the coastal gillnet fisheries of I.R. Iran (2007-2020) and Sri Lanka (1987-2020), with the effort expressed in number of fishing trips for both fleets, although the duration of the trips may strongly vary between vessels and over the years (Fu et al. 2019). In addition, fisheries from Sri Lanka use a combination of longline and gillnet gears without systematic information collected on the breakdown of these gears over time (Herath & Maldeniya 2013), which affects the accuracy of the effort time series available.

Beside these, very few other fisheries target billfish except for the longline fisheries of Australia, EU,Spain, EU,France (Reunion), EU,Portugal, Seychelles, and Mauritius that mostly target swordfish but may have switched to other species such as sharks or tunas over time. Hence, most time series of catch per unit effort (CPUE) for billfish are only available for industrial longline fisheries and described by high proportions of zeros that need to be accounted for in the standardisation process (Lin et al. 2022, Matsumoto et al. 2022).

Spatial distribution of the catch

Geo-referenced catch data for billfish species have been reported to the Secretariat in numbers, weights, or both. Data provided by CPCs have not been systematically raised to the total catches although IOTC Res. 15/02 explicitly calls for data raising and documents describing in detail the adopted extrapolation procedures. Consequently, maps of catch distribution in numbers and weights presented below mainly aim at describing the spatial patterns of the fisheries and should be interpreted with care as the reporting coverage might vary between years and species. Species-specific maps of catch are available from the data review papers on black marlin (IOTC 2022a), blue marlin (IOTC 2022b), striped marlin (IOTC 2022d), Indo-Pacific sailfish (IOTC 2022c), and swordfish (IOTC 2022e).

Most spatial information available on billfish catches between 1950 and 1999 comes from large-scale longline fisheries of Japan, Taiwan,China, and Korea while few geo-referenced catch data have been reported for the most important artisanal fisheries, with the notable exception of Sri Lankan coastal gillnet and longline fisheries from the mid-1980s

(**Figs. 13-14**). Historical maps of catch show the large distribution of billfish across the whole Indian Ocean with a major "hotspot" of catches of black and blue marlins identified in northwestern Australia throughout the 1950s and 1960s (**Fig. 13**). The importance of this "hotspot" decreased throughout the following decades, while catch levels started to become particularly high off the coasts of Somalia during the 1990s and 2000s.

In the last decade, reported geo-referenced catches of billfish caught with longline have been mainly concentrated off the coasts of Somalia and around the Seychelles.

However, there has been a major decline in catches of the species during recent years in the area identified as a marlin hotspot, with the main longline fishing grounds appearing to be located now more south of the area in 2018-2019 (i.e., between 20°S and the equator and 40-70°E) (Fig. 17).

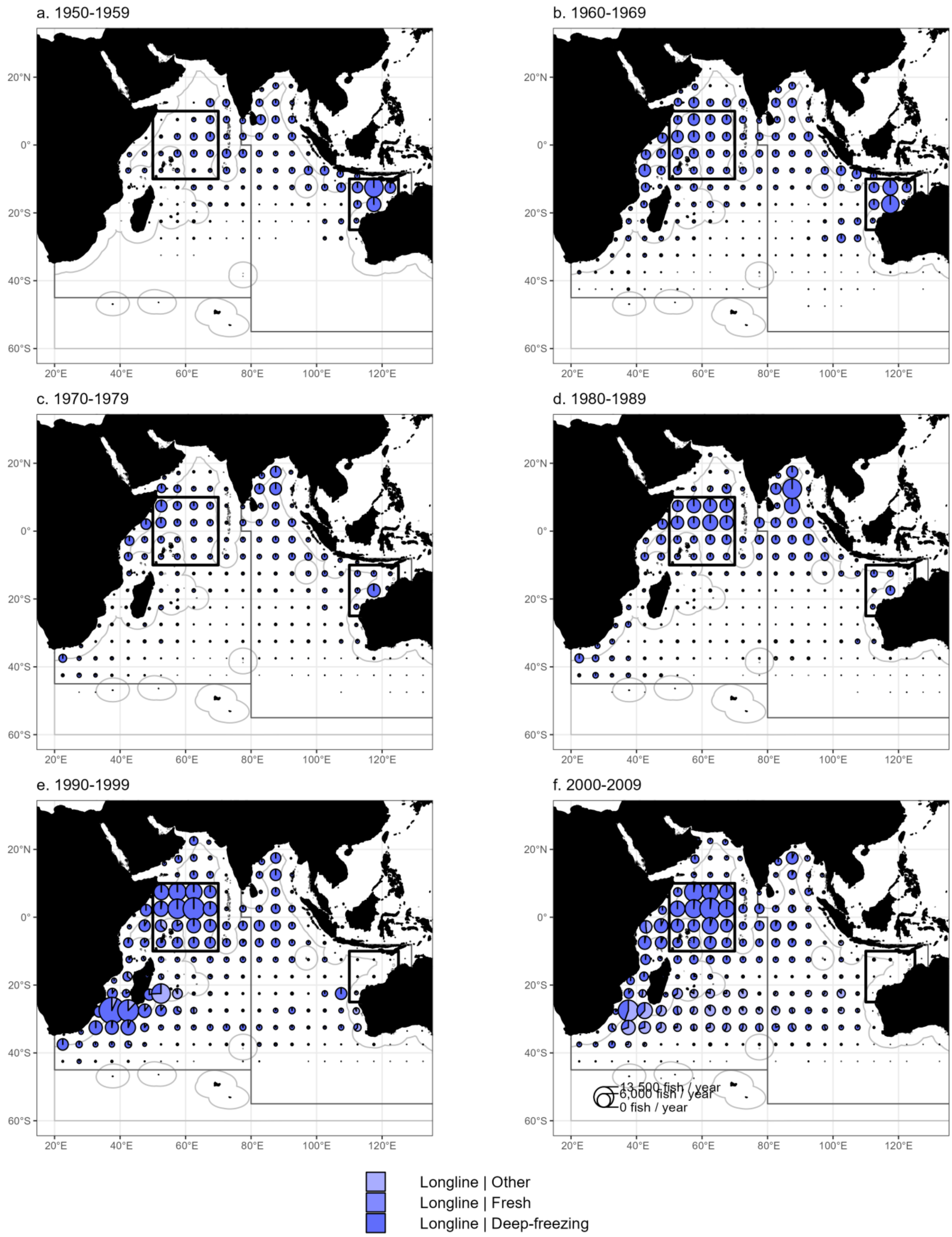

Figure 13: Mean annual time-area catches (in number of fish) of billfish for the period 1950-2009, by decade and fishery. Black solid lines represent the marlin main longline fishing grounds identified by the IOTC WPB

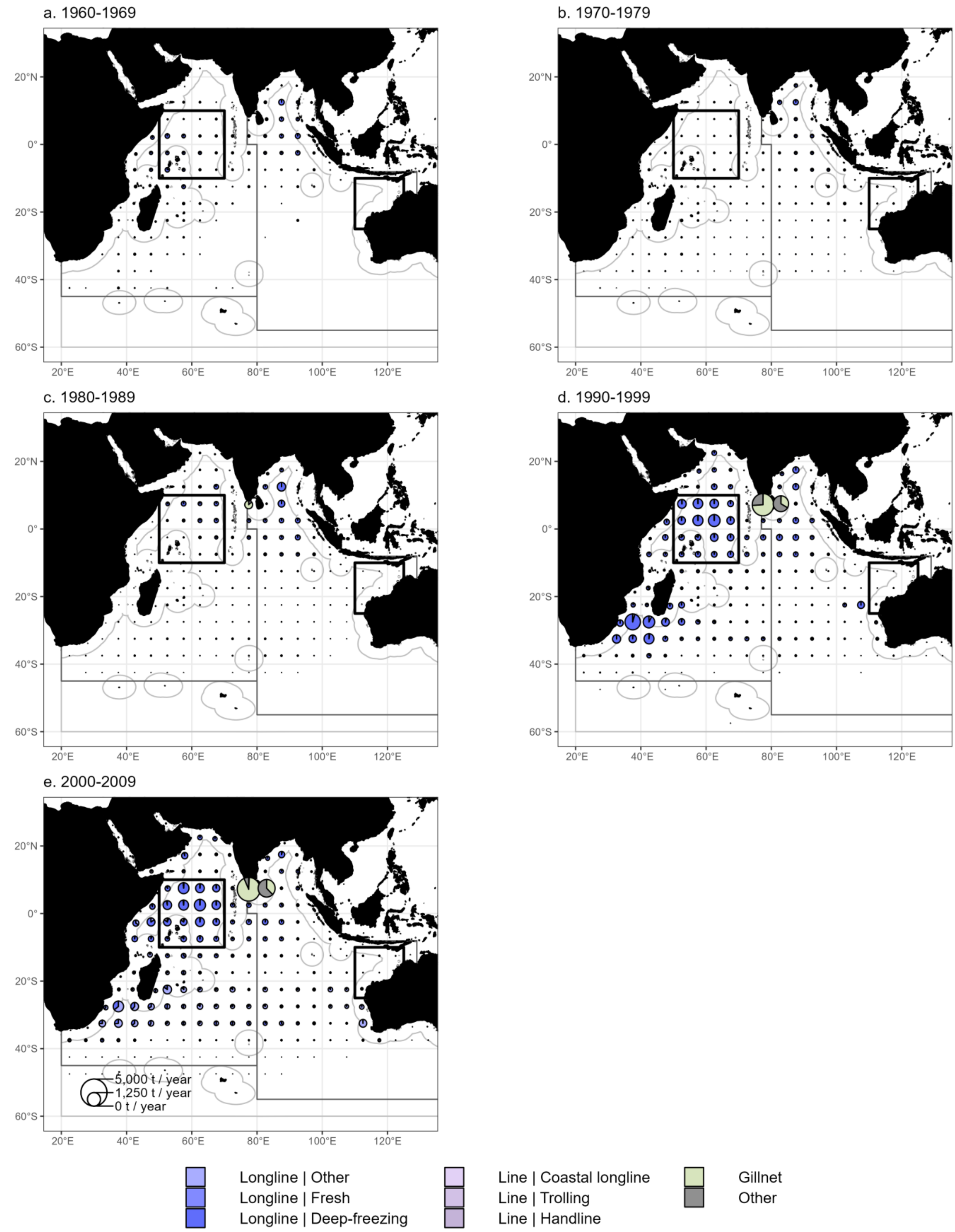

Figure 14: Mean annual time-area catches (in weight of fish) of billfish for the period 1950-2009, by decade and fishery. Black solid lines represent the marlin main longline fishing grounds identified by the IOTC WPB

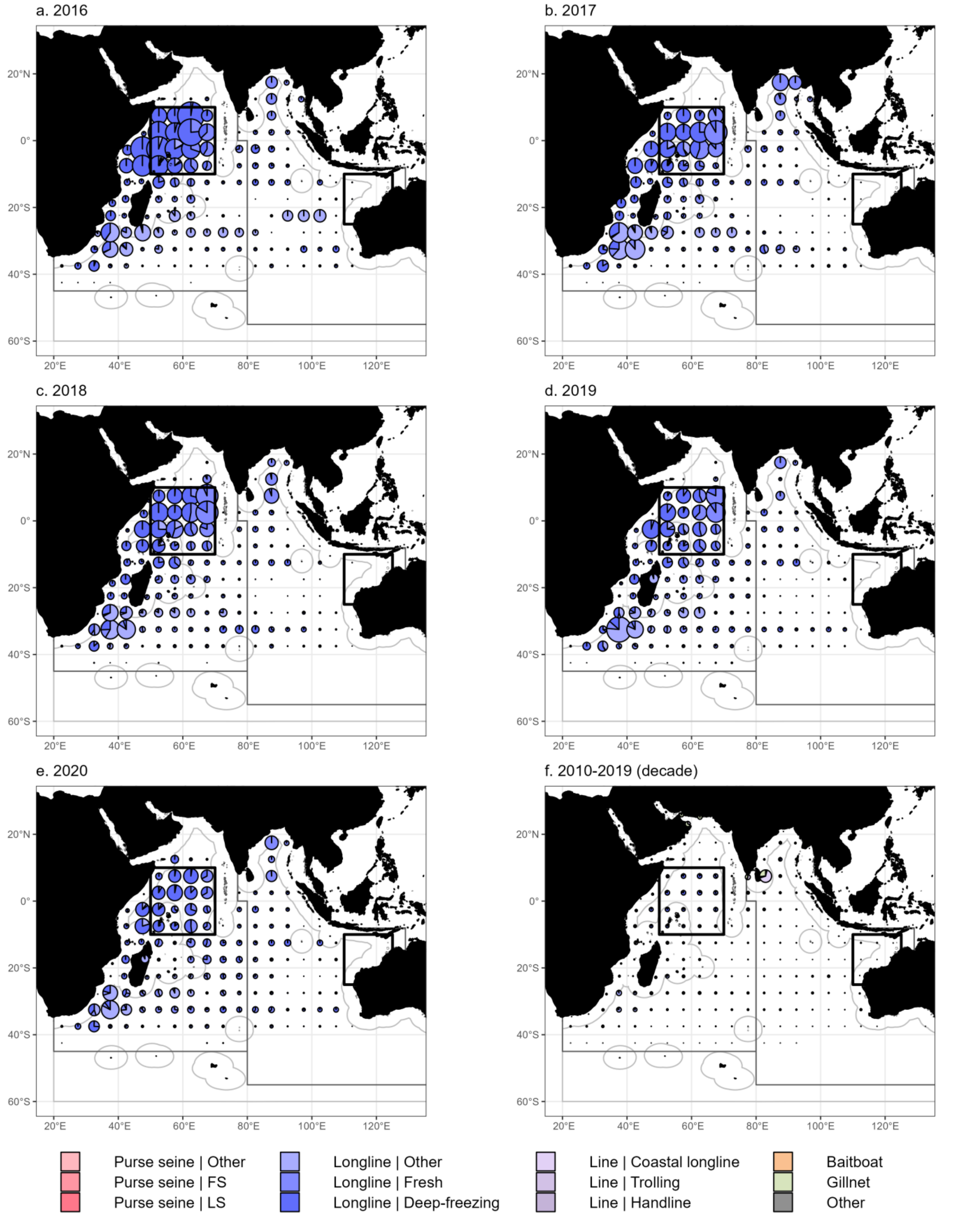

Figure 15: Mean annual time-area catches (in number of fish) of billfish for the last decade 2010-2019 and each year during the recent period 2016-2020. Black solid lines represent the marlin main longline fishing grounds identified by the IOTC WPB

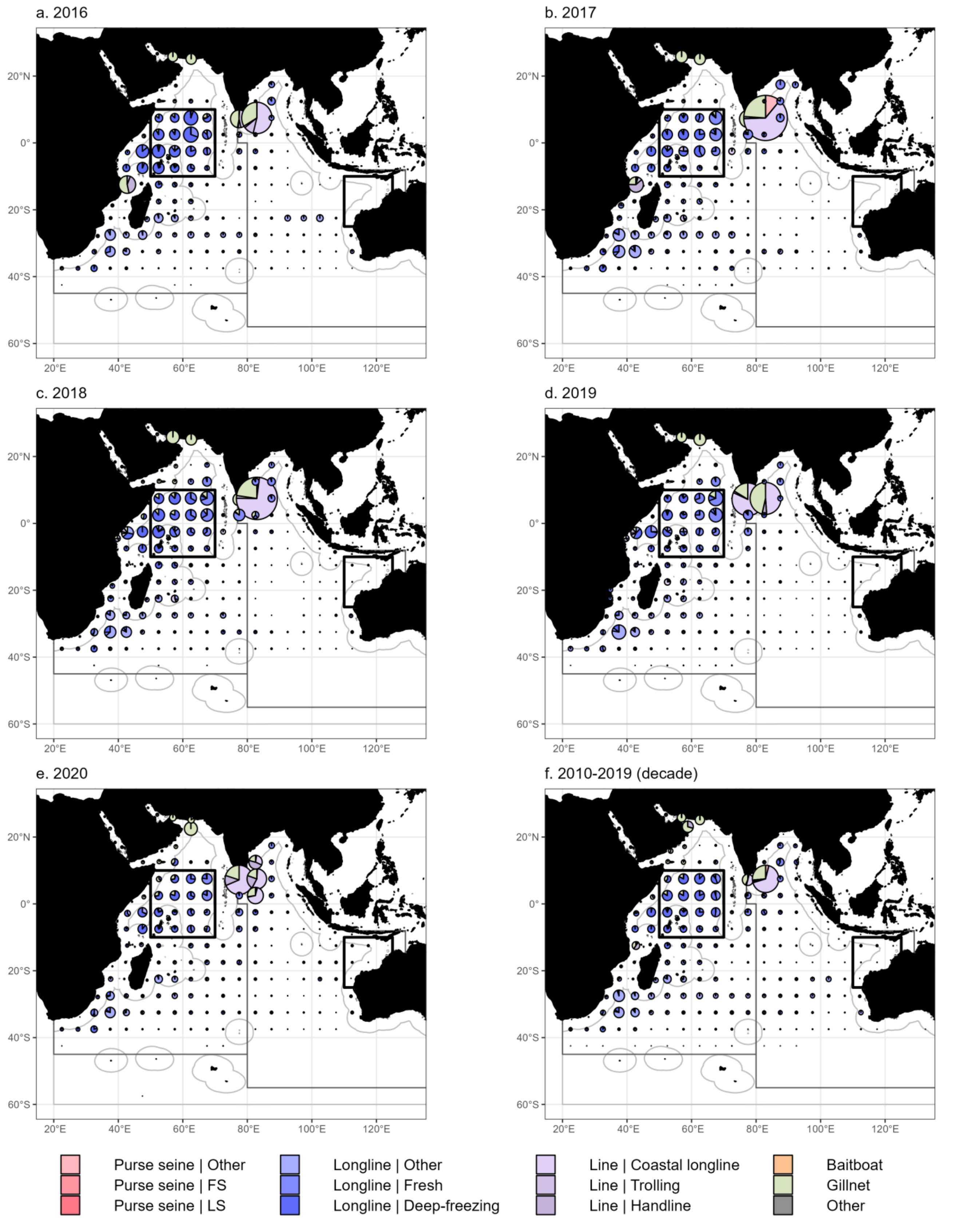

Figure 16: Mean annual time-area catches (in weight of fish) of billfish for the last decade 2010-2019 and each year during the recent period 2016-2020. Black solid lines represent the marlin main longline fishing grounds identified by the IOTC WPB

Uncertainties in catch and effort data

Overall, the general trend in quality is driven by the changes in fishing patterns that occurred in the Indian Ocean over the last decades, reflecting the increased contribution of artisanal fisheries to the total catches of billfish species over time (**Fig. 17**). The reporting quality shows a decreasing trend between the mid-1950s and early-2010s before sharply increasing over the last decade. The percentage of good-quality catch and effort data (scores of 0-2; **Table 3**) decreased from more than 80% in the late 1950s to a minimum of about 30% in the mid-2000s (**Fig. 17**). The situation has however improved over the last decade with the increasing reporting of catch and effort for some artisanal fisheries (e.g., Indonesia, Sri Lanka), although the logbook coverage used to derive the spatial distribution of the catch for these fisheries is generally reported to be low (<30%). The reporting quality of geo-referenced catch and effort data varies between species and over time and information on quality on a species-specific basis is available from the data review papers on black marlin (IOTC 2022a), blue marlin (IOTC 2022b), striped marlin (IOTC 2022d), Indo-Pacific sailfish (IOTC 2022c), and swordfish (IOTC 2022e).

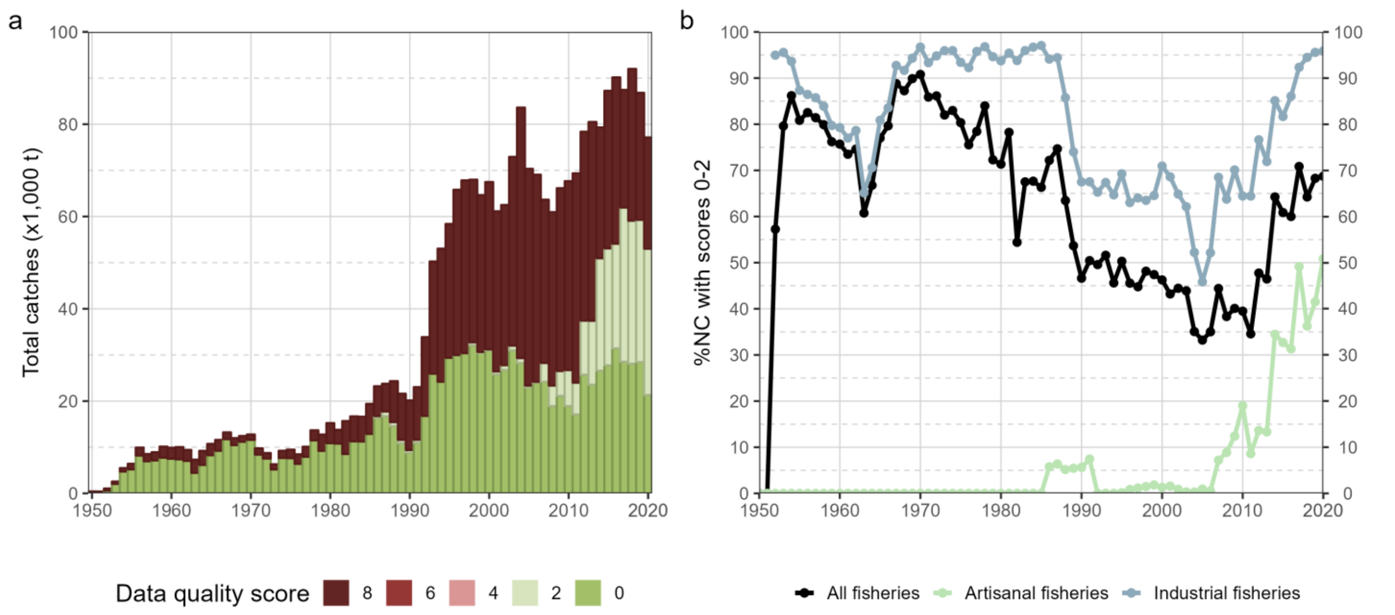

Figure 17: (a) Annual nominal catches of IOTC billfish species (metric tons; t) estimated by quality score and (b) percentage of nominal catches by type of fishery with good quality information (i.e., logbook coverage >30% and compliant with IOTC standards) for the corresponding geo-referenced catch and effort data reported to the IOTC Secretariat

Size composition fo the catch

Size sample availability

The number of billfish sampled for size is largely dominated by longline fisheries which represent 97.5% of all size data available in the IOTC database for billfish species. While large numbers of samples were collected from longline fisheries in the mid-2000s, the sampling showed a major decreasing trend thereafter, in agreement with the decline of the catch reported for this fishery group (see section Nominal catches and discards). Some size data were collected in large numbers (~10,000 samples per year) between the late 1980s and mid-1990s in the gillnet fishery of Sri Lanka through the Indo-Pacific Tuna Program (IPTP), representing the main source of samples from longlines during that period (**Fig. 18**). The number of samples collected in this fishery substantially decreased to about 1,000 fish per year thereafter, with very few samples having been collected for all other fisheries since the 1950s.

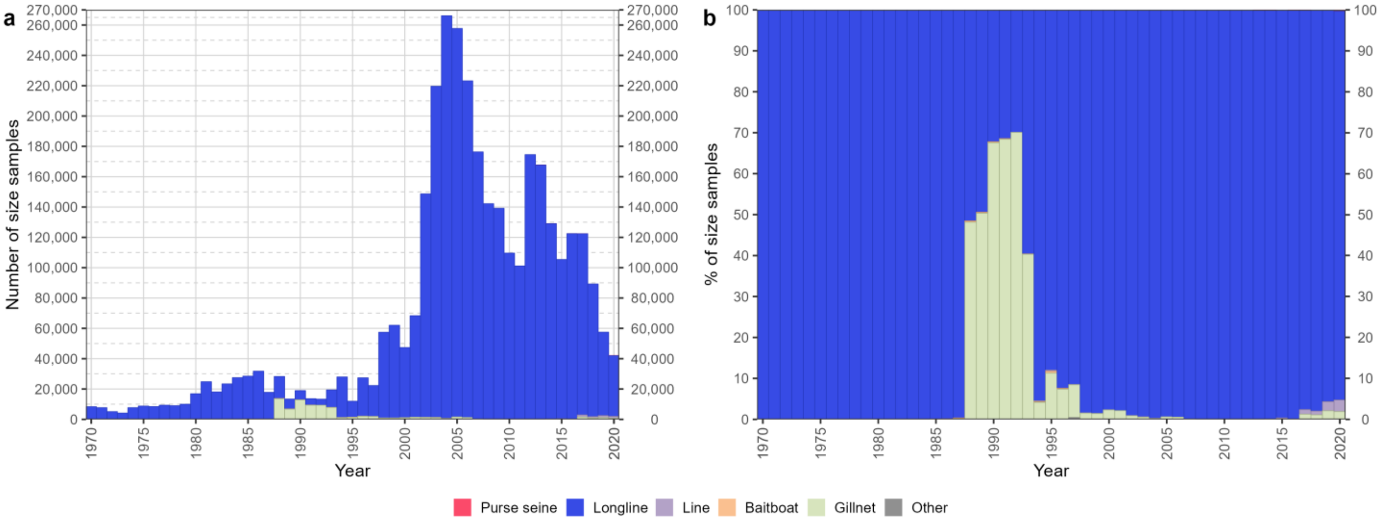

Figure 18: (a) Annual number and (b) relative proportion (%) of billfish standard size samples available by fishery group at the IOTC Secretariat

The number of size samples available for billfish species is very unbalanced and not representative of the importance of each species in the nominal catches. About 80% of all samples are available for swordfish (**Fig. 19**).

Figure 19: Percentage of size samples by species for all standard size samples available at the IOTC Secretariat

Besides the regular data submission by the CPCs, the Secretariat also holds size frequency data collected at sea by scientific observers, which provide size information on bilfish taken in industrial purse seine and longline fisheries (See section Discard levels). Information on size sample availability and distribution on a species-specific basis is available from the data review papers on black marlin (IOTC 2022a), blue marlin (IOTC 2022b), striped marlin (IOTC 2022d), Indo-Pacific sailfish (IOTC 2022c), and swordfish (IOTC 2022e).

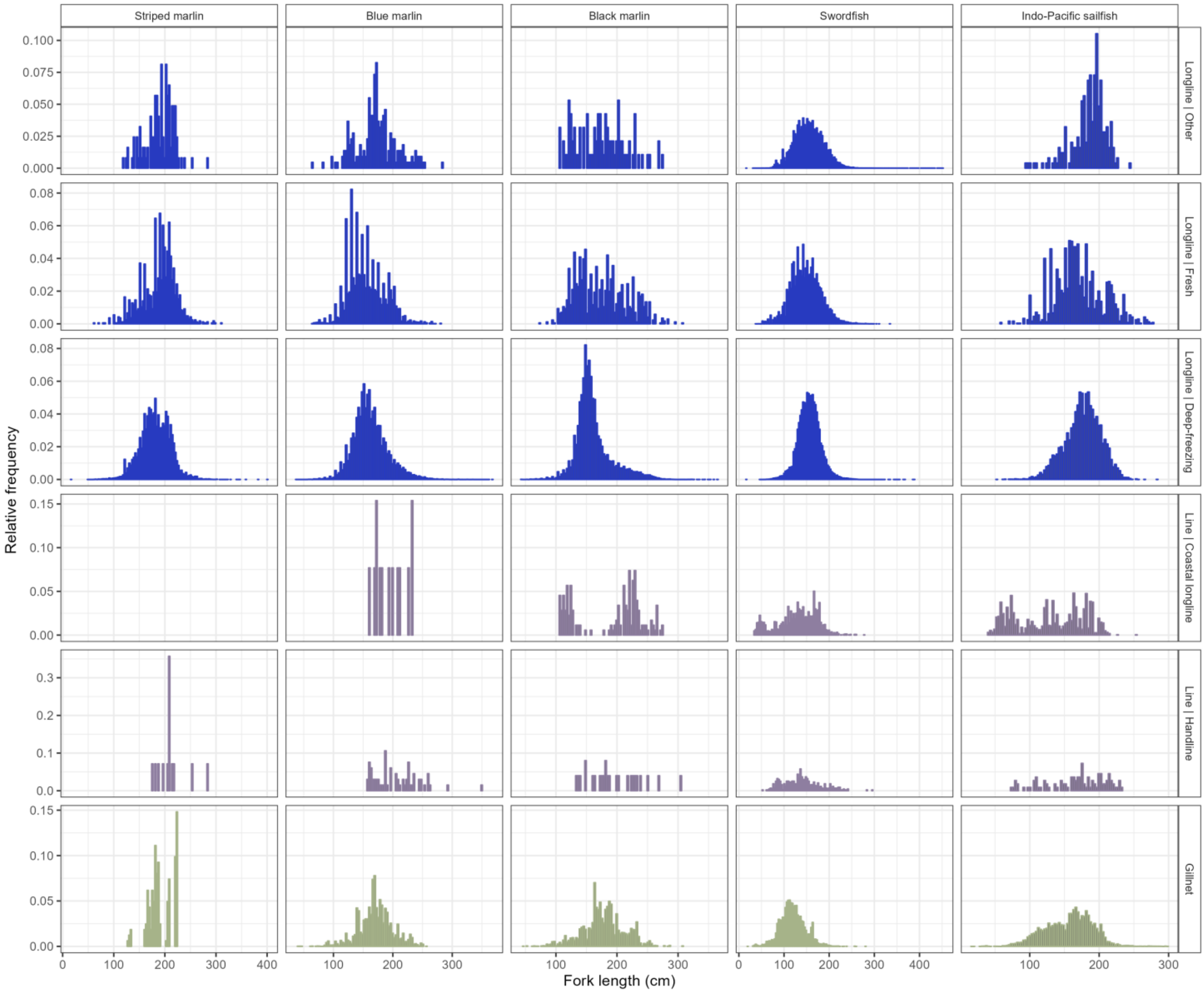

Figure 20: Relative size distributions (fork length; cm) by billfish species and fishery based on all samples available at the Secretariat. Fisheries with less than 500 samples are not shown

Uncertainties in size-frequency data

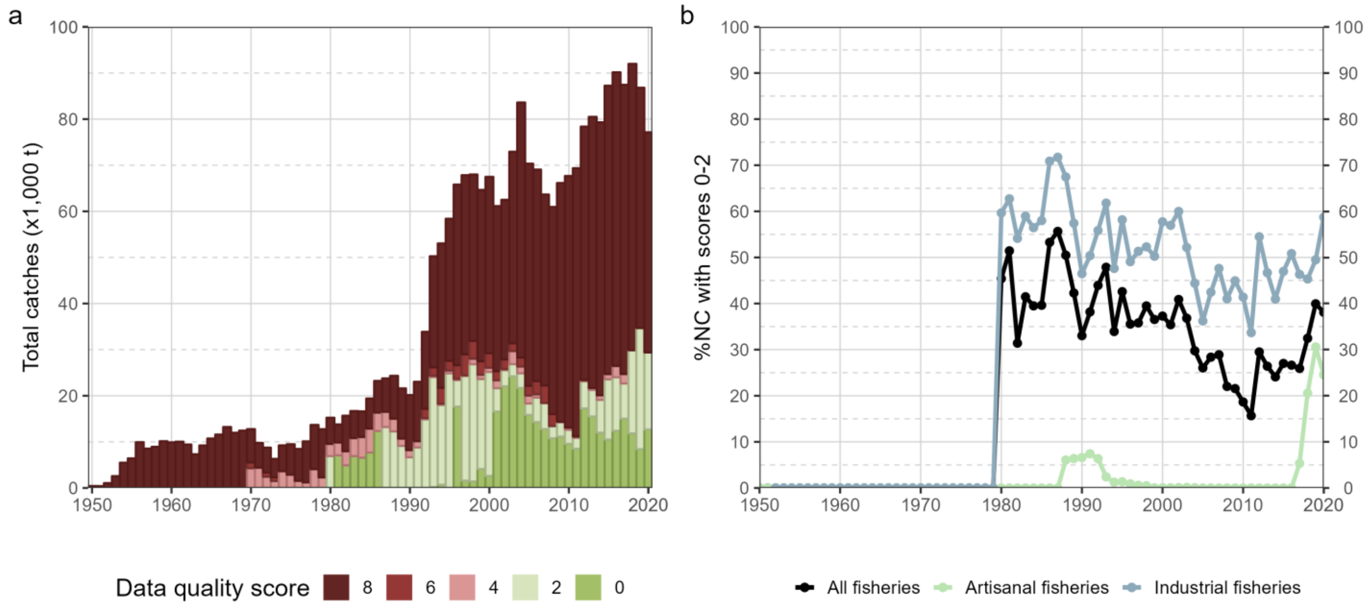

Figure 21: (a) Annual nominal catches of IOTC billfish species (metric tons; t) estimated by quality score and (b) percentage of nominal catches by type of fishery with good quality information (i.e., >1 fish per metric ton caught and compliant with IOTC standards) for the corresponding geo-referenced size frequency data reported to the IOTC Secretariat

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Appendix II: Best scientific estimates of nominal catches for 2020

The overall amount of nominal catches fully estimated in 2020 is 6,829 t, for 11 distinct fleets, representing 8.1% of total catches of IOTC billfish species for the final year of the time series (**Table 8**).

The estimation of the catch data includes three processing steps. First, nominal catches are estimated by the Secretariat for IOTC CPCs as well as non-members that either did not report any catch for 2020 or whose catches were available from other sources. For non-members (United Arab Emirates, Djibouti, Jordan, and Saudi Arabia) and Yemen, catches were preferentially extracted from the FAO Global Capture Production database and further broken down into species (when necessary) and fishing gears based on knowledge of the fisheries present in each of the countries (**Table 8**). For IOTC members that did not report any data (Kenya and Mozambique) or inconsistent data (Madagascar and Tanzania) for some of their fisheries in 2020, nominal catches were repeated from 2019 (**Table 8**).

Table 8: Data source and final estimates of catches (metric tons; t) of IOTC billfish species for non-members (NM) and members (MP) of the IOTC that reported no or inconsistent data for some or all of their fisheries for the year 2020

Fleet code	Fleet	Status	Source	Catch
ARE	United Arab Emirates	NM	FAO	70
DJI	Djibouti	NM	FAO	16
JOR	Jordan	NM	FAO	31
KEN	Kenya	MP	IOTC	950
MDG	Madagascar	MP	IOTC	862
MOZ	Mozambique	MP	IOTC	232
SAU	Saudi Arabia	NM	FAO	3
TZA	Tanzania	MP	IOTC	2,683
YEM	Yemen	MP	FAO	1,982
ALL	All fleets	-	-	6,829

Second, a re-estimation process was applied to catches reported by the artisanal fisheries of India and Indonesia which builds on a comprehensive review conducted in the early 2010s with the purpose of revising the time series of catch from these specific artisanal fisheries and improve the information available to the IOTC (Moreno et al. 2012). In the case of India, the process modifies the catch composition of the gears by Indian Ocean major area for the gillnet, hook and line, and trolling fisheries. In 2020, the total catch of billfish taken by India was 8,905 t, with most of it estimated to have been taken in coastal longline and gillnet fisheries. In the case of Indonesian coastal fisheries, a fixed proportion of total catch for each species and fishing gear is used to derive the catches of each of the IOTC billfish species based on samples of catch composition available for the period 2003-2011 (Moreno et al. 2012). The process results in a decrease of total billfish catches from 15,582 t (reported through official submissions) to 7,494 t (estimateD), with catches increasing for swordfish and decreasing for the four other species (**Fig. 22**).

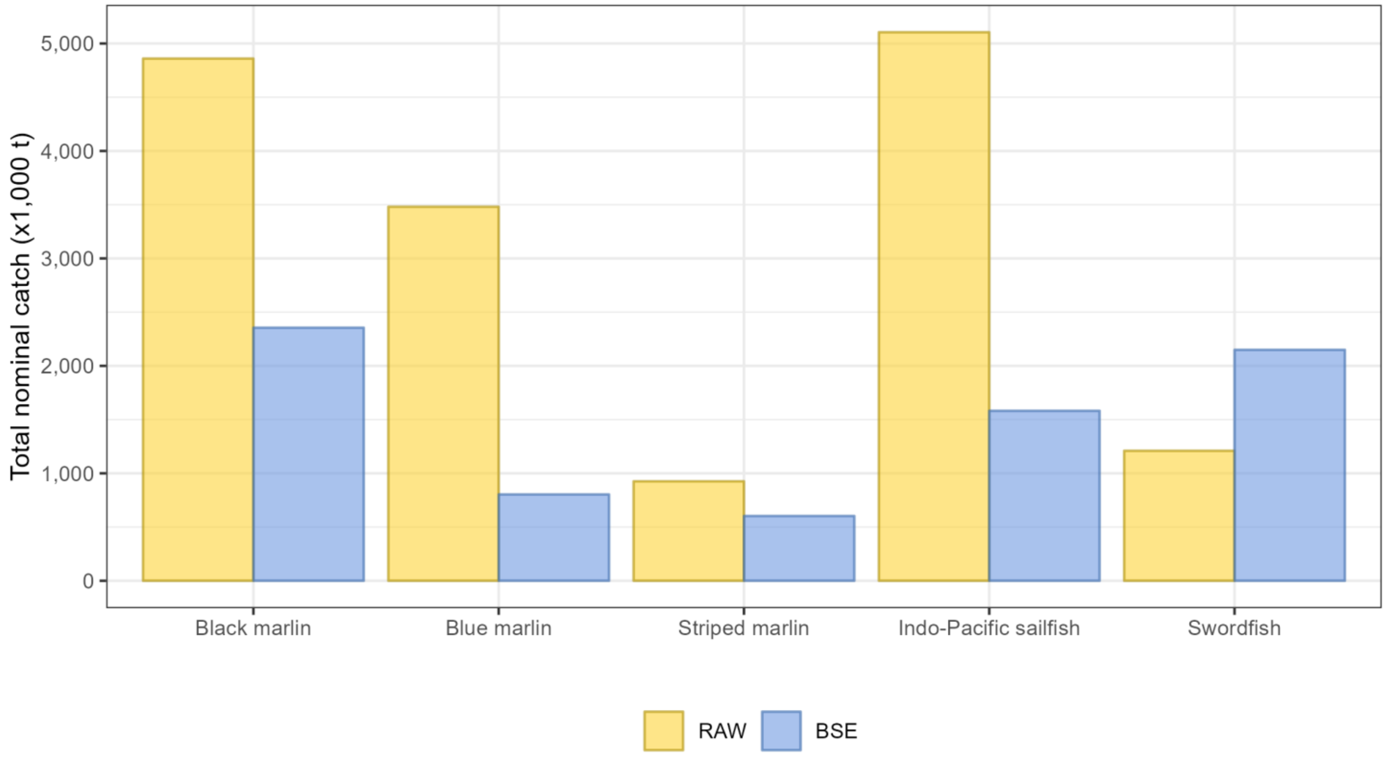

Figure 22: Comparison between the total catches (metric tons; t) of IOTC billfish by Indonesia as submitted to the Secretariat (RAW) and estimated following the current methodology used to derive the best scientific estimates (BSE)

Third, nominal catches reported as species aggregates including IOTC billfish species are further broken down into their single species components to generate the IOTC best scientific estimates (**Table 1**). In 2020, this breakdown by species resulted in the addition of a total of 7,136 t to the catches reported at species level for the five species of interest, corresponding to 8.5% of the final catch estimates (**Fig. 23**).

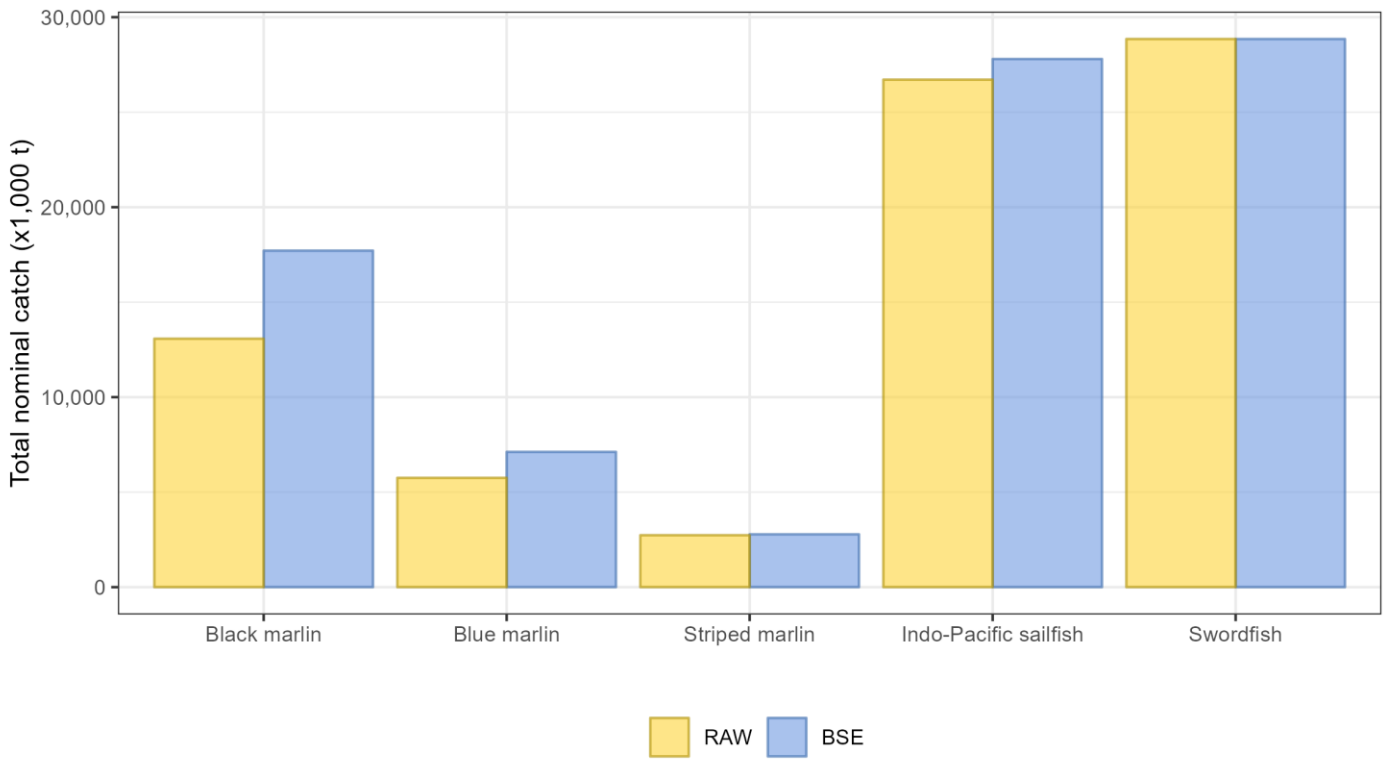

Figure 23: Total catches (metric tons; t) of IOTC billfish species as reported (RAW) and estimated (BSE) after accounting for the catches added through the breakdown of species aggregates

Appendix II: Changes in best nominal catches from previous Working Party

Table 9: Changes in best scientific estimates of nominal catches (metric tons; t) of billfish by year, fleet, fishery group and main Indian Ocean area, limited to absolute values higher than 10 t. Data source: best scientific estimate of nominal catches as estimated annually from 2012 to 2020 for the preceeding statistical year (https://www.iotc.org/WPB/20/Data/03-NC)

Year	Fleet	Fishery group	Area	Current (t)	Previous (t)	Difference (t)
2019	ARE	Gillnet	Western Indian Ocean	69	86	-17
	CHN	Longline	Eastern Indian Ocean	17	3	15
		Longline	Western Indian Ocean	1,435	1,450	-15
	EUFRA	Line	Western Indian Ocean	0	47	-47
	EUGBR	Longline	Western Indian Ocean	0	400	-400
	EUMYT	Line	Western Indian Ocean	47	0	47
	GBR	Longline	Western Indian Ocean	400	0	400
	JOR	Gillnet	Western Indian Ocean	28	0	28
		Line	Western Indian Ocean	11	0	11
	LKA	Gillnet	Eastern Indian Ocean	4,671	3,393	1,278
		Gillnet	Western Indian Ocean	338	1,615	-1,278
		Line	Eastern Indian Ocean	10,121	3,853	6,268
		Line	Western Indian Ocean	0	6,268	-6,268
		Longline	Eastern Indian Ocean	1,222	667	555
		Longline	Western Indian Ocean	3,969	4,525	-555
		Purse seine	Eastern Indian Ocean	66	37	29
		Purse seine	Western Indian Ocean	1	30	-29
	MOZ	Line	Western Indian Ocean	92	72	21
	SYC	Line	Western Indian Ocean	224	4	220
		Longline	Eastern Indian Ocean	0	27	-27
		Longline	Western Indian Ocean	3,148	3,098	50
	YEM	Gillnet	Western Indian Ocean	1,473	186	1,287
		Line	Western Indian Ocean	509	10	499
2018	ARE	Gillnet	Western Indian Ocean	60	86	-26
	EUFRA	Longline	Western Indian Ocean	0	29	-29
	EUGBR	Longline	Western Indian Ocean	0	508	-508
	EUMYT	Longline	Western Indian Ocean	29	0	29
	GBR	Longline	Western Indian Ocean	508	0	508
	JOR	Gillnet	Western Indian Ocean	40	0	40
		Line	Western Indian Ocean	12	0	12

Year	Fleet	Fishery group	Area	Current (t)	Previous (t)	Difference (t)
	LKA	Gillnet	Eastern Indian Ocean	4,077	3,056	1,021
		Gillnet	Western Indian Ocean	188	1,209	-1,021
		Line	Eastern Indian Ocean	9,727	9,497	230
		Line	Western Indian Ocean	0	230	-230
		Longline	Eastern Indian Ocean	1,757	976	781
		Longline	Western Indian Ocean	1,689	2,470	-781
	SYC	Line	Western Indian Ocean	185	4	181
		Longline	Eastern Indian Ocean	0	87	-87
		Longline	Western Indian Ocean	3,708	3,802	-95
	YEM	Gillnet	Western Indian Ocean	1,585	177	1,408
		Line	Western Indian Ocean	397	19	378
2017	EUFRA	Line	Western Indian Ocean	0	12	-12
		Longline	Western Indian Ocean	0	27	-27
	EUGBR	Longline	Western Indian Ocean	0	281	-281
	EUMYT	Line	Western Indian Ocean	12	0	12
		Longline	Western Indian Ocean	27	0	27
	GBR	Longline	Western Indian Ocean	281	0	281
	JOR	Gillnet	Western Indian Ocean	41	0	41
		Line	Western Indian Ocean	11	0	11
	SYC	Line	Western Indian Ocean	258	11	247
		Longline	Eastern Indian Ocean	0	36	-36
		Longline	Western Indian Ocean	2,559	2,771	-212
	YEM	Gillnet	Western Indian Ocean	1,438	158	1,280
		Line	Western Indian Ocean	526	38	488
2016	EUFRA	Line	Western Indian Ocean	0	16	-16
		Longline	Western Indian Ocean	0	26	-26
	EUGBR	Longline	Eastern Indian Ocean	0	63	-63
		Longline	Western Indian Ocean	0	146	-146
	EUMYT	Line	Western Indian Ocean	16	0	16
		Longline	Western Indian Ocean	26	0	26

Year	Fleet	Fishery group	Area	Current (t)	Previous (t)	Difference (t)
	GBR	Longline	Eastern Indian Ocean	63	0	63
		Longline	Western Indian Ocean	146	0	146
	JOR	Gillnet	Western Indian Ocean	22	0	22
		Line	Western Indian Ocean	13	0	13
	SYC	Line	Western Indian Ocean	224	0	224
		Longline	Western Indian Ocean	3,395	3,618	-224
	YEM	Gillnet	Western Indian Ocean	1,664	197	1,468
		Line	Western Indian Ocean	646	33	612
2015	EUFRA	Longline	Western Indian Ocean	0	11	-11
	EUGBR	Longline	Eastern Indian Ocean	0	294	-294
		Longline	Western Indian Ocean	0	80	-80
	EUMYT	Longline	Western Indian Ocean	11	0	11
	GBR	Longline	Eastern Indian Ocean	294	0	294
		Longline	Western Indian Ocean	80	0	80
	JOR	Gillnet	Western Indian Ocean	50	0	50
	SYC	Line	Western Indian Ocean	44	1	43
		Longline	Western Indian Ocean	2,678	2,721	-43
	YEM	Line	Western Indian Ocean	2,740	290	2,450
2014	EUFRA	Longline	Western Indian Ocean	0	44	-44
	EUGBR	Longline	Eastern Indian Ocean	0	378	-378
		Longline	Western Indian Ocean	0	164	-164
	EUMYT	Longline	Western Indian Ocean	44	0	44
	GBR	Longline	Eastern Indian Ocean	378	0	378
		Longline	Western Indian Ocean	164	0	164
	JOR	Gillnet	Western Indian Ocean	45	0	45
	SYC	Line	Western Indian Ocean	51	1	50
		Longline	Western Indian Ocean	1,571	1,621	-50
	YEM	Gillnet	Western Indian Ocean	3,151	342	2,809
		Line	Western Indian Ocean	194	3	191
2013	EUGBR	Longline	Eastern Indian Ocean	0	162	-162

Year	Fleet	Fishery group	Area	Current (t)	Previous (t)	Difference (t)
		Longline	Western Indian Ocean	0	415	-415
	GBR	Longline	Eastern Indian Ocean	162	0	162
		Longline	Western Indian Ocean	415	0	415
	JOR	Gillnet	Western Indian Ocean	23	0	23
		Line	Western Indian Ocean	11	0	11
	SYC	Line	Western Indian Ocean	155	3	153
		Longline	Western Indian Ocean	1,604	1,756	-153
	YEM	Gillnet	Western Indian Ocean	3,038	193	2,845
		Line	Western Indian Ocean	582	187	395
2012	EUGBR	Longline	Eastern Indian Ocean	0	139	-139
		Longline	Western Indian Ocean	0	567	-567
	GBR	Longline	Eastern Indian Ocean	139	0	139
		Longline	Western Indian Ocean	567	0	567
	JOR	Gillnet	Western Indian Ocean	23	0	23
	SYC	Line	Western Indian Ocean	149	1	148
		Longline	Western Indian Ocean	2,186	2,334	-148
	YEM	Gillnet	Western Indian Ocean	2,531	0	2,531
		Line	Western Indian Ocean	1,253	420	833
2011	EUGBR	Longline	Eastern Indian Ocean	0	440	-440
		Longline	Western Indian Ocean	0	238	-238
	GBR	Longline	Eastern Indian Ocean	440	0	440
		Longline	Western Indian Ocean	238	0	238
	SYC	Line	Western Indian Ocean	126	0	126
		Longline	Western Indian Ocean	675	801	-126
	YEM	Gillnet	Western Indian Ocean	1,007	0	1,007
		Line	Western Indian Ocean	2,943	250	2,693