REVIEW OF THE STATISTICAL DATA AVAILABLE FOR NERITIC TUNA AND SEERFISH SPECIES

Prepared by IOTC Secretariat[1]

Purpose

To provide participants at the 11th Working Party on Neritic Tunas (WPNT11) with a review of the data and information available on neritic tuna and seerfish species under IOTC mandate as available in the IOTC databases as of May 2021 (Table **1**). IOTC fisheries statistics are available from 1950 but some subsistence fisheries catching neritic tunas and seerfish have been operating in some coastal areas of the Indian Ocean for centuries (e.g., Yadav et al. 2020). The document summarises data on retained (nominal) catches, catch-and-effort, size-frequency and other related data available for the period 1950-2019 and provides a range of fishery indicators for fisheries catching the six IOTC neritic tuna and seerfish species occurring in the IOTC area of competence (**Table 1**).

Table 1: List of neritic tuna and seerfish species under IOTC mandate

Species code	Name	Scientific name
BLT	Bullet tuna	*Auxis rochei*
COM	Narrow-barred Spanish mackerel	*Scomberomorus commerson*
FRI	Frigate tuna	*Auxis thazard*
GUT	Indo-Pacific king mackerel	*Scomberomorus guttatus*
KAW	Kawakawa	*Euthynnus affinis*
LOT	Longtail tuna	*Thunnus tonggol*

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Materials

Several 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) estimated per year, Indian Ocean major area, fleet, and gear (IOTC Res. 15/02) and can be reported with the IOTC form 1RC.

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

i. By December 30th each year, updates 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 & effort data

Catch and effort data refer to fine-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 has also to be collected and reported to the Secretariat through IOTC form 3FA.

Discard data

The IOTC follows the definition of discard adopted by FAO in previous reports and considers all non-retained catch as discarded catch, including individuals released alive or discarded dead (Alverson et al. 1994, Kelleher 2005). 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.

Furthermore, more detailed information (e.g., higher spatio-temporal resolution, fate) on discards of neritic tuna and seerfish species shall be collected as part of the IOTC Regional Observer Scheme that aims to cover at least 5% of the operations conducted by the industrial tuna fisheries (i.e., vessels larger than 24 m or smaller than 24 m but fishing outside national Exclusive Economic Zones) occurring in the IOTC area of competence (IOTC Res. 11/04).

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 reporting size frequency data to the Secretariat following a stratification by fleet, year, gear, type of school, month, grid and species in agreement with IOTC Res. 15/02. While the great majority of size data reported with IOTC Form 4SF are for retained catches, some size data on fish discarded at sea may be collected through onboard observer programs and reported to the Secretariat as part of the ROS.

Socio-economic data

Little information is available on the socio-economic dimension of fisheries catching neritic tunas and seerfish in the Indian Ocean. The majority of the catches are sold locally, in raw or processed form (e.g., local canneries), or exported to markets in neighbouring countries. In addition, a small component of the catches of neritic tunas, in particular longtail tuna, is also exported to the European Union (EU) or other markets in the region (e.g., Saudi Arabia, Sri Lanka). 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 area reported by Oman since 2005.

Methods

The release of the curated public-domain data sets for neritic tuna and seerfish 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 the 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 one is 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 7 species aggregates including IOTC neritic tuna and seerfish species have been used by some CPCs for reporting nominal catch data between 1950 and 2019 (**Table 2**).

Table 2: Species groups including neritic tuna and seerfish species and used for reporting nominal catches to the IOTC Secretariat between 1950 and 2019

Species code	Name	Scientific name
AG06	Kawakawa, frigate and bullet tunas	*Euthynnus affinis; Auxis spp*
AG10	Skipjack tuna and kawakawa	*Katsuwonus pelamis; Euthynnus affinis*
FRZ	Frigate and bullet tunas	*Auxis thazard, A. rochei*
KGX	Seerfishes nei	*Scomberomorus spp*
TUN	Tunas nei	*Thunnini*
TUS	True tunas nei	*Thunnus spp*
TUX	Tuna-like fishes nei	*Scombroidei*

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).

Details on the results of the estimation process for deriving the 2019 best scientific estimates and changes in time series of nominal catches relative to the previous Working Party on Neritic Tunas are provided in Appendix I and Appendix II, respectively.

Data quality

A scoring system has been designed 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

Historical trends (1950-2019)

The best scientific estimates of nominal catches provide a decadal view on the history of the fisheries catching neritic tuna and seerfish species in the Indian Ocean. These species are caught with a large diversity of fishing gears all over the Indian Ocean although catch levels appear to decrease with latitude and very few catches have been reported over time from the coastal waters of South Africa and Australia.

The contribution of catches of neritic tunas and seerfish to total catches of IOTC species in the Indian Ocean has changed substantially over the last decades in relation with the development and expansion of coastal and industrial fisheries, e.g., with the arrival of industrial purse seine fleets to the Indian Ocean in the early-1980s, which saw an increase in targeting of tropical tunas (**Fig. 1**). In recent years, the six species of neritic tuna and seerfish under IOTC mandate represented about one third of the total catches of IOTC species.

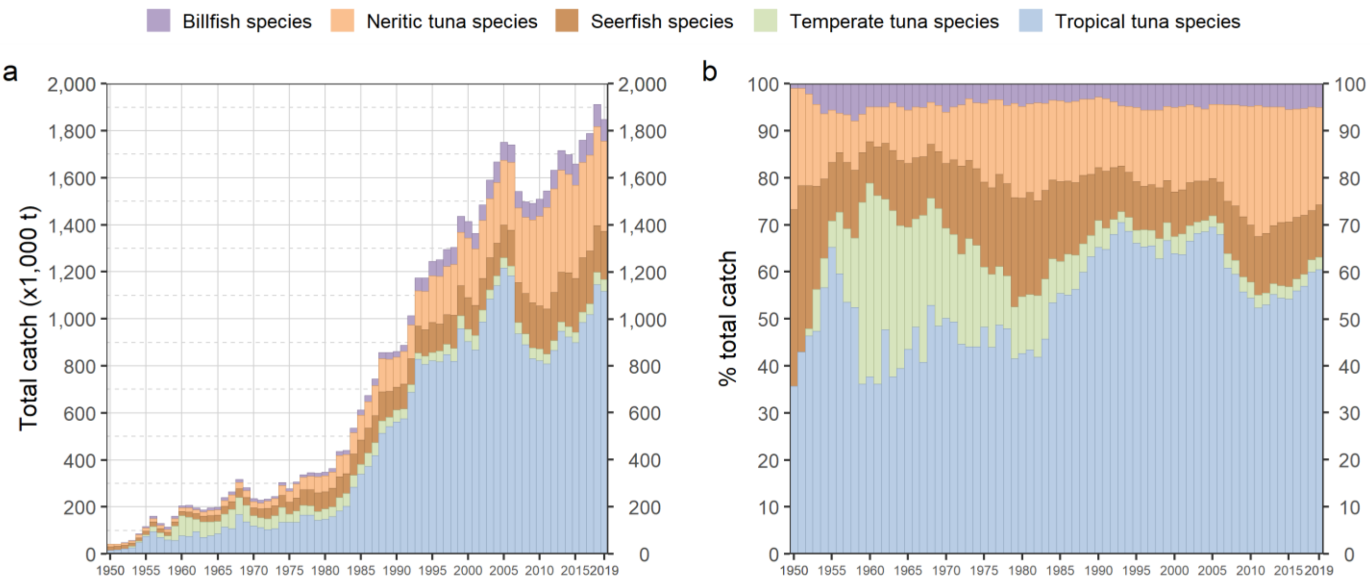


Figure 1: Annual time series of cumulative nominal absolute (a) and relative (b) catches of all IOTC tuna and tuna-like species in metric tons (t) by species cateory for the period 1950-2019

The total nominal catches of the IOTC neritic tuna and seerfish species showed a major increase over the last seven decades, from less than 30,000 t in the 1950s to more than 620,000 t in the 2010s (**Table 4 & Fig. 2**). Neritic tunas are caught mainly using drifting gillnets and purse seine nets in coastal waters – although some species are also caught using troll lines, hand lines, coastal longlines or other gears both in coastal waters and on the high seas (**Fig. 2**).

Table 4: Best scientific estimates of nominal catches of the IOTC neritic tunas and seerfish by decade and fishery in metric tons (t) for the period 1950–2019

Fishery	1950s	1960s	1970s	1980s	1990s	2000s	2010s
Purse seine | Other	178	605	4,800	24,816	45,353	63,557	85,620
Longline | Other	0	0	0	53	2,265	2,415	2,883
Longline | Fresh	0	0	0	0	0	0	210
Longline | Deep-freezing	0	0	0	130	25	5	298
Line | Coastal longline	209	593	1,875	4,764	9,025	26,285	39,454
Line | Trolling	4,421	7,780	12,284	20,391	31,148	37,188	48,126

Fishery	1950s	1960s	1970s	1980s	1990s	2000s	2010s
Line | Handline	991	1,115	4,186	9,246	8,480	13,947	26,384
Baitboat	1,521	2,298	2,859	2,470	5,695	5,686	2,213
Gillnet	19,939	36,710	68,963	123,017	168,975	231,991	352,635
Other	290	559	1,531	14,534	24,016	49,145	64,769
Total	27,549	49,661	96,499	199,421	294,983	430,218	622,593

The composition of the fisheries catching neritic tunas and seerfish varies over time and between species. Overall, gillnet fisheries contribute the most to the catches of the six IOTC neritic tuna and seerfish species while very few catches are reported by high seas longline fisheries (Appendix III). A substantial part of kawakawa is caught with purse seine while the contribution of this gear is smaller for the other neritic tunas (except for bullet tuna since 2018) and negligible for seerfish. An important component of frigate tuna appears to be caught by a combination of coastal longline and trolling although this pattern should be considered with caution as the catch composition by gear is re-estimated for artisanal fisheries of Indonesia (Moreno et al. 2012) and this CPC contributed to about 80% of the total catches of frigate tuna caught with line fisheries over the last three decades. In addition to gillnet and line fisheries, narrow-barred Spanish mackerel and Indo-Pacific king mackerel are caught by several other coastal gears such as trawl, liftnet, Danish seine, and beach seine (Appendix III).

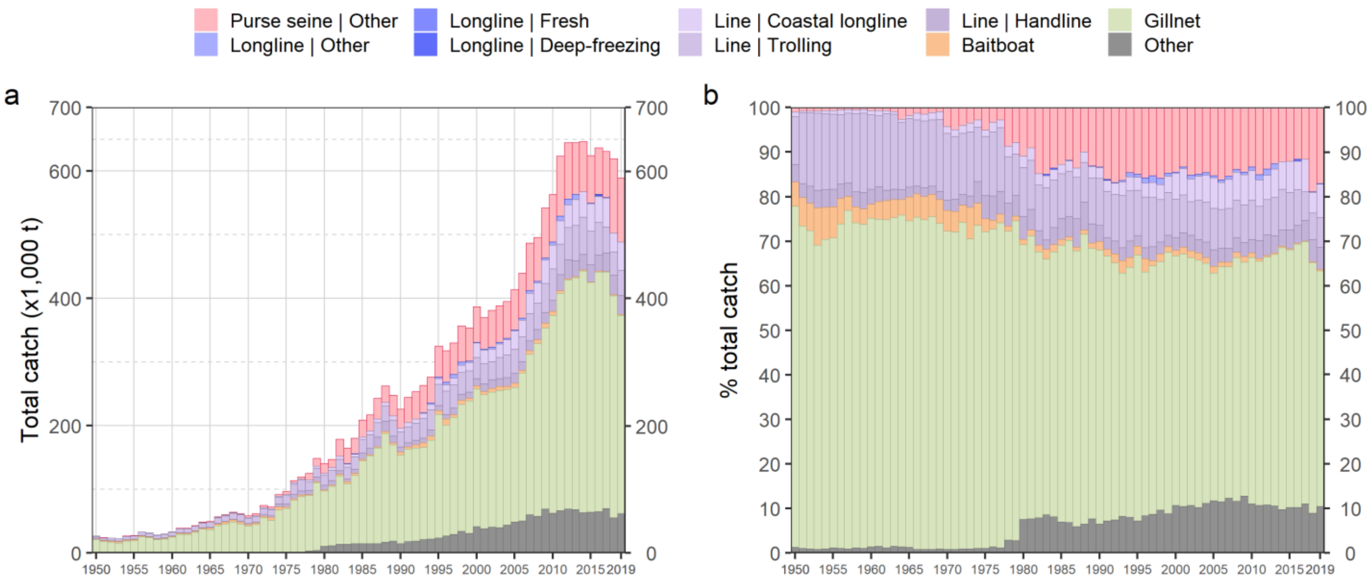


Figure 2: Annual time series of cumulative nominal absolute (a) and relative (b) catches of IOTC neritic tunas and seerfish in metric tons (t) by fishery for the period 1950-2019

More than 17 million metric tons of neritic tunas and seerfish have been reported to have been caught in the Indian Ocean since the 1950s, with narrow-barred Spanish mackerel (COM) being the main contributor with more than 5 million tons caught between 1950 and 2019, i.e., 30% of the total catches (**Fig. 3**). Kawakawa (KAW) and longtail tuna (LOT) contributed about equally with cumulative catches of about 4 million tons (23%) and more than 3.6 million tons (21%) of fish taken during that period while catches of frigate tuna (FRI) and Indo-Pacific king mackerel (GUT) were lower with more than 2.6 and 1.5 million tons, respectively. Bullet tuna (BLT) represents a very small component of the IOTC neritic tunas, i.e., less than 1.5% of the total catches between 1950 and 2019.

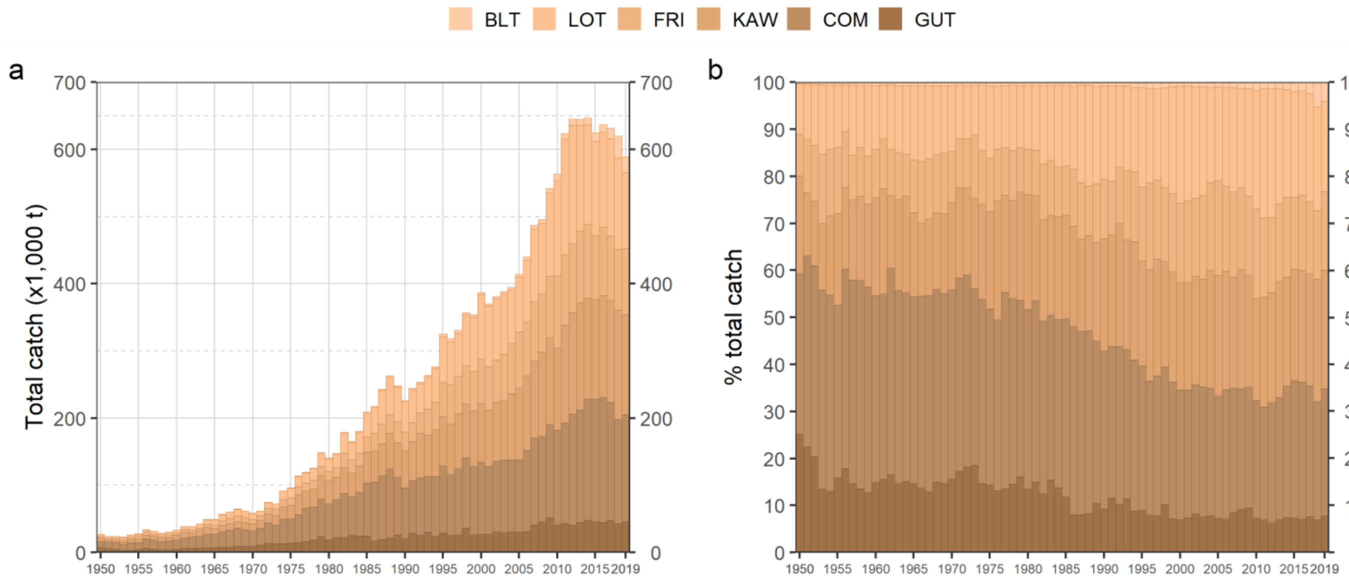


Figure 3: Annual time series of cumulative nominal absolute (a) and relative (b) catches of IOTC neritic tunas and seerfish in metric tons (t) by species for the period 1950-2019

Each of the six IOTC neritic tuna and seerfish species showed an almost steady increase in nominal catches over time (**Fig. 4**). The increase was particularly marked for LOT, KAW, and COM which showed a linear increase described by a slope of more than 3,000 t per year between 1970 and 2019. FRI also showed a substantial increase in catches with a linear coefficient larger than 2,300 t per year since the early 1970s while the increases for GUT and BLT were less dramatic, i.e. about 720 and 310 t per year since 1970, respectively. For BLT, the total catches reported for 2018 and 2019 appear inconsistently higher than the linear predictions, i.e. the total catches doubled from about 15,000 t in 2017 to about 33,000 t in 2018, prior to decreasing to 24,000 t in 2019 (**Fig. 4**). These changes are essentially due to the catches reported by Indonesia for their purse seine fishery that saw the catches of BLT increase from an estimated annual catch of less than 300 t to more than 16,000 t in 2018 and more than 5,600 t in 2019.

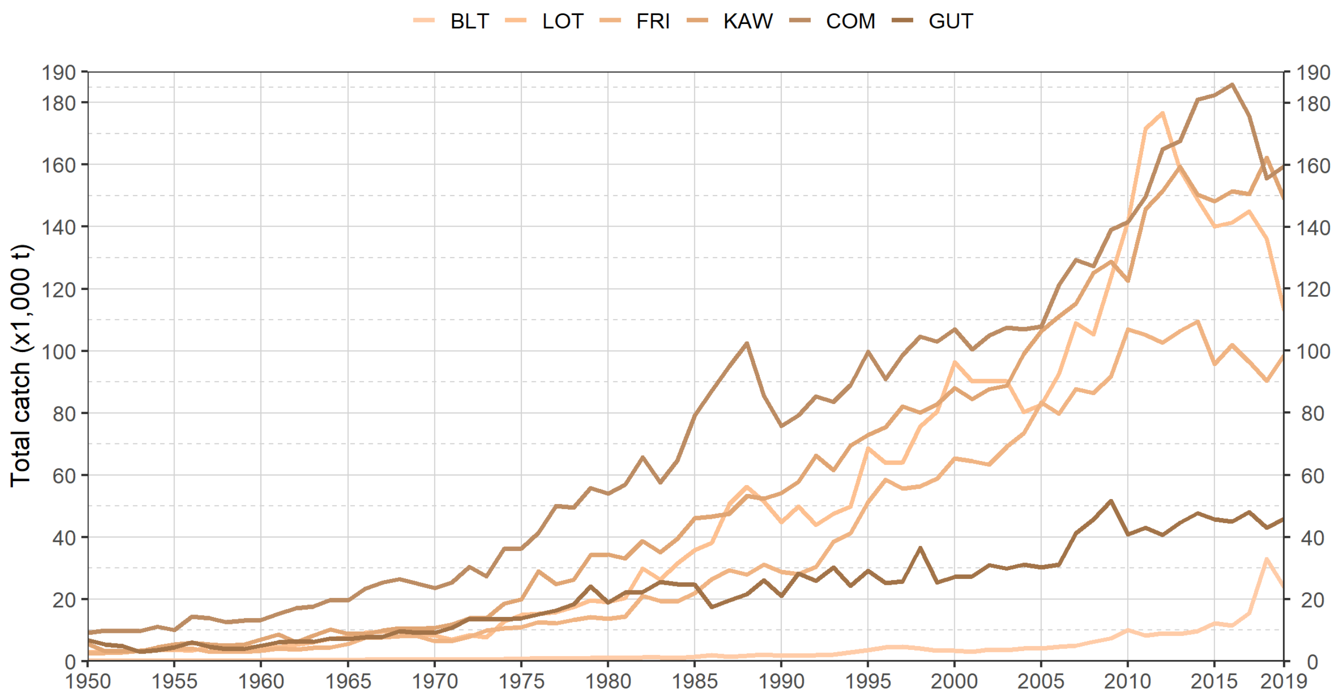


Figure 4: Annual time series of nominal catches of IOTC neritic tunas and seerfish in metric tons (t) by species for the period 1950-2019

Following a period of steady increase in catches for almost seven decades and a maximum nominal catch at about 637,000 t in 2016, the cumulative catches of the six IOTC neritic tuna and seerfish have started to show a decline in recent years (**Fig. 3**). This decrease which concerns LOT, and FRI and COM to a lesser extent, is essentially driven by the reduction of the catches of Pakistani gillnetters since 2017, in relation with an extended fishing closure, volatility in sale price and reduced demand from the Iranian market, and poor environmental conditions that prevailed in 2019 (Moazzam 2021).

Recent fishery features (2015-2019)

In recent years (2015-2019), total nominal catches of the IOTC neritic tuna and seerfish species were about 620,000 t, with gillnet, line, and purse seine fisheries contributing to 57%, 18%, and 14% of all catches, respectively (**Table 5**).

Table 5: Mean annual nominal catches of the IOTC neritic tunas and seerfish in metric tons (t) between 2015 and 2019

Fishery	Fishery code	Catch	Percentage
Gillnet	GN	354,017	57.1
Purse seine | Other	PSOT	87,776	14.1
Other	OT	63,369	10.2
Line | Trolling	LIT	43,878	7.1
Line | Coastal longline	LIC	40,714	6.6
Line | Handline	LIH	28,452	4.6
Baitboat	BB	1,253	0.2
Longline | Deep-freezing	LLD	589	0.1
Longline | Fresh	LLF	392	0.1
Longline | Other	LLO	0	0.0

Between 2015 and 2019, the mean annual catches of the IOTC neritic tunas and seerfish have been dominated by a few CPCs, to the point that almost 70% of all catches was accounted for by three distinct fleets: Indonesia and India which are characterized by a large diversity of coastal gears and fisheries and I.R. Iran where gillnet represents the very large majority of the catches (**Fig. 5**). The composition of the catches by gear greatly varies between fleets for the four neritic tunas but while the dominant countries catching seerfish show a similar composition (Appendix IV).

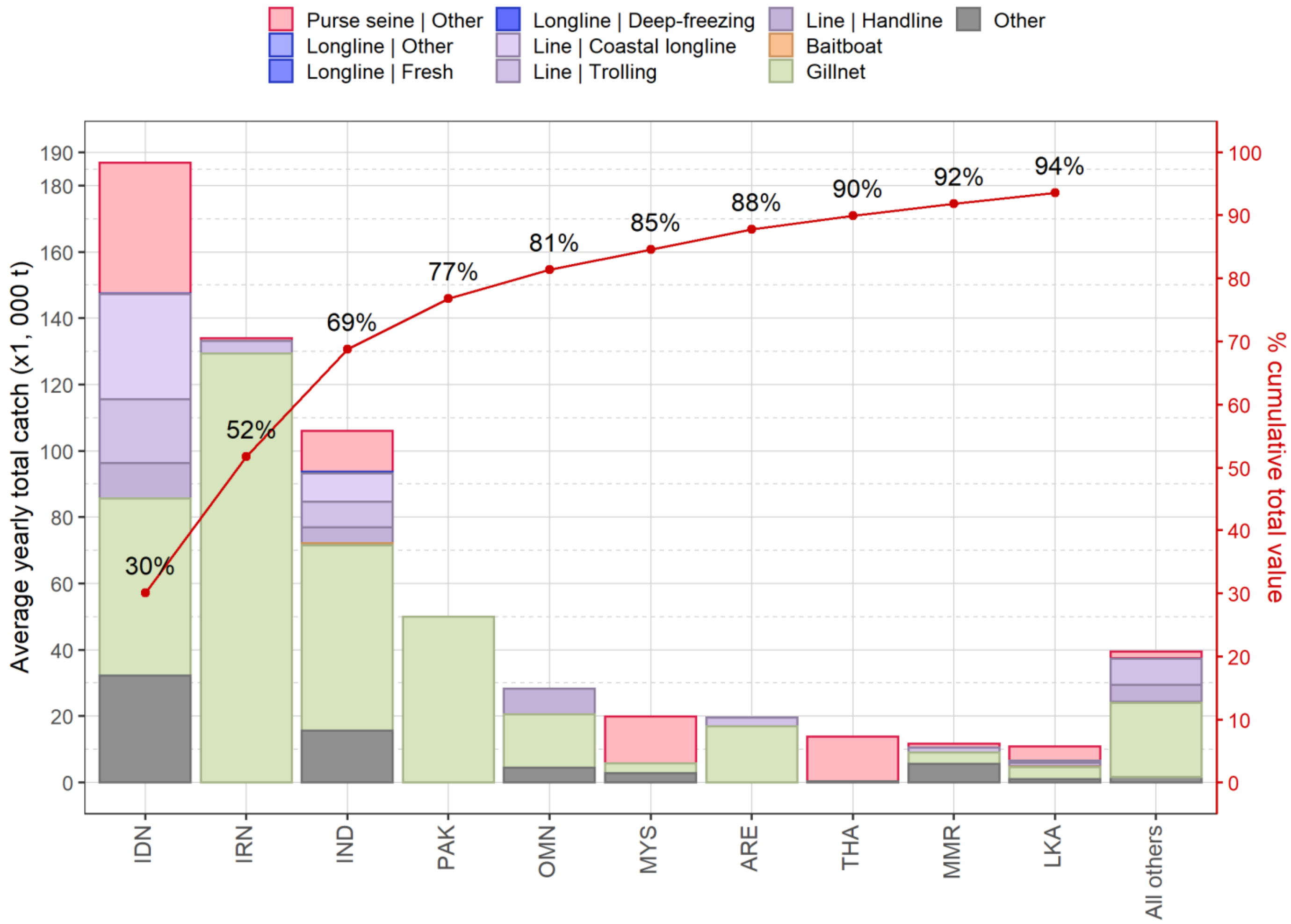


Figure 5: Mean annual catches of the IOTC neritic tunas and seerfish by fleet and fishery in metric tons (t) between 2015 and 2019, with indication of cumulative catches by fleet

Over that period, the total gillnet catches showed a substantial decrease that was mainly driven by the major decline in Pakistani gillnet catches observed since 2016 (Moazzam 2021) (**Fig. 6**). Between 2018 and 2019, the catches showed a dramatic decline for all major gillnet countries, i.e., I.R. Iran (-12%), India (-15%), Oman (-27%), and Pakistan (-32%), suggesting some factors occurred at regional scale (**Fig. 7a**).

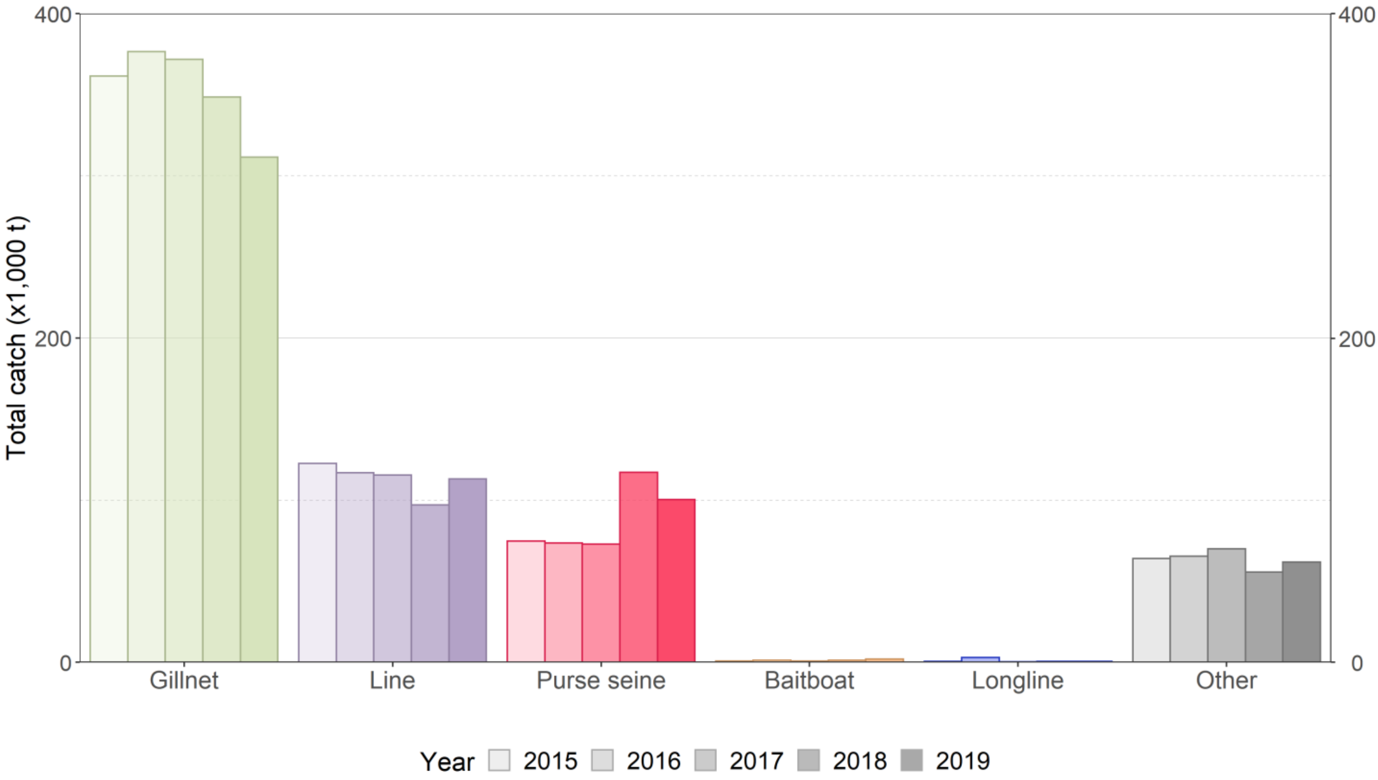


Figure 6: Annual catch trends of IOTC neritic tunas and seerfish by fishery group in metric tons (t) between 2015 and 2019

Catches of neritic tunas and seerfish taken in line fisheries also showed a decreasing trend between 2015 and 2019, but less marked than for gillnet (**Fig. 7b**). By contrast, catches taken in purse seine fisheries showed a major increase in recent years caused by a sharp increase in catches reported by Indonesia in 2018-2019 (**Fig. 6c**). Catches of neritic species in longline and baitboat fisheries appear to be very low and doninated by India (**Fig. 6d-e**). Finally, a large amount of catches (>60,000 t during the period 2015-2019) comes from all other gears, with the main fisheries occurring in the coastal areas of Indonesia, India, Myanmar, and Oman, all showing a decreasing trend in catches between 2015 and 2019 (**Fig. 6f**) .

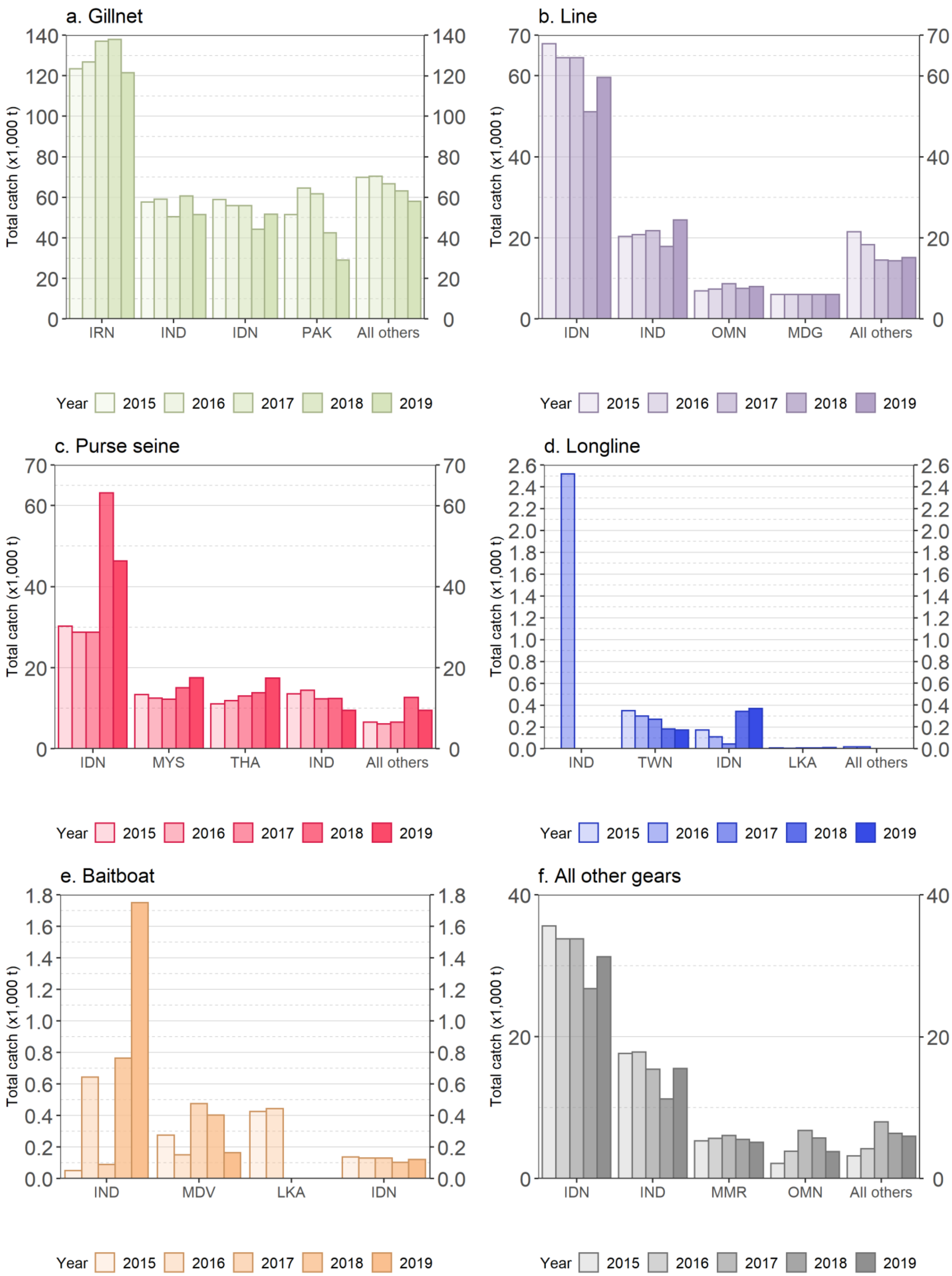


Figure 7: Annual catch trends of IOTC neritic tunas and seerfish by fishery group and fleet in metric tons (t) between 2015 and 2019

Uncertainties in nominal catch data

Overall, total estimated catches for neritic species in the Indian Ocean are considered to be highly uncertain. The majority of catches of neritic species in the Indian Ocean are caught within the EEZ of coastal states, typically by small-scale or artisanal fisheries, which creates considerable challenges in terms of collecting reliable information from the diversity of vessels and fisheries operating in coastal waters. Difficulties in data collection are further compounded by species misidentification, particularly of juvenile tunas, that can lead to dramatic changes in catches by species between years.

In addition, a common problem through the region is the aggregation of neritic species under a common label. Small or juvenile neritic tunas are often also treated commercially as the same species – particularly in the case of frigate and bullet tuna – which are often reported to the Secretariat as species aggregates or commercial categories and therefore require disaggregation in order to produce estimates by species. Likewise, catches of narrow-barred Spanish mackerel and Indo-Pacific king mackerel are often combined and reported to the IOTC Secretariat as species aggregates of seerfish.

In the case of industrial fisheries, catches of neritic tunas recorded by 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, and there are also difficulties in monitoring catches of these species in port. In recent years, development in the industrial purse seine fishery of Indonesia targeting neritic tunas resulted in an increase of reported catches, particularly evident for bullet tuna that showed a sharp increase from a few hundred tons to more than 16,000 t between 2017 and 2018 (Appendix III).

Annual changes in the composition of nominal catches by quality score provide some insight into the level of uncertainty of the data available at the IOTC Secretariat. The quality scores of the nominal catches of the six IOTC neritic tunas and seerfish reflect the amount of catches that has to be estimated by the Secretariat to account for non-reporting of data, estimation of species and gear composition in the case of reporting of aggregate gears and species, and outstanding issues in data quality for some major countries such as Indonesia and India. The percentage of nominal catches fully or partially reported to the Secretariat (i.e. scores between 0 and 2) showed quite large variations between 35% and 60% of the total catches over time, and an encouraging increasing trend since the mid-1990s (**Fig. 8**).

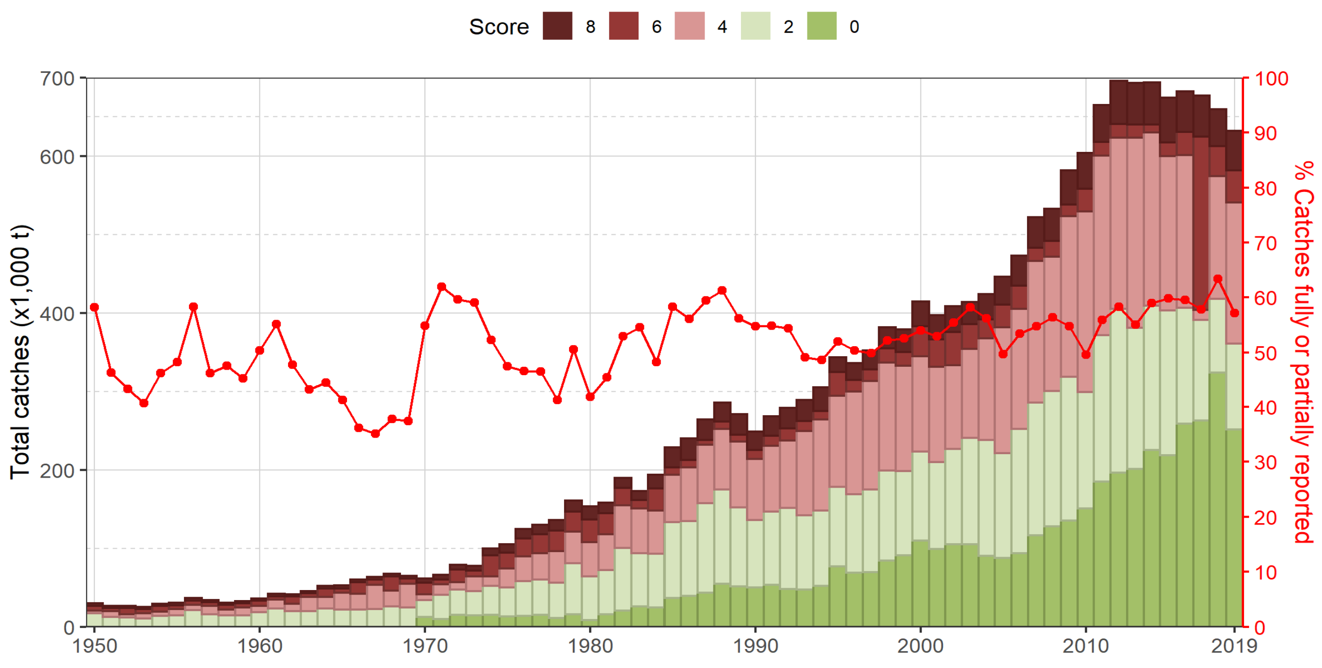


Figure 8: Annual nominal catches of IOTC neritic tunas and seerfish in metric tons (t) estimated by quality score (barplot) and percentage of nominal catch fully/partially reported to the IOTC Secretariat (lines with dots) for all fisheries

The data quality greatly varies between species, with longtail tuna showing the best quality while a large part of the nominal catches were estimated for frigate and bullet tunas between 1950 and 2019 (Appendix V). Kawakawa shows an increasing proportion of nominal catches partially or fully reported to the Secretariat from about 40% in the the mid-1990s to more than 60% in recent years. The two seerfish species show an overall fair quality with an opposite trend in the percentage of catch data reported to the Secretariat in recent years, i.e., a declining trend from 60% to about 50% for narrow-barred Spanish mackerel and an increasing trend from 50% to more than 60% for Indo-Pacific king mackerel.

In 2019, about 40% of the nominal catches 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 the CPCs and non-members of the IOTC that did not report data to the Secretariat (Appendix I - Table 6). In addition, a re-estimation process was performed for the artisanal fisheries of Bangladesh, Malaysia, India, and Indonesia which are considered to be of low quality as well as to account for the reporting of catch data with species aggregates (Appendix I)).

Discards

The total amount of neritic tuna and seerfish 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. Overall, discard data reported to the Secretariat with IOTC Form 1DI are scarce, not extrapolated at the source, and generally not reported according to IOTC reporting standards. This strongly limits the ability to have a comprehensive view of the extent and characteristics of species discard levels for most tuna fisheries occurring in the Indian Ocean.

Overall, discarding is considered to be limited in coastal fisheries targeting neritic tunas and seerfish where there is a demand from canneries and local markets. By contrast, discarding has been found to be common in industrial fisheries that target tropical tunas and billfish but the bycatch volumes, which are seldom recorded in the logbooks nor monitored in ports, are suspected to be small. In the case of purse seine fisheries, the bycatch of neritic tunas has been shown to be essentially caught in association with drifting floating objects and estimated to be less than 2 t per 1,000 t of tropical tuna landed, amounting to a mean annual bycatch of about 600 t of fish during 2011-2017 (Ruiz et al. 2018).

Information collected through national fisheries observer programs and currently available in the ROS database is limited due to the non-compliance of several CPCs with IOTC Res. 11/04 and further accentuated by the various non-standard formats used for data collection and reporting by CPCs which prevent the inclusion of several reported data sets into the database. The information available in the ROS regional database on the interactions of IOTC fisheries with neritic tunas and seerfish during the period 2006 2019 indicates that discarding of neritic species is negligible in longline fisheries but common in purse seine fisheries for frigate tuna, and kawakawa and bullet tuna to a lesser extent (**Fig. 9**). Interestingly, observations of interactions of neritic tunas with the purse seine fishery show the large extent of the distribution of frigate tuna, kawakawa, and bullet tuna across the whole Western Indian Ocean when these species are generally thought to be restricted to coastal areas.

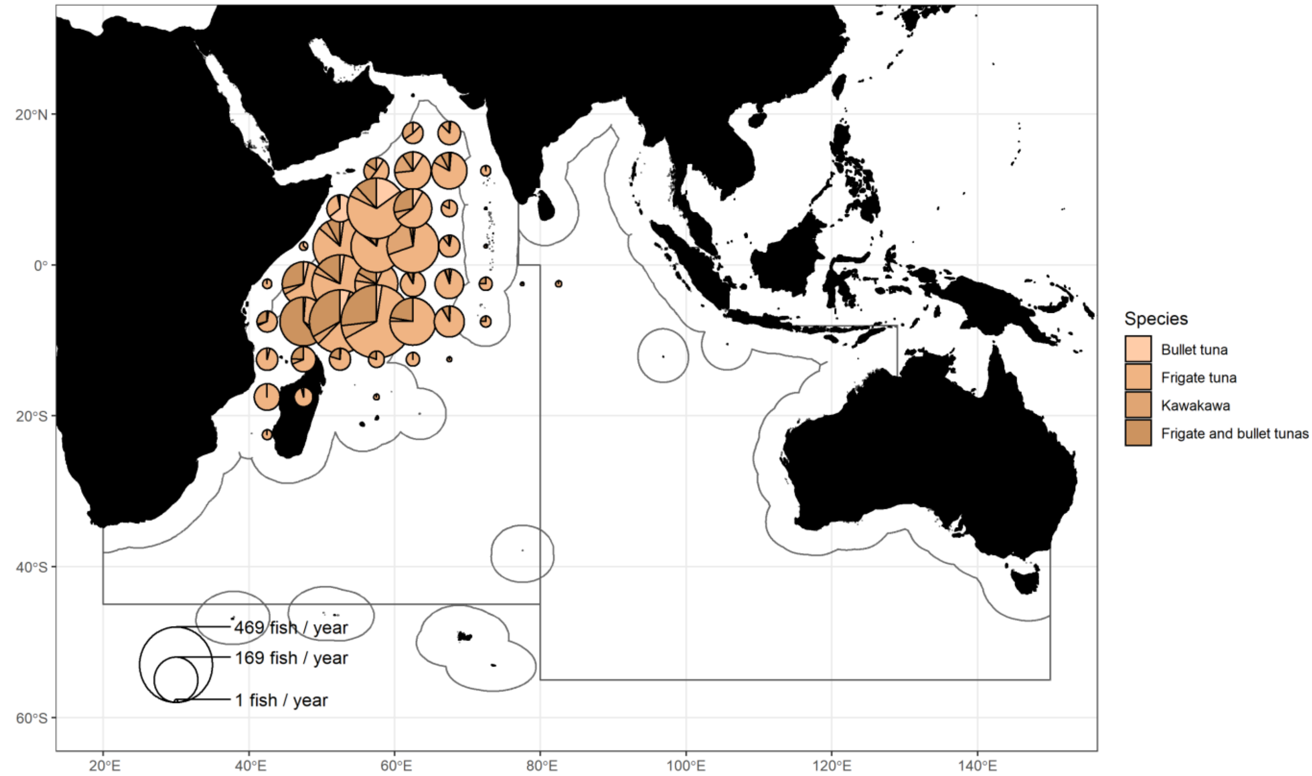


Figure 9: Distribution of the interactions of neritic tunas with Western Indian Ocean purse seine fisheries as available in the ROS regional database

It is to note that the status (i.e. alive or dead) of the neritic tunas discarded at sea in purse seine fisheries is currently not available in the ROS regional database due to the data exchange format used with the national institutes in charge of the observer programs, but most tunas discarded at sea are thought to be dead after release. Also, the current observer protocols only focus on discards while a component of the bycatch of neritic tunas may be retained for some international markets.

Size data collected at sea by scientific observers show that frigate and bullet tunas caught with purse seine have a similar fork length range (25-60 cm) with a median of about 38-40 cm when kawakawa are larger with a median size of 45.5 cm and fish reaching 70 cm (**Fig. 10**).

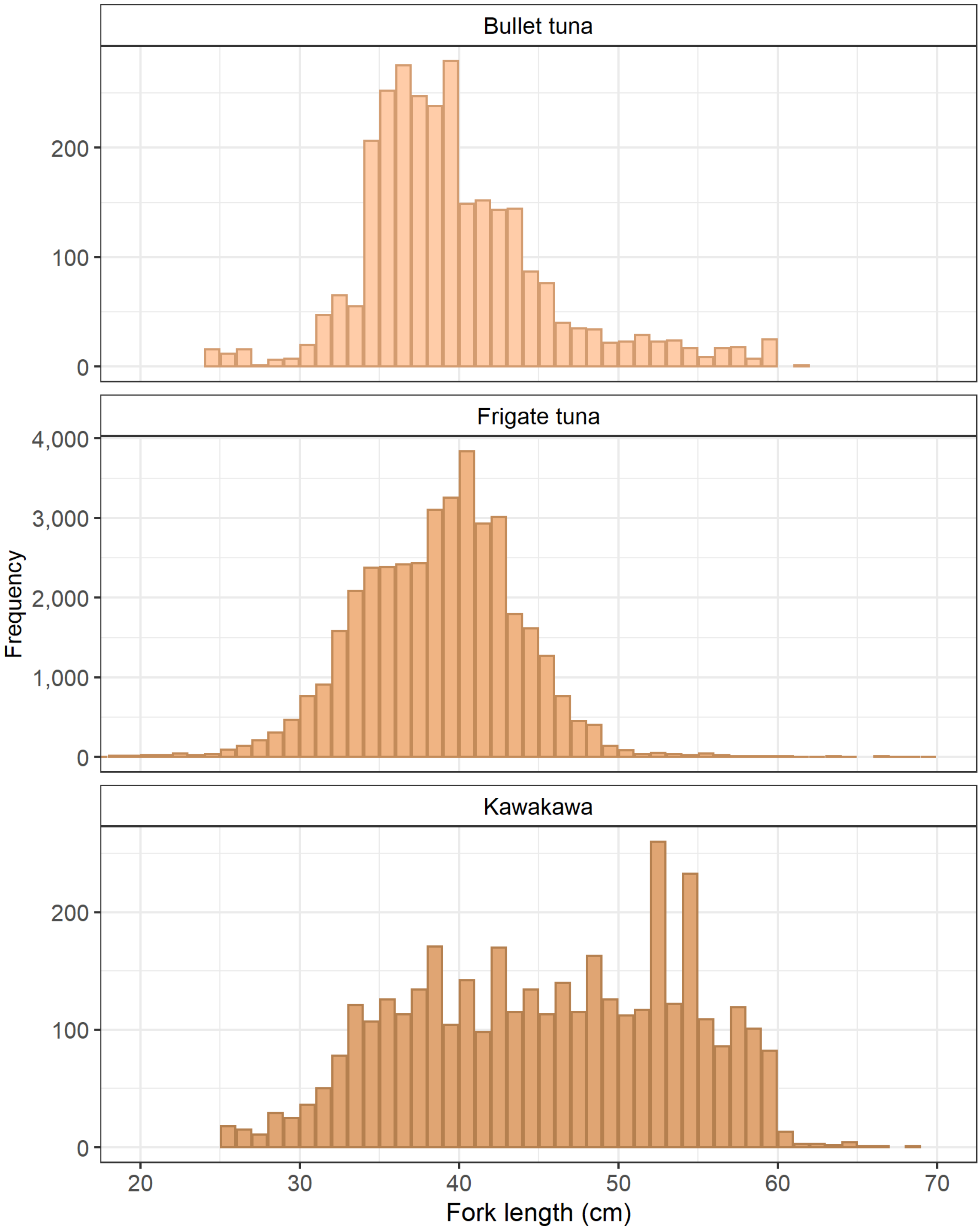


Figure 10: Size frequency distribution of neritic tunas caught and discarded at sea in Western Indian Ocean purse seine fisheries as available in the ROS regional database

Geo-referenced catch and effort

For most of the major fisheries reporting catches of neritic species in the Indian Ocean, catch-and-effort data are not available or only available for a very limited time frame (**Figs. 11-12**). In particular, Indonesia and India have accounted for around half of the total catches of neritic species in the Indian Ocean in recent years while little information is available on the distribution of catch and effort for all their fisheries. Indonesia has started reporting time-area catches for some of its artisanal and industrial fleets according to Resolution 15/02 since 2018 but the coverage appears to be very low (i.e., less than 5%) and not representative of the fishing grounds (**Fig. 11b**). In addition, there are some inconsistencies between the nominal catch and geo-referenced catch data sets.

No catch-and-effort data have been reported for any of the coastal fisheries of India since 1979 while they reported more than 100,000 t of fish caught in recent years. Furthermore, time series of effort are generally inconsistent as different units of effort (e.g., trips, days) may be used over time.

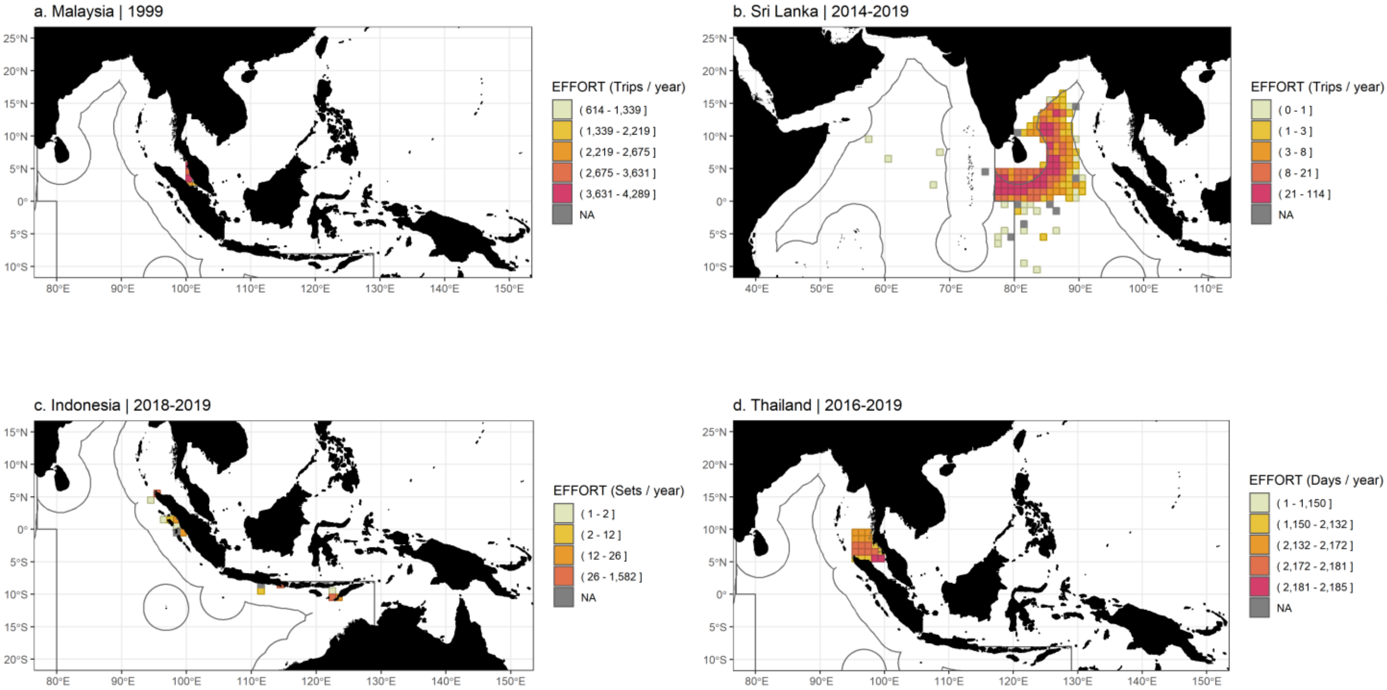


Figure 11: Example of distribution of effort available at the Secretariat for purse seine fisheries catching IOTC neritic tunas and seerfish

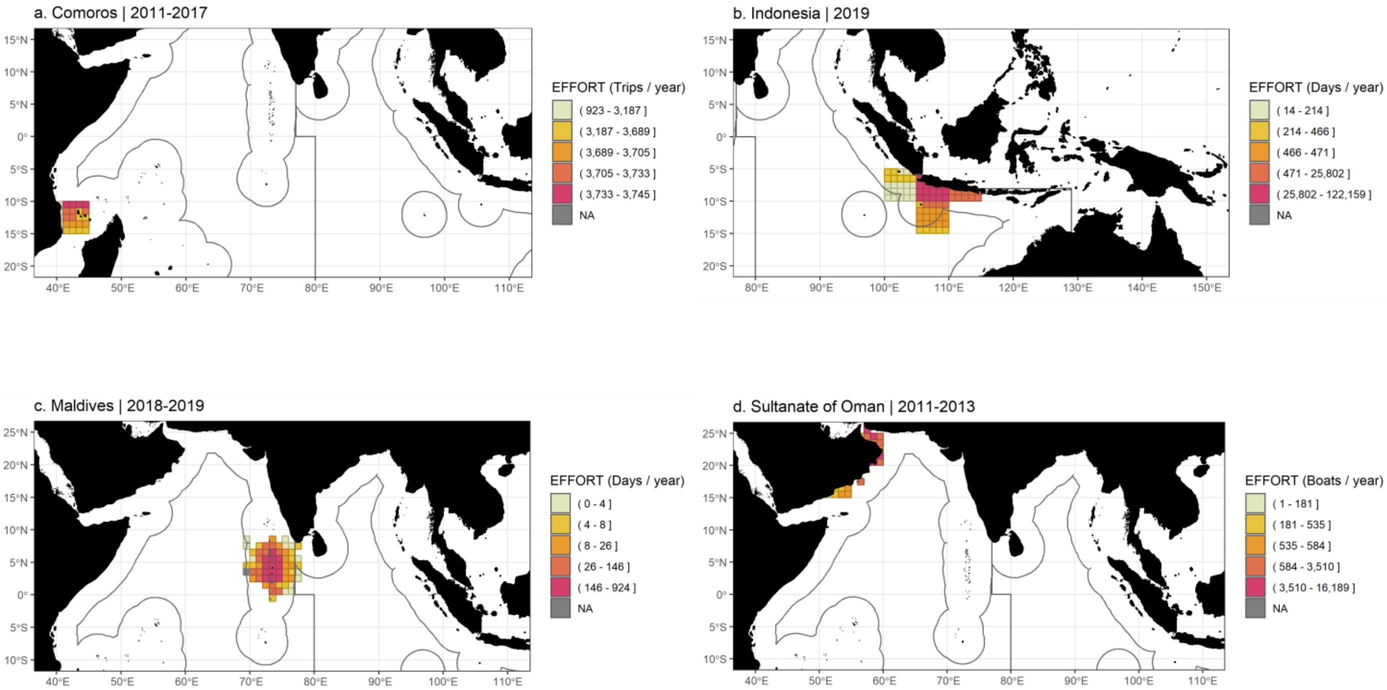


Figure 12: Example of distribution of effort available at the Secretariat for line fisheries catching IOTC neritic tunas and seerfish

By contrast, I.R. Iran has collected a consistent time series of catch and fishing effort since 2007 through a port sampling program for their coastal and offshore gillnet fisheries. Following an IOTC Data Compliance mission conducted in late-2017, I.R. Iran has begun to report catch-and-effort data in accordance with the requirements of Resolution 15/02, which led to an improvement in the availability of time-area catches for Iranian gillnetters – one of the main fisheries accounting for catches of neritic tunas. In addition, a first attempt was made to derive time series of CPUE for longtail tuna, kawakawa, frigate tuna, and narrow-barred Spanish mackerel (Fu et al. 2019).

Appendices

Appendix I: Best scientific estimates for 2019

First, nominal catches were estimated for the CPCs and non-members of the IOTC that did not report any catch for 2019. For non-members, catches were preferentially extracted from the FAO's 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 6**). It is to note that the catches of neritic tuna and seerfish species taken by fisheries of Eritrea and Myanmar have been repeated in the FAO database since 2012 and 2018, respectively. As no catch data was available for United Arab Emirates, Bahrain, and Jordan from the FAO database, nominal catches by gear and species available in the IOTC database for 2018 were repeated for 2019 for these three countries.

For IOTC members, nominal catches were repeated from 2018 except for Eritrea and Sudan that have not reported any information to IOTC since their membership in 1994 and 1996, respectively. Data for these two countries were also extracted from the FAO database and further broken down by gear (**Table 6**). In the case of Seychelles, only data for artisanal fisheries were repeated from 2018 while data reported for purse seine for 2019 were considered accurate.

Overall, nominal catches fully estimated in 2019 amounted to 67,424 t of fish for 17 distinct fleets. This represented 11.4% of all catches of IOTC neritic tuna and seerfish species in 2019 (**Table 6**).

Table 6: Data source and final estimates of catches (t) of IOTC neritic tuna and seerfish species in 2019 for non-members (NM) and members (MP) of the IOTC that did not report catches for the year 2019. RAW_CATCH includes catches of species aggregates with part of them being assigned to species other than neritic tunas and seerfish

FLEET_CODE	FLEET	STATUS	SOURCE	SOURCE_YEAR	RAW_CATCH	CATCH
ARE	United Arab Emirates	NM	IOTC	2018	19,600	19,600
BHR	Bahrain	NM	IOTC	2018	78	77
DJI	Djibouti	NM	FAO	2019	683	621
EGY	Egypt	NM	FAO	2019	660	660
ERI	Eritrea	MP	FAO	2019	518	518
JOR	Jordan	NM	IOTC	2018	106	101
KWT	Kuwait	NM	FAO	2019	165	165
MDG	Madagascar	MP	IOTC	2018	6,021	6,021
MMR	Myanmar	NM	FAO	2019	10,761	10,761
MOZ	Mozambique	MP	IOTC	2018	5,002	5,002
QAT	Qatar	NM	FAO	2019	2,788	2,788
SAU	Saudi Arabia	NM	FAO	2019	8,325	8,325
SDN	Sudan	MP	FAO	2019	170	170
SYC	Seychelles	MP	IOTC	2018	40	165
TMP	East Timor	NM	IOTC	2018	3	0
TZA	Tanzania	MP	IOTC	2018	3,362	3,362
YEM	Yemen	MP	IOTC	2018	9,271	9,088

Second, a re-estimation process was performed for the artisanal fisheries of Bangladesh, Malaysia, India, and Indonesia which are considered to be of low quality. In Bangladesh no fishery specifically targets tuna and the nominal catches of tuna reported have been assumed to be exclusively composed of narrow-barred Spanish mackerel (COM; 59%) and Indo-Pacific king mackerel (GUT; 41%) caught with gillnet since 1986. In 2019, the catches from Bangladesh were estimated to be 91 t and 63 t for COM and GUT, respectively.

For Malaysian coastal fisheries, nominal catches reported for neritic tunas are considered accurate but seerfish catches have only been reported for COM while both COM and GUT have been shown to occur in the landings. Except for handline that was only reported in 1962, the current data processing assumes a fixed proportion by gear for each of the two species (COM-GUT) over time: 82%-18% for troll line, 69%-31% for gillnet, 89%-11% for small purse seine, 63%-37% for trawling, and 83%-17% for coastal longline. In 2019, the total nominal catches were estimated to be 4,158 t and 1,990 t for COM and GUT, respectively.

For India and Indonesia, the current re-estimation process builds on a comprehensive review conducted in the early 2010s to revise time series of catch from artisanal fisheries and improve reporting to the IOTC (Moreno et al. 2012). In the case of Indian coastal fisheries, the process does conserve the total catches reported for each of the 6 IOTC neritic tuna and seerfish species but modifies the gear composition of the catch by Indian Ocean major area for the following gears: beach seine, gillnet (GILL), hook and line (HOOK), small purse seine (PSS), ring nets (RIN), trawl (TRAW) and troll line (TROL). In 2019, the total catches reported by India for the IOTC neritic tuna and seerfish species were larger than 100,000 t, with half of them taken in the gillnet fishery. 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 neritic tuna and seerfish species based on samples of catch composition available for the period 2003-2011 (Moreno et al. 2012). In 2019, about 190,000 t of fish were estimated to be caught in Indonesian fisheries for these six species, predominantly by gillnetters and coastal purse seiners.

Third, nominal catches reported as species aggregates that include IOTC neritic tuna and seerfish species were broken down to generate the best scientific estimates (**Table 2**). In 2019, the breakdown by species resulted in the addition of a total of 7,465 t of fish to the catches reported at the species level for the 6 species of interest, representing 1.3% of the final catch estimates.

Table 7: Total catches (t) of IOTC neritic tuna and seerfish species as reported (Raw) and estimated (Est) after accounting for the catches added through the breakdown of species aggregates

Species code	Raw	Est	Added	%Added
BLT	236,565	243,496	6,931	2.85
COM	5,133,775	5,164,731	30,956	0.60
FRI	2,606,284	2,642,452	36,168	1.37
GUT	1,547,324	1,551,497	4,173	0.27
KAW	3,950,369	3,992,292	41,923	1.05
LOT	3,556,106	3,614,769	58,663	1.62

Appendix II: Changes from previous WPNT

Some small changes occurred in the time series of catches of the IOTC neritic tuna and seerfish species since the last release of the data set of best scientific estimates of nominal catches, representing an overall change of 6,556 t of fish over the period 1950-2019 (**Fig. 13**). The changes concerning the period 2011-2018 are mainly due to the estimation process and mainly concern non-members of the IOTC (Djibouti, Egypt, Jordan, Myanmar, and Qatar) as well as a few members (Eritrea, Sudan, Taiwan,China, Thailand, and Yemen). These changes mostly stem from the use of the proxy fleets in the estimation process and are generally of a few dozen tons per fleet and fishery each year. In total, they resulted in some annual changes of less than 300 t between 2011 and 2017 while the change of about 1,200 t observed in 2018 comes from an update of data provided by Thailand for their coastal purse seine fleet.

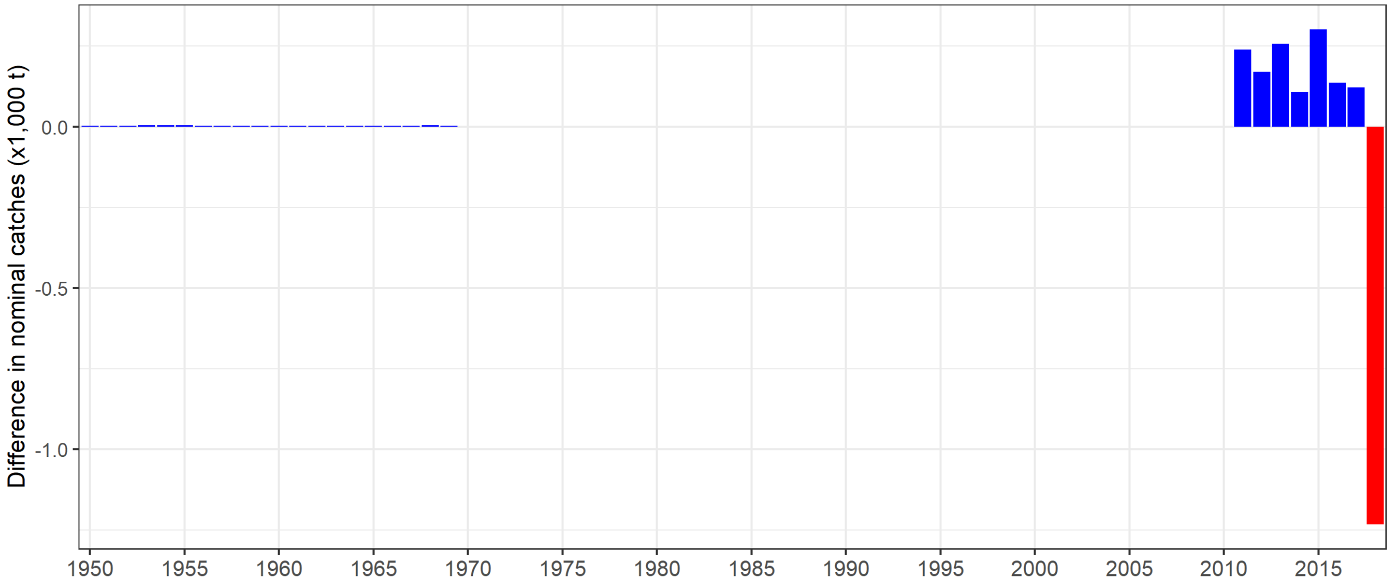


Figure 13: Differences in nominal catches of IOTC neritic tunas and seerfish in metric tons (t) between the 10th and 11th sessions of the IOTC Working Parties on Neritic Tunas

Appendix III: Catch by fishery group, 1950-2019

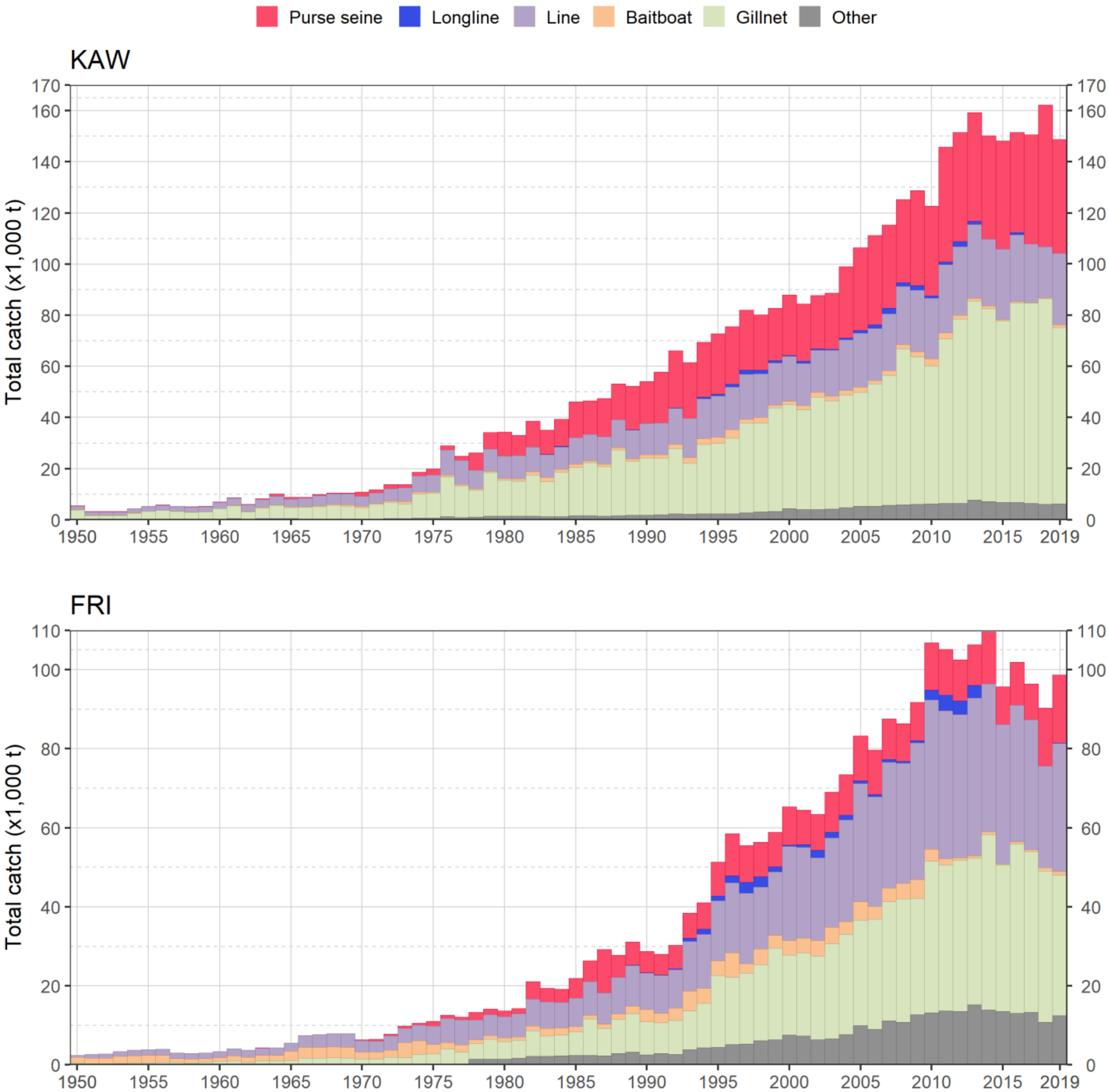


Figure 14: Annual time series of cumulative nominal of kawakawa (KAW) and frigate tuna (FRI) in metric tons (t) by fishery group for the period 1950-2019

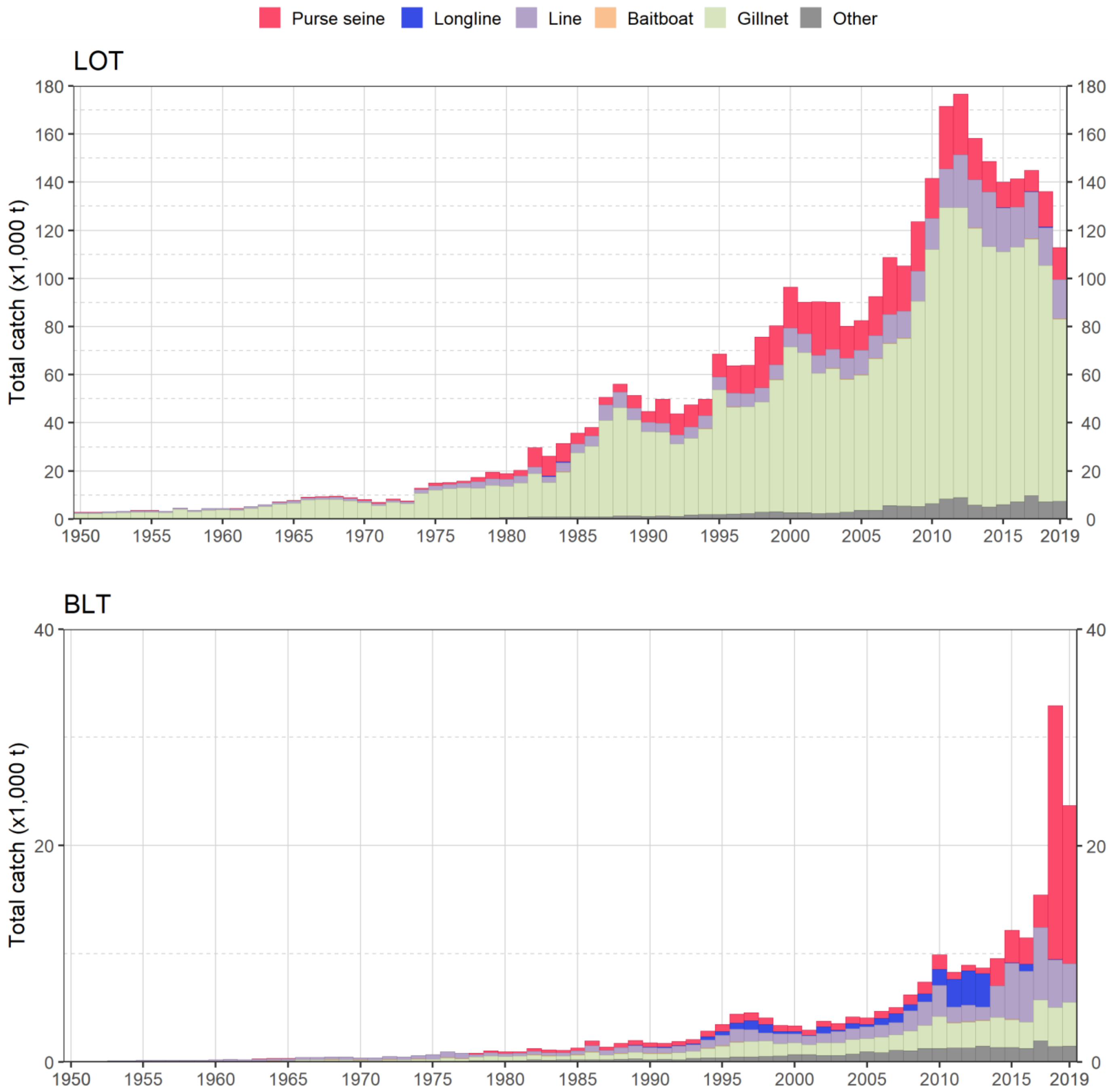


Figure 15: Annual time series of cumulative nominal catches of longtail tuna (LOT) and bullet tuna (BLT) in metric tons (t) by fishery group for the period 1950-2019

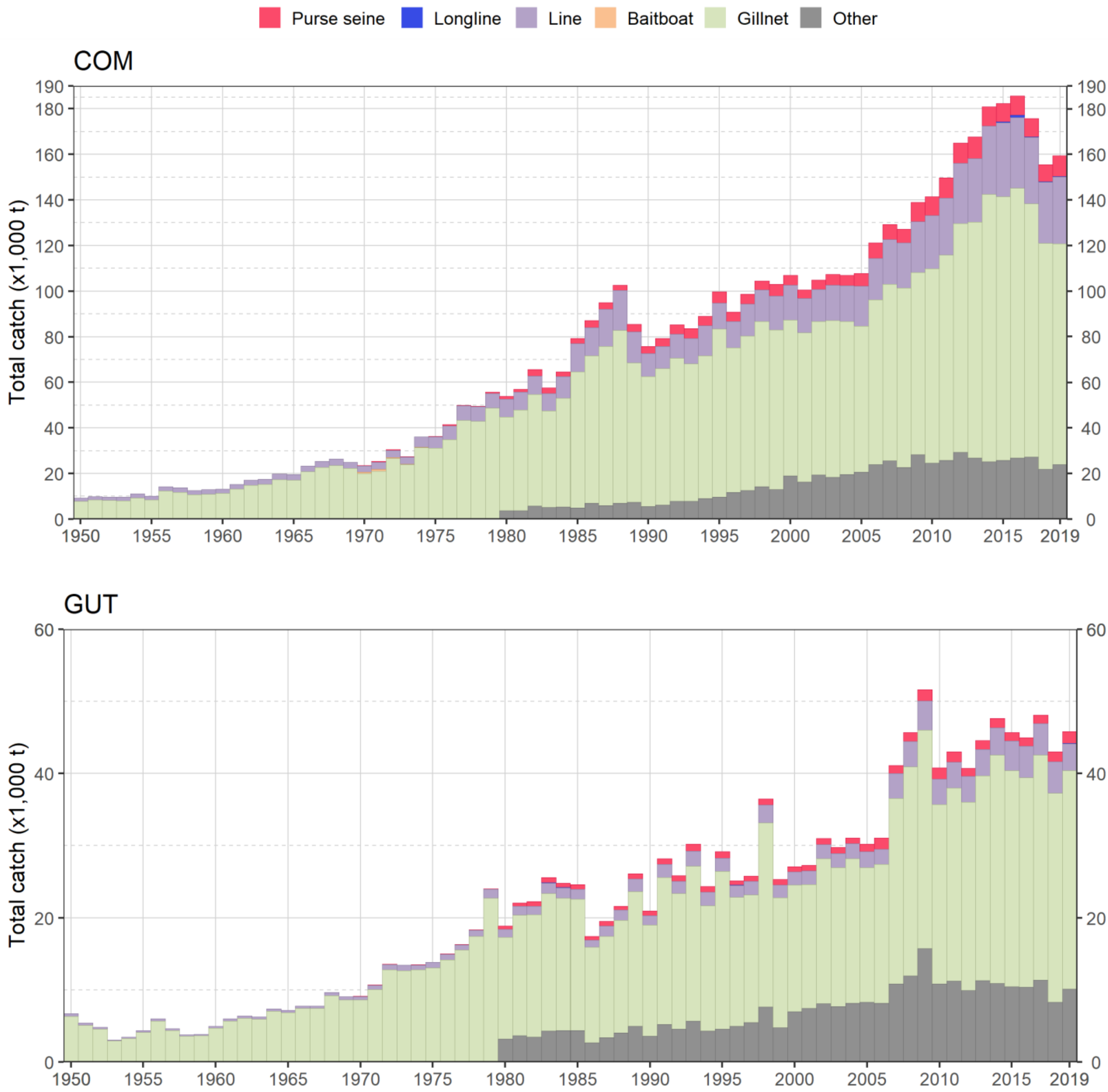
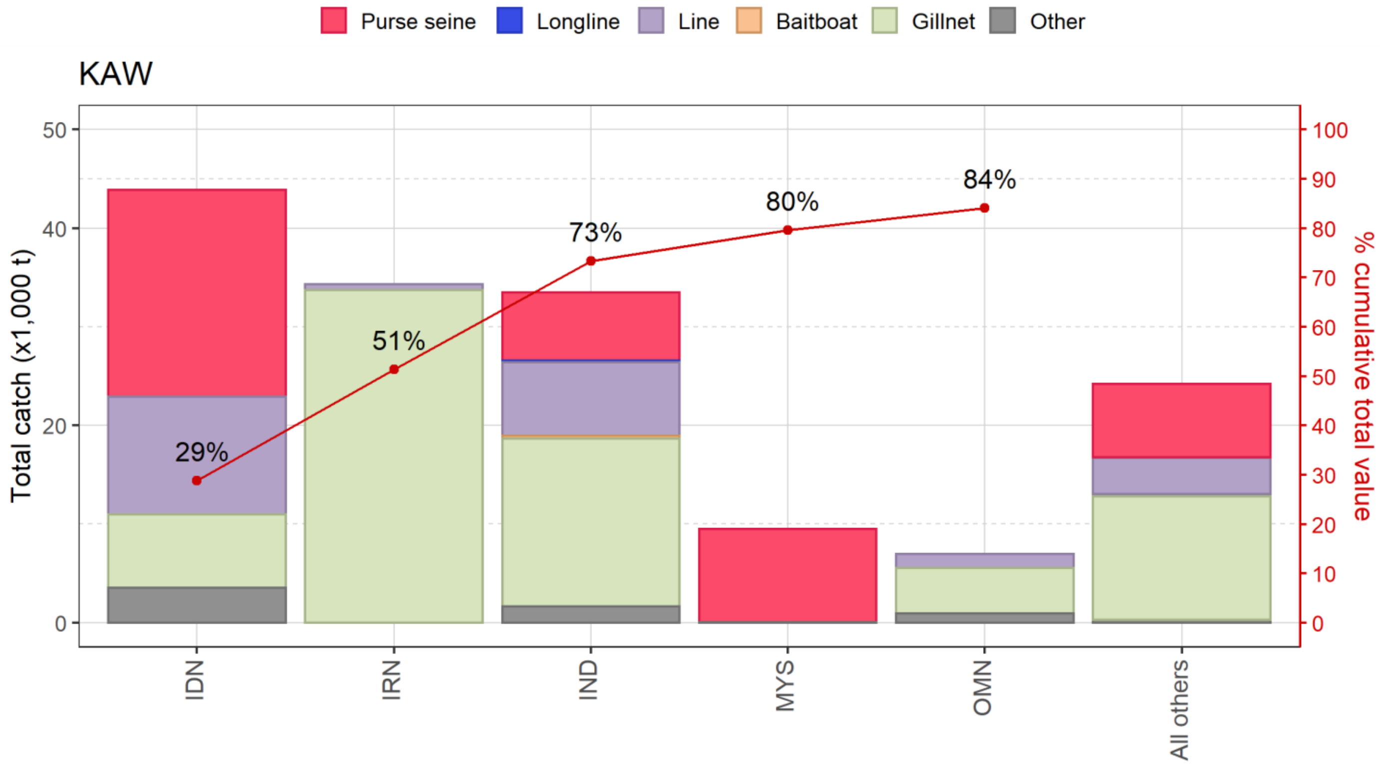


Figure 16: Annual time series of cumulative nominal catches of narrow-barred Spanish mackerel (COM) and Indo-Pacific king mackerel (GUT) in metric tons (t) by fishery group for the period 1950-2019

Appendix IV: Catch composition by CPC, 2015-2019



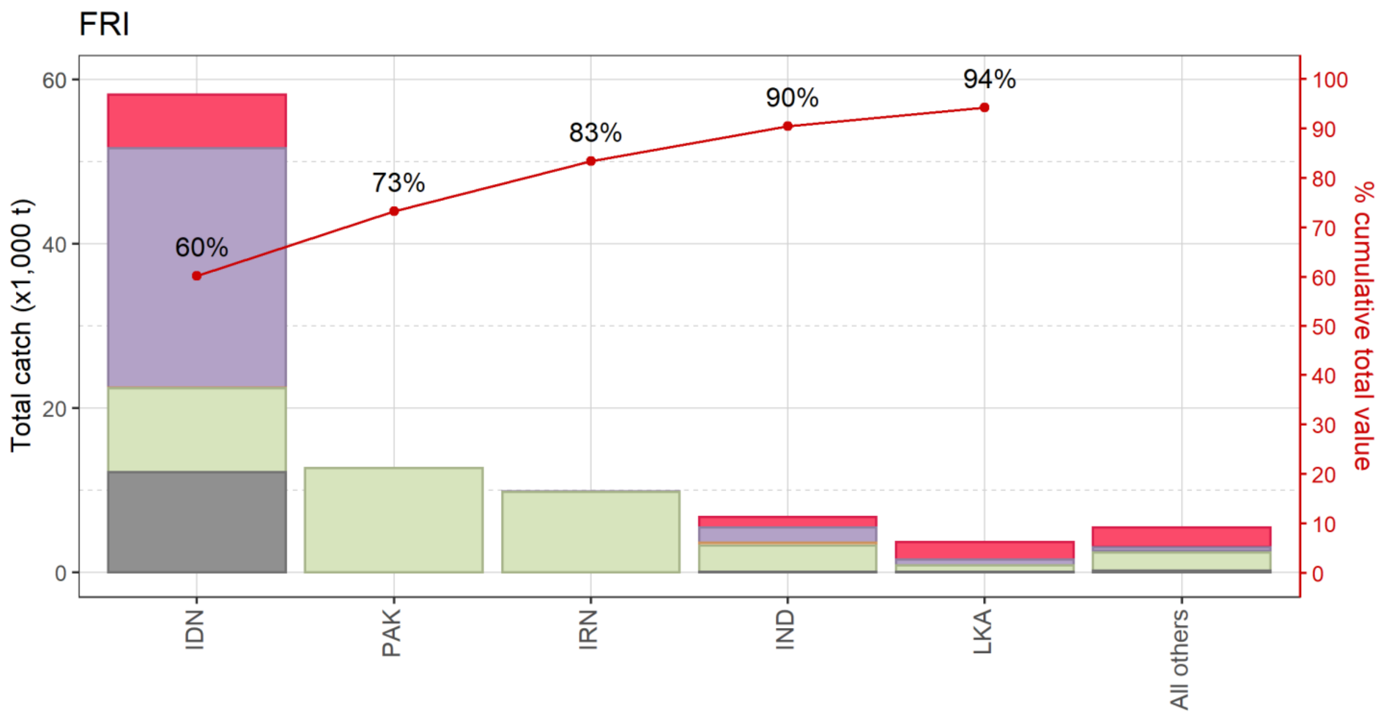


Figure 17: Mean annual nominal catches of kawakawa (KAW) and frigate tuna (FRI) by fleet and fishery in metric tons (t) between 2015 and 2019, with indication of cumulative catches by fleet

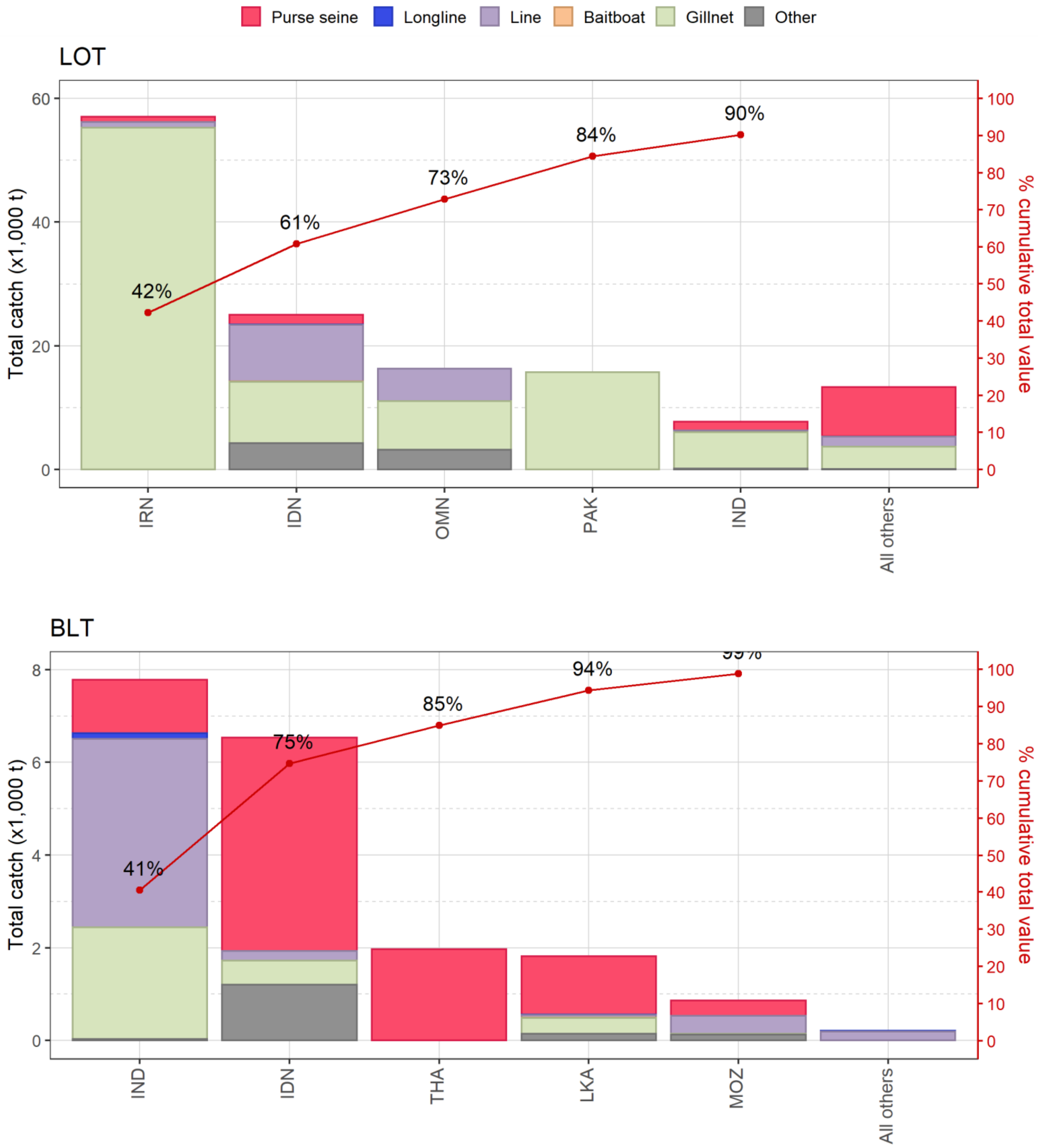


Figure 18: Mean annual nominal catches of longtail tuna (LOT) and bullet tuna (BLT) by fleet and fishery in metric tons (t) between 2015 and 2019, with indication of cumulative catches by fleet

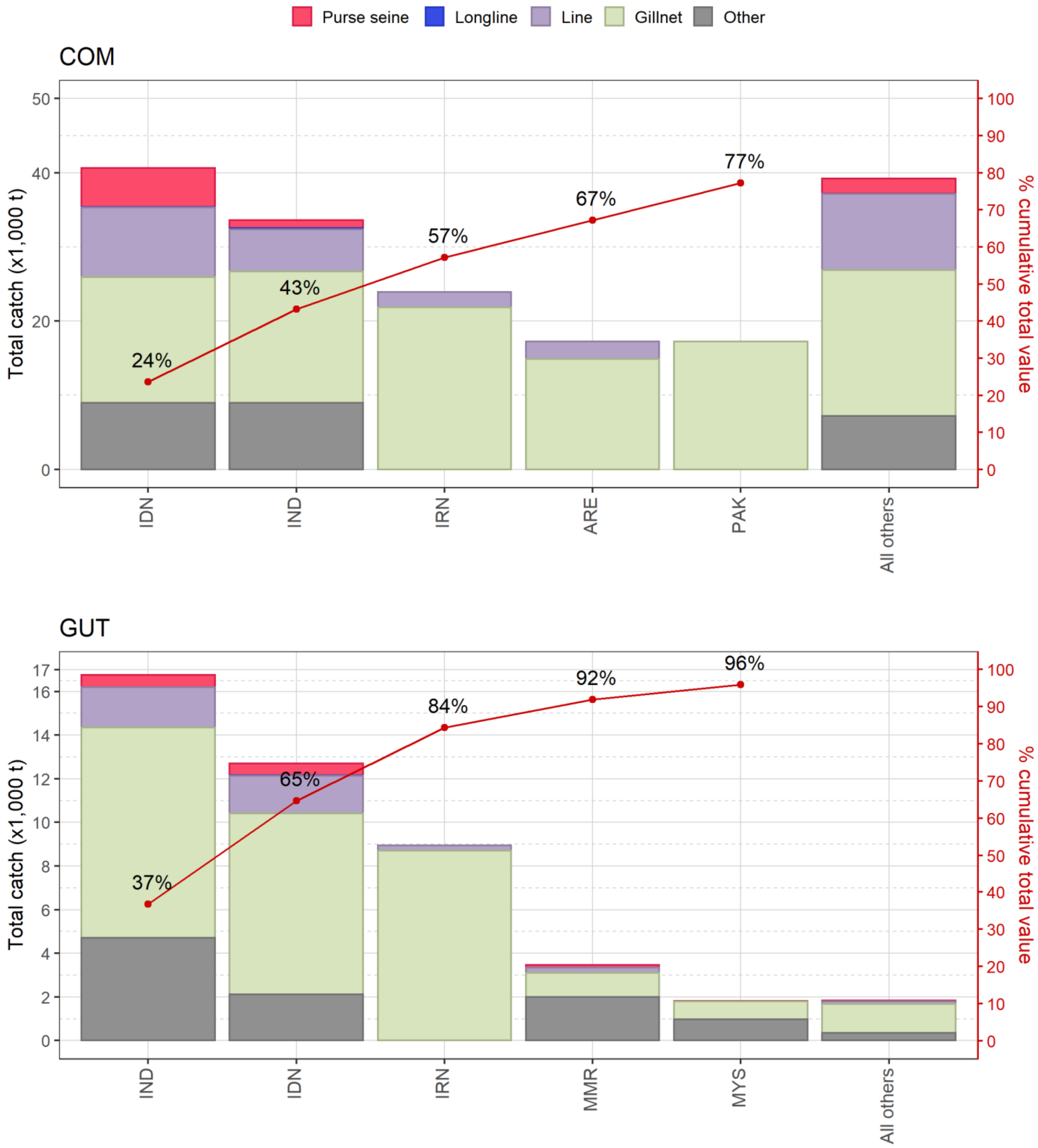


Figure 19: Mean annual nominal catches of narrow-barred Spanish mackerel (COM) and Indo-Pacific king mackerel (GUT) by fleet and fishery in metric tons (t) between 2015 and 2019, with indication of cumulative catches by fleet

Appendix V: Nominal catch data quality plots

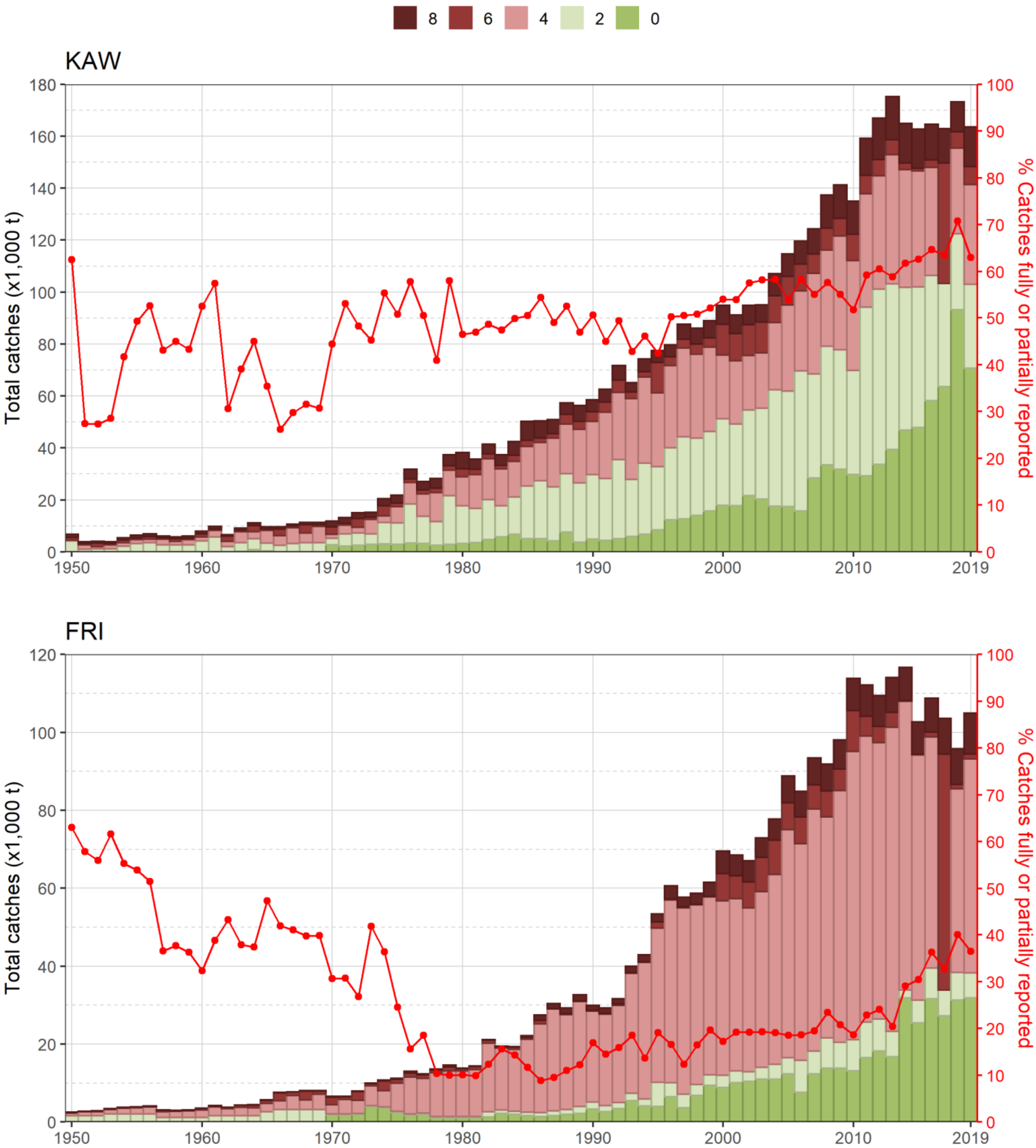


Figure 20: Annual nominal catches of kawakawa (KAW) and frigate tuna (FRI) in metric tons (t) estimated by quality score (barplot) and percentage of nominal catch fully/partially reported to the IOTC Secretariat (lines with dots) for all fisheries in the period 1950–2019

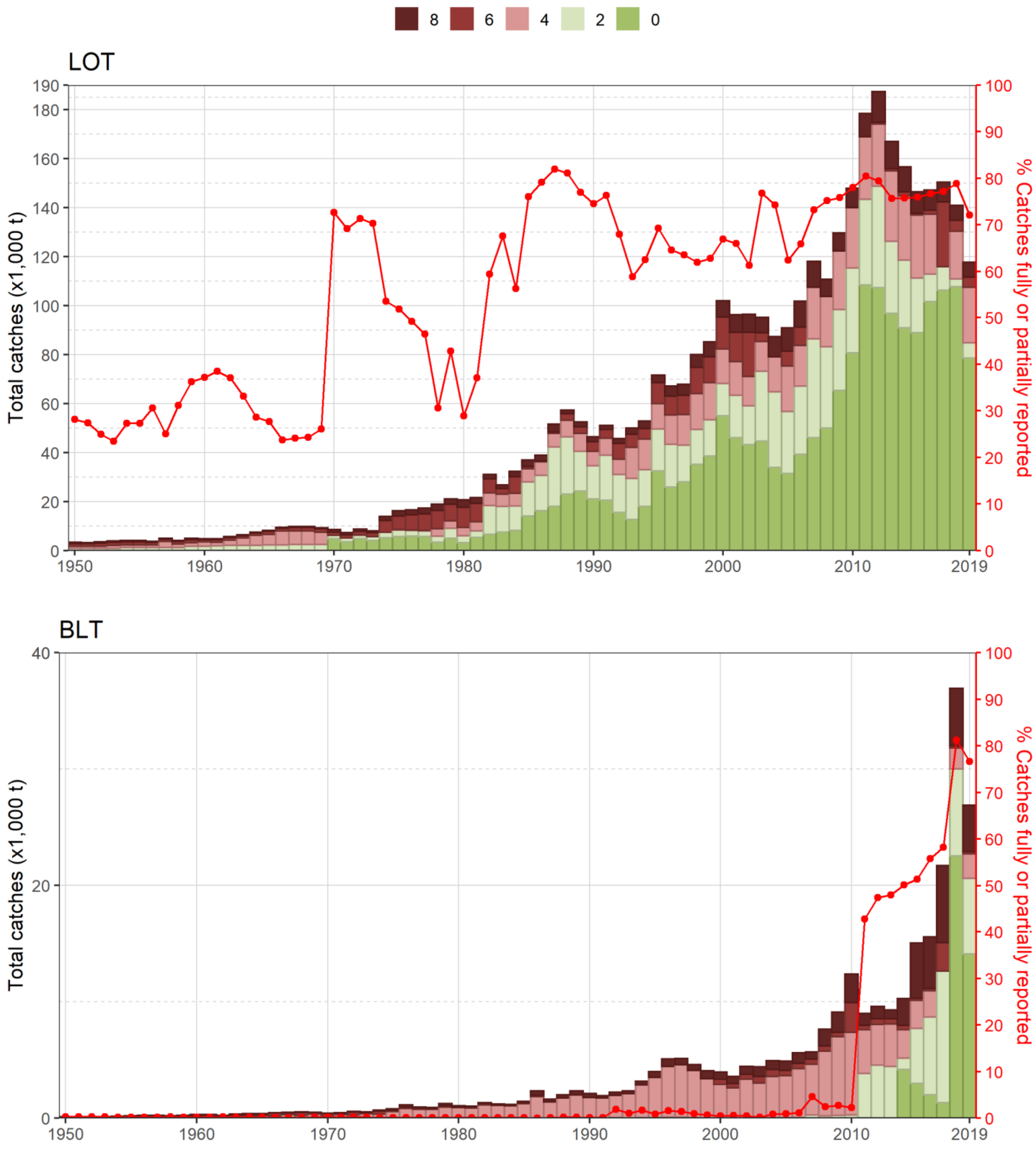


Figure 21: Annual nominal catches of longtail tuna (LOT) and bullet tuna (BLT) in metric tons (t) estimated by quality score (barplot) and percentage of nominal catch fully/partially reported to the IOTC Secretariat (lines with dots) for all fisheries in the period 1950–2019

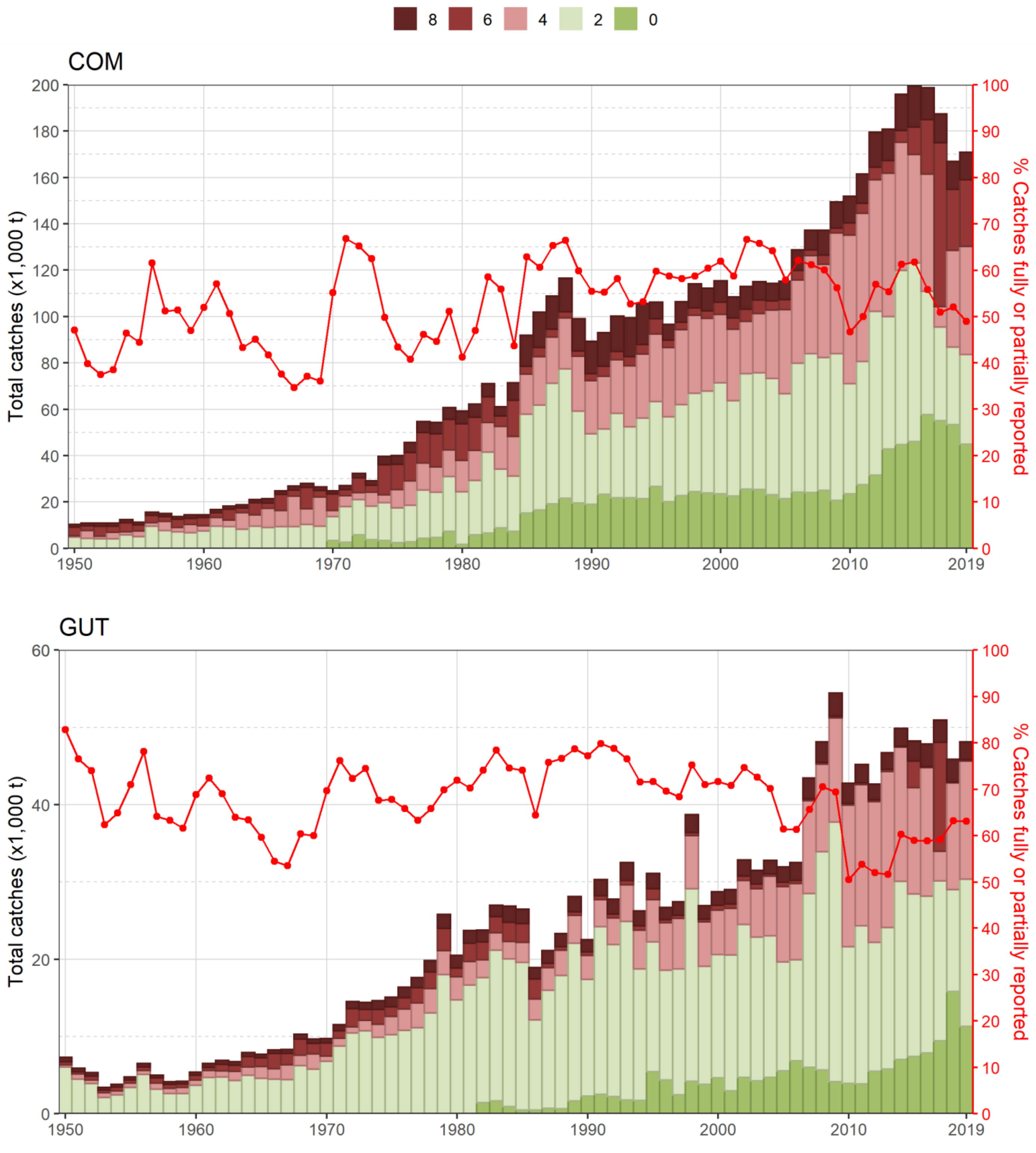


Figure 22: Annual nominal catches of narrow-barred Spanish mackerel (COM) and Indo-Pacific king mackerel (GUT) in metric tons (t) estimated by quality score (barplot) and percentage of nominal catch fully/partially reported to the IOTC Secretariat (lines with dots) for all fisheries in the period 1950–2019

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