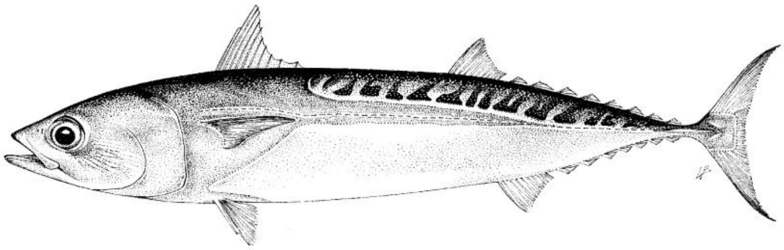
REVIEW OF FISHERIES STATISTICAL DATA AVAILABLE FOR INDIAN OCEAN BULLET TUNA

Author: IOTC Secretariat



Introduction

The overarching objective of the paper is to provide participants at the 14th Session of the IOTC Working Party on Neritic Tunas (WPNT14) with a review of the status of fisheries information available on bullet tuna (*Auxis rochei*) (Risso 1810) occurring in the Indian Ocean. The document describes the temporal and spatial trends in retained catches at global and ocean-basin scale and the main characteristics of the fisheries catching bullet tuna in the Indian Ocean, as well as providing an assessment of the reporting quality of the data sets available at the IOTC Secretariat. A full description of the data sources, processing steps to generate the data sets, and key for reporting quality scores is available in (**IOTC2024_NERI?**).

Bullet tuna (*Auxis rochei*) has been well-researched in countries like India and Indonesia (e.g., (Jasmine et al. 2016), (Lelono et al. 2023)), both of which are significant catchers of this species. Indonesia, in particular, records higher catches in the Indian and Pacific Oceans. However, despite being a neritic species, limited information is available on bullet tuna, and fleets with significant catches often do not provide all the required data sets for this species.

Identifying Auxis spp. can be challenging, especially for juvenile specimens. Since many small tuna species spawn in the same areas, there are cases where all small tunas are grouped together under a generic “tuna” category. Studies on identifying Auxis spp. larvae using various methodologies have demonstrated the challenges of distinguishing between Auxis species at different life stages (e.g., (Ochoa-Muñoz et al. 2018)).

Global catches

Globally, bullet tuna catches increased significantly from 2010, with catches from Western Pacific Ocean peaked 27,000t in 2016, although Indian Ocean had been the only Ocean reported bullet tuna catches to FAO since 1950s. However, in recent years, Indian Ocean, remain the Ocean with significant catches of bullet tuna 22,000t, between 2018 and 2022 (**Fig. 1**).

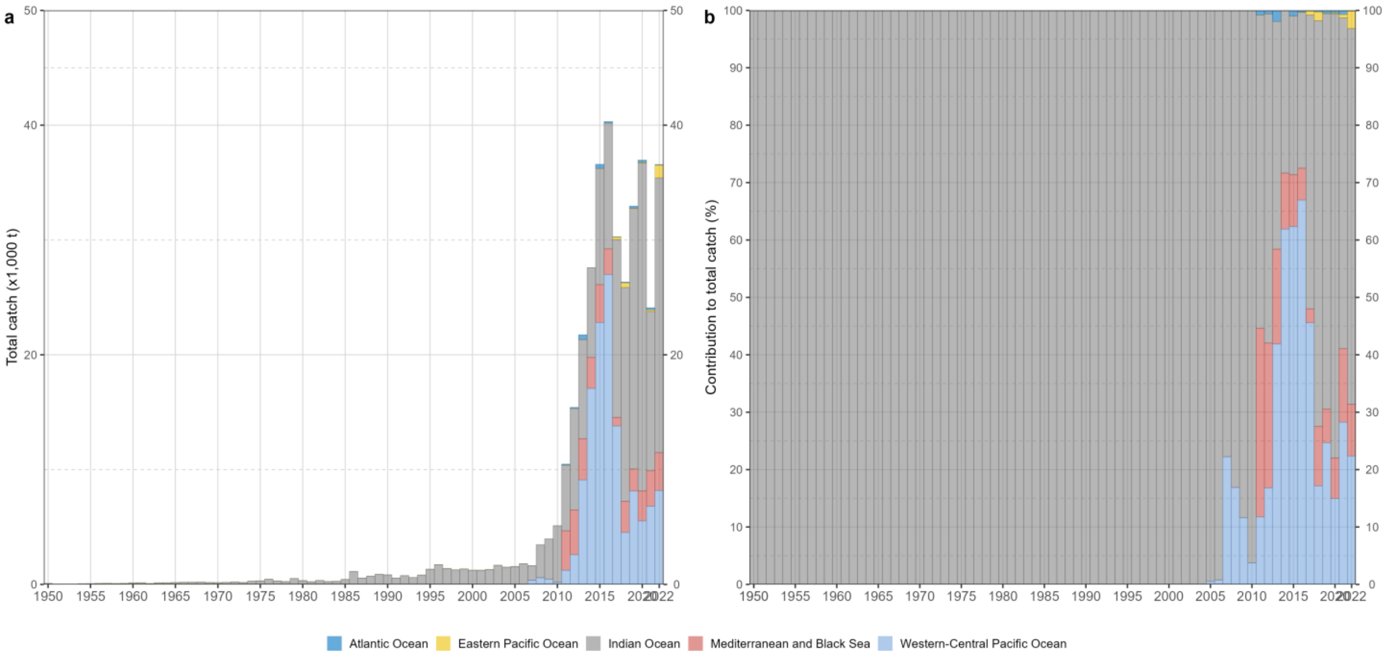


Figure 1: Annual time series of (a) cumulative retained catches (metric tonnes; t) and (b) contribution to the total retained catches (percentage; %) of bullet tuna by ocean basin for the period 1950-2022. Source: FAO global capture production database

Indonesia catches more bullet tuna than any other countries, not only in Indian Ocean, also in the Pacific Ocean (**Fig. 2**).

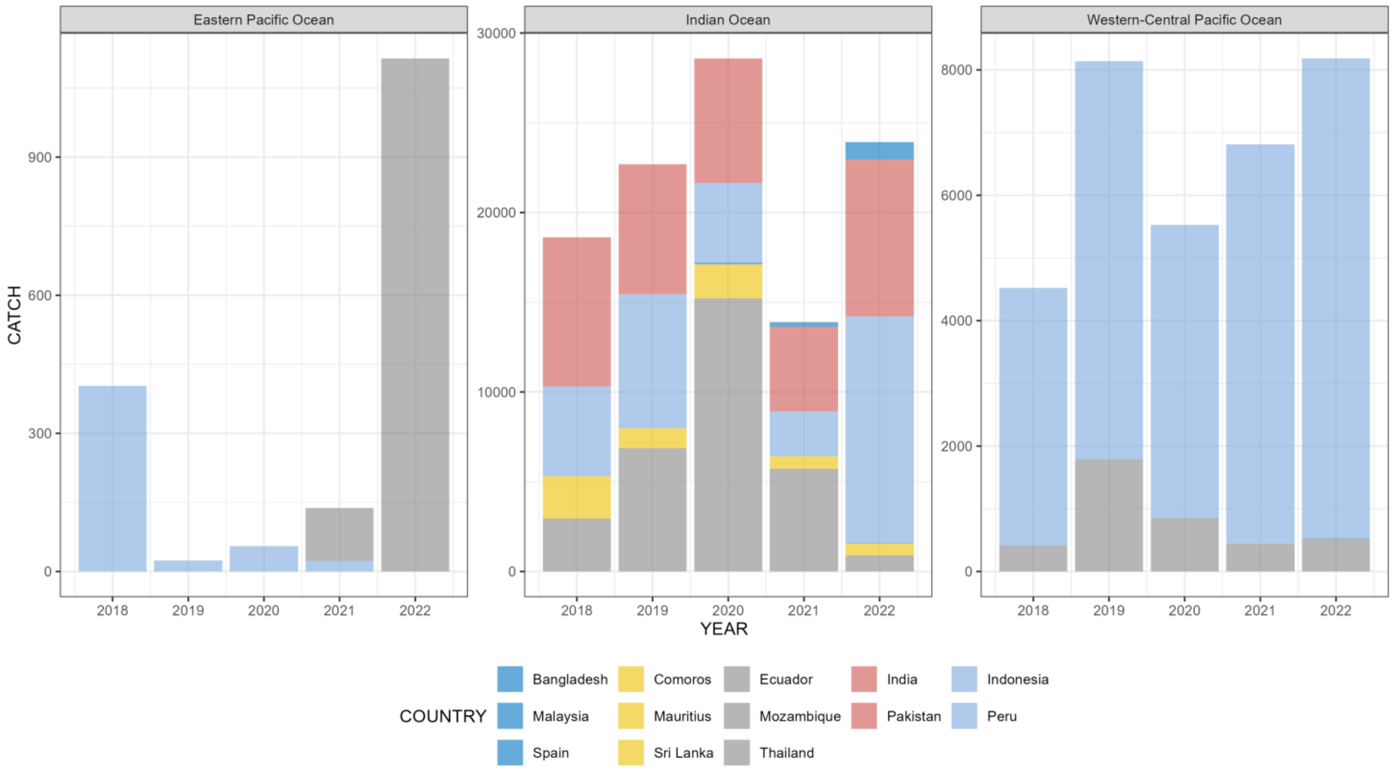


Figure 2: Annual time series of cumulative retained catches (metric tonnes; t) of bullet tuna by country from different Ocean the period 2018-2022. Source: FAO global capture production database

Indian Ocean catches & discards

Historical trends (1950-2022)

Historical catch trends of bullet tuna in the Indian Ocean, show rapid increase from 2000, despite the low catches in decades before 2000 (**tab. 1** and **fig. 3**). The rapid increase relates to significant catches from purse seine fisheries, predominantly in Indonesia. Overall, catches fluctuated from the principle fleet, which is attributed to several factors:

- mis-identification of small tuna species
- aggregating of catches for neritic tuna species

Bullet tuna catches from other fisheries increased from 2010, particularly line and gillnet fisheries (**tab. 1** and **fig. 3**). Reflecting (i) increasing activities in the coastal waters; (ii) improvement in the species disaggregation.

Table 1: Mean annual retained catches (metric tonnes; t) of bullet tuna by decade and fishery for the period 1950-2019. The background intensity colour of each cell is directly proportional to the catch level. Data source: [best scientific estimates of retained catches](https://www.iotc.org/meetings/14th-working-party-neritic-tunas-wpnt14-meetingData/03-NC)

Fishery	1950s	1960s	1970s	1980s	1990s	2000s	2010s
Purse seine | Other	0	0	28	278	552	655	5,057
Longline | Other	0	0	0	3	327	451	1,026
Longline | Fresh	0	0	0	0	0	0	11
Longline | Deep-freezing	0	0	0	0	0	0	65
Line | Coastal longline	3	5	13	28	67	167	552
Line | Trolling	98	172	263	270	486	560	1,692
Line | Handline	11	17	48	95	226	465	901
Baitboat	5	13	16	22	22	0	16
Gillnet	41	153	296	476	971	1,382	2,969
Other	0	1	28	217	406	870	1,410
Total	159	360	693	1,390	3,058	4,551	13,698

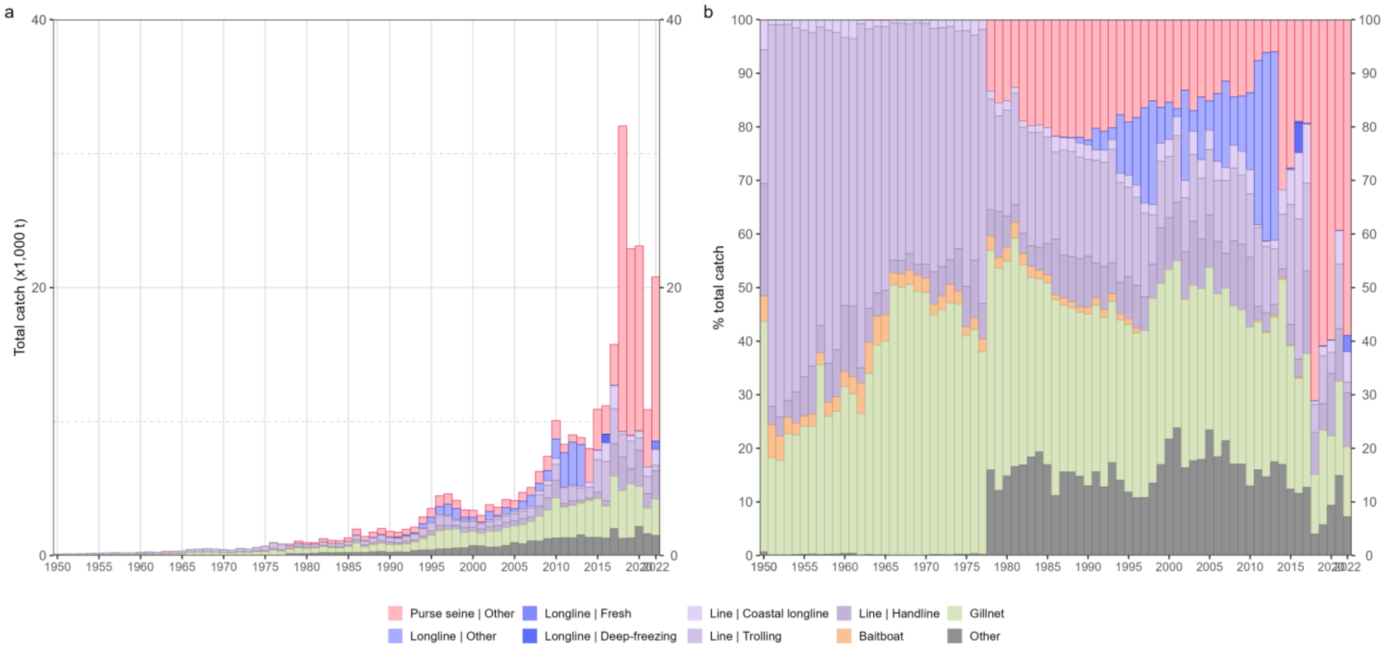
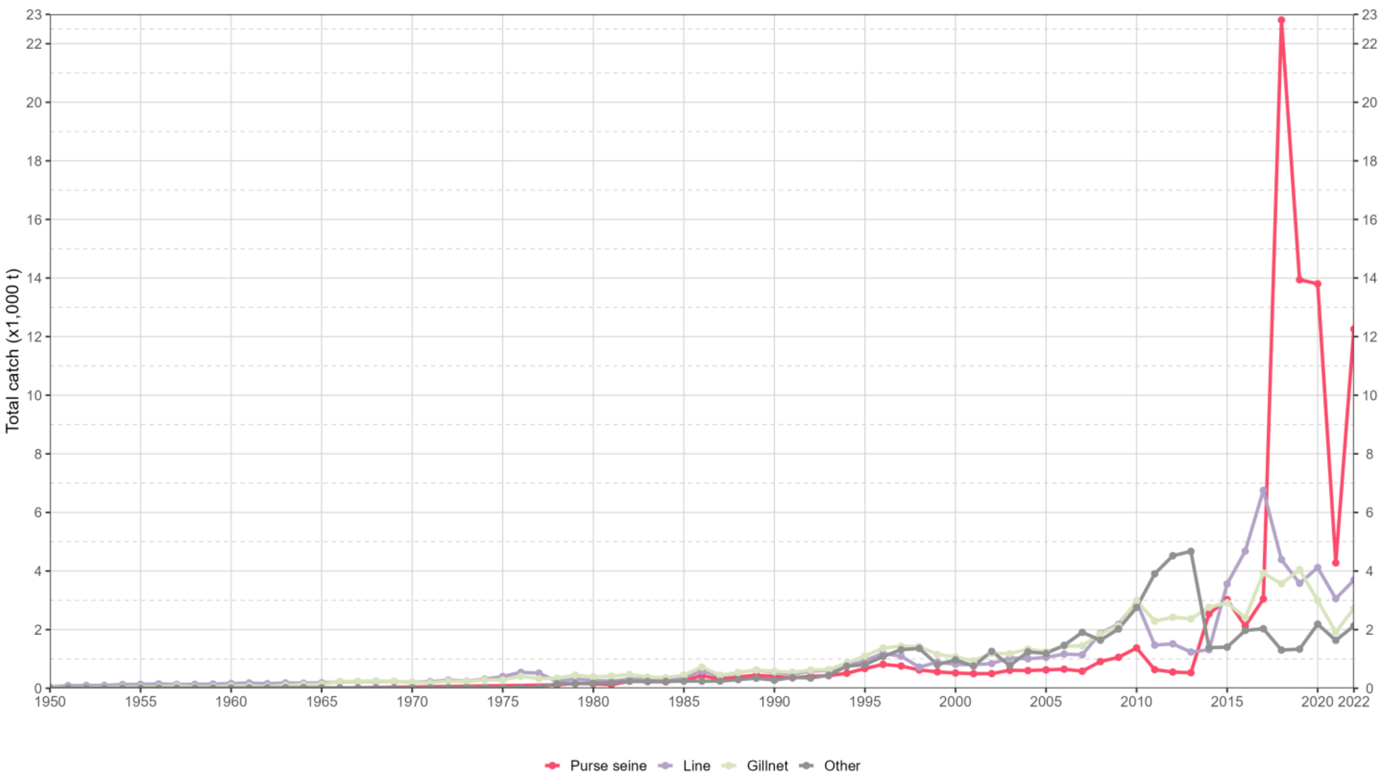


Figure 3: Annual time series of (a) cumulative retained catches (metric tonnes; t) and (b) cumulative contribution to the total retained catches (percentage; %) of bullet tuna by fishery for the period 1950-2022. Data source: best scientific estimates of retained catches

Table 2: Annual retained catches (metric tonnes; t) of bullet tuna by fishery for the period 2013-2022. The background intensity colour of each cell is directly proportional to the catch level. Data source: [best scientific estimates of retained catches](https://www.iotc.org/meetings/14th-working-party-neritic-tunas-wpnt14-meetingData/03-NC)

Fishery	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Purse seine | Other	528	2,538	3,023	2,122	3,047	22,808	13,942	13,804	4,278	12,258
Longline | Other	3,097	0	0	0	1	0	0	0	0	0
Longline | Fresh	0	0	29	23	21	16	13	11	7	622
Longline | Deep-freezing	0	0	2	631	2	3	12	10	2	3
Line | Coastal longline	141	367	704	1,380	1,734	206	403	511	675	1,185
Line | Trolling	910	810	2,443	2,924	2,596	1,667	2,044	915	1,316	406
Line | Handline	185	135	412	376	2,422	2,514	1,132	2,691	1,065	2,098
Baitboat	33	25	21	21	0	0	0	0	0	0
Gillnet	2,368	2,760	2,918	2,402	3,928	3,567	4,045	2,994	1,916	2,721
Other	1,541	1,359	1,350	1,296	2,005	1,283	1,309	2,166	1,625	1,501
Total	8,803	7,995	10,903	11,175	15,756	32,065	22,901	23,102	10,883	20,794



Catch by fishery type

Fisheries from the coastal waters caught over 90% of the total bullet tunas (**fig. 5**). Few industrial fleets reported bullet tunas for several reasons: (i) non commercial value of the species; (ii) aggregated with other small tunas; and (iii) could be discarded or sell as bycatch.

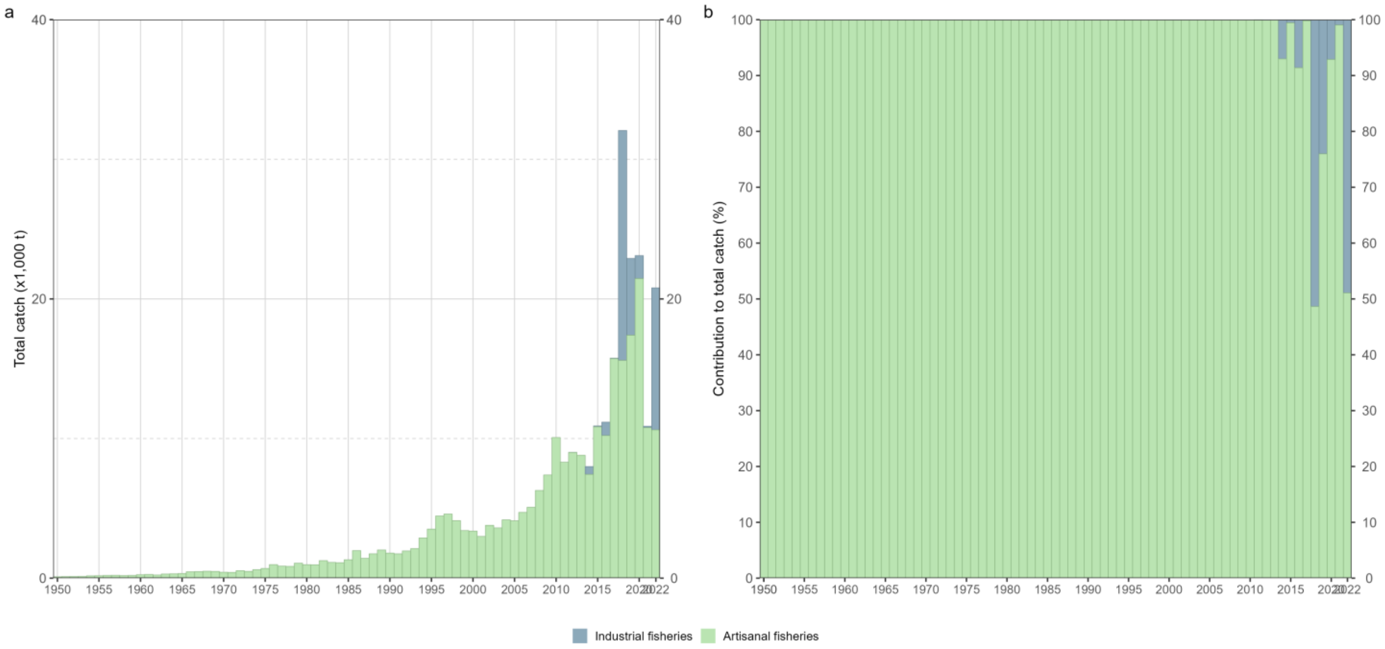


Figure 5: Annual time series of (a) cumulative retained catches (metric tonnes; t) and (b) cumulative contribution to the total retained catches (percentage; %) of bullet tuna by type of fishery for the period 1950-2022. Data source: best scientific estimates of retained catches

Recent fishery features (2018-2022)

Recently, catches of bullet tuna in the Indian Ocean increased significantly, primarily driven by Indonesian purse seine fisheries, following revision of estimation methodology used, splitting catches of industrial and small scale fisheries, and using logbook data as mean of estimating fishery catch data (Sari et al. 2021). Additionally, catches from Indian fisheries increased and Thailand disaggregated catches of neritic species, to indicate the level of bullet tuna catches (Noranarttragoon et al. 2023), instead of aggregating with other small tunas. On average catches vary significant among different fishery groups, with purse seine fisheries averaging 13,000t compared to longline averaging 140t (**tab. 3**). As Indonesia as a major fleet contributed 41% in recent years, with catches from various fisheries and India, contributed 30%, repored from diverse fisheries. Whereas Thailand, catches are exclusively from coastal purse seine fisheries (**fig. ??**).

Table 3: Mean annual retained catches (metric tonnes; t) of bullet tuna by fishery between 2018 and 2022. Data source: [best scientific estimates of retained catches](https://www.iotc.org/meetings/14th-working-party-neritic-tunas-wpnt14-meetingData/03-NC)

Fishery	Fishery code	Catch	Percentage
Purse seine | Other	PSOT	13,418	61.1
Gillnet	GN	3,048	13.9
Line | Handline	LIH	1,900	8.7
Other	OT	1,577	7.2
Line | Trolling	LIT	1,270	5.8
Line | Coastal longline	LIC	596	2.7
Longline | Fresh	LLF	134	0.6
Longline | Deep-freezing	LLD	6	0.0

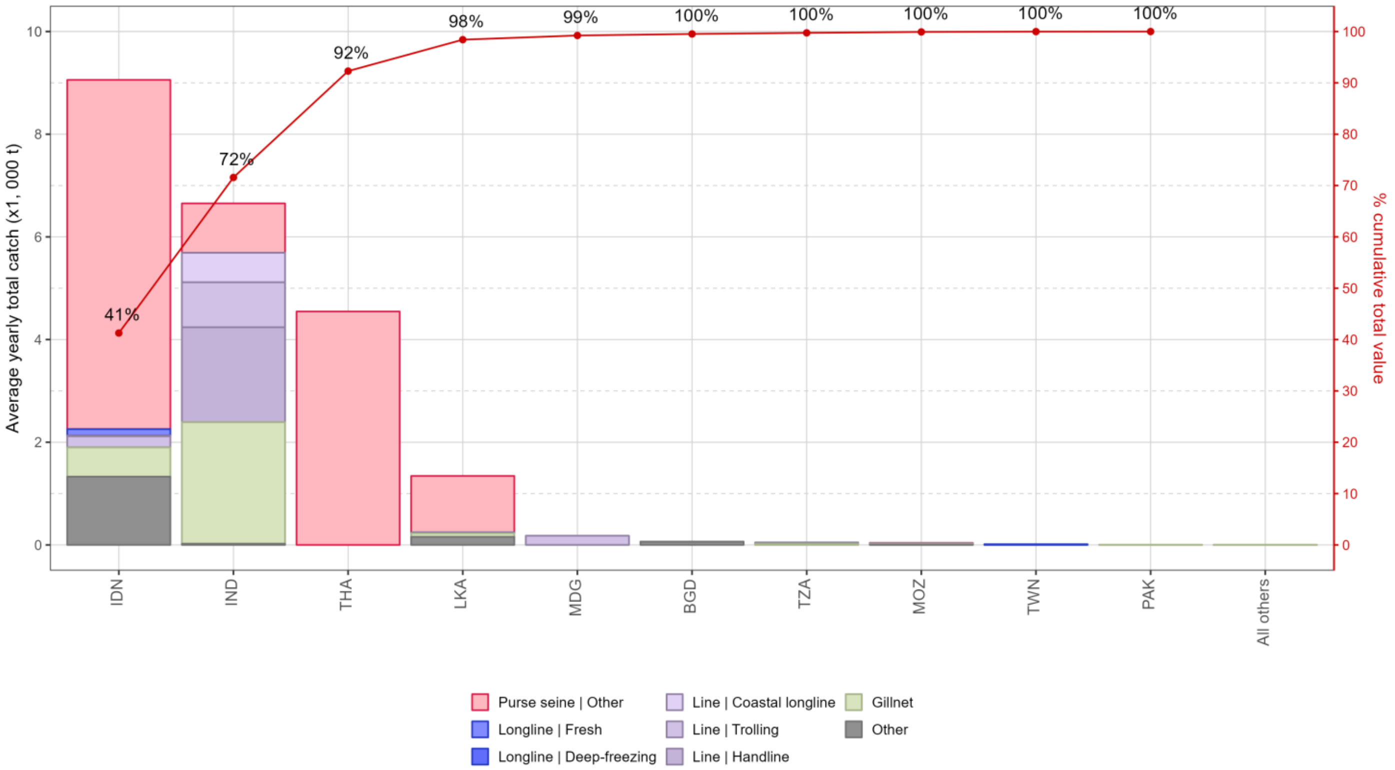


Figure 6: Mean annual retained catches (metric tonnes; t) of bullet tuna by fleet and fishery between 2018 and 2022, with indication of cumulative contribution (percentage; %) of catches by fleet. Data source: [best scientific estimates of retained catches]

Catch by fishery group

Catches fluctuated from purse seine fisheries in recent years between 4,000t in 2021 to 23,000t in 2018. However, catches for other fisheries remain low, ranging from 5,000 to 8,000 in the same period (**fig. ??**).

Fleet wise, the fluctuation are well apparent in purse seine fisheries of Indonesia and Thailand. Line fisheries, however, catches are more stable, although showing declining trend. Gillnet fisheries from India also show fluctuated trend (**fig. ??**).

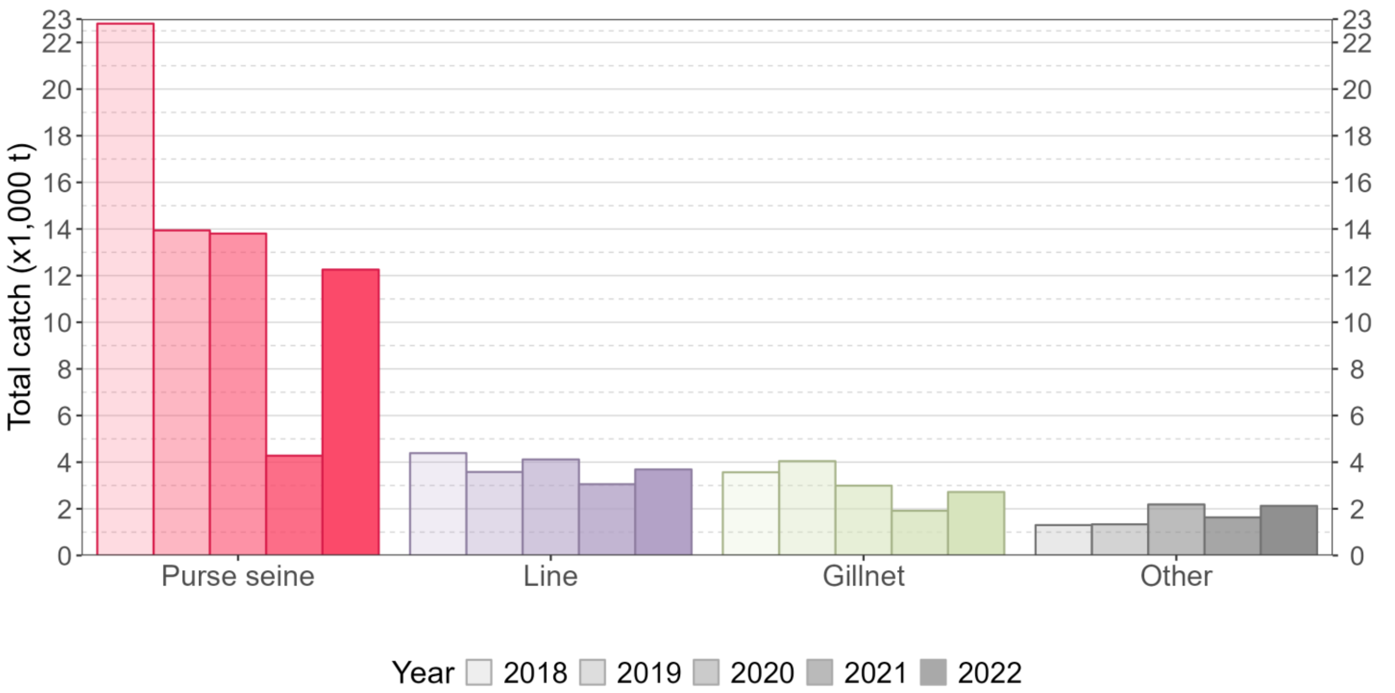


Figure 7: Annual trends in retained catch (metric tonnes; t) of bullet tuna by fishery group between 2018 and 2022. Data source: [best scientific estimates of retained catches]

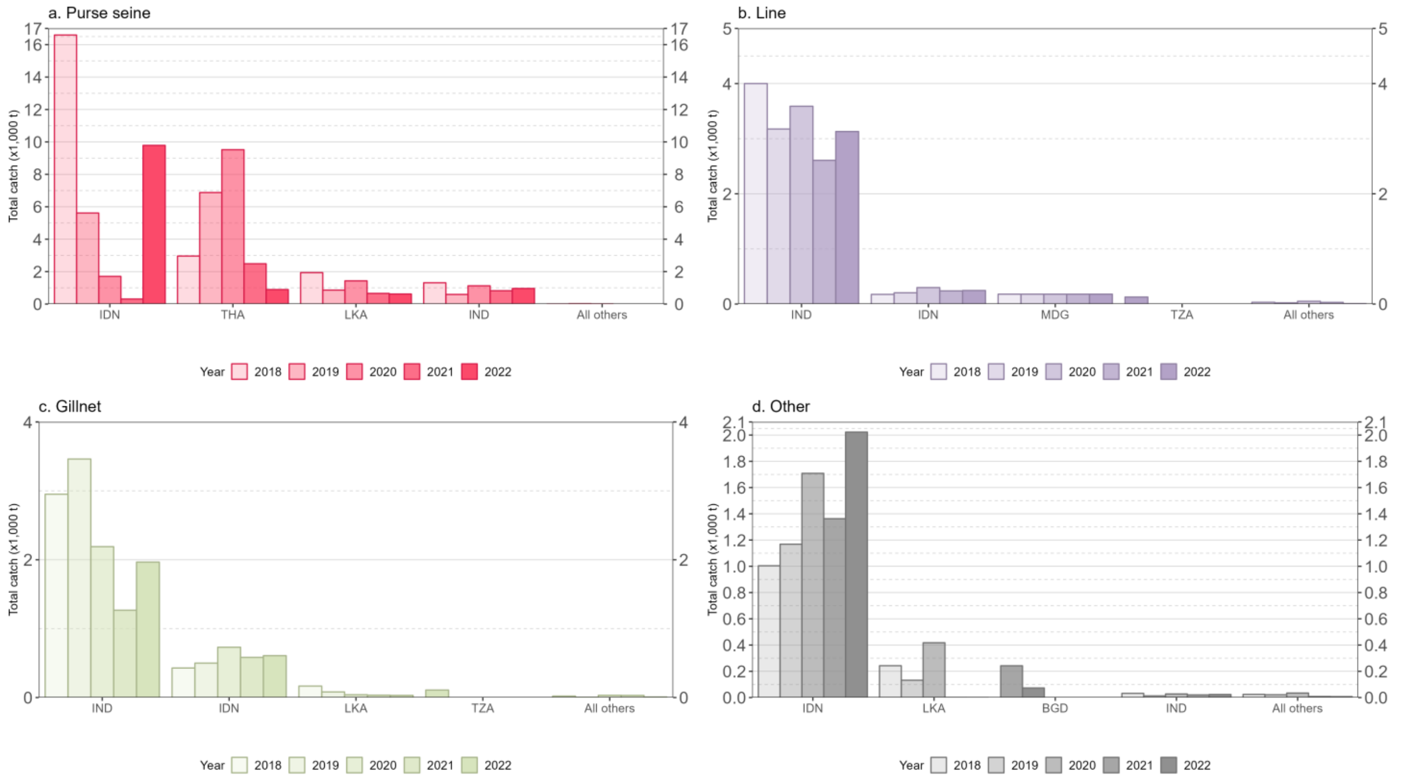


Figure 8: Annual trends in retained catch (metric tonnes; t) of bullet tuna by fishery group and fleet between 2018 and 2022. Data source: best scientific estimates of retained catches

Changes from previous Working Party

Between catch data used for WPNT13 and WPNT14, revised data from Mozambique and Thailand led to modification in the total catches of bullet tuna (**fig. 4**). Historical review of Thailand resulted in a decrease of around 5,000 t from Thailand fisheries.

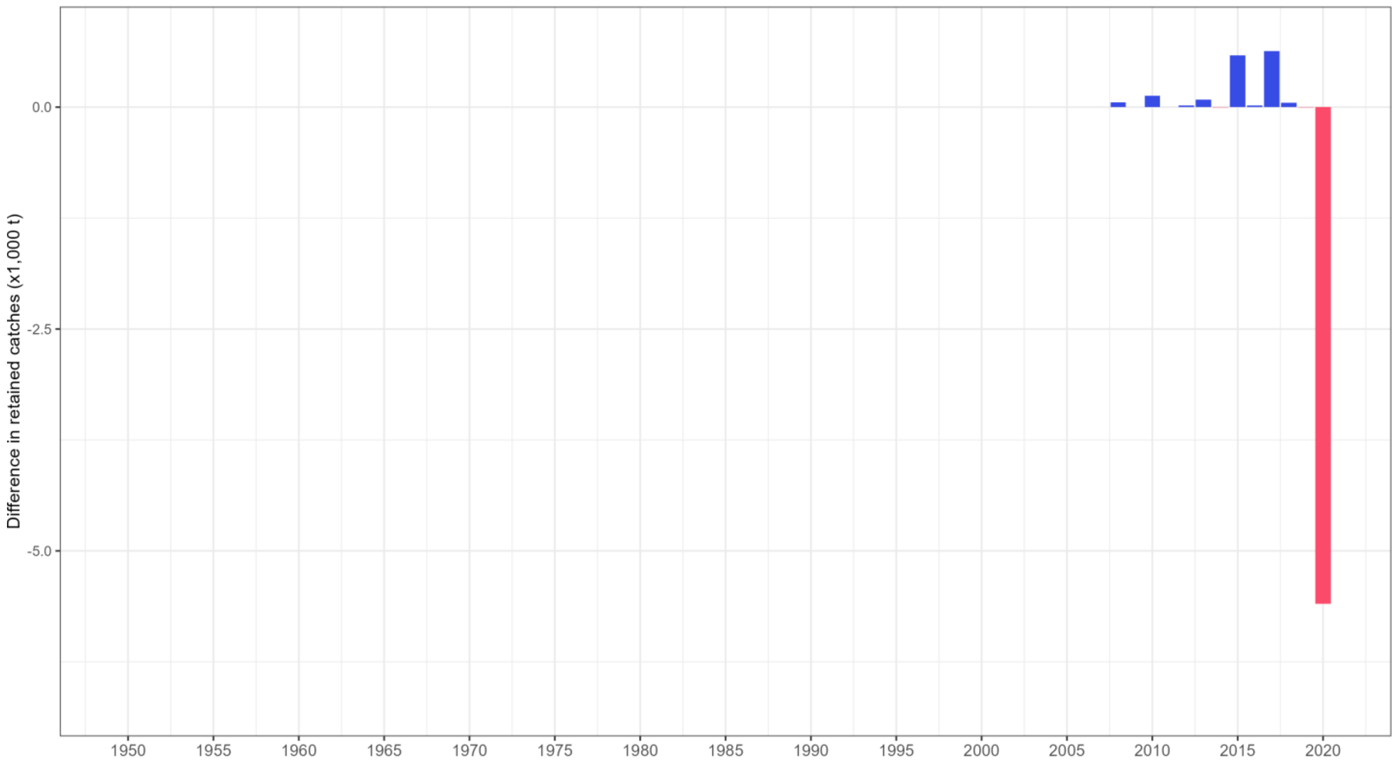


Figure 9: Differences in the annual retained catches (metric tonnes; t) of bullet tuna available at this WPNT and its previous session (WPNT12 meeting held in July 2022). Details by year, fleet, fishery group, and Indian Ocean major area given in Appendix II

Uncertainties in retained catch data

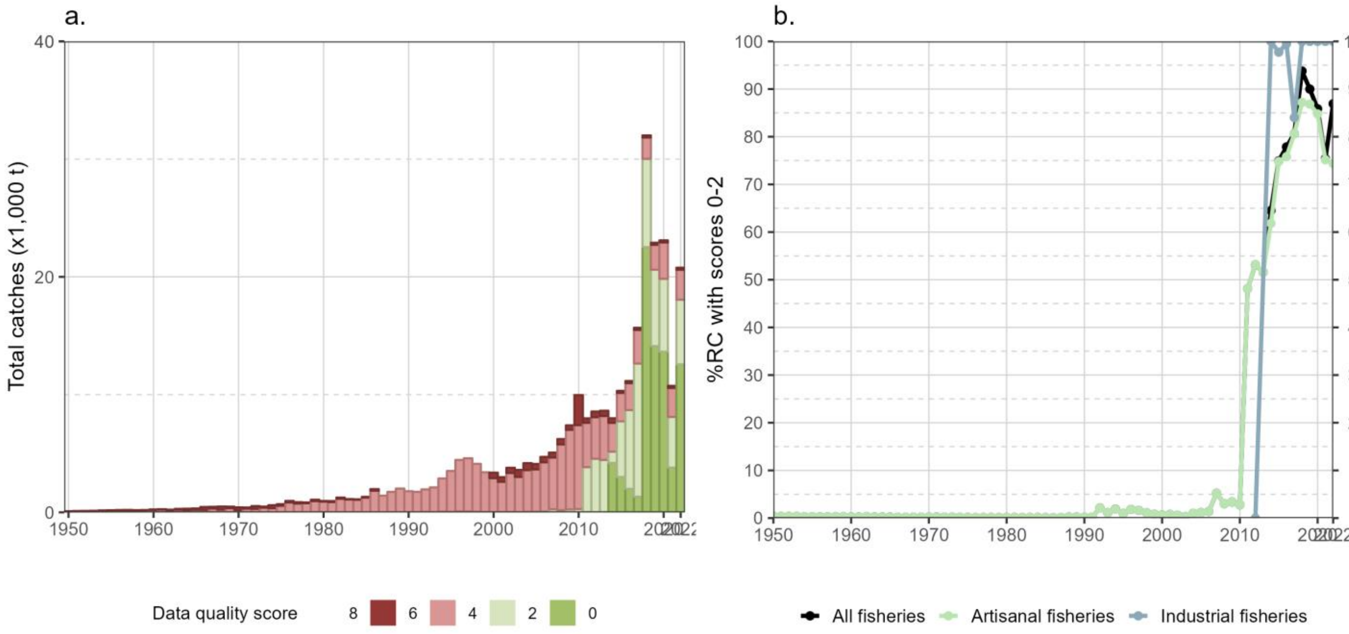


Figure 10: Annual time series of (a) cumulative retained catches (metric tonnes; t) estimated by quality score and (b) contribution of retained catches fully or partially reported to the IOTC Secretariat to all retained catches (percentage; %) of bullet tuna for all fisheries and by type of fishery, for the period 1950-2022

The specific case of bullet tuna

Bullet tuna is the least abundant neritic tuna species with catches essentially dominated by Indian and Indonesian fisheries which represent about two thirds of of its total catch in the Indian Ocean in recent years. Data submitted to the Secretariat by Indonesia over the last decade show major interannual variability in catch levels as well as abrupt changes in the composition of catches by gear (**Fig. 11**).

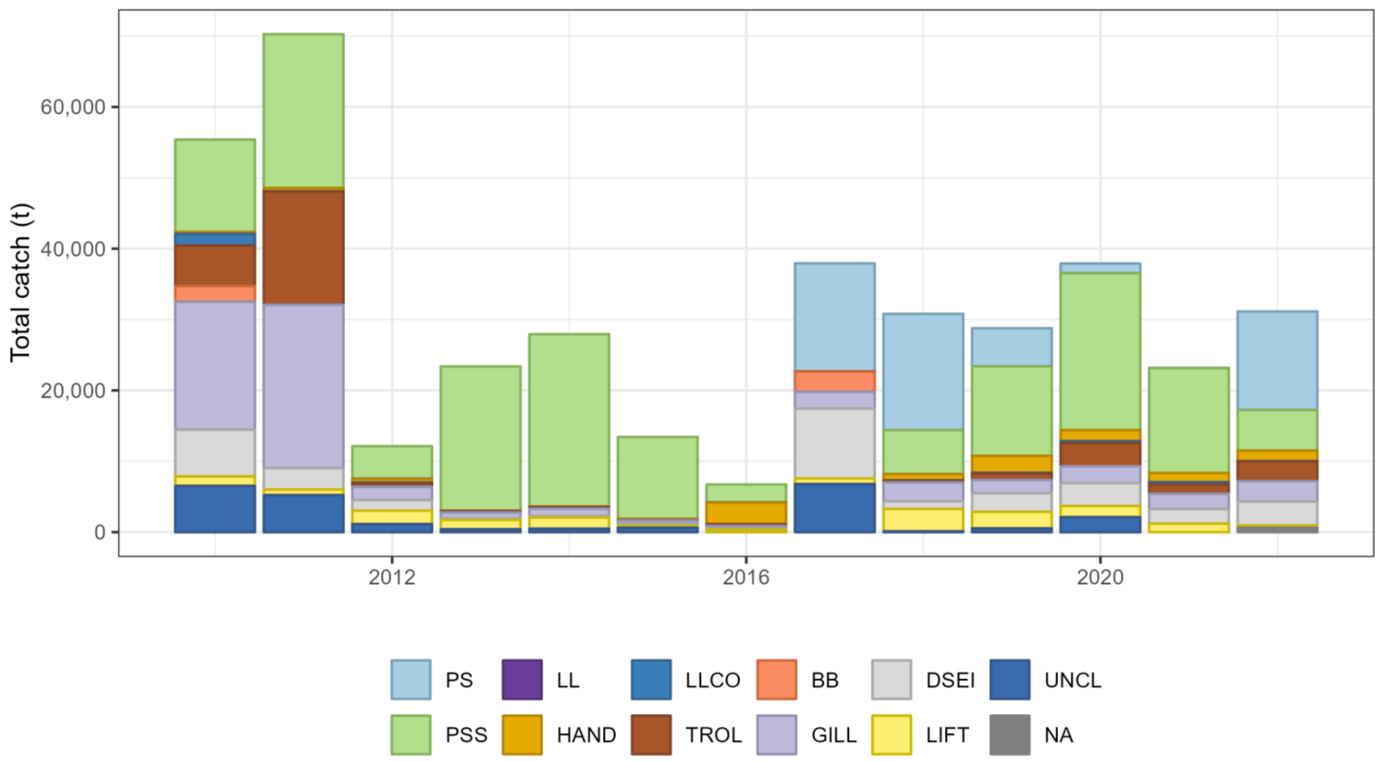


Figure 11: Annual time series of cumulative retained catches (metric tonnes; t) of bullet tuna by fishing gear as submitted to the IOTC Secretariat by Indonesia for the period 2010-2022. PS = industrial purse seines; PSS = coastal purse seines; LL = industrial longlines; HAND = handlines; LLCO = coastal longlines; TROL = trolling lines; BB = pole and lines; GILL = gillnets; DSEI = Danish seines; LIFT = lift nets; UNCL = Unclassified

The issues observed in data submissions stem from the complexity of Indonesian fisheries and are partly explained by long-standing problems with species identification and issues in the attribution of catches to the correct segment of the purse seine fleets (i.e., coastal vs. industrial - according to their IOTC definition in Resolution 15/02) reported to the Indonesian Ministry of Fisheries and Maritime Affairs (MFMA). To address these issues, the Secretariat is currently collaborating with Indonesia to review and improve the IOTC methodology developed in the early 2010s to estimate the catches of bullet tuna (and all other neritic species) taken in Indonesian coastal fisheries (Moreno et al. 2012, Indonesia 2022). In the meantime, the average composition of the catch by gear estimated by the Secretariat results in a major decrease of the catches of bullet tuna reported to the IOTC and the catch levels of the species are considered highly uncertain (**Fig. 12**).

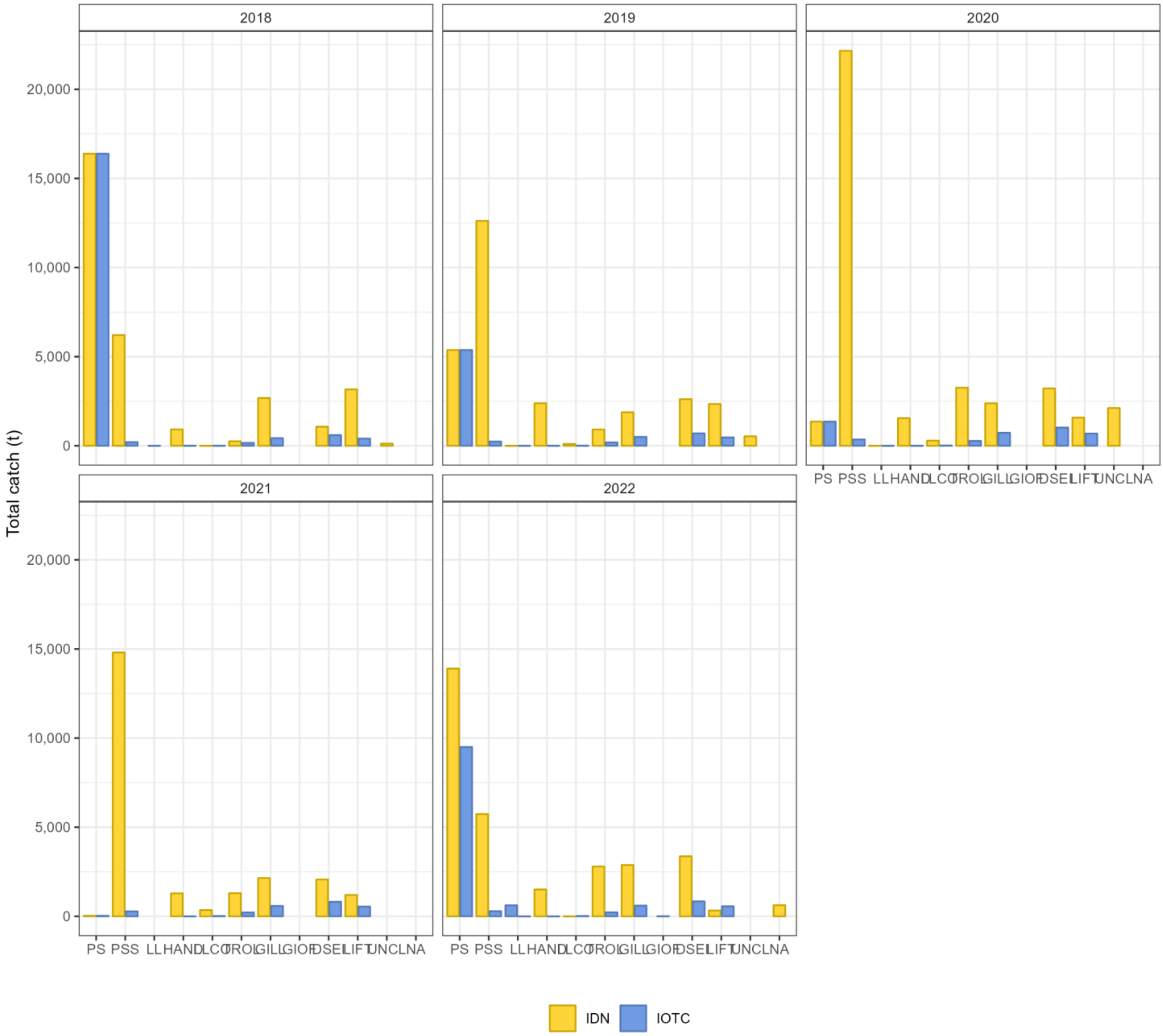


Figure 12: Annual time series of retained catches (metric tonnes; t) by gear as reported to the IOTC Secretariat by Indonesia (IDN) and estimated by the IOTC Secretariat for the period 2018-2022

In addition, the composition of the catch of neritic tunas in the coastal purse seine fishery of Thailand has recently been reviewed and bullet tuna has been reported to occur in the catch since 2018 (**Fig. 13**). This has resulted in the catches of bullet tuna to increase from 0 t in 2017 to 2,960 t and 9,521 t in 2018 and 2020, respectively, during a period when the number of purse seiners has not showed much variation. The uncertainty in the Thailand purse seine catches of bullet tuna adds up to the uncertainties in the Indonesian catches to question the credibility of the time series of catches of bullet tuna currently available from the IOTC Secretariat.

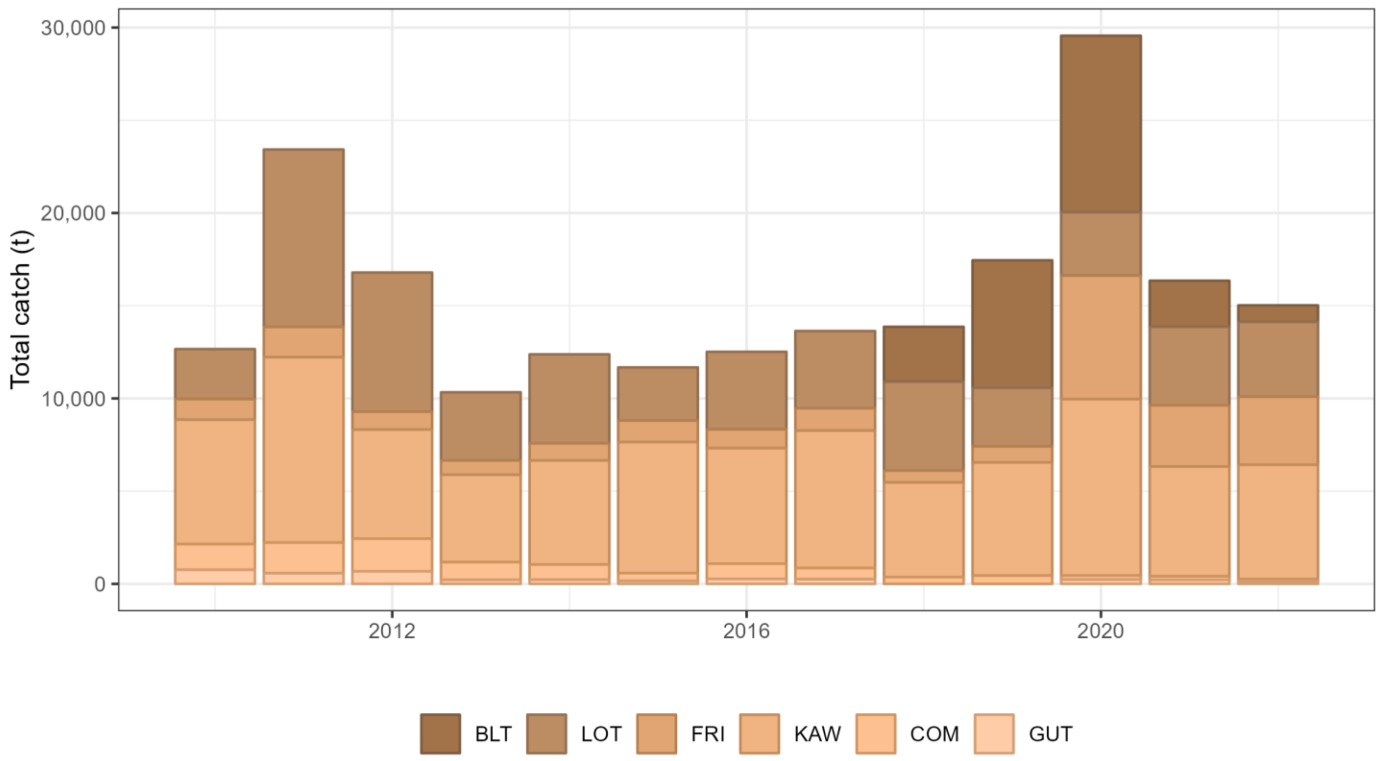


Figure 13: Annual time series of cumulative retained catches (metric tonnes; t) by gear as reported to the IOTC Secretariat by Thailand for the period 2018-2022

Discards

Very little information is available on discards of neritic tunas in coastal and semi-industrial fisheries of the Indian Ocean. Discarding of neritic tunas has been shown to occur in large-scale longline and purse seine fisheries that target tropical tunas and billfish but the quantities are considered to be small (Huang & Liu 2010, Ruiz et al. 2018). The implementation of IOTC Res. 19/05 on the retention of bycatch onboard purse seiners since late 2019 is assumed to have resulted in a reduction of the discards of bullet tuna in this fishery.

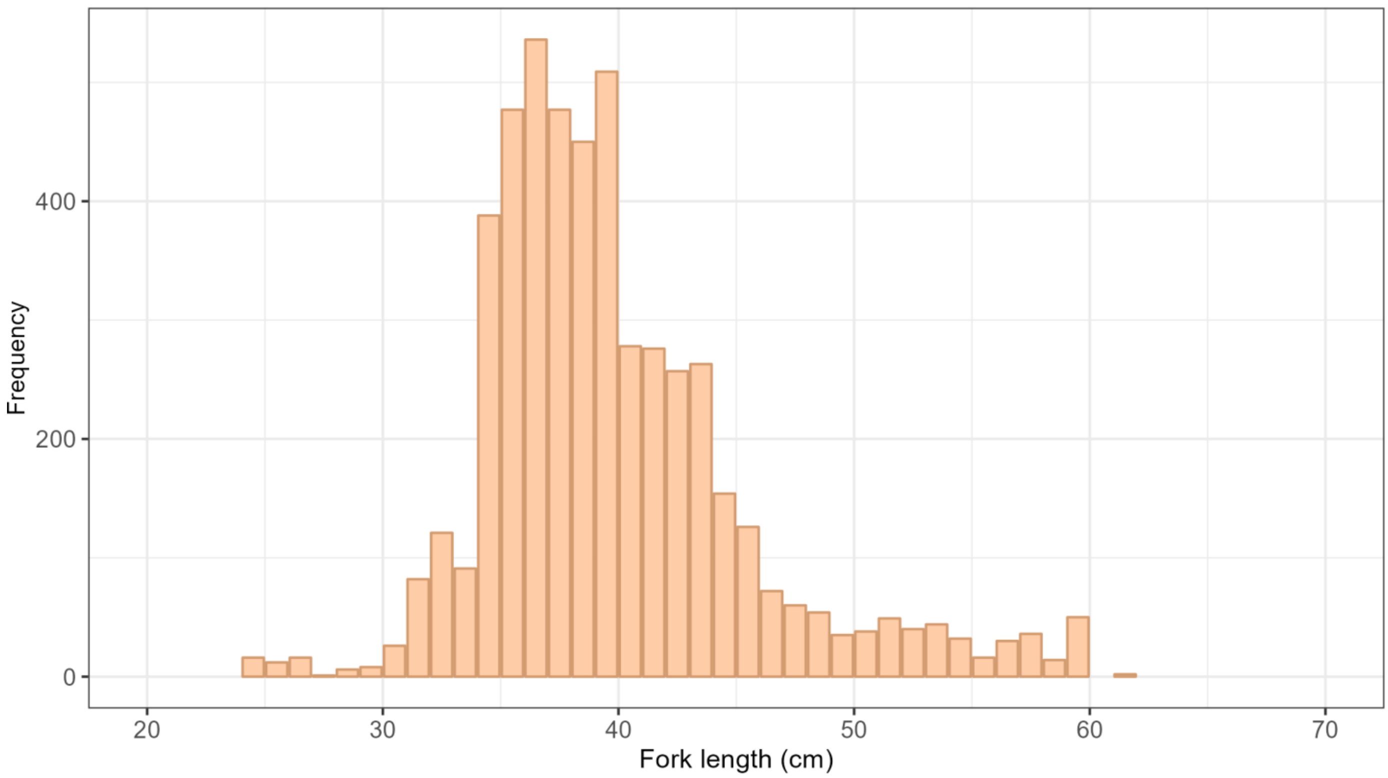


Figure 14: Size-frequency distribution of bullet tuna discarded at sea in purse seine fisheries as available in the ROS regional database

Spatial distribution of catch

Geo-references catches

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

Limited geo-referenced effort data are available for bullet tuna owing to fisheries catching bullet do not collect geo-referenced information, and industrial fisheries reported very low catches of bullet tuna although collecting reliable geo-referenced data **fig. 15**. Noting that Indonesia, the main contributor, only collect geo-referenced data for about 5% of total catch.

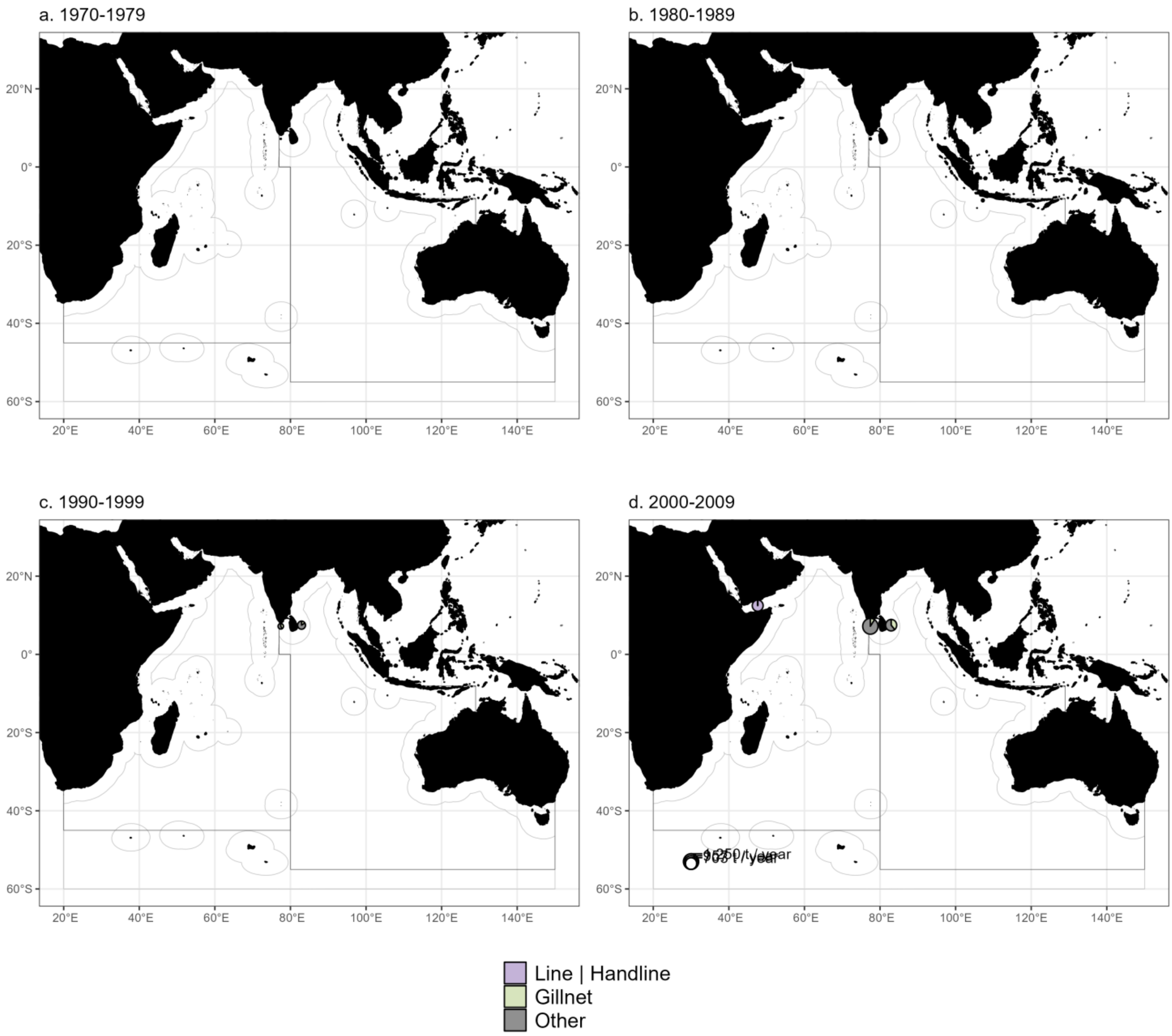


Figure 15: Mean annual time-area catches (metic tonnes; t) of bullet tuna, by decade, 5-degree grid area, and fishery. Light grey solid lines delineate areas beyond national jurisdiction. Data source: time-area catches

Geo-referenced catches by fishery, last years (2018-2022) and decade (2010-2019)

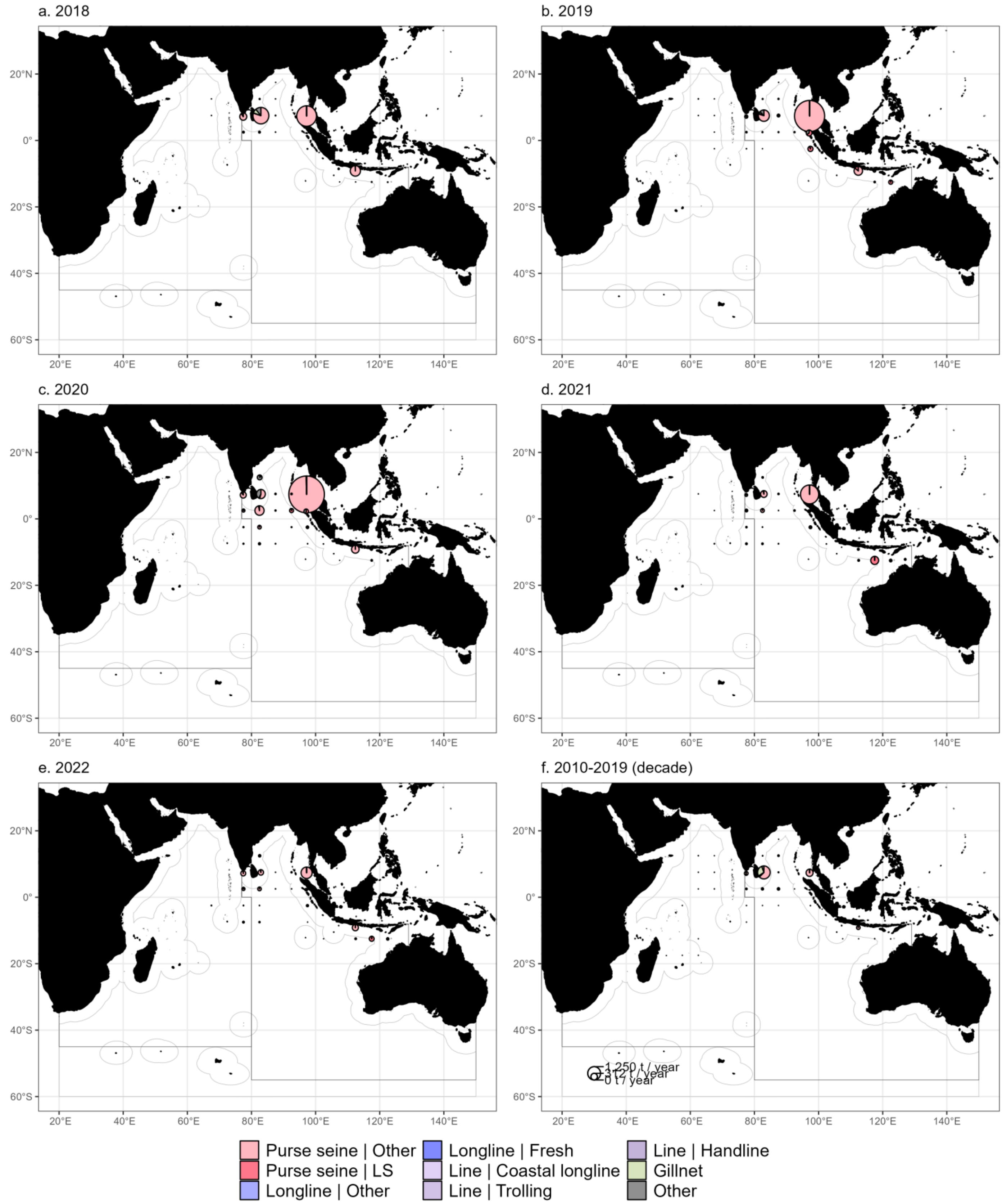


Figure 16: Mean annual time-area catches (metric tonnes; t) of bullet tuna, by year and decade, 5-degree grid area, and fishery. Light grey solid lines delineate areas beyond national jurisdiction. Data source: time-area catches

Domestic catches within areas under national jurisdiction (2018-2022)

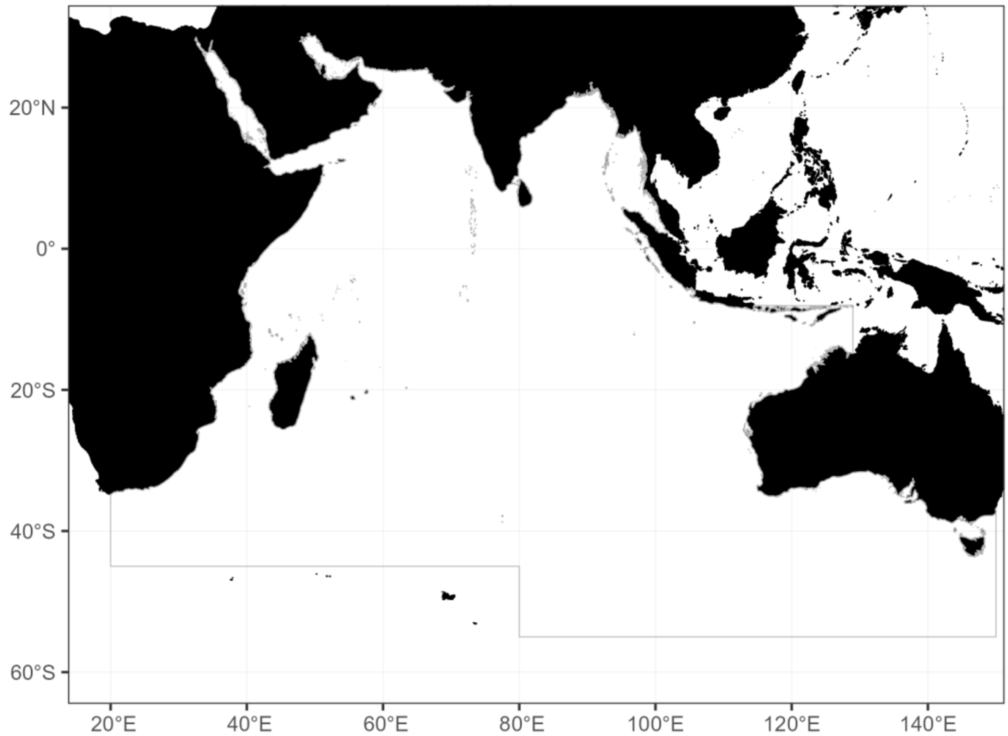


Figure 17: Mean annual density of catch (t km^{-2}) of bullet tuna reported for domestic fisheries operating in areas under national jurisdiction of IOTC coastal states between 2018 and 2022. Data source: best scientific estimates of retained catches

Uncertainties in geo-referenced catch and effort data

As mentioned previously, insufficient geo-referenced data available for bullet tuna due to the nature of the fisheries catching the species, and similarity with other neritic species. Hence, the quality of geo-referenced catch available, related to the retained catches is very low, at 18.4% in 2022 (**fig. 18**) .

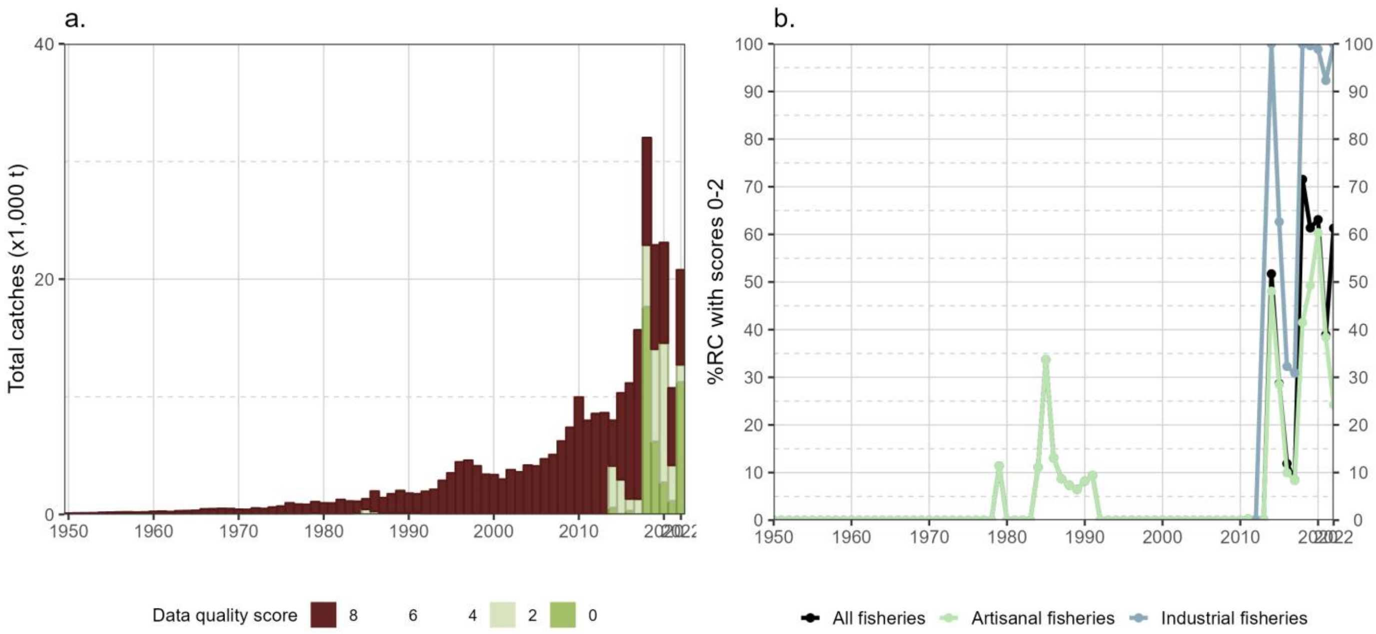


Figure 18: Annual time series of (a) cumulative retained catches (metric tonnes; t) estimated by quality score and (b) contribution of retained catches (percentage; %) with corresponding geo-referenced catch and effort data reported to the IOTC Secretariat in agreement with the requirements of Res. 15/02) to all retained catches of bullet tuna for all fisheries and by type of fishery, for the period 1950-2022

Size composition of the catch

Compared to other neritic species, very few sample of Bullet tuna are collected, representing only 4% of total size frequency data of neritic species.Bullet tuna samples are available from several fisheries, In the past most of the sample were from gillnet fisheries, and recent size data are predominantly from purse seine fisheries (**fig. 19**).

Distribution of size data indicated that sample from purse seine fisheries are available mainly from Eastern Indian (Sri Lanka, Indonesia, Thailand), with few sample collected on the coast of Africa (**fig. 20**), with over 8000 bullet tuna measured in 2006 (**fig. 24**) . Less sample available from line, gillnet, and other fisheries. Samples from gillnet fisheries are mainly from Sr Lanka and Indonesia (**fig. 21**). Similarly for line fisheries (**fig. ??**), with minimum measures taken in recent years (**fig. 26**) . Whereas other fisheries are dominant in Eastern Indian Ocean (**fig. 23**), and although no sample collected historically, over 7000 samples measured in recent years (**fig. 31**).

Samples availability

By fishery group

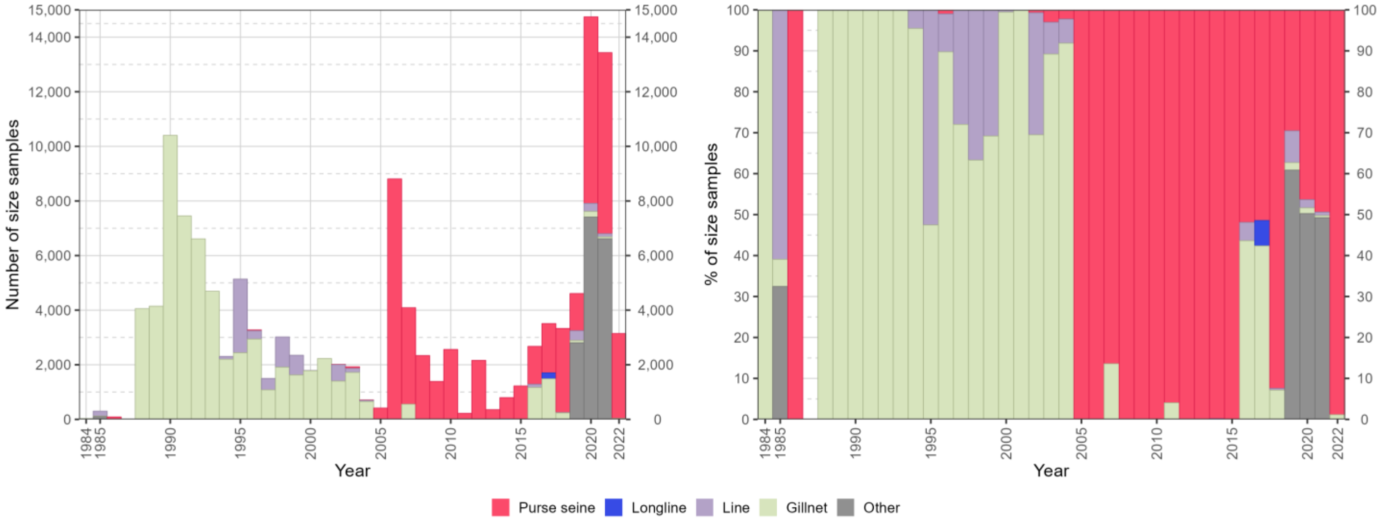


Figure 19: Availability of size-frequency data for bullet tuna as (left) absolute and (right) relative number of samples per year and fishery group. Data source: standardized size-frequency dataset

Purse seine fisheries

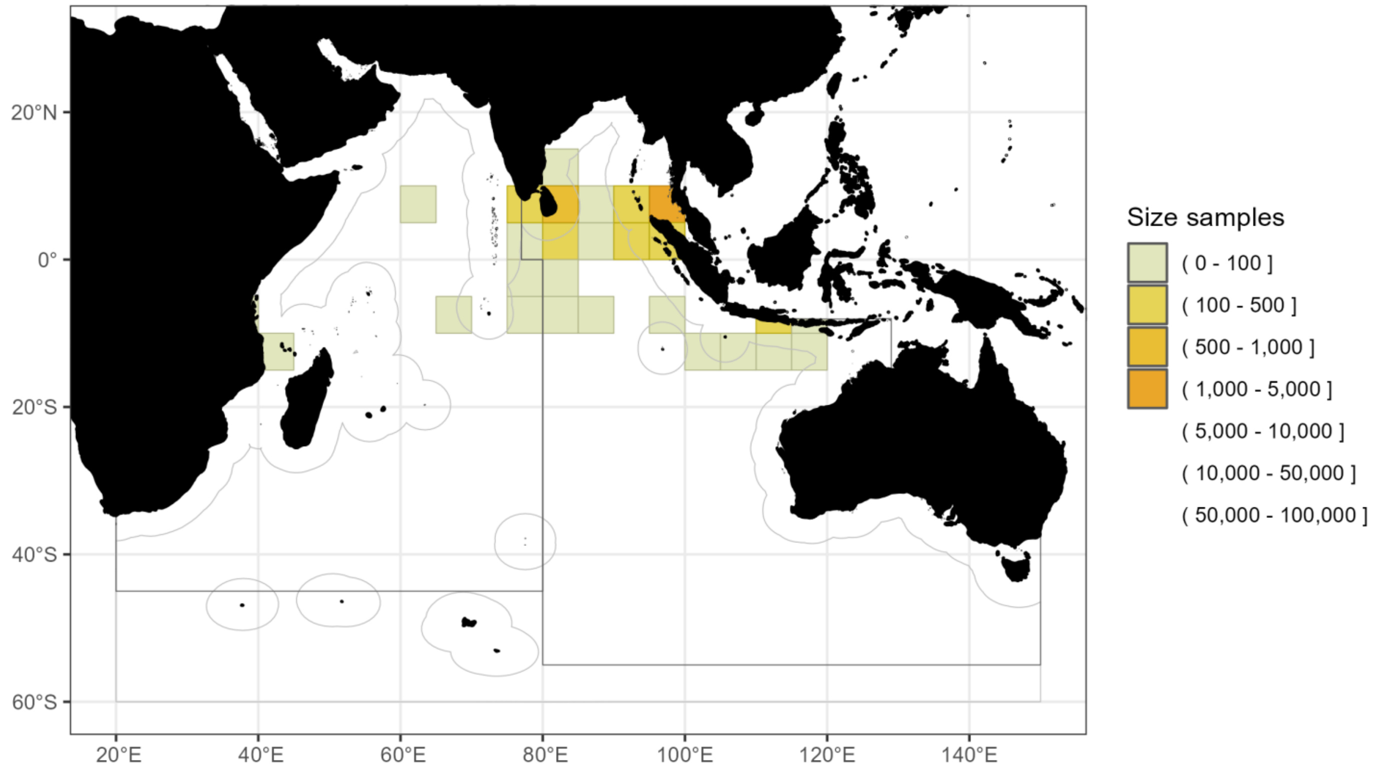


Figure 20: Spatial distribution (mean annual number of samples per 5-degree grid area) of available size-frequency data for bullet tuna caught in purse seine fisheries during 2018-2022. Light grey solid lines delineate areas beyond national jurisdiction. Data source: [standardized size-frequency dataset]

Gillnet fisheries

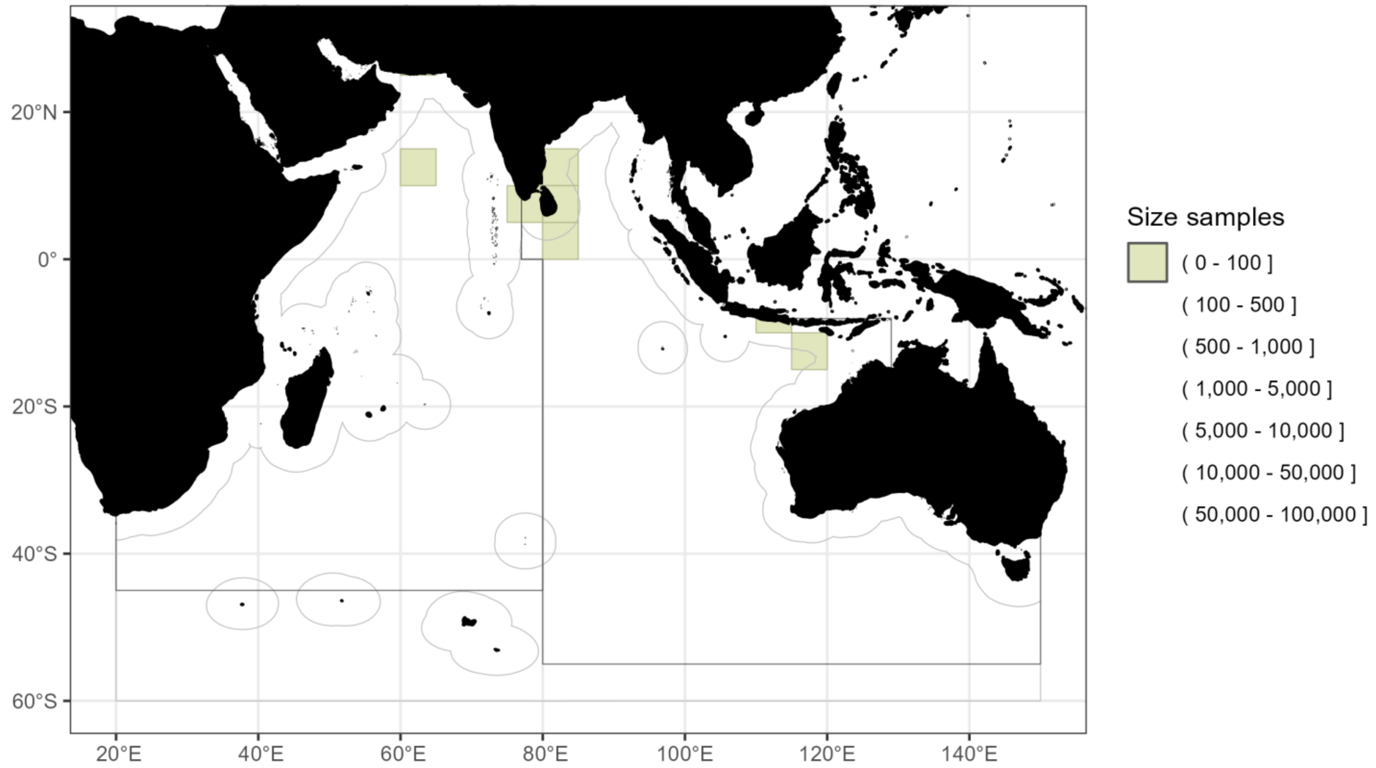


Figure 21: Spatial distribution (mean annual number of samples per 5-degree grid area) of available size-frequency data for bullet tuna caught in gillnet fisheries during 2018-2022. Light grey solid lines delineate areas beyond national jurisdiction. Data source: [standardized size-frequency dataset]

Line fisheries

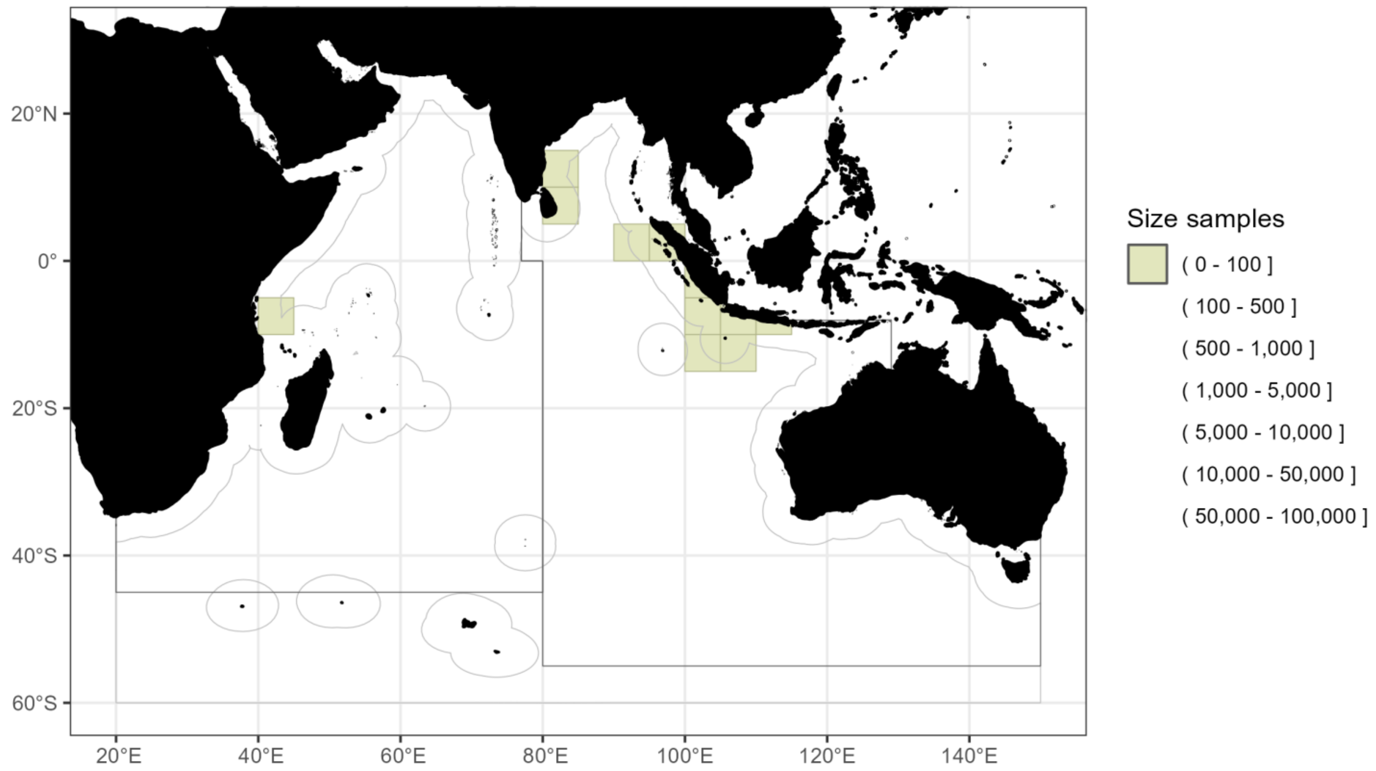


Figure 22: Spatial distribution (mean annual number of samples per 5-degree grid area) of available size-frequency data for bullet tuna caught in line fisheries during 2018-2022. Light grey solid lines delineate areas beyond national jurisdiction. Data source: standardized size-frequency dataset

Other fisheries

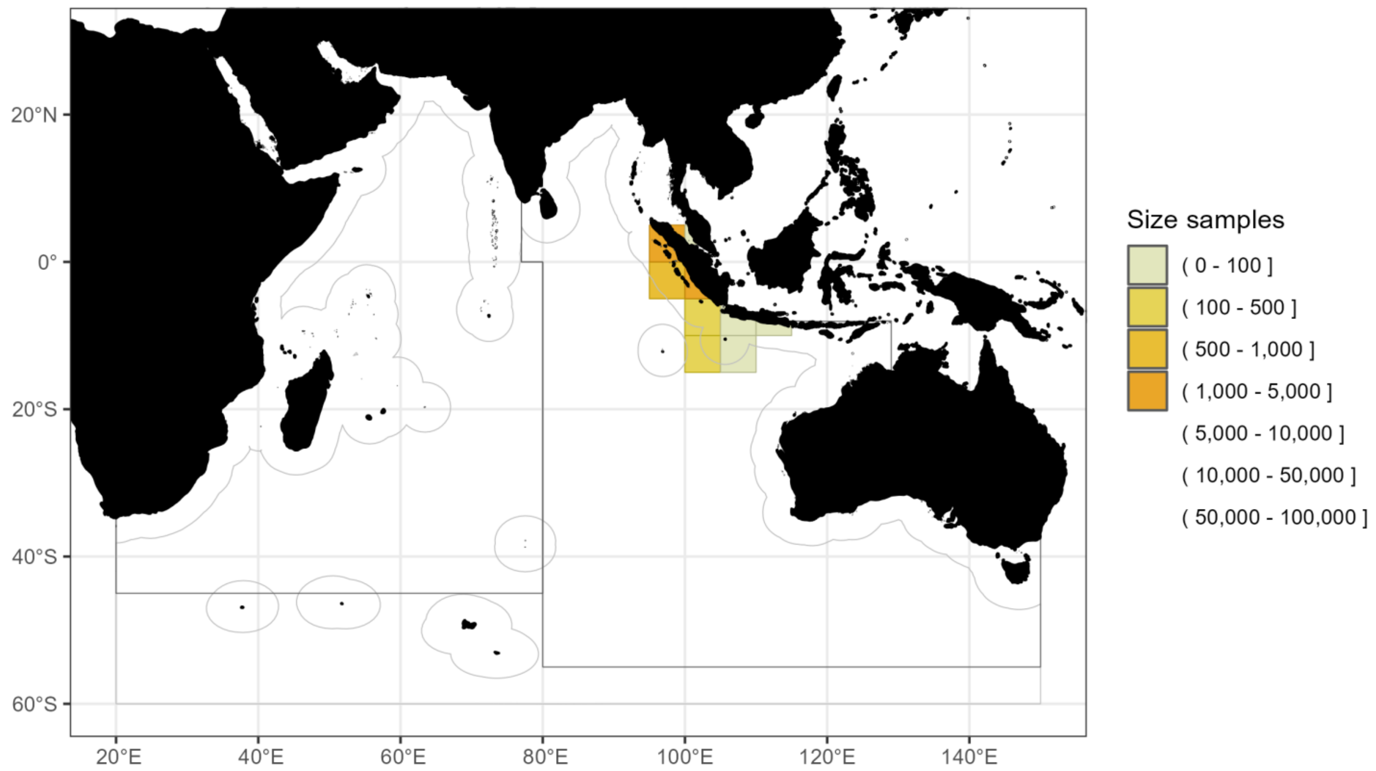


Figure 23: Spatial distribution (mean annual number of samples per 5-degree grid area) of available size-frequency data for bullet tuna caught in other fisheries (Beach seine, Danish seine, Liftnet) during 2018-2022. Light grey solid lines delineate areas beyond national jurisdiction. Data source: standardized size-frequency dataset

By fishery

Purse seine fisheries

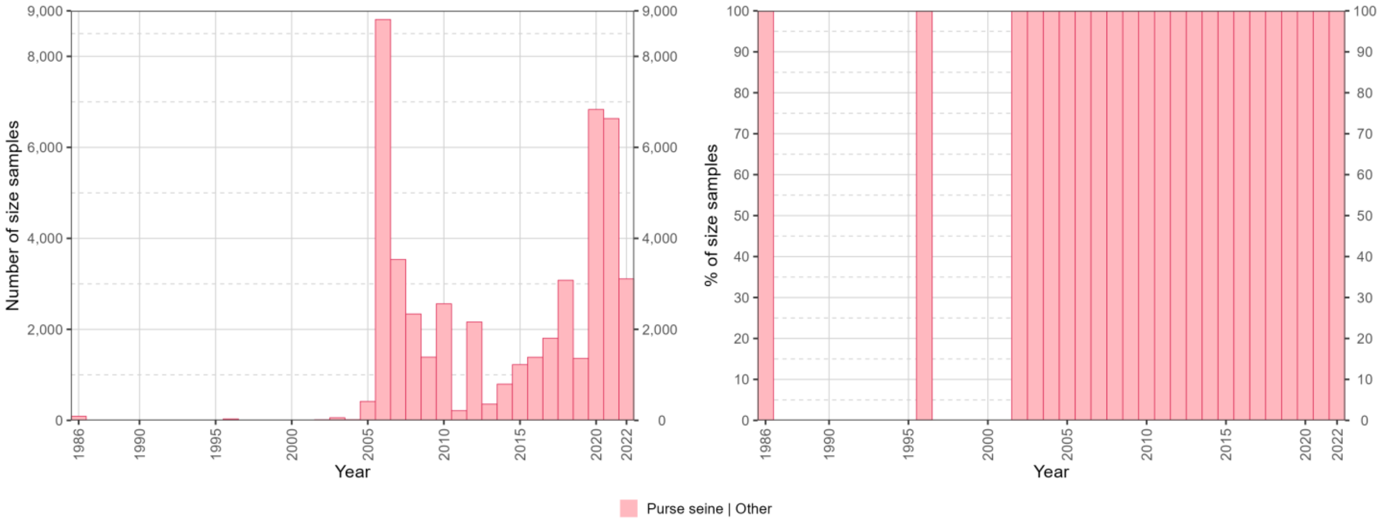


Figure 24: Availability of size-frequency data for bullet tuna as (left) absolute and (b) relative number of samples per year and type of purse seine fishery. Light grey solid lines delineate areas beyond national jurisdiction. Data source: standardized size-frequency dataset

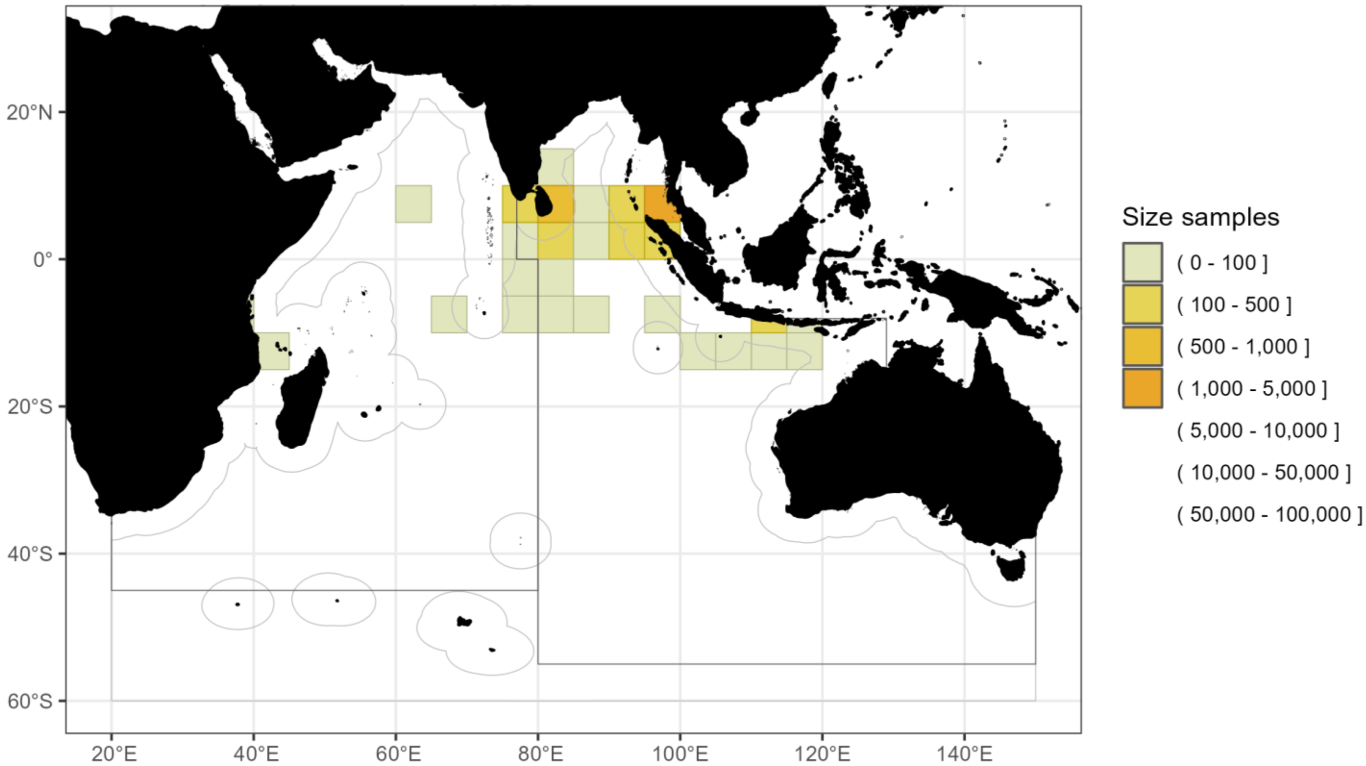


Figure 25: Spatial distribution (mean annual number of samples per 5-degree grid area) of available size-frequency data for bullet tuna caught in coastal and ringnet purse seine fisheries (Purse seine|Other) during 2018-2022. Light grey solid lines delineate areas beyond national jurisdiction. Data source: standardized size-frequency dataset

Gillnet fisheries

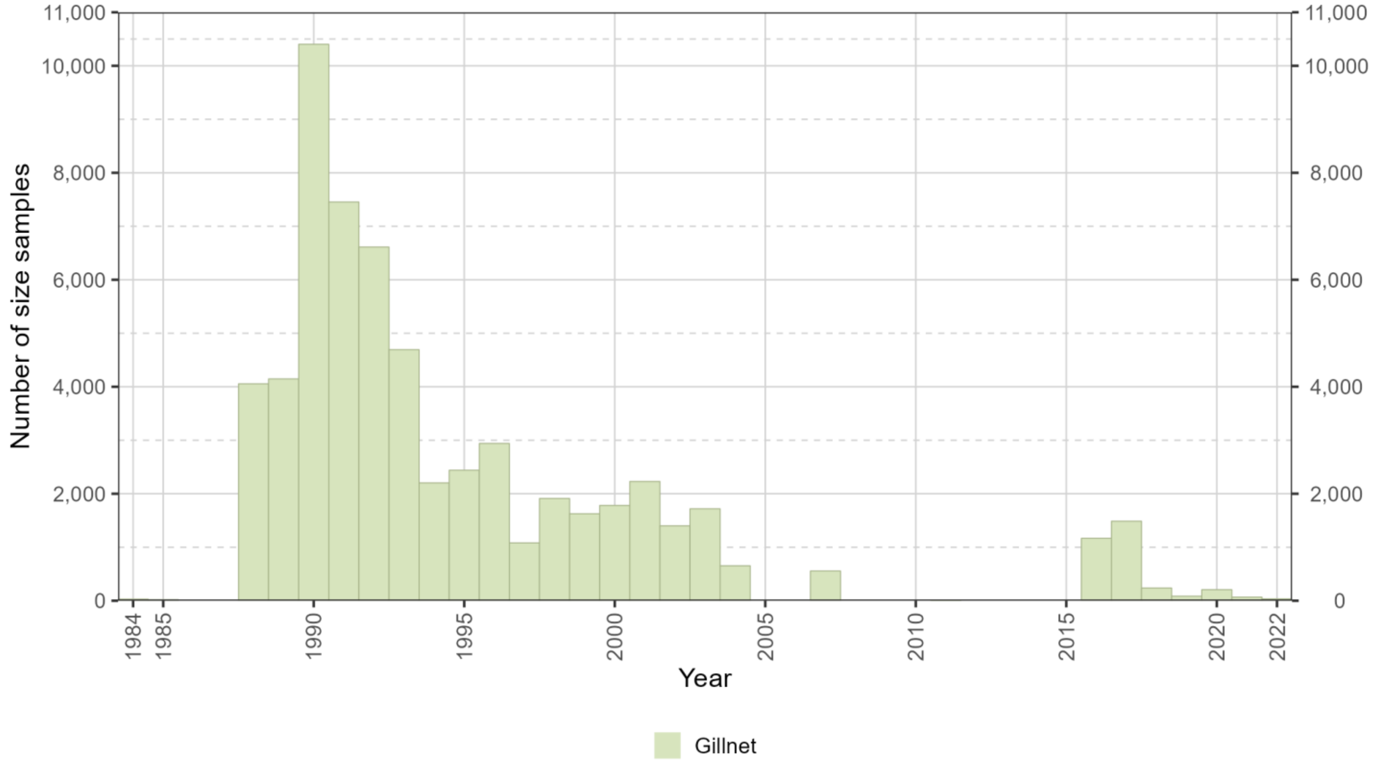


Figure 26: Availability of size-frequency data for bullet tuna as absolute number of samples per year in gillnet fisheries. Data source: standardized size-frequency dataset

Line fisheries

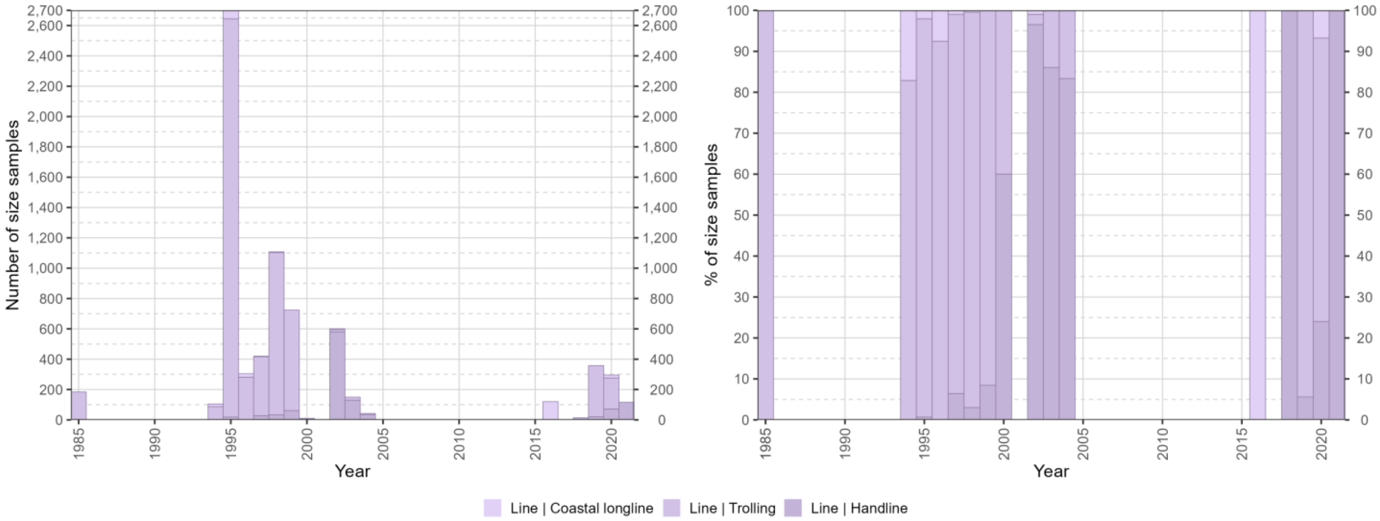


Figure 27: Availability of size-frequency data for bullet tuna as (left) absolute and (right) relative number of samples per year and line fishery type. Data source: standardized size-frequency dataset

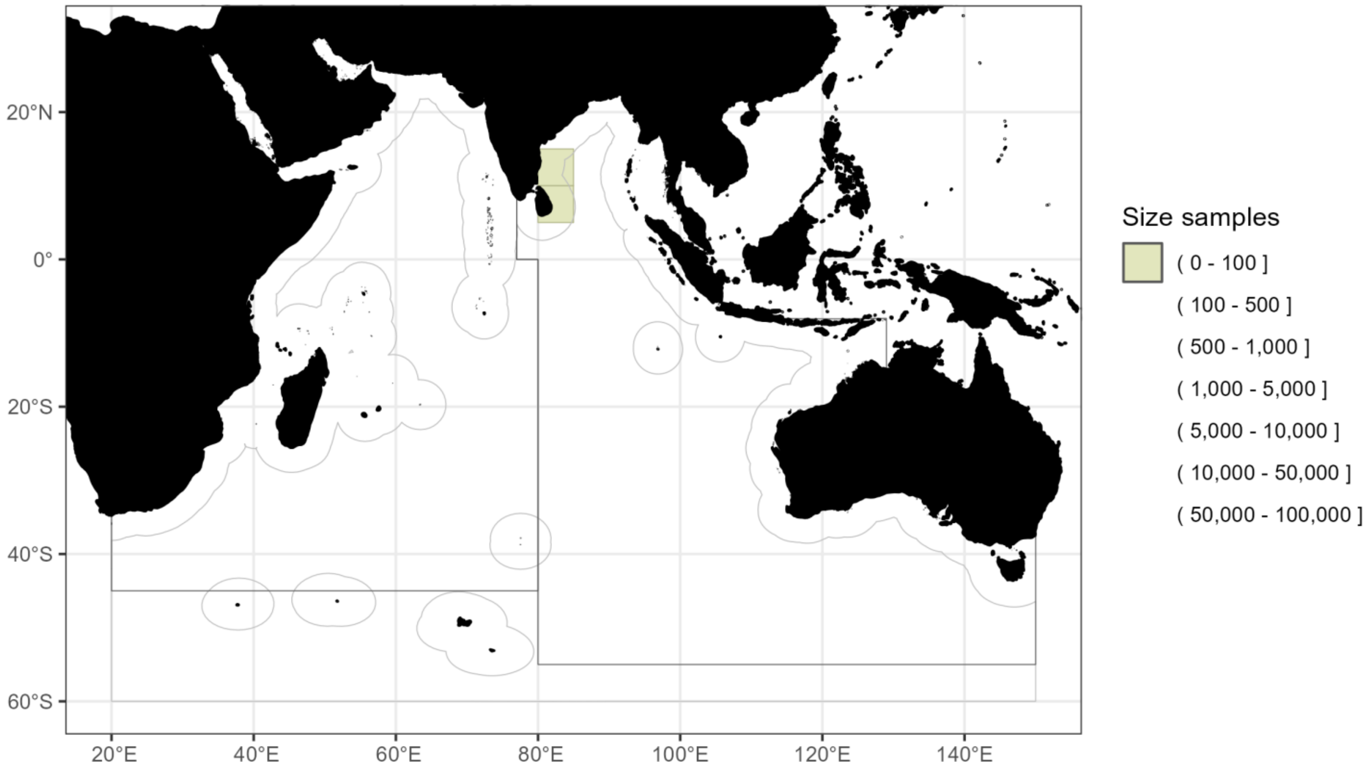


Figure 28: Spatial distribution (mean annual number of samples per 5-degree grid area) of available size-frequency data for bullet tuna caught in coastal longline fisheries during 2018-2022. Light grey solid lines delineate areas beyond national jurisdiction. Data source: [standardized size-frequency dataset]

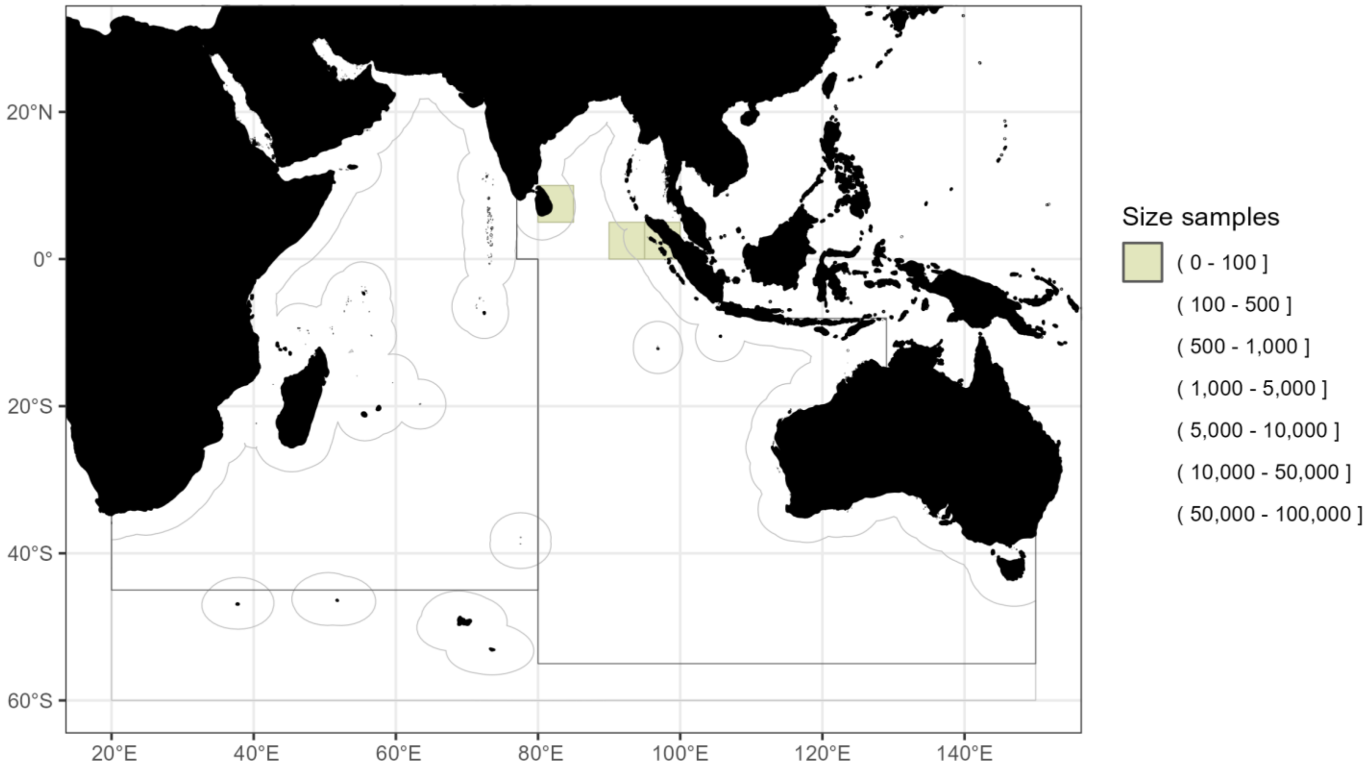


Figure 29: Spatial distribution (mean annual number of samples per 5-degree grid area) of available size-frequency data for bullet tuna caught in handline fisheries during 2018-2022. Light grey solid lines delineate areas beyond national jurisdiction. Data source: [standardized size-frequency dataset]

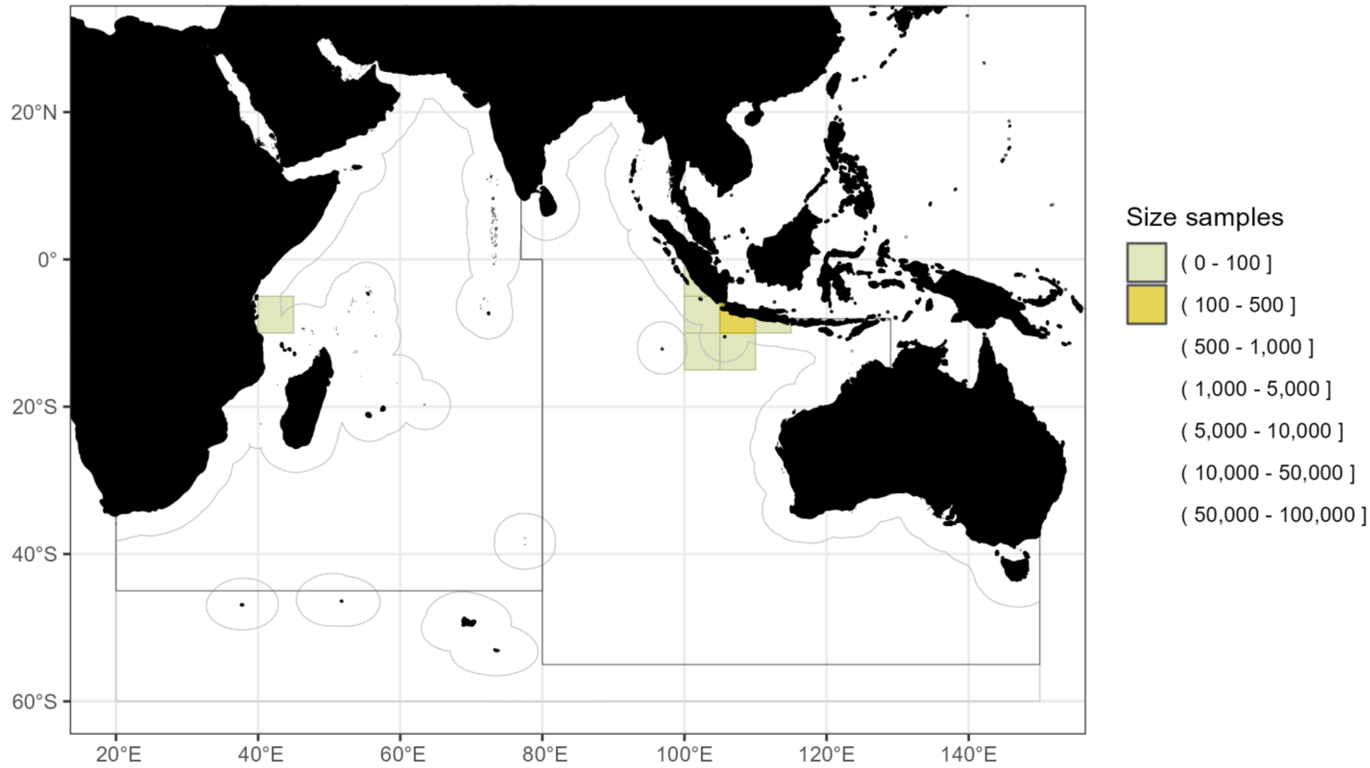


Figure 30: Spatial distribution (mean annual number of samples per 5-degree grid area) of available size-frequency data for bullet tuna caught in trolling fisheries during 2018-2022. Light grey solid lines delineate areas beyond national jurisdiction. Data source: [standardized size-frequency dataset]

Other fisheries

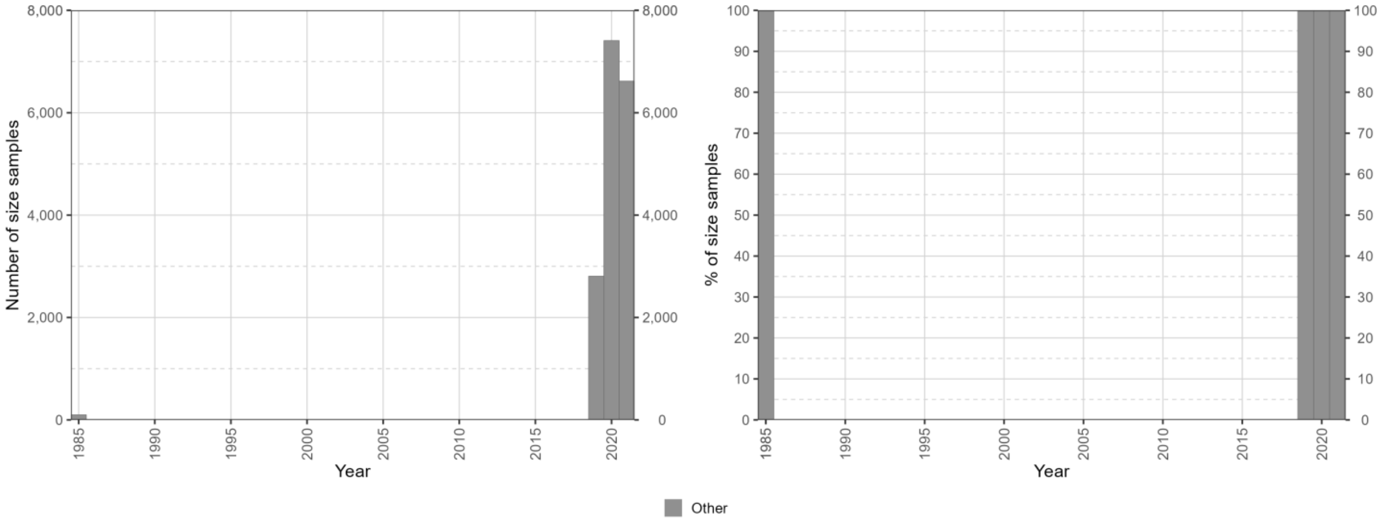


Figure 31: Availability of size-frequency data for bullet tuna as (left) absolute and (right) relative number of samples per year for 'other' fishery types (Beach seine, Danish seine, Liftnet). Data source: [standardized size-frequency dataset]

Temporal patterns and trends in size distributions

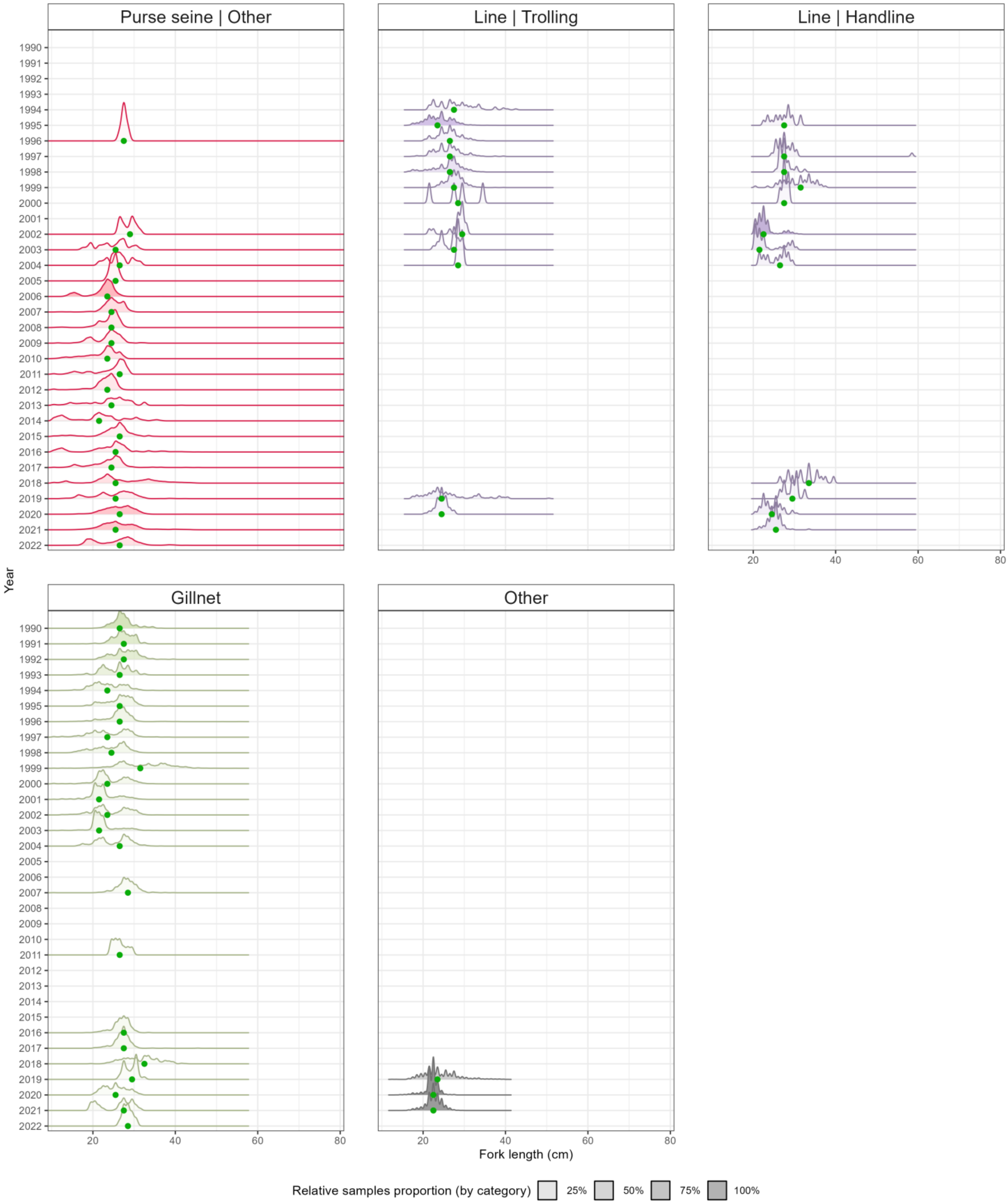


Figure 32: Relative size distribution (fork length; cm) of bullet tuna caught in coastal and ringnet purse seine fisheries (Purse seine|Other), gillnet fisheries, and other fisheries (Beach seine, Danish seine, Liftnet). Fill intensity is proportional to the number of samples recorded for the year, while the green dot corresponds to the median value. Data source: [standardized size-frequency dataset]

Size distribution by fishery and fleet

Purse seine fisheries (other)

Figure 33: Relative size distribution of bullet tuna (fork length; cm) caught in coastal purse seine and ringnet fisheries (Purse seine|Other) by year and main fleet. Data source: [standardized size-frequency dataset]

Gillnet fisheries

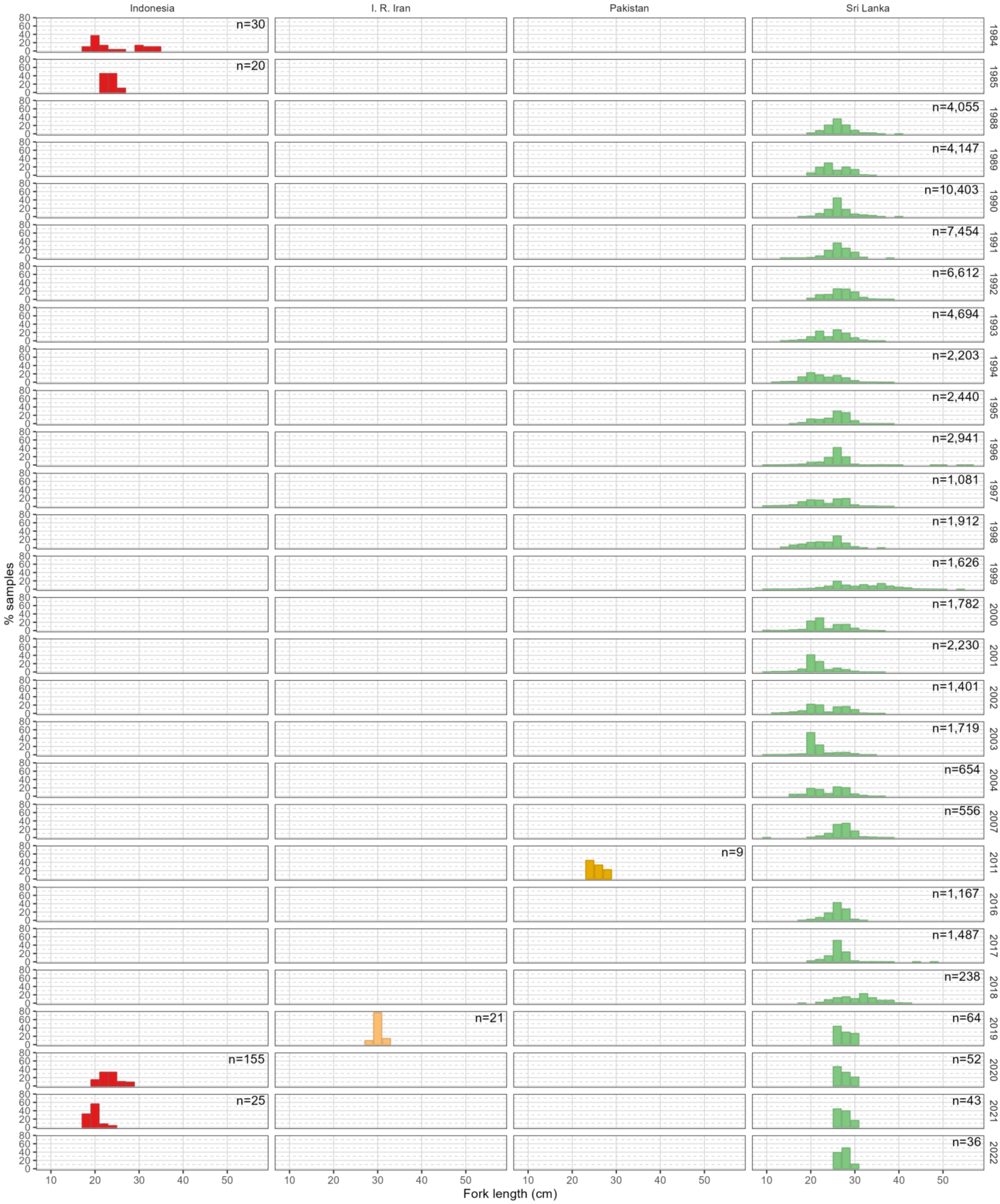


Figure 34: Relative size distribution of bullet tuna (fork length; cm) caught in gillnet fisheries by year and main fleet. Data source: standardized size-frequency dataset

Uncertainties in geo-referenced size-frequency data

The quality of sample data is poorer than other datasets, with 2.1% in 2022 (**fig. 35**).

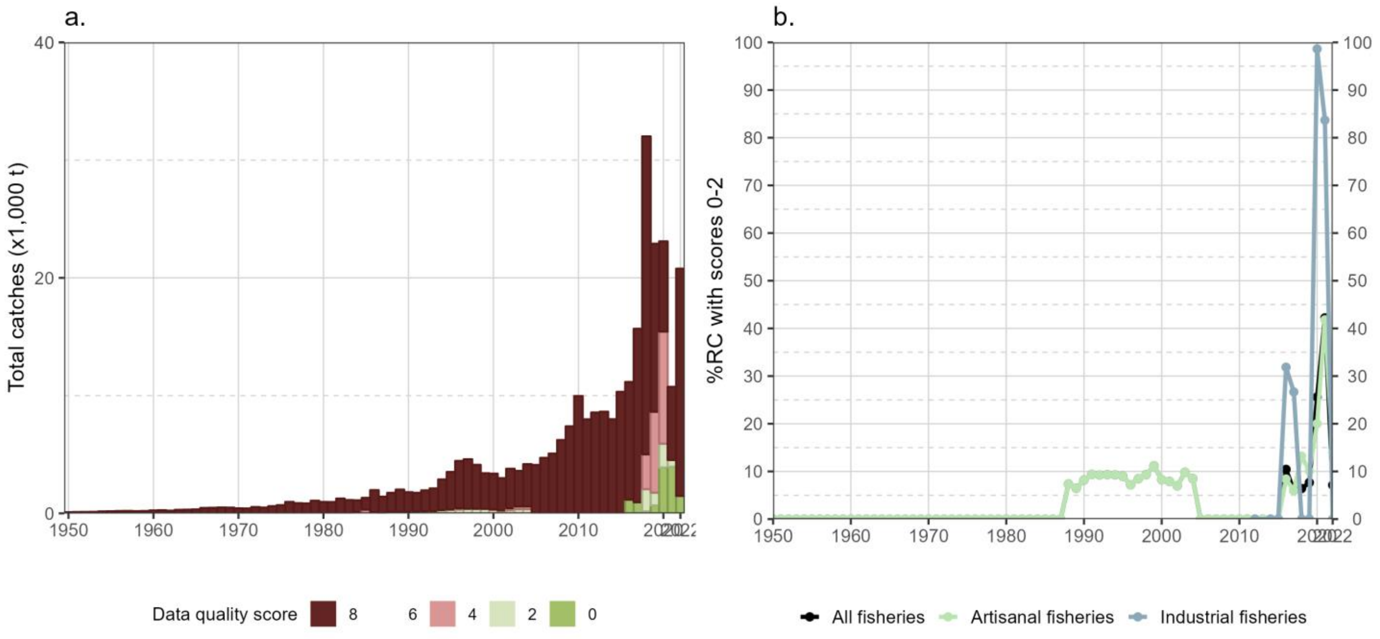


Figure 35: Annual time series of (a) cumulative retained catches (metric tonnes; t) estimated by quality score and (b) contribution of retained catches with corresponding geo-referenced size-frequency data reported to the IOTC Secretariat in agreement with the requirements of Res. 15/02 to all retained caches (percentage; %) of bullet tuna for all fisheries and by type of fishery, for the period 1950-2022

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Appendix II: Changes in best scientific estimates of retained catches from previous WPNT

Table 4: Changes in best scientific estimates of annual retained catches (metric tonnes; t) of bullet tuna by fleet, fishery group, and main Indian Ocean area, limited to absolute values higher than 10 t

Year	Fleet	Fishery group	Area	Current (t)	Previous (t)	Difference (t)
2021	BGD	Other	Eastern Indian Ocean	242	0	242
	IDN	Gillnet	Eastern Indian Ocean	583	0	583
		Line	Eastern Indian Ocean	238	0	238
		Other	Eastern Indian Ocean	1,363	0	1,363
		Purse seine	Eastern Indian Ocean	310	0	310
	IND	Gillnet	Eastern Indian Ocean	227	0	227
		Gillnet	Western Indian Ocean	1,040	0	1,040
		Line	Eastern Indian Ocean	173	0	173
		Line	Western Indian Ocean	2,434	0	2,434
		Other	Western Indian Ocean	20	0	20
		Purse seine	Western Indian Ocean	814	0	814
	LKA	Gillnet	Eastern Indian Ocean	35	0	35
		Purse seine	Eastern Indian Ocean	617	0	617
		Purse seine	Western Indian Ocean	39	0	39
	MDG	Line	Western Indian Ocean	179	0	179
	MOZ	Gillnet	Western Indian Ocean	23	0	23
		Line	Western Indian Ocean	29	0	29
	THA	Purse seine	Eastern Indian Ocean	2,485	0	2,485
2020	MOZ	Gillnet	Western Indian Ocean	30	0	30
		Line	Western Indian Ocean	24	0	24
		Other	Western Indian Ocean	16	0	16
		Purse seine	Western Indian Ocean	21	0	21
	THA	Purse seine	Eastern Indian Ocean	9,521	15,208	-5,687
2018	MOZ	Gillnet	Western Indian Ocean	17	0	17
		Line	Western Indian Ocean	20	0	20
2017	IDN	Gillnet	Eastern Indian Ocean	675	540	134
		Line	Eastern Indian Ocean	276	221	55
		Other	Eastern Indian Ocean	1,577	1,264	314

Year	Fleet	Fishery group	Area	Current (t)	Previous (t)	Difference (t)
		Purse seine	Eastern Indian Ocean	324	260	64
	MOZ	Gillnet	Western Indian Ocean	26	0	26
		Line	Western Indian Ocean	28	0	28
		Other	Western Indian Ocean	11	0	11
2015		Gillnet	Western Indian Ocean	323	0	323
		Line	Western Indian Ocean	259	0	259
2013	IDN	Gillnet	Eastern Indian Ocean	657	637	20
		Other	Eastern Indian Ocean	1,537	1,489	48
2012		Other	Eastern Indian Ocean	1,316	1,305	11
2010	MOZ	Gillnet	Western Indian Ocean	63	0	63
		Line	Western Indian Ocean	50	0	50
2008		Gillnet	Western Indian Ocean	31	0	31
		Line	Western Indian Ocean	24	0	24