REVIEW OF INDIAN OCEAN BIGEYE TUNA STATISTICAL DATA

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Introduction

Bigeye tuna is caught in all oceans, and more abundantly in the Western-Central Pacific Ocean (**Fig. 1**). Global historical catches show an increasing trend from the 1950s to the early 2000s, followed by a sharp decline from the mid-2000s until recent years, with levels reaching a peak low volume of about 346,000 t in 2023.

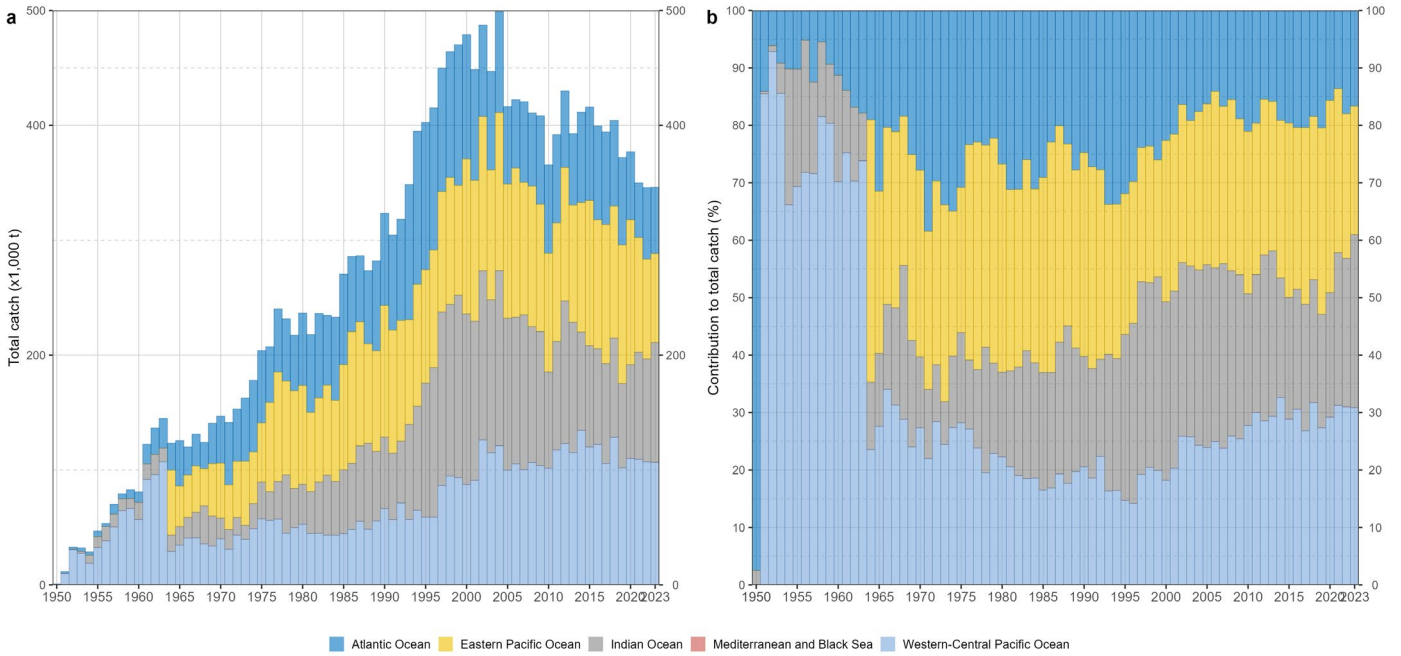

Figure 1: Annual time series of cumulative retained catches (metric tonnes; t) of bigeye tuna by ocean basin for the period 1950-2023 by ocean. Source: FAO (FISHStatJ)

The overarching objective of this paper is to provide participants to the 27th Session of the IOTC Working Party on Tropical Tunas (WPTT27) with a review of the status of the information on bigeye tuna (*Thunnus obesus*; BET) available to the IOTC Secretariat as of June 2025. The document provides an overview of the fisheries catching bigeye tuna in the Indian Ocean through temporal and spatial trends in catches and their main recent features, as well as an assessment of the reporting quality of the data sets. A full description of the data collated and curated by the Secretariat is available in paper IOTC-2025-WPTT27-07.1 (**IOTCWPTT25_3_1?**).

Retained catches

Historical trends (1950-2023)

Retained catches of bigeye tuna show alternating trends over the last seven decades, with annual levels ranging between 7,000 and 121,000 t (from the mid-1950s to the mid-2000s) and with variability across recent years. Catches dropped considerably from the late-2000s, reaching an annual average of 87,000 t during the 2010s, i.e., around 30% less than what caught on average during the previous decade. Longliners and purse seine fisheries comprise over 90% of the catches between the 1950s and 2000s, and over 80% in the last full decade (**Table 1** & **Figs. 2-3**).

Table 1: Best scientific estimates of average annual retained catches (metric tonnes; t) of bigeye tuna by decade and fishery for the period 1950-2023. FS = free-swimming schools. LS = school associated with floating objects. The background intensity colour of each cell is directly proportional to the catch level. Data source: raised time-area catches

Fishery	1950s	1960s	1970s	1980s	1990s	2000s	2010s	2020s
Baitboat	25	57	125	291	641	1,149	811	735
Gillnet	46	77	176	748	1,292	2,326	4,409	3,255
Line | Coastal longline	36	291	372	707	1,322	1,611	7,381	5,494
Line | Handline	22	29	158	306	448	558	2,172	4,138
Line | Trolling	36	61	138	401	953	1,412	1,740	2,562
Longline | Deep-freezing	6,581	21,561	28,814	42,962	63,644	72,584	31,108	23,578
Longline | Fresh	21	36	82	1,364	11,255	10,086	7,071	9,594
Longline | Other				106	357	1,357	1,357	381
Other	5	9	20	54	127	197	374	1,127
Purse seine | Other	89	151	343	8,116	25,290	29,860	30,807	40,824
Total	6,861	22,271	30,228	55,055	105,331	121,141	87,229	91,688

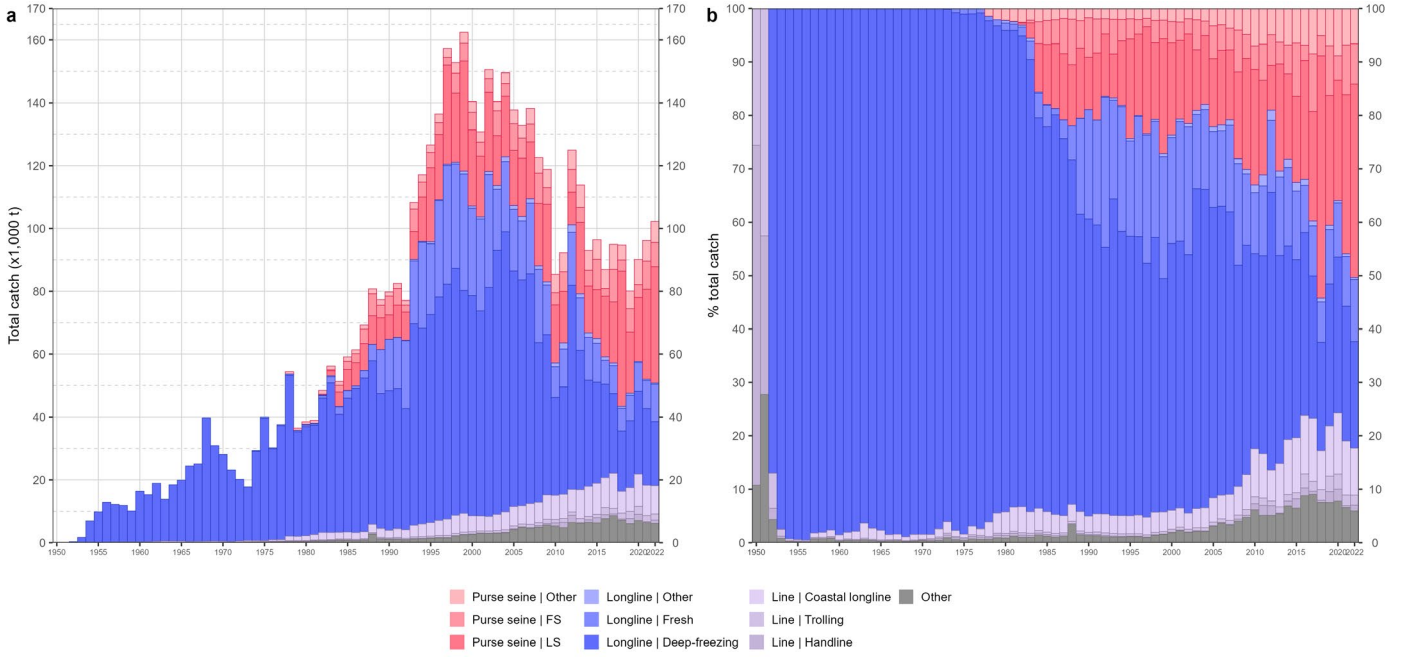

Figure 2: Annual time series of cumulative retained absolute (a) and relative (b) catches (metric tonnes; t) of bigeye tuna by fishery for the period 1950-2023. LS = schools associated with floating objects; FS = free-swimming schools. Data source: raised time-area catches

With the development of the industrial purse seine fishery and the increased activity of vessels using longlines and other gears, bigeye tuna catches increased rapidly in the early 1980s (**Figs. 2-3**). Exceptionally high catch levels were recorded between 1997 and 2007, with the highest catches ever recorded in 2004 at over 138,000 t.

Catches dropped considerably in 2010s as longline fishing effort in the western Indian Ocean was displaced eastwards or reduced due to the threat of piracy close to the areas under the national jurisdiction of Somalia. Catches by purse seiners also declined over the same period, albeit not to the same extent as longliners thanks to the presence of security personnel onboard of purse seine vessels of the EU and Seychelles, which enabled fishing operations to continue.

Catches of all purse seine fisheries combined were variable since 2011, with unusually high catches reported during 2023 (52,000 t) and potentially affected by changes in data processing methodologies introduced by some important fleets (**IOTCWPTT25DP7_2?**).

Longline fisheries, on the contrary, showed marked increasing trends in reported catches of bigeye tuna in post-piracy years, reaching a peak of 42,000 t in 2014 before initiating a new decline that brought catch levels down to the recent minimum of 28,000 t reported in 2019 (**Fig. 3**).

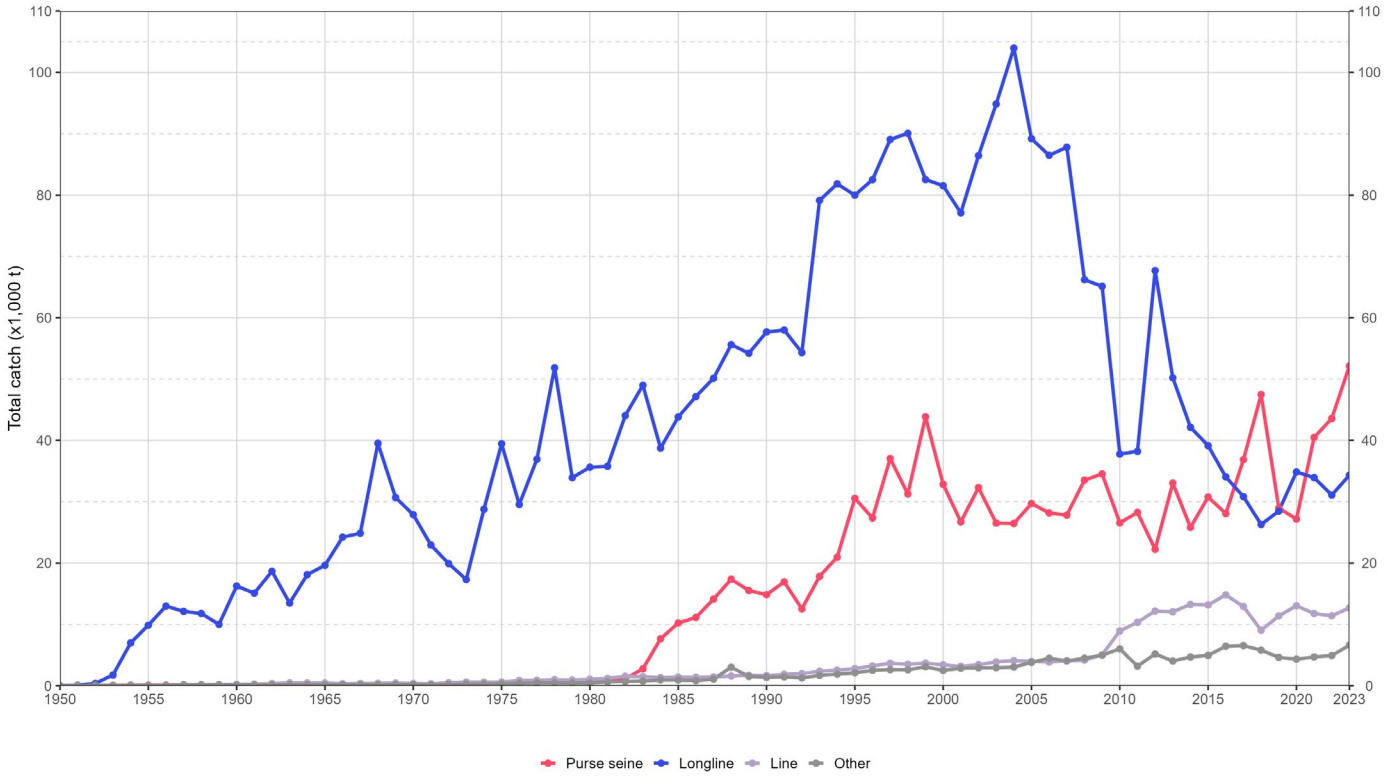

Figure 3: Annual time series of catches (metric tonnes; t) of bigeye tuna by fishery group for the period 1950-2023. Data source: best scientific estimate of retained catches

Table 2: Best scientific estimates of annual retained catches (metric tonnes; t) of bigeye tuna by fishery for the period 2014-2023. The background intensity colour of each cell is directly proportional to the catch level. Data source: raised time-area catches

Fishery	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Purse seine | All	25,814	30,766	28,071	36,865	47,486	28,977	27,177	40,487	43,576	52,145
Longline | Other	1,442	1,511	985	869	633	643	383	455	369	317
Longline | Fresh	9,570	7,603	5,804	7,063	6,424	6,240	7,772	8,885	10,205	11,518
Longline | Deep-freezing	31,136	30,027	27,262	22,905	19,230	21,594	26,701	24,588	20,527	22,495
Line | Coastal longline	9,714	8,685	9,353	9,165	5,319	4,186	4,181	5,440	3,235	9,245
Line | Trolling	1,504	890	2,083	922	1,782	2,875	2,989	2,212	2,622	2,317
Line | Handline	2,042	3,600	3,382	2,827	1,941	4,324	5,874	4,124	5,552	1,133
Baitboat	747	605	1,008	745	488	786	924	873	593	551
Gillnet	3,602	3,983	4,988	5,264	4,980	3,523	2,953	2,524	3,825	3,814
Other	333	359	447	542	333	310	467	1,294	497	2,250
Total	85,904	88,029	83,384	87,166	88,616	73,458	79,421	90,884	91,001	105,784

Catches for the PS fisheries are further splitted into different purse seine fisheries. This is to show the extend by which each of the fisheries are catching bigeye tunas (table 3).

Table 3: Mean annual catches (metric tonnes; t) of bigeye tuna by fishery between 2014 and 2023. LS = schools associated with floating objects; FS = free-swimming schools, and other industrial purse seine fisheries without fishery mode information.

School Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
FS	4,999	9,282	2,343	9,901	3,127	7,075	3,899	8,620	6,925	10,440
LS	14,871	15,324	19,149	19,410	39,456	18,374	20,252	27,373	26,603	22,665
OTH		468	199	349	463	367	182	299	1,899	1,240
Total	19,870	25,073	21,691	29,660	43,046	25,817	24,333	36,291	35,427	34,345

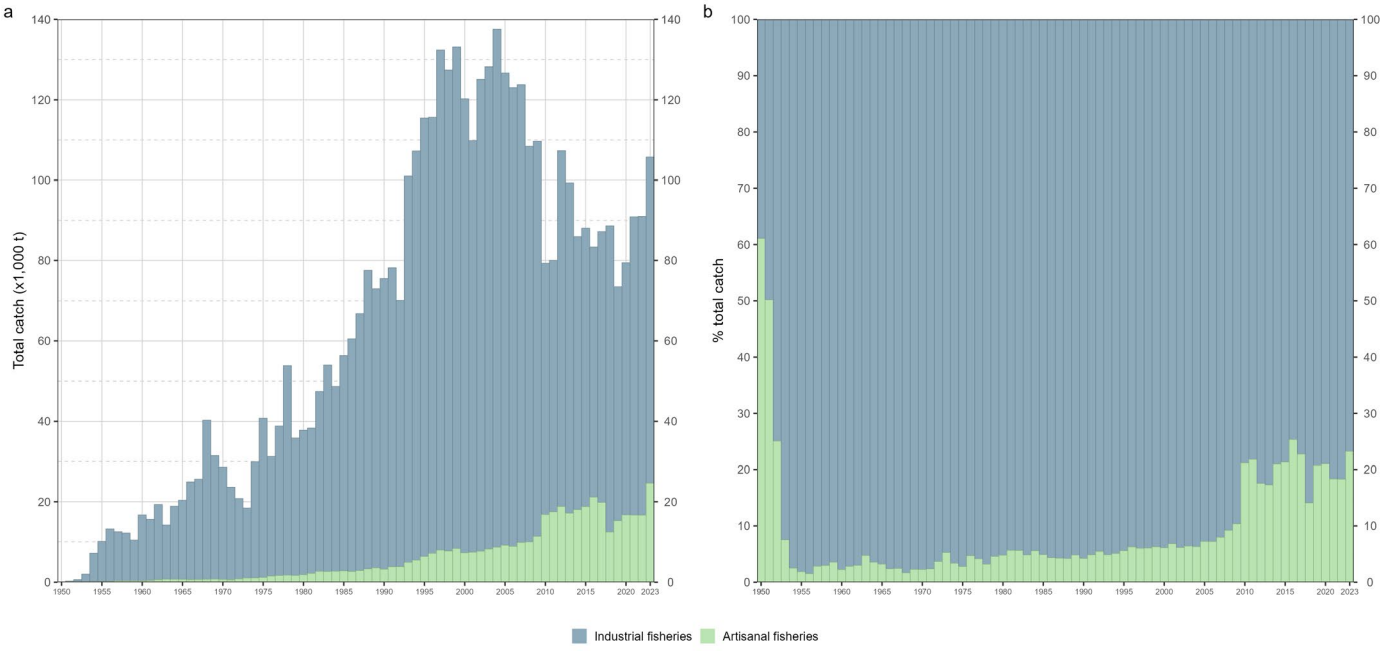

Figure 4: Annual time series of cumulative retained absolute (a) and relative (b) catches (metric tonnes; t) of bigeye tuna by type of fishery for the period 1950-2023. Data source: best scientific estimate of retained catches

Trends in the artisanal fishery component are characterized by relative stable levels between the early-1980s and the mid-2000s, followed by an increase to a maximum of 23% of total catches reported in 2023 for this component. Between 2019 and 2023 average annual catches from artisanal fisheries were close to 20,000 t (20% of total catches), with industrial fisheries catching on average 70,000 t per year (**Fig. 4**).

Regarding purse seine fisheries, historical catches of bigeye tuna by fishing mode show a general dominance in the percentages of catches from schools associated with drifting floating objects (FOBs) accompanied by frequent yearly fluctuations on the relative percentages of the two fishing modes (i.e., free and associated schools). The Seychelles and EU purse seine fleets combined (limited to EU,Spain and EU,France, as little to no data is available for EU,Italy in recent years) reported over 60% of their bigeye tuna catches from FOB-associated schools since the early-2000s.

Between 2014 and 2022, catches from all purse seine fleets combined show a fluctuation between 62% and 92% in the fraction of catches from FOB-associated schools, with around 92% of bigeye tuna catches reported from FOB-associated schools in 2018 and around 1783% in 2022 (**Fig. 5**).

Among the flag-specific components of the EU purse seine fleet, EU,France appears the less dependent on catches of bigeye tuna on FOB-associated schools. However, this was particularly true until 2017 whereas in following years catches appear to be split between the two fishing modes in similar proportion as what reported by the rest of the EU and comparable fleets.

Starting with 2019, the purse seine fishery of Seychelles began reporting a generally higher fraction of bigeye tuna caught on FOB-associated schools compared to all other fleets, recording a peak of almost 98% of catches on FOB-associated schools in 2020.

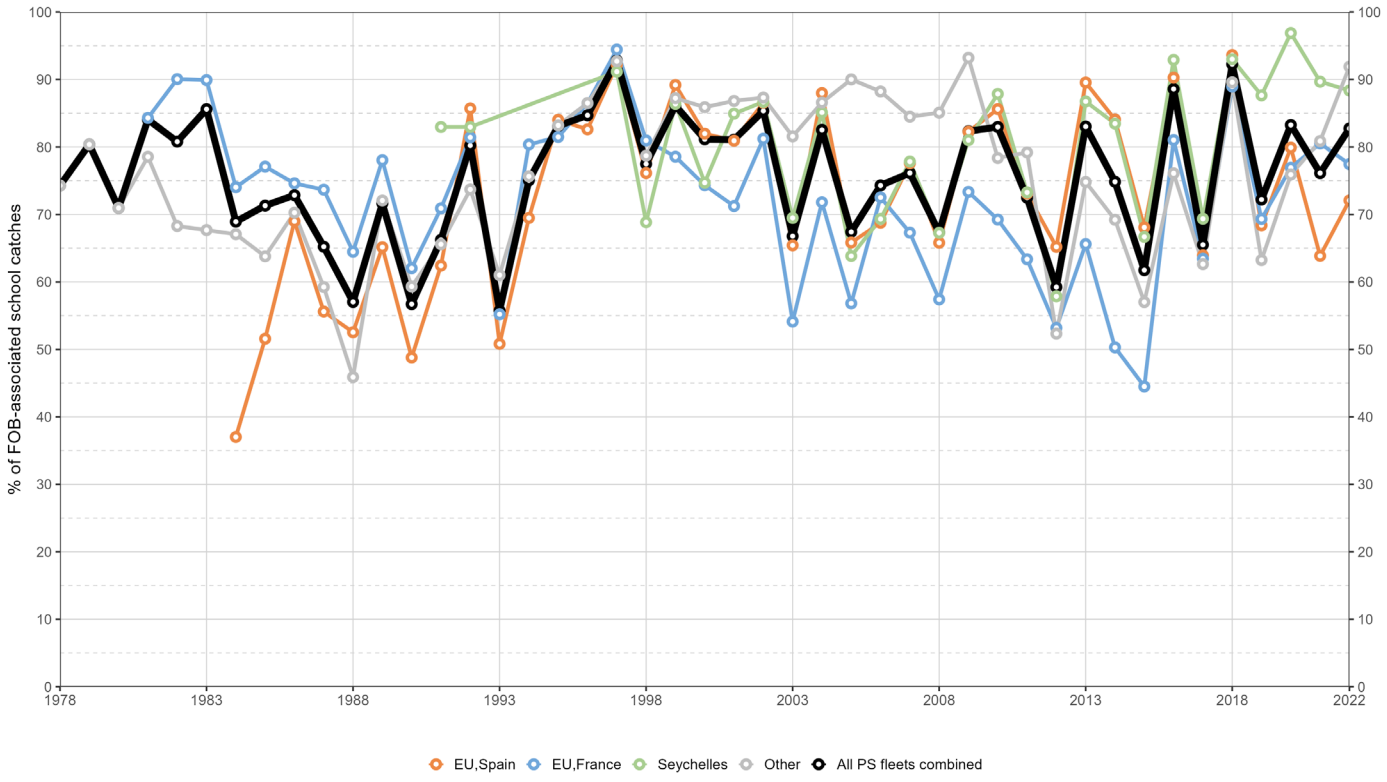

Figure 5: Annual percentages of purse seine FOB-associated catches of bigeye tuna by fleet for the period 1977-2023. *Other* includes purse seine fleets such as ex-Soviet Union, I.R. Iran, France (Mayotte), Mauritius, Japan, Korea, Indonesia, Thailand, EU,Italy, Belize and others. Data source: time-area catch dataset for purse seine fisheries (Res. 15/02)

Recent fishery features (2019-2023)

Bigeye tuna is caught mainly by longline and purse seiner fisheries from different fleets operating all over the Indian Ocean. Between 2019 and 2023, purse seine fisheries (all fishing modes combined) caught an average of more than 338,000 t of bigeye tuna per year, contributing to around 1535% of total nominal catches for the species (**Table 4**). During the same period, industrial longline fisheries represented the second main contributor to total bigeye tuna catches, with about 33,000 t caught annually (around 37% of the total). Line fisheries are the third contributor of catches for the species in recent years, with more than 10,000 t caught annually (around 14% of the total) (**Table 4 & Fig. 3**).

Table 4: Mean annual catches (metric tonnes; t) of bigeye tuna by fishery between 2019 and 2023. LS = schools associated with floating objects; FS = free-swimming schools. Data source: raised time-area catches

Fishery	Fishery code	Catch	Percentage
Purse seine | LS	PSLS	21,082	28.6
Longline | Deep-freezing	LLD	18,467	25.0
Longline | Fresh	LLF	7,637	10.4
Line | Coastal longline	LIC	7,298	9.9
Purse seine | FS	PSFS	5,650	7.7
Purse seine | Other	PSOT	5,379	7.3
Other	OT	5,094	6.9
Line | Trolling	LIT	1,746	2.4
Line | Handline	LIH	1,010	1.4
Longline | Other	LLO	370	0.5

Average annual catches of bigeye tuna between 2019 and 2023 have been shared between several CPCs, with around 93% of all annual catches accounted for by ten distinct fleets, with Indonesia, EU,Spain, Seychelles, and Taiwan,China contributing to 14% or more of average annual catches each (**Fig. 6**).

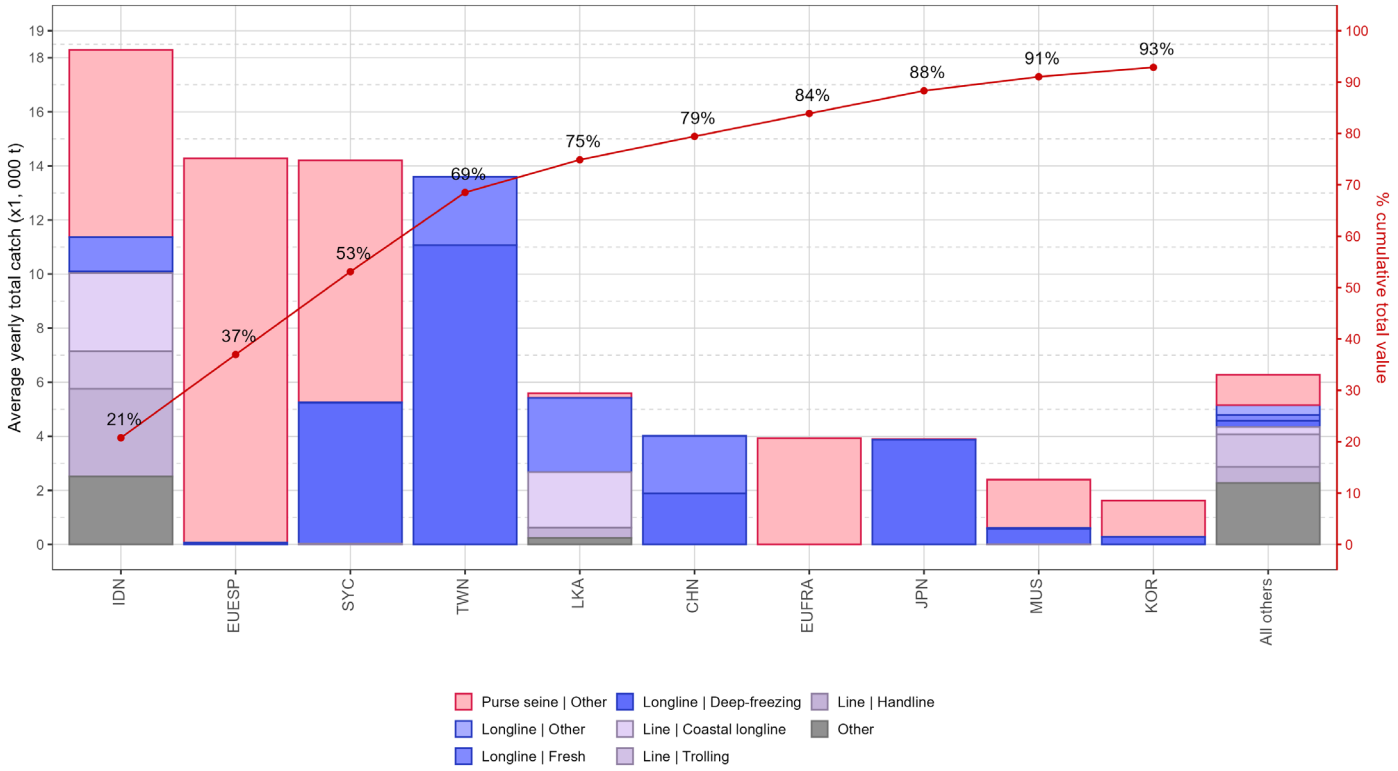

Figure 6: Mean annual catches (metric tonnes; t) of bigeye tuna by fleet and fishery between 2019 and 2023, with indication of cumulative catches by fleet. FS = free-swimming schools; LS = schools associated with floating objects. Data source: raised time-area catches

Catch trends by fishery group indicate a significant increase from the purse seine fisheries in the same period (2019-2023), 16%. The other fisheries catches remained constant (**Fig. 7**).

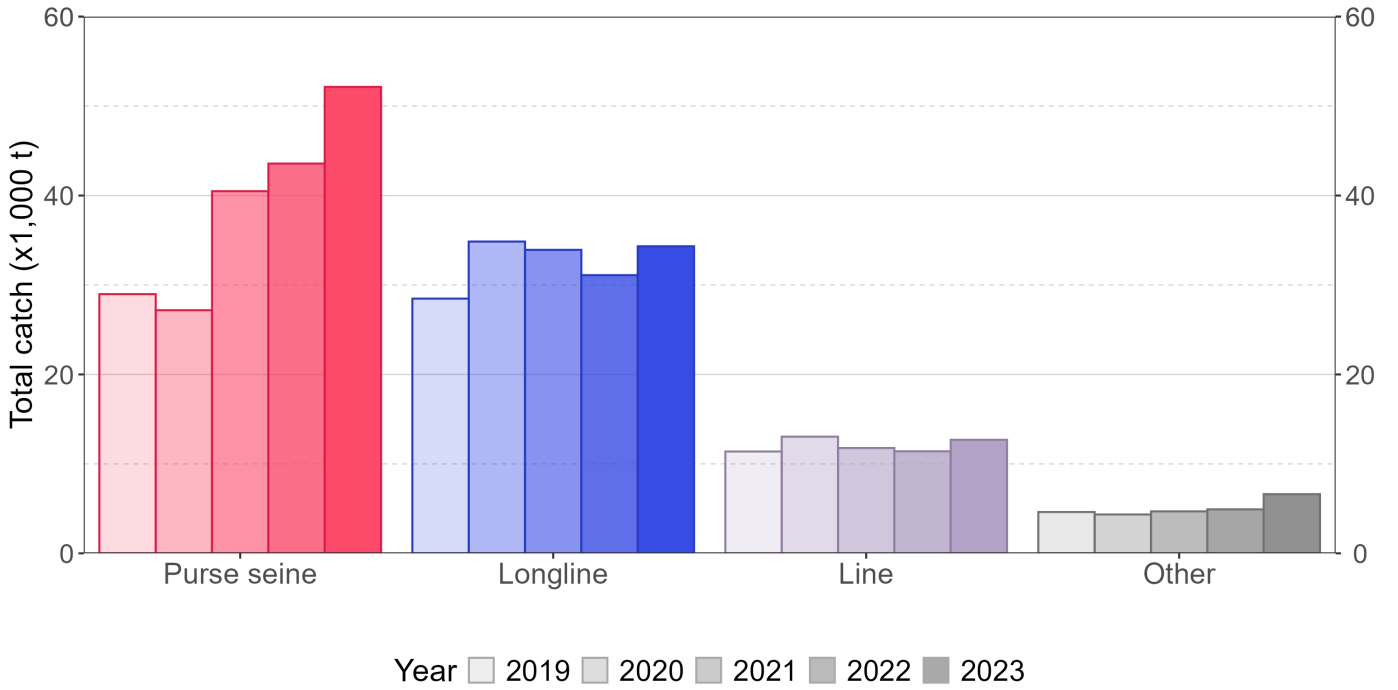

Figure 7: Annual catch (metric tonnes; t) trends of bigeye tuna by fishery group between 2019 and 2023. Data source: best scientific estimate of retained catches

Regarding industrial purse seine fisheries, catches from all fleets combined show contrasting trends in the last five years, with a peak identified in 2018 (**Fig. 7**) and further described in IOTC-2022-WPTT24-03a_Rev1 (**IOTCWPTT24_3a?**), followed by lower catches in 2019 and 2020, and by strong increases in 2021 and 2022 with

catches reaching again 2018 levels. The contribution of all major purse seine fleets, with all fishing modes combined, show similar trends in their contribution to catches in the recent period (**Fig. 9a**).

In terms of the type of school association, catches on free-swimming schools (which tend to be lower) show great variability over the years for all fleets involved (**Fig. 8a**), while catches on FOB-associated schools show relative stable trends, with a few notable exceptions that include EU,Spain (2018), Seychelles, EU,France (2021), and Indonesia (2022) (**Fig. 8b**).

Catches from purse seine fleet show variation in recent years, with Indonesia catches increased substantially in 2023 to over 17,000 t compared to less than 8,000 t in 2022. Catches from EU-Spain declined slightly, whereas Seychelles and EU-France recorded a small increase in 2023 (**Fig. 8b**).

Figure 8: Annual purse seine catch (metric tonnes; t) trends of bigeye tuna by fishing mode and fleet between 2019 and 2023. FS = free-swimming schools; LS = schools associated with floating objects. Data source: raised time-area catches

Recent data from longline fleets show a relative stable trend although with variable fleet contributions, whith increases recorded until 2020 for the deep-freezing and fresh longline fisheries of Taiwan,China, Seychelles, and Japan (**Fig. 9b**), followed by two years of decreases, while all other longline fleets (including those targeting swordfish or bycatch species, aggregated under *all others*) show relatively stable bigeye tuna catch levels since 2019, although with a marked increase detected for 2022 (**Fig. 9b**).

Fleets using line or assimilated gears (handline, troll-line, and coastal longline) show similar trends in catch levels as those identified for the industrial longline fisheries since 2019 (**Fig. 7**). At fleet level, all major contributors appear to be in a phase of slight contractions compared to previous years, with catches in 2021 generally reported at lower levels than 2020, except for Indonesia showing a new increase in catches for 2022 (**Fig. 9c**).

Finally, contributions to catch levels from all remaining fisheries (which include gears such as gillnets, liftnets, and pole-and-lines and are aggregated as *all others*) have been generally stable since 2019, with marked decreases in catches reported by Iranian fisheries complemented by recent increasing trends reported by the fisheries of Indonesia as well as by some other minor fleets (**Fig. 9c-d**) in 2023.

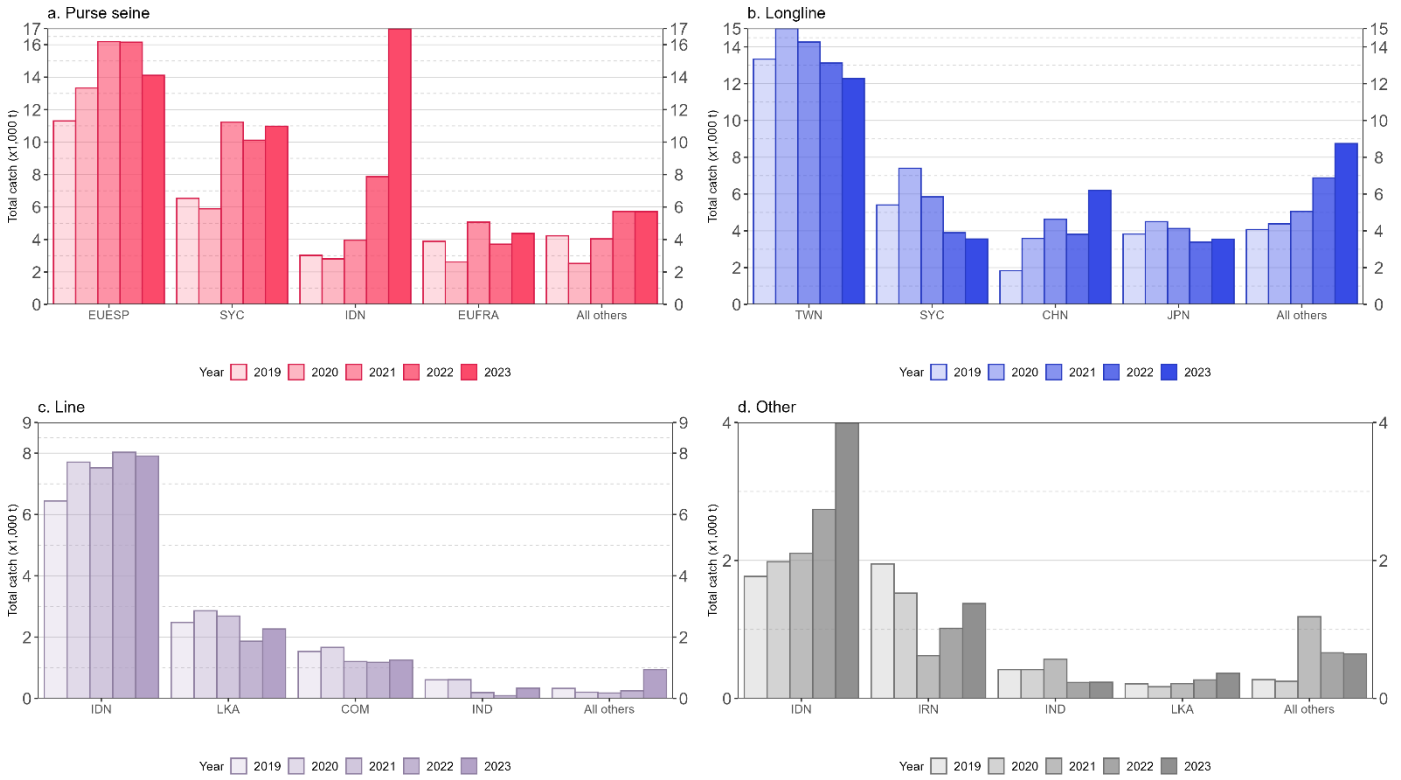

Figure 9: Annual catch trends of bigeye tuna by fishery group and fleet (metric tonnes; t) between 2019 and 2023. Data source: [best scientific estimate of retained catches]

Changes from previous WPTT

In 2024, Indonesia revised the historical catch data of all the fisheries and IOTC species. This impact the historical catches of bigeye tuna, and other tuna. The review reduced catch of bigeye tuna from most fisheries, particularly, purse seine fisheries, with a marked drop of averaging -19,000t between 1995 and 2005 from the longline fisheries and in recent years from the purse seine fisheries, with-7,716t in 2022.

Catch revision was also from EU-ITA for the period 2015 and 2022, leading to an increasing in the catch of bigeye tuna averaging around 300t. Omani purse seine fisheries catch data review for the last two years, after receiving the complete logbook data for all vessels, catches increased by around 600t each year (**Fig. 10** and **Table 5**). Besides the major review from some fleet, changes also for the longline fleet based on final data received in December (Japan - 2019 to 2023, Seychelles 2023).

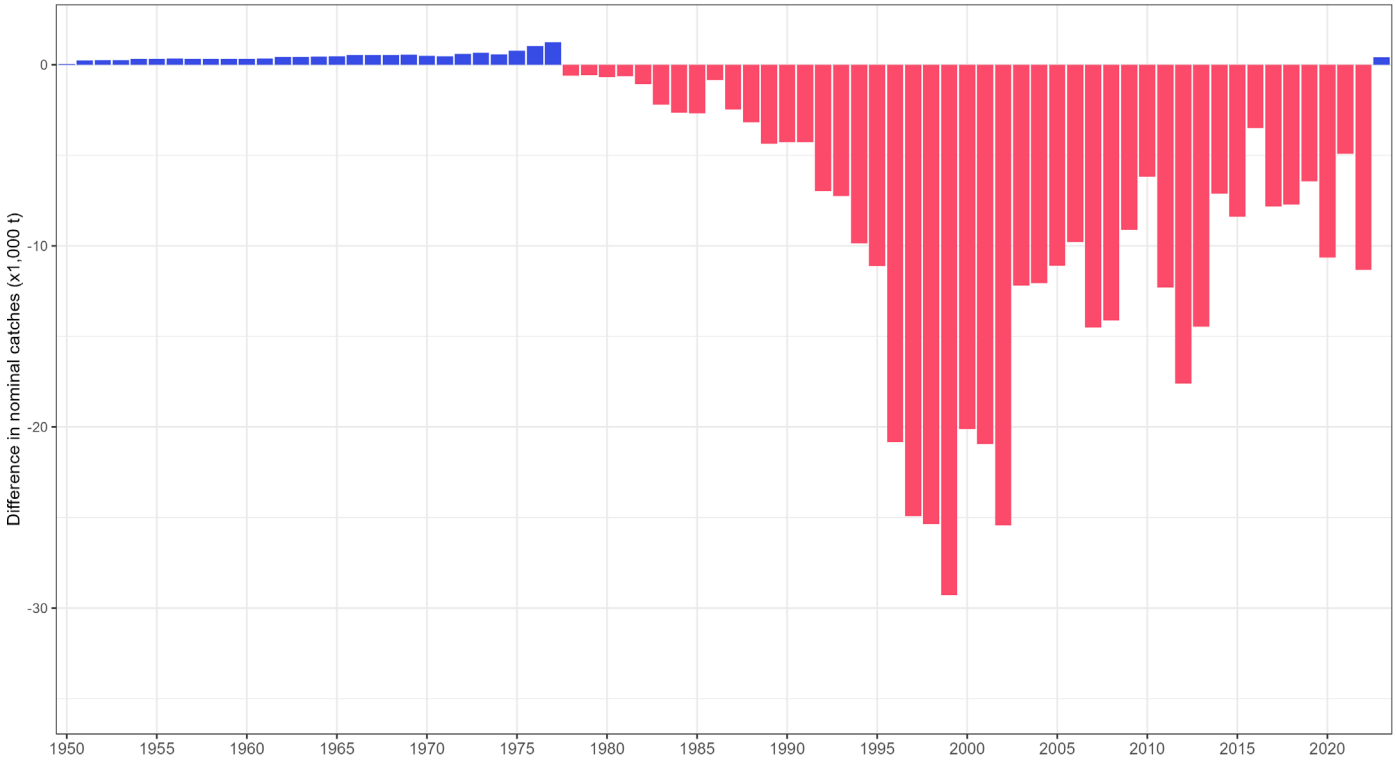

Figure 10: Differences in the available best scientific estimates of retained catches (metric tonnes; t) of bigeye tuna in between this WPTT and its previous session (assessment meeting held in October 2024)

Table 5: Changes in best scientific estimates of annual retained catches (metric tonnes; t) of bigeye tuna by year, fleet, fishery group and main Indian Ocean area, limited to absolute values higher than 10 t. Data source: best scientific estimate of retained catches 2022 and [2023](https://www.iotc.org/WPTT/26/data/03-NC)

Year	Fleet	Fishery group	Area	Current (t)	Previous (t)	Difference (t)
2023	EUITA	Purse seine	Western Indian Ocean	488	0	488
	JPN	Longline	Eastern Indian Ocean	3,364	3,010	354
		Longline	Western Indian Ocean	186	170	17
	OMN	Purse seine	Western Indian Ocean	752	0	752
	SYC	Longline	Eastern Indian Ocean	248	318	-69
		Longline	Western Indian Ocean	3,308	3,101	207
	YEM	Line	Western Indian Ocean	30	0	30

Year	Fleet	Fishery group	Area	Current (t)	Previous (t)	Difference (t)
2022	EUITA	Purse seine	Western Indian Ocean	230	0	230
	IDN	Baitboat	Eastern Indian Ocean	151	0	151
		Gillnet	Eastern Indian Ocean	2,371	1,586	785
		Line	Eastern Indian Ocean	8,029	8,660	-631
		Longline	Eastern Indian Ocean	2,440	4,257	-1,817
		Other	Eastern Indian Ocean	218	2,260	-2,043
		Purse seine	Eastern Indian Ocean	7,871	16,363	-8,492
	JPN	Longline	Eastern Indian Ocean	3,278	3,118	160
	OMN	Purse seine	Western Indian Ocean	546	0	546
2021	EUITA	Purse seine	Western Indian Ocean	299	0	299
	IDN	Baitboat	Eastern Indian Ocean	167	0	167
		Gillnet	Eastern Indian Ocean	1,586	1,538	48
		Line	Eastern Indian Ocean	7,522	7,611	-89
		Other	Eastern Indian Ocean	350	2,193	-1,842
		Purse seine	Eastern Indian Ocean	3,957	7,444	-3,488
	JPN	Longline	Eastern Indian Ocean	3,804	3,534	270
		Longline	Western Indian Ocean	322	297	25
2020	EUITA	Purse seine	Western Indian Ocean	182	0	182
	IDN	Baitboat	Eastern Indian Ocean	355	0	355
		Gillnet	Eastern Indian Ocean	1,160	1,928	-768
		Line	Eastern Indian Ocean	7,707	9,538	-1,831
		Longline	Eastern Indian Ocean	591	1,933	-1,342
		Other	Eastern Indian Ocean	467	2,748	-2,281
		Purse seine	Eastern Indian Ocean	2,802	7,959	-5,158
	JPN	Longline	Eastern Indian Ocean	3,917	3,616	301
		Longline	Western Indian Ocean	582	530	52
	TMP	Gillnet	Eastern Indian Ocean	29	9	20
2019	EUITA	Purse seine	Western Indian Ocean	367	0	367
	IDN	Baitboat	Eastern Indian Ocean	154	0	154
		Gillnet	Eastern Indian Ocean	1,304	1,318	-14

Year	Fleet	Fishery group	Area	Current (t)	Previous (t)	Difference (t)
		Line	Eastern Indian Ocean	6,440	6,522	-82
		Longline	Eastern Indian Ocean	370	2,259	-1,889
		Other	Eastern Indian Ocean	310	1,879	-1,569
		Purse seine	Eastern Indian Ocean	3,019	6,337	-3,318
	JPN	Longline	Eastern Indian Ocean	3,522	3,218	304
		Longline	Western Indian Ocean	303	344	-41

Uncertainties in retained catches data

Reporting quality

The quality of the retained catches of bigeye tuna reported to the IOTC Secretariat shows major variability over the years (**Fig. 11**). The overall quality is mostly driven by the contribution of industrial fisheries to the total catches and shows a major declining trend from the 1970s to the 1990s, when a substantial part of the catch had to be estimated for non-reporting (NEI) and Indonesian longline fleets (Herrera 2002). The situation improved throughout the 2000s although some estimation was still performed for NEI, Indonesian, and Indian longline fleets. The reporting quality has shown an increasing trend since the early 2010s due to increased reporting of retained catches data for some artisanal fleets and implementation of Port State Measures which progressively reduced the extent of illegal, unreported, and unregulated (IUU) fisheries in the Indian Ocean (**Fig. 11**).

Reporting issues have been identified over the last decade for some artisanal fleets, including troll lines from Madagascar, small-scale purse seine and handline fisheries from Mozambique, as well as for the fresh longline fishery of Tanzania which operated between 2011 and 2014. Furthermore, catches of Indonesian artisanal fisheries have been annually re-estimated since the early 2010s based on fixed species compositions that depend on each fishing gear and were derived from samples mostly collected in the 2000s (Moreno et al. 2012). In 2023, the percentage of bigeye tuna catches fully or partially reported to the Secretariat was 83%. Data for 2023, indicated a drop in quality, attributed to the estimation of Indonesia for the coastal fisheries.

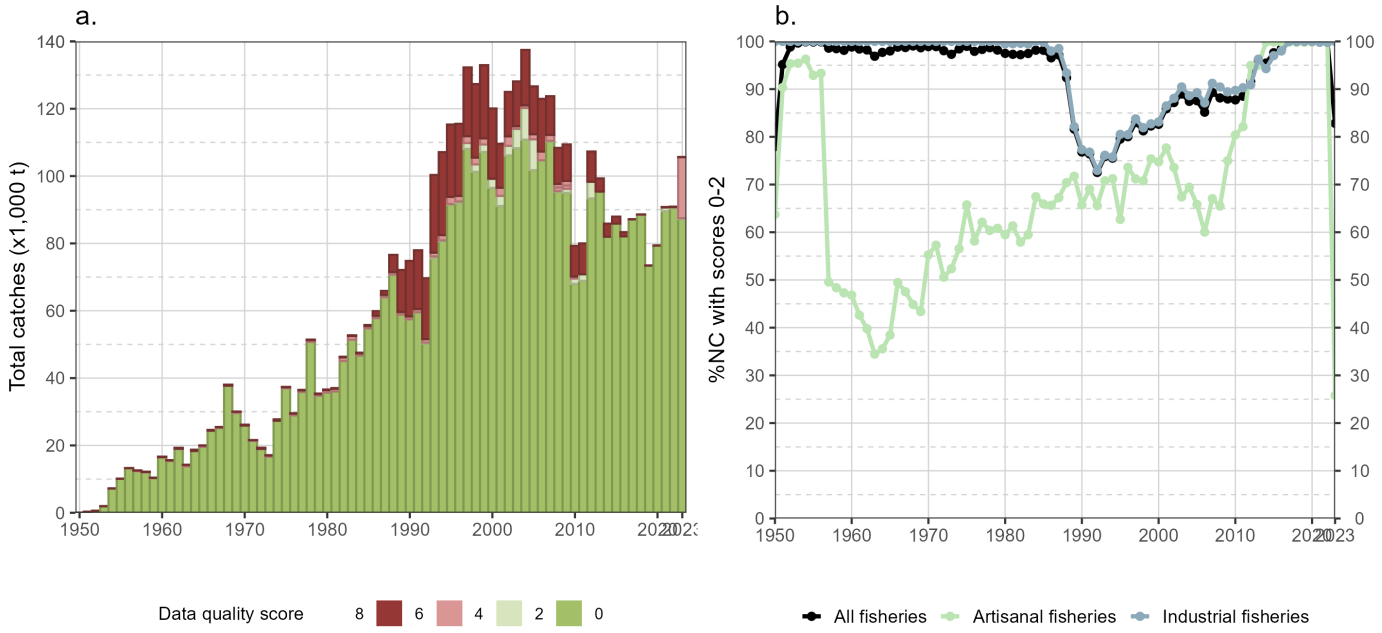

Figure 11: Annual retained catches (metric tonnes; t) of bigeye tuna estimated by quality score (barplot) and percentage of retained catch fully/partially reported to the IOTC Secretariat (lines with dots) for all fisheries (a) and by type of fishery (b), in the period 1950-2023

Discard levels

The total amount of bigeye tuna 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, and except for very specific situations (i.e., the fish caught is considered unfit for human consumption or there is insufficient storage capacity following the final set of a trip), all tropical tunas caught with purse seine have to be retained onboard since 2018 (IOTC Res. 19/05).

Discarding of tropical tunas is thought to be small in coastal fisheries and negligible in baitboat fisheries (Miller et al. 2017). Besides, data collected by observers at sea have shown that the level of discarding of tropical tunas is low in the Indian Ocean purse seine fishery, and discarding mostly occurs in schools associated with floating objects (Amandè et al. 2012). Purse seine discards of bigeye tuna are mainly composed of fish smaller than 60 cm (~5.7 kg) although a few larger fish may be discarded when damaged (**Fig. 12**). Estimates for the main component of the Indian Ocean purse

seine fleet available for the period 2008-2017 show they amounted to a few hundred tonnes annually in that period (Ruiz et al. 2018).

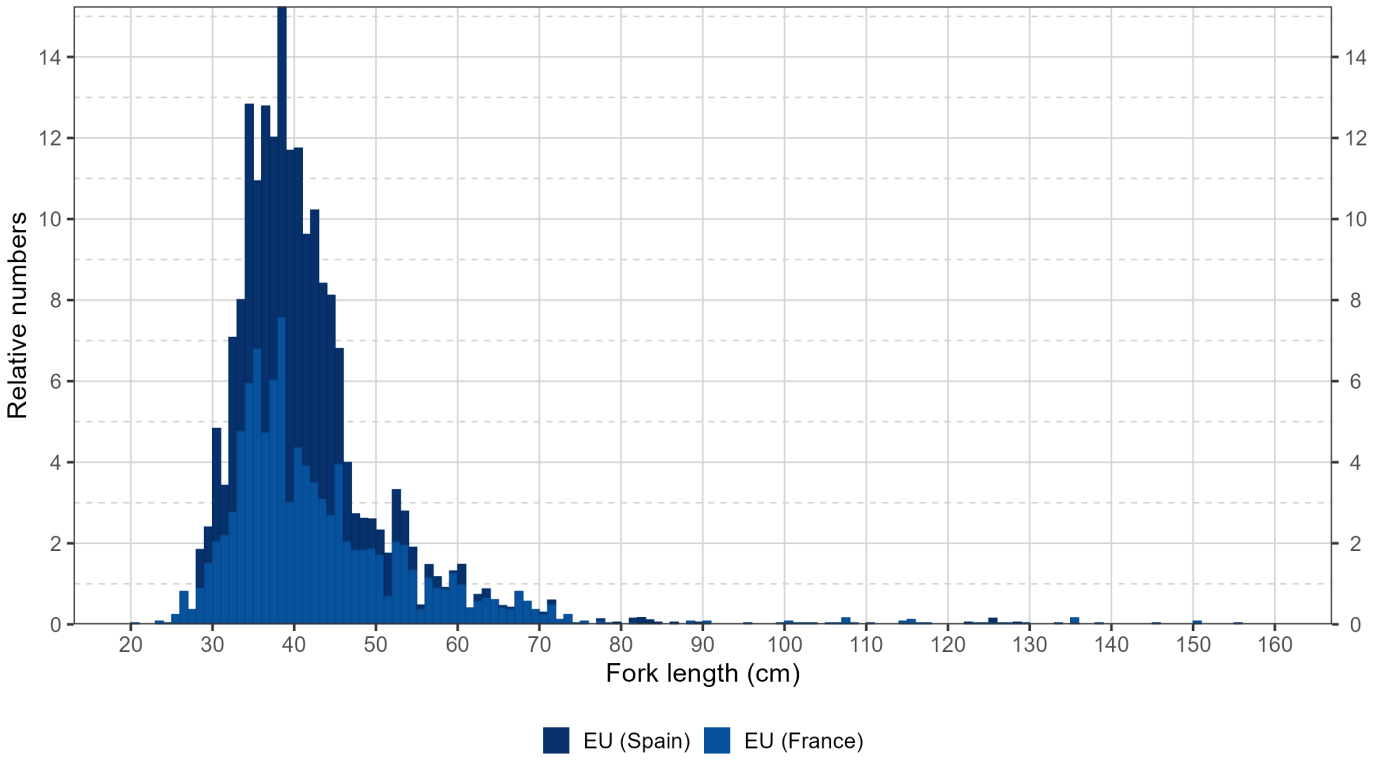

Figure 12: Fork length distribution of bigeye tuna discarded at sea in purse seine fisheries during the period 2016-2020 (n = 8,482). Data source: IOTC ROS database

Discarding may also occur in tropical longline fisheries, mainly due to depredation by sharks and cetaceans (Rabearisoa et al. 2018). In the Taiwan,China longline fishery of the Indian Ocean for instance, the discarding rate of bigeye tuna has been estimated at 4.97% in the fleet targeting bigeye tuna during 2004-2008 (Huang & Liu 2010).

There is currently little information in the ROS database on discarding practices in longline fisheries except for a small sample of fish observed in French and Japanese longliners during 2009-2018. The size of the bigeye tunas discarded at sea by the Reunion-based fresh longline fishery are smaller than in the Japanese deep-freezing longline fishery, i.e., a median of 77.5 cm vs. 87.5 cm (**Fig. 13**). Recently, the practice of high grading in longline fisheries has been suggested to occur in some pelagic longline fisheries operating in the South of the Indian Ocean. Preliminary analysis conducted on size data of retained bigeye tuna caught in Indian Ocean longline fisheries did support the hypothesis of major changes in discarding practice, e.g., that would be linked to high grading in relation with the implementation of Res. 17/01 (Medley et al. 2021).

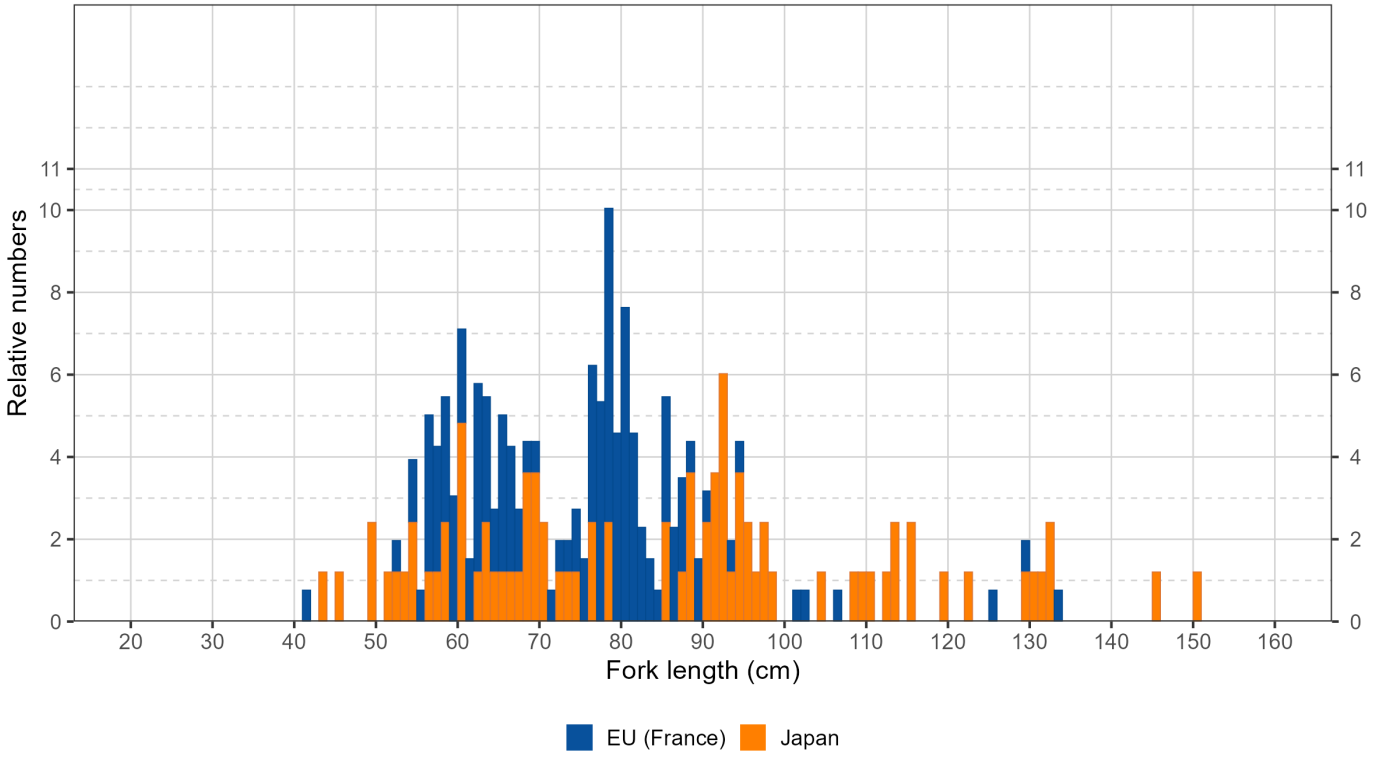

Figure 13: Fork length (cm) distribution of bigeye tuna discarded at sea in longline fisheries during the period 2009-2020 (n = 345). Data source: IOTC ROS database

Overall, more data on discards collected from observers at sea are required to better assess the extent and variability of discarding practices in Indian Ocean longline fisheries. The IOTC Secretariat acknowledges that several of the CPCs currently submitting ROS trip reports have all the information and the technical knowledge to provide the original scientific data in a format more suitable for incorporation in the ROS database, and therefore the Secretariat is seeking active collaboration from all concerned CPCs to ensure that new and historical ROS data could be properly submitted and used for further analysis.

Geo-referenced catch

Spatial distribution of catches

Estimated geo-referenced catches show the spatial expansion and major changes that took place in the fisheries targeting bigeye tuna over the last decades (**Fig. 14**). As early as the 1950s, bigeye tuna was caught by large-scale longline fisheries across most of the Indian Ocean while coastal gillnet and line fisheries were active in the Arabian Sea and baitboats in the Maldives and off the south-western coast of India representing a small contribution to the bigeye tuna total catches.

Throughout the 1960s and 1970s, the longline fisheries expanded in the south-western part of the Indian Ocean, including in the Mozambique Channel (**Fig. 14b-c**). From the 1980s, the purse seine fishery developed in the western Indian Ocean, with most of the bigeye tuna caught by FOB-associated schools (**Fig. 14d**).

During the 1990s and 2000s, the purse seine fishery increased its catches and expanded its fishing grounds in the western Indian Ocean while a large fresh longline and line fishery developed in the north-eastern Indian Ocean (**Fig. 14e-f**).

The overall annual distribution of bigeye tuna catches by fishery has changed little over the period 2019-2023 (**Fig. 15**).

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

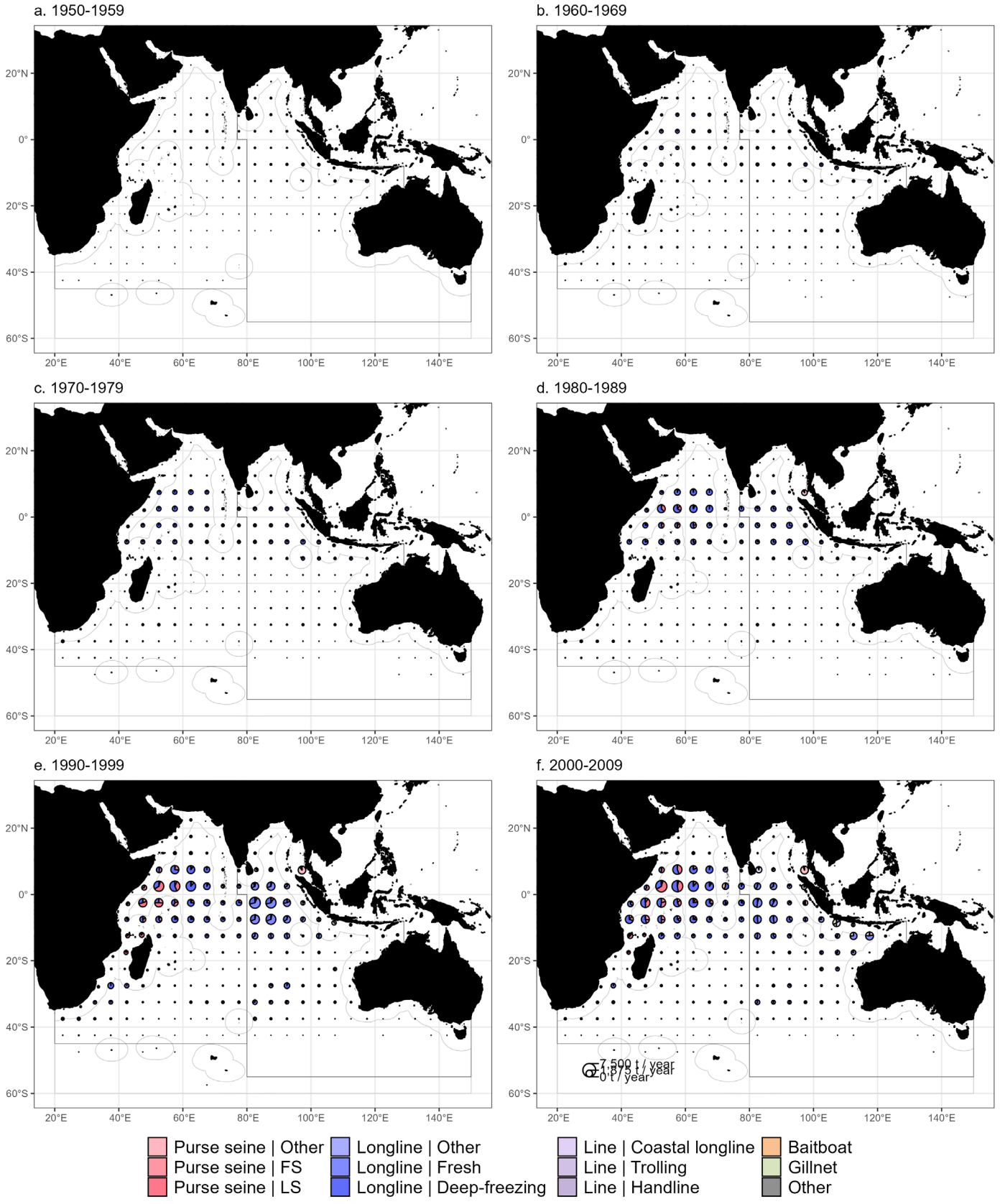

Figure 14: Estimated mean annual time-area catches (metric tonnes; t) of bigeye tuna by decade, 5x5 grid, and fishery. Data source: raised time-area catches

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

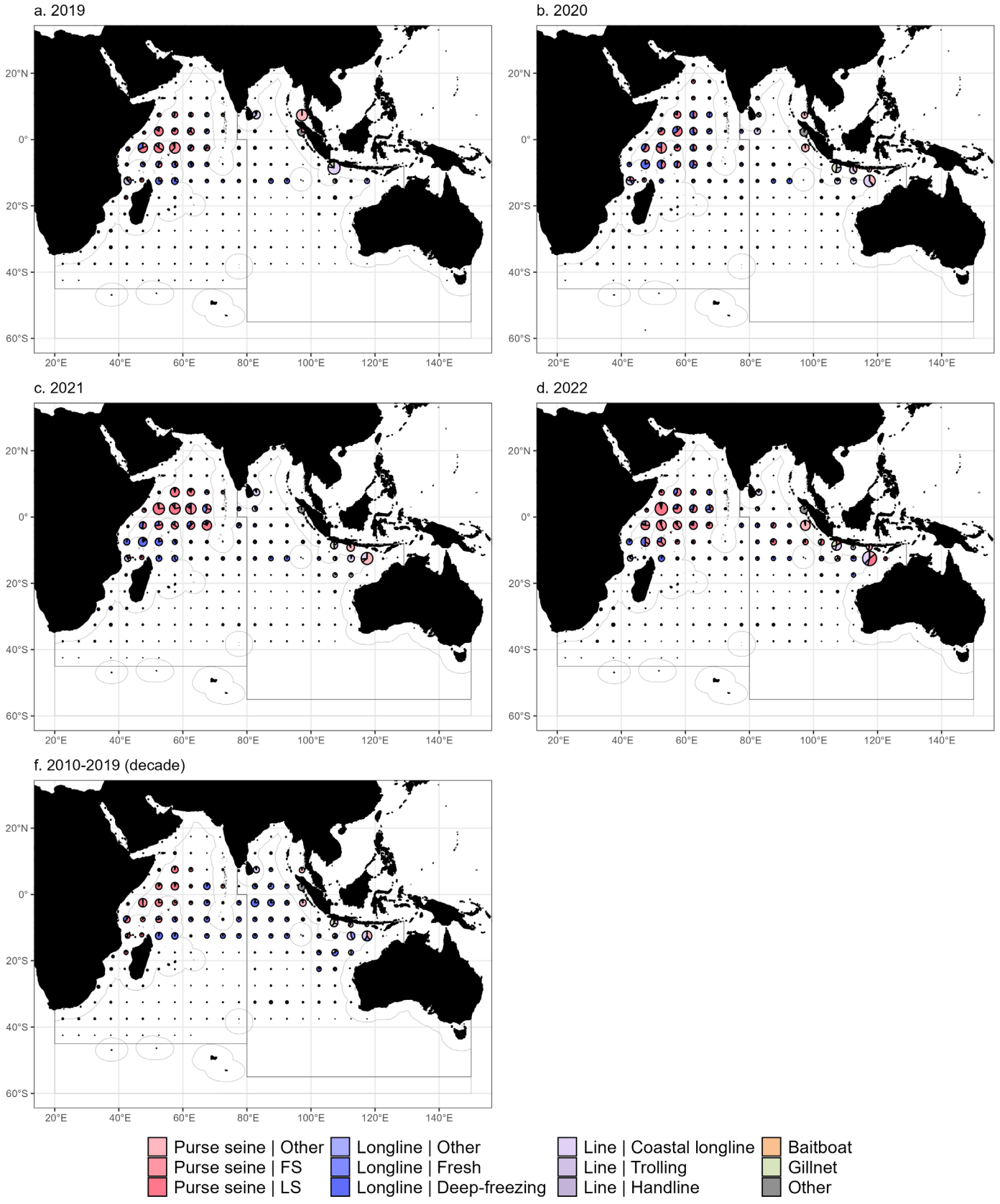

Figure 15: Estimated mean annual time-area catches (metric tonnes; t) of bigeye tuna by year / decade, 5x5 grid, and fishery. Data source: raised time-area catches

Indonesia appears to have developed an industrial purse seine fishery since 2018 (**Fig. 15d-e**), which mainly operates in coastal areas of the eastern Indian Ocean with vessels of length overall (LOA) between 30 and 40 m. Pole and line fishing is essentially concentrated in the Maldives archipelago while line fisheries (handlines, trolling lines, and coastal longlines) are widely used along the coasts of India, Sri Lanka, and Indonesia.

Uncertainties in catch and effort data

Catch and effort series are available for most industrial fisheries and some important artisanal fisheries. However, for many artisanal fisheries, these data are either not available or are considered to be of poor quality. Consequently, the trend in quality of the catch and effort data is driven to some extent by the relative contribution of artisanal fisheries to the total catches of bigeye tuna (**Fig. 16b**).

The main issues identified in the past concern:

- the fresh-tuna longline fisheries of China and Taiwan,China, for which geo-referenced catch and effort data have only been available since 2006 and 2007 when nominal catch data have been reported since 1995 and 2001, respectively;
- purse seine and fresh-tuna longline fisheries of Indonesia, with data only available from 2018 onward (although logbook coverage is thought to be low);
- the purse seine fisheries of I.R. Iran (until 2004) for which data are either incomplete or lacking;
- the longline fisheries of Sri Lanka (since 2014), described by poor quality effort data;
- some coastal fisheries using hand and/or troll lines for which no data (or incomplete data) have been reported to the Secretariat, in particular: Comoros (until 2018), Indonesia (2018 and 2020), Mauritius (since 2011 but without data from 2013 to 2015), and France,Reunion (until 2012).

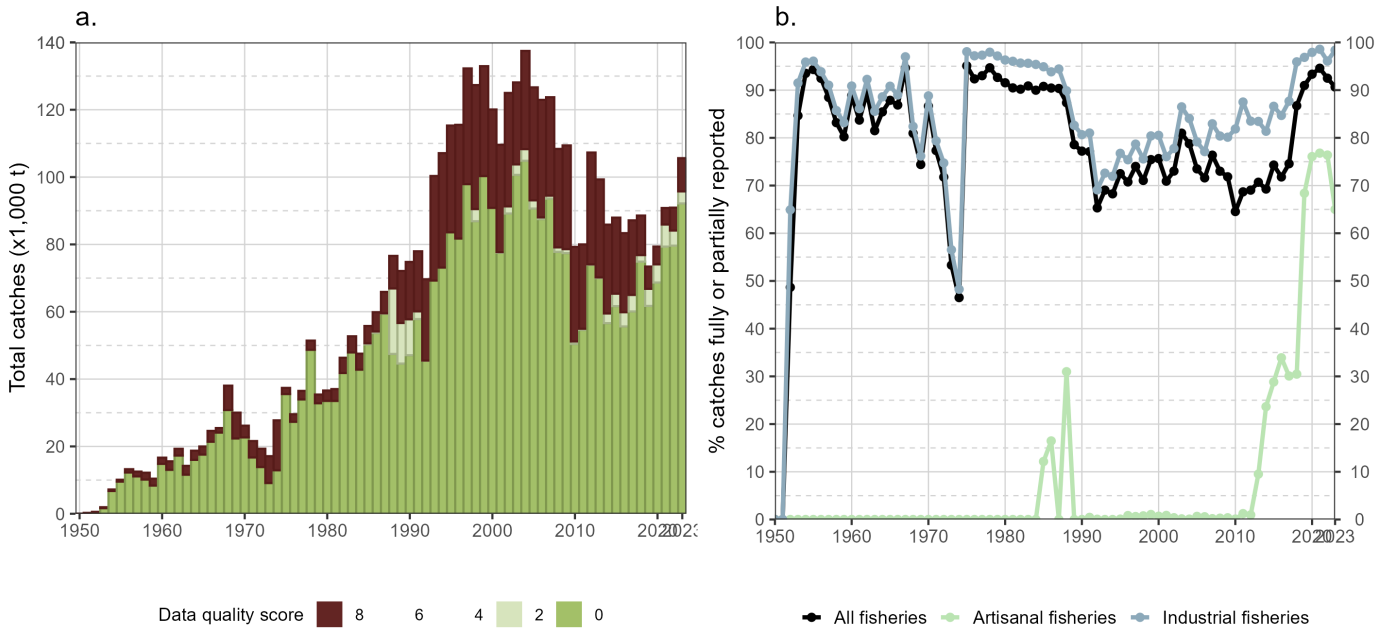

Figure 16: (a) Annual retained catches (metric tonnes; t) of bigeye tuna estimated by quality score and (b) percentage of geo-referenced catches reported to the IOTC Secretariat in agreement with the requirements of Res. 15/02 for all fisheries and by type of fishery, in the period 1950-2023

The percentage of data considered of good quality (scores of 0-2) varied between 65% and 81% during the 1990s and 2000s and has stabilized over the last decade showing an overall increasing trend from 69% in 2014 to 95% in 2021 (**Fig. 16a-b**). Catch and effort data have progressively become available for some important fisheries such as coastal and fresh longlines as well as hand lines from Sri Lanka since 2014, coastal longlines from I.R. Iran since 2016, small-scale purse seines and fresh longlines from Indonesia since 2018, and some smaller fisheries such as trolling from Indonesia and hand line from Kenya since 2018.

Nevertheless, geo-referenced catch and effort data were not available for about 9% (i.e., around 9,900 t) of the total retained catches of bigeye tuna in 2023.

Size composition of the catch

Samples availability

By fishery group

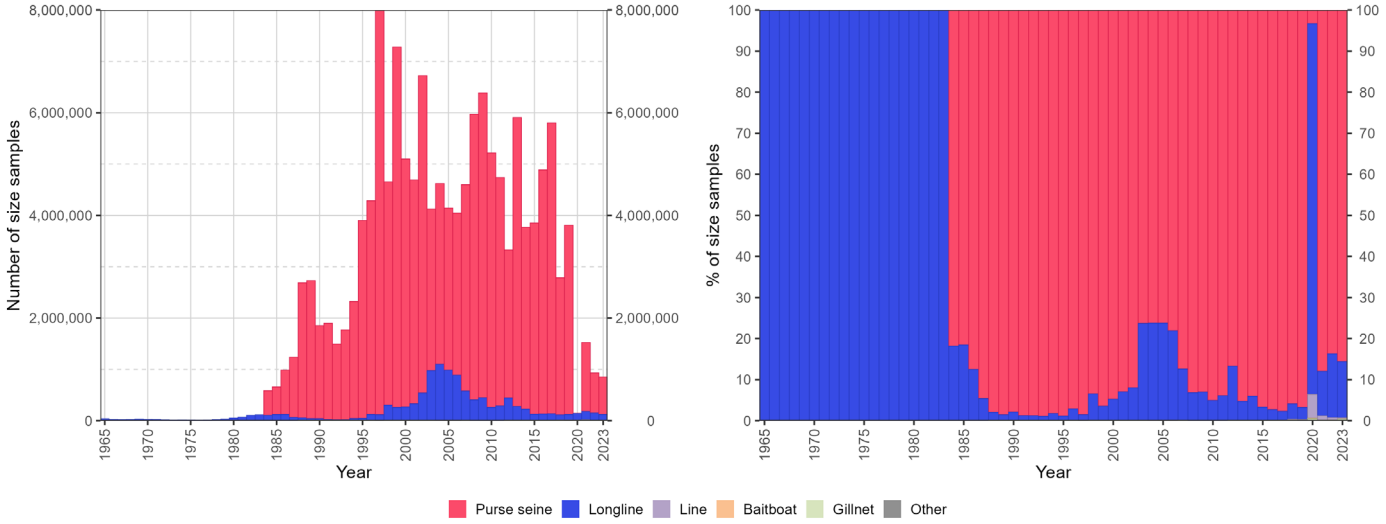

Figure 17: Availability of bigeye tuna size-frequency data as absolute number of samples (left) and relative number of samples (right) per year and fishery group. Data source: standardized size-frequency dataset (Res. 15/02)

Comprehensive size-frequency data for bigeye tuna are only available from the beginning of the 1980s (see also Uncertainties in size-frequency data).

Most of the samples available to the IOTC Secretariat have been collected since the development of the purse seine fishery in the Indian Ocean, and reported as *raised* samples (i.e., processed at the source to represent *catch-at-size* for the fleets and years concerned). This explains the magnitude of the samples available from these fisheries which at its peak reached over 20 million individual lengths reported for a single year (**Fig. 17**).

The contribution of longline fisheries to the total available samples for the species became more evident during the 2000s, and reflects the actual level of catches from these fisheries. In general, samples from all other fisheries (using baitboats, gillnets and miscellaneous gears mostly of artisanal nature) are limited and highly dependent on the fleet (**Fig. 32**).

Due to the CoViD-19 pandemic, size-frequency data of bigeye tuna collected by purse seine fisheries are basically unavailable for 2020, if not for a very limited number of individuals sampled by EU,France, Mauritius, and Seychelles.

The spatial distribution of the available samples by fishery type in the last five years is generally representative of the fishing grounds where the fisheries operate, and proportional to the level of recorded captures (**Fig. 18**).

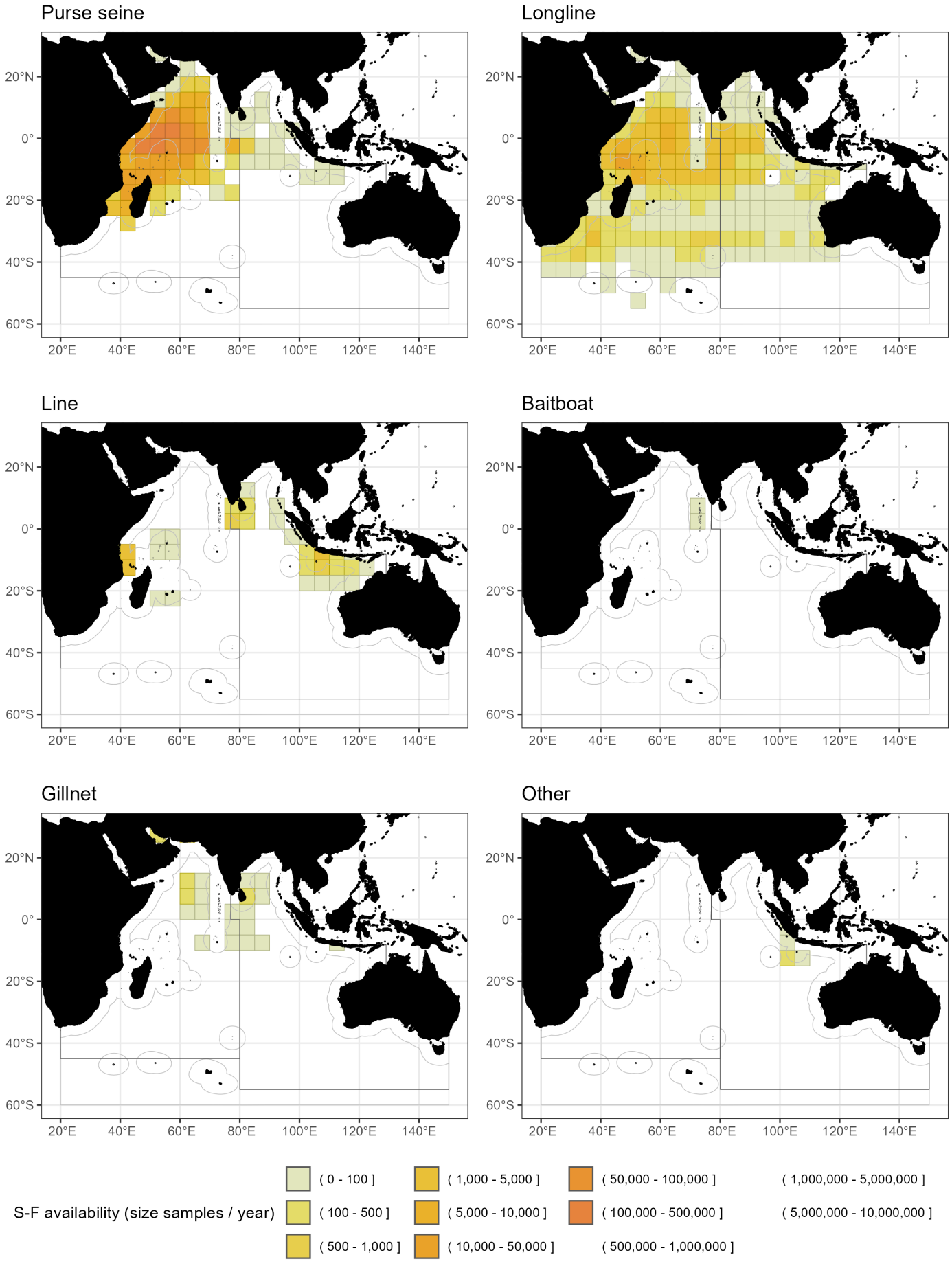

Figure 18: Spatial distribution (average number of samples per grid per year) of available bigeye tuna size-frequency data for each fishery group in the period 2019-2023. Data source: standardized size-frequency dataset (Res. 15/02)

By fishery

Purse seine fisheries

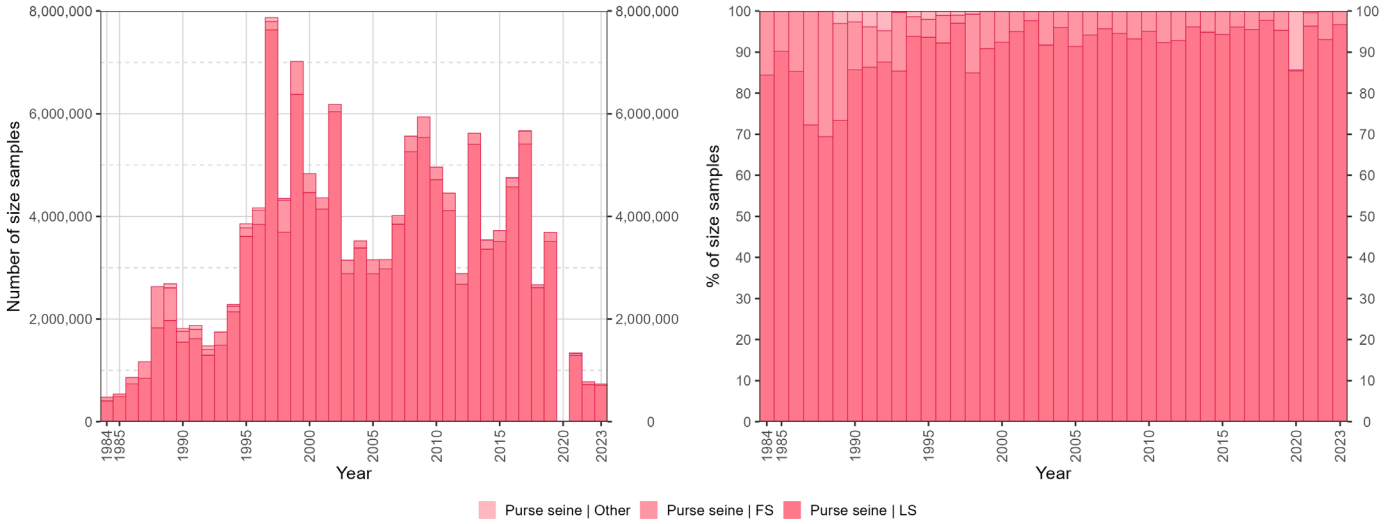

Figure 19: Availability of bigeye tuna size-frequency data as absolute number of samples (left) and relative number of samples (right) per year and purse seine fishery type. Data source: standardized size-frequency dataset (Res. 15/02)

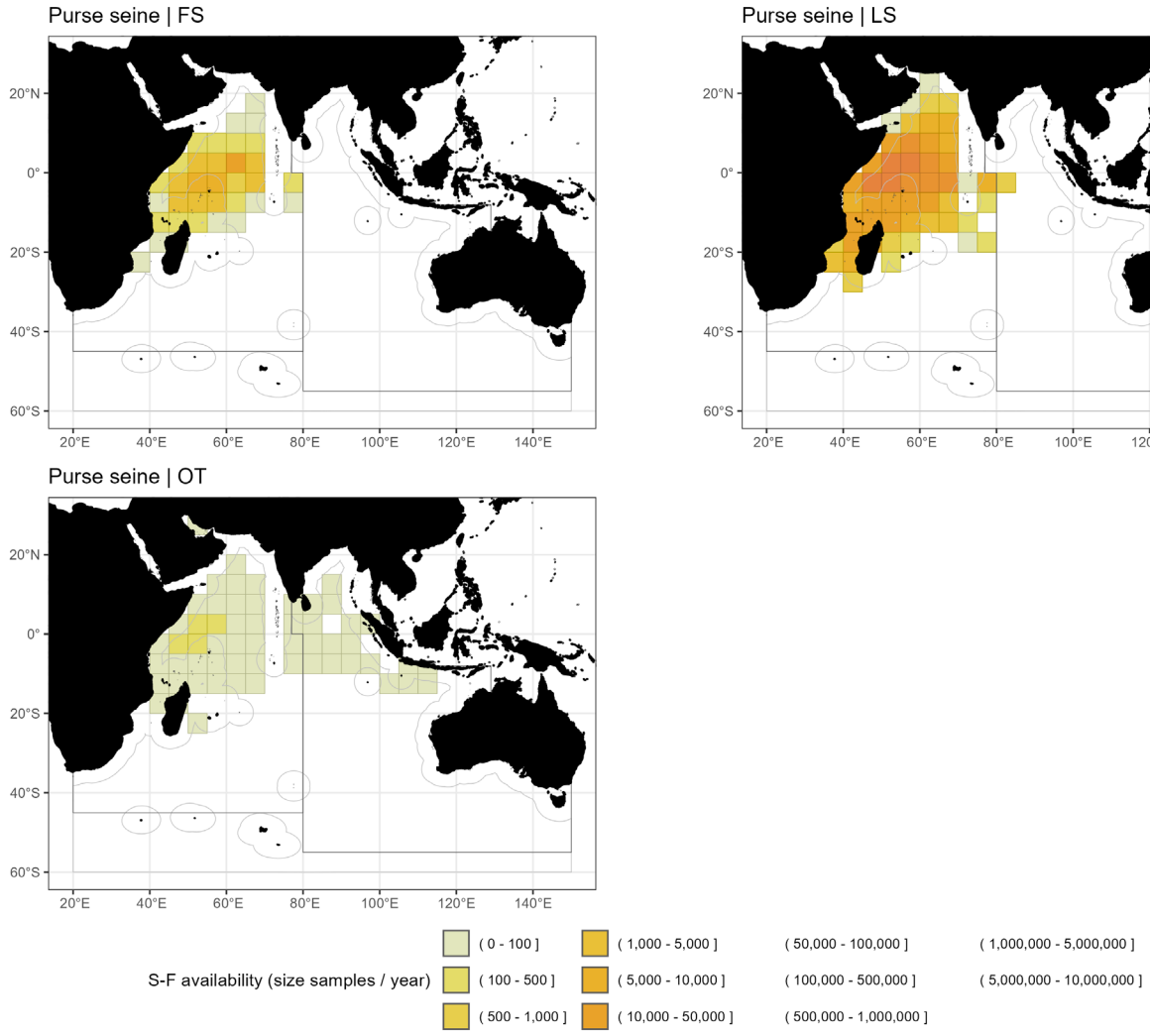

Figure 20: Spatial distribution (average number of samples per grid per year) of available bigeye tuna size-frequency data by purse seine fishery types in the period 2019-2023. Data source: standardized size-frequency dataset (Res. 15/02)

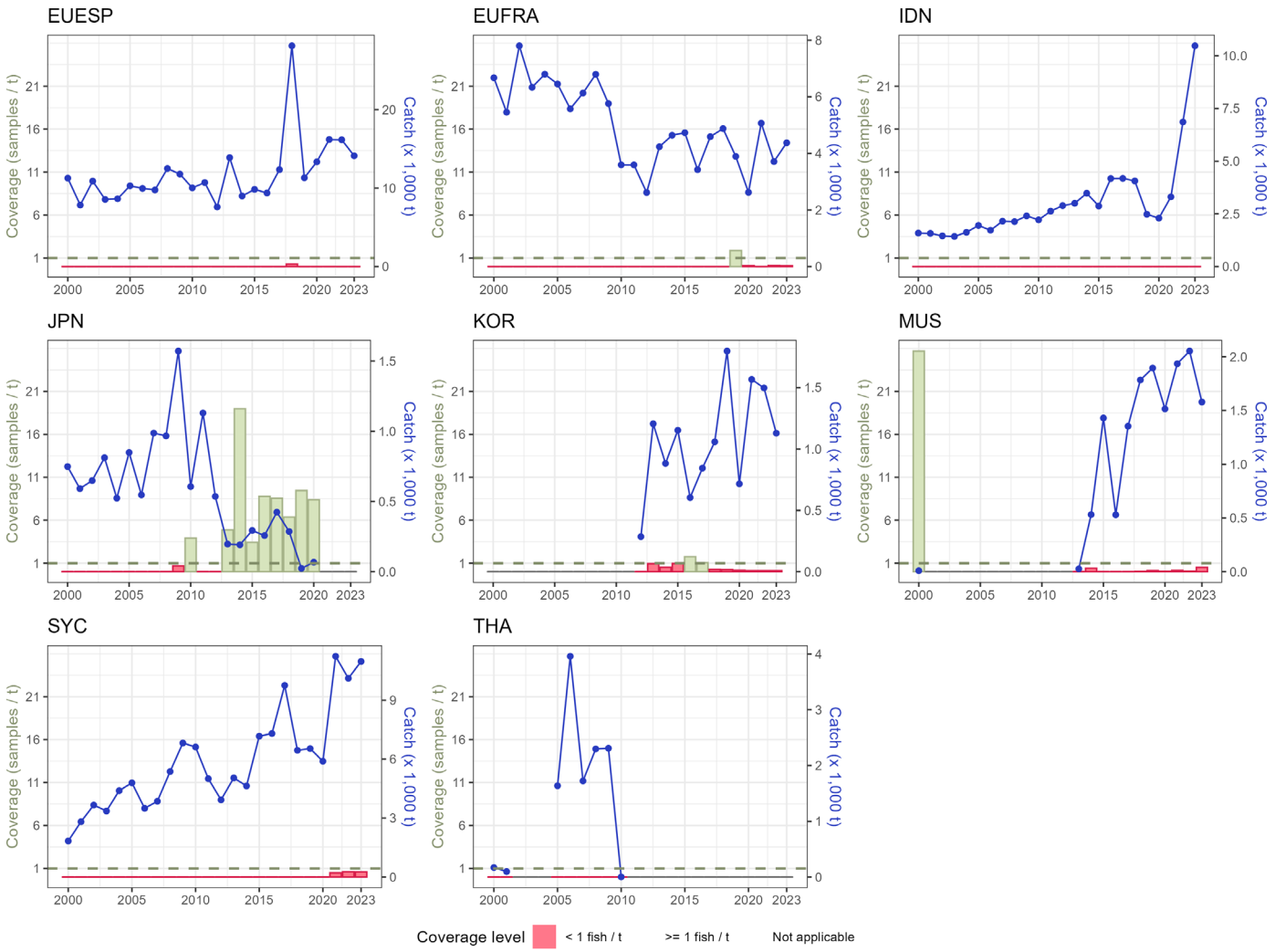

Figure 21: Size-frequency samples coverage (number of fish measured by t of retained catches) of bigeye tuna caught by the major purse seine fleets, by fleet and year (2000-2023). Data source: standardized size-frequency dataset (Res. 15/02)

Longline fisheries

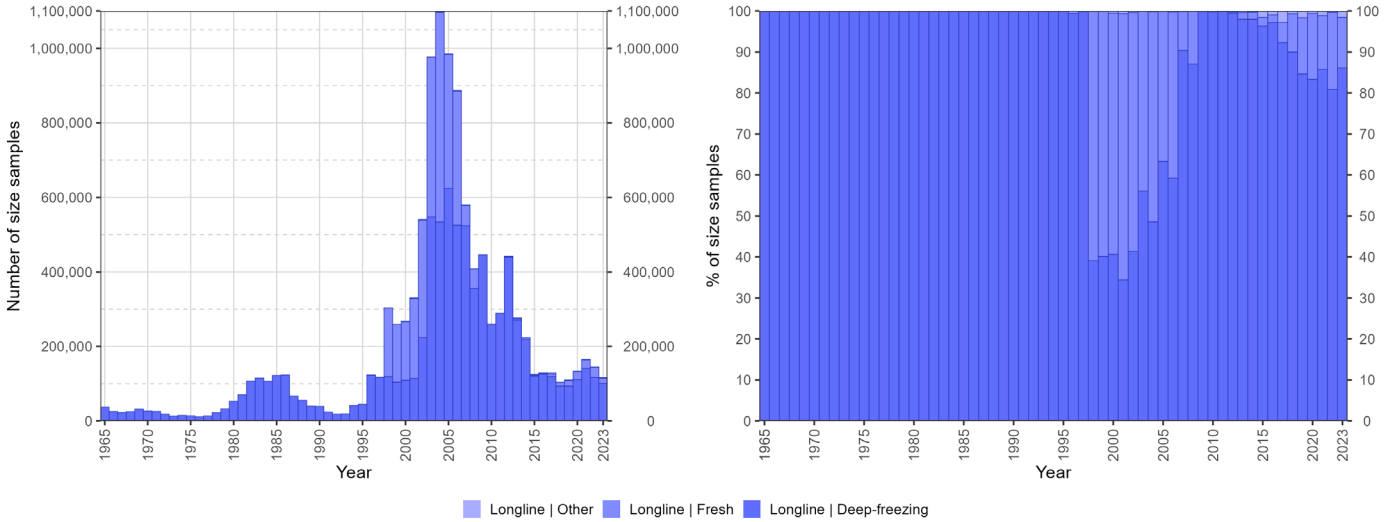

Figure 22: Availability of bigeye tuna size-frequency data as absolute number of samples (left) and relative number of samples (right) per year and longline fishery type. Data source: standardized size-frequency dataset (Res. 15/02)

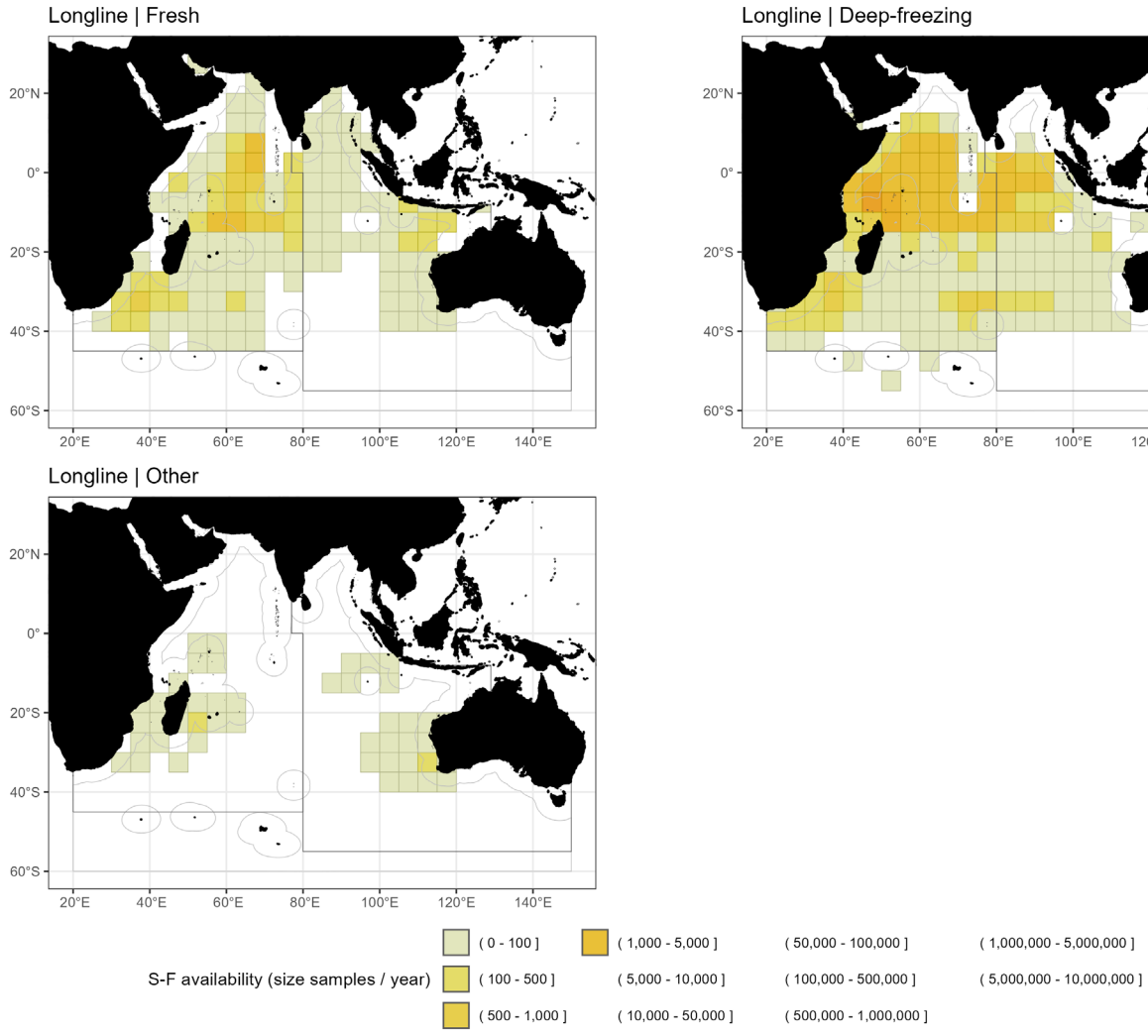

Figure 23: Spatial distribution (average number of samples per grid per year) of available bigeye tuna size-frequency data by longline fishery types in the period 2019-2023. Data source: standardized size-frequency dataset (Res. 15/02)

Coverage levels of bigeye tuna samples over the considered timeframe confirm how deep-freezing longliners from Taiwan,China are regularly exceeding the minimum threshold of 1 measured fish per metric ton of retained catches. Size-frequency data from the other major deep-freezing longline fleets reached or surpassed that level only in a few years over the same period, except those from Seychelles which are relatively well sampled (**Fig. 24**). Information

provided by the Seychelles Fishing Authority indicates that complementary size-frequency data collected throughout the period 2015-2021 should be submitted to the Secretariat in 2023. However, it is important to note how the analysis of longline size-frequency data available at the IOTC Secretariat shows strong variability in the quality and reliability of the data available from Taiwan,China and Seychelles over time and space, leading to recommendation of omitting these data from stock assessments until the issues have been addressed (Hoyle et al. 2021) (see also details in the Uncertainties in size-frequency data section).

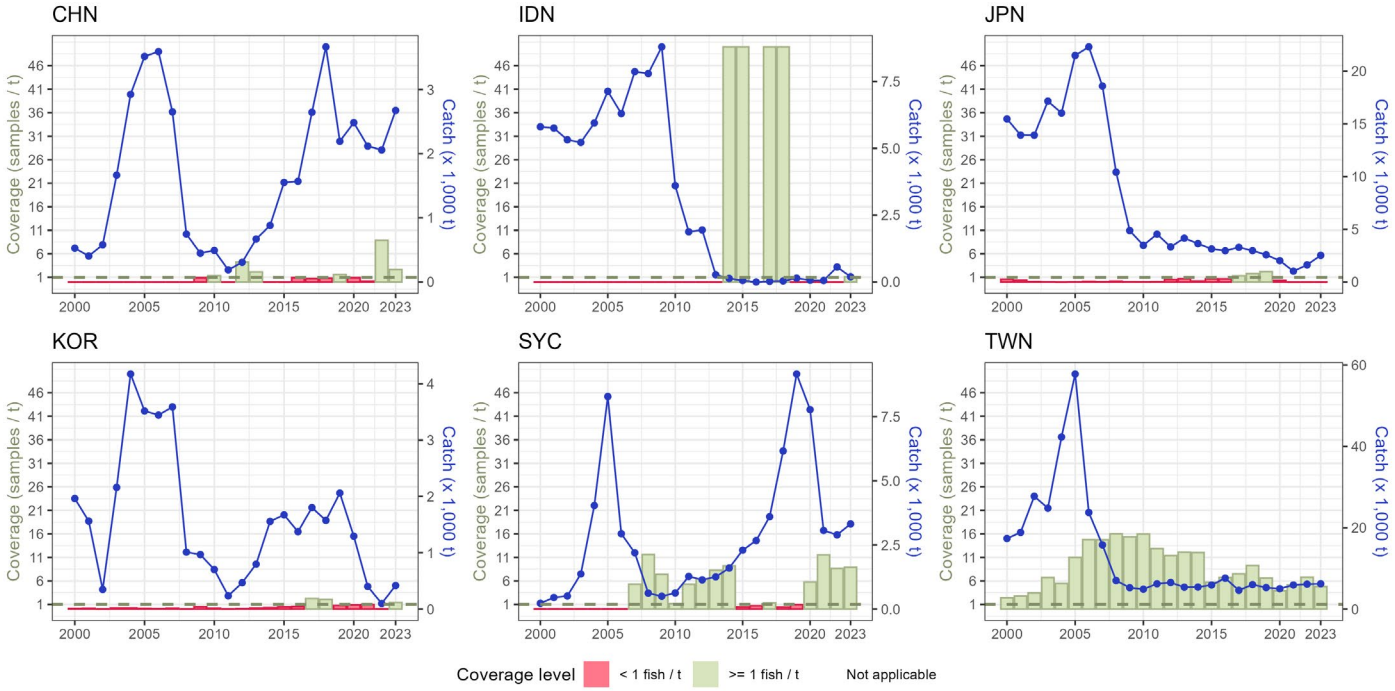

Figure 24: Size-frequency samples coverage (number of fish measured by t of retained catches) of bigeye tuna caught by the major deep-freezing longline fleets, by fleet and year (2000-2023). Data source: standardized size-frequency dataset (Res. 15/02)

In the case of fresh-tuna longliners, the level of coverage (and more in general the availability of samples) varies greatly with the fleet and years considered. In recent years, only Taiwan,China managed to consistently reach the minimum level of coverage, while all other fleets alternate several years for which no samples are available with sporadic peaks in sampling rate (e.g., Indonesia in 2019-2020, and Malaysia in 2020-2021) (**Fig. 25**).

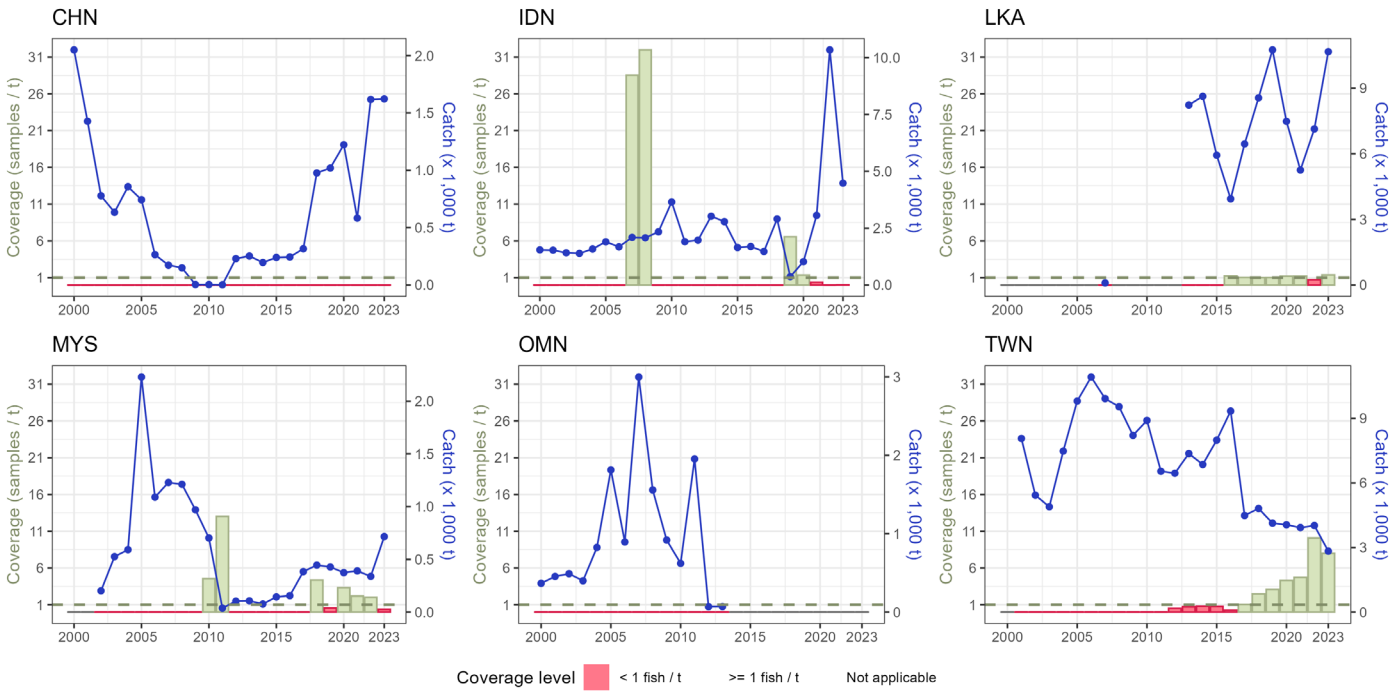

Figure 25: Size-frequency samples coverage (number of fish measured by t of retained catches) of bigeye tuna caught by the major fresh-tuna longline fleets, by fleet and year (2000-2023). Data source: standardized size-frequency dataset (Res. 15/02)

Longliners targeting swordfish are also known to interact frequently with the species. Among the major fleets involved in this fishery, Australia is the one that has been generally sampling the species at very good levels, i.e., well above the minimum threshold required by IOTC. Madagascar, which was able to provide size frequency data in recent years thanks to a project funded by the World Bank, has failed to provided size data in 2021 upon termination of the project. All other fleets tend to alternate years of sufficient sampling with years in which no information is collected or reported to the Secretariat. The swordfish longline fishery of EU,Spain ranks worst in terms of coverage level, with no single year in the considered timeframe where the minimum coverage was reached (**Fig. 26**).

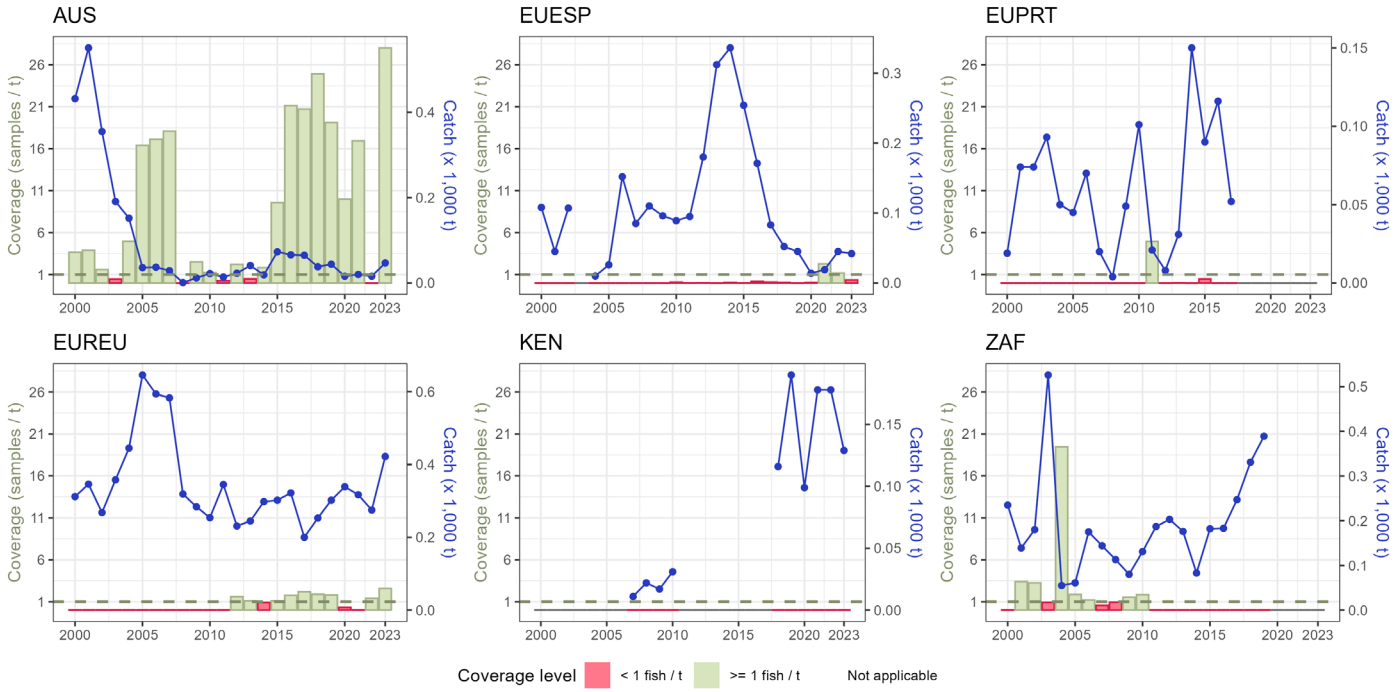

Figure 26: Size-frequency samples coverage (number of fish measured by t of retained catches) of bigeye tuna caught by the major swordfish targeting longline fleets, by fleet and year (2000-2023). Data source: standardized size-frequency dataset (Res. 15/02)

Line fisheries

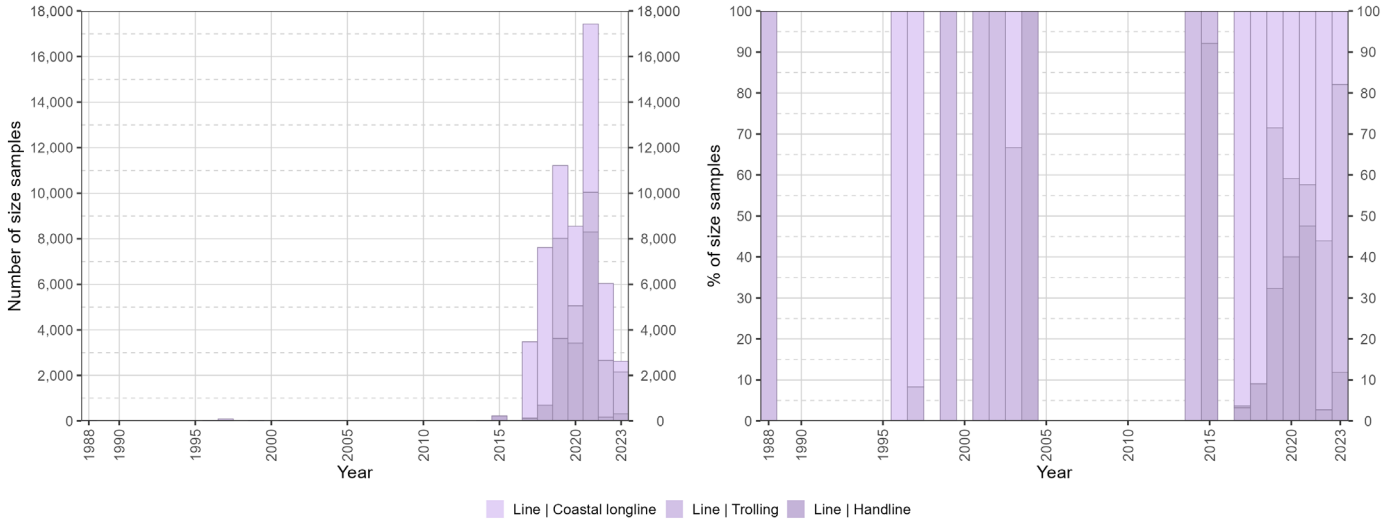

Figure 27: Availability of bigeye tuna size-frequency data as absolute number of samples (left) and relative number of samples (right) per year and line fishery type. Data source: standardized size-frequency dataset (Res. 15/02)

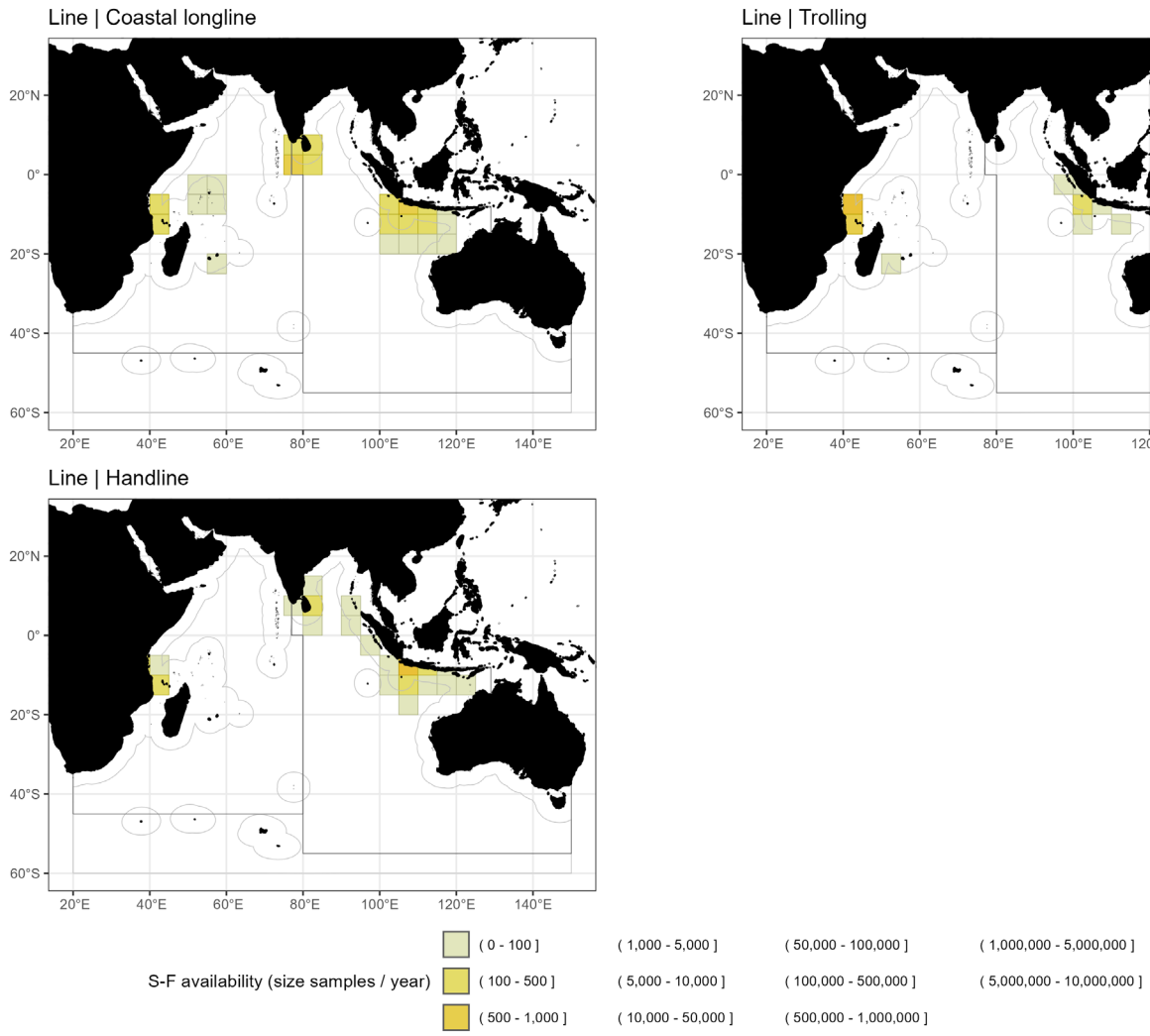

Figure 28: Spatial distribution (average number of samples per grid per year) of available bigeye tuna size-frequency data by line fishery types in the period 2019-2023. Data source: standardized size-frequency dataset (Res. 15/02)

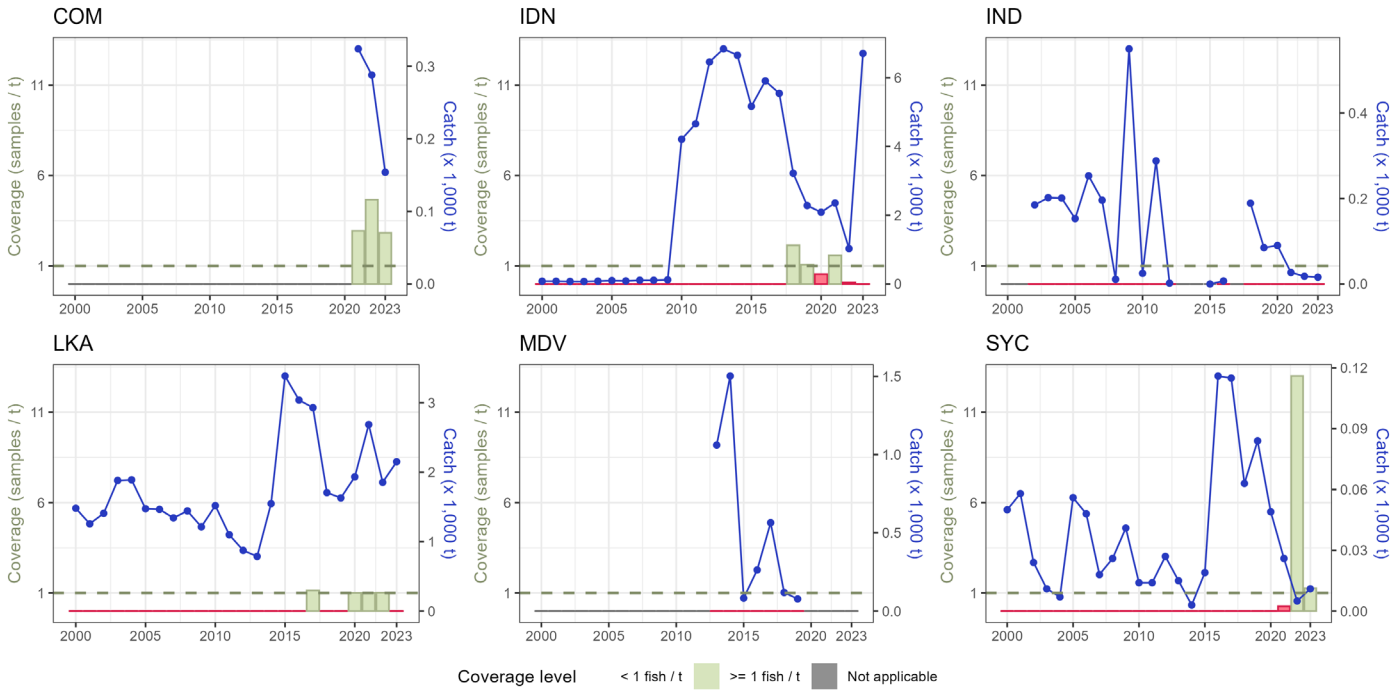

Figure 29: Size-frequency samples coverage (number of fish measured by t of retained catches) of bigeye tuna caught by the major coastal longline fleets, by fleet and year (2000-2023). Data source: standardized size-frequency dataset (Res. 15/02)

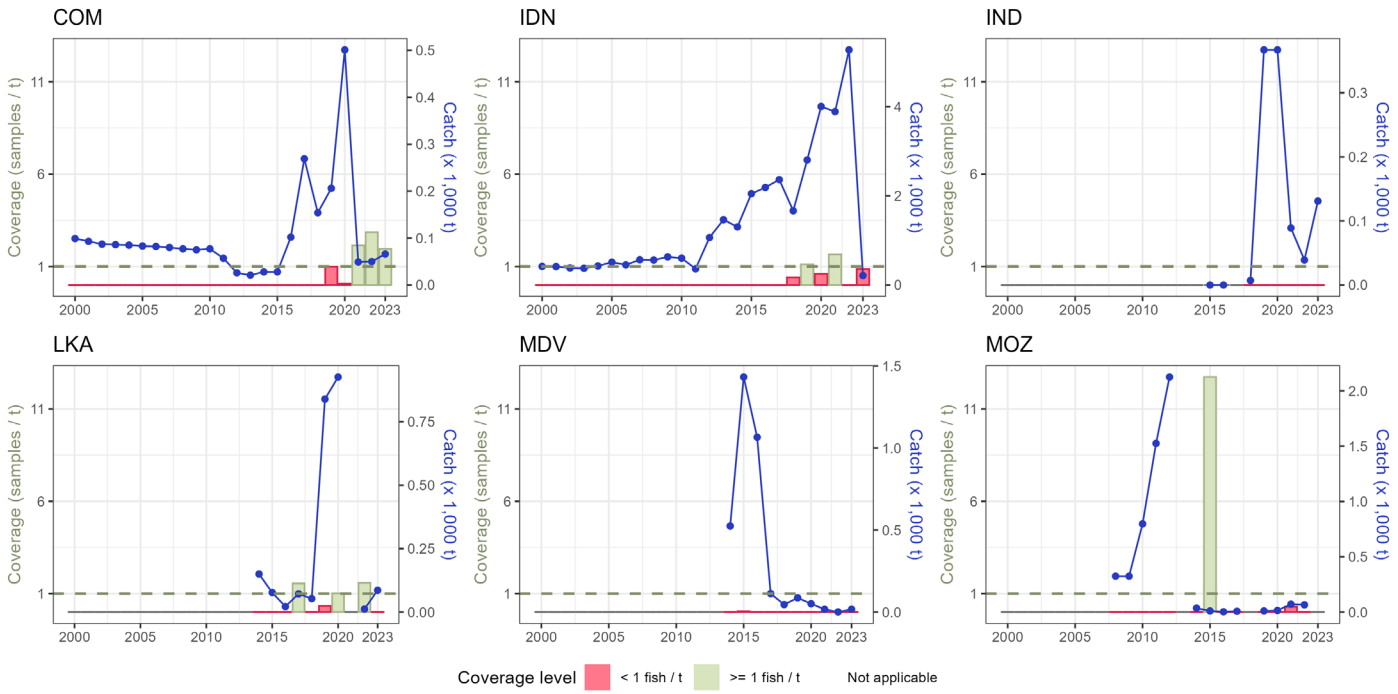

Figure 30: Size-frequency samples coverage (number of fish measured by t of retained catches) of bigeye tuna caught by the major handline fleets, by fleet and year (2000-2023). Data source: standardized size-frequency dataset (Res. 15/02)

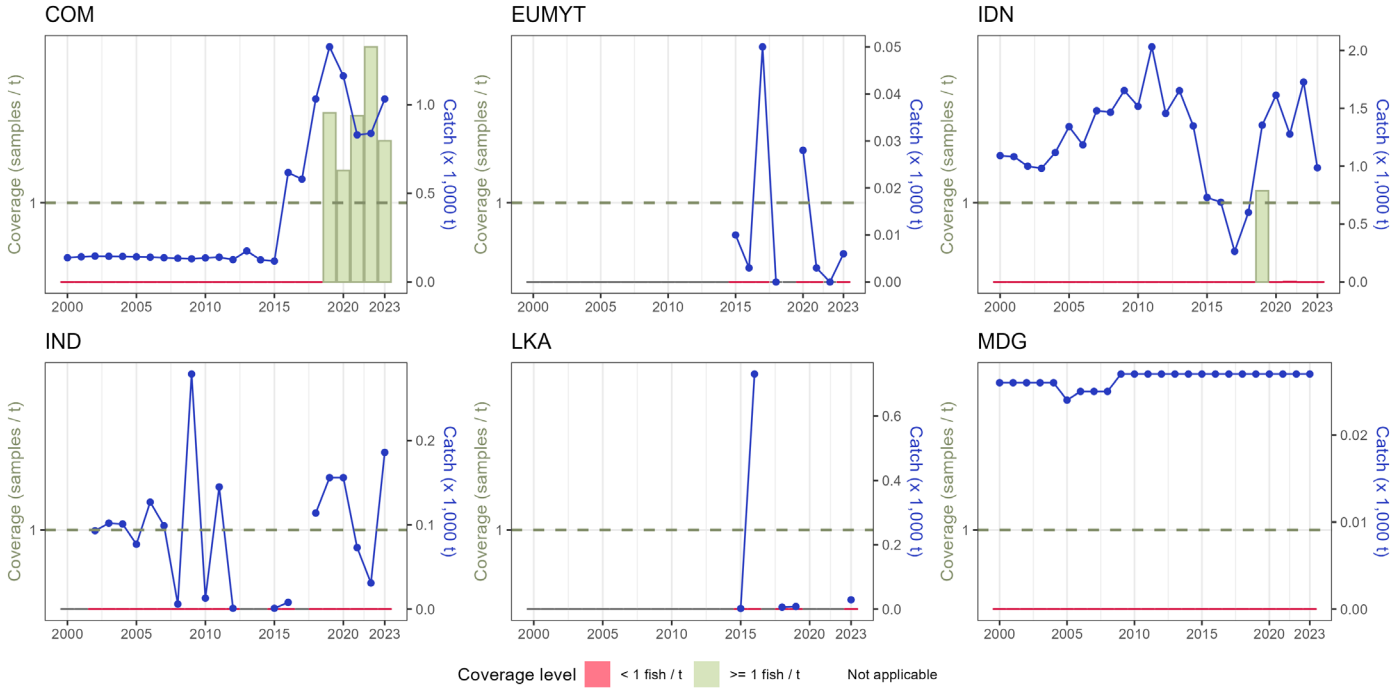

Figure 31: Size-frequency samples coverage (number of fish measured by t of retained catches) of bigeye tuna caught by the major troll line fleets, by fleet and year (2000-2023). Data source: standardized size-frequency dataset (Res. 15/02)

Other fisheries

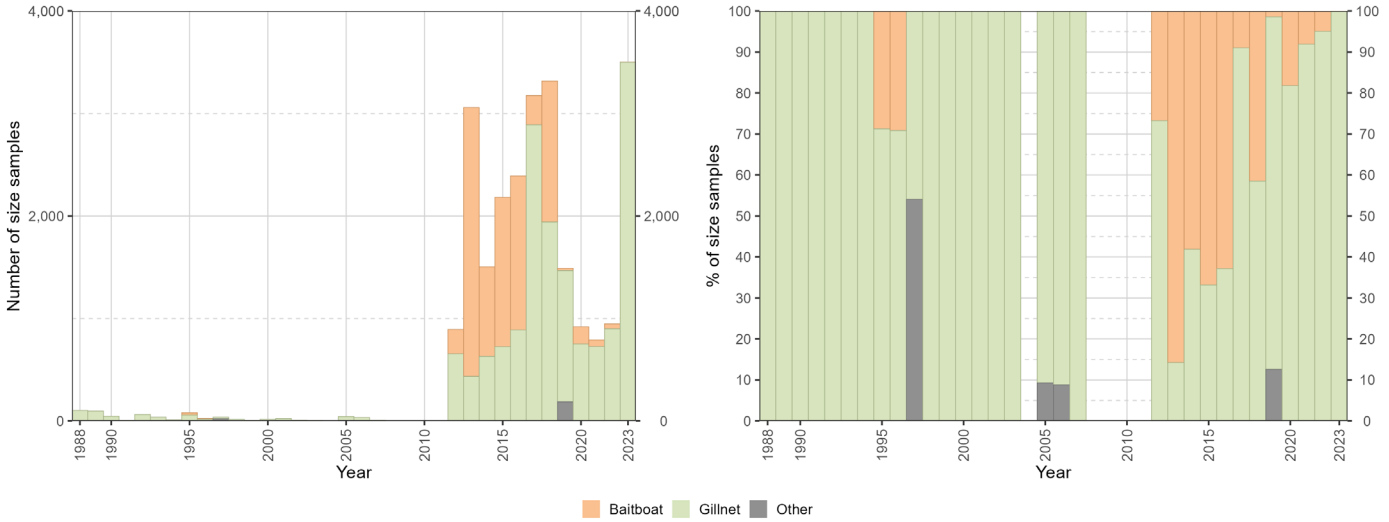

Figure 32: Availability of bigeye tuna size-frequency data as absolute number of samples (left) and relative number of samples (right) per year and all other fishery types. Data source: standardized size-frequency dataset (Res. 15/02)

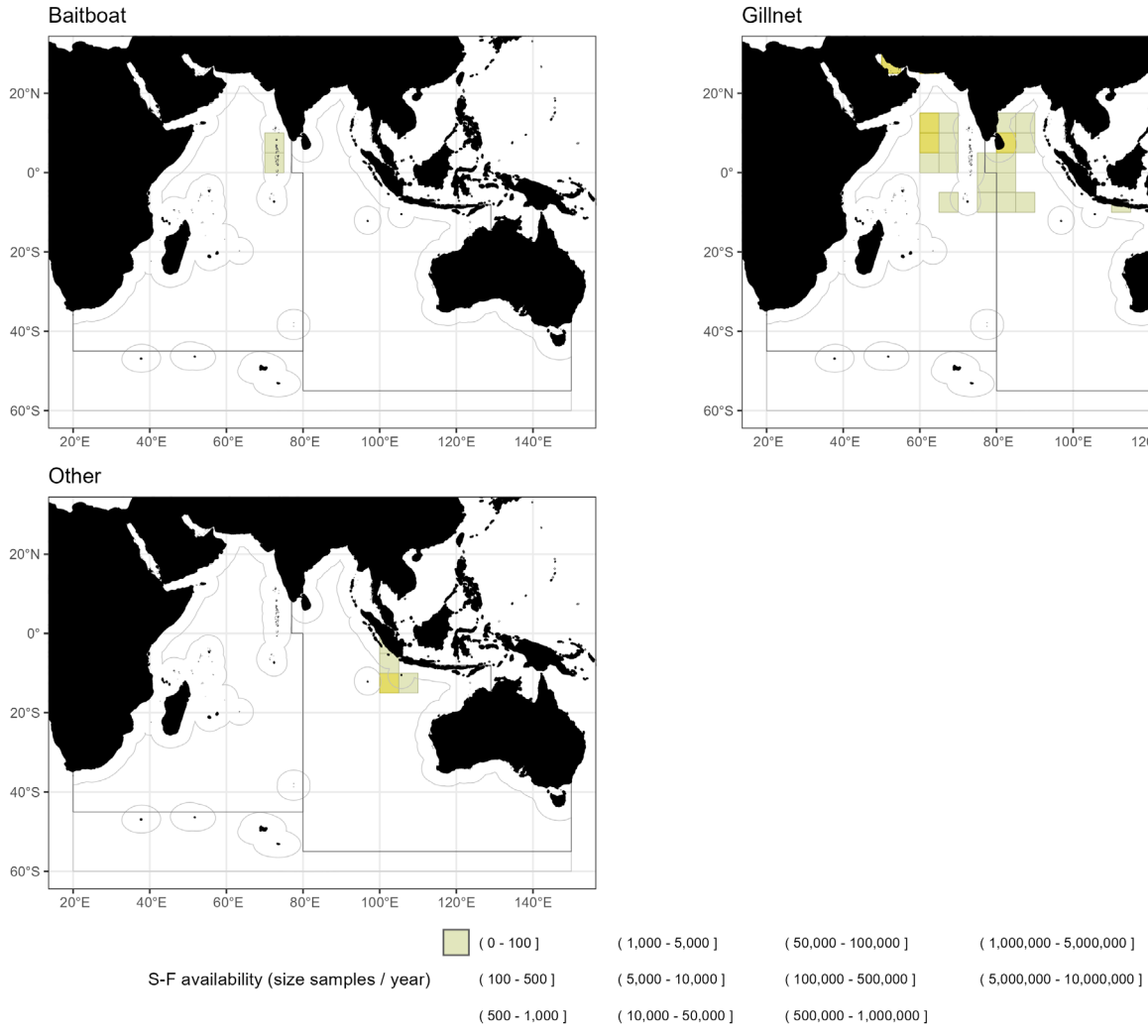

Figure 33: Spatial distribution (average number of samples per grid per year) of available bigeye tuna size-frequency data by all other fishery types in the period 2019-2023. Data source: standardized size-frequency dataset (Res. 15/02)

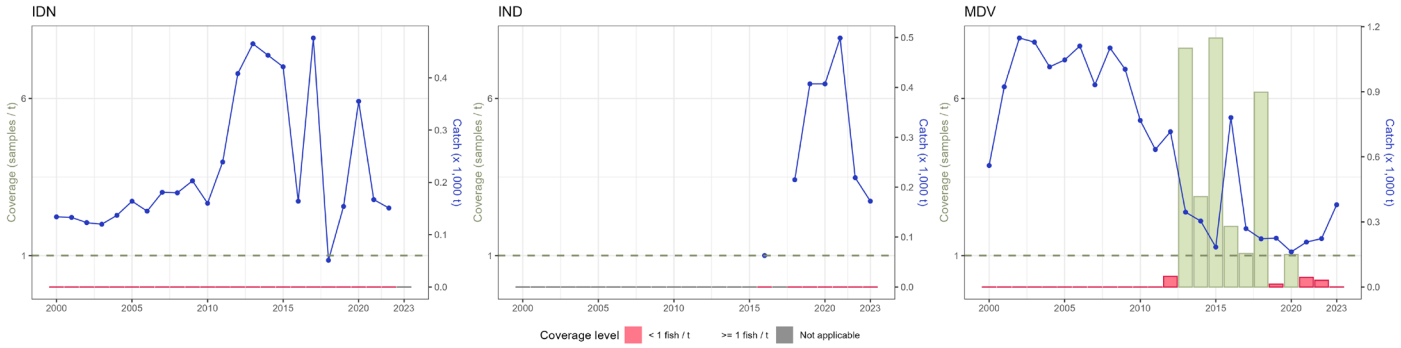

Figure 34: Size-frequency samples coverage (number of fish measured by t of retained catches) of bigeye tuna caught by the major baitboat fleets, by fleet and year (2000-2023). Data source: standardized size-frequency dataset (Res. 15/02)

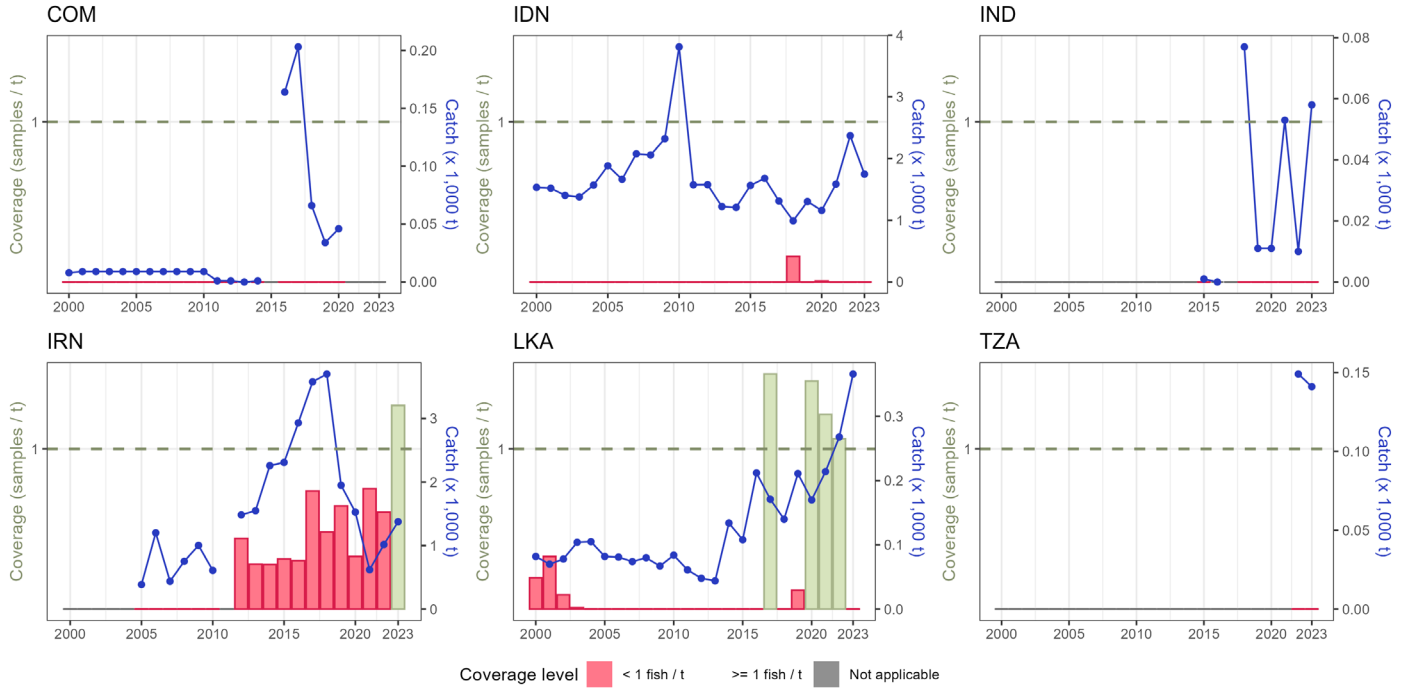

Figure 35: Size-frequency samples coverage (number of fish measured by t of retained catches) of bigeye tuna caught by the major gillnet fleets, by fleet and year (2000-2023). Data source: standardized size-frequency dataset (Res. 15/02)

The sampling levels reached by coastal fisheries are generally low, and in some cases (e.g., handline and baitboat fisheries) this might reflect the limited level of interactions with the species. Among all fisheries and fleet concerned, only Indonesian handlines appear to be well sampled in recent years. Coastal longline fisheries, which are considered as the most relevant among all artisanal fisheries catching bigeye tuna, are instead very limited in terms of coverage levels and sample availability. It could also be possible that the limited availability of samples (which in the case of small-scale fisheries are to be recorded at the landing sites) reflects well known issues in the ability of identifying the species, with smaller individuals that might have been reported as yellowfin tuna instead.

Temporal patterns and trends in size distributions

Industrial purse seine fisheries

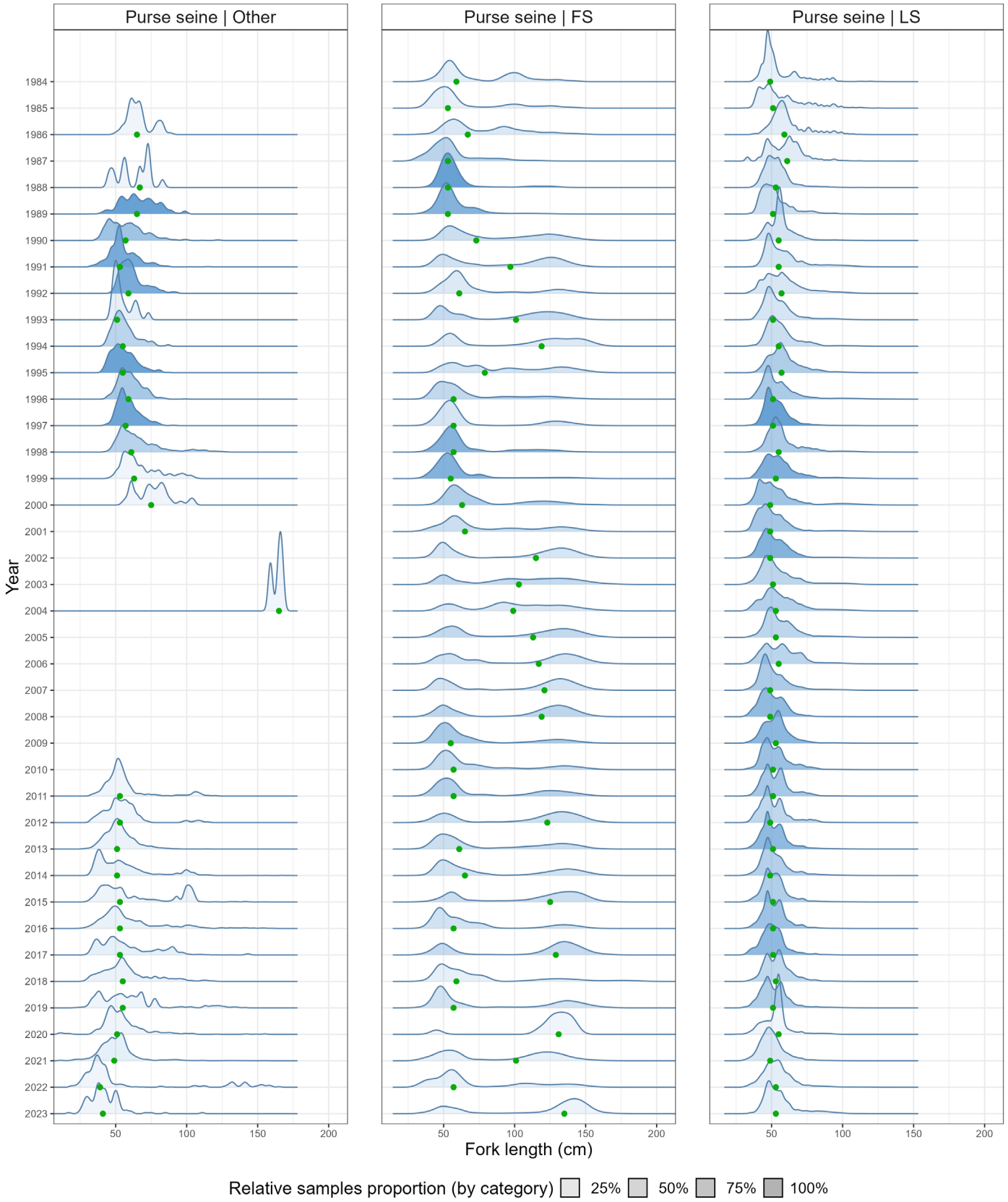

Figure 36: Relative size distribution (fork length; 2-cm size bins) of bigeye tuna caught by all purse seine fleets for the period 1984-2023. Other = no information provided on the school association; FS = free-swimming schools; LS = schools associated with floating objects. Fill intensity is proportional to the number of samples recorded for the year, while the green dot corresponds to the median value. Data source: standardized size-frequency dataset (Res. 15/02)

Industrial longline fisheries

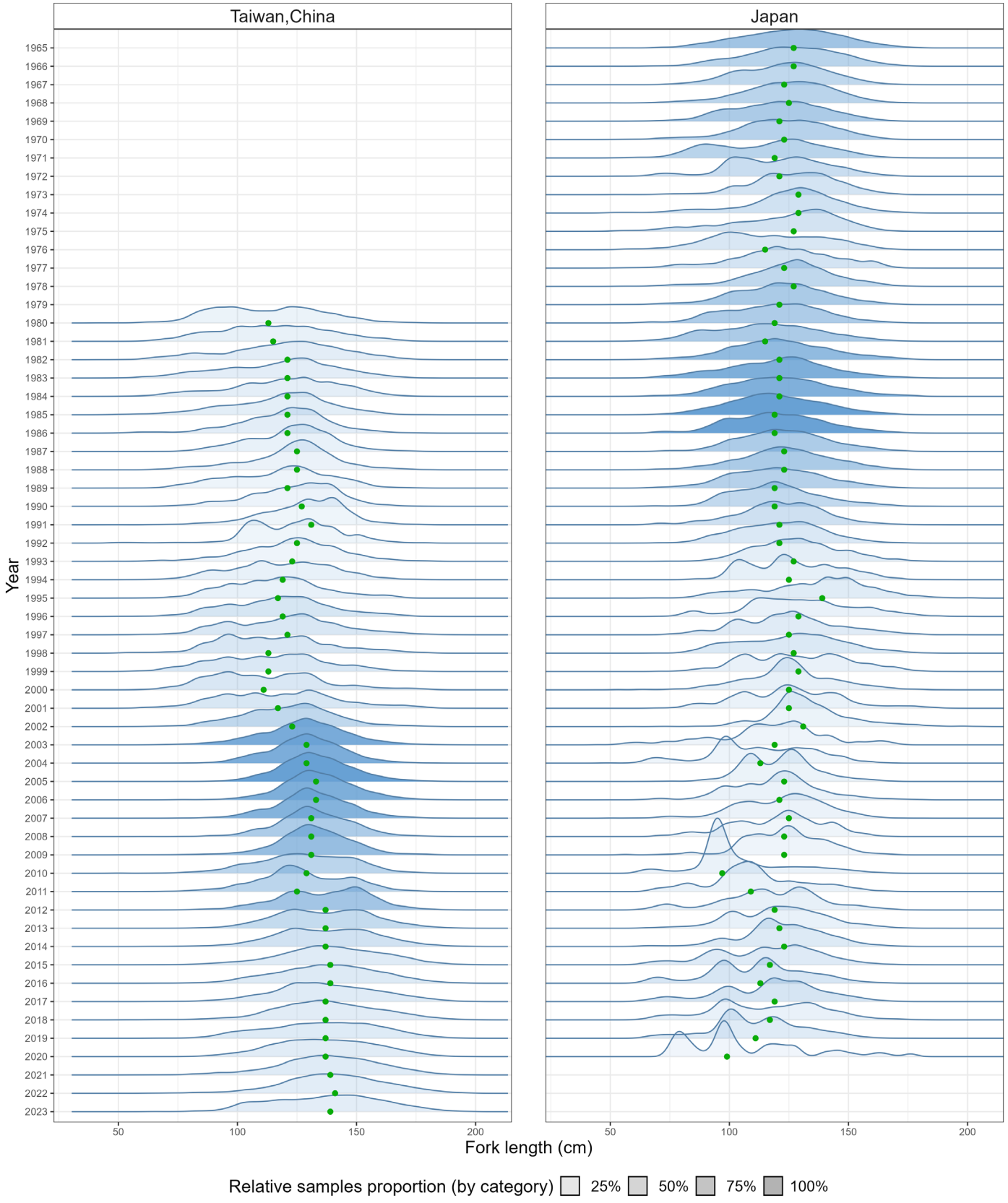

Figure 37: Relative size distribution (fork length; 2-cm size bins) of bigeye tuna caught by the main deep-freezing longline fleets for the period 1965-2023. Fill intensity is proportional to the number of samples recorded for the year, while the green dot corresponds to the median value. Data source: standardized size-frequency dataset (Res. 15/02)

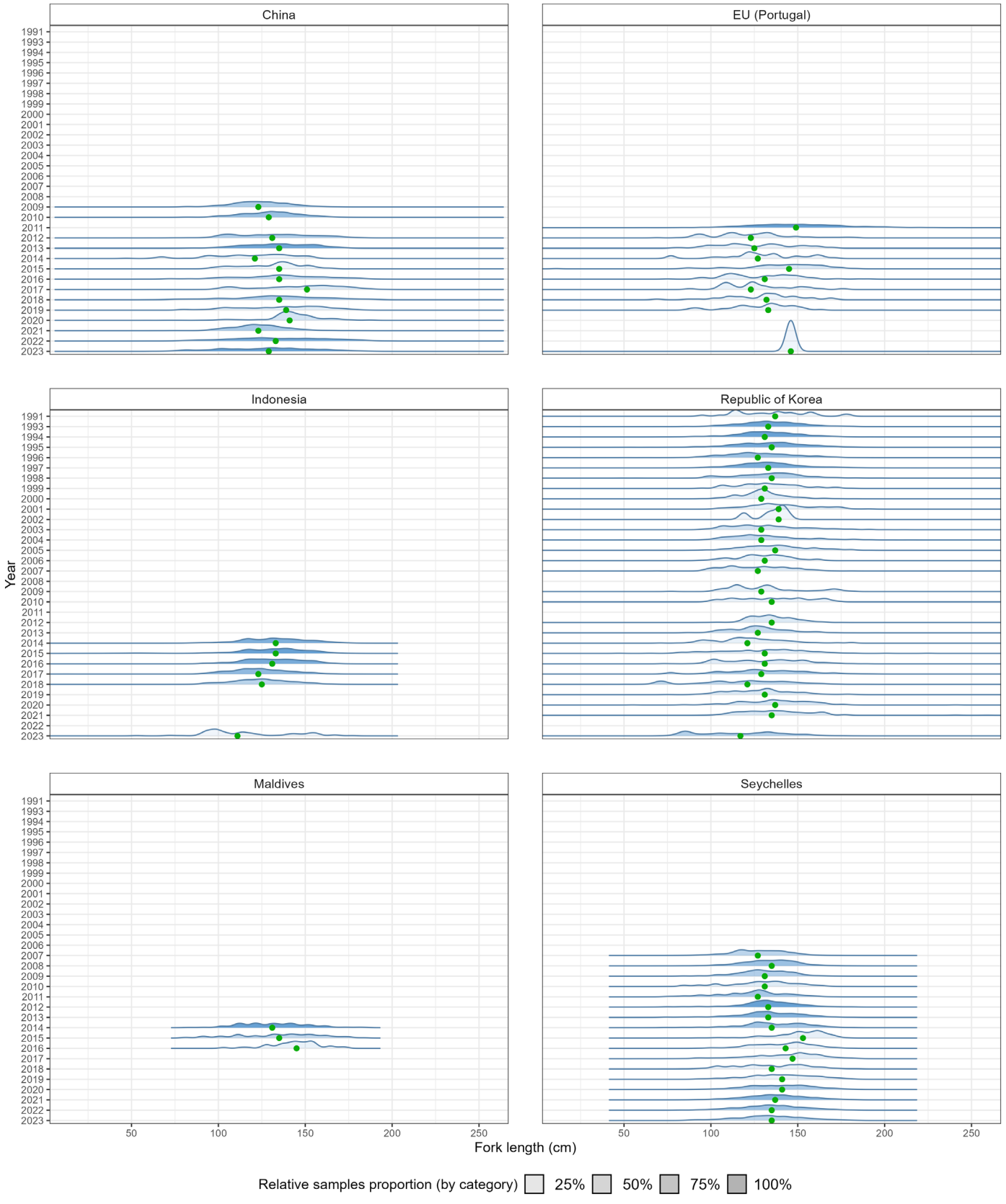

Figure 38: Relative size distribution (fork length; 2-cm size bins) of bigeye tuna caught by all other longline fleets (excluding Japan and Taiwan,China), by fleet for the period 1991-2023. Data source: standardized size-frequency dataset (Res. 15/02)

Temporal trends in estimated average weights

Trends in average weights of bigeye tuna in the catch can be derived from the raised time-area catches in weight and numbers. While they can be estimated for the entire time series and for each fishery, due to the lack of original samples

for several strata (especially in the early periods of the fisheries) they are considered accurate only for those periods for which actual samples are available and cover strata that correspond to at least 50 t of retained catches per year.

Considering the limitations in the original data and in the process that produces this estimation, it shall be noted that the average weights calculated for the longline fisheries of Japan and Taiwan,China are relatively stable and fluctuate at around 40-60 kg (**Fig. 40**). The FOB-associated component of all Indian Ocean purse seine fisheries shows a relative stable trend since the mid-1980s, with an estimated average weight of kg in 2023 which remains the lowest among all fisheries considered.

In fact, the overall estimated trend in average weights (**Fig. 40 - 'All fisheries'**) shows a clear decreasing pattern, driven in recent years by the behaviour in average weights estimated for the FOB-associated component of the purse seine fisheries (**Fig. 40 - 'Purse seine | LS'**), which is the fishery accounting for the majority of catches for the species in the same period.

Trends in average weight for all other fisheries (baitboat, gillnet, and all other gears) are more difficult to assess due to the inherently artisanal nature of several of these, which in turn implies a lower number of available samples, often of lower quality compared to those provided by industrial fleets (recorded through logbooks or collected by scientific observers, in several cases).

The estimated average weight for all fisheries combined reaches a recent peak in 2022 at around kg, which might be explained (among other factors) by the high average weight estimated for 'other' fisheries in the same year, and which requires further investigation.

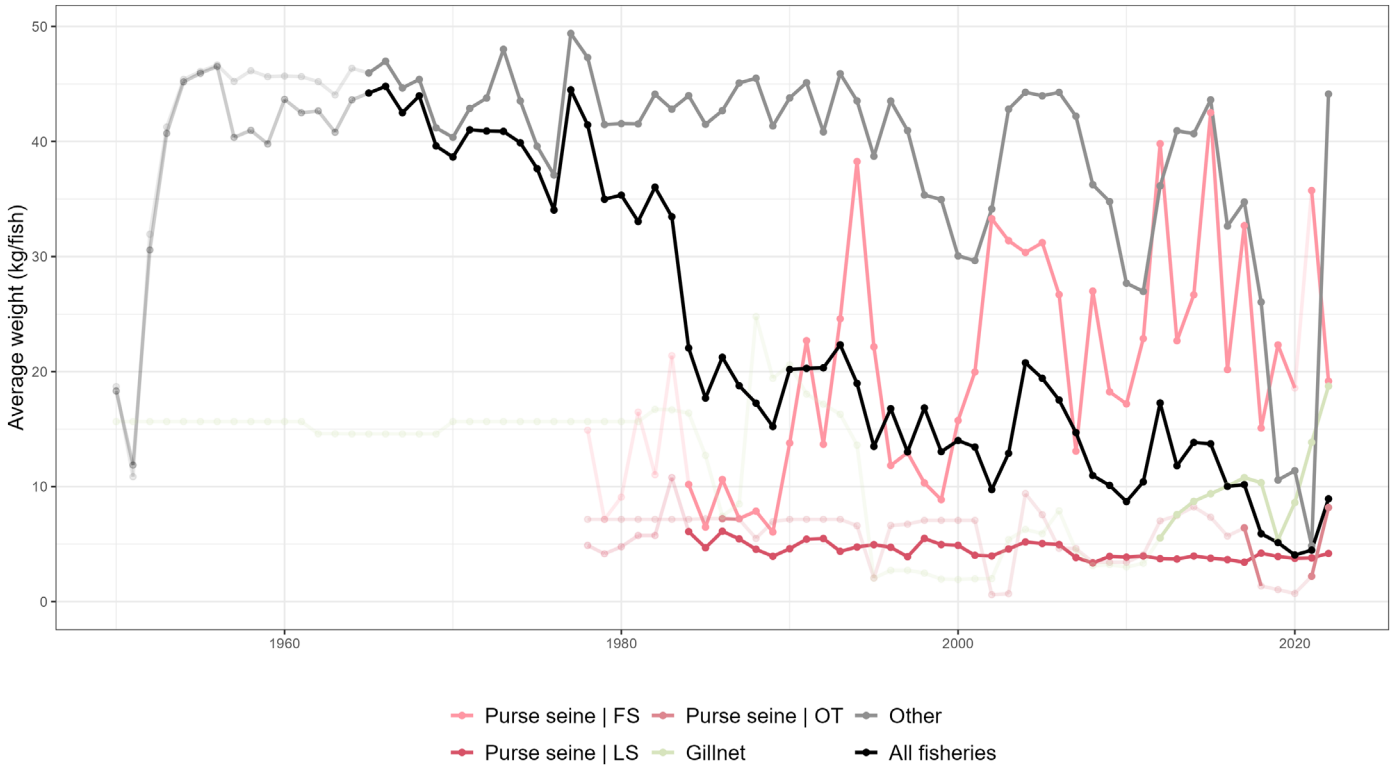

Figure 39: Combined estimated bigeye tuna average weight (kg/fish) in the catch by fishery and year. Semi-transparent points correspond to years for which the original size samples cover strata with reported catches (by year and fishery) **lower** than 50 t. LS = schools associated with floating objects; FS = free-swimming schools. Longline | Japan = includes data from longliners flagged by Japan, Rep. of Korea and Thailand; Longline | Taiwan = includes data from longliners flagged by Taiwan,China and all other flags not otherwise mentioned. Data source: raised time-area catches

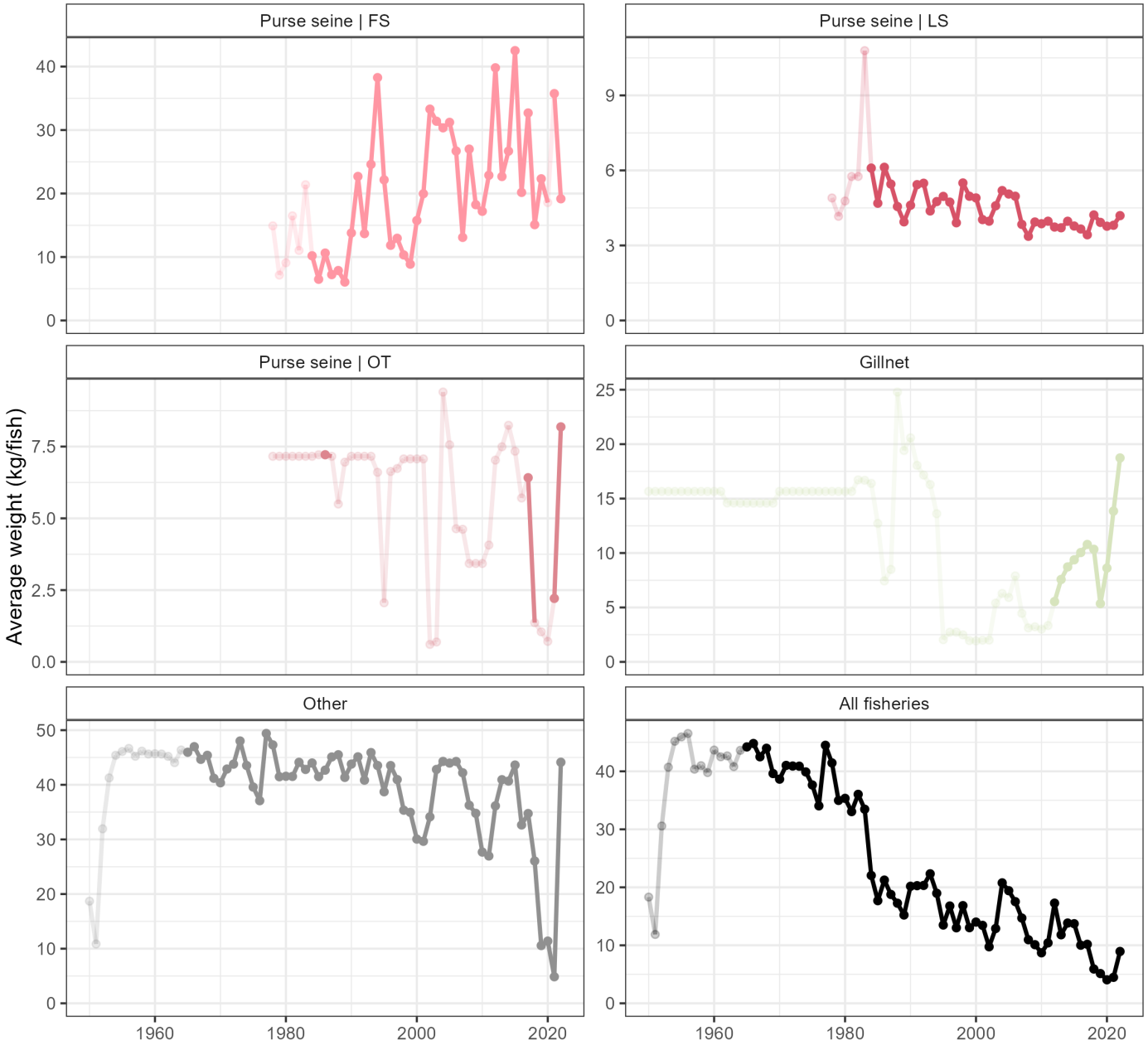

Figure 40: Estimated bigeye tuna average weight (kg/fish) in the catch by fishery and year. Semi-transparent points correspond to years for which the original size samples cover strata with reported catches (by year and fishery) **lower** than 50 t. LS = schools associated with floating objects; FS = free-swimming schools. Longline | Japan = includes data from longlines flagged by Japan, Rep. of Korea and Thailand; Longline | Taiwan = includes data from longlines flagged by Taiwan,China and all other flags not otherwise mentioned. Data source: raised time-area catches

Overall, the trend in average weights that results from combining data for all fisheries together shows a clear and steady decrease in the size of fish caught since the beginning of the 1990s. This overall trend can be explained by the generalized decline in deployed efforts by several industrial longline fleets combined with the rapid increase in catches from FOB-associated schools in the purse seine fishery (**Fig. 39**).

Spatial distribution of average weights

Estimated average weights by decade (1950-2019)

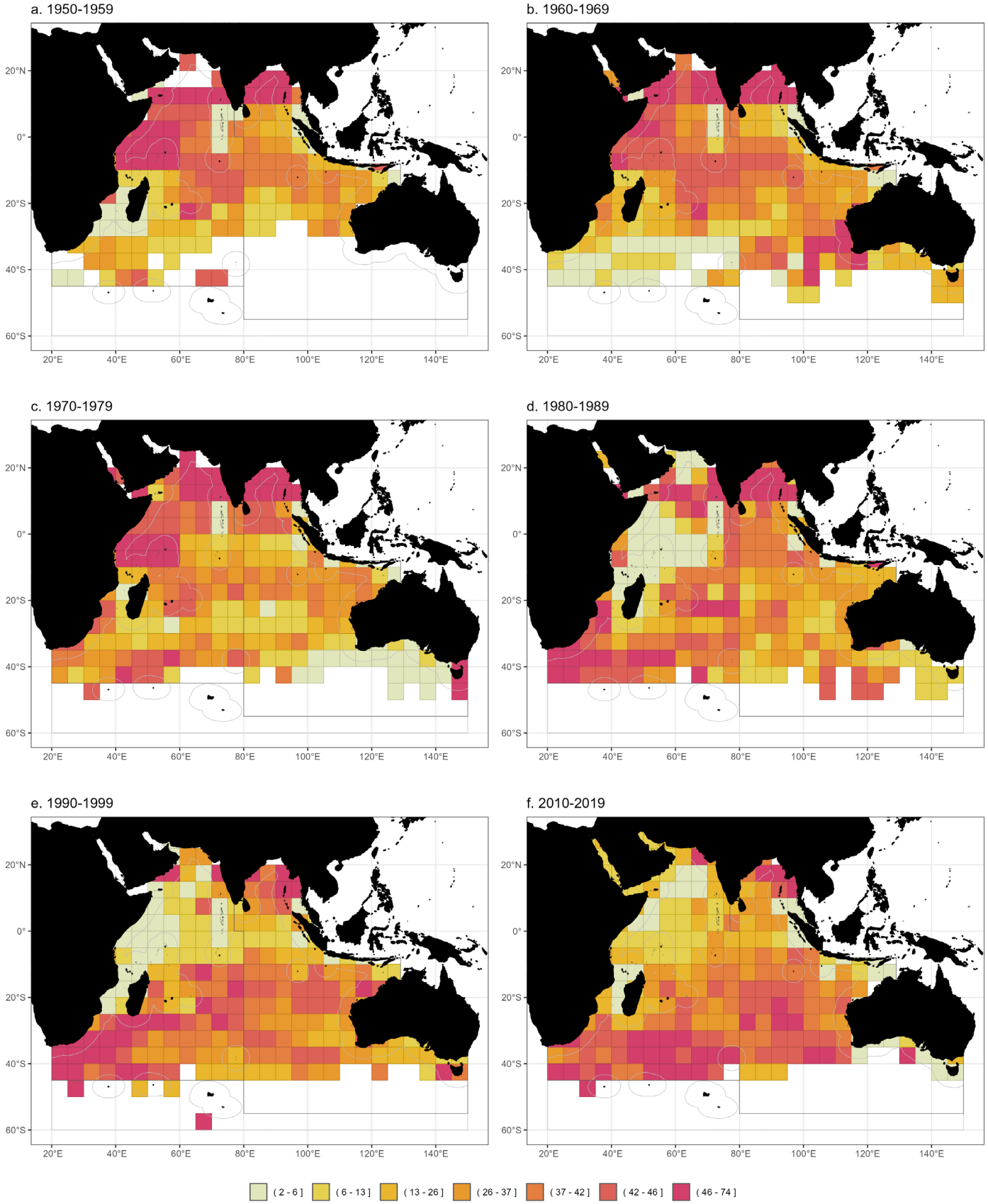

Figure 41: Estimated bigeye tuna average weight (kg/fish) in the catch by decade and 5x5 grid, for all fisheries combined for the period 1950-2019. Data source: raised time-area catches

Estimated average weights by year (2019-2023) and last decade (2010-2019)

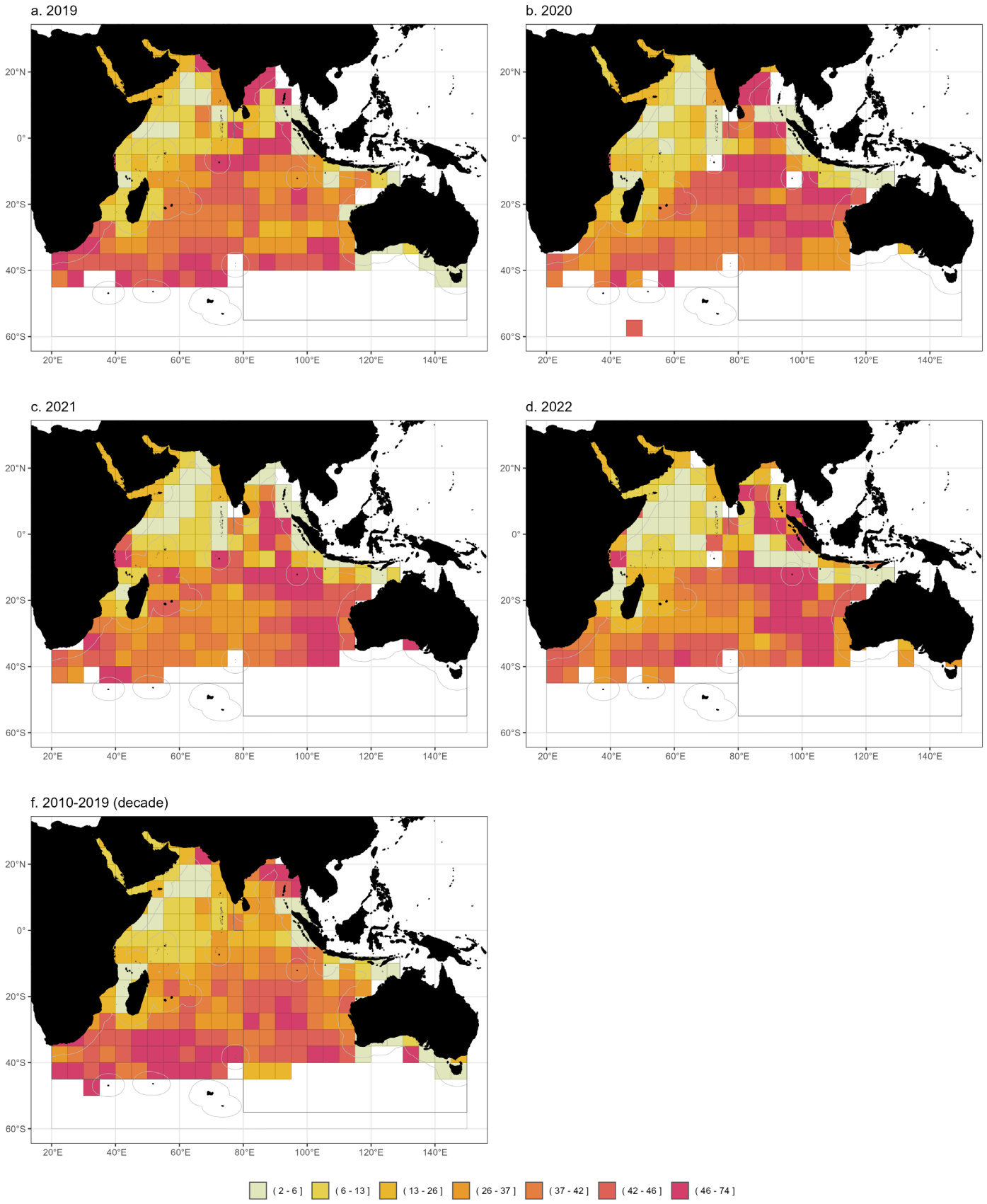

Figure 42: Estimated bigeye tuna average weight (kg/fish) in the catch by year and 5x5 grid, for all fisheries combined for the period 2019-2023 and for the decade 2010-2019. Data source: raised time-area catches

Estimated average weights by fishery group in recent years (2019-2023)

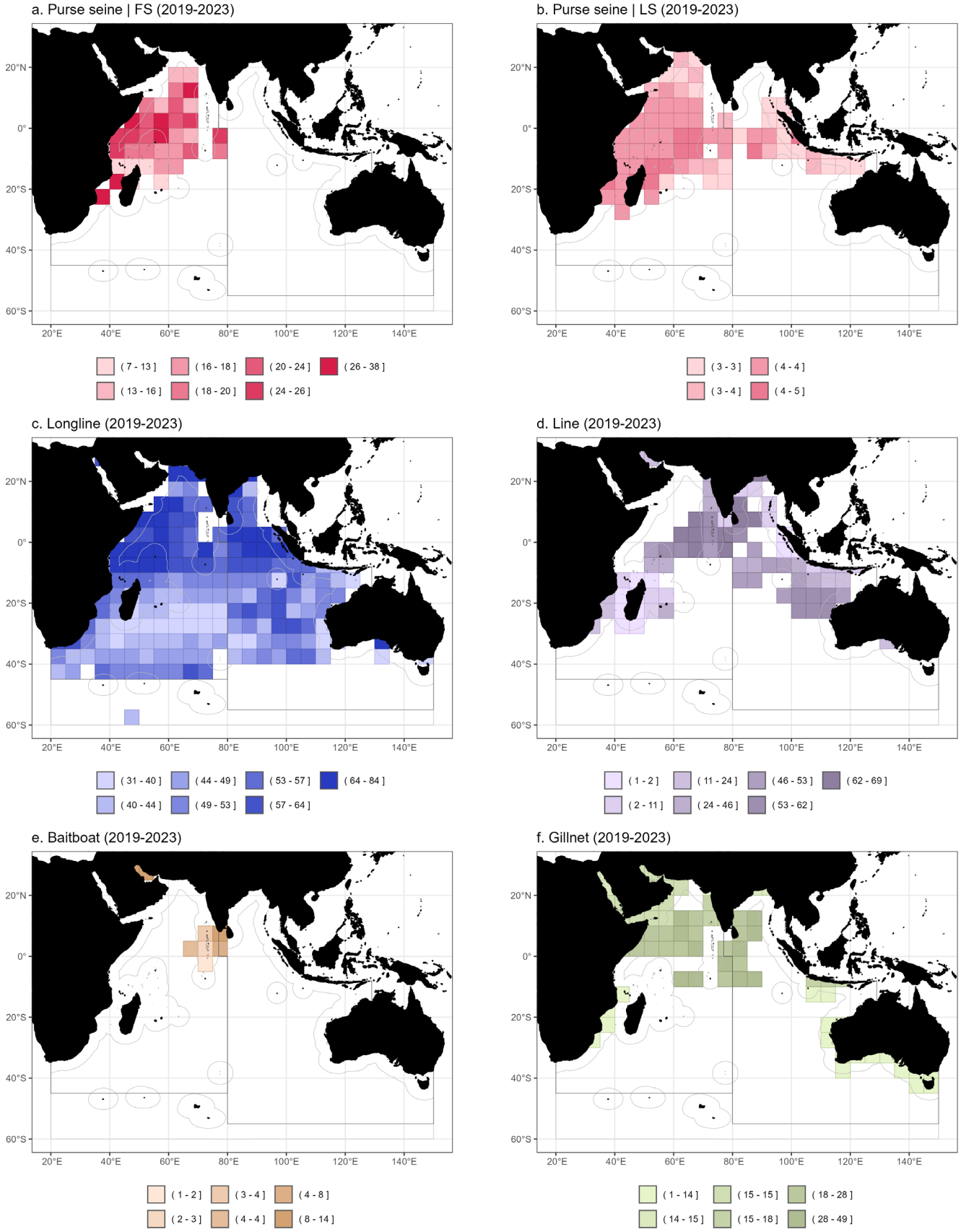

Figure 43: Estimated bigeye tuna average weight (kg/fish) in the catch by 5x5 grid and fishery group for the period 2019-2023. LS = schools associated with floating objects; FS = free-swimming schools. Data source: raised time-area catches

Uncertainties in size-frequency data

The overall quality – as measured by the percentage of retained catches with size data of quality scores between 0-2 – of size data available for bigeye tuna in IOTC databases is poor, particularly for artisanal fisheries. Almost no size data are available prior to the 1980s and the fraction of data of acceptable quality averages around 56% since 1984 (ranging between 35% and 86%) with a marked increase in quality from about 54% in 2023 to around 86% in 2019 (**Fig. 44**).

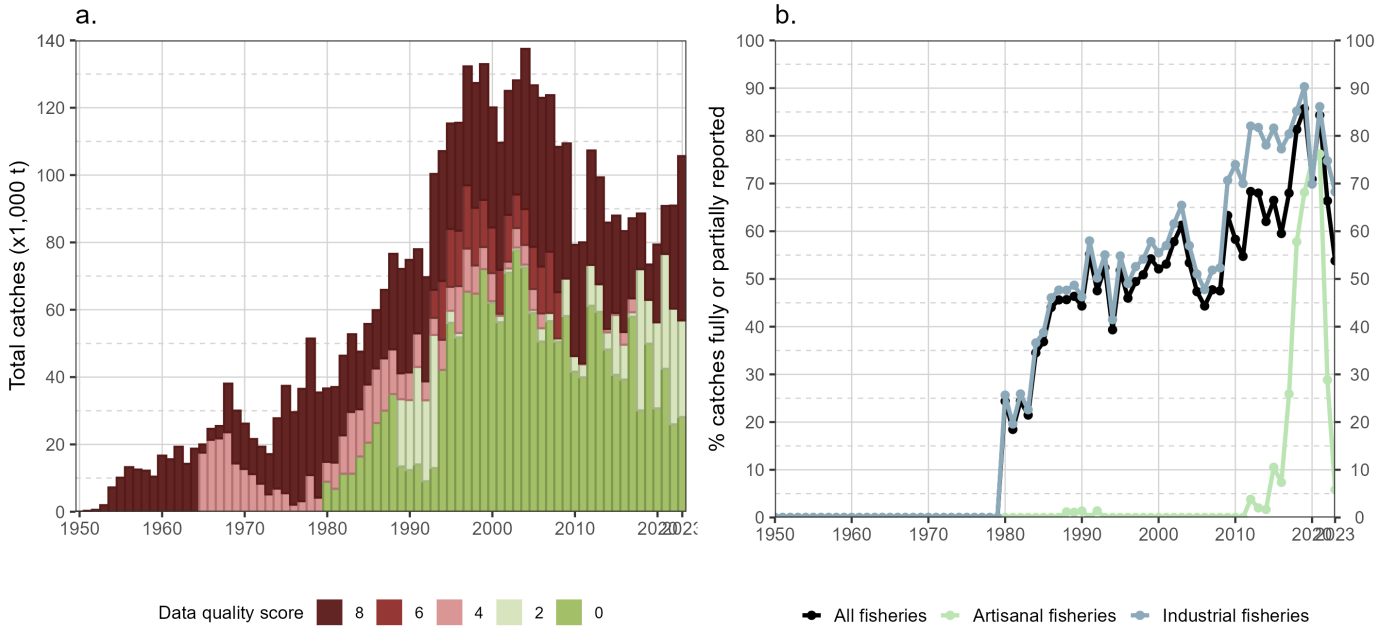

Figure 44: (a) Annual retained catches (metric tonnes; t) of bigeye tuna estimated by quality score and (b) percentage of geo-referenced size-frequency data reported to the IOTC Secretariat in agreement with the requirements of Res. 15/02 (lines with dots) for all fisheries and by type of fishery, in the period 1950–2023

Industrial purse seine fisheries

Size-frequency data for bigeye tuna are available for several years for the major industrial purse seine fleets. Depending on the fleet and year, though, the data can comprise a mix of *raw* (as recorded) and *raised* (to total catches) measurements, which in turn yield sensible differences in the magnitude of the fish sampled across fleets and years. Regarding the EU and comparable fleets (i.e., Seychelles and Mauritius in the last decade), it has been suggested by national scientists that raw and raised samples differ only in total numbers of fish measured, and that actual differences in the resulting size distribution between the two types of records can be treated as negligible.

Considering the main purse seine fleets, the difference in number of fish sampled between free-swimming schools (**Fig. 45**) and FOB-associated schools (**Fig. 47**) reflects the different percentages of sets taken on the two different fishing modes, with free-school sets being generally lower in numbers than FOB-associated ones.

Also, the length distributions for the two fishing modes tend to have very distinct characteristics, with fish measured from free-swimming schools showing two modes, of which the most marked is located at around 140 cm FL, while fish measured from FOB-associated schools tends to have one single mode at around 50 cm FL.

For free-swimming schools, though, data show some notable exceptions to this trend, specifically for EU,France (2016 and 2018), EU,Spain (2016 and 2019), Mauritius (2017), and Seychelles (2016, 2018 and 2019) (**Table 6**), which all show a much higher first mode in the lower part of the size distribution (at around 50 cm FL) (**Fig. 45**).

In the case of size-frequencies from FOB-associated schools, the main mode is defined around 50 cm FL. Altought some data showing values at around 100 and 130 cm FL for EU,Spain (2018) and EU,France (2019, 2020) not really represent a sub-mode as in free-swimming schools (**Table 7**). Data for these strata have been provided as raw measurements, while all others are reported as raised to total catches, i.e., they can be considered to represent catch-at-size (**Fig. 47**).

Considering the impracticalities of managing a mix of raw and raised size data, as it is currently the case, the IOTC Secretariat is liaising with concerned CPCs to ensure that either both data sets are provided at the same time, or preference is given to raw measurements for both historical and new data submissions.

It is also worth noting that data for the Italian-flagged component of the EU purse seine fleet are only available for the years 2015 and 2017. Also, data from Mauritian purse seiners with correct attribution of the fishing mode are only available for the year 2017, as data for 2018 and 2019 - collected by observers at sea - have been reported to the IOTC Secretariat without explicit information on the school type.

It has been challenging for several fleets to implement regular sampling programmes in 2020 due to the insurgence of the CoViD-19 pandemic, and therefore size data for 2020 are very limited in numbers, particularly when considering fish caught on free-swimming schools for which data are only available from EU,France albeit to levels corresponding to a negligible fraction of what usually provided in the past (**Fig. 45**).

Size-frequency data for 2020 are completely absent for EU,Spain and only available in limited numbers for EU,France, Mauritius, and Seychelles (**Fig. 47**), with EU,Spain confirming their ongoing effort to recover the missing size data and share it as soon as possible (IOTC, pers. comm.).

Size-frequency data for all other industrial purse seine fleets include information from Indonesia, I.R. Iran, Japan, and Republic of Korea (**Fig. 49**). Unfortunately, except for I.R. Iran in 2015, the size data submitted to the IOTC Secretariat by these fleets are not categorized by fishing mode and therefore cannot be directly compared with the corresponding information from all other fleets. At the same time, the characteristics of the size distributions available for each of these fleets are such to suggest that Indonesian purse seiners as well as Japanese and Korean ones (to a lesser extent) are mostly fishing on FOB-associated schools, whereas Iranian purse seiners appear to have been fishing predominantly on free-swimming schools in recent years (**Fig. 49**).

Size data reported by non-EU fleets do not always comply with the requirement of sampling at least one fish per metric tonne of retained catches by species. In particular, data from Indonesia and the Republic of Korea (collected by observers at sea) are consistently below the threshold set by Res. 15/02 for all years concerned, and this further questions the representativeness of the length samples reported by the two fleets.

Finally, these fleets seem to have been less affected by the CoViD-19 pandemic, as data were regularly provided by all of them (albeit in lower numbers for Indonesia and I.R. Iran).

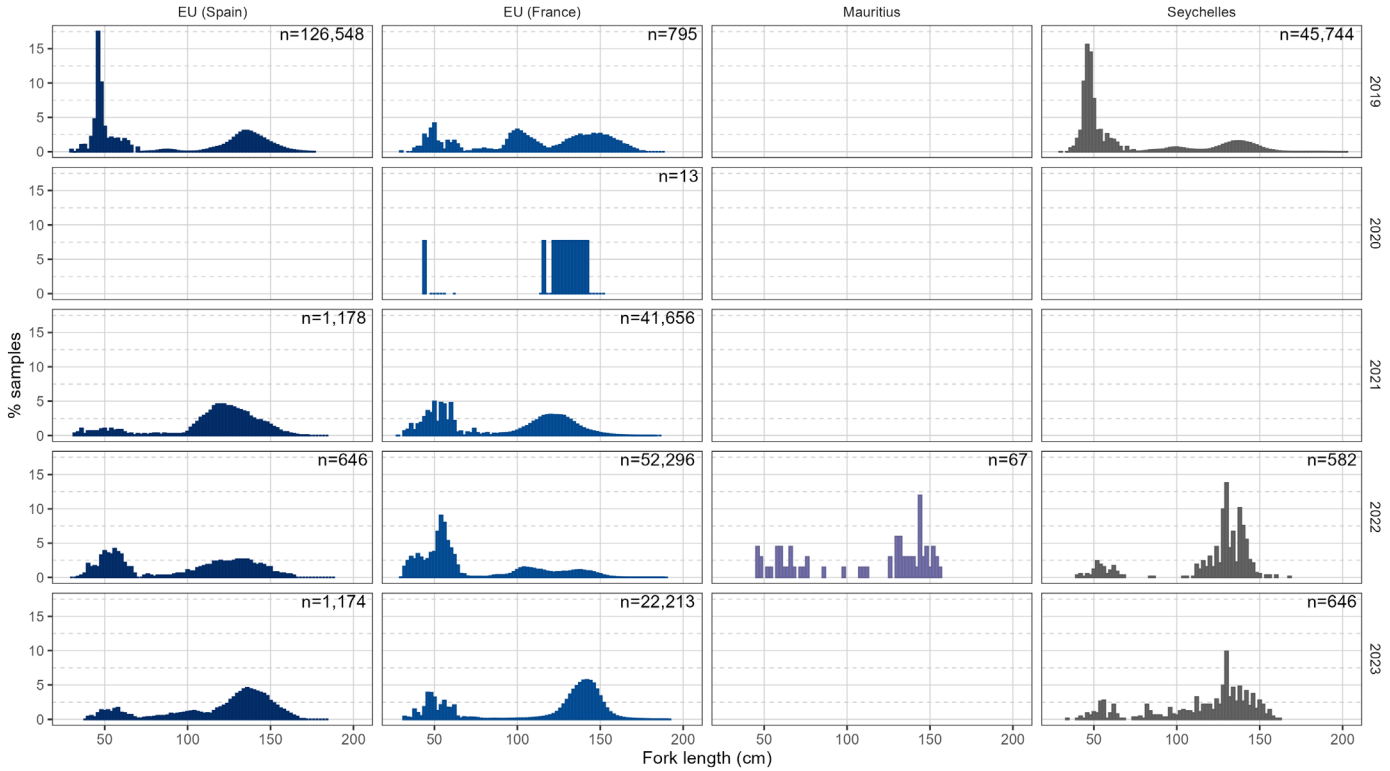

Figure 45: Relative size distribution of bigeye tuna (fork length; cm) recorded for free-swimming schools, by year (2019–2023) and main purse seine fleet. Data source: standardized size-frequency dataset (Res. 15/02)

Table 6: Percentage of sampled bigeye tuna with fork length below 50 cm recorded by the major purse seine fleets fishing on free-swimming schools, as reported for the period 2019-2023. Data source: [standardized size-frequency dataset](https://www.iotc.org/WPTT/26/data/11-SFYFT) (Res. 15/02)

Fleet	2019	2020	2021	2022	2023
EU (Spain)	38		6	11	4
EU (France)	10	8	17	25	14
Mauritius				7	
Seychelles	47			2	2

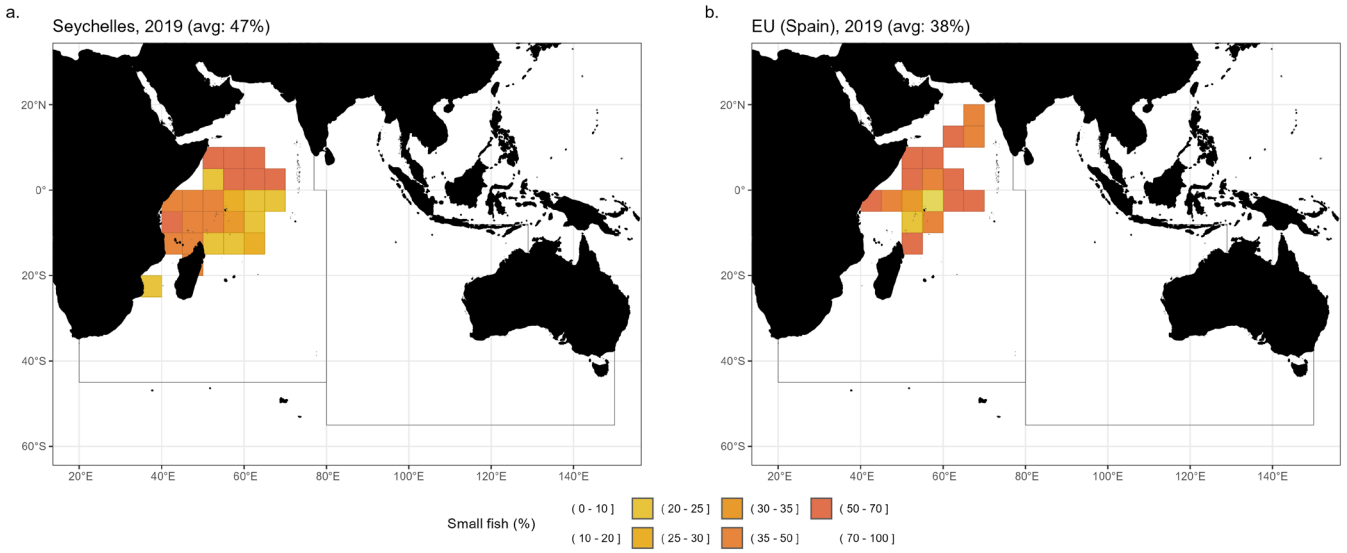

Figure 46: Spatial distribution of sampled bigeye tuna with fork length below 50 cm recorded by the major purse seine fleets fishing on free-swimming schools, as reported for the period 2019-2023. Data source: standardized size-frequency dataset (Res. 15/02)

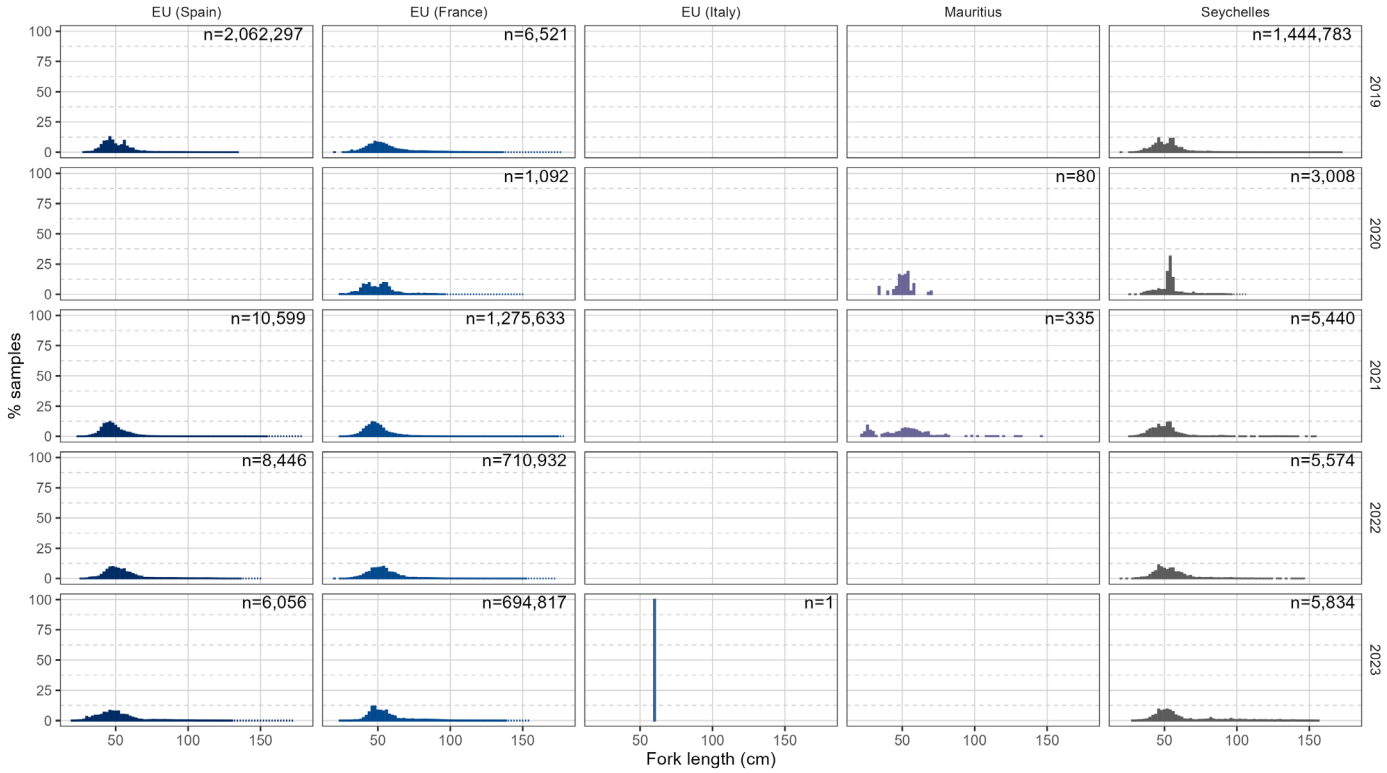

Figure 47: Relative size distribution of bigeye tuna (fork length in cm) recorded for FOB-associated schools, by year (2019–2023) and major purse seine fleet. Data source: standardized size-frequency dataset (Res. 15/02)

Table 7: Percentage of sampled bigeye tuna with fork length above 50 cm recorded by the major purse seine fleets fishing on FOB-associated schools, as reported for the period 2019-2023. Data source: [standardized size-frequency dataset](https://www.iotc.org/WPTT/26/data/11-SFYFT) (Res. 15/02)

Fleet	2019	2020	2021	2022	2023
EU (Spain)	46		40	61	47
EU (France)	64	51	45	64	62
Mauritius		65	59		
Seychelles	57	79	54	62	69

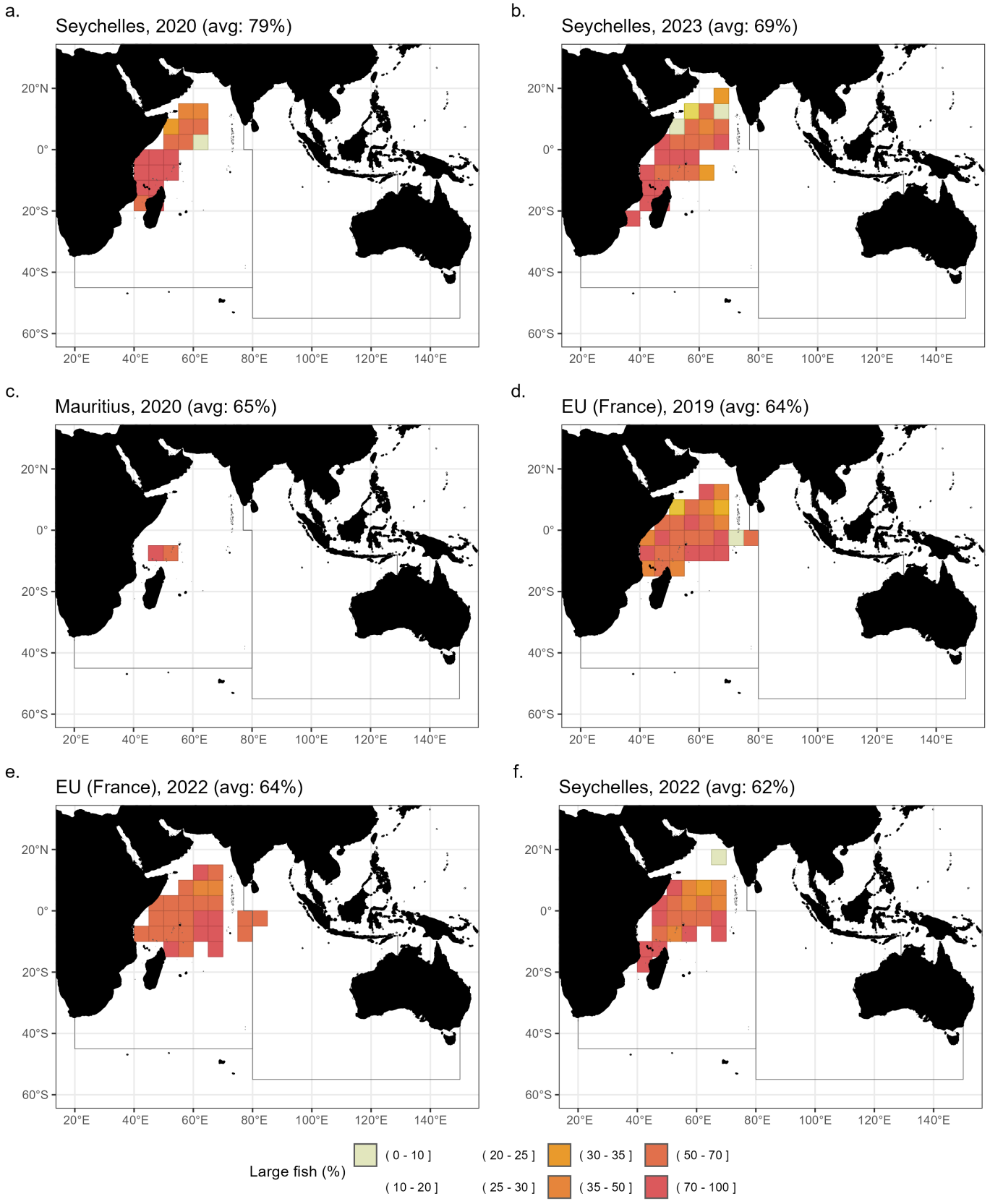

Figure 48: Spatial distribution of sampled bigeye tuna with fork length above 50 cm recorded by the major purse seine fleets fishing on FOB-associated schools, as reported for the period 2019-2023. Data source: standardized size-frequency dataset (Res. 15/02)

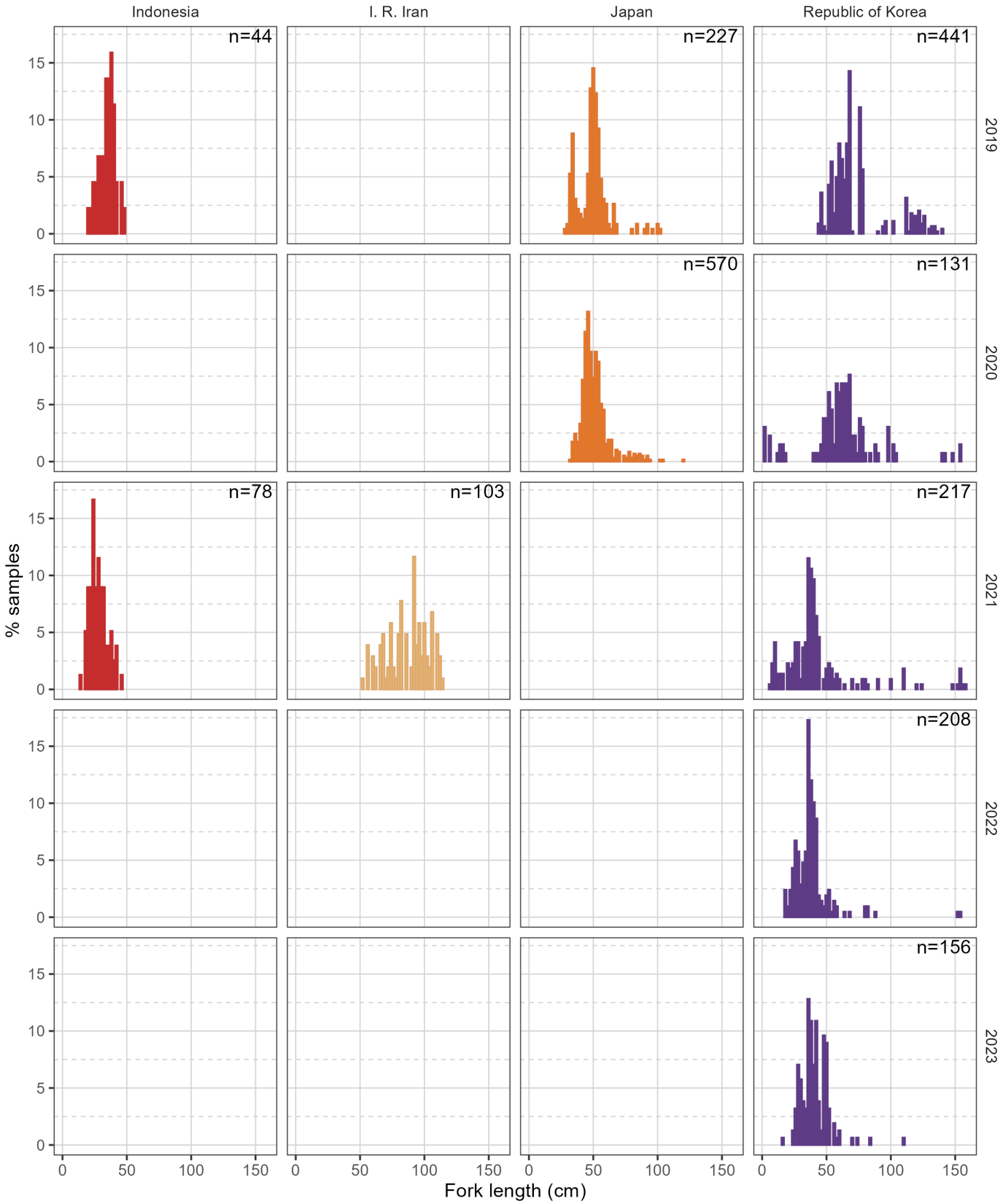

Figure 49: Relative size distribution of bigeye tuna (fork length; cm) recorded for unclassified schools, by year (2019–2023) and other purse seine fleet. Data source: standardized size-frequency dataset (Res. 15/02)

Industrial longline fisheries

The major industrial longline fisheries appear to be well-sampled for several years and fleets, with some of them (Japan, Rep. of Korea, China, Taiwan,China and EU,Portugal) having consistently reported data from observers at sea in recent periods. Nevertheless, ongoing discussions on potential bias in sampling involving the longline fleets of Japan and Taiwan,China (mostly) have not yet been resolved (Geehan & Hoyle 2013, Hoyle et al. 2021).

In the case of the deep-freezing longline fleet of Taiwan,China, the availability of well-sampled size-frequency data and of geo-referenced catches (both in numbers and weights) enables the comparison of the average weights calculated from the two data sets. Average weights from the size-frequency data set are calculated by applying the length-weight conversion equation to the number of samples reported for each size bin (IOTC-2022-WPTT24-DATA13), while average weights from the catch and effort data set are calculated by dividing the catch in weight by the catch in numbers available for the same strata. Furthermore, size-frequency data for the longline fishery of Taiwan,China are sampled well-above the minimum level of 1 fish per tonne of retained catches (as required by Res. 15/02), if not for the years between 1989 and 1993.

The average weights calculated from the two data sets are in (variable) agreement only until 2002: from this point in time onward, the average weight calculated from the size-frequency data set is consistently higher than the average weight calculated from the catch and effort data set up to a maximum difference of around 10 kg / fish in favour of the former, as detected in 2023 (when the coverage level of the size-frequency data was of around NA samples per metric tonne) (**Fig. 50**).

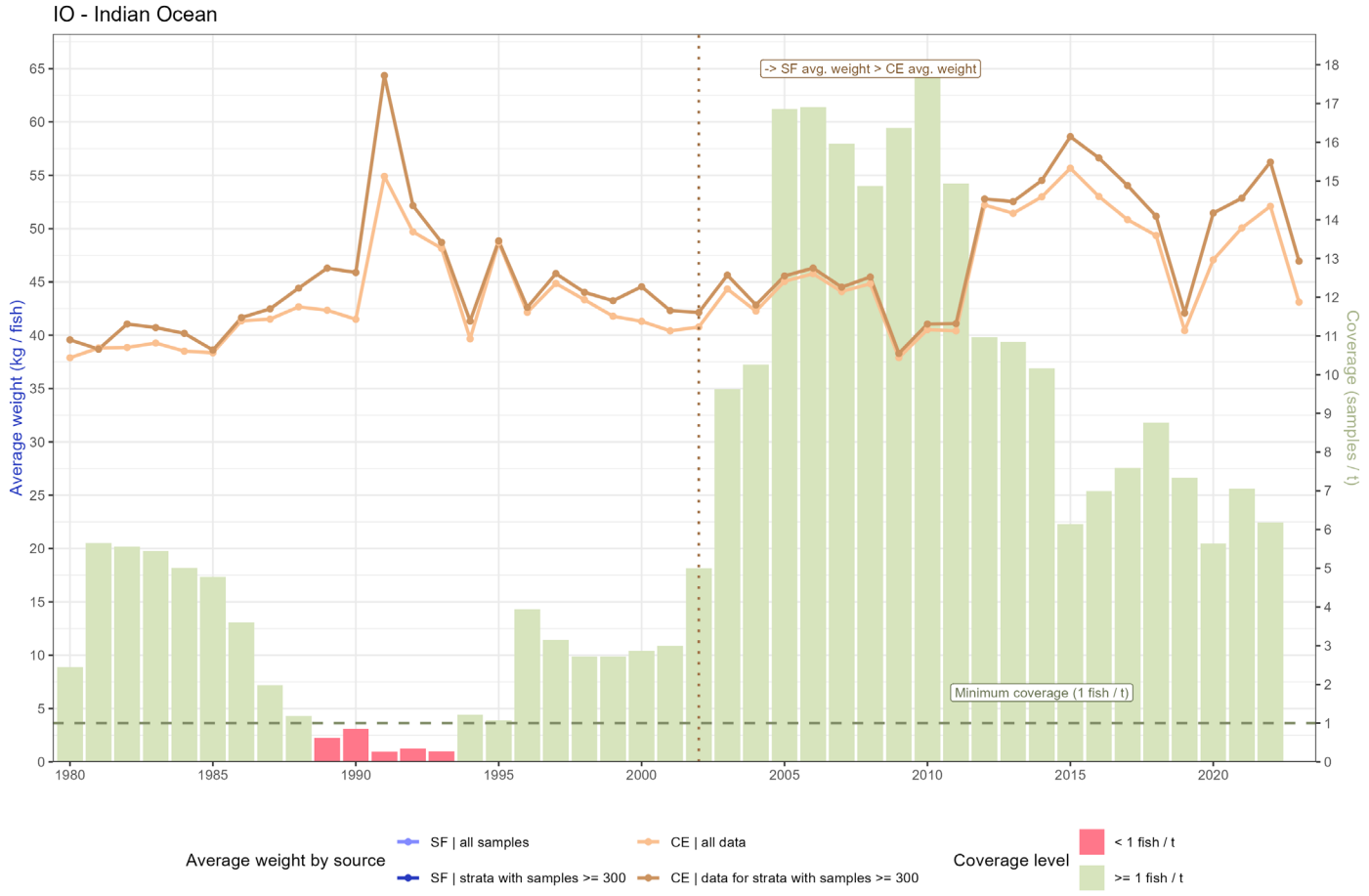

Figure 50: Difference in average weights (all Indian Ocean areas) of bigeye tuna caught by the deep-freezing fleet of Taiwan,China as calculated from the available size-frequency and catch and effort data (1980-2023). Data source: standardized size-frequency dataset and time-area catch dataset for longline fisheries (Res. 15/02)

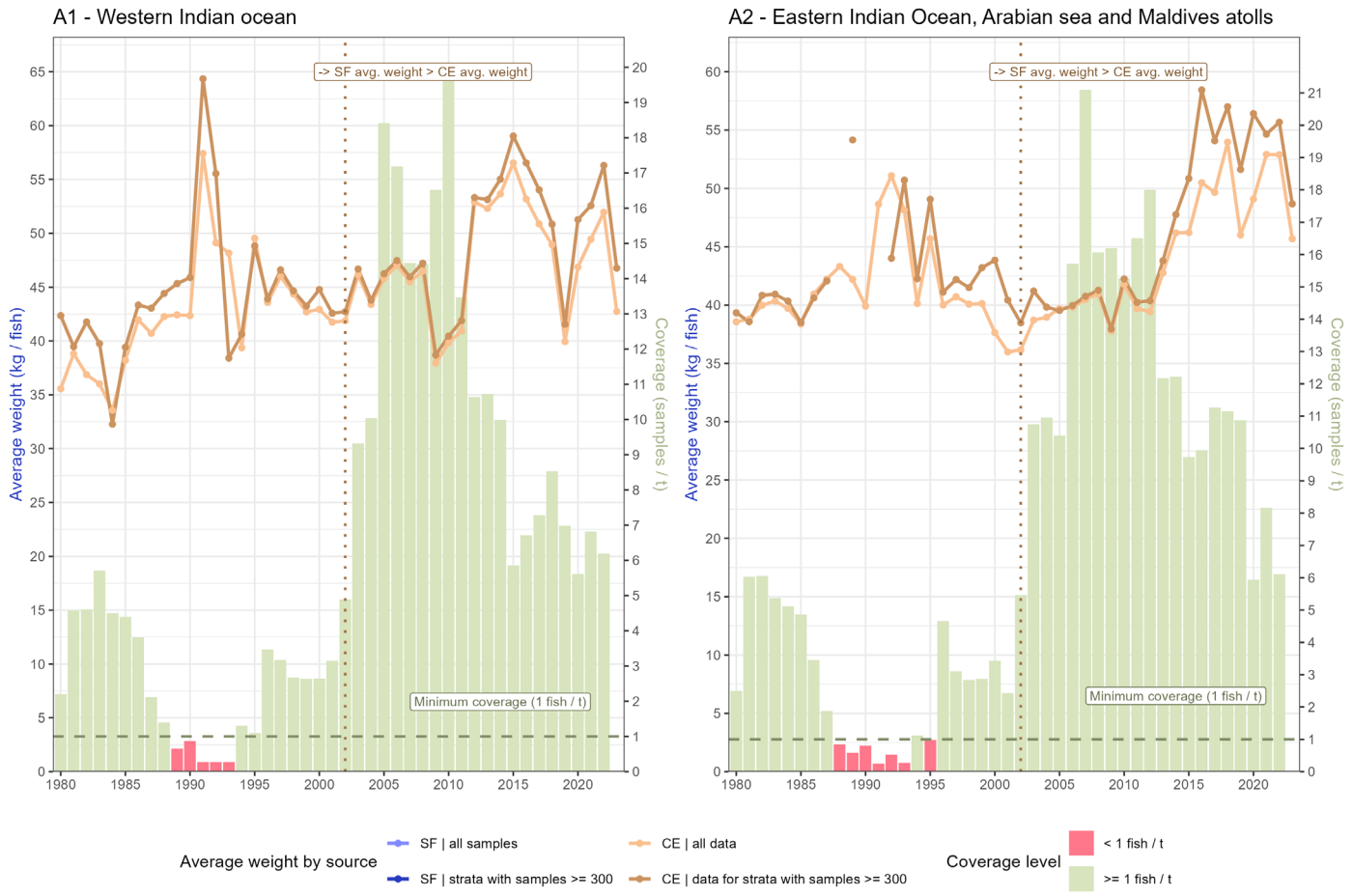

Figure 51: Difference in average weights by stock-assessment areas of bigeye tuna caught by the deep-freezing fleet of Taiwan,China as calculated from the available size-frequency and catch and effort data (1980-2023). Data source: standardized size-frequency dataset and time-area catch dataset for longline fisheries (Res. 15/02)

These results suggest that, from 2002 onward, either the size sampling was biased towards larger fish (blue lines), or that the logbook data used to produce the catch and effort records submitted to the IOTC Secretariat are inaccurate (orange lines). This, notwithstanding the fact that length measurements for the Taiwan,China longline fleet include samples taken by scientific observers at sea (generally less than 5-10% of total annual samples since 2002).

In the period considered (2000-2023), bigeye tuna size-frequency records submitted by the Japanese fleet were comprised of 20,643.64 individuals recorded in logbooks and 66,901 individuals measured by onboard observers. In this case, the number of individuals measured by observers amounted to ~320% of those recorded in logbooks, also because starting from 2012 Japan has been providing - in agreement with the requirements of Res. 15/02 - size-frequency data exclusively sourced through their national observer programme.

On the contrary, and in the same period considered, bigeye tuna size-frequency records submitted by the Taiwan,China fleet were comprised of 5,567,333 individuals recorded in logbooks, and 138,149 individuals measured by onboard observers. In this case, the magnitude of the size data collected by observers corresponds to ~2.5% of that reported in logbooks, even though Taiwan,China has been consistently providing both sources of information since 2002.

Further analysis based on the comparison of size-frequency distributions of yellowfin tuna caught by longliners from Japan and Taiwan,China during 2000-2023 in common strata (defined as the combination of assessment areas and 5-year intervals) shows that:

- logbook size data for Japan and Taiwan,China can only be compared during the 2000s, as the former was completely replaced by scientific observer data from 2010 onwards. Nevertheless, when data are available for both fleets, these appear to be in relatively good agreement only in the early 2000s, and specifically in the southern (A3) and northernmost / southernmost areas of the Indian Ocean (A0) (**Fig. 52**)

- size data from scientific observers are available from both fleets for a longer period of time (from 2010 onwards) and in relatively good agreement during the 2010s, and more specifically in the eastern (A2) and southern (A3) areas of the Indian Ocean during the early 2010s, and in the western (A1) and southern (A3) areas of the Indian Ocean during the late 2010s (**Fig. 53**);
- size data for Taiwan,China deep-freezing longliners are generally available to the IOTC Secretariat as data recorded both by scientific observers and through logbooks, except for some strata in the 2000s when observers were only deployed in the eastern (A2) and southern (A3) areas of the Indian Ocean (**Fig. 54**);
- when size data for Taiwan,China deep-freezing longliners are available in good numbers through both scientific observers and logbook data, the two sources are generally in agreement, particularly from 2010 onwards and more specifically in the eastern (A2) and southern (A3) areas of the Indian Ocean (**Fig. 54**);
- for previous years, and in particular in the western (A1) and northernmost / southernmost (A0) areas of the Indian Ocean, data from logbooks seems to be biased towards larger fish, with a mode set approximately at around 140-150 cm in fork length, while data from logbook shows a second mode at around 100 cm in fork length (**Fig. 54**);
- size data for Japanese deep-freezing longliners from the 2010s onwards is available to the IOTC Secretariat almost exclusively as data collected by scientific observers (**Fig. 55**);
- very few samples have been recorded by Japanese deep-freezing longliners in the last two years (2020-2021) and these originate exclusively from the southern (A3) areas of the Indian Ocean (**Fig. 55**);
- as in the case of Taiwan,China, size data from Japanese observers also confirm a tendency in measuring smaller fish compared to the information recorded on logbooks during the late 2000s, when the latter were still available (**Fig. 55**).

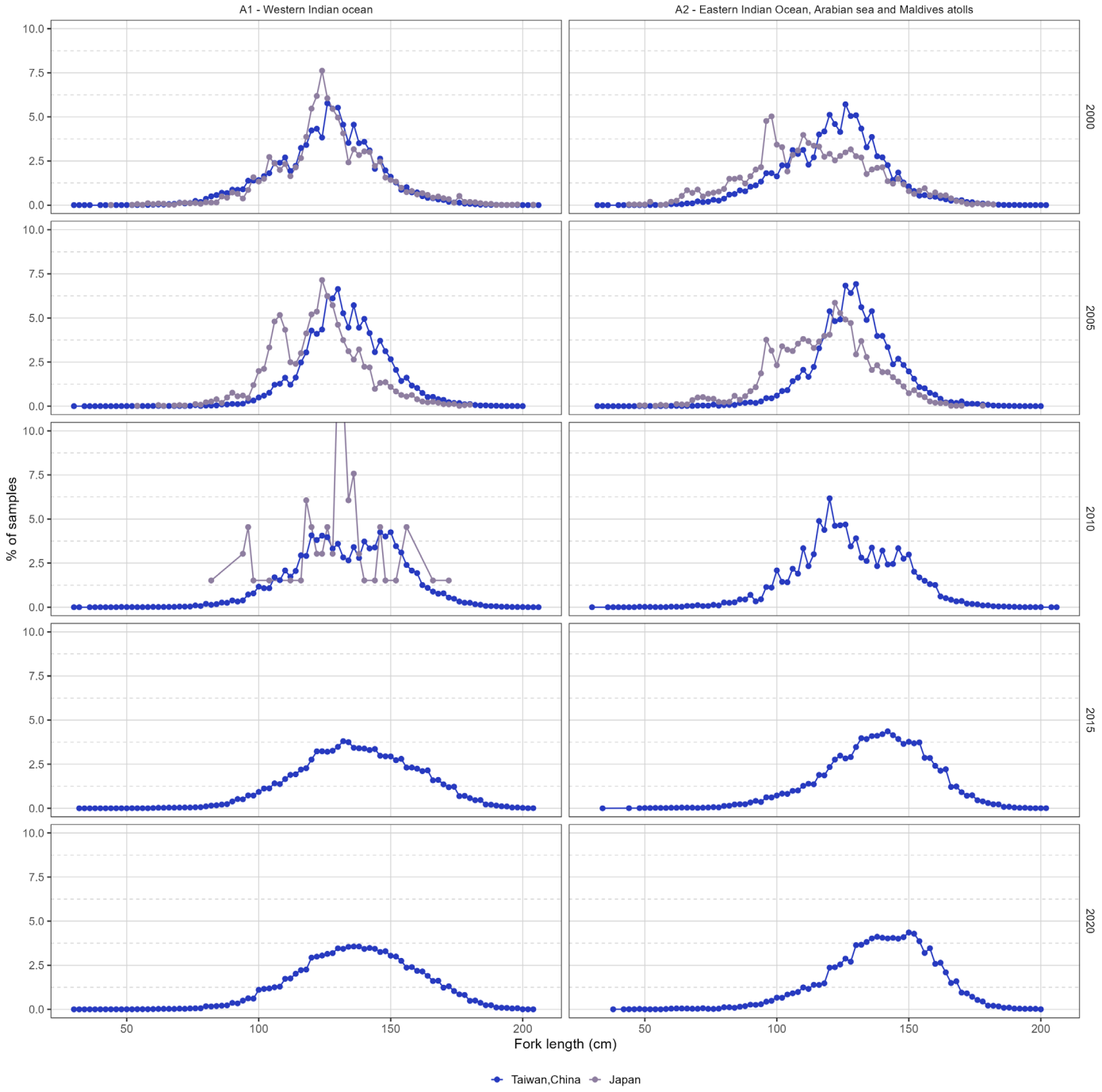

Figure 52: Relative size distribution (fork length; 2-cm size bins) of bigeye tuna reported through logbooks by the deep-freezing longline fleets of Japan and Taiwan,China, by stock assessment area and five-year periods. Data source: standardized size-frequency dataset (Res. 15/02)

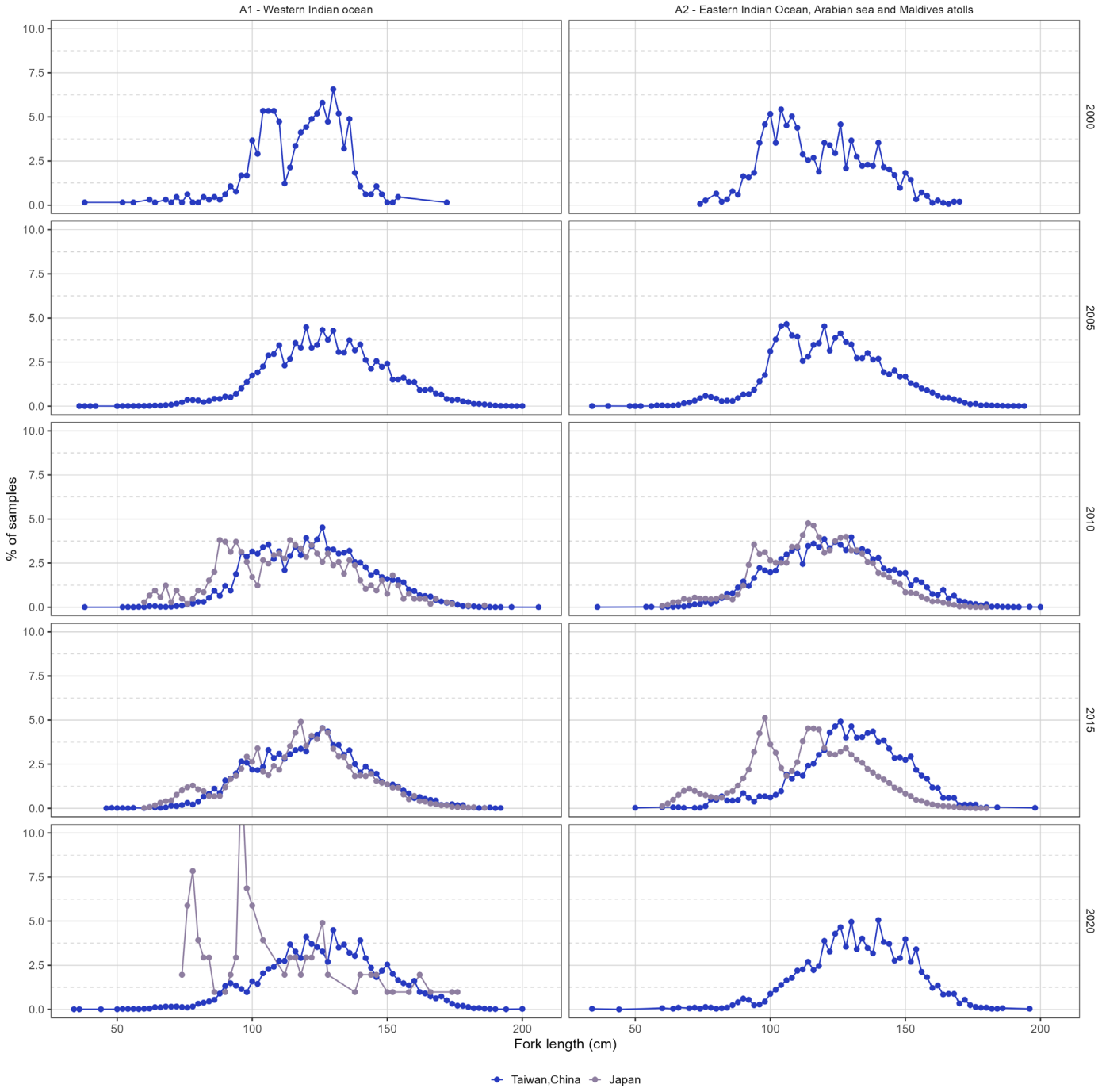

Figure 53: Relative size distribution (fork length; 2-cm size bins) of bigeye tuna reported through scientific observers by the deep-freezing longline fleets of Japan and Taiwan,China, by stock assessment area and five-year periods. Data source: standardized size-frequency dataset (Res. 15/02)

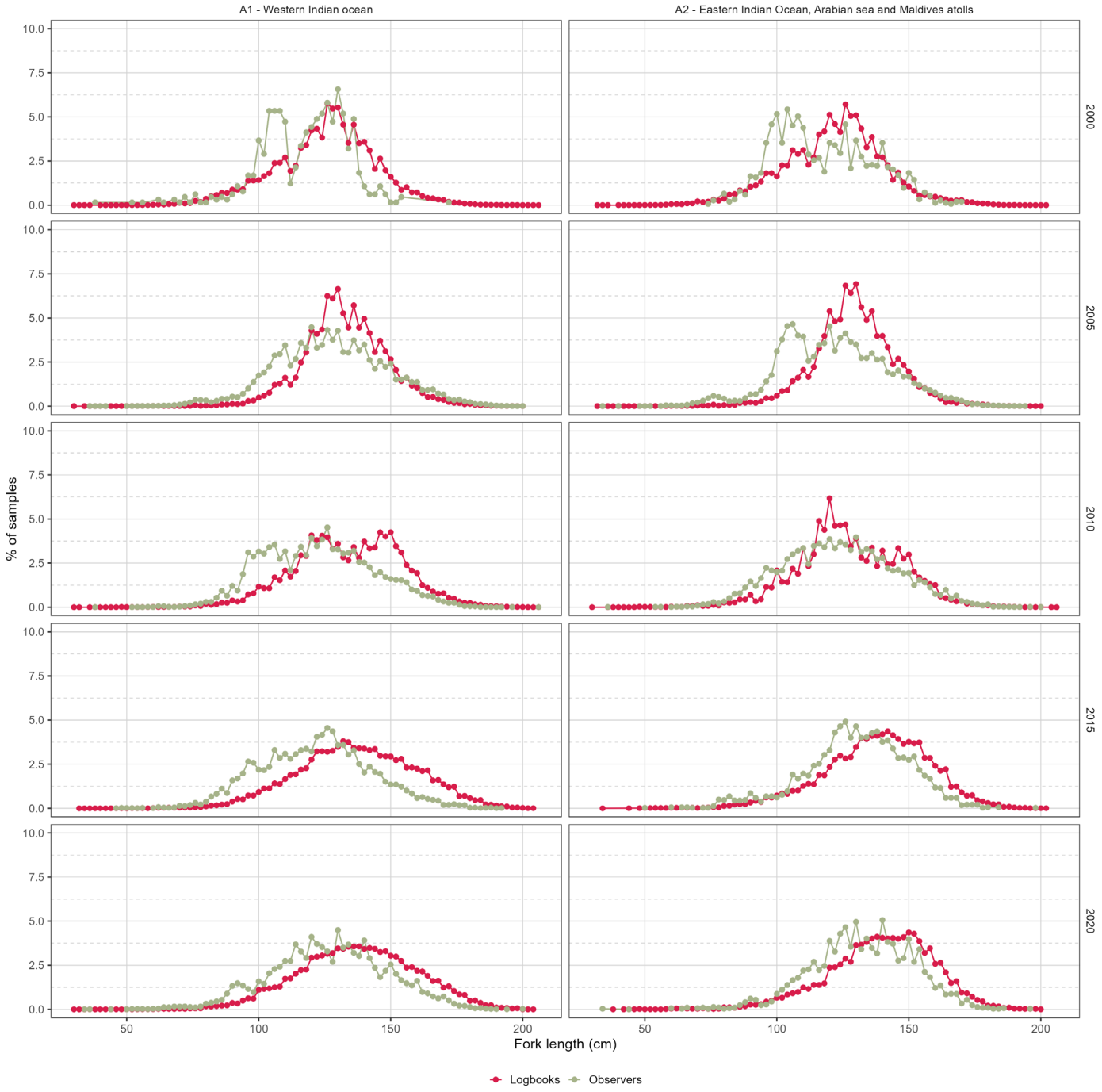

Figure 54: Relative size distribution (fork length; 2-cm size bins) of bigeye tuna reported by the deep-freezing longline fleets of Taiwan,China, by source (scientific observers vs. logbooks), stock assessment area and five-year periods. Data source: standardized size-frequency dataset (Res. 15/02)

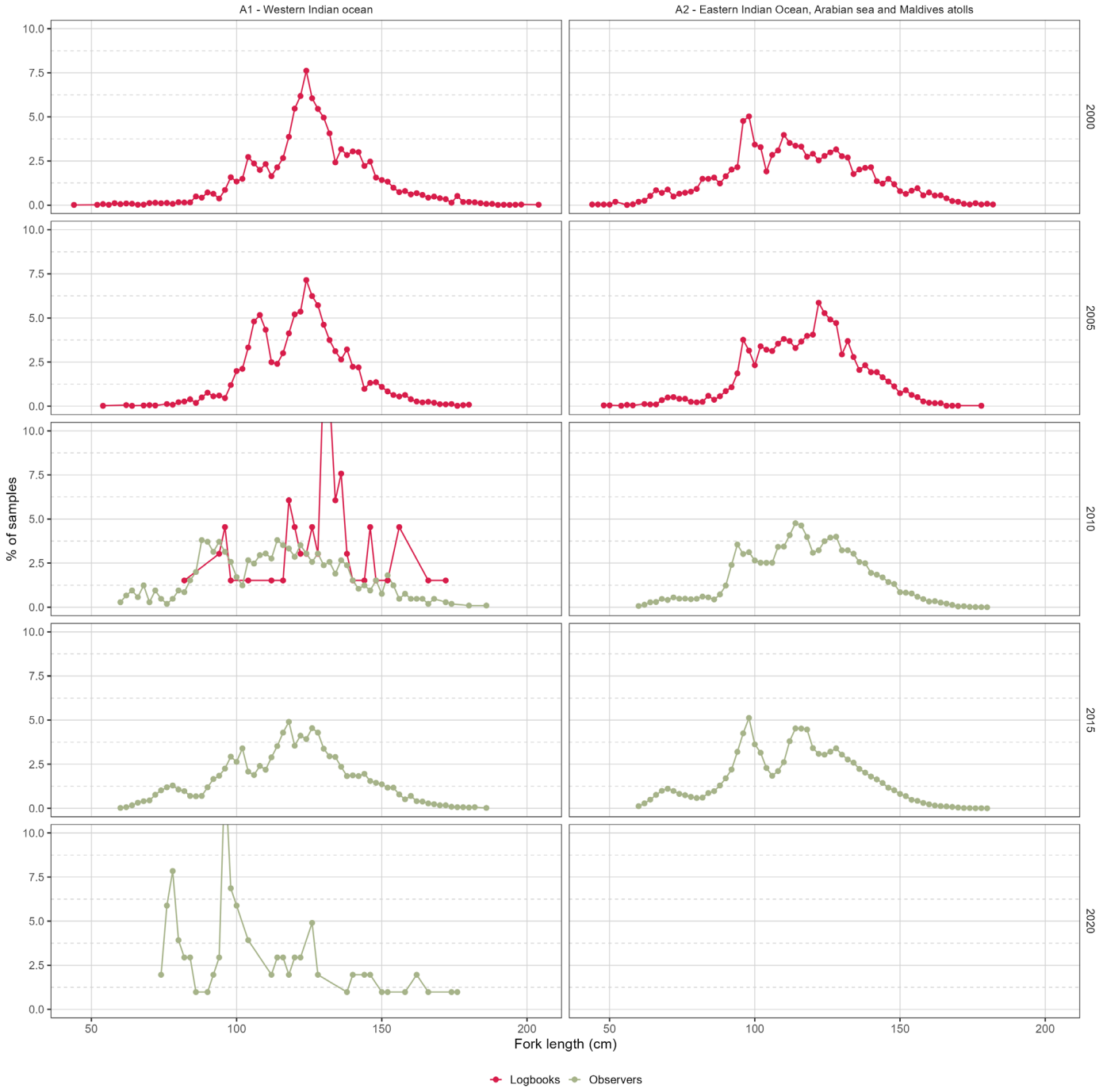

Figure 55: Relative size distribution (fork length; 2-cm size bins) of bigeye tuna reported by the deep-freezing longline fleets of Japan, by source (scientific observers vs. logbooks), stock assessment area and five-year periods. Data source: standardized size-frequency dataset (Res. 15/02)

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