REVIEW OF THE STATISTICAL DATA AVAILABLE FOR BYCATCH SPECIES

Prepared by IOTC Secretariat[1]

Purpose

To provide participants to the 21^st^ Session of the IOTC Working Party on Ecosystems and Bycatch (WPEB21) with a review of the status of the information available on non-targeted, associated, and dependent species of IOTC fisheries ("bycatch") defined by the IOTC Scientific Committee as:

"All species, other than the 16 species listed in Annex B of the IOTC Agreement, caught or interacted with by fisheries for tuna and tuna-like species in the IOTC area of competence. A bycatch species includes those non-IOTC species which are (a) retained (byproduct), (b) incidentally taken in a fishery and returned to the sea (discarded); or (c) incidentally affected by interacting with fishing equipment in the fishery but not taken."

The document summarises the current information received for species or species groups other than the 16 IOTC species listed in the IOTC Agreement, in accordance with relevant Resolutions adopted by the Commission. It provides an overview of the data available in the IOTC Secretariat databases as of August 2025 for sharks, rays, seabirds, marine turtles, cetaceans, and other bycatch species with special focus on blue shark (*Prionace glauca*), under assessment this year.

The document also describes the progress achieved in relation to the collection and verification of data, identifies problem areas and proposes actions that could be undertaken to improve them.

Materials

Several fisheries data sets shall be reported to the IOTC Secretariat by the Contracting Parties and Cooperating Non-Contracting Parties (CPCs) as per the IOTC Conservation and Management Measures (CMMs) and following the standards and formats defined in the IOTC Reporting guidelines. The IOTC forms becomes the mandatory format to report the data to the Secretariat as they facilitate data curation and management.

Retained catch data

Correspond to the total retained catches (in live weight) per year, Indian Ocean major area, fleet, fishing gear, and species (IOTC Res. 15/02) and shall be reported through IOTC form 1RC. For other species than the 16 IOTC species the raw estimates is the main consolidated data set, while the best scientific estimates are only available for the 16 IOTC species.

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

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

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

[1] IOTC-Statistics@fao.org

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

Geo-referenced catch and effort data

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

Discard data

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

Nevertheless, discard data reported to the Secretariat with IOTC Form 1DI are generally scarce, not raised, and not complying with all IOTC reporting standards. Therefore, the most accurate information available on discards comes from the IOTC Regional Observer Scheme (IOTC Res. 25/06) that aims to collects detailed information (e.g., exact location in space and time of the sets and interactions, including the fate of observed individuals) on discards of IOTC and bycatch species for industrial fisheries.

Size-frequency data

The size composition of catches may be derived from the data set of individual body lengths or weights collected at sea and during the unloading of fishing vessels. For longline fisheries, size-frequency data may be collected as part of the Regional Observer Scheme, where such fleets have at least 5% observer coverage of all fishing operations. The IOTC Form 4SF provides all fields requested for a complete reporting of size-frequency data to the stratification by fleet, year, gear, type of school, month, grid and species as required by IOTC Res. 15/02. While the great majority of size data reported through IOTC Form 4SF are for retained catches, CPCs can also use the same form to report size data of discarded individuals.

Regional Observer Scheme

Resolution 25/06 on a *Regional Observer Scheme* (ROS) makes provision for the development and implementation of national observer schemes among the IOTC CPCs starting from July 2010 with the overarching objective of collecting *"verified catch data and other scientific data related to the fisheries for tuna and tuna-like species in the IOTC area of competence"*. The ROS aims to cover *"at least 5% of the number of operations/sets for each gear type by the fleet of each CPC while fishing in the IOTC Area of competence of 24 meters overall length and over, and under 24 meters if they fish outside their EEZs shall be covered by this observer scheme"*. Observer data collected as part of the ROS include: (i) fishing activities and vessel positions, (ii) catch estimates with a view to identifying catch composition and monitoring discards, bycatch and size frequency, (iii) gear type, mesh size and attachments employed by the master, and (iv) information to enable the cross-checking of entries made to the logbooks (i.e., species composition and quantities, live and processed weight and location).

The ROS data fields were revised and agreed by the SC27, then the Secretariat provided an updated version of the ROS forms at the WGEMS05. Although some modifications are still underway, the specific gillnet fields still need to be reviewed, as no gillnet fishing experts were involved to provide input to the review process.

Morphometric data

The current length-length and length-weight IOTC reference relationships for pelagic sharks mostly come from historical data collected in the Atlantic Ocean or Western-Central Pacific Ocean (Skomal and Natanson 2003; Francis and Duffy 2005). However, several morphometric data sets have been collected for sharks through different research and monitoring programs conducted in the Indian Ocean over the last decades, including measurements taken at sea and on land (Garcia-Cortés and Mejuto 2002; Ariz et al. 2007; Romanov and Romanova 2009; Espino et al. 2010; Filmalter et al. 2012). Hence, different statistical relationships have been established for several Indian Ocean pelagic sharks based on data that may cover different size ranges as well as different areas and time periods.

Methods

Data available for bycatch species

The present report is based on the compilation of information derived from the data sets of bycatch species referenced in the related resolutions that were reported to the Secretariat, i.e.:

- Retained catch data for shark and ray species, including those reported as species aggregates;
- Catch and effort data for shark and ray species, including those reported as species aggregates;
- Size-frequency data for shark and ray species;
- Information on discards for shark and ray species available from the ROS;
- Fishery interactions with marine turtles, cetaceans, and seabirds derived from the ROS.

Retained catch data for bycatch species should be considered with caution, due to several reasons that include the historically low reporting rates and a tendency to report catches for aggregated shark and ray species. Information available on the estimates of total discards collated through IOTC form 1DI was not used in the present report as the data are currently very limited, often provided using heterogeneous formats (not fully compliant with IOTC standards) which do not include several metadata fields (e.g., reason for discard, fate) as well as the detailed information on sampling coverage and raising procedures adopted (if any).

Data processing

The preparation of the curated public-domain data sets for bycatch species follows three main data processing steps which are briefly summarized below.

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

Second, when retained catches are not reported by a CPC, catch data from the previous year may be repeated or derived from a range of sources, e.g., the FAO FishStat database. In addition, for some specific fisheries characterized by well-known, outstanding issues in terms of data quality, a process of re-estimation of species and/or gear composition may be performed based on data available from other years or areas, or by using proxy fleets, i.e., fleets occurring in the same strata which are assumed to have a very similar catch composition (Moreno et al. 2012).

Finally, filtering and conversions are applied to the size data reported for the most common shark and ray species in order to harmonize their format and structure, and remove data which are non-compliant with IOTC standards, e.g., provided with size bins exceeding the maximum width considered meaningful for the species (IOTC 2020). All samples collected using types of measurement other than fork length (FL; straight distance from the tip of the upper snout to the fork of the tail) are converted into FL by using the IOTC equations and binned by constant intervals of 5 cm in size. If no IOTC-endorsed equations exist to convert from a given length measurement for a species to the standard FL measurement, the original size-frequency data are not disseminated although they are kept within the IOTC databases for future reference.

Results

Overall bycatch levels & trends

Overall levels of reported catches of shark and ray species have increased over time due to the development and expansion of tuna and tuna-like fisheries across the Indian Ocean, reaching over 80,000 tonnes in 2016 (**Fig. 1**). Although the data reported in 2017 showed a reduction of around 10,000 tonnes, it was the period from 2018 to 2022 that saw the most significant impact, with an average catch reduction of 40%, due to Indonesia's catch re-estimation endorsed by SC27.

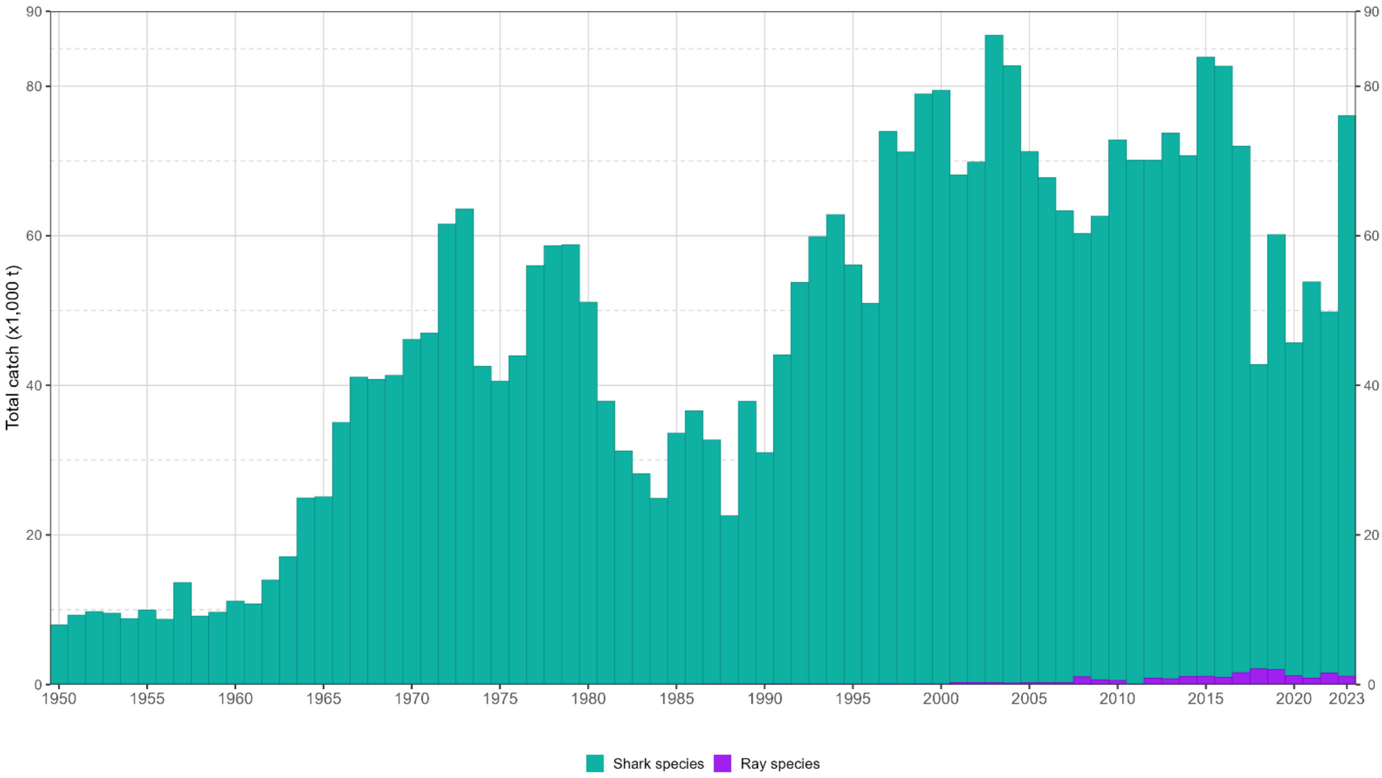

Figure 1: Annual cumulative absolute (a) and relative (b) time series of retained catches (metric tonnes; t) of shark and rays for the period 1950-2023

Until the mid-1980s, shark catches were almost entirely reported as aggregate species. However, over the years, and as a result of the adoption of CMMs and improvements to monitoring programmes by some CPCs, species-level reporting has accounted for 40% of total shark catches in recent years. Blue sharks account for 55% of reported shark catches at species level, followed by silky sharks (about 12%) and shortfin mako sharks (7%) (**Fig. 2**).

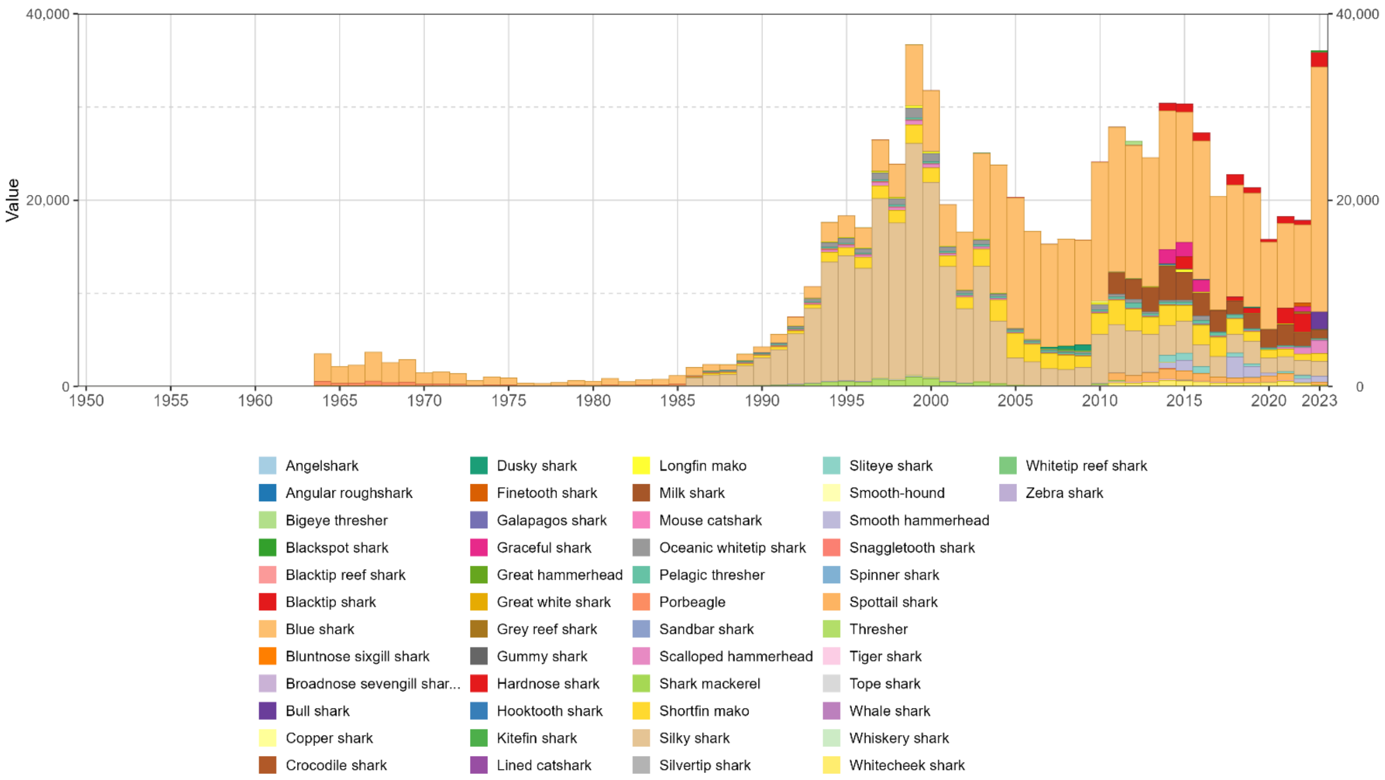

Figure 2: Annual cumulative absolute (a) and relative (b) time series of retained catches (metric tonnes; t) of sharks reported at species level for the period 1950-2023

Although aggregate shark catches represent around 60% of the total, in some cases the data are obtained from other sources (e.g. FAO) or repeated from year to year (e.g. MDG) due to inconsistency or lack of reporting by some fleets. On the other hand, in recent years, some CPCs have improved their monitoring programmes (KEN, TZA) by significantly reducing the level of reporting of aggregate shark species. Rays' catches accounted for 1460 tons in recent years (period 2019-2023) and are mostly reported as aggregated species (**Fig. 3**).

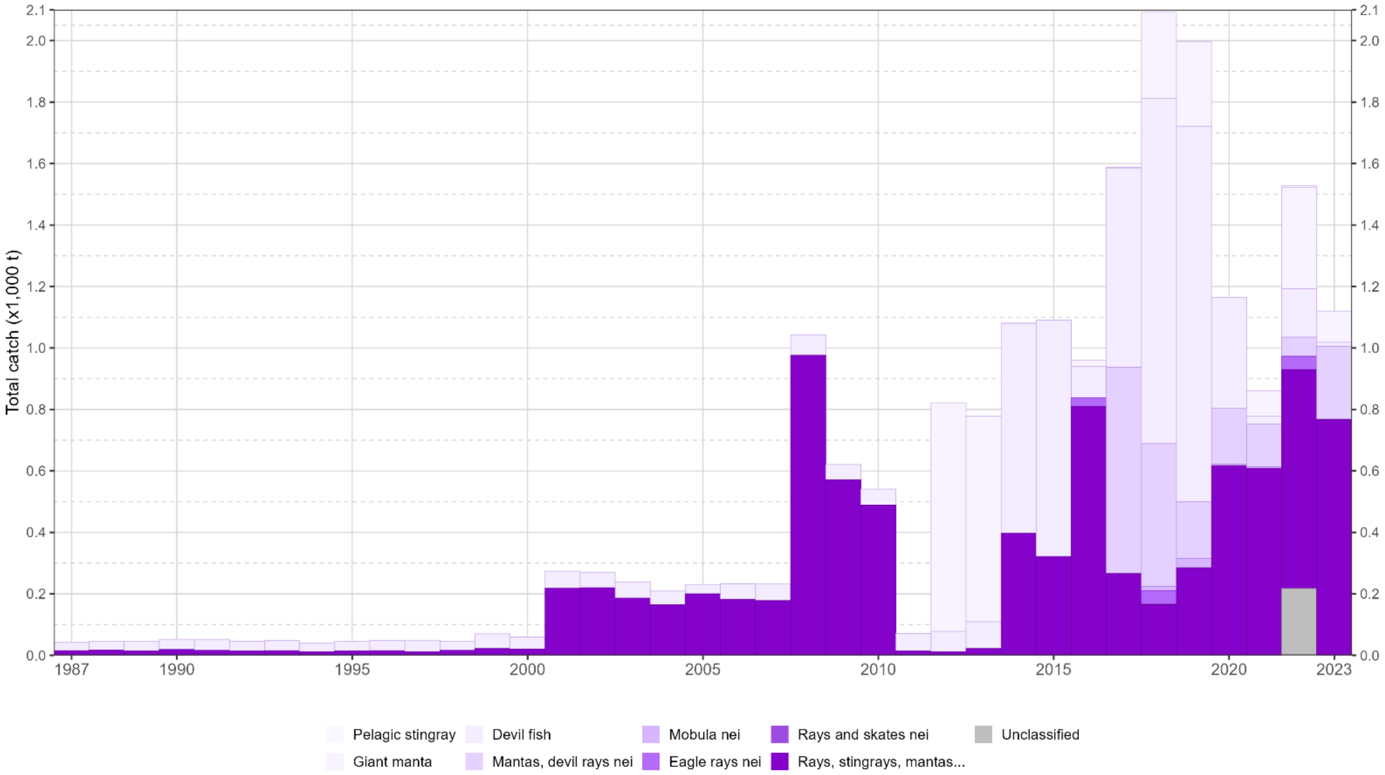

Figure 3: Annual cumulative absolute (a) and relative (b) time series of retained catches (metric tonnes; t) of rays for the period 1950-2023

Sharks and rays interactions with IOTC fisheries

As the available data on total discards in most fisheries remain sparse and fragmented, therefore discards are inferred from observer data collected through the ROS program. For longline fisheries 70% of the recorded interactions corresponds to blue shark, followed by oceanic whitetip sharks, silky shark and shortfin mako shark (**Fig. 4**). The recorded interactions with rays in longline fisheries are almost entirely for Pelagic stingray (**Fig. 4**).

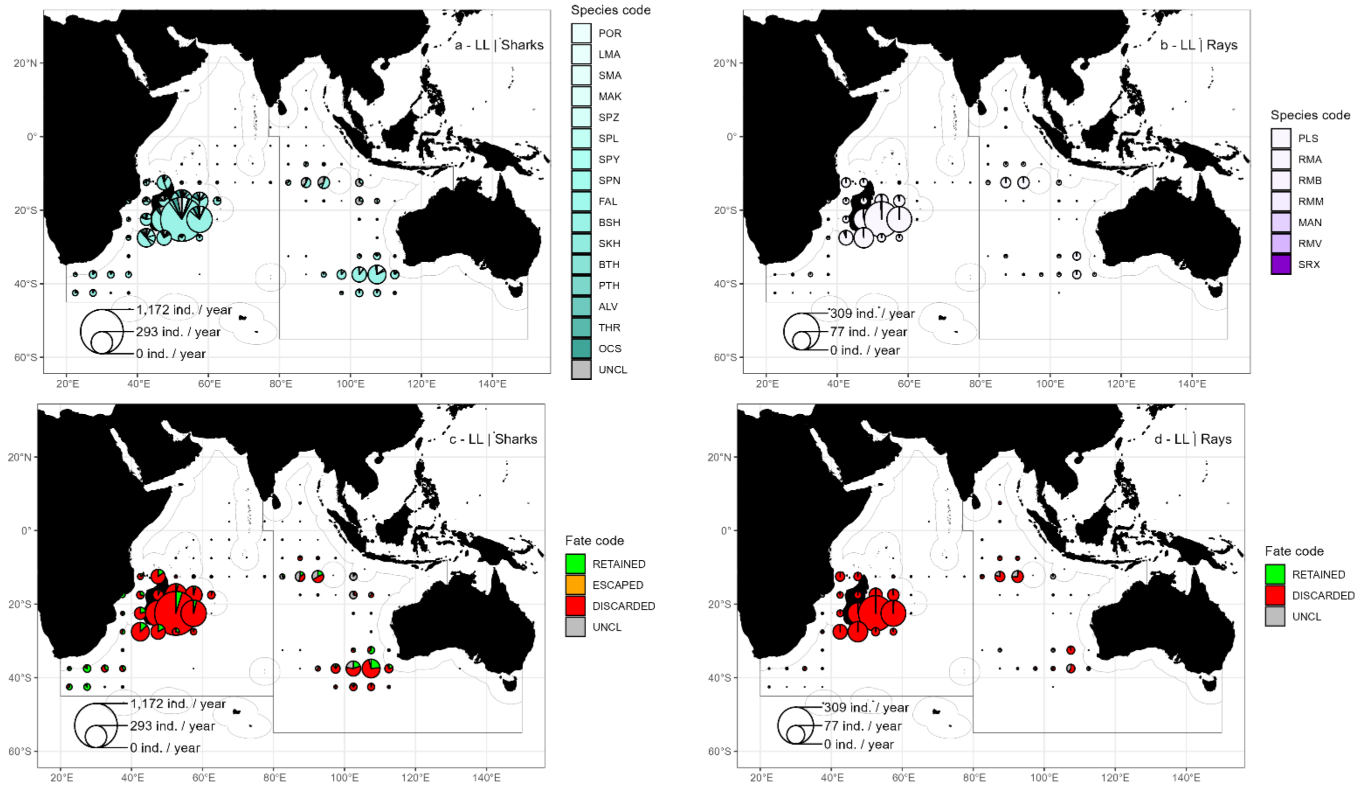

Figure 4: Mean annual number of shark and rays interactions (numbers of individuals per year) with longline fisheries by species and fate as reported to the Secretariat during the period 2009-2022.

For purse seine fisheries the recorded interactions are dominated by silky shark (98%) with some interactions recorded for oceanic whitetip sharks (**Fig. 5**). Pelagic stingray it's also the main species interacting with purse seine fisheries (47%), followed by Devil fish (24%), mobula nei (16%) and Gian manta (10%) (**Fig. 5**).

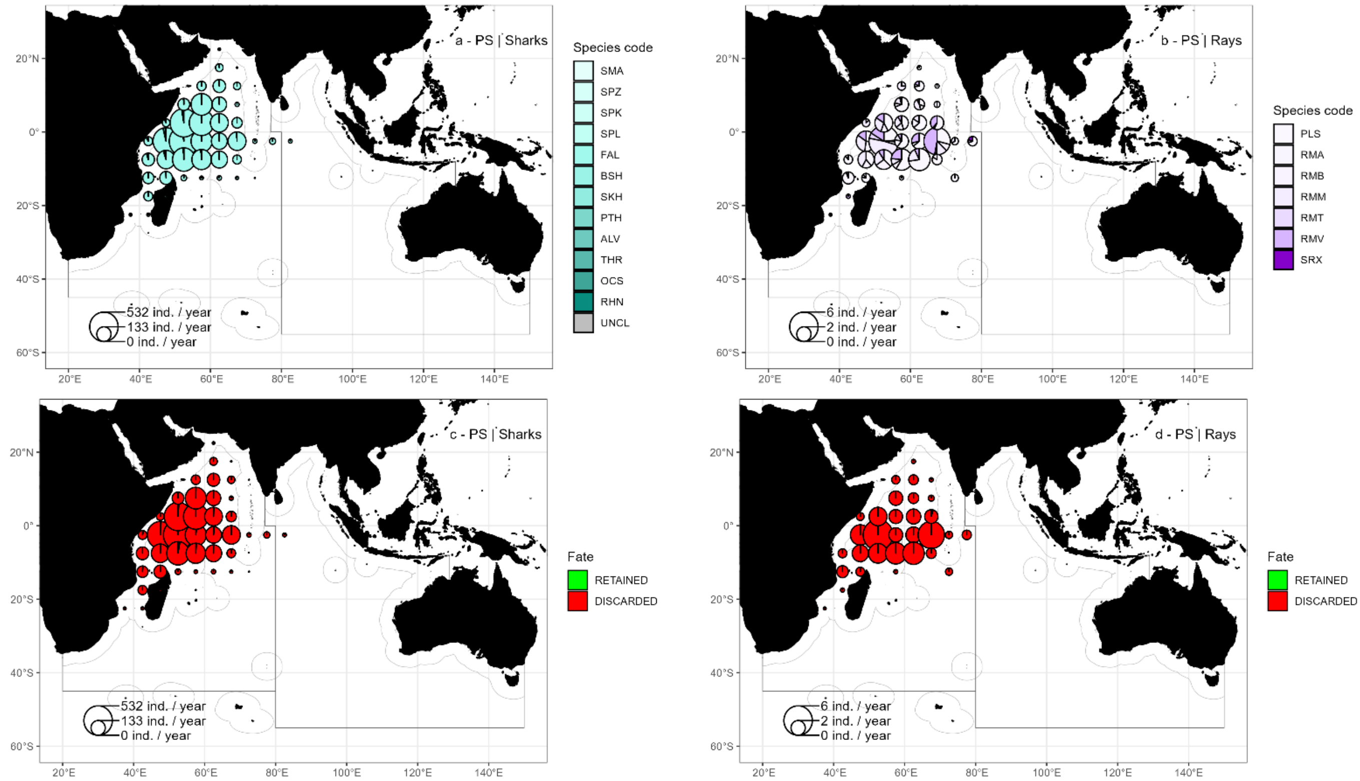

Figure 5: Mean annual number of shark and rays interactions (numbers of individuals per year) with purse seine fisheries by species and fate as reported to the Secretariat during the period 2009-2022

Size composition of the catch

The main species of sharks with available size samples are blue shark, shortfin mako, silky shark and porbeagle and mostly coming from coming from logbooks (**Fig. 6**).

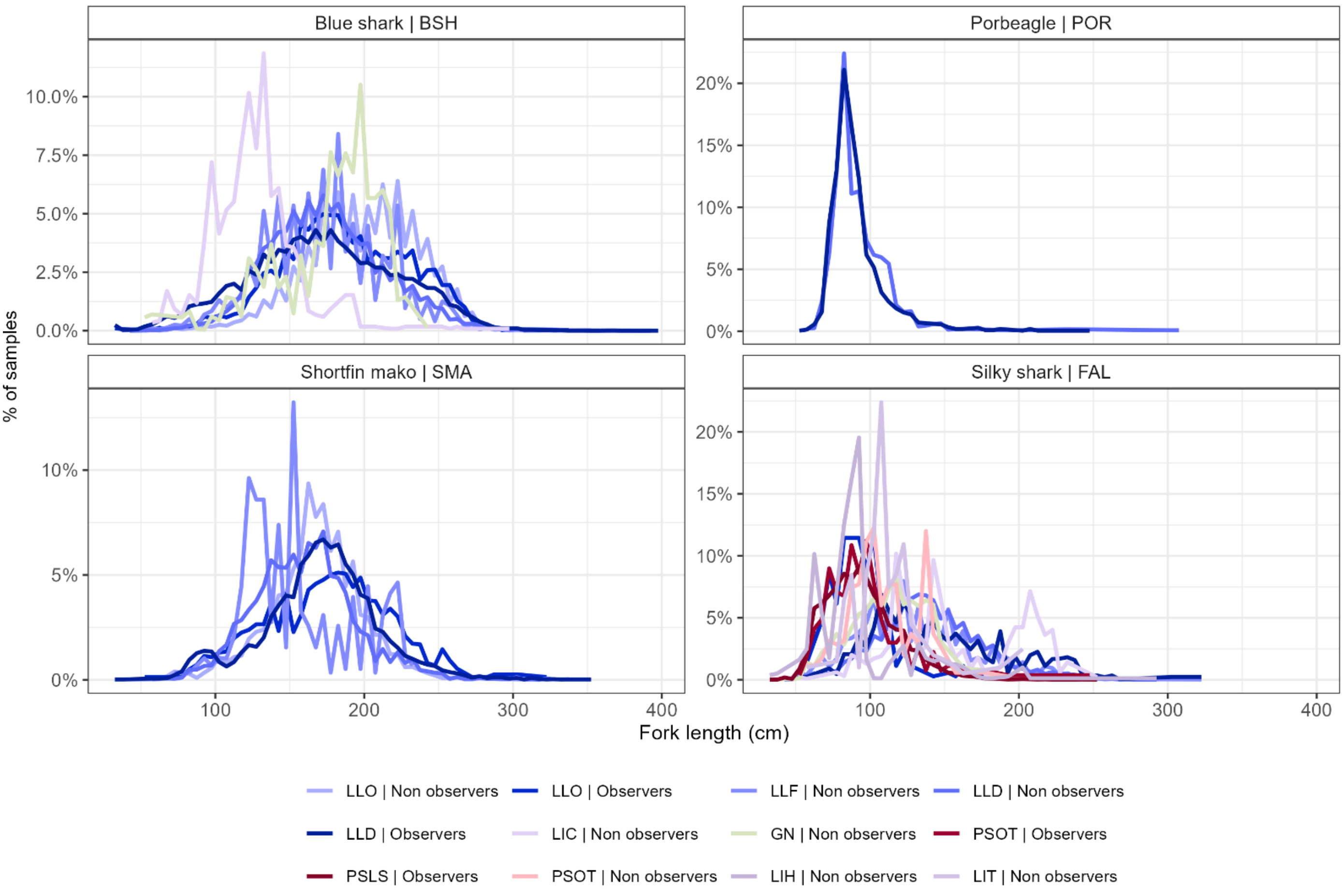

Figure 6: Size distribution of fish size (for more than 2000 samples) collected as per Res. 15/02 and reported at species level through IOTC forms 4SF or equivalent.

Blue sharks catch levels & trends

In previous years the average annual catch of blue sharks for the period 2018–2022 was around 24,000 tonnes, 64% of which was taken by Indonesia. Nevertheless, the application of the re-estimation methodology to Indonesian catches, presented at WPDCS20 and endorsed by SC27, resulted in a 25% reduction in blue shark catches over the same period (**Fig. 1**). Therefore, blue shark catches remain associated with considerably uncertainties due to estimates of blue shark catches from Indonesian artisanal fisheries.

The change in the time series also implies a reordering of the contributions of blue shark catches by the three main fleets (Taiwan, China, EU, Spain and Indonesia) until 2022. Reported catches of blue sharks by Indonesia in 2023 dominate once again, with similar values to previous reports, as the re-estimation methodology has not yet been applied to the latest data submission (**Fig. 7**).

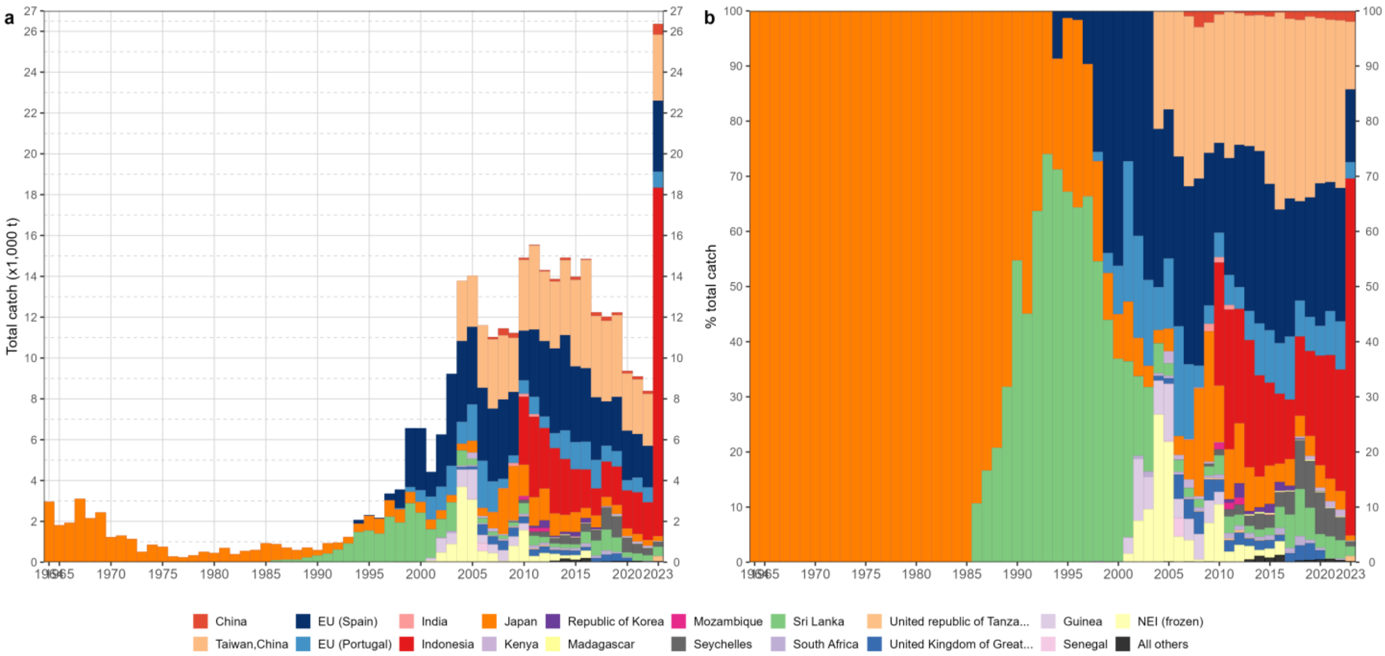

Figure 7: Annual cumulative absolute (a) and relative (b) time series of retained catches (metric tonnes; t) of blue shark by fleet for the period 1950-2023

Vulnerability to fisheries

Catches of blue shark have increased sharply from mid 1990s, period in which longline, and line fisheries accounted for more than 70% of total catches of these species (**Fig. 8**).

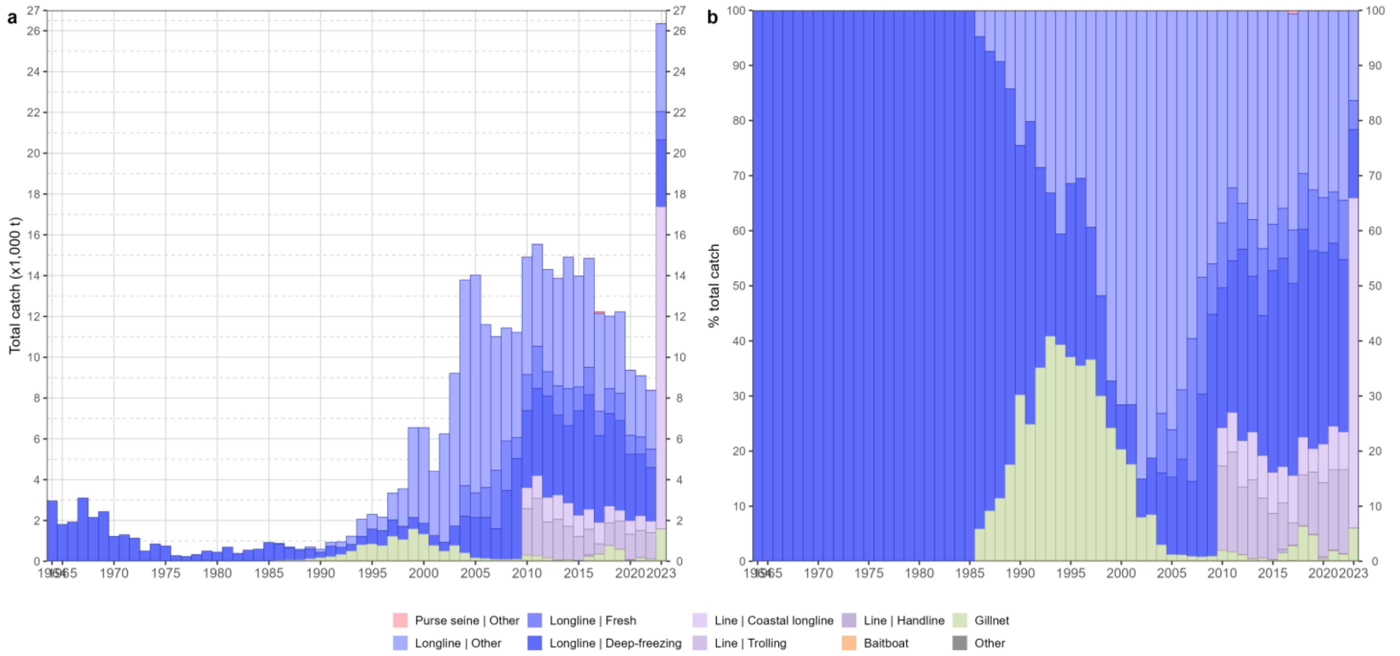

Figure 8: Annual absolute (a) and relative (b) time series of retained catches (metric tonnes; t) of blue shark by fishery for the period 1950-2023. 'Other' corresponds to all other fisheries combined

Table 1: Blue shark catches by year and fishery in the period 2014 to 2023.

Fishery	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Purse seine | Other	0	0	2	76	0	1	0	0	4	1
Longline | Other	6,447	5,421	5,334	4,799	3,555	3,987	3,185	2,998	2,885	4,312
Longline | Fresh	1,810	1,177	1,345	1,187	1,221	1,345	930	844	903	1,394
Longline | Deep-freezing	3,787	5,115	5,614	4,266	4,532	4,393	3,255	3,021	2,622	3,271
Line | Coastal longline	1,147	1,040	980	1,049	822	519	658	718	575	15,784
Line | Trolling	1,621	1,168	1,247	499	1,114	1,382	1,256	1,326	1,275	7
Line | Handline	3	7	102	13	9	14	41	12	11	3
Baitboat	1	0	0	2	0	1	1	0	0	0
Gillnet	80	31	217	332	761	579	30	170	103	1,582
Other	8	8	4	11	2	4	7	3	4	0
Total	14,904	13,968	14,845	12,231	12,017	12,224	9,362	9,092	8,382	26,354

Recent fishery features (2019-2023)

Until 2022, most longline fisheries reported a decline in blue shark catches. However, this trend was reversed in 2023 with blue shark catches increasing by 70% and 30% for the EU, Spain and Taiwan, China respectively (**Fig. 9**). Although with small amounts, China, Mauritius, Sri Lanka and Tanzania also reported considerable increases in blue shark catches. The sharp increase in line and gillnet catches of blue sharks in 2023 is entirely dependent on Indonesia's reported catches and is subject to review (**Fig. 10**). Although, subject to revision of the 2023 blue shark catch data, Indonesia, together with Taiwan, China; EU, Spain; EU, Portugal and Seychelles are responsible for 90% of blue shark catches in the recent period (**Fig. 11**).

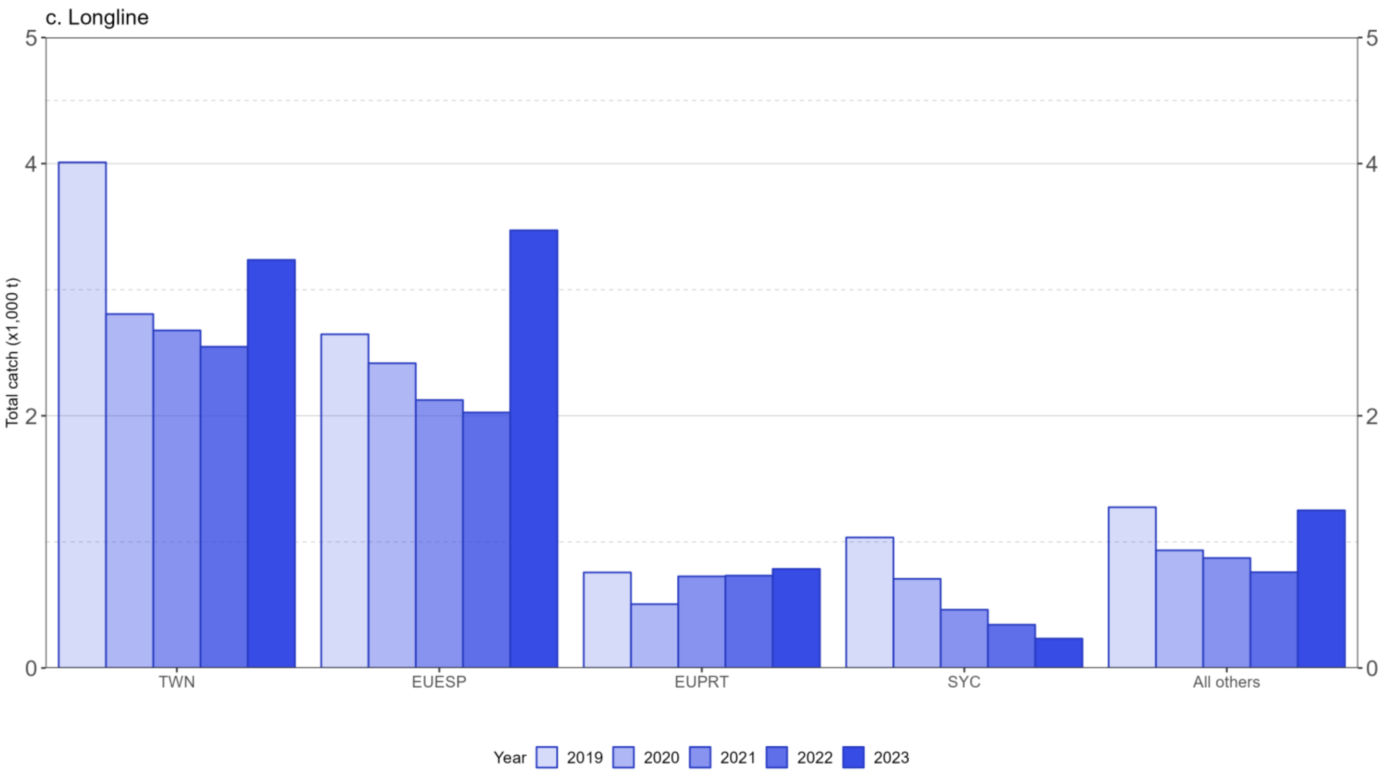

Figure 9: Annual catch trends (metric tonnes; t) of blue shark by longline fisheries between for the period 2019-2023

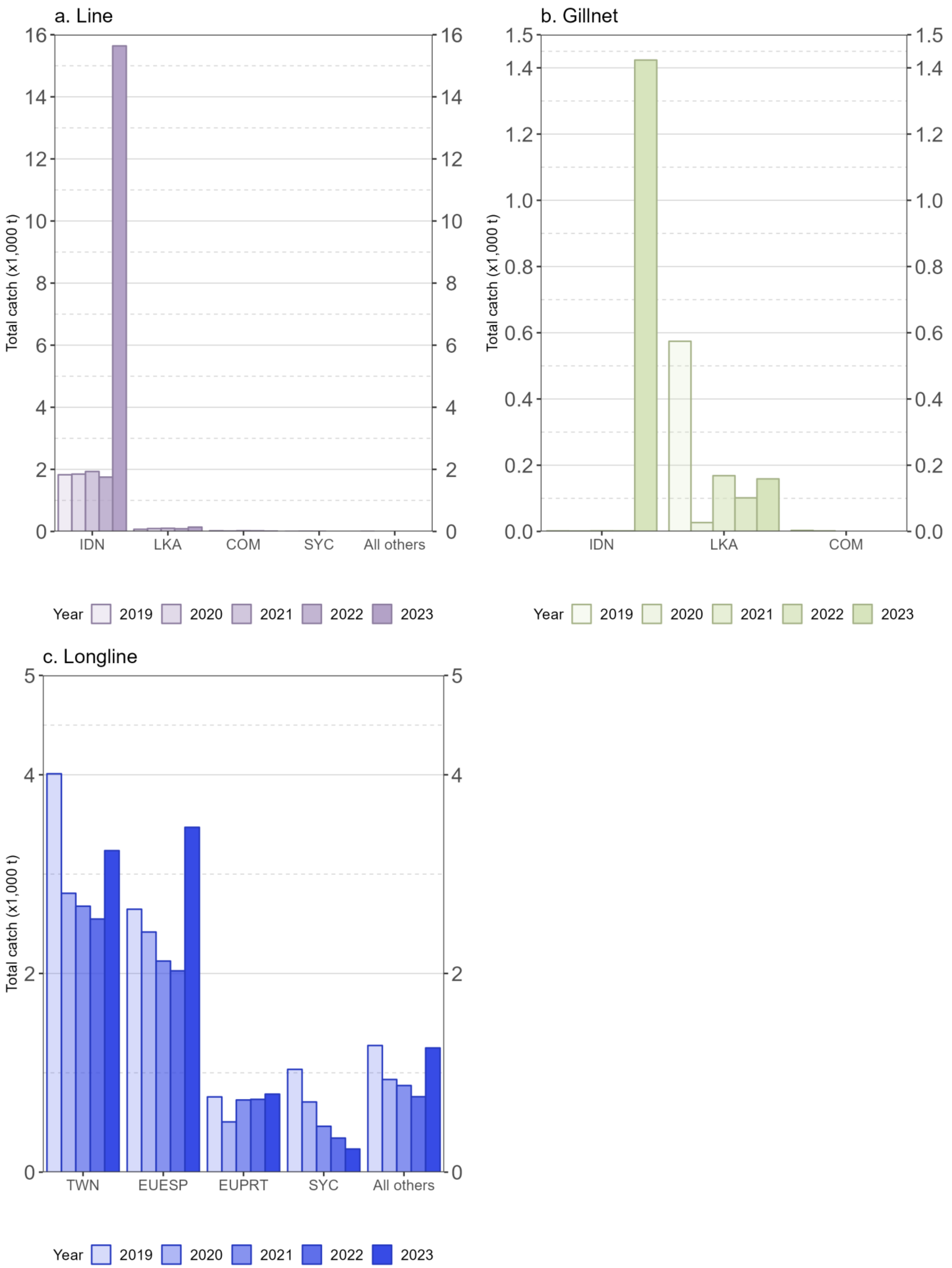

Figure 10: Annual catch trends (metric tonnes; t) of blue shark by fishery group between for the period 2019-2023

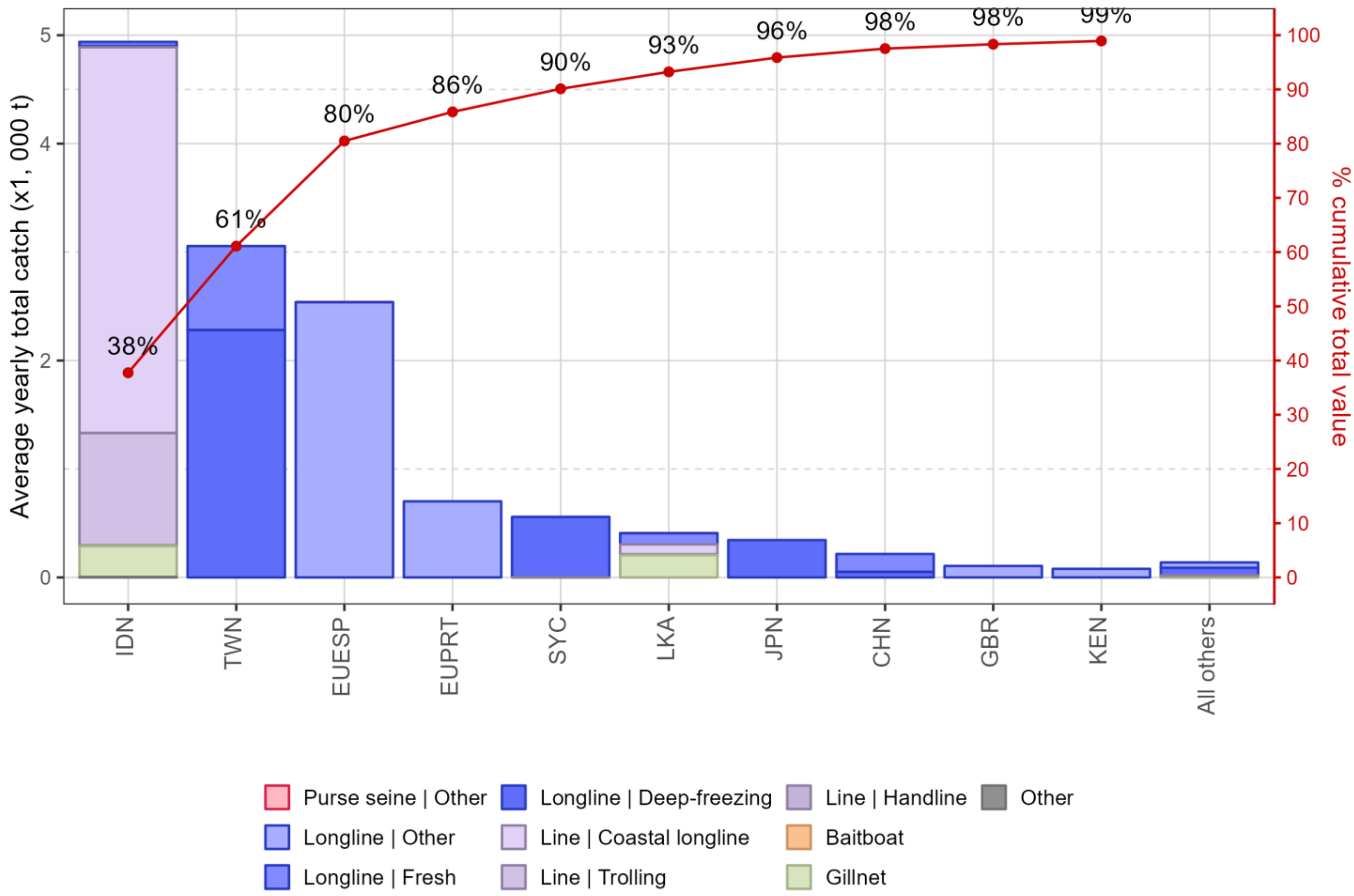

Figure 11: Average annual catch trends of blue shark by fleet and fishery for the period 2019-2023

Discarding practices

Longline fisheries

Data on total discards in most fisheries remain sparse and fragmented, therefore discards are inferred from observer data collected through the ROS program. The ROS data presented in this document are from EU France, Japan, Seychelles and Sri Lanka longline fisheries with varying years by fleet within the period 2007-2021 and which do not fully cover the longline fishing grounds. Acknowledging some differences between fleets, approximately 80% of recorded interactions with blue sharks result in discards, of which 80% of individuals are discarded alive. (**Fig. 12**).

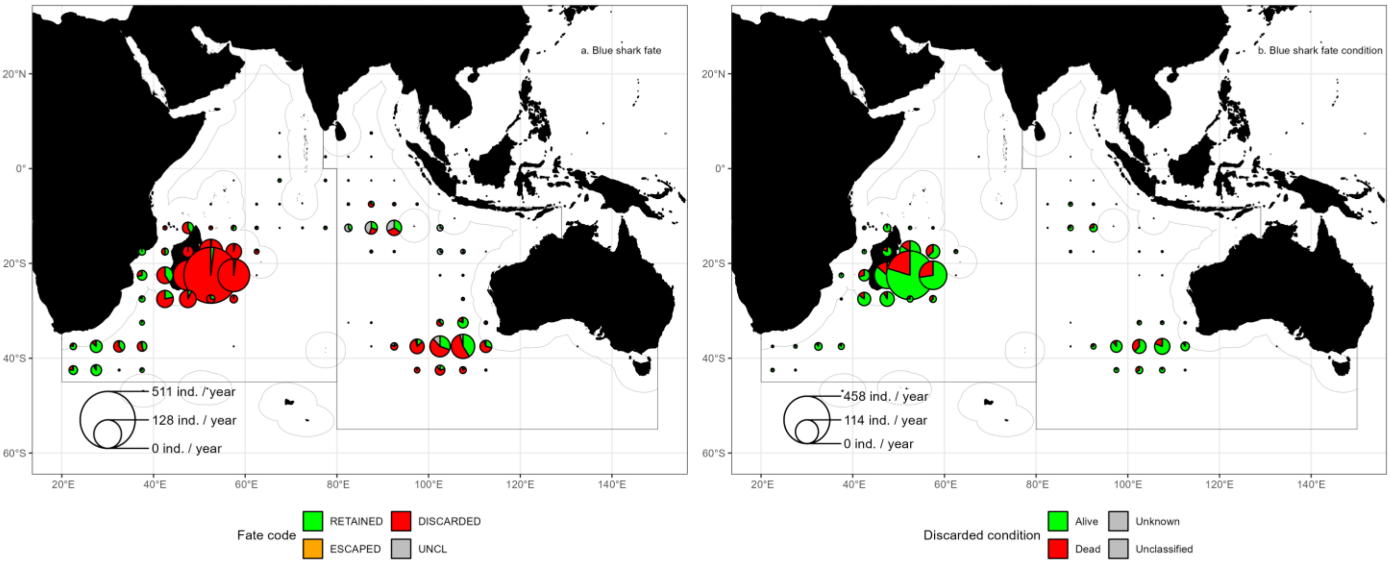

Figure 12: Mean annual number of blue shark interactions (numbers of individuals per year) with longline fisheries by fate (a) and discard condition (b) as reported to the Secretariat during the period 2009-2021

Size composition of the catch – Blue shark

The number of size samples for blue shark reported according to Res. 15/02 varies greatly between fleets and fisheries accounting 318,933 size samples available for blue shark which around 80% are from logbooks **(Table 2).**

Table 2: Total number of fish size samples collected as per Res. 15/02 and reported at species level for blue shark covering the period 2005-2023 through IOTC forms 4SF or equivalent

		Year		Number of samples			
Fleet code	**Fishery group**	**From**	**To**	**Logbooks**	**Observers**	**Total**	**% Logbooks**
TWN	LL	2012	2023	214,185	11,584	225,769	94.87
EUPRT	LL	2011	2023	9,553	16,228	25,781	37.05
JPN	LL	2009	2020	2,389	18,897	21,286	11.22
SYC	LL	2007	2023	15,777	0	15,777	100.00
EUESP	LL	2009	2023	5,494	2,468	7,962	69.00
KOR	LL	2007	2018	3,593	3,898	7,491	47.96
ZAF	LL	2005	2023	3,004	865	3,869	77.64
LKA	GN	2005	2023	2,294	0	2,294	100.00
CHN	LL	2012	2023	993	578	1,571	63.21
GBR	LL	2017	2019	0	1,463	1,463	0.00
KEN	LL	2023	2023	0	1,414	1,414	0.00
LKA	LI	2018	2021	886	0	886	100.00
LKA	LL	2017	2023	763	0	763	100.00
MDG	LL	2018	2019	690	0	690	100.00
IDN	LL	2018	2022	287	395	682	42.08
EUREU	LL	2016	2023	0	542	542	0.00
IDN	LI	2019	2021	414	0	414	100.00
COM	LI	2019	2023	142	0	142	100.00
LKA	PS	2022	2022	39	0	39	100.00
MOZ	LI	2015	2015	34	0	34	100.00
MOZ	LL	2015	2015	34	0	34	100.00
MUS	LL	2018	2019	15	0	15	100.00
EUMYT	LL	2017	2017	0	13	13	0.00
EUREU	LI	2023	2023	1	0	1	100.00
IDN	GN	2020	2020	1	0	1	100.00

Blue shark size data from deep-freezing longliners are consistent between observer and non-observer data indicating a median fork length of about 175 cm **(Fig. 13)** and **(Fig.14)**. Size data collected for blue shark by observers onboard longliners targeting swordfish show a distribution described by a median fork length of 182 cm, which is smaller than the median of the sizes collected by other enumerators (222 cm), **(Fig. 13)** and **(Fig.14)**. The fresh longliners also shows differences between the median fork length reported by observers on board (157cm) and by enumerators (182 cm) **(Fig. 13)** and **(Fig.14)**. However, in all three cases, it is necessary to consider the sample size obtained by observers vs. enumerators, 55148 vs. 216156 for deep-freezing longliners, 3023 vs. 16314 for longliners targeting swordfish, and 172 vs. 23869 for fresh longliners.

For the remaining fisheries without observer length data, the average reported fork lengths are 187 cm for gillnet fisheries, 162 cm for handline fisheries and 130 cm for coastal longlines, with very small sample sizes**. (Table 2), (Fig.15).**

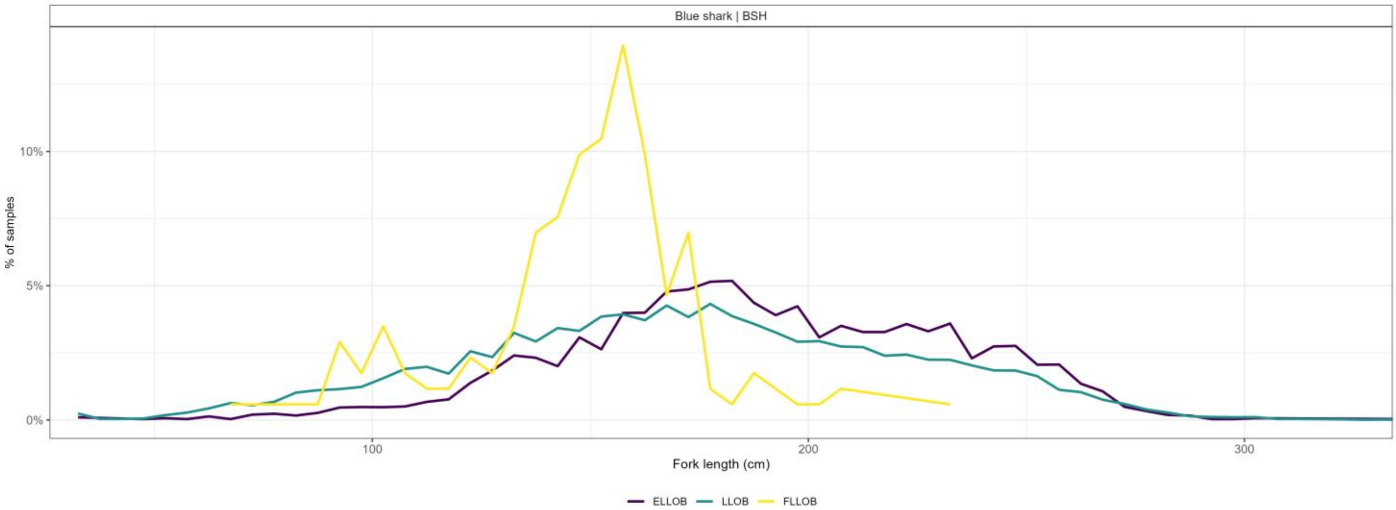

Figure 13: Relative distribution of fork lengths (cm) by 5 cm classes for blue shark sampled by observers in longline fisheries

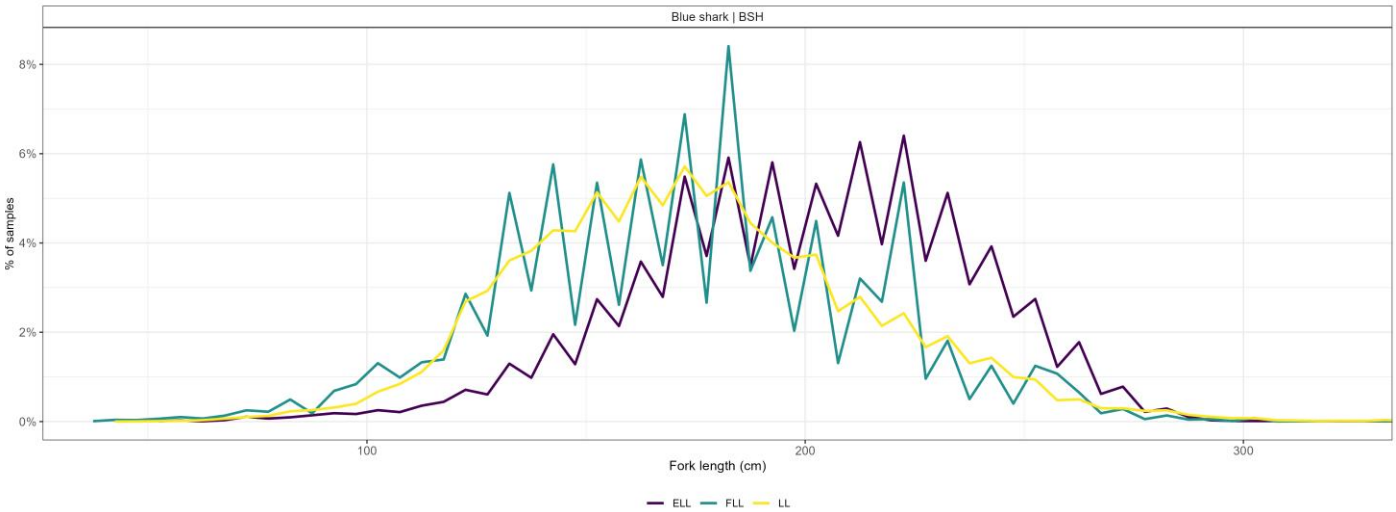

Figure 14: Relative distribution of fork lengths (cm) by 5 cm classes for blue shark sampled by enumerators in longline fisheries

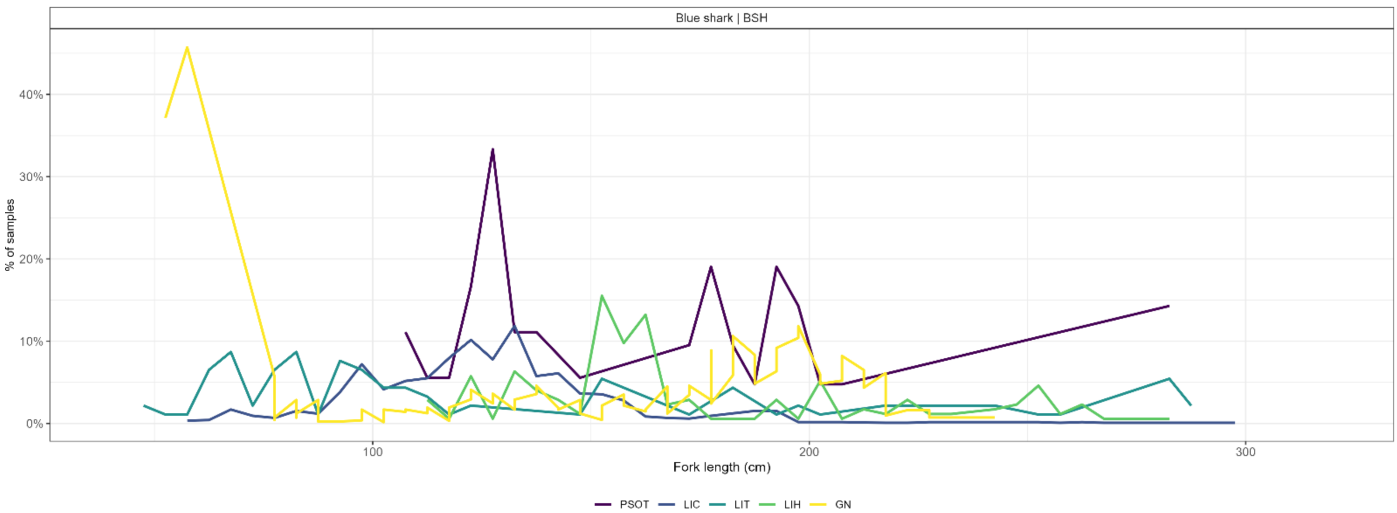

Figure 15: Relative distribution of fork lengths (cm) by 5 cm classes for blue shark sampled by enumerators in other fisheries

There are some major outstanding issues in the reporting of size data:

- **Gillnet fisheries of I.R. Iran and Pakistan**: to date, I.R. Iran and Pakistan have not reported size-frequency data of sharks species caught by their gillnet fisheries;

- **Longline fisheries of India, Malaysia, and Oman**: to date, these countries have seldom or not at all reported size-frequency data of shark species caught by their longline fisheries.
- **Coastal fisheries of India, Indonesia, Madagascar, and Yemen**: to date, these countries have seldom or not at all reported size-frequency data for their coastal fisheries. Madagascar reported size-frequency data for blue shark, silky shark, and smooth hammerhead shark for 2018-2020, and Indonesia for blue shark and silky shark for 2019-2020.

On the other hand, Eu,Portugal returned to reporting size data after 4 years, due to the restrictions on the deployment of on-board observers as a consequence of the Covid19, and Kenya reported blue shark size data for the first time, also from observers.

Spatial information on blue shark catches

Geo-referenced catches of sharks and rays are reported both in number of fish and total weight, and generally represent only a subset of the annual retained catches reported by fleet and gear for each species. Due to the general lack of information on the size composition of the catch, these cannot be converted into a common unit and therefore spatial distribution maps of catches are provided both in numbers and in weight. Overall, the distribution of the catches of sharks and rays shows the increasing improvements of data reporting over time, with data becoming available for more shark and ray species from an increasing number of CPCs and fisheries over the last four decades.

Spatial information available on retained catches of blue shark in numbers starting on the 2000s and is mostly reported from longliners of China, Japan, Seychelles and Taiwan,China (**Fig. 16**). Most of the fleets capturing blue shark increased the reporting of georeferenced cathes in weight along the decades **(Fig. 17).** Nevertheless, although Eu,Spain is one of the main longline fleets retaining blue shark, the georeferenced catches are poorly reported, with data provided only in 2020 (**Fig. 18**) and (**Fig. 19**).

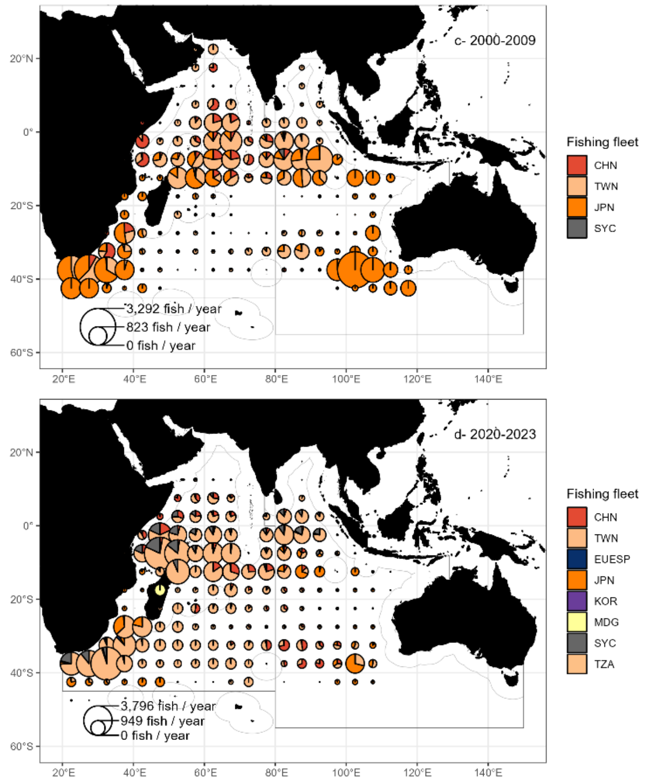

Figure 16: Mean annual georeferenced catches by number of blue sharks by fishing fleet and decade reported to the Secretariat.

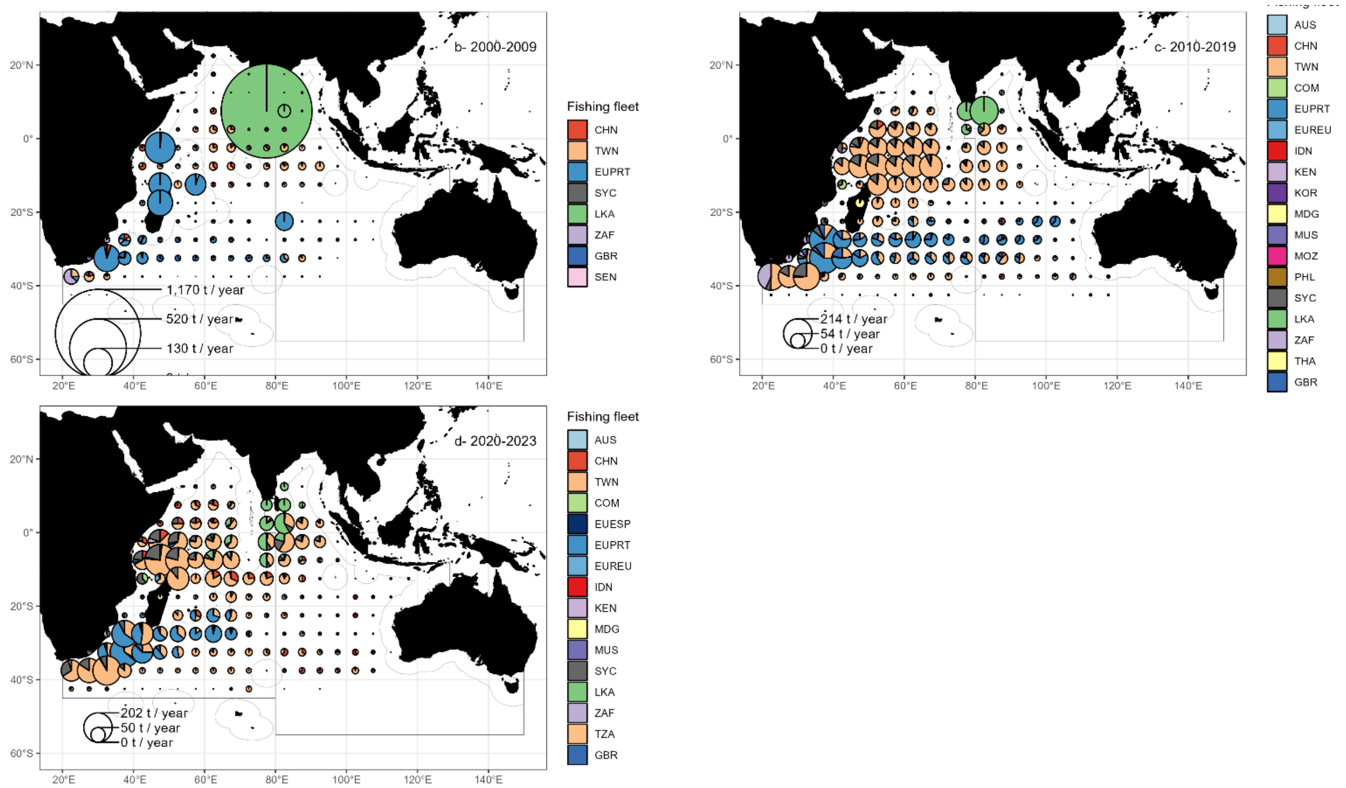

Figure 17: Mean annual georeferenced catches by weight of blue sharks by fishing fleet and decade reported to the Secretariat.

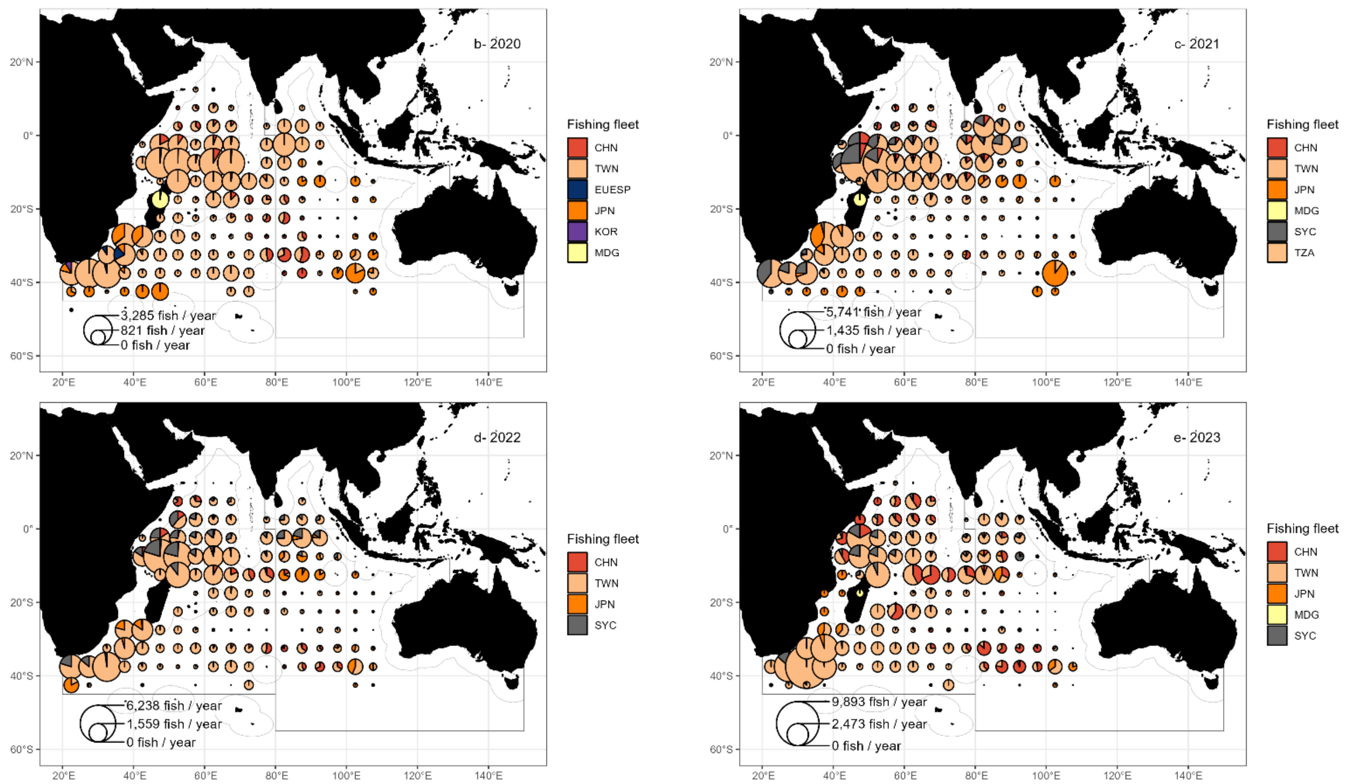

Figure 18: Mean annual georeferenced catches by number of blue sharks by fishing fleet and year reported to the Secretariat from 2020 to 2023.

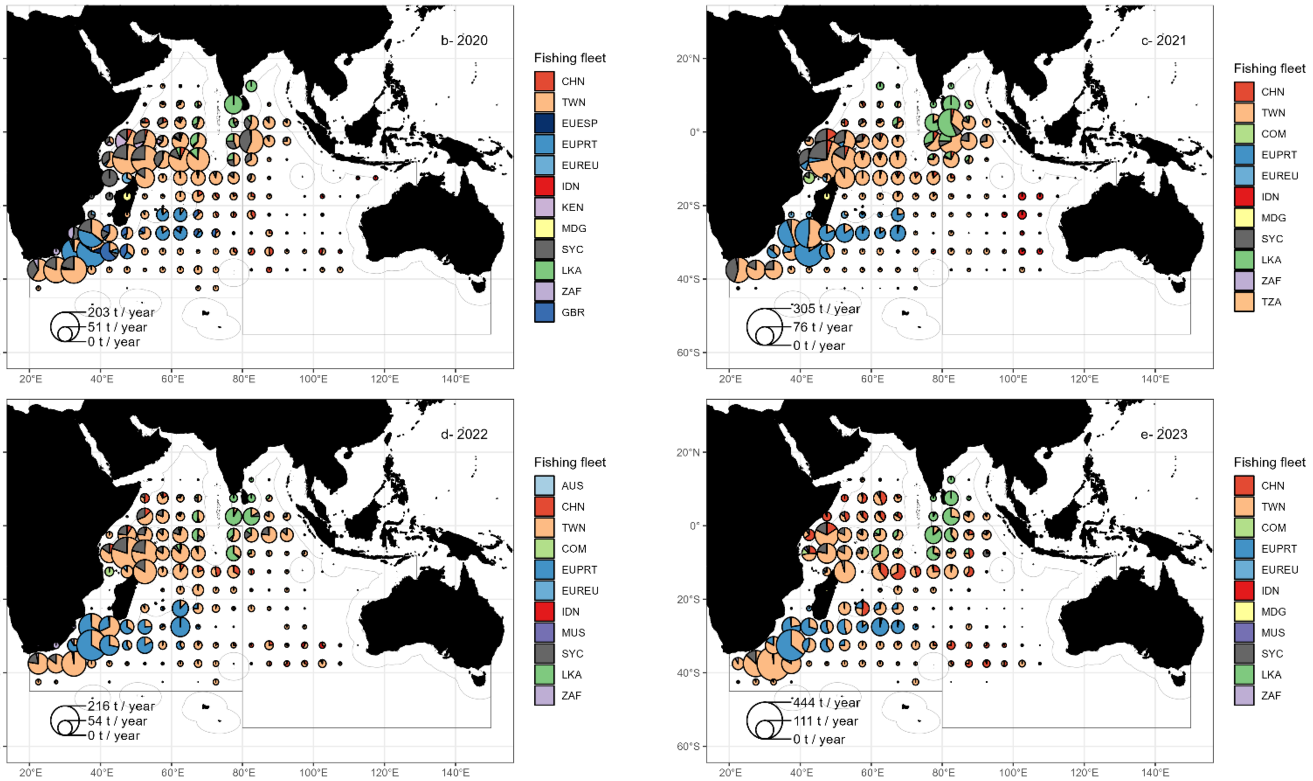

Figure 19: Mean annual georeferenced catches by weight of blue shark by fishing fleet and year reported to the Secretariat from 2020 to 2023.

References

Ariz, J., Delgado De Molina, A., Ramos, M.L., and Santana, J.C. 2007. Length-weight relationships, conversion factors and analyses of sex-ratio, by length range, for several species of pelagic sharks caught in experimental cruises on board Spanish longliners in the South Western Indian Ocean during 2005. *In* IOTC Proceedings. IOTC, Victoria, Seychelles, 11-13 July 2007. p. 24. Available from https://www.iotc.org/documents/length-weight-relationships-conversion-factors-and-analyses-sex-ratio-length-range-several.

Coelho, R., Mejuto, J., Domingo, A., Yokawa, K., Liu, K.-M., Cortés, E., Romanov, E.V., Silva, C. da, Hazin, F., Arocha, F., Mwilima, A.M., Bach, P., Zárate, V.O. de, Roche, W., Lino, P.G., García-Cortés, B., Ramos-Cartelle, A.M., Forselledo, R., Mas, F., Ohshimo, S., Courtney, D., Sabarros, P.S., Perez, B., Wogerbauer, C., Tsai, W.-P., Carvalho, F., and Santos, M.N. 2018. Distribution patterns and population structure of the blue shark (*Prionace glauca*) in the Atlantic and Indian Oceans. Fish and Fisheries **19**(1): 90–106. doi:https://doi.org/10.1111/faf.12238.

Espino, D., Garcia-Cortés, B., and Mejuto, J. 2010. Relationships between size, body weights and fin weight of blue shark (*Prionace glauca*) caught as by-catch in the Spanish surface longline fishery in the Indian Ocean. ICCAT Collective Volume of Scientific Papers **65**(6): 2183–2194.

Filmalter, J., Séret, B., and Dagorn, L. 2012. Length-length / weight relationships for the silky shark *Carcharhinus falciformis*, in the western Indian Ocean. *In* IOTC Proceedings. IOTC, Cape Town, South Africa, 17-19 September 2012. p. 10. Available from https://www.iotc.org/documents/length-and-length-weight-relationships-silky-shark-carcharhinus-falciformis-western-indian.

Francis, M.P., and Duffy, C. 2005. Length at maturity in three pelagic sharks (*Lamna nasus*, *Isurus oxyrinchus*, and *Prionace glauca*) from New Zealand. Fishery Bulletin **103**: 489–500. Available from https://aquadocs.org/handle/1834/26212.

Garcia-Cortés, B., and Mejuto, J. 2002. Size-weight relationships of the swordfish (*Xiphias gladius*) and several pelagic shark species caught in the Spanish surface longline fishery in the Atlantic, Indian and Pacific Oceans. ICCAT Collective Volume of Scientific Papers **54**(4): 1132–1149.

Martin, S., Fiorellato, F., and Rice, J. 2017. Approaches to the reconstruction of catches of Indian Ocean blue shark (*Prionace glauca*). IOTC, San Sebastian, Spain, 04-08 September 2017. p. 33. Available from https://www.iotc.org/documents/approaches-reconstruction-catches-indian-ocean-blue-shark.

Musyl, M.K., and Gilman, E.L. 2018. Post-release fishing mortality of blue (*Prionace glauca*) and silky shark (*Carcharhinus falciformes*) from a Palauan-based commercial longline fishery. Reviews in Fish Biology and Fisheries **28**(3): 567–586. doi:10.1007/s11160-018-9517-2.

Nakano, H., and Stevens, J.D. 2008. The biology and ecology of the blue shark, *Prionace glauca*. *In* Sharks of the Open Ocean. John Wiley & Sons, Ltd. pp. 140–151. doi:10.1002/9781444302516.ch12.

Petersen, S.L., Honig, M.B., Ryan, P.G., Underhill, L.G., and Compagno, L.J. 2009. Pelagic shark bycatch in the tuna- and swordfish-directed longline fishery off southern Africa. African Journal of Marine Science **31**(2): 215–225. doi:10.2989/AJMS.2009.31.2.9.881.

Romanov, E.V., and Romanova, N. 2009. Size distribution and length-weight relationships for some large pelagic sharks in the Indian Ocean. IOTC, Mombasa, Kenya, 12-14 October 2009. p. 12. Available from https://www.iotc.org/documents/size-distribution-and-length-weight-relationships-some-large-pelagic-sharks-indian-ocean-2009.

Skomal, G.B., and Natanson, L.J. 2003. Age and growth of the blue shark (*Prionace glauca*) in the North Atlantic Ocean. Fishery Bulletin **101**: 627–639.