REVIEW OF THE STATISTICAL DATA AVAILABLE FOR BYCATCH SPECIES

PREPARED BY: IOTC SECRETARIAT[1], 12 & 24 OCTOBER 2014

PURPOSE

To provide participants at the 10th Session of the IOTC Working Party on Ecosystems and Bycatch (WPEB10) with a review of the status of the information available on non-targeted, associated and dependent species of IOTC fisheries, termed 'Bycatch'. Bycatch has been 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."

This paper covers data on sharks[2], seabirds, marine turtles, marine mammals and other bycatch in the IOTC Secretariat databases as of 1 October 2014.

This 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. The document 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.

BACKGROUND

Prior to each WPEB meeting the IOTC Secretariat develops a series of maps, figures and tables that highlight historic and emerging trends in the bycatch data held by the IOTC Secretariat. This information is used during each WPEB meeting to inform discussions around stock assessment and in developing advice for the Scientific Committee.

The report covers the following areas:

- Overview of requirements
- Status of reporting
- Summary of fisheries data available for sharks:
  - Total reported catches of sharks in the Indian Ocean
  - Main species of sharks caught in IOTC fisheries
  - Catch rates of sharks reported by fleets
  - Spatial information on sharks catches
  - Length-frequency data on sharks
- Summary of fisheries data available for seabirds
  - Main species and fisheries concerned
  - Status of data on seabird bycatch
- Summary of fisheries data available for marine turtles
  - Main species and fisheries concerned
  - Status of data on marine turtle bycatch
- Other species caught incidentally by IOTC fisheries, in particular Cetaceans
- Main issues identified concerning the data on non-IOTC species available to the IOTC

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[2] Following standard international practice, the term shark is accepted to include both sharks and rays.

Overview of minimum data reporting requirements

The Resolutions relevant to each taxonomic group are listed below and provided in more detail in Appendix 1.

All bycatch

- IOTC Resolution 10/02: ***Mandatory statistical requirements*** *for IOTC Members and Cooperating Non-Contracting Parties (CPC's)*
- IOTC Resolution 13/03: *On the* ***recording of catch and effort by fishing vessels*** *in the IOTC area of competence*
- IOTC Resolution 11/04: *On a* ***regional observer scheme***

Sharks

- IOTC Resolution 05/05: *Concerning the conservation of* ***SHARKS*** *caught in association with fisheries managed by IOTC*
- IOTC Resolution 12/09: *On the conservation of* ***THRESHER SHARKS*** *(family Alopiidae) caught in association with fisheries in the IOTC Area of Competence*
- IOTC Resolution 13/05: *On the conservation of* ***WHALE SHARKS*** *(Rhincodon typus)*
- IOTC Resolution 13/06: *On a scientific and management framework on the conservation of* ***SHARK*** *species caught in association with IOTC managed fisheries*

Seabirds

- IOTC Resolution 12/06 *On reducing the incidental bycatch of* ***SEABIRDS*** *in* ***longline fisheries***

Marine turtles

- IOTC Resolution 12/04 *On the conservation of* ***MARINE TURTLES***

Marine mammals

- IOTC Resolution 13/04 *On the conservation of* ***CETACEANS***

Major data categories covered by the report

A summary of the type of datasets that need to be provided for sharks and other bycatch species including the time periods concerned, fleets and species and the level of requirement for reporting (obligatory or voluntary) are provided in Table 1 and Table 2.

Sharks: The same standards as those existing for IOTC species apply to the most commonly caught species of sharks and rays, as defined by the Commission in 2007 and extended in 2012, and 2013, including:

- **Nominal catches** which are highly aggregated statistics for each species estimated per fleet, gear and year for a large area. If these data are not reported the Secretariat attempts to estimate a total catch although this is not possible in many cases. A range of sources is used for this purpose (including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling and data published through web pages or other means).
- **Catch-and-effort data** which refer to the fine-scale data – usually from logbooks, and reported per fleet, year, gear, type of school, month, grid and species. Information on the use of fish aggregating devices (FADs) and supply vessels is also collected.
- **Length frequency data** which refer to individual body lengths of IOTC species and sharks per fleet, year, gear, type of school, month and 5 degrees square areas.
- **Observer data** which refer to fine-scale data as collected by scientific observers onboard vessels authorised to operate in the IOTC area, and reported at the end of each observer trip.

Seabirds, marine turtles, marine mammals, and other species**:** the following standards apply:

- **Total bycatch** which are highly aggregated statistics for all species combined or, where available, by species, estimated per fleet, gear and year for the whole IOTC area.
- **Catch-and-effort** and **observer data:** As for sharks.

IOTC CPCs are also encouraged to collect and report detailed data on other species, where possible.

Table 1. Timeline of reporting requirements indicating the years for which each type of dataset should be reported

	Timeline of reporting requirements										
	<----------	2006	2007	2008	2009	2010	2011	2012	2013	2014	---------->	Deadlines
<----------	Historic data on sharks according to IOTC reporting requirements											Jun (Dec) 30th 2006
Mandatory		Nominal catch data for main shark species										Jun (Dec) 30th 2006 of year following that for which data are due
Voluntary		Nominal catch data for other shark species										Jun (Dec) 30th 2006 of year following that for which data are due
Mandatory				Catch-and-effort data for main shark species								Jun (Dec) 30th 2006 of year following that for which data are due
Voluntary	all CPCs			Catch-and-effort data for other shark species								Jun (Dec) 30th 2006 of year following that for which data are due
Mandatory				Size frequency data for main shark species								Jun (Dec) 30th 2006 of year following that for which data are due
Voluntary				Size frequency data for other shark species								Jun (Dec) 30th 2006 of year following that for which data are due
Mandatory	all CPCs with vessels in the IOTC Record of Authorised Vessels					Estimates of amounts of thresher sharks discarded dead + SF distribution						IOTC SC meeting Dec 2011
Mandatory	all CPCs					Total incidental catches of marine turtles						Jun (Dec) 30th 2006 of year following that for which data are due
Mandatory	all CPCs with vessels >=24m in the IOTC Record of Authorised Vessels					Scientific observer data from vessels >=24m						No later than 150 days after the end of each observer trip
Mandatory	all CPCs with LL fleets in the IOTC area						Total incidental catches of seabirds from LL					Jun (Dec) 30th 2006 of year following that for which data are due
Mandatory	all CPCs with PS, LL and GN fleets in the IOTC area								Total incidental catches of marine mammals			as above; first report due 2014
Mandatory	all CPCs with vessels <24m in the IOTC Record of Authorised Vessels								Scientific observer data from vessels <24m			No later than 150 days after the end of each observer trip

Table 2. List of bycatch species of concern to the IOTC and reporting requirements, by type of fishery. Fisheries: Purse seine (PS), Longline (LL), Gillnet (GN), Pole-and-line (BB), Hand line (HL), Trolling (TR).

Common name	Scientific name	Species Code[3]	Reporting requirements by fishery					
			PS	LL	GN	BB	HL	TR
Blue shark	*Prionace glauca*	**BSH**		**O**	**o**			
Mako sharks	*Isurus spp.*	**MAK**		**O**	**o**			
Porbeagle	*Lamna nasus*	**POR**		**O**	**o**			
Hammerhead Sharks	*Sphyrnidae*	**SPN**		**o**	**o**			
Whale shark	*Rhincodon typus*	**RHN**	**o**		**o**			
Thresher sharks	*Alopias spp.*	**THR**	**o**	**o**	**o**			
Oceanic whitetip shark	*Carcharhinus longimanus*	**OCS**	**o**	**o**	**o**			
Crocodile shark	*Pseudocarcharias kamoharai*	PSK		v	v			
Silky shark	*Carcharhinus falciformis*	FAL	v					
Tiger shark	*Galeocerdo cuvier*	TIG		v	v			
Great White Shark	*Carcharodon carcharias*	WSH		v				
Pelagic stingray	*Pteroplatytrygon violacea*	PSL		v	v			
Mantas and devil rays	*Manta spp. (Mobulidae)*	MAN	v	v	v			
Other sharks nei		SKH	v	**O**	**o**	**o**	**o**	**o**
Other rays nei		SRX	v	v	v	**o**	**o**	**o**
Other marine fish nei		MZZ	v	**o**	**o**	**o**	**o**	**o**
Marine turtles nei		TTX	**o**	**o**	**o**	**o**	**o**	**o**
Seabirds nei				**o**	**o**			
Marine mammals nei			**o**	**o**	**o**			

Reporting requirements:
O: As from 2008 catch shall be recorded in logbooks and reported to the IOTC
o: As from 2013 catch shall be recorded in logbooks and reported to the IOTC
v: As from 2013 recording and reporting of catches to the IOTC is encouraged

[3] Species in bold indicate those specified as mandatory for reporting in Resolution 13/03 and which are therefore classified as 'main' in this report.

STATUS OF REPORTING

The most common bycatch species with mandatory reporting requirements (shown as **O** and **o**) and other species with voluntary reporting requirements (shown as v) are listed in Table 2. Table 2 summarises those bycatch species identified by the Commission in 2013, through the adoption of IOTC Resolution 13/03 *On The recording of Catch and Effort by fishing vessels in the IOTC Area of Competence* by type of fishery. A comprehensive list of shark species known to occur in Indian Ocean fisheries directed at IOTC species or pelagic sharks is provided in Appendix 2. Species of seabirds and marine turtles are presented in Table 5 and Table 6, respectively. Table 3 provides a summary of the data that have been provided by CPCs for industrial fleets according to the requirements in Table 1. This table includes all parties having reported some of the specified data, regardless of how complete the datasets provided might be. The data sets include:

- Historical data (<2006) on sharks reported according to IOTC requirements
- Nominal catch data for 'main' shark species
- Nominal catch data for all other shark species (including those reported in aggregate)
- Catch and effort data for 'main' shark species
- Catch and effort data for all other shark species (including those reported in aggregate)
- Size frequency data for 'main' sharks species
- Size frequency data for all other shark species
- Estimates of amounts of thresher sharks[4] discarded dead and size frequency distribution of discards.
- Estimates of total incidental catches of seabirds from longline and gillnet fisheries
- Estimates of total incidental catches of marine turtles
- Estimates of total incidental catches of marine mammals

Bycatch data provided by the Regional Observer Scheme

Bycatch data has been provided in reports from scientific observers on board vessels 24m LOA or greater from Australia, China, EU-France, EU-Portugal, Japan, Mozambique, Republic of Korea, South Africa. Reports from scientific observers on board vessels less than 24m LOA have been received from Madagascar.

[4] For the reporting on the quantity of thresher sharks discarded dead and size frequency distribution of discards, it is unclear if the requirements are for the collection of size data on all discards or only for dead discards. Collecting size frequency information on thresher sharks before release may compromise survival of specimens that are caught alive (rates of mortality at capture have been estimated at around 50% in the Atlantic Ocean).

Table 3. Datasets provided by industrial fleets according to IOTC reporting requirements. Grey cells indicate which fleets have reported data for IOTC species, whereas green cells indicate which fleets have provided the bycatch data specified. Results are based on the nominal catch, catch –and-effort and size frequency data held within the databases at the IOTC Secretariat on October 1st 2014 and information on seabirds, marine turtles, mammals and thresher sharks is taken from National Reports to the Scientific Committee or other documents[5].

	BAIT BOAT AUSTRALIA	BAIT BOAT KOREA REP	BAIT BOAT MADAGASCAR	BAIT BOAT EU (SPAIN)	GILL NET IRAN I R	GILL NET PAKISTAN	GILL NET TAIWAN,CHINA	LONG LINE AUSTRALIA	LONG LINE BELIZE	LONG LINE CHINA	LONG LINE EU (FRANCE)	LONG LINE FRANCE (OT)	LONG LINE GUINEA	LONG LINE HONG KONG	LONG LINE INDIA	LONG LINE INDONESIA	LONG LINE IRAN I R	LONG LINE JAPAN	LONG LINE KENYA	LONG LINE KOREA REP	LONG LINE MADAGASCAR	LONG LINE MALAYSIA	LONG LINE MALDIVES	LONG LINE MAURITIUS	LONG LINE MOZAMBIQUE	LONG LINE OMAN	LONG LINE PAKISTAN	LONG LINE PHILIPPINES	LONG LINE EU (PORTUGAL)	LONG LINE SENEGAL	LONG LINE SEYCHELLES	LONG LINE SOUTH AFRICA	LONG LINE EU (SPAIN)	LONG LINE SRI LANKA	LONG LINE TAIWAN,CHINA	LONG LINE TANZANIA	LONG LINE THAILAND	LONG LINE EU (UK)	LONG LINE VANUATU	LONG LINE YEMEN AR RP	PURSE SEINE AUSTRALIA	PURSE SEINE BELIZE	PURSE SEINE EU (FRANCE)	PURSE SEINE FRANCE (OT)	PURSE SEINE IRAN I R	PURSE SEINE JAPAN	PURSE SEINE KOREA REP	PURSE SEINE MALAYSIA	PURSE SEINE MAURITIUS	PURSE SEINE SEYCHELLES	PURSE SEINE EU (SPAIN)	PURSE SEINE SRI LANKA	PURSE SEINE THAILAND
Historic data (<2006)																																																								
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Marine mammals (≥2013)																																																							

[5] Additional reported data sources: Iran port sampling report for gillnets, discard reporting forms from Sri Lanka, Korea, South Africa, Maldives and France and observer reports for Japan longline and EU (France and Spain) purse seine fleets.

The availability of shark nominal catch data over the period 1950–2013 for those shark species identified by the Commission (Table 2), by species, gear type, and year, is presented in Appendix 3. The collection and reporting of catches of sharks caught in association with species managed by the IOTC (tuna and tuna-like species) has been very uneven over time and so the information on the bycatch of sharks gathered in the IOTC database is thought to be very incomplete.

SUMMARY OF FISHERIES DATA AVAILABLE FOR SHARKS

Data available on the total catches of sharks in the Indian Ocean

The total shark nominal catch data are presented in Fig. 1 by CPC. Very few countries have reported catches of sharks for the early years, but the number of countries reporting increases over time. Total reported catches also increase over time with a particularly dramatic increase in reported catches in the 1990s, reaching a peak of approximately 120 000mt in 1999. Since then reported nominal catches have fluctuated and are currently around 100 000mt.

These figures should be reviewed with caution given the historically low reporting rates. In addition to the underestimates from lack of reporting, when the catches are reported they are thought to represent only the catches of those species that are retained onboard without taking in to account discards (nominal catches). In many cases the reported catches refer to dressed weights while no information is provided on the type of processing undertaken, creating more uncertainty in the estimates of catches in live weight equivalents. Nevertheless, reporting rates in recent years have improved substantially (Appendix 3) following the adoption of new measures by the Commission on sharks and other bycatch, which call for IOTC CPCs to collect and report more detailed statistics on bycatch species to the IOTC.

Main reported gear types associated with shark bycatch for IOTC fisheries

Fig. 2 shows the distribution of catches by gear type. Gillnets report the highest nominal catches of sharks in 2013, making up nearly 40% of catches followed by the handline and longline fleets. Of gillnets, the majority comprise standard, unclassified gillnets, followed by gillnet, handline and troll line combinations and gillnet/longline combinations.

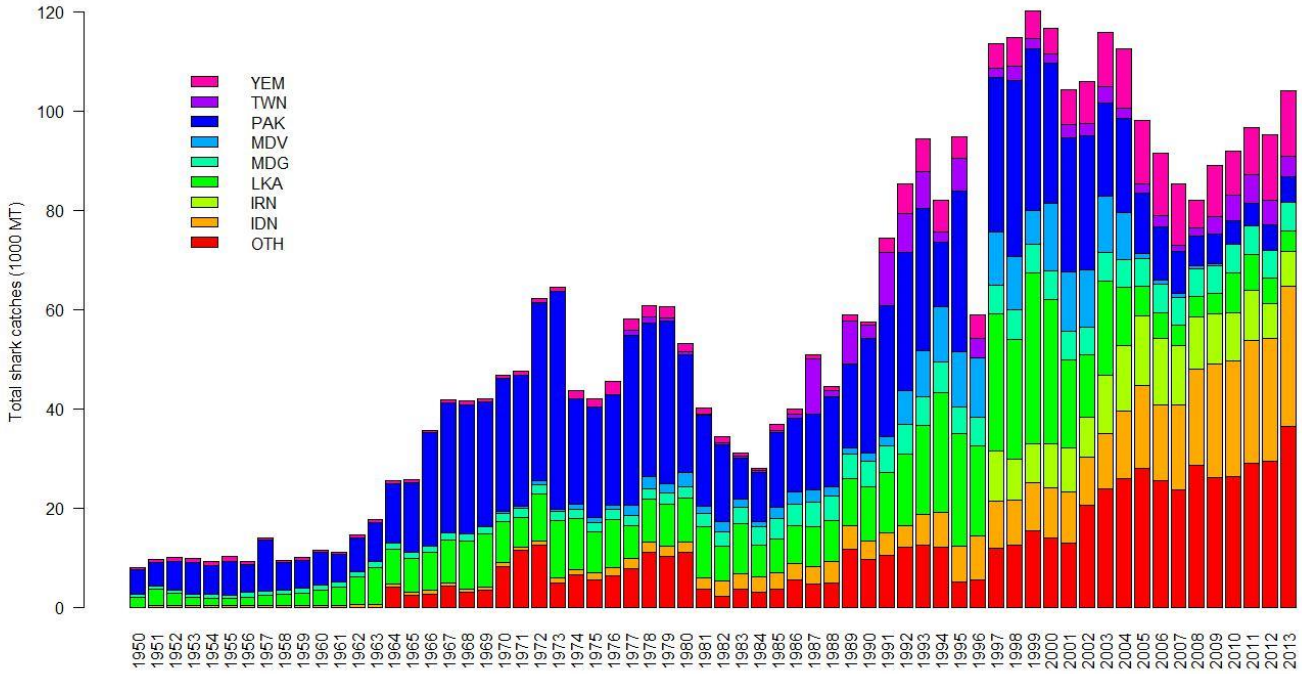


Fig. 1. Total reported nominal catches of sharks by CPC from 1950–2013

Fig. 2. Summary of shark catches reported by gear type (1950–2013). Bait boat/pole and line (BB), gillnet (GILL), Handline (HAND), Line (LINE), logline (LL), Purse seine (PS), small purse seines/ring nets (PSS), troll lines (TROLL) and all other gear types (OTHER).

Main species of sharks caught in IOTC fisheries

A list of all species of sharks that are known to occur in Indian Ocean fisheries directed at IOTC species or pelagic sharks is provided in Appendix 2. In addition to an increase in reporting of shark catches over time, the resolution of the data provided has been improving with an increased proportion of reported shark catches provided identified to species/genus (Fig. 3). Of the shark catches reported by species, the blue shark forms the greatest proportion, comprising >60% of total catches, with silky, thresher, hammerhead and makos forming a smaller percentage (Fig.4).

The increase in reporting by species is apparent in the species-specific catch series (Fig. 5) with steadily increasing trends in reporting since the 1970s seen for blue, thresher, hammerhead and mako sharks. The reporting of catches of oceanic whitetips and rays has increased very rapidly in a much shorter time frame, while the reported catches of silky sharks peak just prior to 2000.

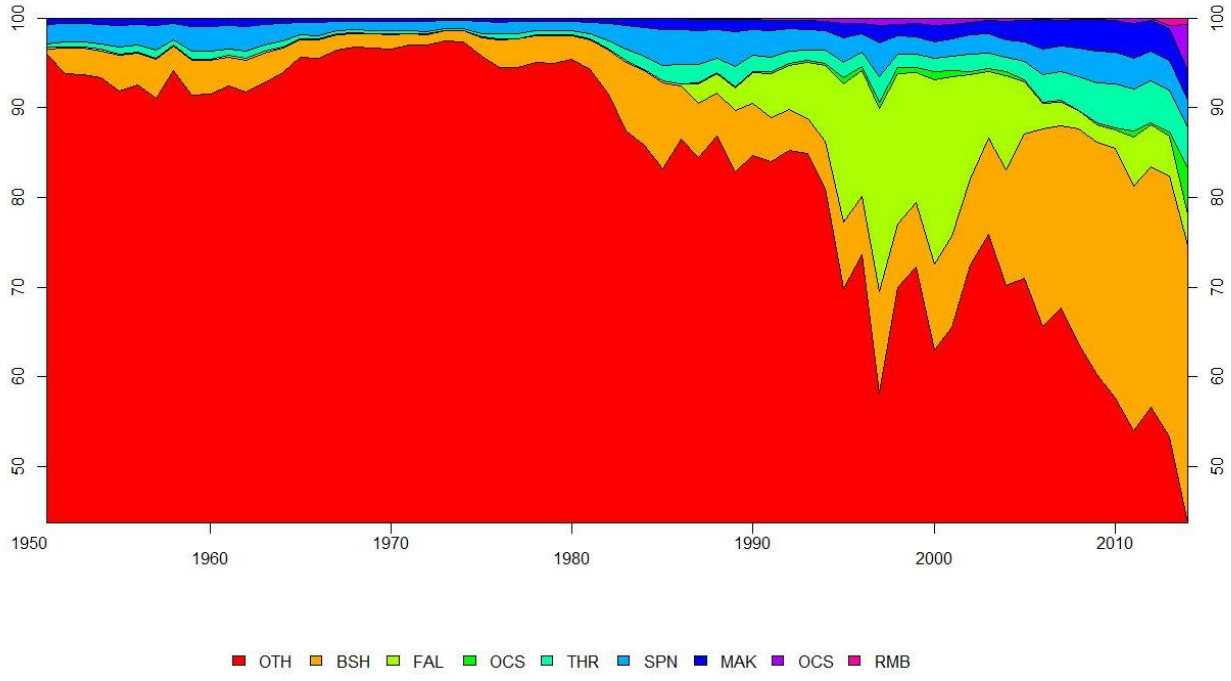


Fig. 3. Proportion of shark catches reported by species and as aggregate catch (OTH).

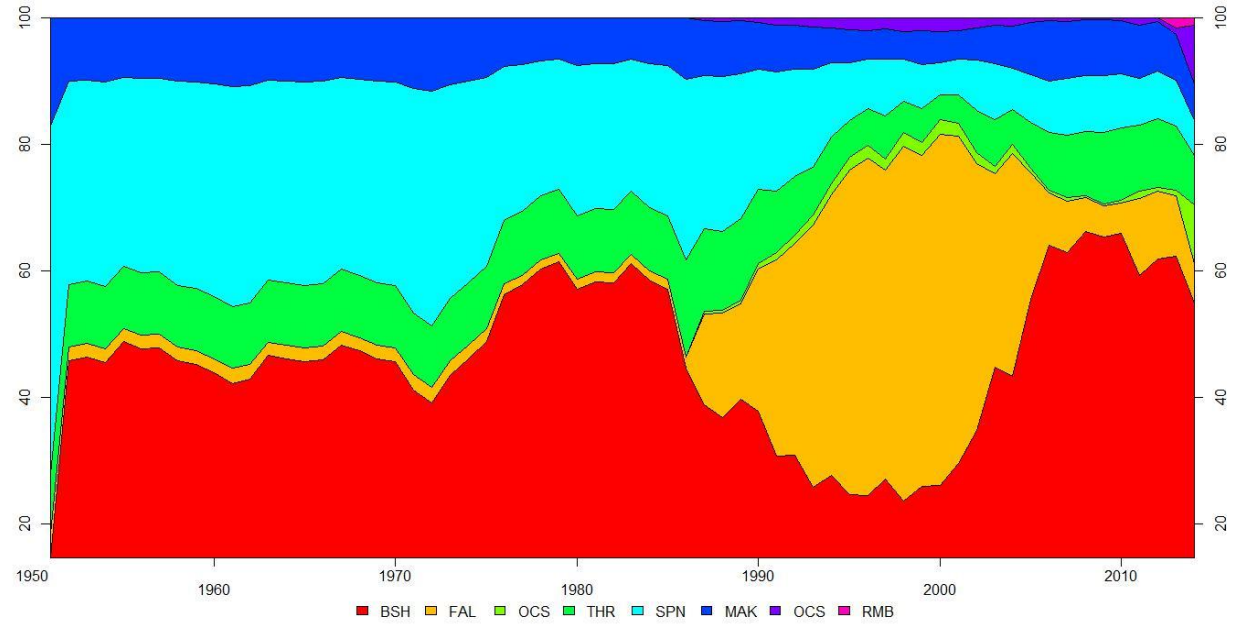
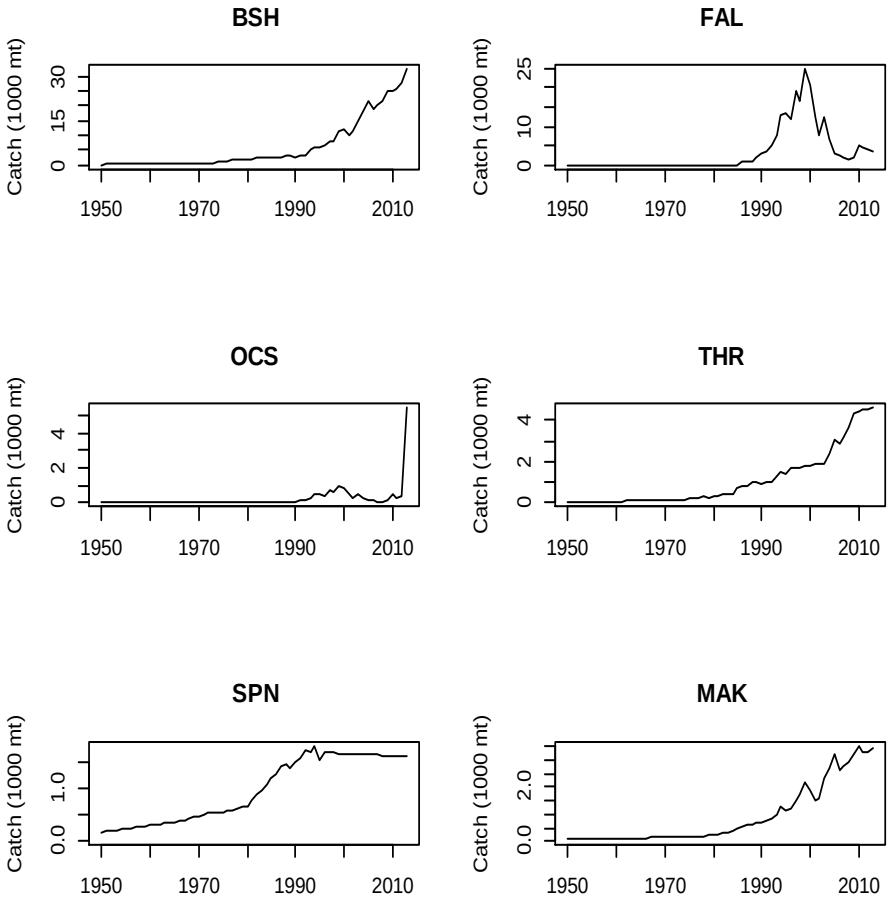


Fig.4. Proportion of reported shark catches by species



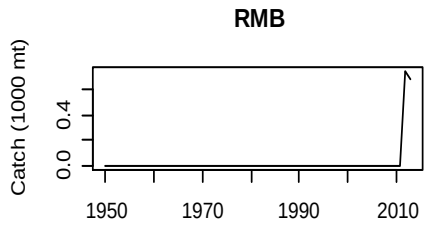


Fig. 5. Catches reported by species for all fleets (1950-2013)

There are some clear trends in species catches by gear types as indicated in (Table 4). Reported catches by longlines comprise predominantly blue sharks followed by mako sharks, while reported catches of handline gears are also dominated by blue sharks, followed by thresher sharks. Silky sharks dominate the reported catches of purse seiners and troll lines reported relatively high catches of hammerhead sharks. Reporting by species is very uncommon for gillnet fleets, where the majority of catches are reported in aggregate.

Table 4. Species-specific catches by gear type (2005–13)

	BB	GILL	HAND	LINE	LL	PS	PSS	TROL
OTH	100%	92%	14%	100%	22%	28%	100%	61%
BSH	0%	3%	59%	0%	56%	0%	0%	0%
FAL	0%	4%	0%	0%	7%	72%	0%	2%
THR	0%	0%	17%	0%	0%	0%	0%	4%
SPN	0%	0%	6%	0%	0%	0%	0%	26%
MAK	0%	0%	3%	0%	10%	0%	0%	8%
OCS	0%	0%	0%	0%	4%	0%	0%	0%

Reported catches and catch rates by fleet

Fleets reporting the highest nominal catches of sharks since 2000 are shown in Fig. 6. This highlights the relatively high catches of the Indonesia line fisheries (including troll lines, hook and line, hand line and coastal longlines) and the gillnet fisheries of Pakistan, I.R. Iran and Yemen.

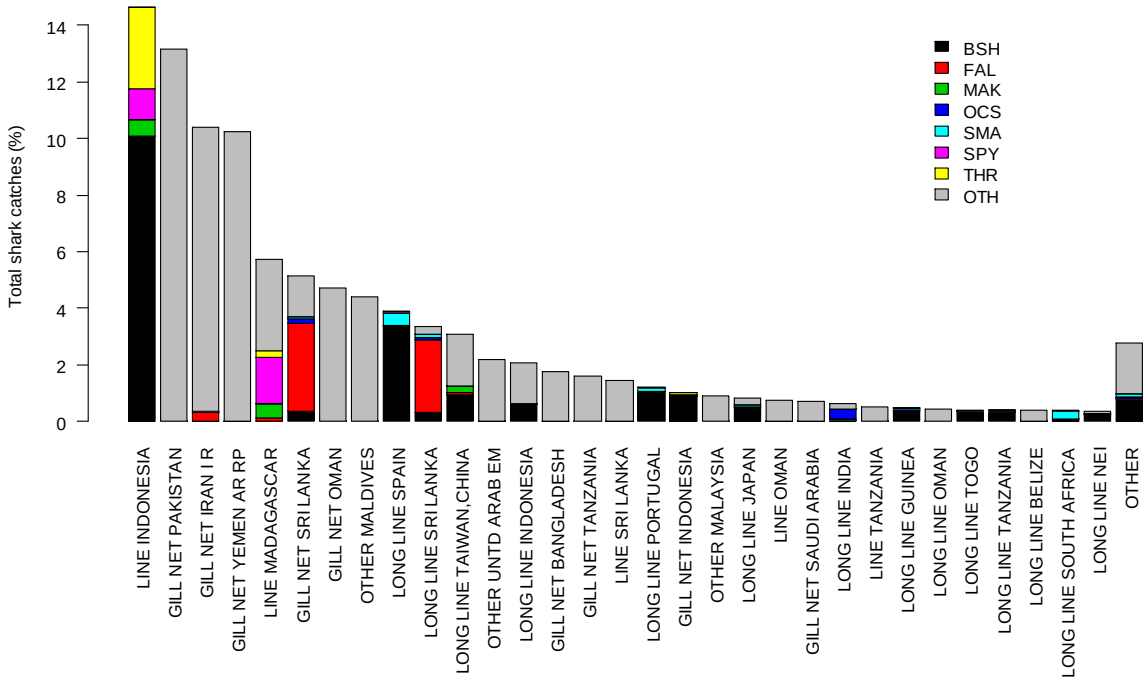


Fig. 6. Total shark catches reported by fleet and species from 2000–13

While industrial longliners and drifting gillnets harvest important amounts of pelagic sharks, industrial purse seiners, pole-and-lines and most coastal fisheries are unlikely to harvest important amounts of pelagic sharks.

- **Pole and line fisheries:** The shark catches reported for the pole and line fisheries of Maldives are very low and none are reported for India. The amounts of sharks caught by these fisheries, if any, are not thought significant.

- **Gillnet fisheries:** The species of sharks caught are thought to vary significantly depending on the area of operation of the gillnets:
    - Gillnets operated in areas having low concentrations of pelagic sharks: The gillnet fisheries of most coastal countries operate these gears in coastal waters. The abundance of pelagic sharks in these areas is thought low.
    - Gillnets operated in areas having high concentrations of pelagic sharks: Gillnets operated in Sri Lanka, Indonesia and Yemen (waters around Socotra), in spite of being set in coastal areas, are likely to catch significant amounts of pelagic sharks.
- **Gillnets operated on the high seas:** Vessels from Taiwan,China were using drifting gillnets (driftnets) from 1982 to 1992, when the use of this gear was banned worldwide. The catches of pelagic sharks were very high during that period. Driftnet vessels from Iran and Pakistan have been fishing on the high seas since, but with lower catch rates. This was initially in waters of the Arabian Sea but covering a larger area in recent years as they expanded their range to include the tropical waters of the western Indian Ocean and Mozambique Channel. The quantity of sharks caught by these fleets is thought to be relatively high, representing between 25–50% of the total combined catches of sharks and other species.

- **Gillnet/longline fishery of Sri Lanka:** Between 1 200 and 3 200 vessels (12 m average length) operating gillnets and longlines in combination have been harvesting important amounts of pelagic sharks since the mid-1980s. The longlines are believed to be responsible for most of the catches of sharks. Catches of sharks comprised ~45% of the total combined catch for all species in 1995 and declined to <2% in the late 2000s. Catches of sharks by vessel by year have also decreased markedly since the mid-1990s.

- **Fisheries using handlines:** The majority of fisheries using hand lines and trolling in the Indian Ocean operate these gears in coastal waters, so although the total proportion of sharks caught has been high historically, the amount of pelagic sharks caught are thought to be low. The proportion of other species of sharks might change depending on the area fished and time of the day.

- **Deep-freezing tuna longliners** and **fresh-tuna longliners**: Catches of sharks are thought to represent between 20–40% of the total combined catch for all species. However, the catches of sharks recorded in the IOTC database only make for a small proportion of the total catches of all species over longline fleets. The catches series for sharks are, therefore, thought to be very incomplete. However, levels of reporting have improved in recent years, following the implementation of catch monitoring schemes in different ports of landing of fresh-tuna longliners[6], and the recording of catches of main species of sharks in logbooks and observer programmes. The catches estimated, however, are unlikely to represent the total catches of sharks for this fishery due to the paucity of information on levels of discards of sharks, which are thought high in some areas and for some species.
- **Freezing (fresh) swordfish longliners**: Catches of sharks are thought to represent between 40–60% of the total combined catch for all species. The amount of sharks caught by longliners targeting swordfish in the Indian Ocean has been monotonically increasing since the mid-1990s. The catches of sharks recorded for these fleets are thought more realistic than those recorded for other longline fisheries. The high catches are thought to be due to:
    - Gear configuration and time fished: The vessels targeting swordfish use surface longlines and set the lines at dusk or during the night. Many pelagic sharks are thought to be abundant at these depths and most active during dusk or night hours.
    - Area fished: The fleets targeting swordfish have been deploying most of the fishing effort in the Southwest Indian Ocean, in the vicinity of South Africa, southern Madagascar, Reunion and Mauritius. High amounts of sharks are thought to occur in these areas.

[6] The IOTC-OFCF (Overseas Fisheries Cooperation Foundation of Japan) Project implemented programmes in cooperation with local institutions in Thailand and Indonesia.

  - Changes in the relative amounts of swordfish and sharks in the catches: Some of the vessels targeting swordfish are known to alternate swordfish and sharks, in particular blue shark, as main target, depending on the season, or when catch rates of swordfish are poor.

- **Industrial tuna purse seiners:** Catches of sharks are thought to represent less than 0.5% of the total combined catch for all species (10% of total discards). In 2012, the European Union reported preliminary estimates of catches of sharks for EU-France purse seiners for the period 2003–2010, as derived from samples collected by observers during 2003–07. The Secretariat has started receiving information on the Iranian purse sine fleet but has not received data from other purse seine fleets concerning bycatch levels of sharks (Seychelles or Thailand).
- **Trolling fisheries:** The majority of fisheries trolling in the Indian Ocean operate in coastal waters so the amounts of pelagic sharks caught are thought to be low. The amount that other species of sharks make out of the catches of tuna and tuna-like species might change depending on the area fished and time of the day.

Spatial information on sharks catches

Fig. 7 and Fig. 8 present the spatial catches of sharks reported in numbers for deep-freezing longliners flagged in Taiwan,China over time. The reporting by species has improved over time, indicating that the majority of the catches are Blue sharks with an increase in catches of silky sharks in the northern Indian Ocean apparent in recent years. The presence of low numbers of dusky sharks in the reported catches are somewhat surprising given its coastal distribution but may reflect species identification errors.

Fig. 9 shows the shark catches reported by the Japanese longline fleet from 2009-2013. These show a clear dominance of Blue sharks, followed by relatively minor catches of shortfin mako and porbeagle sharks. However, it is important to note that time-area catches of sharks by species are only available from 2007 for Taiwan,China or 2009 for Japan, while these fleets have been operating in the Indian Ocean since the 1950s. Unlike Taiwan,China, for which catches of sharks are available in aggregated form up to the late 1970s, Japan has not provided catches of sharks other than those reported for 2009 and following years. In addition, the catches available are considered to be incomplete, as they are likely to not include discards. Time area catches of sharks are also available from some other fleets, as recorded in Table 3.

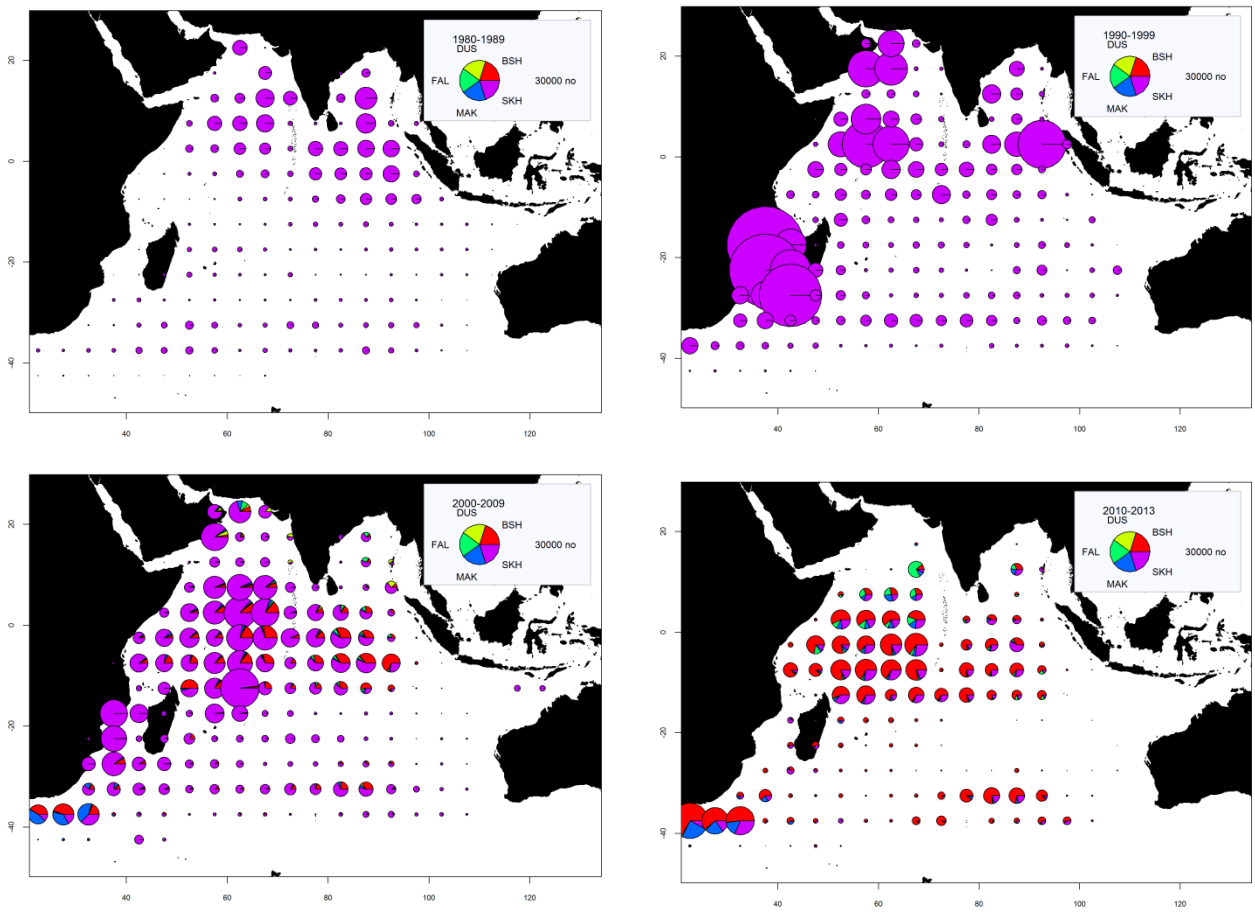


Fig. 7. Time-area catches (total numbers) of sharks for deep-freezing longliners flagged in Taiwan,China, by decade (also including 2010-2013) and species. Unidentified sharks catches are shown in purple.

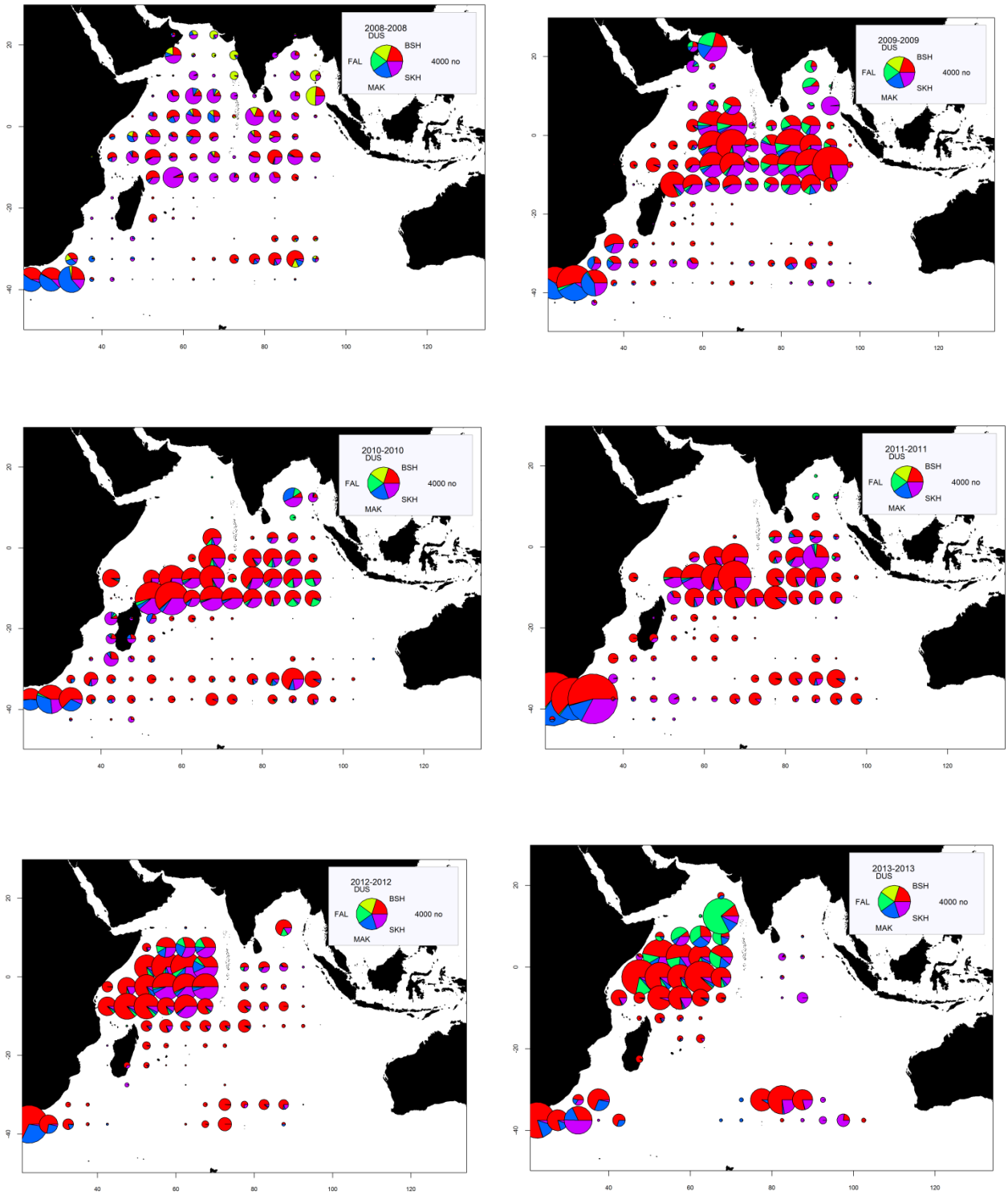


Fig. 8. Time-area catches (total numbers) of sharks for deep-freezing longliners flagged in Taiwan,China, by year (2008-2013) and species. Unidentified sharks catches are shown in purple.

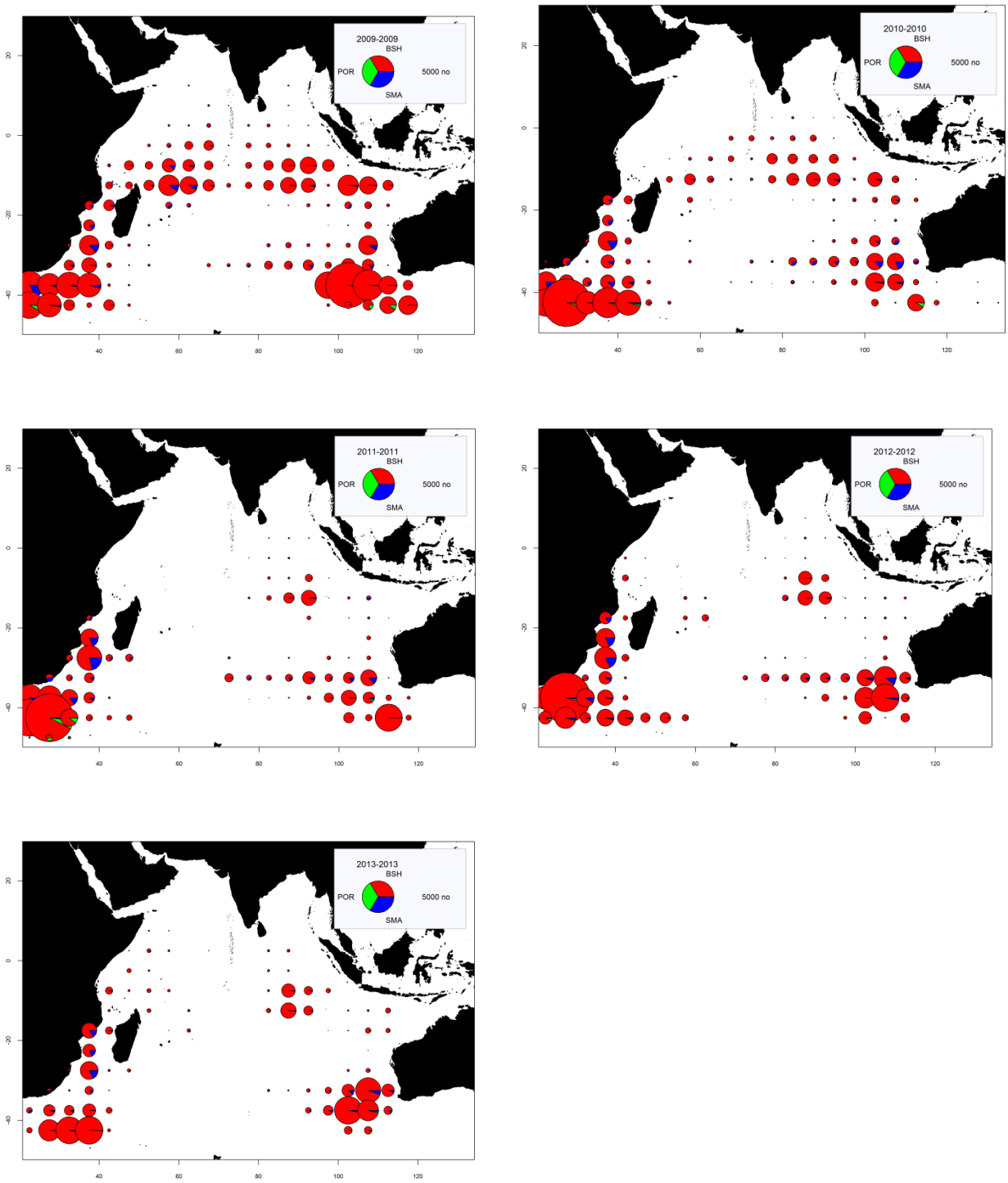


Fig. 9. Time-area catches (total numbers) of sharks for deep-freezing longliners flagged in Japan by year (2009-2013) and species.

Length frequency data

Due to the different types of length measurement reported, a number of conversions were performed to standardise the length-frequency information. Given the increasing amount of data reported and the need for standardisation, a set of species-specific conversion factors and proxies that have been agreed by the Working Party could help improve the estimates. Conversion factors currently used are provided in Appendix 4.

Data are reported aggregated using different length classes ranging from 1cm to 10cm intervals. In addition to this, there appears to be rounding taking place when the smaller size intervals are used, creating abnormal peaks in the distributions. The graphs shown below have been aggregated to 5cm intervals in order to smooth this effect.

Fig. 10 shows the aggregated fork length frequency distribution for the longline fleets reporting size information on blue sharks for all areas between 2005 and 2013. The data reported for vessels flagged for China, Japan, Korea and Portugal include data reported for longline fleets with observers onboard. The results highlight the difference in the selectivity of fleets for different sized specimens, with the EU (Portuguese) fleet selecting larger blue sharks than the other fleets.

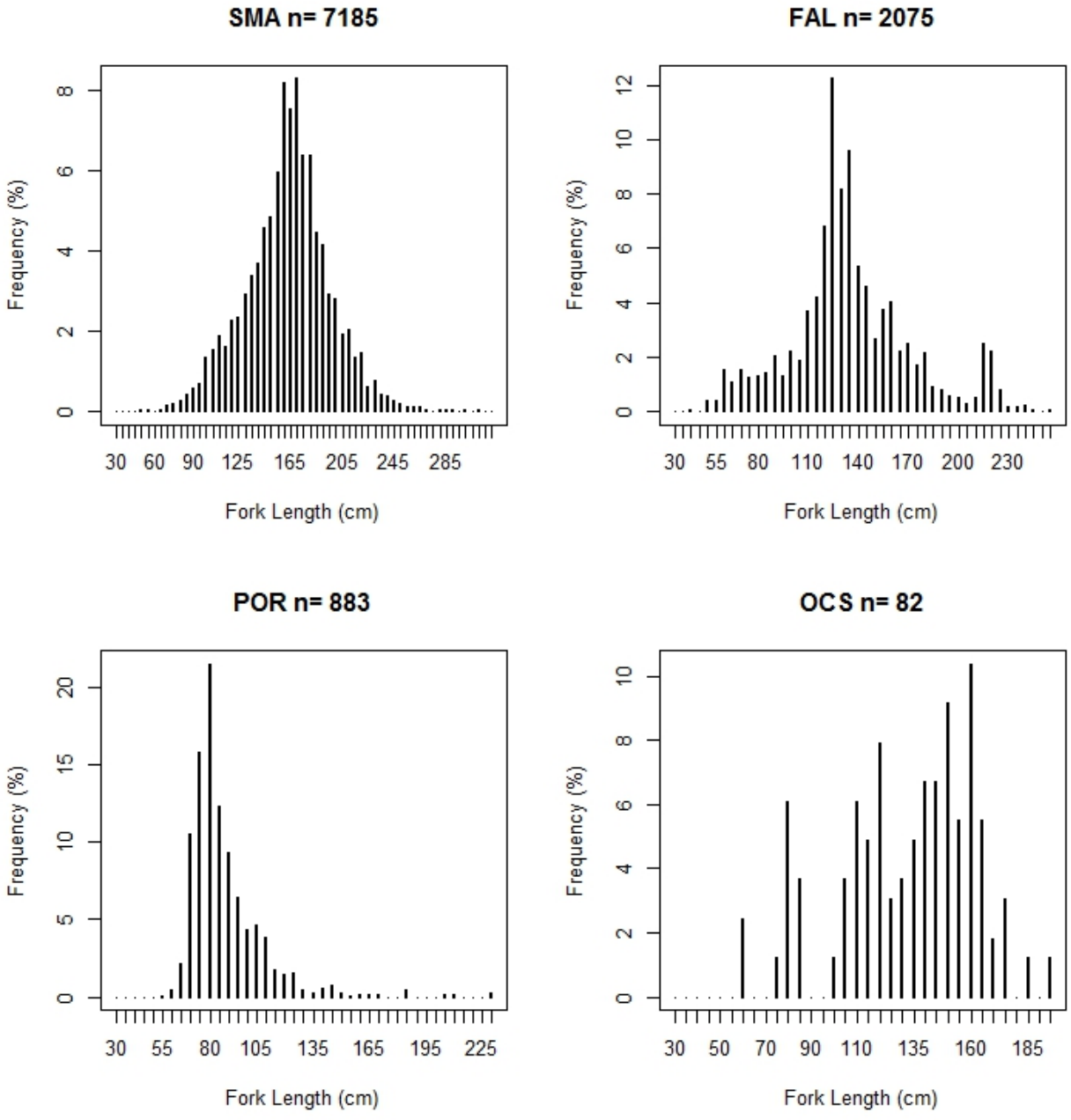


Fig. **11** shows the length distributions for the other shark species with reported size frequency data aggregated across all fleets and all years.

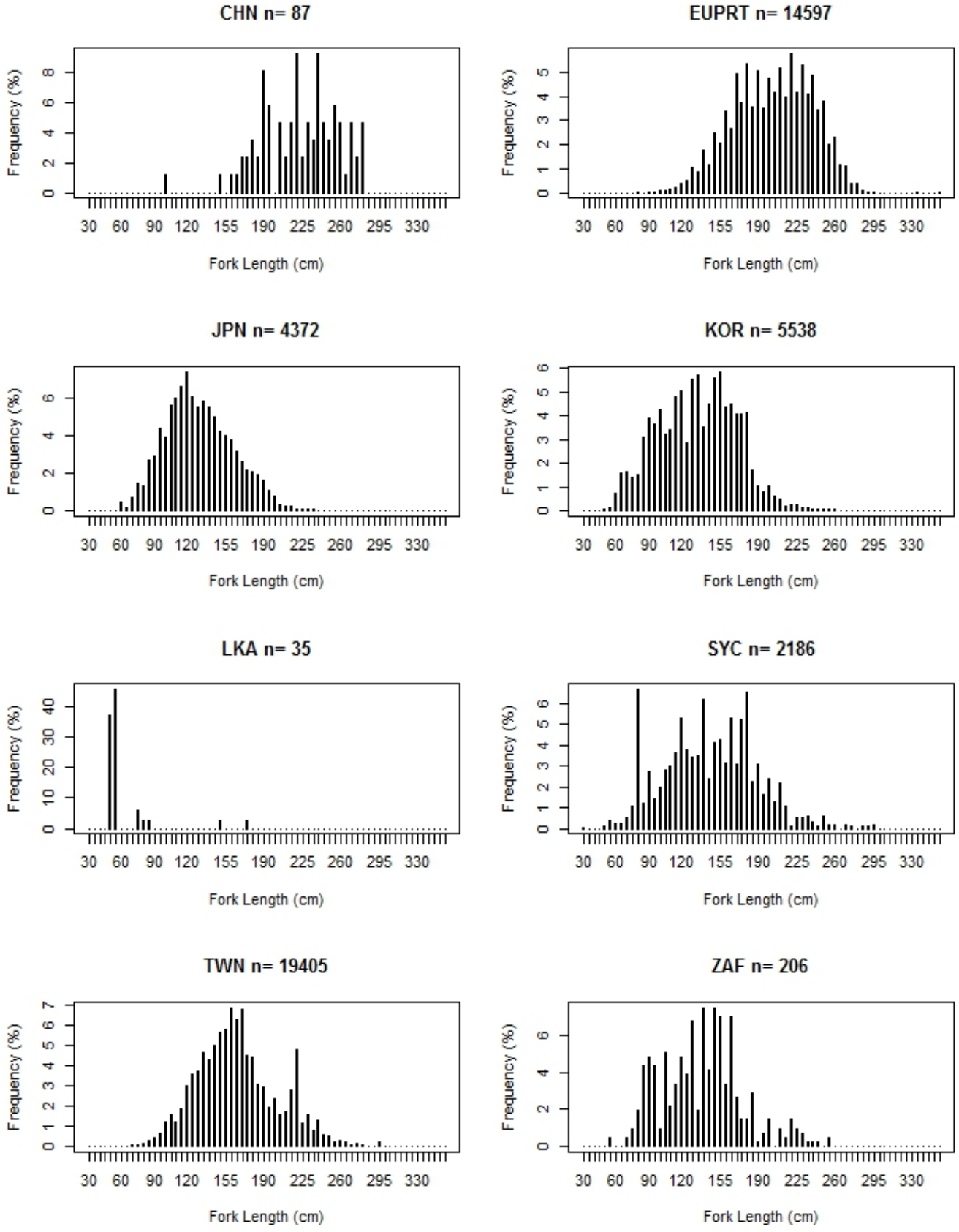


Fig. 10. Fork length frequency distributions (%) of blue shark derived from the samples reported for the longline fleets of China (LL), EU(Portugal) (ELL), Japan (LL), Korea (LL), Sri Lanka (G/L), Seychelles (LL) Portugal (ELL), Taiwan,China (FLL/LL) and South Africa (ELL) between 2005 and 2013 in 5 cm length classes.

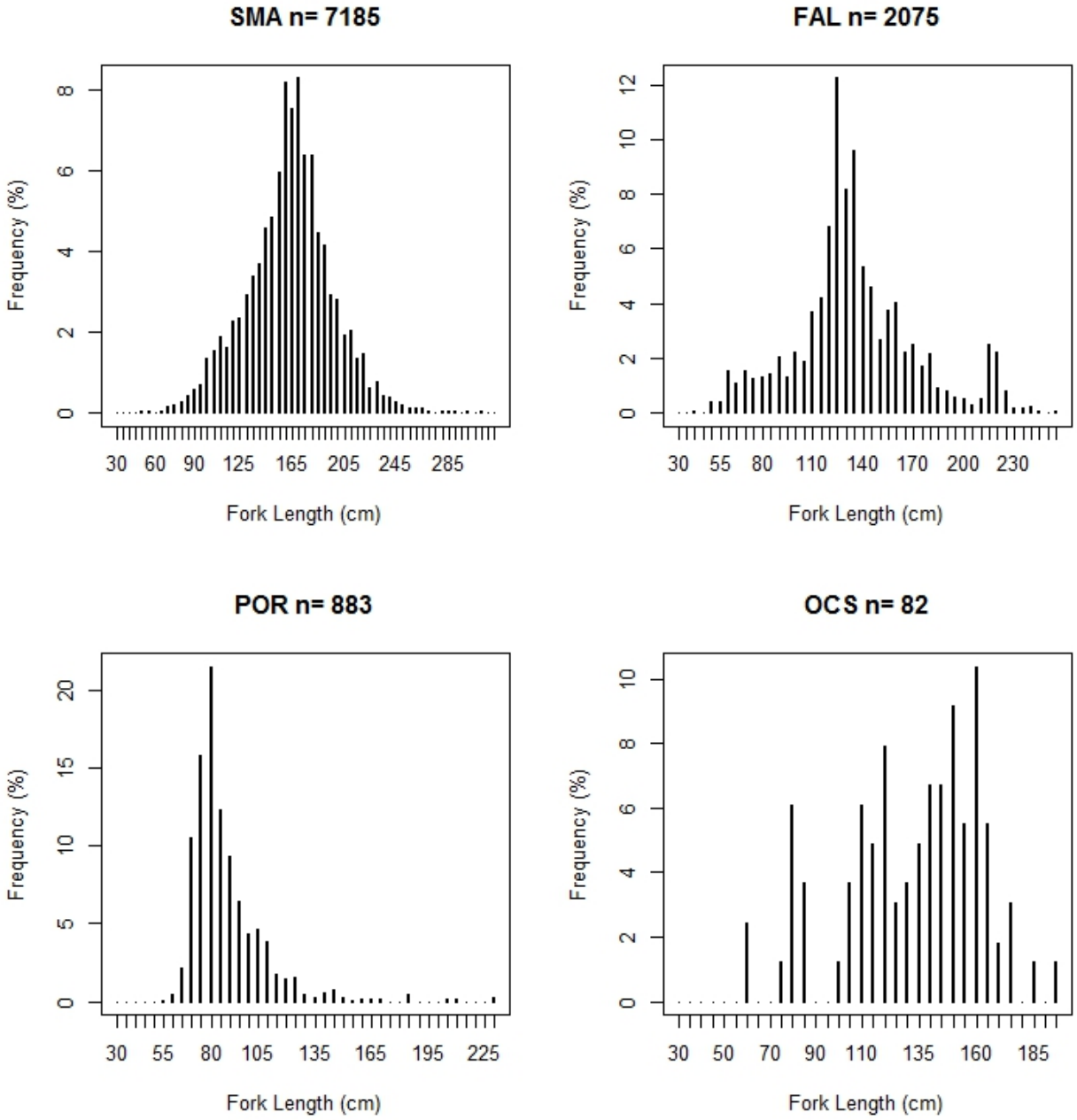


Fig. 11. Fork length frequency distributions (%) for silky, porbeagle, shortfin mako and oceanic whitetip sharks between 2005 and 2013.

SUMMARY OF FISHERIES DATA AVILABLE FOR SEABIRDS

Main species and fisheries concerned

The main species of seabirds likely to be caught as bycatch in IOTC fisheries are presented in Table 5[7].

Table 5. Main species of seabirds likely to be incidentally caught on longline operations

Common Name	Status*	Scientific Name
Amsterdam Albatross	Critically Endangered	*Diomedea amsterdamensis*
Antipodean Albatross	Vulnerable	*Diomedea antipodensis*
Black-browed Albatross	Endangered	*Thalassarche melanophrys*
Buller's Albatross	Near Threaten	*Thalassarche bulleri*
Campbell Albatross	Vulnerable	*Thalassarche impavida*
Chatham Albatross	Vulnerable	*Thalassarche eremite*
Grey-headed Albatross	Vulnerable	*Thalassarche chrysostoma*
Light-mantled Albatross	Near Threatened	*Phoebetria palpebrata*
Northern Royal Albatross	Endangered	*Diomedea sanfordi*
Southern Royal Albatross	Vulnerable	*Diomedea epomophora*
Salvin's Albatross	Vulnerable	*Thalassarche salvini*
Shy Albatross	Near Threatened	*Thalassarche cauta*
White-capped Albatross	Near Threatened	*Thalassarche steadi*
Sooty Albatross	Endangered	*Phoebetria fusca*
Tristan Albatross	Critically Endangered	*Diomedea dabbenena*
Wandering Albatross	Vulnerable	*Diomedea exulans*
Atlantic Yellow-nosed Albatross	Endangered	*Thalassarche chlororhynchos*
Indian Yellow-nosed Albatross	Endangered	*Thalassarche carteri*
Northern Giant Petrel	Least Concern	*Macronectes halli*
Southern Giant Petrel	Least Concern	*Macronectes giganteus*
White-chinned Petrel	Vulnerable	*Procellaria aequinoctialis*
Westland Petrel	Vulnerable	*Procellaria westlandica*
Short-tailed Shearwater	Least Concern	*Puffinus tenuirostris*
Sooty Shearwater	Near Threatened	*Puffinus griseus*

*****Source IUCN 2006, BirdLife International 2004b.

The interaction between seabirds and IOTC fisheries is likely to be significant only in Southern waters (below 25 degrees South), an area where most of the effort is exerted by longliners. Incidental catches are, for this reason, likely to be of importance only for longline fleets having vessels operating in these areas (Taiwan,China, Japan, Rep. of Korea, the European Union, Indonesia, and Malaysia).

[7] As in IOTC–2007–WPEB–22, Appendix 2, page 24. Paper submitted on behalf of the Agreement for the Conservation of Albatrosses and Petrels (ACAP)

Status of data on seabird bycatch

The parties having provided data on interactions of IOTC fisheries with species of seabirds are recorded in Table 3. These are Australia, Japan, EU-France, EU-Portugal, France (OT), Republic of Korea, South Africa, China (nil capture), and Taiwan,China. Some information on the incidental catches of seabirds by some longline fleets operating in the Southern Indian Ocean is also held by the Secretariat. The data available were provided by the CCSBT and are to be completed with more recent information in the future.

The paucity of the information available makes it difficult to estimate total levels of seabird bycatch by vessels in the IOTC area of competence.

SUMMARY OF FISHERIES DATA AVILABLE FOR MARINE TURTLES

Main species and fisheries concerned

The main species of marine turtles likely to be caught as bycatch by IOTC fisheries are listed in Table 6.

Table 6. Main species of Indian Ocean marine turtles[8].

Common Name	Scientific Name
Loggerhead turtle	*Caretta caretta*
Olive ridley turtle	*Lepidochelys olivacea*
Green turtle	*Chelonia mydas*
Hawksbill turtle	*Eretmochelys imbricata*
Leatherback turtle	*Dermochelys coriacea*
Flatback turtle	*Natator depressus*

The interaction between marine turtles and IOTC fisheries is likely to be significant only in tropical areas, involving both industrial and artisanal fisheries, notably for:

- Industrial purse seine fisheries, in particular on sets using fish aggregating devices (European Union, Seychelles, Iran, Thailand, Japan)
- Gillnet fisheries operating in coastal waters or on the high seas (Sri Lanka, Iran, Pakistan, Indonesia)
- Industrial longline fisheries operating in tropical areas (China, Taiwan,China, Japan, Indonesia, Seychelles, India, Oman)

Both loggerhead and leatherback turtles are caught incidentally on IOTC fisheries in higher numbers than the other species.

Status of data on marine turtle bycatch

The parties having provided data on interactions of IOTC fisheries with species of marine turtles are recorded in Table 3. These are, by type of fishery:

- Surface: EU-France; EU-Spain
- Longline: Australia; China (nil capture), Taiwan,China, EU-France, EU-Portugal, EU-Spain, EU-UK, France (OT), Japan, Republic of Korea, South Africa
- Driftnet: None

The paucity of the information available makes it difficult to estimate levels of marine turtle bycatch by species.

[8] Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia

MAIN ISSUES IDENTIFIED CONCERNING DATA ON NON-IOTC SPECIES AVAILABLE TO THE IOTC

General issues

There are a number of key issues with the data that are apparent from this summary. The main points are discussed below.

- Unreported catches

Although some fleets have been operating since 1950, there are many cases where historical catches have gone unreported as many countries were not collecting fishery statistics in years prior to 1970. It is therefore thought that important catches of sharks might have gone unrecorded in several countries. There are also a number of fleets which are still not reporting on their interactions with bycatch species, despite fleets using similar gears reporting high catch rates of bycatch.

Some fleets have also been noted to report catches by species only for those that have been specifically identified by the Commission and do not report catches of other species even in aggregate form. This creates problems for the estimation of total catches of all sharks and for attempts to apportion aggregate catches into species groups at a later date. The changing requirements for species-specific reporting also complicates the interpretation of these data.

- Errors in reported catches

For the fleets that do report interactions, there are a number of issues with these estimates. The estimates are sometimes based on retained catches rather than total catches, and so if discarding is high then this is a major source of error. Errors are also introduced due to the processing of the retained catches that is undertaken. This creates problems for calculating total weight or numbers, as sometimes dressed weight might be recorded instead of live weights. For high levels of processing, such as finning where the carcasses are not retained, the estimation of total live weight is extremely difficult.

- Poor resolution of data

Historically, shark catches have not been reported by species but simply as an aggregated total, however, the proportion of catches reported by species has increased substantially in recent years. Misidentification of shark species is also common. Processing creates further problems for species identification, requiring a high level of expertise and experience in order to be able to accurately identify specimens, if at all. The level of reporting by gear type is much higher and catches reported with no gear type allocated form a small proportion of the total.

The main consequence of this is that the estimation of total catches of sharks in the Indian Ocean is compromised by the paucity of the data available.

The following list is provided by the IOTC Secretariat for the consideration of the WPEB. The list covers the main issues which the Secretariat considers affect the quality of the statistics available at the IOTC, by type of dataset and type of fishery.

SHARKS

1. **Catch-and-Effort data from gillnet fisheries:**
   - Drifting gillnet fisheries of Iran and Pakistan: To date, Iran and Pakistan have not reported catches of sharks, by species, for their gillnet fisheries.
   - Gillnet/longline fishery of Sri Lanka: Sri Lanka has not reported catch-and-effort data for sharks as per the IOTC standards.
   - Driftnet fishery of Taiwan,China (1982–92): Catch-and-effort data does not include catches of sharks by species.
2. **Catch-and-Effort data from Longline Fisheries:**
   - Historical catches of sharks from major longline fisheries: To date, Japan, Taiwan,China, Indonesia and Rep. of Korea, have not provided estimates of catches of sharks, by species, for years before 2006.
   - Fresh-tuna longline fisheries of Indonesia and Malaysia: Indonesia and Malaysia have not reported catches of sharks by IOTC standards for longliners under their flag. In addition Indonesia has not reported catch-and-effort data for its longline fishery to date.
   - Freezing longline fisheries of EU-Spain, India, Indonesia, Malaysia, and Oman: These countries have not reported catch-and-effort data of sharks by species for longliners under their flag.
3. **Catch-and-Effort data from coastal fisheries:**
   - Coastal fisheries of India, Indonesia, Madagascar, Sri Lanka and Yemen: To date, these countries have not provided detailed catches of sharks to the IOTC, in particular Thresher and other pelagic shark species caught by their coastal fisheries.
4. **Discard levels from surface and longline fisheries:**
   - Discard levels of sharks from major longline fisheries: To date the EU(Spain), Japan and Indonesia, have not provided estimates of total discards of sharks, by species, in particular thresher sharks and oceanic whitetip sharks, although the EU, Japan and Rep. of Korea are reporting observer data.
   - Discard levels of sharks for industrial purse seine fisheries: To date, the European Union (before 2003), Iran, Japan, Seychelles, and Thailand, have not provided estimates of total quantities of discards of sharks, by species, for industrial purse seiners under their flag, although the EU and Japan are reporting observer data.
5. **Size frequency data:**
   - Gillnet fisheries of Iran and Pakistan: To date, Iran and Pakistan have not reported size frequency data for their driftnet fisheries.
   - Longline fisheries of India, Malaysia, Oman and Philippines: To date, these countries have not reported size frequency data for their longline fisheries, including length frequency of discards of thresher sharks.
   - Coastal fisheries of India, Indonesia, Madagascar, Sri Lanka and Yemen: To date, these countries have not reported size frequency data for their coastal fisheries.
6. **Biological data:**
   - Surface and longline fisheries, in particular China, Taiwan,China, Indonesia and Japan: The Secretariat had to use length-age keys, length-weight keys, ratios of fin-to-body weight, and processed weight-live weight keys for sharks from other oceans due to the general paucity of biological data available from the Indian Ocean.

General issues with the data across the majority of fleets that are apparent from this summary include:

- Unreported catches

Although some fleets have been operating since 1950, there are many cases where historical catches have gone unreported as many countries were not collecting fishery statistics in years prior to 1970. It is therefore thought that important catches of sharks might have gone unrecorded in several countries. There are also a number of fleets which are still not reporting on their interactions with bycatch species, despite fleets using similar gears reporting high catch rates of bycatch.

- Errors in reported catches

For the fleets that do report interactions, there are a number of issues with these estimates. The estimates are sometimes based on retained catches rather than total catches, and so if discarding is high then this is a major source of error. Errors are also introduced due to the processing of the retained catches that is undertaken. This creates problems for calculating total weight or numbers, as sometimes dressed weight might be recorded instead of live weights. For high levels of processing, such as finning where the carcasses are not retained, the estimation of total live weight is extremely difficult.

- Poor resolution of data

Historically, shark catches have not been reported by species but simply as an aggregated total, however, the proportion of catches reported by species has increased substantially in recent years. Misidentification of shark species is also common. Processing creates further problems for species identification, requiring a high level of expertise and experience in order to be able to accurately identify specimens, if at all. The level of reporting by gear type is much higher and catches reported with no gear type allocated form a small proportion of the total.

The main consequence of this is that the estimation of total catches of sharks in the Indian Ocean is compromised by the paucity of the data available.

OTHER BYCATCH

1. Incidental catches of SEABIRDS:

- Longline fisheries operating in areas with high densities of seabirds. Seychelles has not reported incidental catches of seabirds for longliners under their flag.

2. Incidental catches of MARINE TURTLES:

- Gillnet fisheries of Pakistan: to date, there have been no reports on incidental catches of marine turtles for the driftnet fisheries.
- Longline fisheries of Malaysia, Oman, Philippines, and Seychelles: To date, these countries have not reported incidental catches of marine turtles for their longline fisheries.
- Purse seine fisheries of the EU (excluding 2003–07 and EU-France), Iran, Japan, Seychelles, and Thailand: To date these countries have not reported incidental catches of marine turtles for their purse seine fisheries, including incidental catches of marine turtles on Fish Aggregating Devices.

While the CPCs that have not provided any information have been mentioned specifically here, there are still many CPCs that are providing data that are not consistent with the IOTC minimum reporting standards. This includes not reporting bird bycatch data by species and not providing an estimation of the total mortality of marine turtles incidentally caught in their fisheries.

APPENDIX 1

OVERVIEW OF MINIMUM DATA REPORTING REQUIREMENTS

All bycatch

- IOTC Resolution 10/02: ***Mandatory statistical requirements*** *for IOTC Members and Cooperating Non-Contracting Parties (CPC's)*
    - *Paragraph 3(end): These* ***provisions***[9]*,* ***applicable to*** *tuna and tuna-like species, shall also be applicable to the most commonly caught* ***shark species*** *and, where possible, to the less common shark species. CPC's are also* ***encouraged*** *to record and provide data on* ***species other than sharks*** *and tunas taken as bycatch.*
- IOTC Resolution 13/03: *On the* ***recording of catch and effort by fishing vessels*** *in the IOTC area of competence*
    - *Paragraph 1: Each flag CPC shall ensure that all* ***purse seine, longline, gillnet, pole and line, handline, and trolling*** *fishing vessels flying its flag and authorized to fish species managed by IOTC be* ***subject to a data recording system****.*
    - *Paragraph 10: The Flag State and the States which receive this information shall* ***provide all the data*** *for any given year to the* ***IOTC Secretariat*** *by June 30th of the following year* ***on an aggregated basis****. The confidentiality rules set out in Resolution 12/02 Data Confidentiality Policy and Procedures for fine–scale data shall apply.*
- IOTC Resolution 11/04: *On a* ***regional observer scheme***
    - *Paragraph 2: In order to improve the collection of scientific data, 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. For vessels under 24 meters if they fish outside their EEZ, the above mentioned coverage should be achieved progressively by January 2013.*
    - *Paragraph 4: The number of the* ***artisanal*** *fishing vessels landings shall also be monitored at the landing place by field samplers. The indicative level of the coverage of the artisanal fishing vessels should progressively increase towards 5% of the total levels of vessel activity (i.e. total number of vessel trips or total number of vessels active).*
    - *Paragraph 11: The* ***observer*** *shall, within 30 days of completion of each trip, provide a* ***report*** *to the CPCs of the vessel. The CPCs shall send* ***within 150 days*** *at the latest each report, as far as continuous flow of report from observer placed on the longline fleet is ensured, which is recommended to be provided with* ***1°x1° format*** *to the Executive Secretary, who shall make the report available to the Scientific Committee upon request. In a case where the vessel is fishing in the EEZ of a coastal State, the report shall equally be submitted to that coastal State.*

Sharks

- IOTC Resolution 05/05: *Concerning the conservation of* ***SHARKS*** *caught in association with fisheries managed by IOTC*
    - *Paragraph 1: Contracting Parties, Cooperating non-Contracting Parties (CPCs) shall annually report data for catches of sharks, in accordance with IOTC data reporting procedures, including available historical data.*
- IOTC Resolution 12/09: *On the conservation of* ***THRESHER SHARKS*** *(family Alopiidae) caught in association with fisheries in the IOTC Area of Competence*
    - *Paragraph 1: This measure shall apply to all fishing vessels on the IOTC Record of authorised Vessels.*
    - *Paragraph 4: CPCs shall* ***encourage*** *their* ***fishers*** *to record and* ***report incidental catches*** *as well as* ***live releases****. These data will be then kept at the IOTC Secretariat.*

[9] Refers to nominal catch, catch-and-effort, and size frequency data for sharks

- *Paragraph 8: The Contracting Parties, Co-operating non-Contracting **Parties**, especially those **directing fishing activities for sharks**, shall **submit data for sharks**, as required by IOTC data reporting procedures.*

- IOTC Resolution 13/05: *On the conservation of **WHALE SHARKS** (Rhincodon typus)*

  - *Paragraph 1: This measure shall apply to all fishing vessels flying the flag of a CPC and on the IOTC Record of Fishing Vessels or authorised to fish for tuna and tuna-like species managed by the IOTC on the high seas. The provisions of this measure do not apply to artisanal fisheries operating exclusively in their respective EEZ.*

  - *Paragraph 3: CPCs shall require that, in the event that a whale shark is unintentionally encircled in the **purse seine net**, the master of the vessel shall:*

    b) report the incident to the relevant authority of the flag State, with the following information:

    *i. the **number of individuals**;*
    *ii. a short **description of the interaction**, including details of how and why the interaction occurred, if possible;*
    *iii. the **location** of the encirclement;*
    iv. the steps taken to ensure safe release;
    *v. an assessment of the life **status** of the animal **on release**, including whether the whale shark was released alive but subsequently died.*

  - *Paragraph 4: CPCs using **other gear types** fishing for tuna and tuna-like species associated with a whale shark shall **report all interactions** with whale sharks to the relevant authority of the flag State and include all the information outlined in paragraph 3b(i–v).*

  - *Paragraph 7: **CPCs shall report the information and data collected under paragraph 3(b) and paragraph 4** through logbooks, or when an observer is onboard through observer programs, and **provide to the IOTC Secretariat** by 30 June of the following year and according to the timelines specified in Resolution 10/02 (or any subsequent revision).*

  - *Paragraph 8: **CPCs shall report**, in accordance with Article X of the IOTC Agreement, **any instances in which whale sharks have been encircled by the purse seine nets** of their flagged vessels.*

  - *Paragraph 9: For **CPCs having national and state legislation** for protecting the species shall be exempt from reporting to IOTC, but are **encouraged to provide data** for the IOTC Scientific Committee consideration.*

- IOTC Resolution 13/06: *On a scientific and management framework on the conservation of **SHARK** species caught in association with IOTC managed fisheries*

  - *Paragraph 5: **CPCs** shall **encourage their fishers to record incidental catches as well as live releases of OCEANIC WHITETIP SHARKS**. These **data shall be kept at the IOTC Secretariat**.*

  - *Paragraph 8: The **CPCs, especially those targeting sharks**, shall **submit data for sharks**, as required by IOTC data reporting procedures.*

Seabirds

- IOTC Resolution 12/06 *On reducing the incidental bycatch of **SEABIRDS** in **longline fisheries***

  - *Paragraph 1 (start): CPCs shall **record data on seabird incidental bycatch by species**, notably through scientific observers in accordance with Resolution 11/04 and report these annually.*

  - *Paragraph 2: CPCs that have not fully implemented the provisions of the IOTC Regional Observer Scheme outlined in paragraph 2 of Resolution 11/04 shall **report seabird incidental bycatch through logbooks**, including details of species, if possible.*

Marine turtles

- IOTC Resolution 12/04 *On the conservation of **MARINE TURTLES***

  - *Paragraph 3: CPCs shall **collect** (including through logbooks and observer programs) and **provide to the IOTC Secretariat** no later than 30 June of the following year in accordance with Resolution 10/02 (or any subsequent revision), **all data on their vessels' interactions with marine turtles**. The data shall include the level of logbook or observer coverage and an **estimation of total mortality of marine turtles** incidentally caught in their fisheries.*

Marine mammals

- IOTC Resolution 13/04 *On the conservation of* ***CETACEANS***
    - *Paragraph 1: This measure shall apply to all fishing vessels flying the flag of a CPC and on the IOTC Record of Fishing Vessels or authorised to fish tuna and tuna-like species managed by the IOTC on the high seas. The provisions of this measure do not apply to artisanal fisheries operating exclusively in their respective EEZ.*
    - *Paragraph 3: CPCs shall require that, in the event that a cetacean is unintentionally encircled in a* ***purse seine net****, the master of the vessels shall:*

        b) report the incident to the relevant authority of the flag State, with the following information:
        i. the ***species*** *(if known);*
        ii. the ***number of individuals****;*
        iii. a short description of the ***interaction****, including details of how and why the interaction occurred, if possible;*
        iv. the ***location*** *of the encirclement;*
        v. the steps taken to ensure safe release;
        vi. an assessment of the ***life status*** *of the animal on release, including whether the cetacean was released alive but subsequently died.*

    - *Paragraph 4: CPCs using* ***other gear types*** *fishing for tuna and tuna-like species associated with cetaceans shall* ***report all interactions with cetaceans*** *to the relevant authority of the flag State and include all the information outlined in paragraph 3b(i–vi).*
    - *Paragraph 7:* ***CPCs shall report the information and data collected under paragraph 3(b) and paragraph 4****, through logbooks, or when an observer is onboard through observer programs, and* ***provide to the IOTC Secretariat*** *by 30 June of the following year and according to the timelines specified in Resolution 10/02 (or any subsequent revision).*
    - *Paragraph 8:* ***CPCs shall report****, in accordance with Article X of the IOTC Agreement, any* ***instances in which cetaceans have been encircled by the purse seine nets*** *of their flagged vessels.*
    - *Paragraph 9 (part): For* ***CPCs having national and state legislation*** *for protecting these species shall be exempt from reporting to IOTC, but are* ***encouraged to provide data*** *for the IOTC Scientific Committee consideration.*

APPENDIX 2

SHARK SPECIES THAT ARE KNOWN TO OCCUR ON FISHERIES DIRECTED AT IOTC SPECIES OR SHARKS

Code	English Name	Source	French Name	Scientific Name
AML	Grey Reef Shark	IOTC	Requin dagsit	*Carcharhinus amblyrhynchos*
BLR	Blacktip reef shark	IOTC	Requin pointes noires	*Carcharhinus melanopterus*
BRO	Copper shark	IOTC	Requin cuivre	*Carcharhinus brachyurus*
CCB	Spinner Shark	IOTC	Requin tisserand	*Carcharhinus brevipinna*
CCG	Galapagos shark	IOTC[3]	Requin des Galapagos	*Carcharhinus galapagensis*
DOP	Shortnose spurdog	IOTC	Aiguillat nez court	*Squalus megalops*
DUS	Dusky shark	IOTC	Requin de sable	*Carcharhinus obscurus*
GAG	Tope shark	IOTC	Requin-hâ	*Galeorhinus galeus*
GAM	Mouse Catshark	IOTC	Chien islandais	*Galeus murinus*
NTC	Broadnose sevengill shark	IOTC	Platnez	*Notorhynchus cepedianus*
OXY	Angular rough shark	IOTC	Centrine commune	*Oxynotus centrina*
SBL	Bluntnose sixgill shark	IOTC	Requin griset	*Hexanchus griseus*
SCK	Kitefin shark	IOTC	Squale liche	*Dalatias licha*
SHBC	Banded catshark	IOTC	Holbiche des plages	*Halaelurus lineatus*
SHCW	Cow sharks	IOTC	Requins griset	*Hexanchidae spp.*
SMD	Smooth-hound	IOTC	Emissole lisse	*Mustelus mustelus*
SPZ	Smooth hammerhead	IOTC	Requin marteau commun	*Sphyrna zygaena*
SSQ	Velvet dogfish	IOTC	Squale grogneur velouté	*Scymnodon squamulosus*
SSU	Australian angelshark	IOTC	Ange de mer australien	*Squatina australis*
AGN	Angelsharks, sand devils nei	FAO	Ange de mer commun	*Squatina squatina*
CCD	Whitecheek shark	IOTC[1]	Requin joues blanches	*Carcharhinus dussumieri*
CCM	Hardnose shark	IOTC[1]	Requin nez rude	*Carcharhinus macloti*
CCQ	Spot-tail shark	IOTC[1]	Requin queue tachet	*Carcharhinus sorrah*
CEM	Smallfin gulper shark	FAO[2]	Squale-chagrin cagaou	*Centrophorus moluccensis*
CLD	Sliteye shark	IOTC[3]	Requin sagrin	*Loxodon macrorhinus*
CPU	Little gulper shark	FAO[2]	Petit squale-chagrin	*Centrophorus uyato*
CYT	Ornate dogfish	FAO[2]	Aiguillat élégant	*Centroscyllium ornatum*
MTM	Arabian smooth-hound	IOTC[3]	Emissole d'Arabie	*Mustelus mosis*
ODH	Bigeye sand tiger shark	FAO[2]	Requin noronhai	*Odontaspis noronhai*
ORI	Slender bambooshark	FAO[2]	Requin-chabot élégant	*Chiloscyllium indicum*
ORR	Grey bambooshark	FAO[2]	Requin-chabot gris	*Chiloscyllium griseum*
ORZ	Tawny nurse shark	FAO[2]	Requin nourrice fauve	*Nebrius ferrugineus*
OSF	Zebra shark	FAO[2]	Requin zèbre	*Stegostoma fasciatum*
PWS	Sawsharks nei	FAO	Requins scies nca	*Pristiophorus spp*
RHA	Milk shark	IOTC[3]	Requin museau pointu	*Rhizoprionodon acutus*
SHL	Lanternsharks nei	FAO	Sagres nca	*Etmopterus spp*
SLA	Spadenose shark	IOTC[1]	Requin épée	*Scoliodon laticaudus*
RHN	Whale shark	IOTC[1]	Requin baleine	*Rhincodon typus*
PTH	Pelagic thresher	IOTC[1]	Renard pelagique	*Alopias pelagicus*
BTH	Bigeye thresher	IOTC[1]	Renard a gros yeux	*Alopias superciliosus*
ALV	Thresher	IOTC[1]	Renard	*Alopias vulpinus*
SMA	Shortfin mako	IOTC[1]	Taupe bleue	*Isurus oxyrinchus*
LMA	Longfin mako	IOTC[1]	Petite taupe	*Isurus paucus*
PSK	Crocodile shark	IOTC[1]	Crocodile shark	*Pseudocarcharias kamoharai*
ALS	Silvertip shark	IOTC[1]	Requin pointe blanche	*Carcharhinus albimarginatus*
FAL	Silky shark	IOTC[1]	Requin soyeux	*Carcharhinus falciformis*
OCS	Oceanic whitetip	IOTC[1]	Requin océanique	*Carcharhinus longimanus*
CCP	Sandbar shark	IOTC[1]	Requin gris	*Carcharhinus plumbeus*
TIG	Tiger shark	IOTC[1]	Requin tigre commun	*Galeocerdo cuvier*
BSH	Blue shark	IOTC[1]	Peau bleue	*Prionace glauca*
SPL	Scalloped hammerhead	IOTC[1]	Requin marteau halicorne	*Sphyrna lewini*

Code	English Name	Source	French Name	Scientific Name
POR	Porbeagle	IOTC[1]	Requin-taupe commun	*Lamna nasus*
WSH	Great White Shark	IOTC[1]	Grand requin blanc	*Carcharodon carcharias*
CWZ	Other Requiem Sharks	IOTC[1]	Requins Carcharhinus nca	*Carcharhinus spp*
SPN	Hammerhead Sharks	IOTC[1]	Requins marteau nca	*Sphyrna spp*

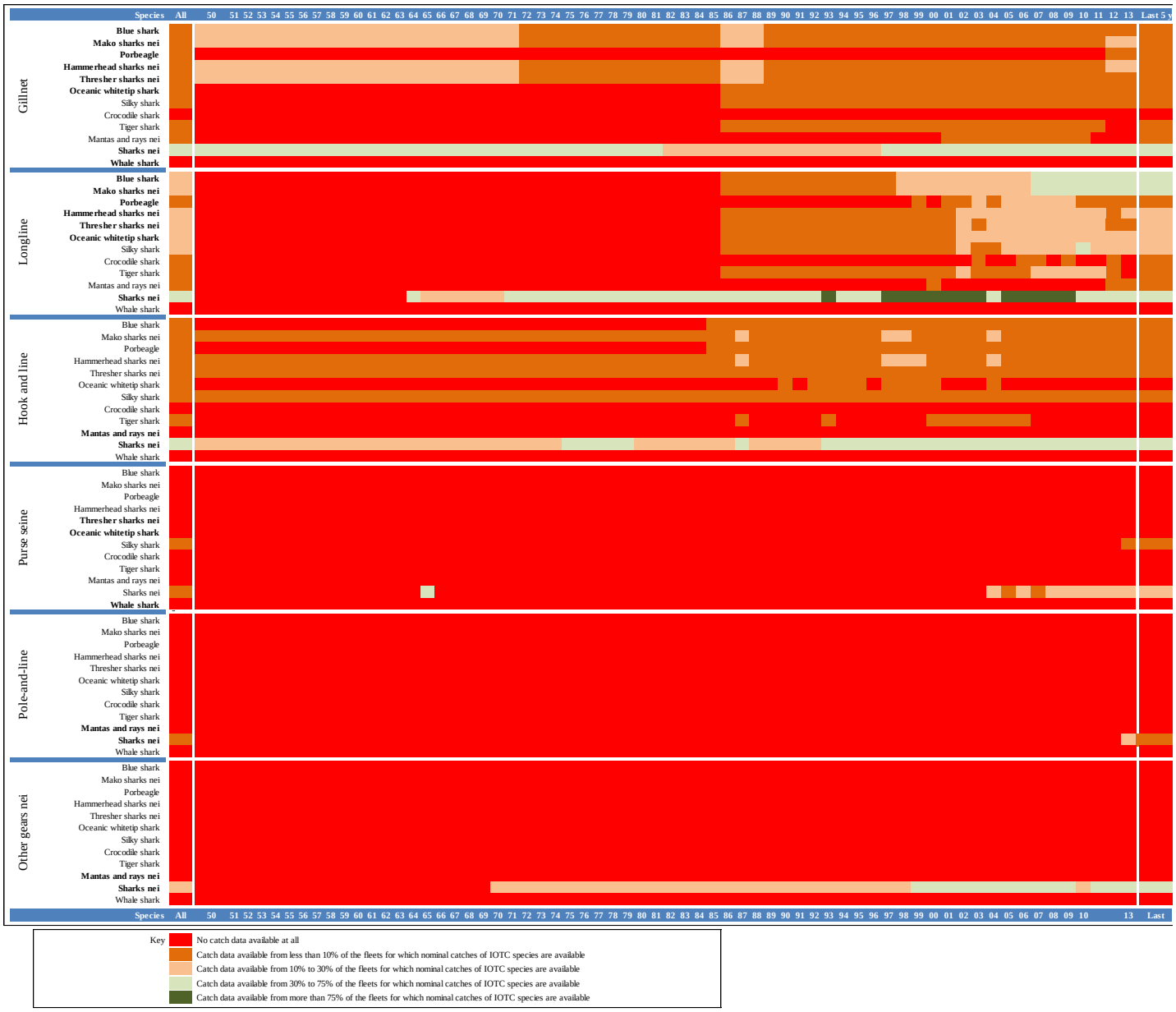
Note that most of the catches of sharks are not available by species and when available by species they are not considered to be an unbiased sample of the catch in the Indian Ocean

1. IOTC–2007–WPEB–13 (Sharks of India)
2. FAO: Case studies of the management of elasmobranch fisheries
3. IOTC: Information collected in Yemen by the IOTC/OFCF Project

APPENDIX 3
AVAILABILITY OF CATCH DATA FOR SHARKS BY GEAR

Availability of catch data for the main shark species expressed as the proportion of fleets for which catch data on sharks are available out of the total number of fleets[10] for which data on IOTC species are available, by fishery, species of shark, and year, for the period 1950–2013.

Shark species in bold are those identified as mandatory for reporting by the Commission in 2013, for which data shall be recorded in logbooks and reported to the IOTC Secretariat; reporting of catch data for other species can be done in aggregated form (i.e. all species combined as ***sharks nei*** or ***mantas and rays nei***).
Hook and line refers to fisheries using handline and/or trolling and ***Other gears nei*** to other unidentified fisheries operated in coastal waters.
Catch rates of sharks on pole-and-line fisheries are thought to be nil or negligible.
Average levels of reporting for 1950–2013 and 2009–2013 are shown in columns ***All*** and ***Last***, respectively.



[10] The definition of fleets has changed since the previous report. Previously a fleet fishing in two areas were considered as two separate fleets, whereas here they are considered as one.

APPENDIX 4

ESTIMATION OF CATCHES AT SIZE FOR IOTC SHARK SPECIES

Table 1: Equations used to convert from non-standard measurement to fork length and from fork length to round weight.

Species	*From type measurement — To type measurement*	*Equation*	*Parameters*	*n*	*FL range*	*IOTC reported data*
Blue shark (BSH) *Prionace glauca*	Fork length – Round Weight(kg)[A]	$RND=a.L^b$	a= 0.0000031841 b= 3.1313	4529	52-288	No. of samples: 46 440 Min: 13 cm Max: 357 cm
	Precaudal length – Fork Length[B]	$FL=\frac{PCL+b}{a}$	a= 0.9075 b= 0.3956	n/a	n/a	
	Total length – Fork length[C]	FL=a.TL+b	a= 0.8561 b= -4.5542	6485	n/a	
	Fork length (unconverted tape measure) – Fork Length[D]	FL = a.FLUT+b	a= 0.98 b= -0.8	782	n/a	
Shortfin Mako (SMA) *Isurus oxyrinchus*	Fork length – Round Weight[A]	$RND=a.L^b$	a= 0.0000052432 b= 3.1407	2081	65-338	No. of samples: 7186 Min: 52 cm Max: 323 cm
	Precaudal length – Fork Length[B]	FL=a.PCL+b	a= 1.100 b= 0.766	n/a	n/a	
	Total length – Fork length[C]	FL=a.TL+b	a= 0.9047 b= 0.5963	1114	n/a	
	Fork length (unconverted tape measure) – Fork Length	FL=a.TL+b	a= 0.968 b= -0.973	n/a	n/a	
Oceanic whitetip (OCS) *Carcharhinus longimanus*	Fork length – Round Weight[C]	$RND= a.L^b$	a= 0.000018428 b= 2.9245	n/a	n/a	No. of samples: 82 Min: 62 cm Max: 197 cm
	Total length – Fork length[C]	FL=a.TL+b	a= 0.8602 b= -7.2885	n/a	n/a	
Porbeagle (POR) *Lamna nasus*	Fork length – Round Weight[A]	$RND=a.L^b$	a= 0.000014823 b= 2.9641	15	106-227	No. of samples: 901 Min: 50 cm Max: 233 cm
	Precaudal length – Fork Length[B]	FL=a.PCL+b	a= 1.098 b= 1.99	n/a	n/a	
Silky Shark (FAL) *Carcharhinus falciformis*	Fork length – Round Weight[A]	$RND=a.L^b$	a= 0.000015406 b= 2.9221	n/a	n/a	No. of samples: 2075 Min: 42 cm Max: 257 cm
	Total length – Fork length[C]	FL=a.TL+b	a= 0.8113 b=1.0883	520	n/a	
Bigeye Thresher (BTH) *Alopias superciliosus*	Fork length – Round Weight[E]	$RND=a.L^b$	a= 0.00001413 b= 2.99565	185	110-256	No. of samples: 42 Min: 14 cm Max: 169cm
Thresher (ALV) *Alopias vulpinus*	Fork length – Round Weight[A]	$RND=a.L^b$	a= 0.00018821 b= 2.5188	88	154-262	No. of samples: 1
Crocodile Shark (PSK) *Pseudocarcharias kamoharai*	Fork length – Round Weight[D]	$RND= a.L^b$	a= 0.00033532 b= 2.1156	n/a	n/a	No. of samples: 118 Min: 70 cm Max: 140 cm
	Total length – Fork length[C]	FL=a.TL+b	a=0.8083 b=7.1478	407	62-103	
Scalloped hammerhead (SPL) *Sphyrna lewini*	Fork length – Round Weight[A]	$RND=a.L^b$	a=0.000000777 b=3.0669	390	79-423	No. samples
	Total length – Fork length[C]	FL=a.TL+b	a=0.7994 b=-1.0546	20	115-230	
Smooth hammerhead (SPZ) *Sphyrna zygaena*	Total length – Fork length[C]	FL=a.TL+b	a=0.8039 b=-4.3490	70	114-262	No. of samples: 3

A: Data from Western North Atlantic: Kohler, N.E., Casey, J.G and Truner, P.A. (1996). Length-length and length-weight relationships for 13 shark species from the Western North Atlantic. NOAA Technical Memorandum NMFS-NE-110, p83.

B: Inverse equation from north Pacific: Clarke, S., Yokawa, K., Matsunaga, H and Nakano, H (2011). Analysis of North Pacific Shark Data from Japanese Commercial Longline and Research/Training Vessel Records. WCPFC-SC7-2011/EB-WP-02.

C: Data from Indian Ocean: Ariz J, A Delgado de Molina, M.L Ramos, J.C Santana (2007). Length-weight relationships, conversion factors and analyses of sex-ratio, by length-range, Observers onboard Spanish Longliners in South Western Indian Ocean during 2005. IOTC-2007-WPEB-04.

D: Data from the Canadian Atlantic: Campana, S.E., Marks, L., Joyce, W. and Kohler, N. (2005). Catch, bycatch and indices of population status of Blue shark (Prionace glauca) in the Canadian Atlantic. Collect. Vol. Sci. Pap. ICCAT, 58(3): 891-934.

E: Data from the Soviet Indian Ocean Taun Longline Research Programme: Romanov, E.V., Romanova, N.V. (2012). Size distribution and length-weight relationships for some large pelagic sharks in the Indian Ocean. Communication 2. Bigeye thresher shark, tiger shark, silvertip shark, sandbar shark, great hammerhead shark and scalloped hammeread shark. IOTC-2012-WPEB08-22.

Alternative equations

Blue shark:

- *Campana et al., 2005.*
- *Romanov, E., 2012, conversion factors from standard length to fork length for Blue shark, email correspondence to IOTC Secretariat, July 2013.*

Shortfin Mako shark:

- *Kohler, et al., 1996.*
- *Romanov, E., 2012, conversion factors from standard length to fork length for Shortfin Mako shark, email correspondence to IOTC Secretariat, July 2013.*

Portbeagle shark:

- *Kohler, et al., 1996.*

Silky shark:

- *Kohler, et al., 1996.*

Bigeye Thresher shark:

- *Kohler, et al., 1996.*

Scalloped hammerhead shark:

- *Kohler, et al., 1996.*
- *Romanov & Romanova, 2012.*

Table 2: Number and proportion of samples reported to the IOTC Secretariat by measurement type and shark species.

	Eye-Fork Length (unconverted tape measure lengths)	Fork length	Fork length (unconverted tape measure lengths)	Precaudal length	Total length	Total no. of samples
Blue shark		42102	1	1554	2783	46440
Bigeye thresher		37	5			42
Silky shark		2067	8			2075
Longfin mako	1	12			16	29
Oceanic whitetip shark		74			8	82
Porbeagle		680		203	18	901
Crocodile shark		94			24	118
Pelagic Thresher Shark					1	1
Requiem sharks nei					333	333
Sharks various nei		1			6	7
Shortfin mako	1	6992	5	66	122	7186
Scalloped hammerhead			3			3

	Eye-Fork Length (unconverted tape measure lengths)	Fork length	Fork length (unconverted tape measure lengths)	Precaudal length	Total length	Total
Blue shark		91%	0%	3%	6%	100%
Bigeye thresher		88%	12%			100%
Silky shark		100%	0%			100%
Longfin mako	3%	41%			55%	100%
Oceanic whitetip shark		90%			10%	100%
Porbeagle		75%		23%	2%	100%
Crocodile shark		80%			20%	100%
Pelagic Thresher Shark					100%	100%
Requiem sharks nei					100%	100%
Sharks various nei		14%			86%	100%
Shortfin mako	0%	97%	0%	1%	2%	100%
Scalloped hammerhead			100%			100%
Total	2	52060	22	1823	3324	57231

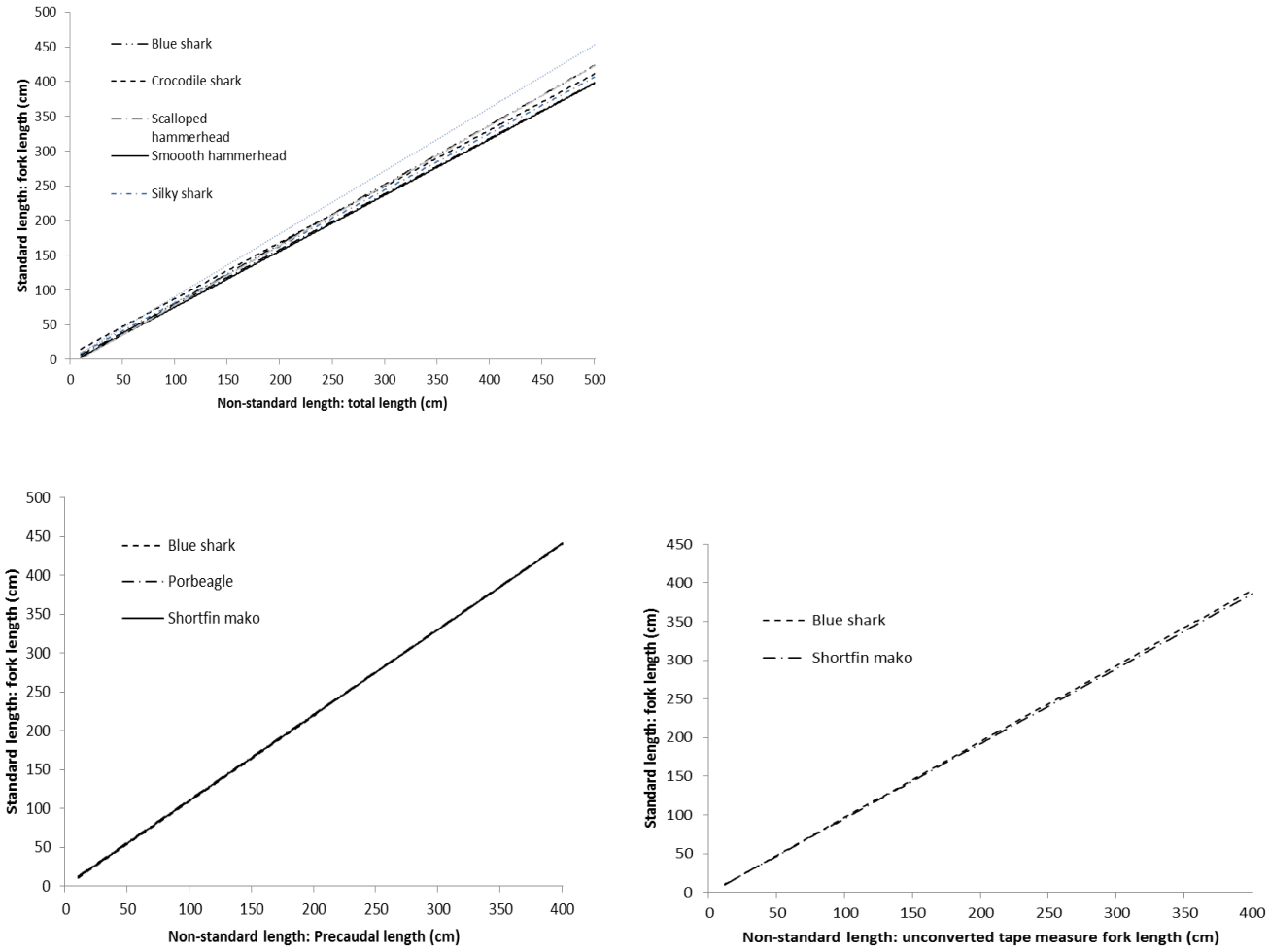


Fig. 1. Conversion equations from non-standard to standard length by shark species

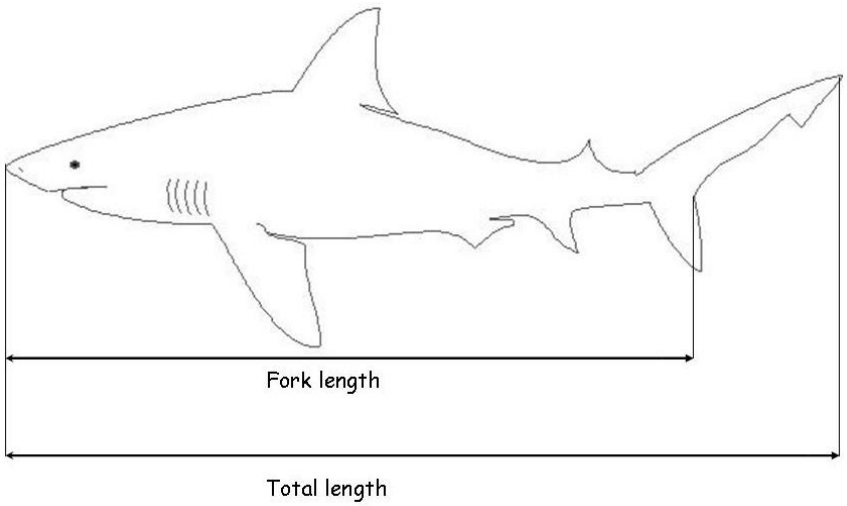


Fig. 2. Measurement types used for sharks