

INDO-PACIFIC SAILFISH

SUPPORTING INFORMATION

(Information collated from reports of the Working Party on Billfish and other sources as cited)

CONSERVATION AND MANAGEMENT MEASURES

Indo-Pacific sailfish (*Istiophorus platypterus*) in the Indian Ocean is currently subject to a number of Conservation and management measures adopted by the Commission, although none are species specific:

- Resolution 15/01: *On the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 15/02: *Mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPC's)*
- Resolution 15/11: *On the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*
- Resolution 14/05: *Concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 11/04: *On a regional observer scheme*
- Resolution 10/08: *Concerning a record of active vessels fishing for tunas and swordfish in the IOTC area*

FISHERIES INDICATORS

Indo-Pacific sailfish: General

Indo-Pacific sailfish (*Istiophorus platypterus*) is a large oceanic apex predator that inhabits tropical and subtropical Indo-Pacific oceans (**Fig. 1**). **Table 1** outlines some key life history parameters relevant for management. There is limited reliable information on the catches of this species and no information on the stock structure or growth and mortality in the Indian Ocean.

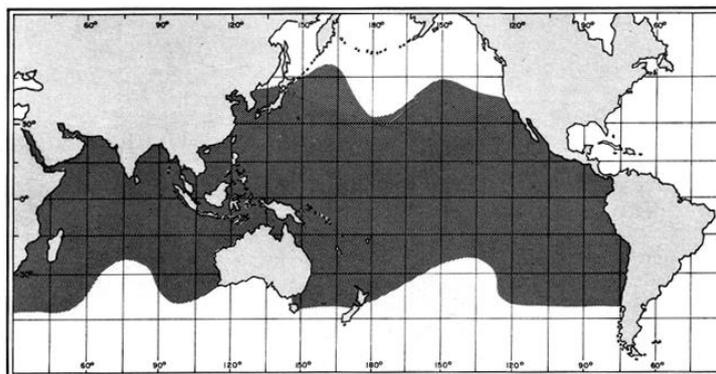


Fig. 1. Indo-Pacific sailfish: The worldwide distribution of Indo-Pacific sailfish (Source: Nakamura, 1984).

Table 1. Indo-Pacific sailfish: Biology of Indian Ocean Indo-Pacific sailfish (*Istiophorus platypterus*).

Parameter	Description
Range and stock structure	Found throughout the tropical and subtropical regions of the Pacific and the Indian Oceans. It is mainly found in surface waters above the thermocline, close to coasts and islands in depths from 0 to 200 m. Indo-Pacific sailfish is a highly migratory species and renowned for its speed and (by recreational fishers) for its jumping behaviour — one individual has been reported burst swimming at speeds in excess of 110 km/h. The stock structure of Indo-Pacific sailfish in the Indian Oceans is uncertain: apparently there are local reproductively isolated stocks. At least one stock was reported in the Persian Gulf with no or very little intermixing with open Indian Ocean stocks. However outside of the Gulf no stock differentiation has been determined; thus for the purposes of assessment, one pan-ocean stock is assumed. However, spatial heterogeneity in stock indicators (catch-per-unit-effort trends) for other billfish species indicates that there is potential for localised depletion.
Longevity	Females: 11–13 years; Males: 7–8 years
Maturity (50%)	Age: females n.a.; males n.a. Size: females n.a.; males n.a.
Spawning season	Spawning in Indian waters occurs between December to June with a peak in February and June. In subtropical waters of the southern hemisphere spawning is associated with warmer months: in Mozambique Channel and around Reunion Island high percentage of ripe females occurs in December.

Size (length and weight)	<p>Maximum: 350 cm FL and weight 100 kg total weight.</p> <p>The Indo-Pacific sailfish is one of the smallest-sized billfish species, but is relatively fast growing. Individuals may grow to over 3 m and up to 100kg, and live to around 7 years.</p> <p>Young fish grow very quickly in length then put on weight later in life. Sexual dimorphism in size, growth rates and size and age at maturity - females reach larger sizes, grow faster and mature later than males.</p> <p>Females: 300 cm LJFL, 50+ kg total weight; Males: 200 cm LJFL, 40+ kg total weight in the Indian Ocean.</p> <p>Recruitment into the fishery: varies by fishing method, apparently at age 0+ and size less than 100 cm LJFL for artisanal fleets. The average weight of fish caught in the Kenyan sports fishery is ~25 kg whole weight.</p>
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n.a. = not available. Sources: Nakamura 1985, Hoolihan 2003, 2004, 2006, Speare 2003, Hoolihan & Luo 2007, Sun et al. 2007, Froese & Pauly 2009, Ndegwa & Herrera 2011

Fisheries and main catch trends

- **Main fishing gear (2012–2016):** gillnets account for around 75% of total catches in the Indian Ocean, followed by troll and hand lines (20%), with remaining catches recorded under longlines and other gears (**Fig. 2**).
- **Main fleets (and primary gear associated with catches): percentage of total catches (2012–16):** Three quarters of the total catches of Indo-Pacific sailfish are accounted for by four countries situated in the Arabian Sea: Iran (gillnet): 30%; Pakistan (gillnet): 18%; India (gillnet and troll): 18%; and Sri Lanka (gillnet and fresh longline): 9% (**Fig. 3**).

This species is also a popular catch for sport fisheries (e.g. Kenya, Mauritius, and Seychelles).

- **Main fishing areas:** Primary: north-west Indian Ocean (Arabian Sea).
 - **Retained catch trends:** Catches have increased sharply since the mid-1990's (from around 5,000 t in the early 1990s to nearly 30,000 t from 2011 onwards) (**Table 2**) – largely due to the development of a gillnet/longline fishery in Sri Lanka and, especially, the extension of Iranian gillnet vessels operating in areas beyond the EEZ of I.R. Iran. In the case of I.R. Iran, gillnet catches have increased from less than 1,000 t in the early 1990's to between 7,000 t and over 11,000 t since 2014.
- Catches from drifting longline fleets have also likely increased, but have been under reported as the species has little commercial value. In recent years, deep-freezing longliners from Japan have reported catches of Indo-Pacific sailfish in the central western Indian Ocean, between Sri Lanka and the Maldives and the Mozambique Channel.
- **Discard levels:** Moderate to high, however discard levels are largely unknown for most industrial fisheries, mainly longliners.

Table 2: Indo-Pacific sailfish: best scientific estimates of catches by type of fishery for the period 1950–2016 (in metric tons).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
LL	297	804	385	256	1,400	1,416	2,165	2,534	1,257	656	451	700	903	1,573	1,065	1,010
GN	165	181	506	1,802	6,056	12,504	13,417	13,863	18,310	21,037	19,920	21,229	22,957	21,836	21,452	19,772
HL	171	213	456	1,428	2,467	3,925	4,024	4,445	5,405	5,999	5,477	5,048	5,579	4,647	6,722	7,023
OT	-	-	2	24	41	85	95	134	171	175	184	180	275	176	170	170
Total	633	1,197	1,349	3,511	9,963	17,930	19,701	20,976	25,143	27,867	26,031	27,157	29,715	28,232	29,409	27,975

Fisheries: Longline (**LL**); Gillnet (**GN**); Hook-and-Line (includes handline, trolling, baitboat, and sport fisheries) (**HL**); Other gears (includes coastal purse seine, Danish purse seine, beach seine, and purse seine) (**OT**).

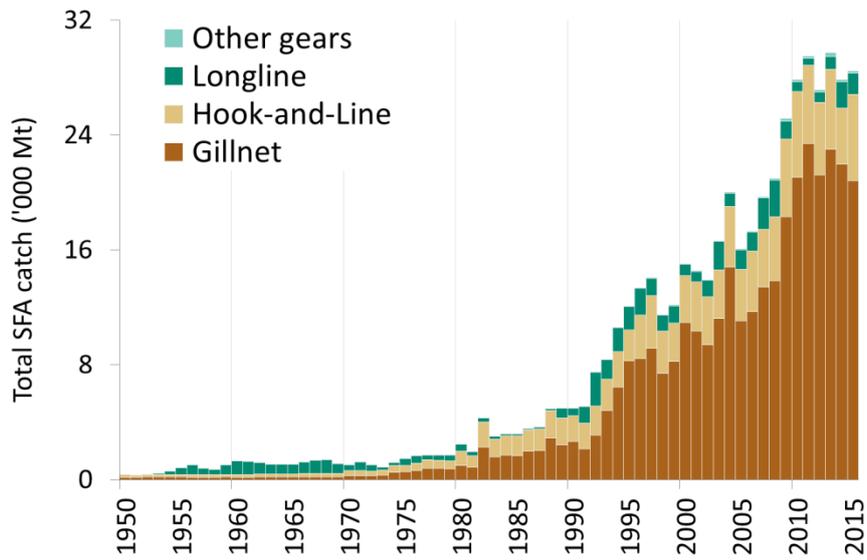


Fig. 2. Indo-Pacific sailfish: catches by gear and year recorded in the IOTC Database (1950–2016)¹.

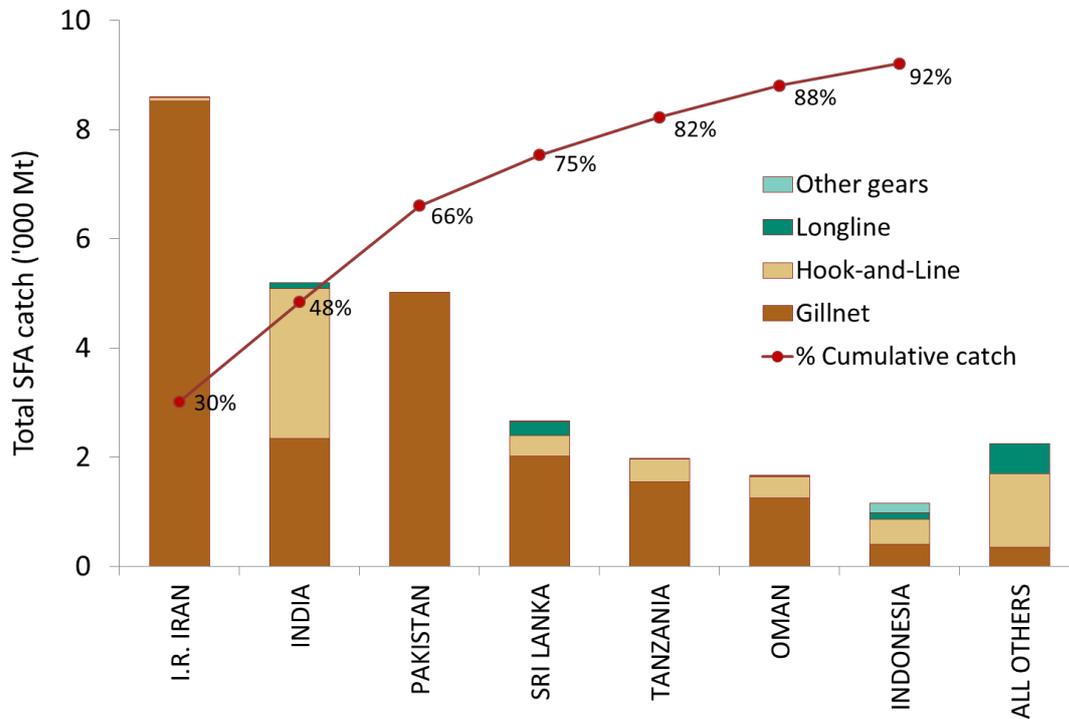


Fig. 3: Indo-Pacific sailfish: average catches in the Indian Ocean over the period 2012–16, by fleet and gear. Fleets are ordered from left to right, according to the volume of catches reported. The red line indicates the (cumulative) proportion of catches of Indo-Pacific sailfish for the fleets concerned, over the total combined catches reported from all fleets and gears.

¹ **Definition of fisheries:** Longline (LL); Gillnet (GN); Hook-and-Line (includes handline, trolling, baitboat, and sport fisheries) (HL); Other gears (includes coastal purse seine, Danish purse seine, beach seine, and purse seine) (OT).

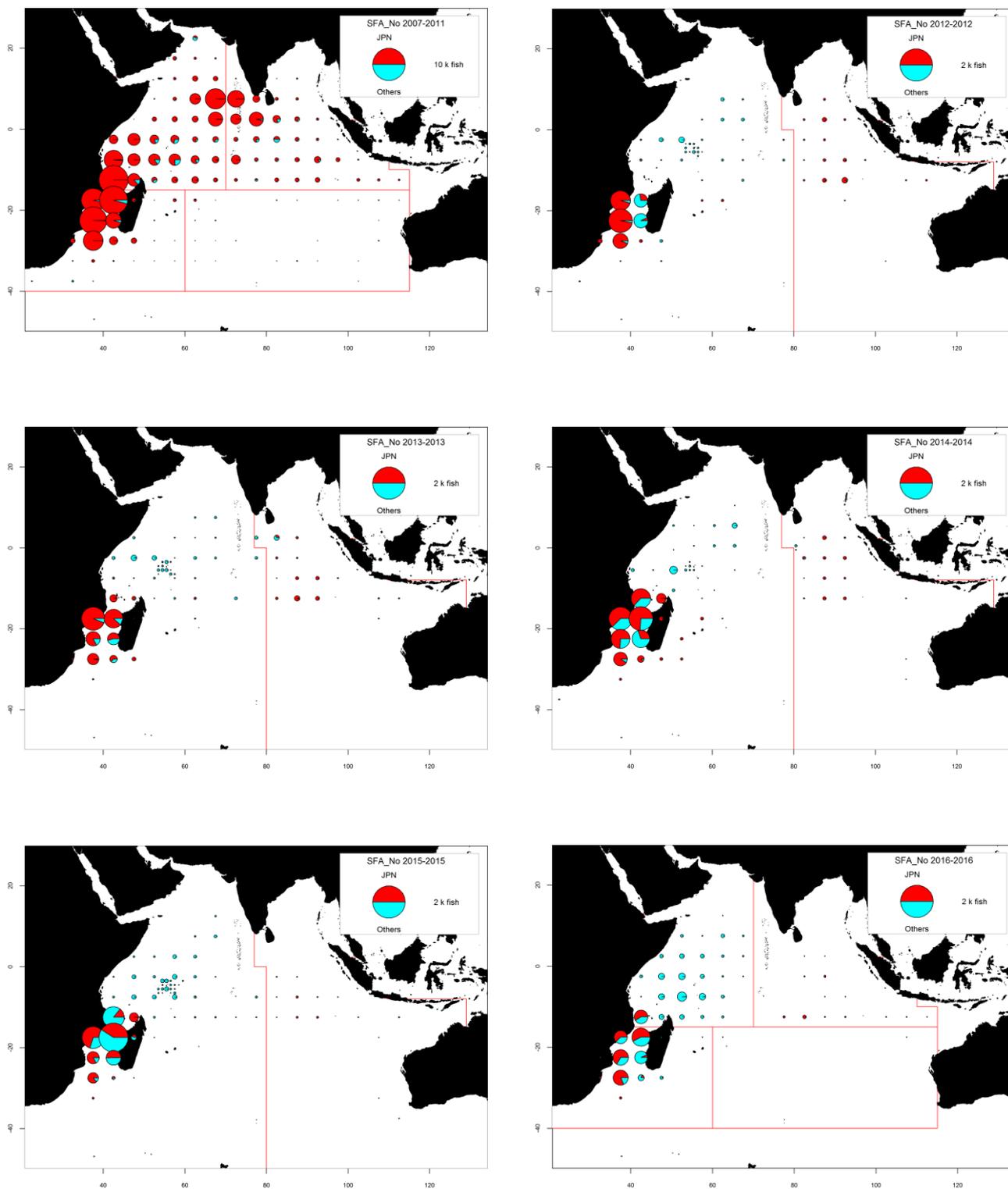


Fig. 4a-f. Time-area catches (in number of fish) of Indo-Pacific sailfish as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for the period 2007–11, by fleet and for 2012–16, by year and fleet. Red lines represent the IOTC Areas. Source: IOTC catch and effort data.

Indo-pacific sailfish: estimation of catches – data related issues

Retained catches – a very high proportion of the catches of Indo-Pacific sailfish are estimated, or adjusted, by the IOTC Secretariat are (Fig.5), due to a number of uncertainties in the catches listed below. However, unlike the other billfish species, Indo-Pacific sailfish are more reliably identified because of the large and distinctive first dorsal fin that runs most of the length of the body:

- **Species aggregates:** catch reports often refer to total catches of all billfish species combined; catches by species are estimated by the Secretariat for some artisanal fisheries (e.g., gillnet/longline fishery of Sri Lanka and artisanal fisheries of India and Pakistan) and industrial fisheries (e.g., longliners of Indonesia and Philippines). Catches of Indo-Pacific sailfish reported for some fisheries may also refer to the combined catches of more than one species of billfish, in particular marlins and shortbill spearfish (i.e., in the case of coastal fisheries).
- **Non-reporting fleets:** catches of non-reporting industrial longliners (e.g., India, NEI) and the gillnet fishery of Indonesia are estimated by the Secretariat using alternative information.
- **Non-target species:** catches are likely to be incomplete for industrial fisheries for which Indo-Pacific sailfish is not a target species.
- **Missing or incomplete catches:** catches are likely to be incomplete for some artisanal fisheries (e.g. gillnets of Pakistan, pole and lines of Maldives) due to under-reporting.

There is also a lack of catch data for most sport fisheries.

Indo-Pacific sailfish – Nominal catch-per-unit-effort (CPUE) trends

- **Availability:** Standardized and nominal CPUE series have not yet been developed. No catch and effort data are available from sports fisheries, other than partial data from the sports fisheries of Kenya; or other artisanal fisheries (e.g., I.R. Iran and Pakistan (gillnet), Sri Lanka (gillnet-longline), Indonesia (gillnet)) or industrial fisheries (NEI longliners and all purse seiners).

Indo-Pacific sailfish – Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- **Average fish weight:** can only be assessed for the longline fishery of Japan since 1970 and for the gillnet/longline fishery of Sri Lanka since the late 1980s. The number of specimens measured on Japanese longliners in recent years is, however, very low. Furthermore, specimens discarded might be not accounted for in industrial fisheries, where they are presumed to be of lower size (leading to possible bias of existing samples).
- **Catch-at-Size (Age) table:** not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates, or conflicting catch-and-effort data. Fish size is derived from various length and weight information, however the reliability of the size data is reduced for some fleets and when relatively few fish out of the total catch are measured.
- **Sex ratio data:** have not been provided to the Secretariat by CPCs.

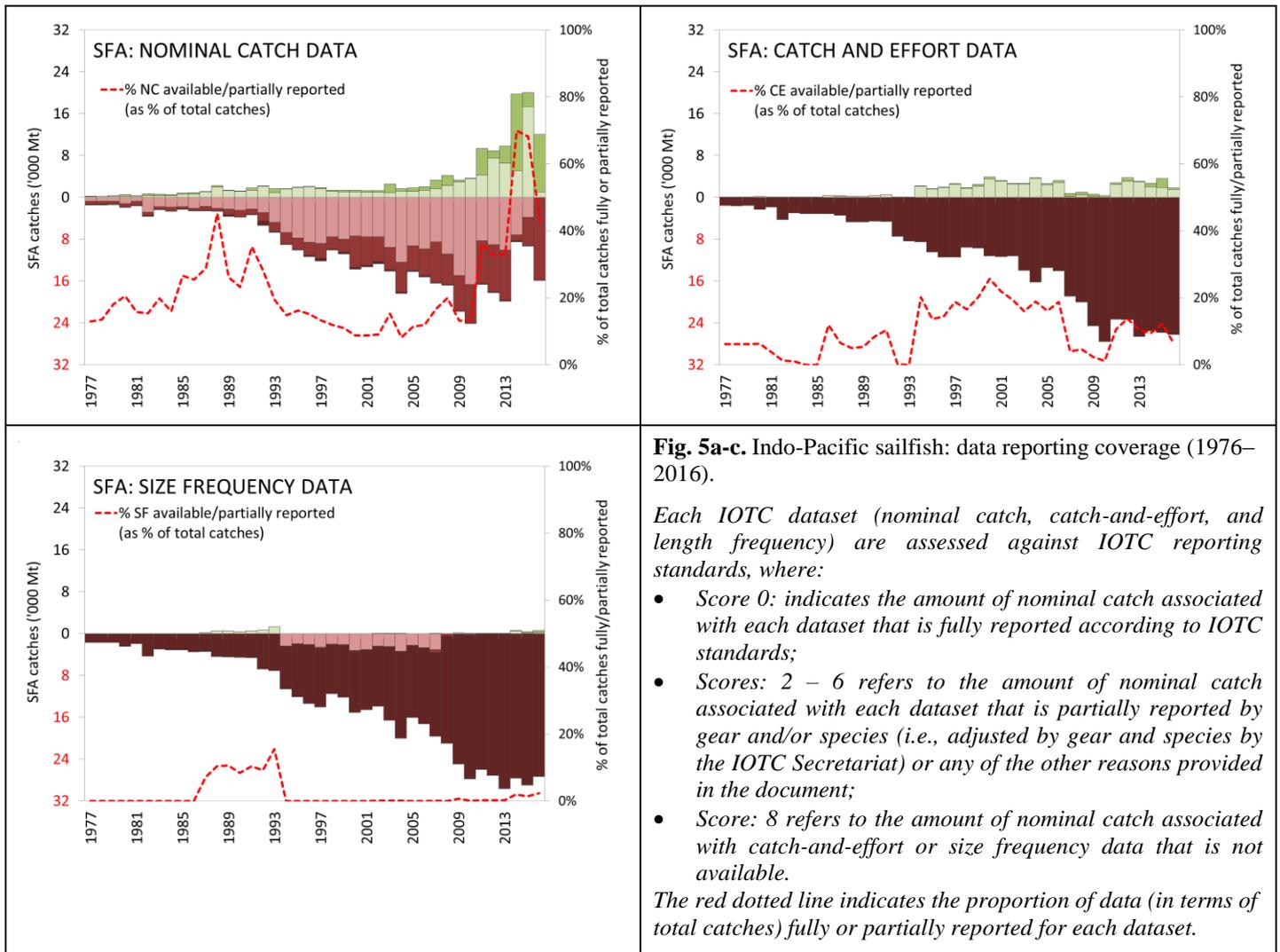


Fig. 5a-c. Indo-Pacific sailfish: data reporting coverage (1976–2016).

Each IOTC dataset (nominal catch, catch-and-effort, and length frequency) are assessed against IOTC reporting standards, where:

- Score 0: indicates the amount of nominal catch associated with each dataset that is fully reported according to IOTC standards;
- Scores: 2 – 6 refers to the amount of nominal catch associated with each dataset that is partially reported by gear and/or species (i.e., adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document;
- Score: 8 refers to the amount of nominal catch associated with catch-and-effort or size frequency data that is not available.

The red dotted line indicates the proportion of data (in terms of total catches) fully or partially reported for each dataset.

Key to IOTC Scoring system

Nominal Catch	By species	By gear
Fully available	0	0
Partially available (part of the catch not reported by species/gear)*	2	2
Fully estimated (by the IOTC Secretariat)	4	4

*Catch assigned by species/gear by the IOTC Secretariat; or 15% or more of the catches remain under aggregates of species

Catch-and-Effort	Time-period	Area
Available according to standards	0	0
Not available according to standards	2	2
Low coverage (less than 30% of total catch covered through logbooks)	2	
Not available at all	8	

Size frequency data	Time-period	Area
Available according to standards	0	0
Not available according to standards	2	2
Low coverage (less than 1 fish measured by metric ton of catch)	2	
Not available at all	8	

Key to colour coding

	Total score is 0 (or average score is 0-1)
	Total score is 2 (or average score is 1-3)
	Total score is 4 (or average score is 3-5)
	Total score is 6 (or average score is 5-7)
	Total score is 8 (or average score is 7-8)

Fishing effort trends

Total effort from longline vessels flagged to Japan, Taiwan, China and EU, Spain by five degree square grid in 2015 and 2016 are provided in **Fig.6**, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets in 2015 and 2016 are provided in **Fig.7**.

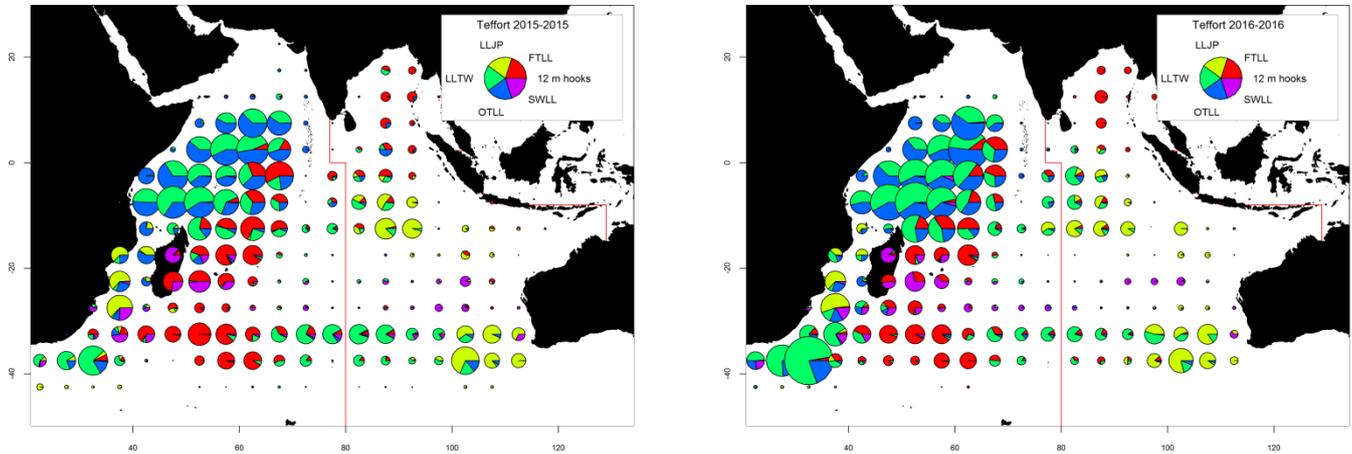


Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2015 (left) and 2016 (right). **LLJP** (light green): deep-freezing longliners from Japan; **LLTW** (dark green): deep-freezing longliners from Taiwan, China; **SWLL** (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets); **FTLL** (red): fresh-tuna longliners (China, Taiwan, China and other fleets); **OTLL** (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets).

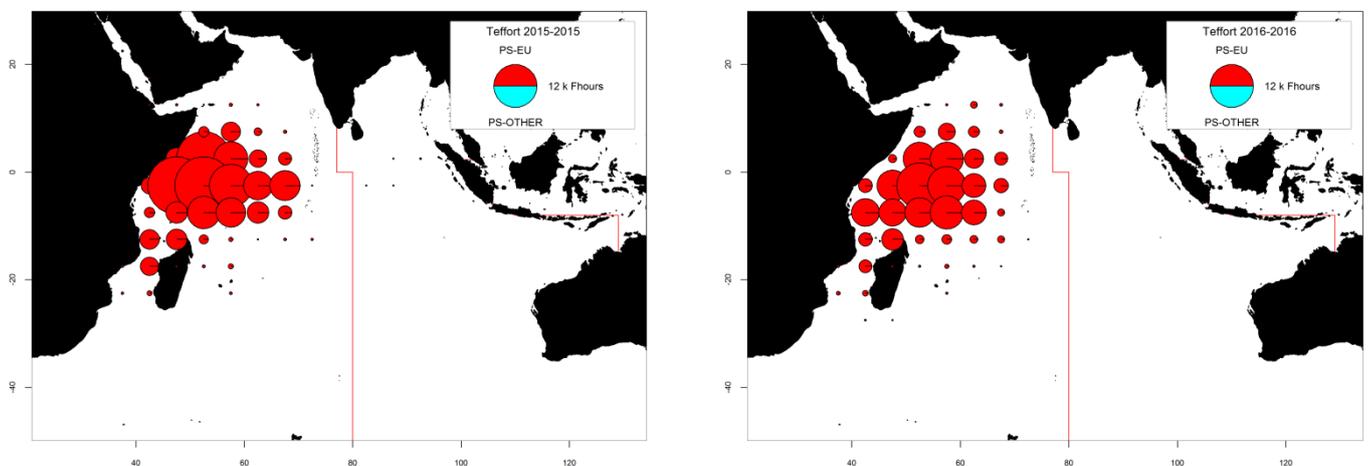


Fig. 7. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2015 (left) and 2016 (right). **PS-EU** (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags); **PS-OTHER** (light blue): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand).

Indo-Pacific sailfish: Standardised catch-per-unit-effort (CPUE) trends

The approaches examined in 2015 on gillnet catchability and CPUE are important, and even if not accurate at the time due to reported fishery effort, they give a good idea of what may be happening within the fishery. Further analysis on the gillnet component of the I.P. sailfish fishery should be undertaken, and such indices should be developed across all marlins in the Indian Ocean. While the longline fishery is useful for examining CPUE given the distribution of I.P. sailfish, it may not be the best index to use as an index of abundance to use in an assessment.

The following should be noted regarding the state of CPUE analysis for fleets with important catches of I.P. sailfish in the IOTC area of competence:

- Data used in CPUE calculations for artisanal fleets needs to improve so we have an index from the largest component of the catch for I.P. sailfish.
- In addition nominal CPUE from the gillnet component of the fleet should be standardised (e.g. using vessel days, or size of vessels operating, etc.).
- Trends in nominal CPUE differ considerably among fleets that operate in the same area, and efforts should be made to understand this difference.
- Alternative models to assess zeros should be used in the standardisation process for longline fleets, as well as possibly using area effects rather than environmental effects.

Of the I.P. sailfish CPUE series available for assessment purposes, separate index from the gillnet fleets, and Japan and Rep. of Korea longline series were used in the final stock assessment models investigated in 2015, for the reasons discussed above (**Fig. 8**).

- IOTC Rep. of Korea longline data (1974–1987) from document IOTC–2015–WPB13–24.
- IOTC gillnet data (1983–2013) from document IOTC–2015–WPB13–25.
- Japan longline data (1994–2014) from document IOTC–2015–WPB13–26.

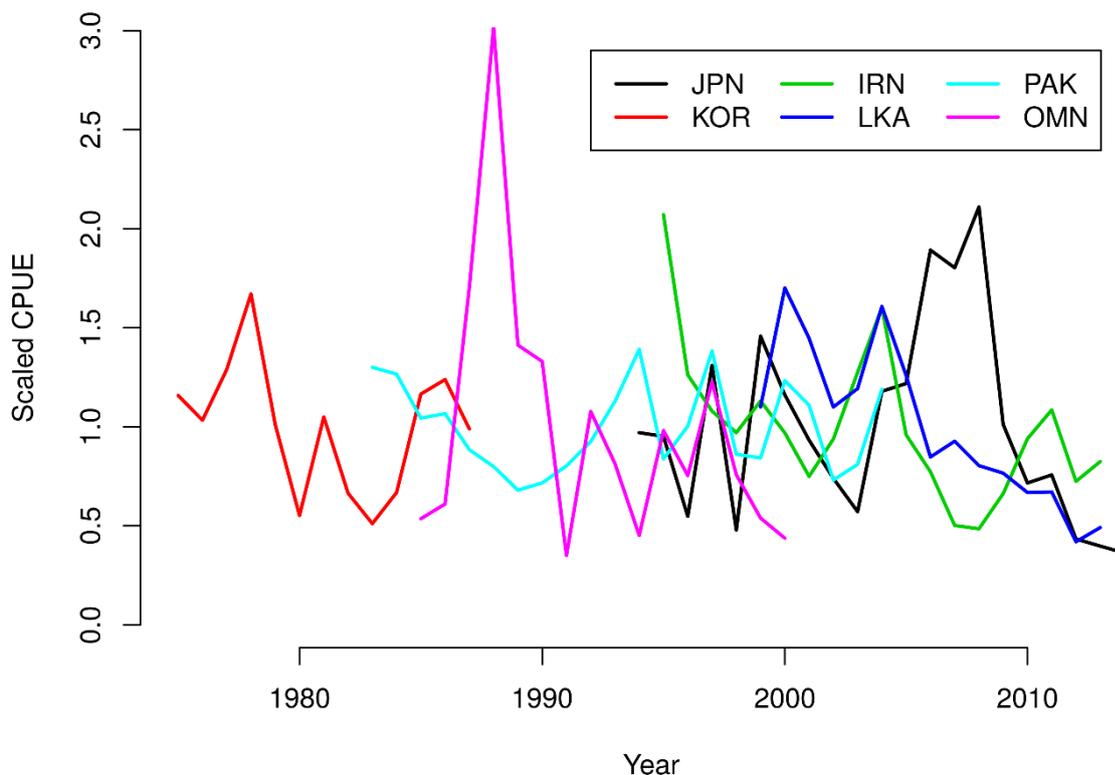


Fig. 8. I.P. sailfish: Catch rates of I.P. sailfish for Rep. of Korea (standardised KOR), I.R. Iran (IRN), Sri Lanka (LKA), Oman (OMN) and Pakistan (PAK) as calculated based on the IOTC catch and effort aggregated dataset (whole Indian Ocean), and for Japan (standardised JPN) as calculated using detailed dataset. Values were scaled with respect to their overall means.

STOCK ASSESSMENT

Since 2015 was the first year the BSPM model was applied, the Stock Reduction Analysis (SRA) has been kept as the basis for current stock status advice. This was primarily due to the following reasons:

- the data was highly uncertain on both the catch and effort series for the gillnet fleet, and
- Japan longline CPUE was from a fleet that catches a small portion of I.P. sailfish.

The key assessment results for the SRA are shown in **Table 3**. The following should be noted with respect to the SRA modelling approach presented at the meeting:

- The method being assumption based would create difference if the assumptions changed.
- The results were consistent with the assessment done in 2014, though they give a different picture than what the longlines CPUE series indicates.
- The use of this method is useful to estimate target yield but may not be a good indicator of current biomass level.

TABLE 3. Indo-Pacific sailfish: Key management quantities from the SRA approach used in 2015.

Management Quantity	Indian Ocean
2014 catch estimate (t)	29,860
Mean catch from 2010–2014 (t)	28,980
MSY (1000 t) (80% CI)	25.00 (16.18–35.17)
Data period (catch)	1950–2014
F _{MSY} (80% CI)	0.26 (0.15–0.39)
SB _{MSY} OR *B _{MSY} (1,000 t) (80% CI)	87.52 (56.3–121.02)
F ₂₀₁₄ /F _{MSY} (80% CI)	1.05 (0.63–1.63)
B ₂₀₁₄ /B _{MSY} (80% CI)	1.13 (0.87–1.37)
SB ₂₀₁₄ /SB _{MSY} (80% CI)	n.a.
B ₂₀₁₄ /B ₁₉₅₀ (80% CI)	0.56 (0.44–0.67)
SB ₂₀₁₄ /SB ₁₉₅₀ (80% CI)	n.a.
B ₂₀₁₄ /B _{1950, F=0} (80% CI)	n.a.
SB ₂₀₁₄ /SB _{1950, F=0} (80% CI)	n.a.

LITERATURE CITED

- Froese R, Pauly DE (2009) FishBase, version 02/2009, FishBase Consortium, <www.fishbase.org>
- Hoolihan J (2003) Sailfish movement in the Arabian Gulf: a summary of tagging efforts. *Mar Freshw Res* 54:509–513
- Hoolihan JP, Premanandh J, D'Aloia-Palmieri M-A, Benzie JAH (2004) Intraspecific phylogeographic isolation of Arabian Gulf sailfish *Istiophorus platypterus* inferred from mitochondrial DNA. *Mar Biol* 145:465–475
- Hoolihan JP (2006) Age and growth of Indo-Pacific sailfish, *Istiophorus platypterus*, from the Arabian Gulf. *Fish Res* 78: 218-226
- Hoolihan JP, Luo J (2007) Determining summer residence status and vertical habitat use of sailfish (*Istiophorus platypterus*) in the Arabian Gulf. *ICES J Mar Sci* 64: 1791–1799
- IOTC Secretariat (2015) Stock assessment of Indo-Pacific sailfish in the Indian Ocean. IOTC-2015-WPB13-28
- Nakamura I (1985) FAO species catalogue. Billfish of the world. An annotated and illustrated catalogue of marlins, sailfishes, spearfishes, and swordfishes known to date. FAO Fish Synop 125(5) 65 p
- Ndegwa S, Herrera M (2011) Kenyan Sports Fishing Sailfish Catches. IOTC–2011–WPB09–09