IOTC–2014–WPNT04–07_Rev1

REVIEW OF THE STATISTICAL DATA AVAILABLE FOR THE NERITIC TUNA SPECIES

PREPARED BY: IOTC SECRETARIAT[1], 13 & 23 JUNE 2014

PURPOSE

To provide participants at the 4th Working Party on Neritic Tunas (WPNT04) with a review of the status of the information available on neritic tuna species in the databases at the IOTC Secretariat as of May 2014, as well as a range of fishery indicators, including catch and effort trends, for fisheries catching neritic tunas in the IOTC area of competence. It covers data on nominal catches, catch-and-effort, size-frequency and other data.

BACKGROUND

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

This document summarises the standing of a range of information received for neritic tuna species, in accordance with IOTC Resolution 10/02 *Mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*[2]. Section 2 identifies problem areas relating to the statistics of neritic tuna species. Section 3 looks into the main fisheries and catch data available for each species; and main issues identified concerning the statistics available at the IOTC Secretariat for each species. Information regarding current data reviews and capacity building activities by the IOTC Secretariat aimed at improving the quality of catch neritic tuna species are provided in Appendix I.

The report covers the following areas:

- Overview
- Main issues relating to the data available on neritic tunas
- Overview of neritic tuna fisheries in the Indian Ocean:
  - Catch trends
  - Status of fisheries statistics for neritic tuna species
- Major reviews to catch series since the last WPNT Meeting

Major data categories covered by the report

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 estimates a total catch from a range of sources (including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; and data reported by parties on the activity of vessels under their flag (IOTC Resolution 10/08; IOTC Resolution 12/05) or other flags (IOTC Resolution 12/07; IOTC Resolution 05/03).

Catch and effort data which refer to the fine-scale data – usually from logbooks – reported in aggregated format: per fleet, year, gear, type of school, month, grid and species. Information on the use of fish aggregating devices (FADs) and activity of vessels that assist industrial purse seiners to locate tuna schools (supply vessels) is also collected.

Length frequency data: individual body lengths of IOTC species per fleet, year, gear, type of school, month and 5 degrees square areas.

[1] Lucia Pierre (lp@iotc.org), James Geehan (jg@iotc.org) & Miguel Herrera (mh@iotc.org)

[2] This Resolution superseded IOTC Resolutions 98/01, 05/01 and 08/01

Neritic tuna species and main fisheries in the Indian Ocean

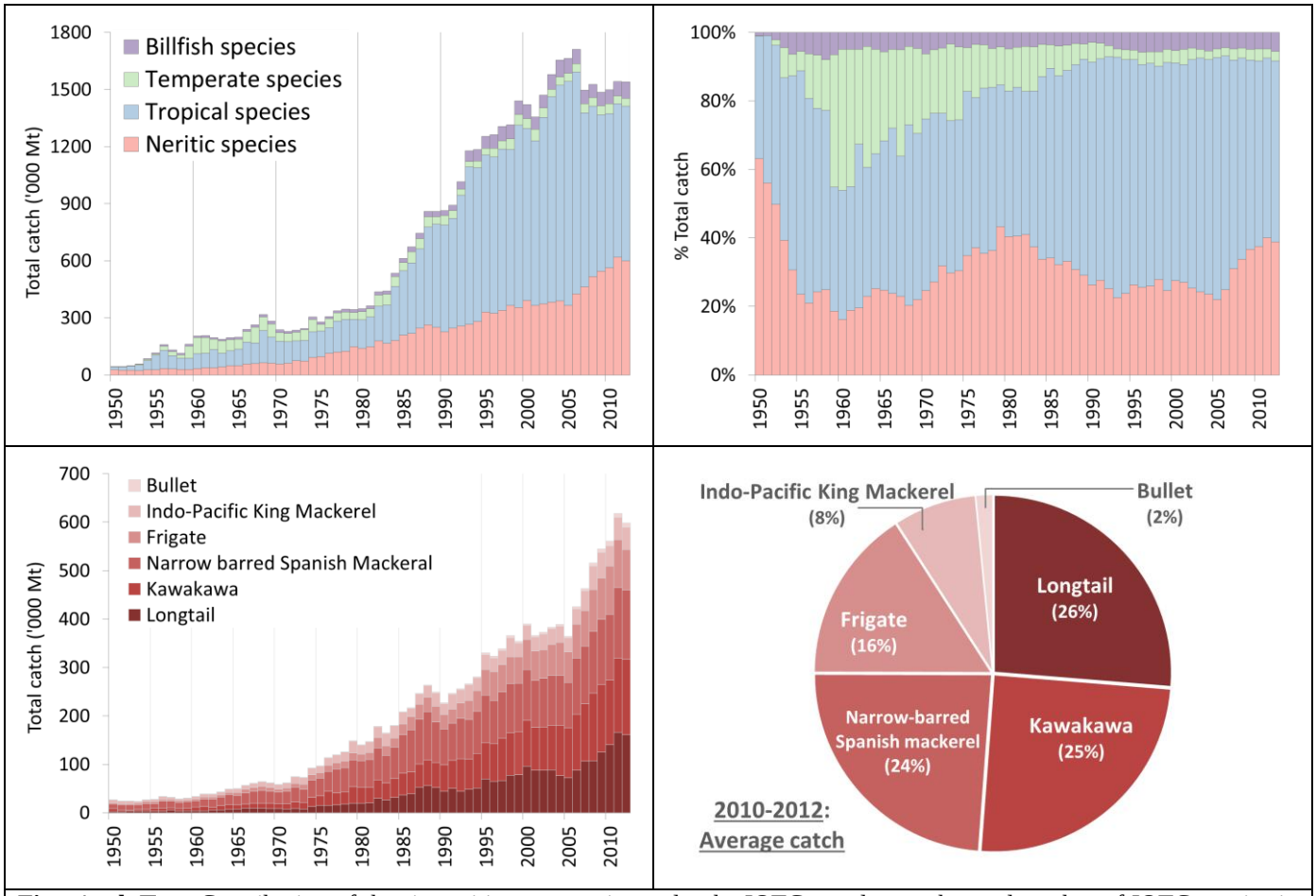
Table 1 below shows the six species of tunas and seerfish under IOTC management.

Table 1. Neritic tuna species under the IOTC mandate

IOTC code	English name	Scientific name
LOT	Longtail tuna	*Thunnus tonggol*
FRI	Frigate tuna	*Auxis thazard*
BLT	Bullet tuna	*Auxis rochei*
KAW	Kawakawa	*Euthynnus affinis*
COM	Narrow-barred Spanish mackerel	*Scomberomorus commerson*
GUT	Indo-Pacific king mackerel	*Scomberomorus guttatus*

DISCUSSION

The contribution of neritic tunas to the total catches of IOTC species in the Indian Ocean has changed over the years (Fig. 1a.b.), in particular following the arrival of industrial purse seine fleets to the Indian Ocean in the early-1980s targeting tropical tunas leading to a relative decline in the proportion of catch accounted for by neritic tuna species. With the onset of piracy in the late-2000s, the activities of fleets operating in the north-west Indian Ocean have been displaced or reduced – particularly the Asian longline fleet targeting tropical tunas – leading to a relative increase in the proportion of catches from neritic species. Hence, in recent years (2008–12), the catches of neritic tunas in the Indian Ocean have accounted for 37% of the combined catches of all IOTC species (compared to 29% over the period 1950–2012).

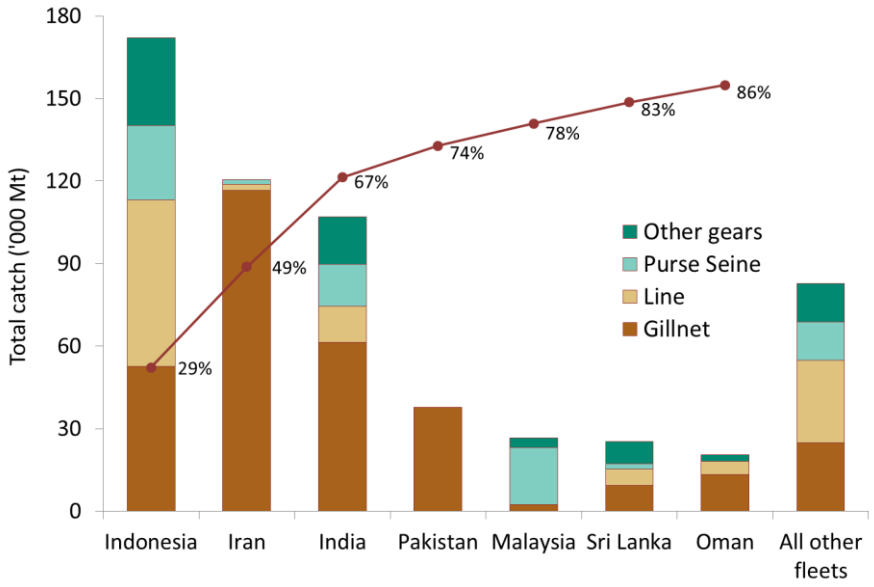


Figs. 1a-d. Top: Contribution of the six neritic tuna species under the IOTC mandate to the total catches of IOTC species in the Indian Ocean, over the period 1950–2012 (a. Top left: total catch; b. Top right percentage, same colour key as Fig. 1a). **Bottom:** Contribution of each neritic species to the total combined catches of neritic tunas (c. Bottom left: nominal catch of each species, 1950–2012; d. Bottom right: share of neritic catch by species, 2010–12 average catch)**.**

Among the neritic tuna species longtail tuna, kawakawa, and narrow-barred Spanish mackerel dominate, with catches of each species accounting for 75% of the total catches of neritic species in recent years (2010–12; Fig. 1d.). While the catch levels of frigate tuna were also high during the same period (16%), the catches of Indo-Pacific king mackerel and bullet tuna were at lower levels, with around 10% of the total catches of the neritic species.

While the majority of coastal countries in the IOTC region have important fisheries for neritic tunas (Fig. 2), in recent years the coastal fisheries of four countries (Indonesia, Iran, India and Pakistan), have reported as much as 74% (Figs. 2 & 3) of the total catches of neritic tuna species from all Indian Ocean fleets combined.

The majority of the catches of neritic tuna species are sold locally, in raw or processed form (e.g. local canneries), or exported to markets in neighbouring countries. In addition, a small component of the catches of neritic tunas, in particular longtail tuna, is also exported to the European Union (EU) or other markets in the region (e.g. Saudi Arabia, Sri Lanka, etc.).



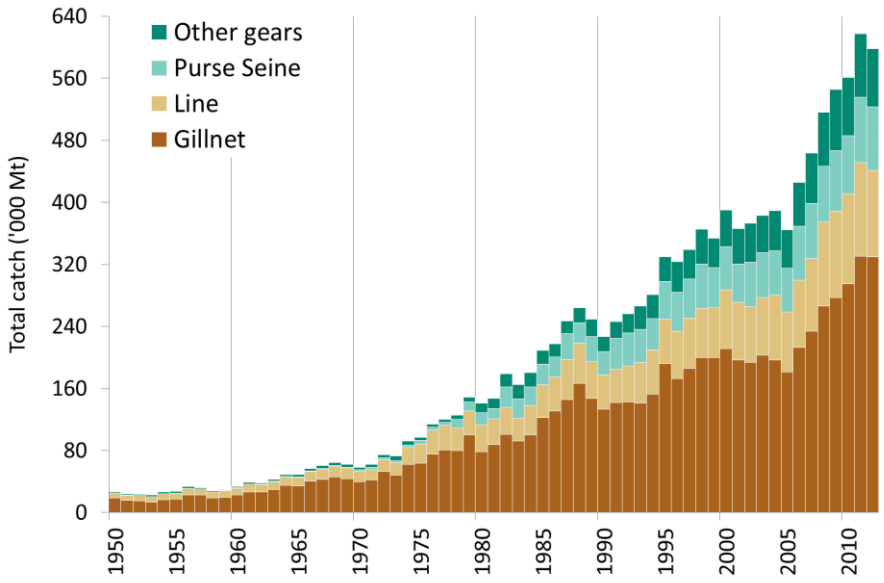


Fig. 2a-b. Top: Average catches of neritic tunas in the Indian Ocean over the period 2010–12, by country.
Countries are ordered from left to right, according to the importance of catches of neritic tunas reported. The red line indicates the (cumulative) proportion of catches of neritic tunas for the countries concerned, over the total combined catches of neritic tunas reported from all countries and fisheries.

Bottom: All neritic species: Annual catches by gear recorded in the IOTC Database (1950–2012).

Neritic tunas are mainly caught using drifting gillnets and seine nets in coastal waters although some species are also caught using industrial purse seines, hand lines, troll lines or other gears both in coastal waters and on the high seas (Fig. 2b). Although neritic tunas are the target of several fisheries they are also caught as a bycatch of fisheries targeting large tunas, small pelagic species, or other non-tuna species. The status by species is provided in Table 2.

Table 2. Main fisheries, fishing areas and catches status of neritic tuna species under the IOTC mandate. KAW: kawakawa; LOT: longtail tuna, FRZ: frigate and bullet tunas combined; YFT: yellowfin tuna.

Species	Known fisheries	Area	Status	Main Fleet/s	Importance Catches
Longtail tuna	Industrial purse seine	Arabian Sea	Target: in association with YFT	Iran	Low-Medium
	Coastal purse seine	Andaman Sea	Target: along with KAW, FRZ	Thailand, Malaysia, Indonesia	Medium (?)
	Gillnet	Persian Gulf, Arabian Sea	Target - Bycatch	Iran, Pakistan, Oman	High
		South Indonesia		Indonesia	Medium (?)
	Longline, line, sport and other gears	Various	Bycatch	Yemen, India	Low-Medium (?)
Frigate tuna	Industrial purse seine	Western Indian Ocean	By-catch: tuna schools associated under fish aggregating devices (FAD)	EU, Iran, Seychelles, Thailand	Low-Medium
	Coastal purse seine	Andaman Sea	Target: along with KAW, LOT	Thailand	Low
		India	Bycatch (?)	India	Low
	Ring net	Sri Lanka	Target	Sri Lanka	Medium
		Indonesia	Target (?)	Indonesia	High (?)
	Pole and line	Maldives	Bycatch	Maldives	Medium
	Gillnet	India, Indonesia, Sri Lanka, Iran	Bycatch	India, Indonesia, Sri Lanka, Iran	High
	Longline, line and other gears	India and other areas	Bycatch	India, Sri Lanka	High (?)
Bullet tuna	Coastal purse seine	India and other (?)	Bycatch (?)	India	Medium (?)
	Danish seine	Indonesia	Bycatch (?)	Indonesia	High (?)
	Gillnet	India, Sri Lanka, Indonesia and other (?)	Bycatch	India, Sri Lanka, Indonesia, Other	High (?)
	Hand line and troll line	India, Sri Lanka and other (?)	Bycatch (?)	India, other (?)	High (?)
Kawakawa	Industrial purse seine	Western Indian Ocean	Bycatch: tuna schools associated under fish aggregating devices (FAD) in coastal waters	EU, Iran, Seychelles, Thailand	Low
	Coastal purse seine	Andaman Sea	Target: along with FRZ, LOT	Thailand, Malaysia, Indonesia, India	High
		Indonesia	Target: along with SKJ, FRZ (?)		
		India	Bycatch (?)		
	Gillnet	Arabian Sea, India	Bycatch	India, Iran, Yemen, Pakistan, Oman	High
	Hand line and troll line	India and other (?)	Bycatch (?)	India, other (?)	Medium (?)
	Other gears	Maldives and other	Bycatch	Maldives and other (?)	Low (?)
Narrow-barred Spanish mackerel	Gillnet	India, Indonesia, Arabian Sea and Persian Gulf	Target	India, Indonesia, Pakistan, Iran, UAE, Sri Lanka and other	High
	Hand line and troll line	Madagascar, India and other	Target (?)	Madagascar, India, other (?)	Medium (?)
	Other gears (trawl)	Andaman Sea, India	Bycatch	Thailand, India	Medium (?)
Indo-Pacific king	Gillnet	India, Indonesia	Bycatch	India, Indonesia	High

Species	Known fisheries	Area	Status	Main Fleet/s	Importance Catches
mackerel					
	Hand line and troll line	Indonesia and other (?)	Bycatch	Indonesia, other (?)	Low (?)
	Other gears (trawl)	India and other (?)	Bycatch	India, other (?)	Medium (?)

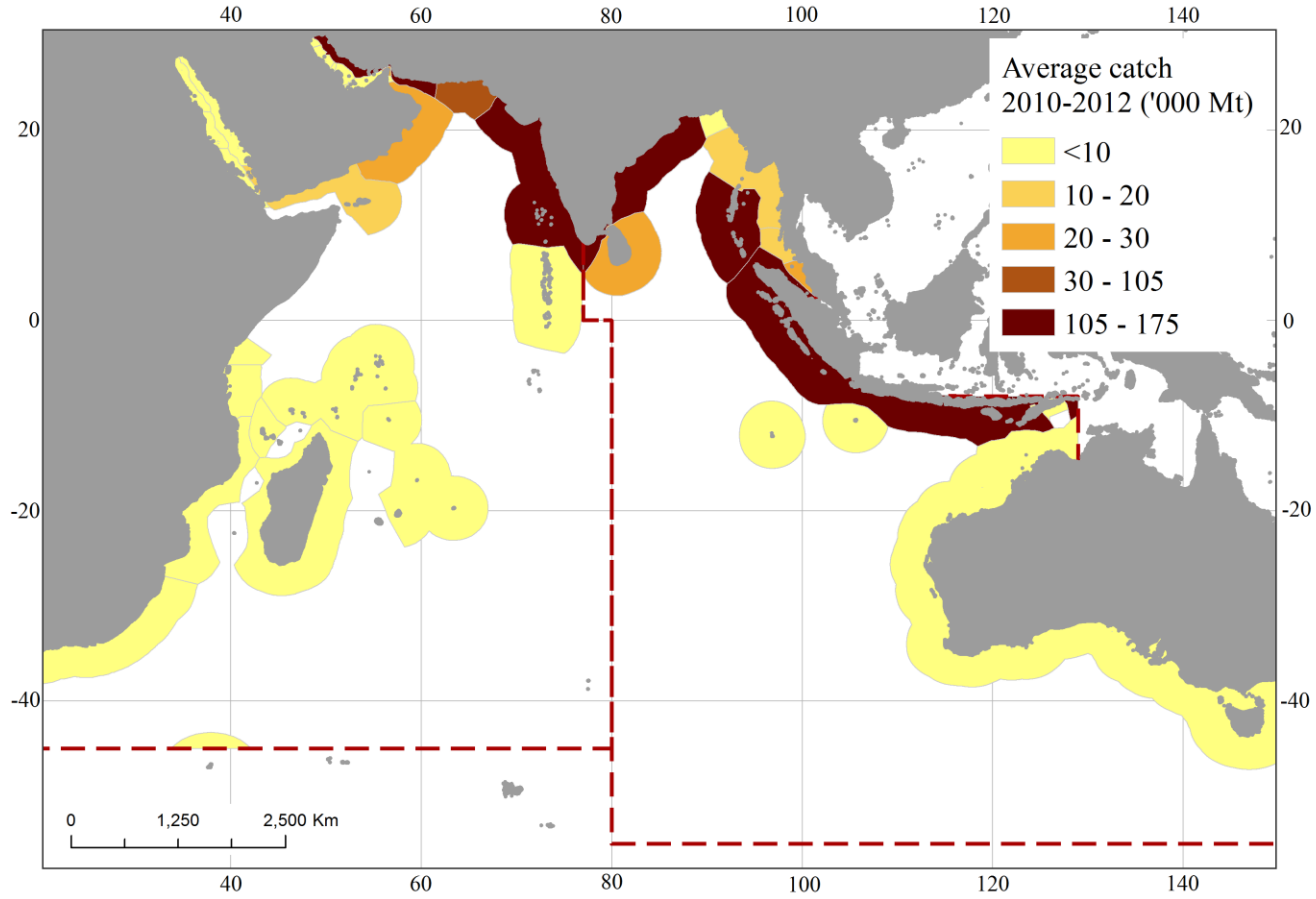


Fig. 3. Average catches of neritic tunas in the Indian Ocean over the period 2010–12, by country EEZ. The intensity of the shading of EEZs represent the importance of catches of all IOTC neritic species in each country (refer to the key at the top right of the map for details). Boundaries separating the IOTC east and west Indian Ocean areas are denoted by the red dashed line. Definition of EEZ the Flanders Marine Institute (http://www.vliz.be/vmdcdata/marbound/download.php).

MAIN ISSUES IDENTIFIED RELATING TO THE STATISTICS OF NERITIC TUNAS

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

1. **Catch-and-Effort data from Coastal Fisheries:**

- **Coastal** fisheries of **Yemen, Madagascar, Mozambique,** and **Myanmar**: The catches of neritic tunas for these fisheries have been estimated by the IOTC Secretariat in recent years. The quality of the estimates is thought to be poor due to the paucity of the information available about the fisheries operating in these countries.
- **Coastal** fisheries of **Sri Lanka, Indonesia, India, Oman, Thailand** and **Malaysia:** These countries do not fully report catches of neritic tunas by species and/or gear, as per the IOTC standards. The IOTC Secretariat allocated catches by gear and species where necessary. In the case of Indonesia, Thailand and Malaysia, the IOTC Secretariat – in collaboration with BOBLME and OFCF – are currently engaged in projects and data mining activities to improve the quality of data collected and estimation of catch-and-effort for fisheries targeting neritic species in each of the three countries.

2. **Catch-and-Effort data from Surface and Longline Fisheries:**

- **Drifting gillnet** fisheries of I.R. **Iran** and **Pakistan,** and **Gillnet** and **Longline** fishery of **Sri Lanka**: A substantial component of these fleets operate in offshore waters, including waters beyond the EEZs of the flag countries concerned. Although all countries have reported total catches of neritic tunas, they have not reported catch-and-effort data as per the IOTC standards.
- **All industrial tuna purse seine** fisheries: The total catches of frigate tuna, bullet tuna and kawakawa reported for industrial purse seine fleets are considered to be very incomplete, as they do not account for all catches retained onboard and do not include amounts of neritic tuna discarded[3]. The same applies to catch-and-effort data.
- **Discard levels for all fisheries**: The total amount of neritic tunas discarded at sea remains unknown for most fisheries and time periods, other than EU purse seine fisheries during 2003–07.

3. **Size data from All Fisheries:**

- **Coastal** fisheries of **Sri Lanka, Indonesia, India, Oman, Thailand, Malaysia, Yemen, Madagascar, Mozambique,** and **Myanmar:** None of these countries has reported length frequency data for neritic tuna species in recent years.
- **Drifting gillnet** fisheries of **I.R. Iran** and **Pakistan,** and **Gillnet** and **Longline** fishery of **Sri Lanka**: A substantial component of these fleets operate in offshore waters, including waters beyond the EEZs of the flag countries concerned. Although all countries have reported total catches, and I.R. Iran and Sri Lanka have provided some data on the sizes of neritic tunas caught by their fisheries, the length frequency data has not been provided as per the IOTC standards.
- **All industrial tuna purse seine** fisheries: There is a generalised lack of length frequency data of neritic tuna species retained catches and discards from industrial purse seine vessels, in particular frigate tuna, bullet tuna and kawakawa (all purse seine fleets).

4. **Biological data for all tropical tuna species:**

- All fisheries: There is a generalised lack of biological data for most neritic tuna species in the Indian Ocean, in particular the basic data that would be used to establish length-weight-age keys, non-standard measurements-fork length keys and processed weight-live weight keys for these species.

[3] This information is available for purse seiners operating under EU flags for 2003-07, as estimated using data collected by observers.

STATUS OF FISHERIES STATISTICS FOR NERITIC TUNAS

Longtail tuna (LOT)

Fisheries and catch trends

Longtail tuna is caught mainly by using gillnets and, to a lesser extent, seine nets, and trolling (Table 3; Fig. 4). Longtail tunas are caught in the western and to a lesser degree the eastern Indian Ocean (Fig. 5). The catch estimates for longtail tuna were derived from small amounts of information and are therefore uncertain[4] (Fig. 7).

TABLE 3. Longtail tuna: Best scientific estimates of the catches of longtail tuna by type of fishery for the period 1950–2012 (in metric tonnes). Data as of May 2014.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Purse seine	44	204	1,306	5,381	10,937	17,718	19,551	13,313	12,390	16,131	23,835	18,877	20,649	16,538	20,595	21,767
Gillnet	2,593	5,849	8,983	24,872	39,423	58,205	54,974	46,212	43,455	51,570	59,905	67,508	83,300	101,251	118,288	110,825
Line	909	1,160	2,547	5,187	7,220	14,095	11,511	14,095	14,219	16,519	17,666	15,339	15,681	16,628	18,486	20,160
Other	0	0	125	1,091	1,993	3,577	2,527	2,912	2,661	3,370	5,103	5,928	5,221	6,507	8,527	7,779
Total	**3,546**	**7,213**	**12,961**	**36,530**	**59,573**	**93,595**	**88,562**	**76,532**	**72,725**	**87,590**	**106,509**	**107,653**	**124,851**	**140,923**	**165,896**	**160,532**

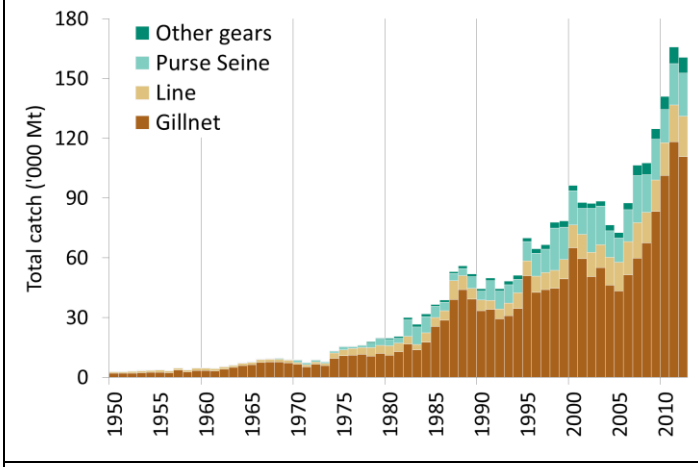


Fig. 4. Longtail tuna: Annual catches of longtail tuna by gear recorded in the IOTC Database (1950–2012).

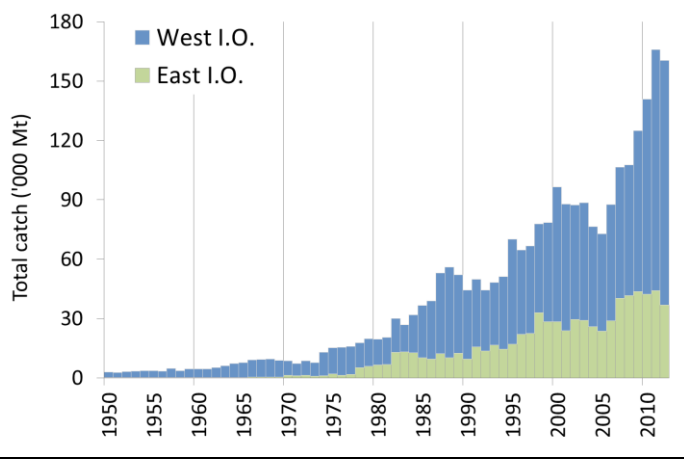


Fig. 5. Longtail tuna: Annual catches of longtail tuna by IOTC area recorded in the IOTC Database (1950–2012).

The catches provided in Table 3 are based on the information available at the IOTC Secretariat and the following observations on the catches cannot currently be verified. Estimated catches of longtail tuna increased steadily from the mid 1950's, reaching around 15,000 t in the mid-1970's, to over 35,000 t by the mid-1980's, and over 96,000 t in 2000. Catches dropped after 2000 to around 72,000 t by 2005 but have increased since then, with the highest catches ever recorded in 2011 at 166,000 t.

In recent years (2010–12), the countries attributed with the highest catches of longtail tuna are Iran (47%), Indonesia (15%), Pakistan (9%), Malaysia (9%) and, to a lesser extent, Oman, Yemen, India and Thailand (19%) (Fig. 6). I.R. Iran, in particular, has reported large increases in the catch of longtail tuna since 2009 where the increase in catches of longtail tuna have coincided with a decrease in catches of skipjack tuna as a consequence of increased gillnet effort in coastal waters and the Arabian Sea due to the threat of Somali piracy in the western tropical Indian Ocean.

The size of longtail tunas taken by the Indian Ocean fisheries typically ranges between 20 and 100 cm depending on the type of gear used, season and location (Fig. 12). The fisheries operating in the Andaman Sea (coastal purse seines and trolling) tend to catch longtail tuna of small size (20–45cm) while the gillnet fisheries of Iran and Pakistan (Arabian Sea) catch larger specimens (50–100cm).

[4] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

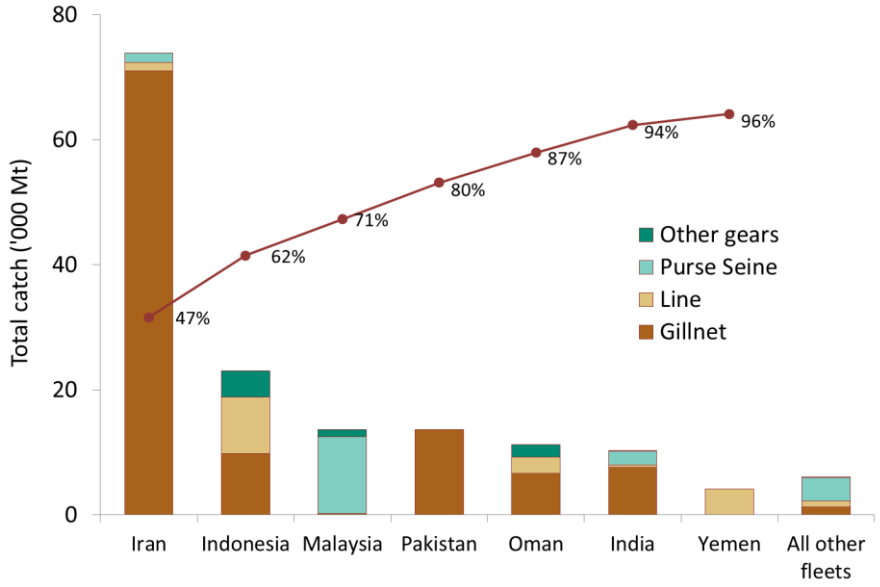


Fig. 6: Longtail tuna: Average catches in the Indian Ocean over the period 2010–12, by country. Countries are ordered from left to right, according to the importance of catches of longtail reported. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

Status of Fisheries Statistics at the IOTC

Retained catches are uncertain (Fig. 7), notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of longtail tuna by species or by gear for 1950–2004; catches of longtail tuna, kawakawa and other species were reported aggregated for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. However, a recent review by the IOTC Secretariat conducted by an independent consultant in 2012 indicated that catches of longtail tuna had been severely overestimated by Indonesia. While the new catches estimated for the longtail tuna in Indonesia remain uncertain, representing around 15% (30% in the past) of the total catches of this species in the Indian Ocean in recent years (2009–11), the new figures are considered more reliable than those existing in the past.
- Artisanal fisheries of India and Oman: Although these countries report catches of longtail tuna, until recently the catches have not been reported by gear. The IOTC Secretariat used alternative information to assign the catches reported by Oman by gear. The catches of India were also reviewed by the independent consultant in 2012 and assigned by gear on the basis of official reports and information from various alternative sources. The catches of longtail tuna from Oman and India represent around 14% of the total catches of this species in recent years (2010–12).
- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches of longtail tuna to the IOTC Secretariat. While catch levels are unknown they are unlikely to be substantial.
- Other artisanal fisheries: The IOTC Secretariat had to estimate catches of longtail tuna for the artisanal fisheries of Yemen (no data reported to the IOTC Secretariat) and until recently Malaysia (with catches of the main neritic tunas aggregated and reported as longtail).

Discard levels are believed to be very low although they are unknown for most fisheries.

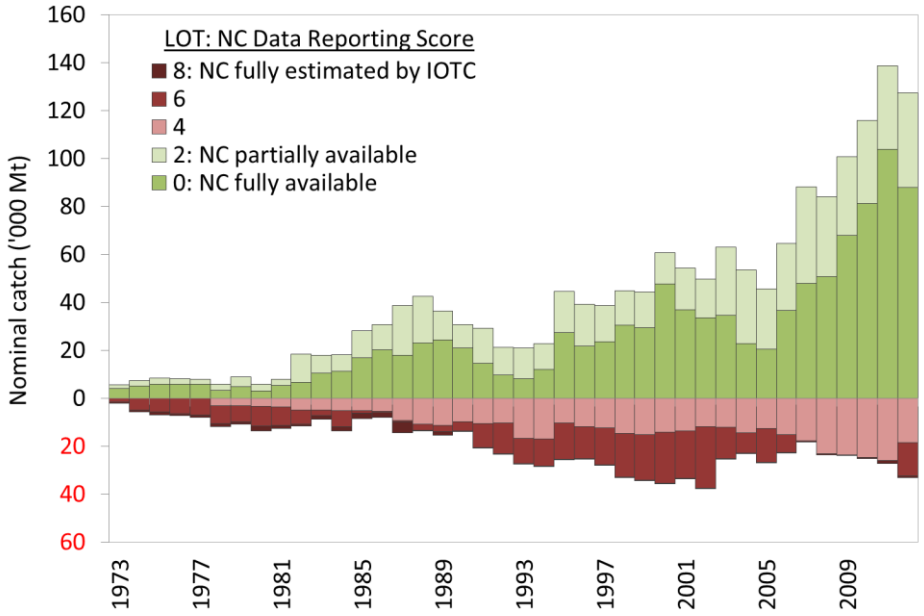


Fig. 7. Longtail tuna: nominal catch; uncertainty of annual catch estimates (1950–2012).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2014.

Changes to the catch series: Although there have not been significant changes to the total catches of longtail tuna since the WPNT meeting in 2012, the IOTC Secretariat has conducted revisions to the catch series for some fleets, primarily Malaysia following an IOTC-OFCF data mining missing in January 2014. Indonesia is also subject to an on-going review of the catch-series by the IOTC Secretariat, and further improvements to the catch series for longtail in particular are expected for WPNT in 2015.

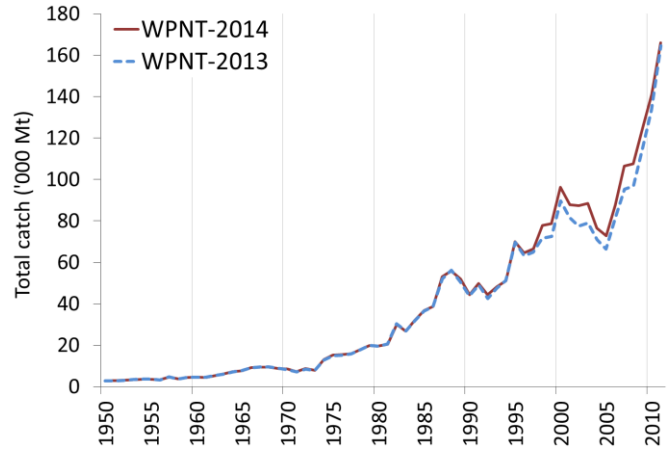


Fig. 8. Longtail tuna: Catches used by the WPNT in 2013 versus those estimated for the WPNT in 2014 (1950–2012).

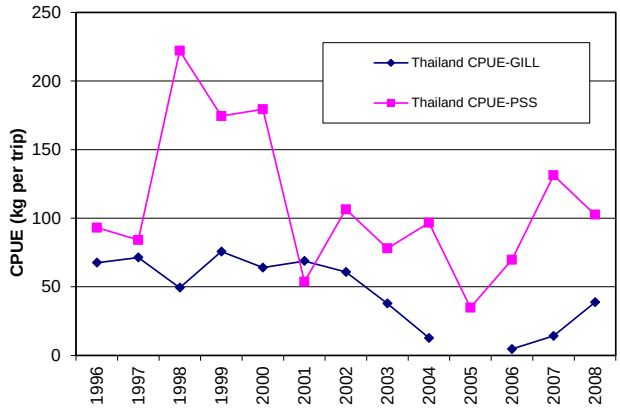


Fig. 9. Longtail tuna: Nominal CPUE series for gillnet (GILL) and coastal purse seine (PSS) fisheries of Thailand derived from the available catches and effort data (1996–2012).

CPUE Series: Catch-and-effort series are available from some fisheries but they are considered highly incomplete (Fig. 10). In most cases catch-and-effort data are only available for short periods of time. Reasonably long catches and

effort series (extending for more than 10 years) are only available for Thailand small purse seine vessels and gillnet vessels (Fig. 9).

Trends in average weight can only be assessed for Iranian gillnets but the amount of specimens measured has been very low for a number of years (i.e., below the minimum sampling standard of one fish per tonne of catch recommended by the IOTC Secretariat) (Fig. 11). The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme); unfortunately, the data collection did not continue after the end of the IPTP activities.

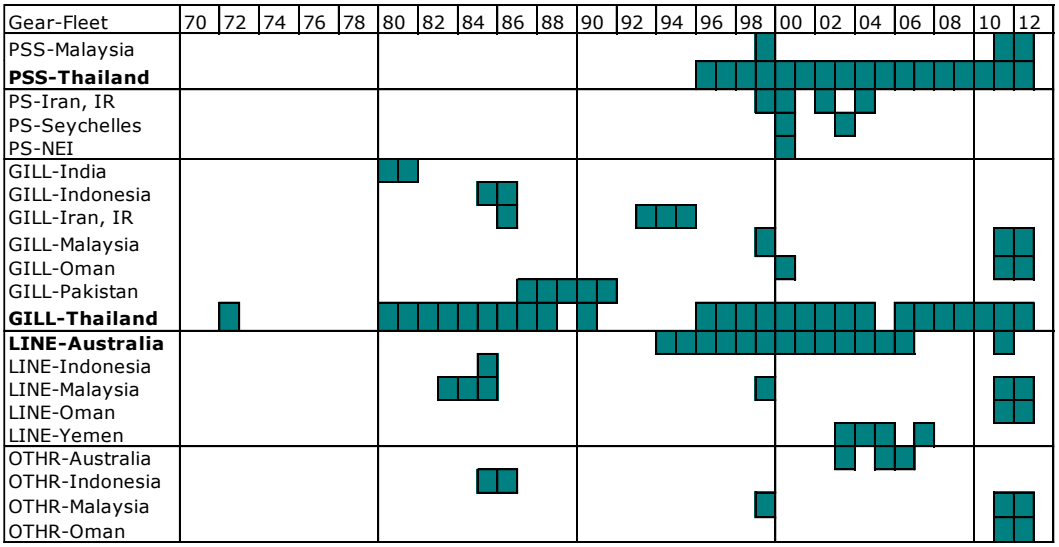


Fig. 10. Longtail tuna: Availability of catches and effort series, by fishery and year (1970–2012)[5]. Note that no catches and effort are available at all for 1950–1971.

Catch-at-Size (Age) table: Catches-at-Size are not available for the longtail tuna due to the paucity of size data available from most fleets (Fig. 11) and the uncertain status of the catches for this species (Fig. 7). Length distributions derived from the data available for gillnet fisheries are shown in Fig. 12. No data available for all other fisheries.

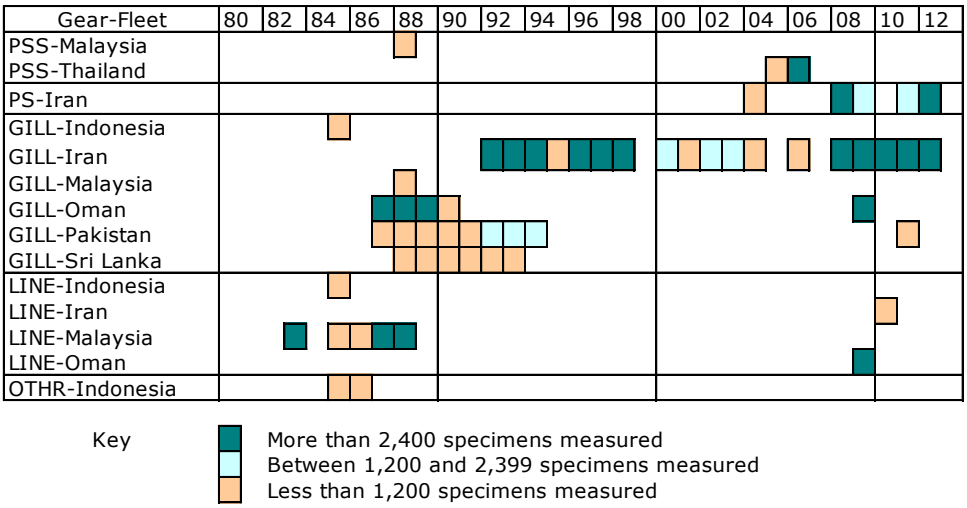


Fig. 11. Longtail tuna: Availability of length frequency data, by fishery and year (1980–2012)[6]. Note that no length frequency data are available at all for 1950–1982.

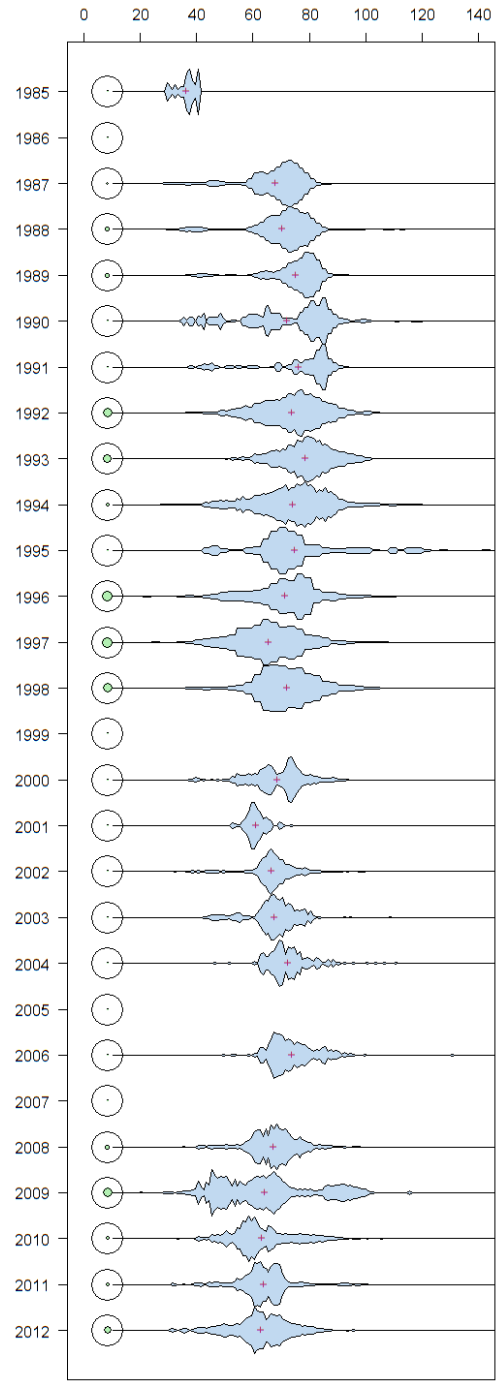
[5] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, catch-and-effort data are sometimes incomplete for a given year, existing only for short periods.

[6] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

Other biological data: The equations available for longtail tuna are shown below:

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Longtail tuna	Fork length – Round Weight[c]	RND=a*L^b	a= 0.00002 b= 2.83		Min:29 Max:128

LOT (Gillnet samples): size (in cm)



LOT (Gillnet): no. of samples ('000)

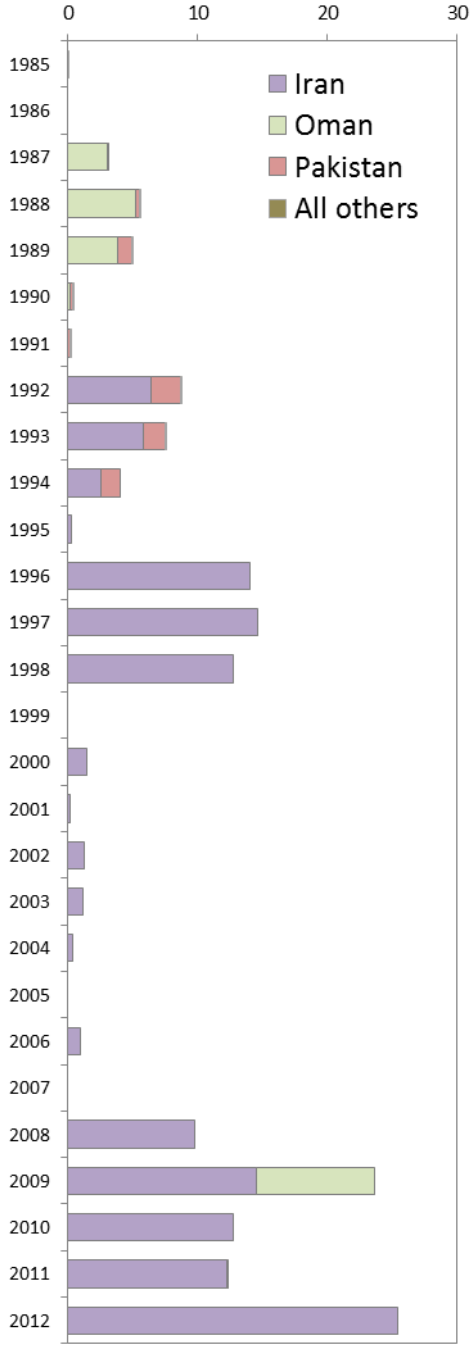


Fig. 12a-b. Left: Longtail tuna: length frequency distributions for gillnet fisheries (total amount of fish measured by 1cm length class) derived from data available at the IOTC Secretariat. The black outline circles (to the left of each distribution) indicate the minimum sampling standard set by IOTC of one fish per metric tonne; the green proportional circles indicate the relative sampling coverage in each year (i.e., circles with areas greater than the minimum sampling standard indicate relatively high sampling coverage in a given year).

Right: Number of longtail specimens sampled for lengths, by fleet (gillnet only).

Frigate tuna (FRI)

Fisheries and catch trends

Frigate tuna is taken from across the Indian Ocean area using gillnets, handlines and trolling, and pole-and-lines (Table 4; Fig. 13). This species is also an important bycatch for industrial purse seine vessels and is the target of some ring net fisheries (recorded as purse seine in Table 4). The catch estimates for frigate tuna were derived from very small amounts of information and are therefore highly uncertain[7] (Fig. 16).

TABLE 4. Frigate tuna: Best scientific estimates of the catches of frigate tuna by type of fishery for the period 1950–2012 (in metric tonnes). Data as of May 2014.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Purse seine	0	13	935	4860	7549	9,838	10145	10341	10096	11004	9649	10054	9571	12038	11237	10105
Gillnet	479	1234	2848	6980	14522	19,734	18662	19251	18316	21524	21941	25217	23579	30874	30476	29771
Line	1270	2413	4420	7423	13751	26,146	22750	25692	22586	25986	27897	34275	34416	38197	38286	29077
Other	1441	2007	2349	3683	9279	13,239	12238	12229	12204	11997	13725	16531	17887	18535	19111	14153
Total	**3,190**	**5,668**	**10,552**	**22,946**	**45,102**	**68,958**	**63,794**	**67,513**	**63,203**	**70,511**	**73,211**	**86,078**	**85,453**	**99,643**	**99,110**	**83,108**

The catches provided in Table 4 are based on the information available at the IOTC Secretariat and the following observations on the catches cannot currently be verified. Estimated catches have increased steadily since the late 1970's, reaching around 30,000 t in the late-1980's to between 55,000 and 60,000 t by the mid-1990's, and remaining at the same level in the following ten years. Since 2006 catches have increased, rising to nearly 100,000 t in 2010 and 2011, with current catches at around 83,000 t. The catches of frigate tuna have been higher in the east since the late 1990's, with ¾ of the catches of frigate tuna taken in the eastern Indian Ocean in recent years (Fig.14).

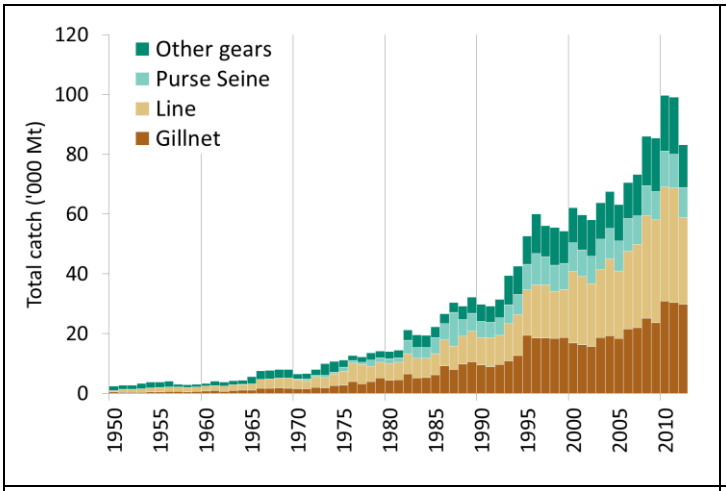


Fig. 13. Frigate tuna: Annual catches of frigate tuna by gear recorded in the IOTC Database (1950–2012).

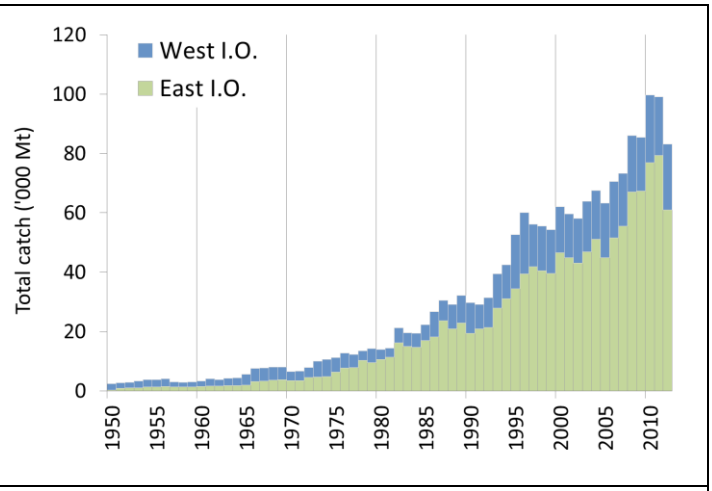


Fig. 14. Frigate tuna: Annual catch of frigate tuna by IOTC area recorded in the IOTC Database (1950–2012).

In recent years, over 90% of catches of frigate tuna have been concentrated in four countries: Indonesia (59%), India (14%), Sri Lanka (11%), and I.R. Iran (7%) (Fig. 15).

The size of frigate tunas taken by the Indian Ocean fisheries typically ranges between 20 and 50 cm depending on the type of gear used, season and location (Fig. 21). The fisheries operating in the Andaman Sea (coastal purse seines and troll lines) tend to catch frigate tuna of small to medium size (15–40 cm) while the gillnet, baitboat and other fisheries operating in the Indian Ocean catch usually larger specimens (25–50 cm).

[7] The uncertainty in the catch estimates has been assessed by the IOTC Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

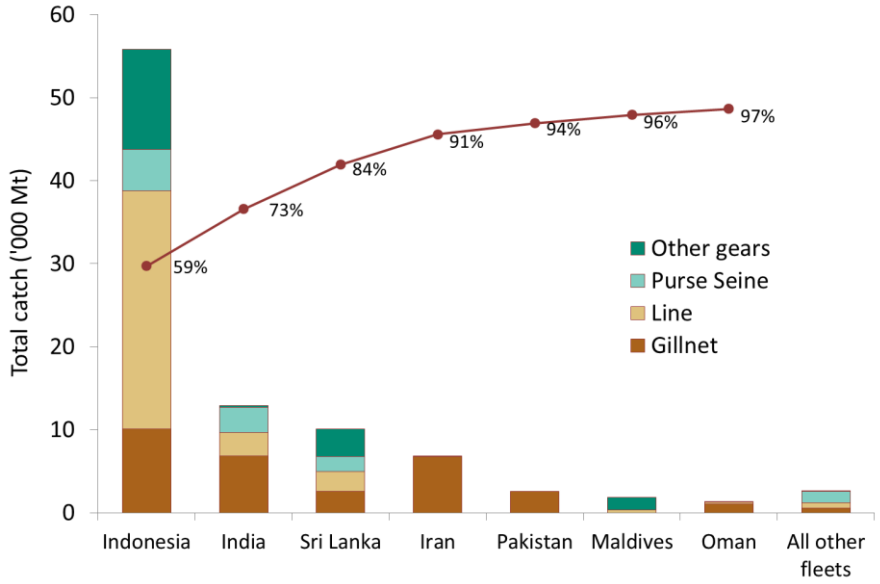


Fig. 15. Frigate tuna: average catches in the Indian Ocean over the period 2010–12, by country. Countries are ordered from left to right, according to the importance of catches of frigate tuna reported. The red line indicates the (cumulative) proportion of catches of frigate for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

Status of Fisheries Statistics at the IOTC

Retained catches are highly uncertain (Fig. 16) notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of frigate tuna by species or by gear for 1950–2004; catches of frigate tuna, bullet tuna and other species were reported aggregated for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. However, in a recent review by the IOTC Secretariat conducted by an independent consultant in 2012 he indicated that the catches of frigate tuna had been underestimated by Indonesia. While the new catches estimated for the frigate tuna in Indonesia remain uncertain, representing around 59% of the total catches of this species in the Indian Ocean in recent years (2010–12), the new figures are considered more reliable than those existing in the past.
- Artisanal fisheries of India and Sri Lanka: Although these countries report catches of frigate tuna until recently the catches have not been reported by gear. The catches of both countries were also reviewed by an independent consultant in 2012 and assigned by gear on the basis of official reports and information from various other alternative sources. The new catch series was previously presented to the WPNT in 2013, in which the new catches estimated for Sri Lanka are as much as three times higher than previous estimates. In recent years, the combined catches of frigate tuna for both countries have represented 24% of the total catches of this species in the Indian Ocean.
- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches of frigate tuna to the IOTC Secretariat. Catch levels are unknown.
- Other artisanal fisheries: The catches of frigate tuna and bullet tuna are seldom reported by species and, when they are reported by species, usually refer to both species (due to misidentification, with all catches assigned to the frigate tuna).
- Industrial fisheries: The catches of frigate tuna recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, and its catches are seldom recorded in the logbooks, nor can they be monitored in port. The EU recently reported catch levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.

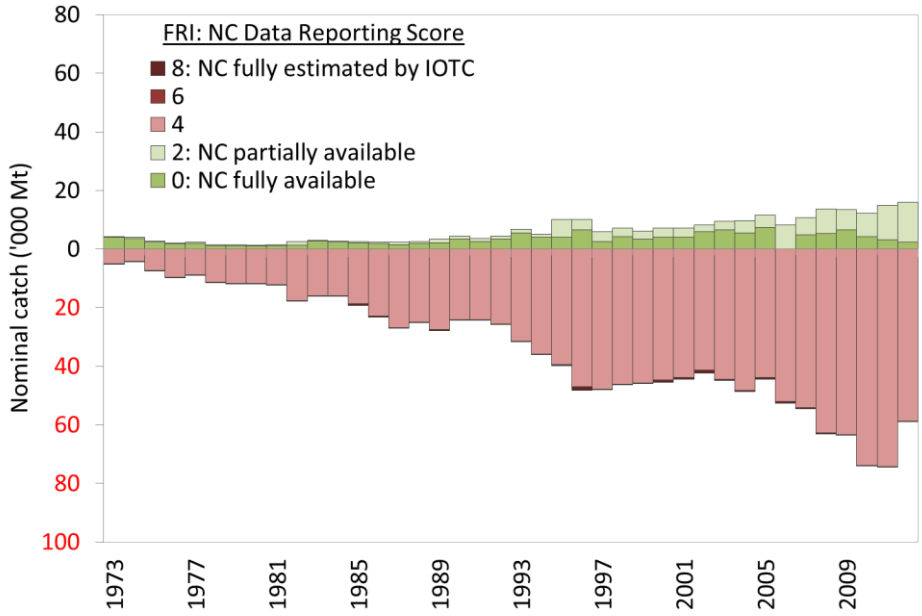


Fig. 16. Frigate tuna: nominal catch; uncertainty of annual catch estimates (1950–2012).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2014.

Discard levels are moderate for industrial purse seine fisheries. The EU recently reported discard levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.

Changes to the catch series: The overall catch series of frigate tuna has not changed substantially since the WPNT meeting in 2012 (Fig. 17). The IOTC Secretariat is currently undertaking reviews of the catch series for Indonesia, Malaysia and Thailand which are likely revise the catch estimates for the next WPNT in 2015; however at present the total catches of frigate remain at similar levels when compared to previous estimates.

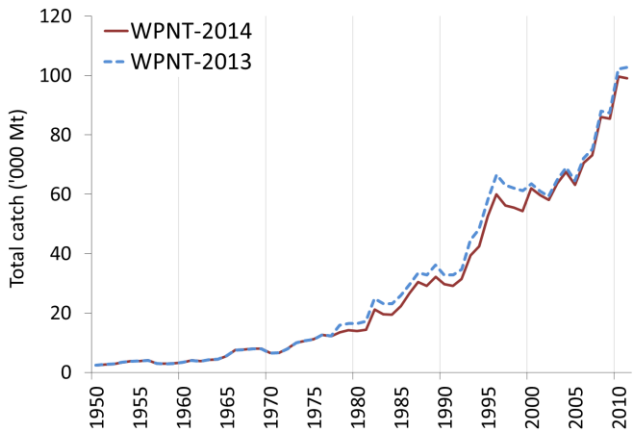


Fig. 17. Frigate tuna: Catches used by the WPNT 2013 *versus* those estimated for the WPNT in 2014 (1960–2012).

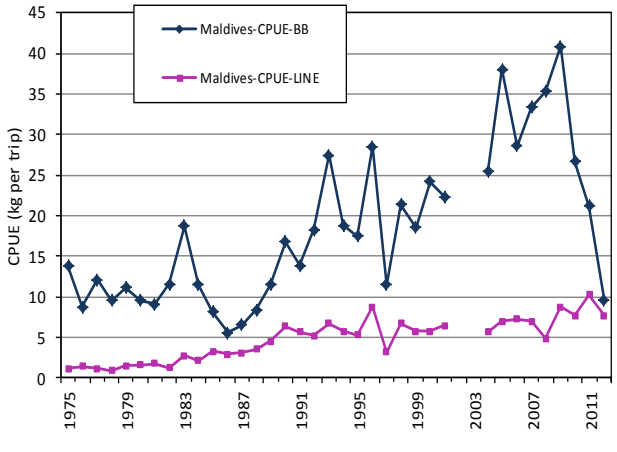


Fig. 18. Frigate tuna: Nominal CPUE series for the baitboat (BB using mechanized boats) and line (LINE, including handlines and trolling using mechanized boats) fisheries of Maldives derived from the available catches and effort data (1975–2012).

CPUE Series: Catch-and-effort series are available from some fisheries but they are considered highly incomplete (Fig. 19). In most cases catch-and-effort data are only available for short periods. Reasonably long catch-and-effort

series (extending for more than 10 years) are only available for Maldives baitboats and hand and troll lines (Fig. 18) and Sri Lanka gillnets. The catches and effort recorded for Sri Lankan gillnets are, however, thought to be inaccurate due to the dramatic changes in CPUE recorded between consecutive years.

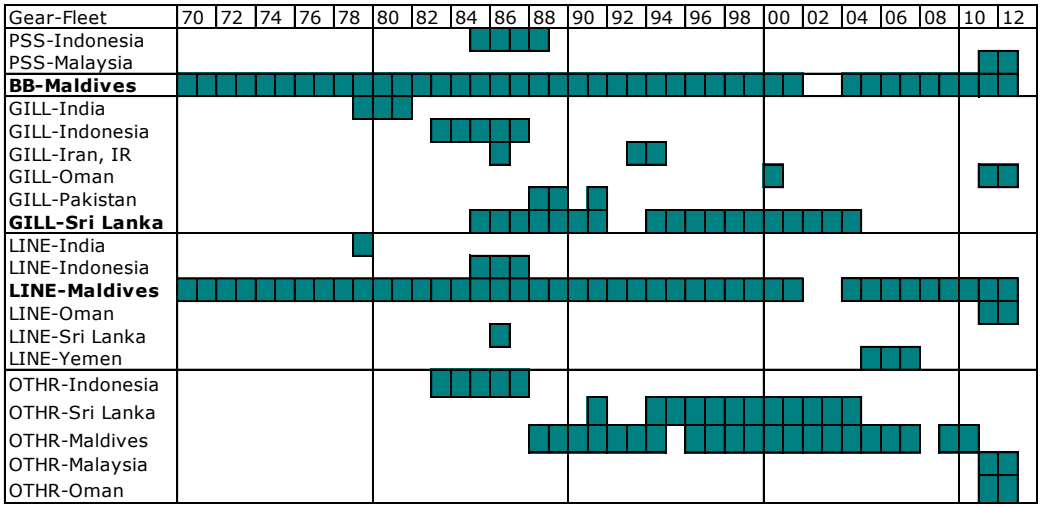


Fig. 19: Frigate tuna: Availability of catches and effort series, by fishery and year (1970–2012)[8]. Note that no catches and effort are available at all for 1950–69.

Trends in average weight can only be assessed for Sri Lankan gillnets and Maldivian pole-and-lines but the amount of specimens measured has been very low in recent years (Fig. 20). The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme). Unfortunately, the data collection did not continue in most countries after the end of the IPTP activities.

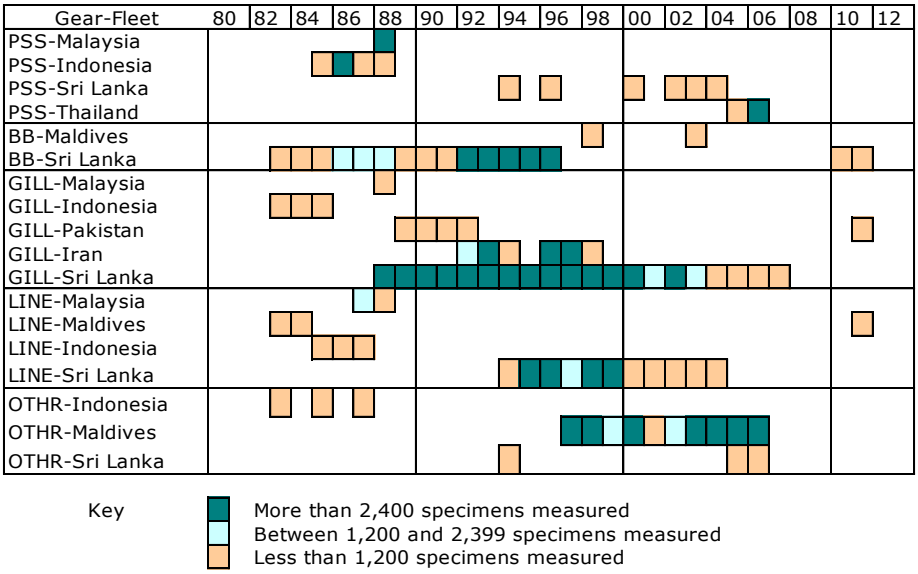


Fig. 20: Frigate tuna: Availability of length frequency data, by fishery and year (1980–2012)[9]. Note that no length frequency data are available at all for 1950–82.

Catch-at-Size(Age) table: Catch-at-Size data are not available for the frigate tuna due to the paucity of size data available from most fleets (Fig. 20) and the uncertain status of the catches for this species (Fig. 16). Length distributions derived from the data available for gillnet fisheries are shown in Fig. 21. No data available for all other fisheries.

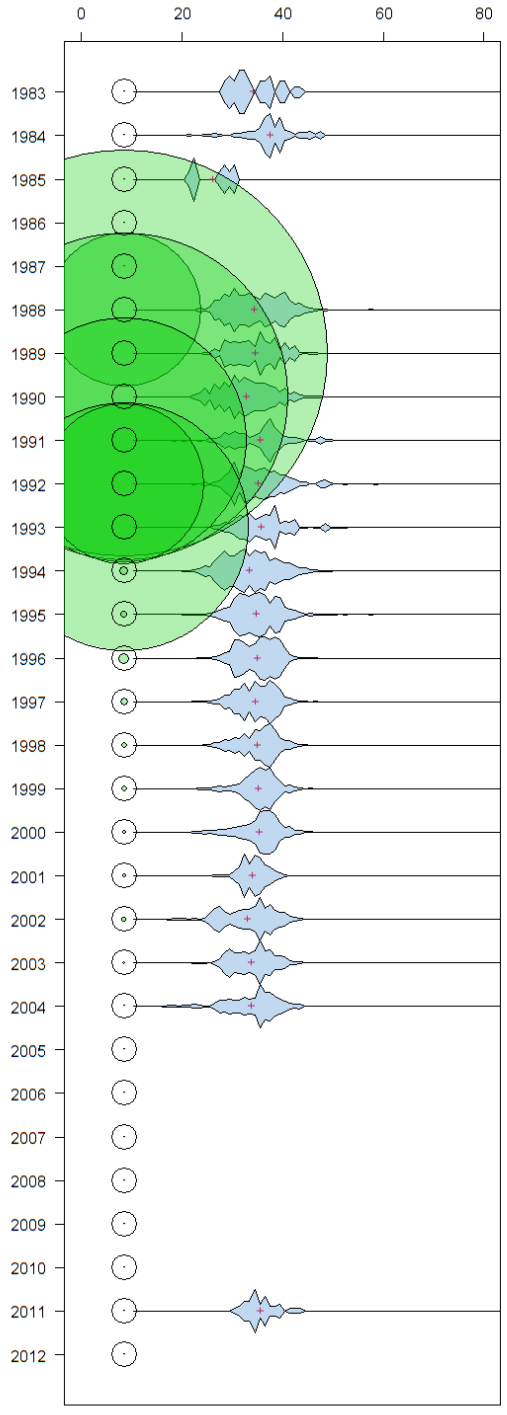
[8] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

[9] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

Other biological data: The equations available for frigate tuna are shown below:

Species	*From type measurement — To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Frigate tuna	*Fork length — Round WeightA*	*RND=a*L^b*	*a= 0.00001700 b= 3.0*		*Min:20 Max:45*

FRI (Gillnet samples): size (in cm)



FRI (Gillnet): no. of samples (‘000)

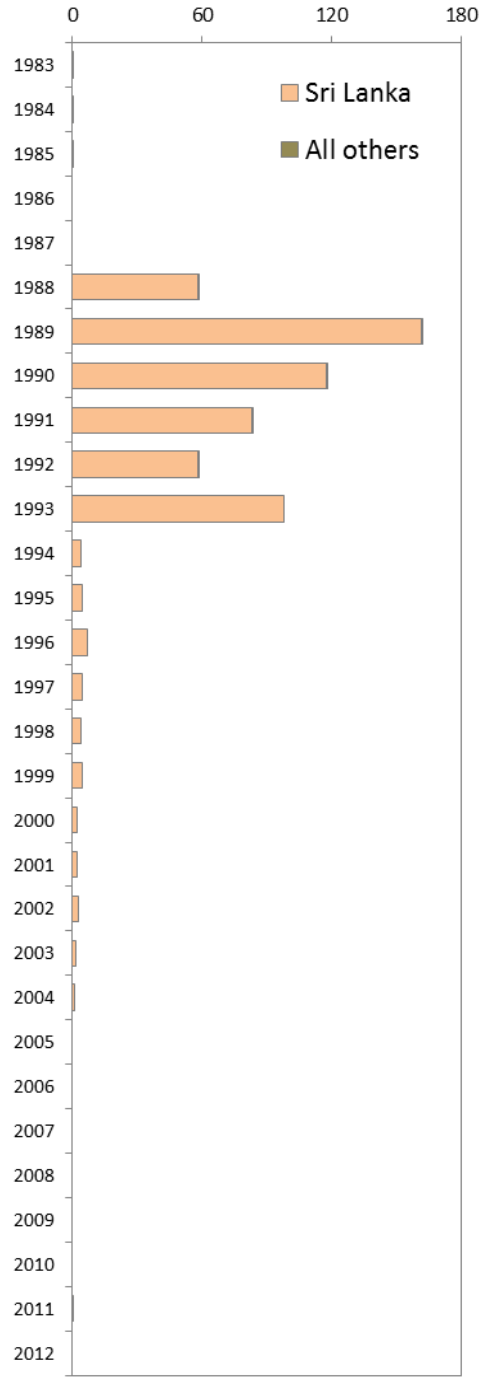


Fig. 21a-b. Left: Frigate tuna (gillnet fisheries): Length frequency distributions (total amount of fish measured by 1cm length class) derived from data available at the IOTC Secretariat. The black outline circles (to the left of each distribution) indicate the minimum sampling standard set by IOTC of one fish per metric tonne; the green proportional circles indicate the relative sampling coverage in each year (i.e., circles with areas greater than the minimum sampling standard indicate relatively high sampling coverage in a given year).

Right: Number of frigate tuna specimens (gillnet fisheries) sampled for lengths, by fleet and year.

Bullet tuna (BLT)

Fisheries and catch trends

Bullet tuna is caught mainly by gillnet, handline, and trolling, across the broader Indian Ocean area (Table 5; Fig. 22). This species is also an important catch for coastal purse seiners. The catch estimates for bullet tuna were derived from very small amounts of information and are therefore highly uncertain[10] (Fig. 25).

TABLE 5. Bullet tuna: Best scientific estimates of the catches of bullet tuna by type of fishery for the period 1950–2012 (in metric tonnes). Data as of May 2014.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Purse seine	-	2	28	278	552	646	612	603	562	635	548	935	1,051	1,372	638	606
Gillnet	41	153	296	531	1,222	1,722	1,525	1,699	1,501	1,840	1,623	2,293	2,577	3,346	2,721	2,872
Line	113	193	325	393	780	1,182	1,034	1,004	999	1,152	1,113	1,881	2,178	2,903	1,165	1,245
Other	5	13	44	242	755	1,278	775	1,239	882	1,390	1,745	1,769	2,000	2,746	3,922	4,155
Total	**159**	**362**	**693**	**1,444**	**3,309**	**4,828**	**3,947**	**4,545**	**3,943**	**5,016**	**5,028**	**6,878**	**7,807**	**10,367**	**8,447**	**8,878**

The catches provided in Table 5 are based on the information available at the IOTC Secretariat and the following observations on the catches cannot currently be verified. Estimated catches of bullet tuna reached around 2,000 t in the early 1990's, increasing markedly in the following years to reach a peak in 1997, at around 4,900 t. The catches decreased slightly in the following years and remained at values of between 3,700 t and 4,000 t until the late-2000's, increasing sharply again up to the 10,000 t recorded in 2010, the highest catch ever recorded for this species in the Indian Ocean. Bullet tunas have been caught in both Indian Ocean basins in recent years, with the majority of the catch in the East Indian Ocean (Fig. 23).

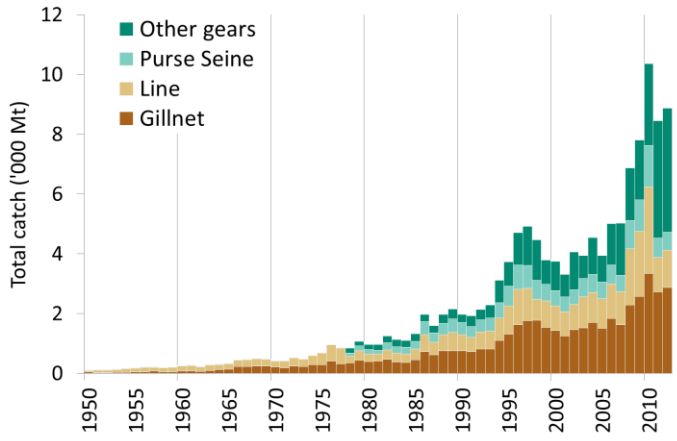


Fig. 22. Bullet tuna: Annual catches of bullet tuna by gear recorded in IOTC Database (1950–2012).

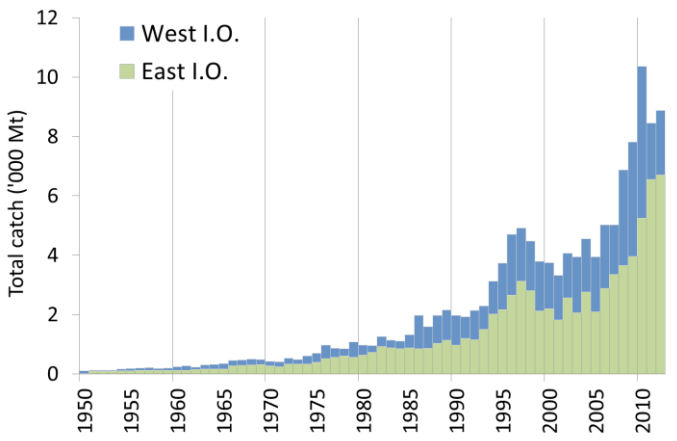


Fig. 23. Bullet tuna: Annual catches of bullet tuna by IOTC area recorded in IOTC Database (1950–2012).

In recent years the catches of bullet tuna estimated for the fisheries of India, Sri Lanka and Indonesia have represented over 90% of the total combined catches of this species from all fisheries in the Indian Ocean (Table 2, Fig. 24).

Length frequency data for the bullet tuna is only available for some Sri Lanka fisheries and periods. These fisheries catch bullet tuna ranging between 15 and 35 cm.

[10] The uncertainty in the catch estimates has been assessed by the IOTC Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

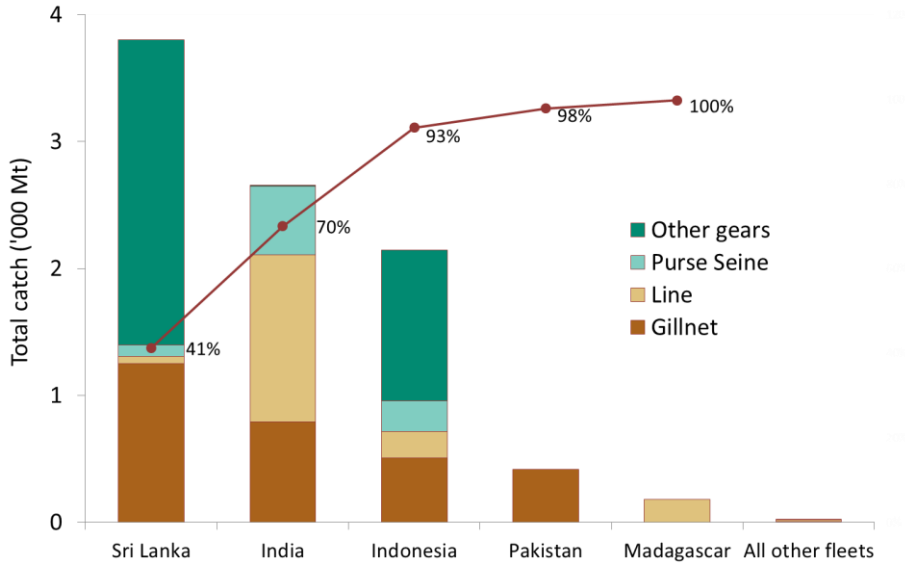


Fig. 24. Bullet tuna: average catches in the Indian Ocean over the period 2010–12, by country. Countries are ordered from left to right, according to the importance of catches of bullet tuna reported. The red line indicates the (cumulative) proportion of catches of bullet tuna for the countries concerned, over the total combined catches of bullet tuna reported from all countries and fisheries.

Status of Fisheries Statistics at the IOTC

Retained catches are highly uncertain for all fisheries (Fig. 25) due to:

- Aggregation: Bullet tunas are usually not reported by species, but are instead aggregated with frigate tunas or, less frequently, other small tuna species.
- Mislabelling: Bullet tunas are usually mislabelled as frigate tuna, with their catches reported under the latter species.
- Underreporting: the catches of bullet tuna by industrial purse seiners are rarely, if ever, reported.

It is for the above reasons that the catches of bullet tunas in the IOTC database are thought to be highly uncertain and represent only a small fraction of the total catches of this species in the Indian Ocean.

Discard levels are moderate for industrial purse seine fisheries. The EU recently reported discard levels of bullet tuna for its purse seine fleet, for 2003–07, estimated using observer data.

Changes to the catch series: The catch series of bullet tuna has not changed substantially since the WPNT meeting in 2013 (Fig. 26).

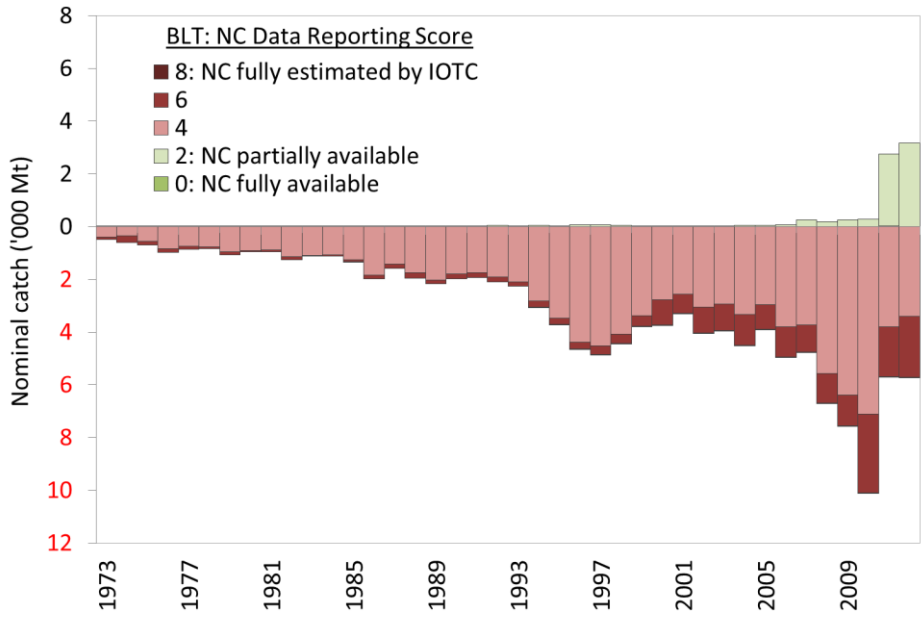


Fig. 25. Bullet tuna: nominal catch; uncertainty of annual catch estimates (1950–2012).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2014.

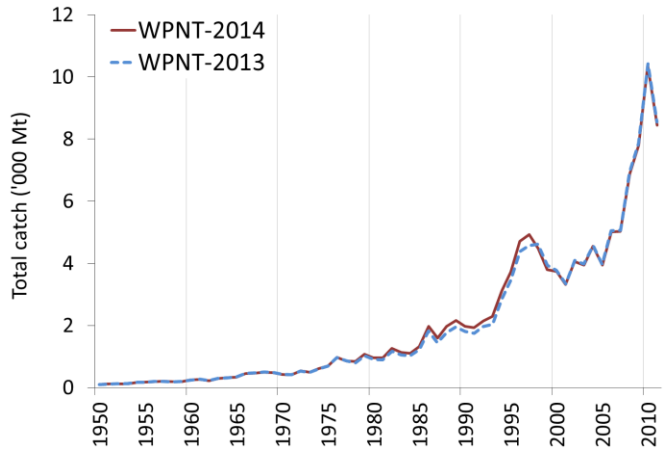


Fig. 26. Bullet tuna: Catches used by the WPNT in 2013 versus those estimated for the WPNT in 2014 (1950–2011).

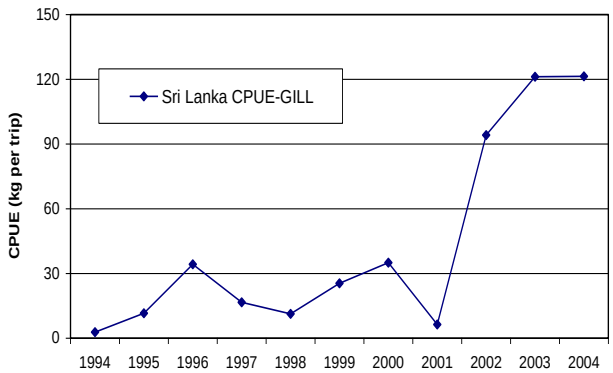


Fig. 27. Bullet tuna: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004).

CPUE Series: Catch-and-effort series are not available for most fisheries (Fig. 28) and, when available, they are usually considered to be of poor quality for the fisheries having reasonably long catch-and-effort data series, as is the case with the gillnet fisheries of Sri Lanka (Fig. 27).

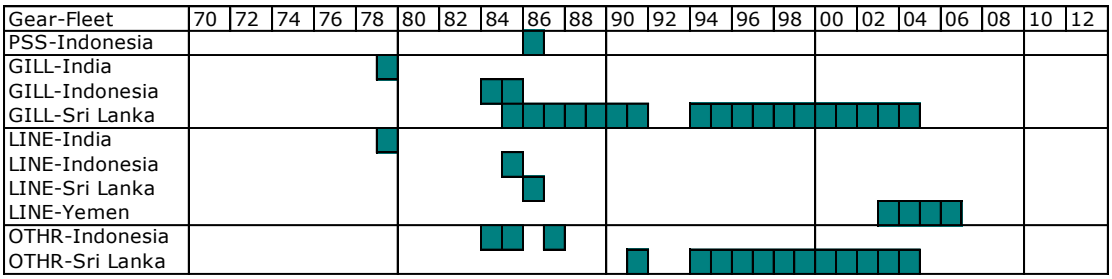


Fig. 28. Bullet tuna: Availability of catches and effort series, by fishery and year (1970–2012)[11]. Note that no catches and effort are available at all for 1950–78.

Trends in average weight cannot be assessed for most fisheries. Reasonable long series of length frequency data are only available for Sri Lankan gillnets and lines but the amount of specimens measured has been very low in recent years (Fig. 28).

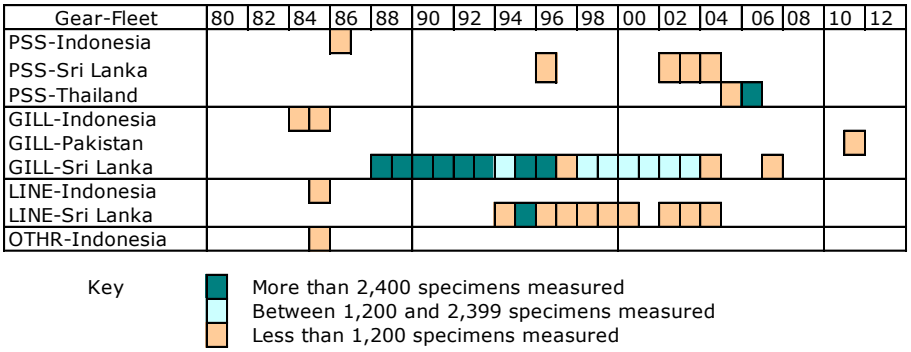


Fig. 29. Bullet tuna: Availability of length frequency data, by fishery and year (1980–2012)[12]. Note that no length frequency data are available at all for 1950–83.

Catch-at-Size(Age) table: Catch-at-Size data are not available for the bullet tuna due to the paucity of size data available from most fleets (Fig. 29) and the uncertain status of the catches for this species (Fig. 25).

Other biological data: The equations available for bullet tuna are shown below

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Bullet tuna	*Fork length – Round WeightA*	*RND=a*L^b*	*a= 0.00001700* *b= 3.0*		*Min:10* *Max:40*

[11] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

[12] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

Kawakawa (KAW)

Fisheries and catch trends

Kawakawa is caught mainly by coastal purse seines, gillnets and, handlines and trolling (Table 6 and Fig. 30); and may be also an important bycatch of the industrial purse seiners. The catch estimates for kawakawa were derived from very small amounts of information and are therefore highly uncertain[13] (Fig. 34).

TABLE 6. Kawakawa: Best scientific estimates of the catches of kawakawa by type of fishery for the period 1950–2012 (in metric tonnes). Data as of May 2014

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Purse seine	100	385	2,227	11,362	21,393	28,006	22,121	27,811	28,127	33,739	30,305	34,275	36,743	35,043	42,229	40,883
Gillnet	2,179	4,098	9,187	16,665	29,737	50,264	43,998	45,727	45,953	52,585	55,378	66,102	63,557	57,974	69,937	76,682
Line	2,102	3,642	7,146	11,216	16,739	22,527	19,314	22,780	20,796	22,108	23,439	29,457	29,745	30,005	31,370	29,092
Other	295	719	1,357	2,690	5,129	7,702	6,534	7,511	7,551	7,847	9,151	9,401	10,065	9,991	10,059	9,359
Total	**4,676**	**8,844**	**19,918**	**41,933**	**72,997**	**108,499**	**91,967**	**103,830**	**102,427**	**116,279**	**118,272**	**139,235**	**140,110**	**133,012**	**153,595**	**156,017**

The catches provided in Table 6 are based on the information available at the IOTC Secretariat and the following observations on the catches cannot currently be verified. Annual estimates of catches for the kawakawa increased markedly from around 20,000 t in the mid-1970's to reach the 45,000 t mark in the mid-1980's and 156,000 t in 2012, the highest catches ever recorded for this species. In recent years the catches of kawakawa have been recorded at similar levels in in the two Indian Ocean basins (Fig. 31).

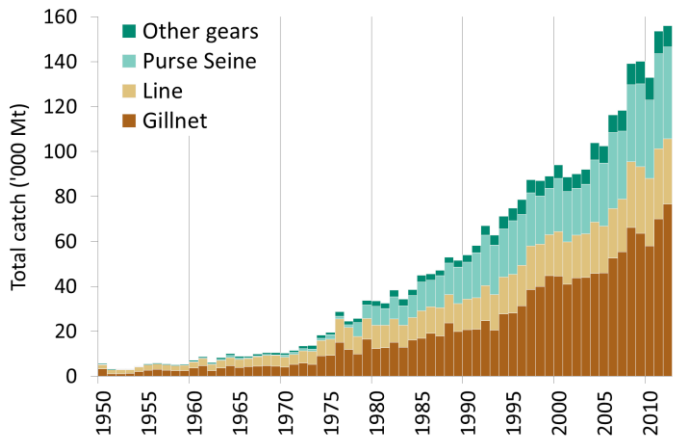


Fig. 30. Kawakawa: Annual catches of kawakawa by gear recorded in the IOTC database (1950–2012).

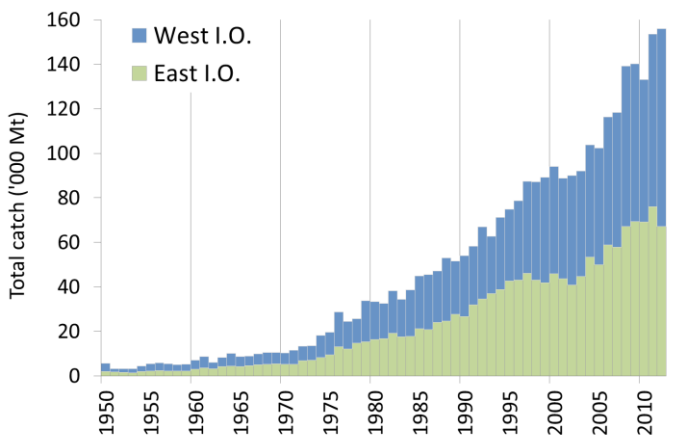


Fig. 31. Kawakawa: Annual catches of kawakawa by IOTC area recorded in the IOTC database (1950–2012).

In recent years, the countries attributed with the highest catches are Indonesia (26%), India (22%), Iran (15%), and Pakistan (9%) and Sri Lanka (6%) and Malaysia (6%) (Table 2, Fig. 32).

The size of kawakawa taken by the Indian Ocean fisheries typically ranges between 20 and 60 cm depending on the type of gear used, season and location (Fig. 38). The coastal purse seine fisheries operating in the Andaman Sea tend to catch kawakawa of small size (15–30 cm) while the gillnet, baitboat and other fisheries operating in the Indian Ocean catch usually larger specimens (25–55 cm).

[13] The uncertainty in the catch estimates has been assessed by the IOTC Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

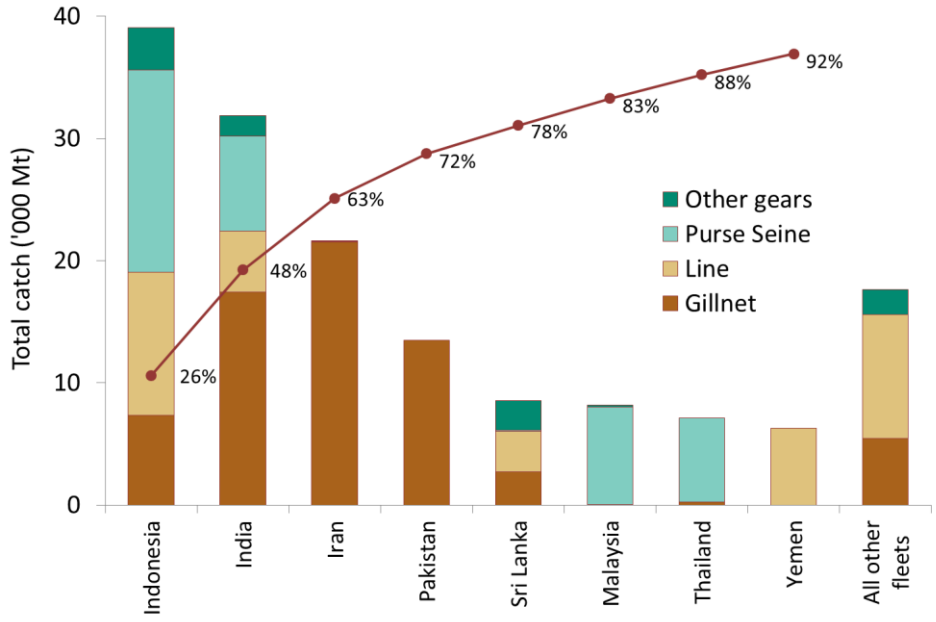


Fig. 32. Kawakawa: average catches in the Indian Ocean over the period 2010–12, by country. Countries are ordered from left to right, according to the importance of catches of kawakawa reported. The red line indicates the (cumulative) proportion of catches of kawakawa for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

Status of Fisheries Statistics at the IOTC

Retained catches are uncertain (Fig. 33) notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of kawakawa by species or by gear for 1950–2004; catches of kawakawa, longtail tuna and, to a lesser extent, other species were reported aggregated for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. However, a review by the IOTC Secretariat conducted by an independent consultant in 2012 indicated that the catches of kawakawa had been overestimated by Indonesia. While the new catches estimated for kawakawa in Indonesia remain uncertain, representing around 26% of the total catches of this species in the Indian Ocean in 2010–12 (compared to around 38% in previous years, prior to the review of Indonesia's catch series), the new figures are considered more reliable than those previously recorded in the IOTC database.
- Artisanal fisheries of India: Although India reports catches of kawakawa they are not always reported by gear. The catches of kawakawa in India were also reviewed by the IOTC Secretariat in 2012 and assigned by gear on the basis of official reports and information from various other alternative sources. The catches of kawakawa in India have represented 22% of the total catches of this species in the Indian Ocean in 2010-12 (compared to around 17% in previous years, prior to the review of India's catch series).
- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches to the IOTC Secretariat. Catch levels are unknown.
- Other artisanal fisheries: The catches of kawakawa are usually not reported by species, being combined with catches of other small tuna species like skipjack tuna and frigate tuna (e.g., coastal purse seiners of Thailand, and until recently Malaysia).
- Industrial fisheries: The catches of kawakawa recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, its catches are seldom recorded in the logbooks, nor are they monitored in port. The EU recently reported catch levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.

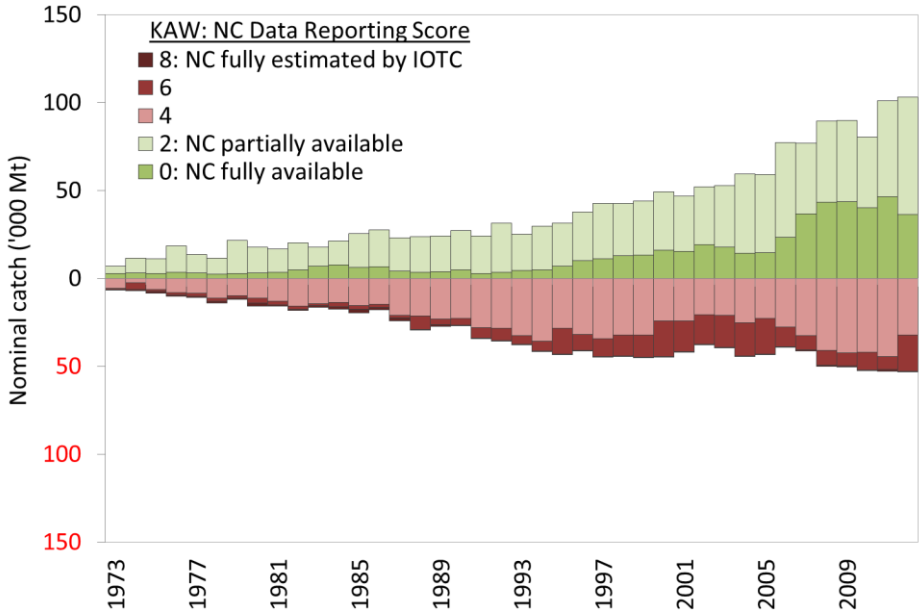


Fig. 33. Kawakawa: nominal catch; uncertainty of annual catch estimates (1950–2012).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2014.

Discard levels are moderate for industrial purse seine fisheries. The EU recently reported discard levels of kawakawa for its purse seine fleet, for 2003–07, estimated using observer data.

Changes to the catch series: The overall catch series of kawakawa has not changed substantially since the WPNT meeting in 2012 (Fig. 34). The IOTC Secretariat is currently undertaking reviews of the catch series for Indonesia, Malaysia and Thailand which are likely revise the catch estimates for the next WPNT in 2015; however at present the total catches of kawakawa remain at similar levels when compared to previous estimates.

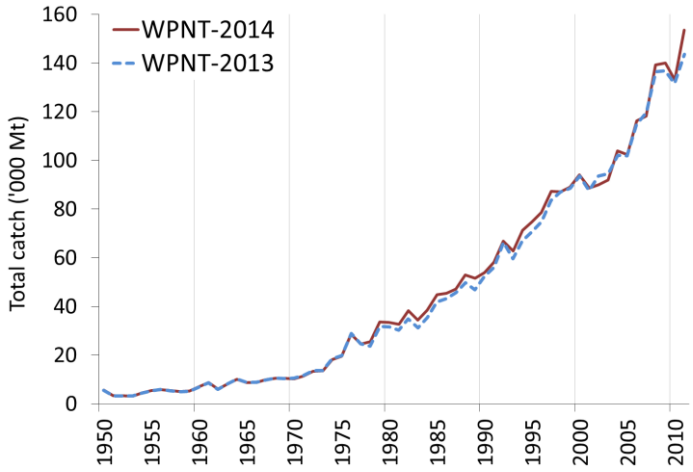


Fig. 34. Kawakawa: Catches used by the WPNT in 2013 versus those estimated for the WPNT in 2014 (1950–2011).

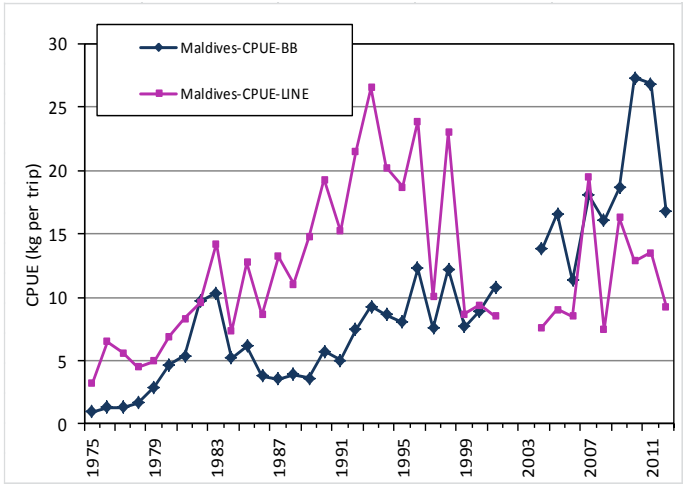


Fig. 35. Kawakawa: Nominal CPUE series for the baitboat (BB) and troll line (TROL) fisheries of Maldives (1975–2012) derived from the available catches and effort data.

CPUE Series: Catch-and-effort series are available from some fisheries but they are considered highly incomplete (Fig. 36). In most cases catch-and-effort data are only available for short periods. Reasonably long catch-and-effort

data series (extending for more than 10 years) are only available for Maldives baitboats and troll lines and Sri Lanka gillnets (Fig. 35). The catch-and-effort data recorded for Sri Lankan gillnets are, however, thought to be inaccurate due to the dramatic changes in CPUE recorded between consecutive years.

Trends in average weight can be assessed for Sri Lankan gillnets but the amount of specimens measured has been very low in recent years (Fig. 37). The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme); unfortunately, the data collection did not continue after the end of the IPTP activities. In addition since 1998 there has been some sampling of lengths from Iranian gillnets (collected from vessels operating in the Arabian Sea), although average lengths and distribution of lengths of samples are significantly larger than specimens reported by other fleets.

Other biological data: The equations available for kawakawa are shown below

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Kawakawa	*Fork length – Round WeightA*	*RND=a*L^b*	*a= 0.0000260 b= 2.9*		*Min: 20 Max: 65*

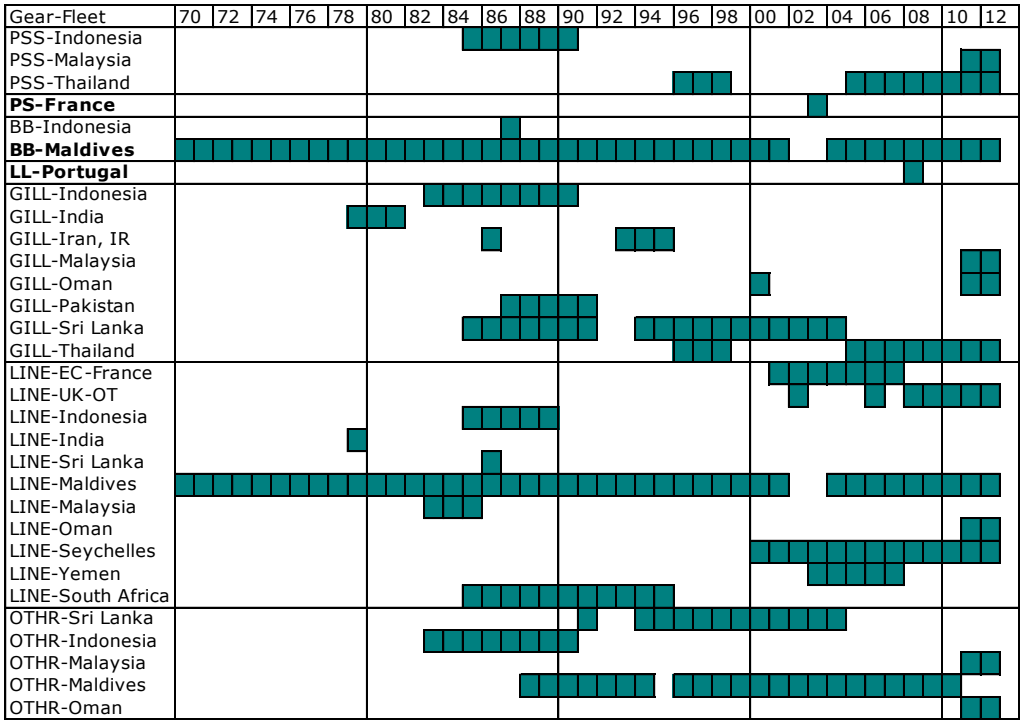


Fig. 36. Kawakawa: Availability of catches and effort series, by fishery and year (1970-2012)[14]. Note that no catches and effort are available at all for 1950–69.

Catch-at-Size(Age) table: Catch-at-Size data are not available for the kawakawa due to the paucity of size data available from most fleets (Fig. 37) and the uncertain status of the catches for this species (Fig. 33). Length distributions derived from the data available for gillnet fisheries are shown in Fig. 38. No data available for all other fisheries.

[14] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

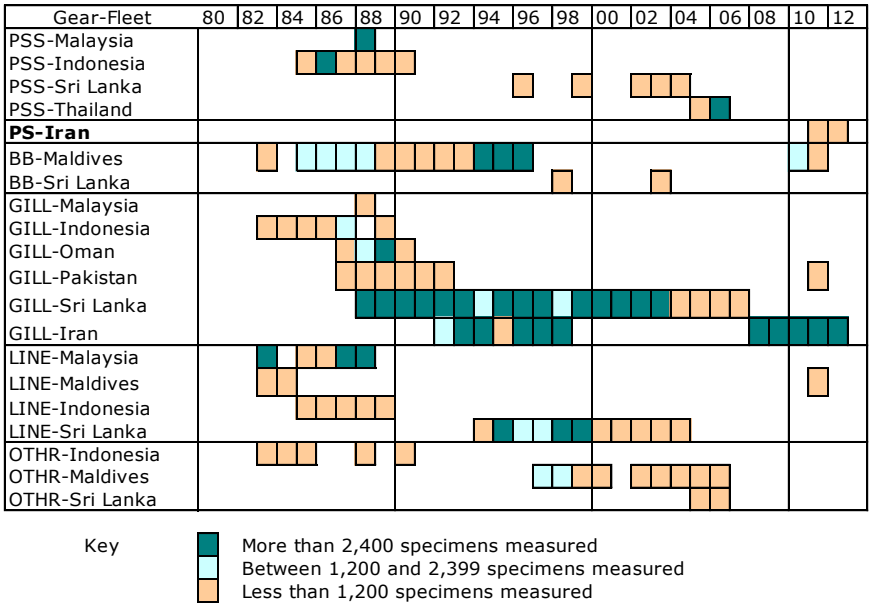
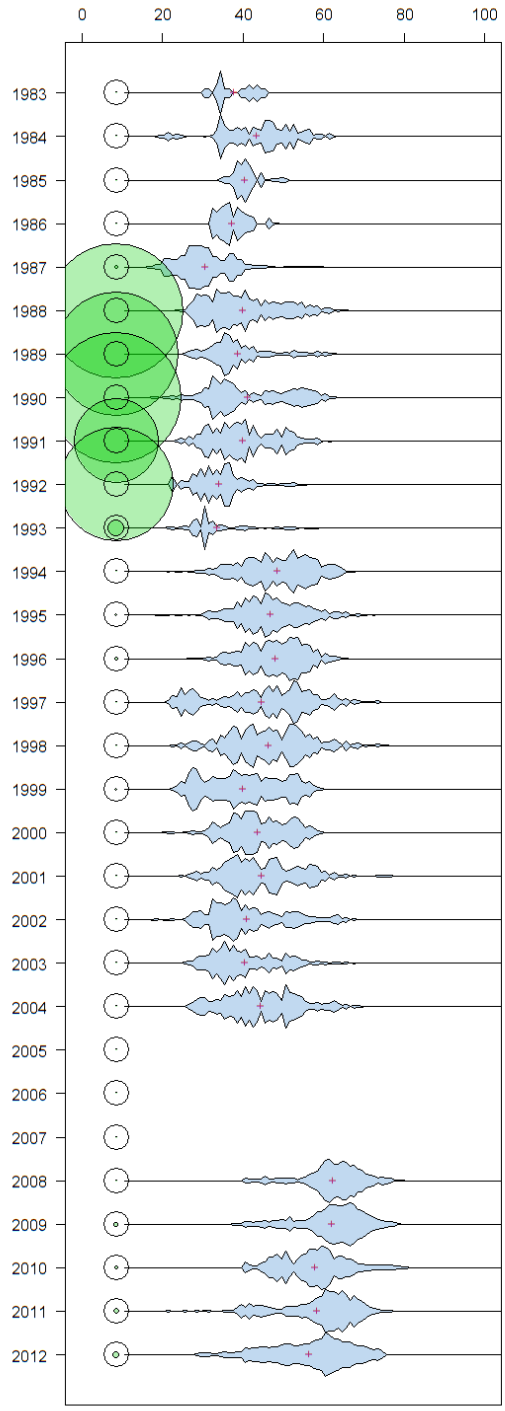


Fig. 37. Kawakawa: Availability of length frequency data, by fishery and year (1980-2012)[15]. Note that no length frequency data are available at all for 1950–82.

[15] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

KAW (Gillnet samples): size (in cm)



KAW (Gillnet): no. of samples ('000)

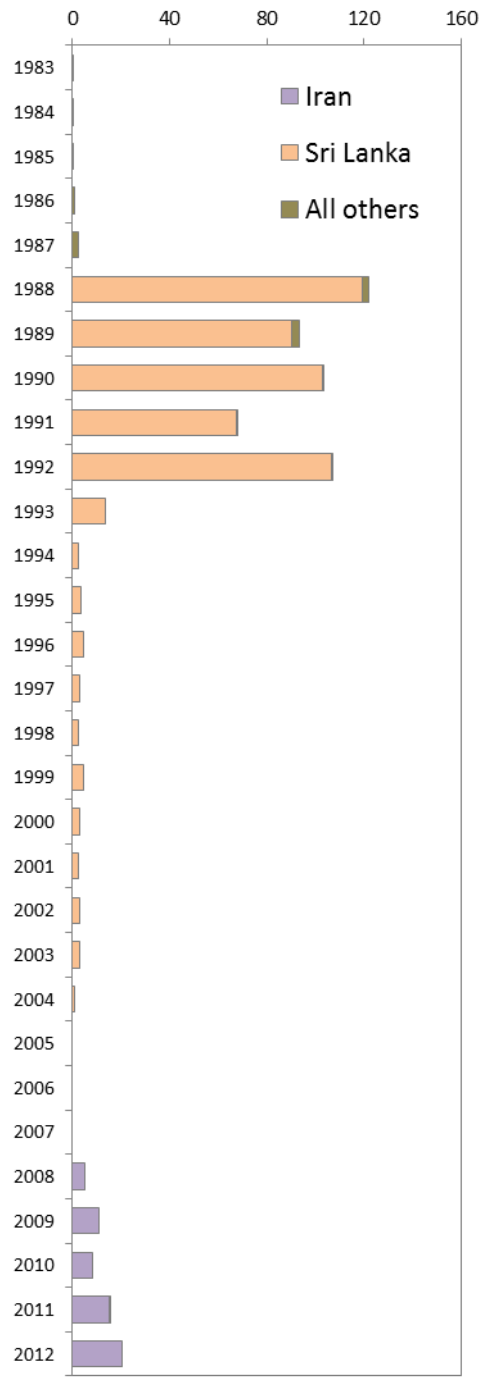


Fig. 38a-b. Left: Kawakawa: Length frequency distributions for gillnet fisheries (total amount of fish measured by 1cm length class) derived from data available at the IOTC Secretariat. The black outline circles (to the left of each distribution) indicate the minimum sampling standard set by IOTC of one fish per metric tonne; the green proportional circles indicate the relative sampling coverage in each year (i.e., circles with areas greater than the minimum sampling standard indicate relatively high sampling coverage in a given year).

Right: Number of kawakawa specimens sampled for lengths, by fleet (gillnet only).

Narrow-barred Spanish mackerel (COM)

Fisheries and catch trends

Narrow-barred Spanish mackerel[16] is targeted throughout the Indian Ocean by artisanal and recreational fishers. The main method of capture is gillnet, but significant numbers of are also caught trolling (Fig. 39).

TABLE 7. Narrow-barred Spanish mackerel: Best scientific estimates of the catches of narrow-barred Spanish mackerel by type of fishery for the period 1950–2012 (in metric tonnes). Data as of May 2014.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Purse seine	0	0	284	2,352	4,136	5,435	4,692	4,563	4,695	7,326	5,918	6,654	8,358	8,916	9,020	7,200
Gillnet	8,680	16,862	29,732	51,762	60,008	64,364	63,078	61,989	53,775	65,161	69,222	73,058	72,112	75,172	80,611	80,613
Line	2,581	3,300	7,106	14,464	14,741	19,140	17,365	17,398	16,950	19,272	20,077	24,103	25,714	25,729	27,762	28,730
Other	57	96	468	5,614	9,739	20,995	18,285	19,528	18,327	23,309	24,271	23,652	27,933	25,589	27,869	26,790
Total	**11,318**	**20,258**	**37,590**	**74,192**	**88,624**	**109,934**	**103,420**	**103,478**	**93,747**	**115,068**	**119,487**	**127,467**	**134,116**	**135,406**	**145,261**	**143,333**

The catch estimates for narrow-barred Spanish mackerel were derived from very small amounts of information and are therefore highly uncertain[17] (Fig. 42). The catches provided in Table 7 are based on the information available at the IOTC Secretariat and the following observations on the catches cannot currently be verified. The catches of narrow-barred Spanish mackerel increased from around 50,000 t the late-1970's to over 100,000 t by the late-1990's. The highest catches of narrow-barred Spanish mackerel were recorded in 2011, amounting to 145,000 t. Narrow-barred Spanish mackerel is caught in both Indian Ocean basins, with approximately equal proportions of catches recorded in the East and West Indian Ocean since the mid-2000s (Fig. 40).

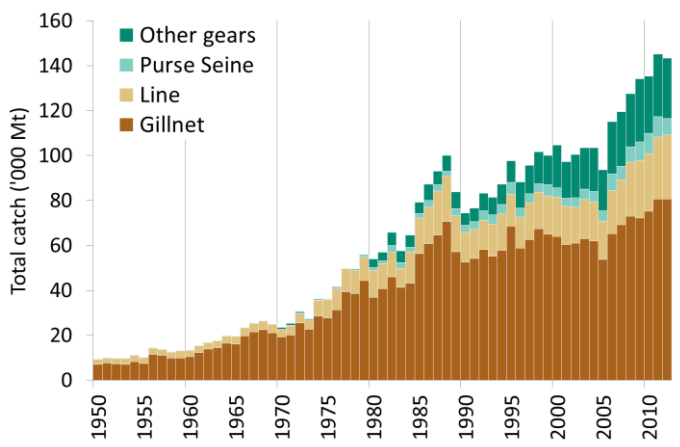


Fig. 39. Narrow-barred Spanish mackerel: Annual catches of narrow-barred Spanish mackerel by gear recorded in the IOTC database (1950–2012).

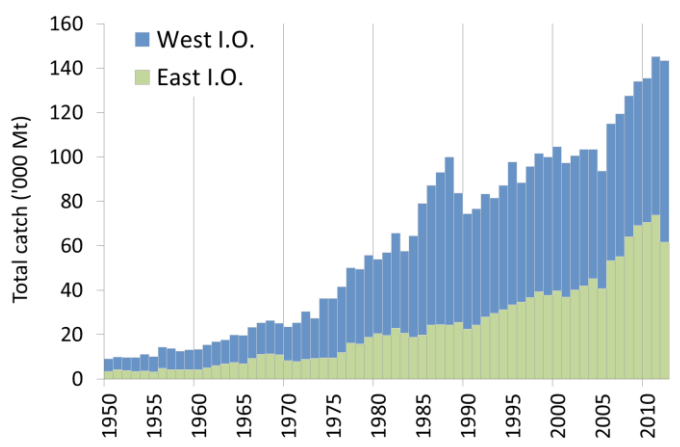


Fig. 40. Narrow-barred Spanish mackerel: Annual catches of narrow-barred Spanish mackerel by IOTC area recorded in the IOTC database (1950–2012).

In recent years, the countries attributed with the highest catches of narrow-barred Spanish mackerel are Indonesia (28%) and India (22%) and, to a lesser extent, I.R. Iran, Myanmar, the UAE and Pakistan (26%) (Fig. 41).

The size of narrow-barred Spanish mackerel taken by the Indian Ocean fisheries typically ranges between 30 and 140 cm depending on the type of gear used, season and location (Fig. 47). The size of narrow-barred Spanish mackerel taken varies by location with 32–119 cm fish taken in the Eastern Peninsular Malaysia area, 17–139 cm fish taken in

[16] Hereinafter referred to as Spanish mackerel

[17] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated

the East Malaysia area and 50-90 cm fish taken in the Gulf of Thailand. Similarly, narrow-barred Spanish mackerel caught in the Oman Sea are typically larger than those caught in the Persian Gulf.[18]

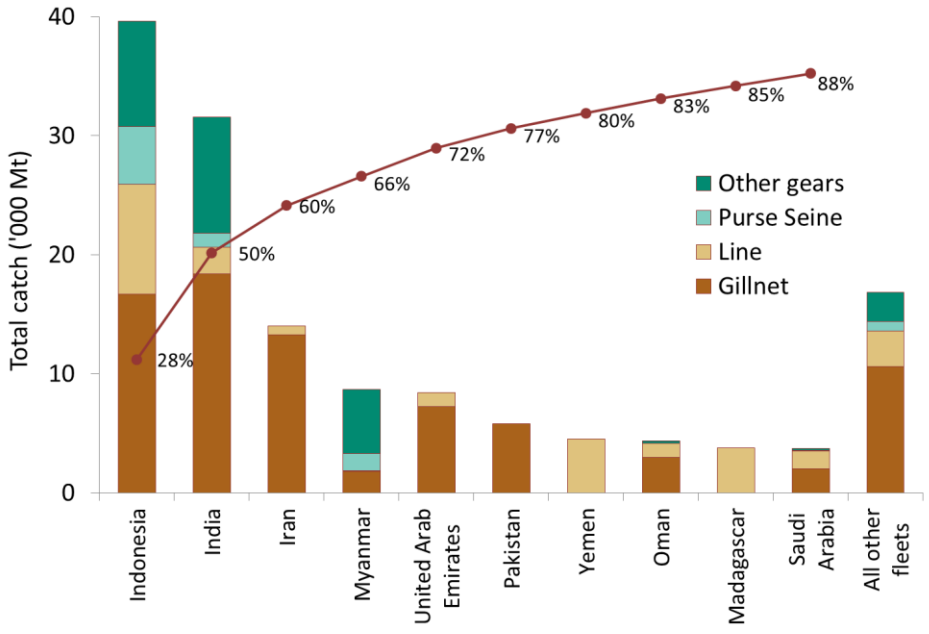


Fig. 41. Narrow-barred Spanish mackerel: average catches in the Indian Ocean over the period 2010–12, by country. Countries are ordered from left to right, according to the importance of catches of narrow-barred Spanish mackerel reported. The red line indicates the (cumulative) proportion of catches narrow-barred Spanish mackerel for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

Status of Fisheries Statistics at the IOTC

Retained catches are uncertain (Fig. 42) notably for the following fisheries:

- Artisanal fisheries of Indonesia and India: Indonesia and India have only recently reported catches of Spanish mackerel by gear, including catches by gear for the years 2005–08 and 2007–08, respectively. In the past, the IOTC Secretariat used the catches reported in recent years to break the aggregates for previous years, by gear and species. However, in a review conducted by the IOTC Secretariat by an independent consultant in 2012 the catches of narrow-barred Spanish mackerel were reassigned by gear. In recent years, the catches of narrow-barred Spanish mackerel estimated for Indonesia and India component represent around 50% of the total catches of this species in recent years.
- Artisanal fisheries of Madagascar: To date, Madagascar has not reported catches of narrow-barred Spanish mackerel to the IOTC. During 2012 the IOTC Secretariat conducted a review aiming to break the catches recorded in the FAO database as narrow-barred Spanish mackerel by species, on the assumption that all catches of tunas and tuna-like species had been combined under this name (the review used data from various sources including a reconstruction of the total marine fisheries catches of Madagascar (1950–2008), undertaken by the Sea Around Us Project). The new catches estimated are thought to be very uncertain.
- Artisanal fisheries of Somalia: Catch levels are unknown.
- Other artisanal fisheries UAE do not report catches of narrow-barred Spanish mackerel by gear. Although most of the catches are believed to be taken by gillnets, some narrow-barred Spanish mackerel may be also caught by using small surrounding nets, lines or other artisanal gears. In addition, Thailand report catches of narrow-barred Spanish mackerel and Indo-Pacific king mackerel aggregated.
- All fisheries: In some cases the catches of seerfish species are mislabelled, the catches of Indo-Pacific king mackerel and, to a lesser extent, other seerfish species, labelled as narrow-barred Spanish mackerel. Similarly, the catches of wahoo in some longline fisheries are thought to be mislabelled as narrow-barred Spanish

[18] The IOTC Secretariat did not find any data in support of this statement.

mackerel. This mislabelling is thought to have little impact in the case of the narrow-barred Spanish mackerel but may be important for other seerfish species.

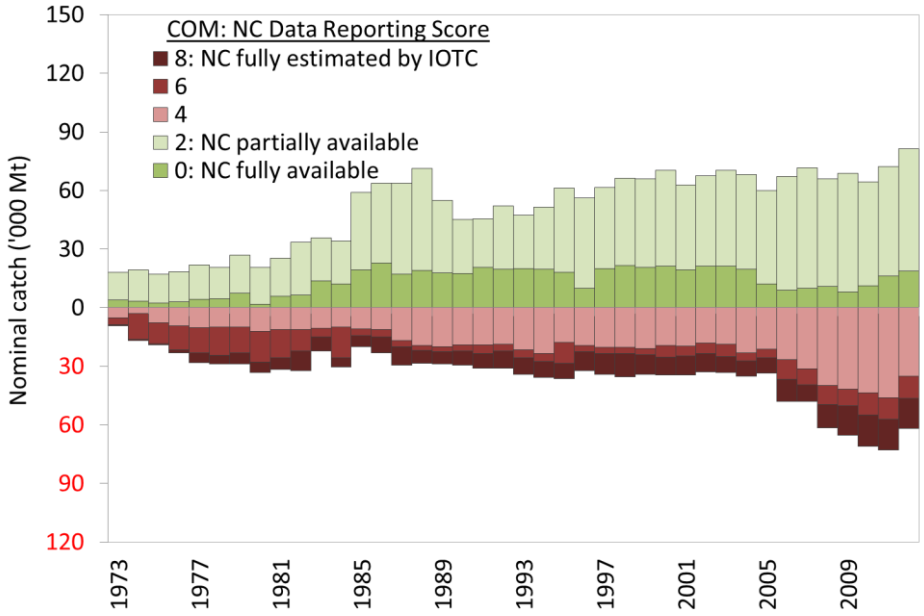


Fig. 42. Narrow-barred Spanish mackerel: uncertainty of annual catch estimates (1950–2012).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2014.

Discard levels are believed to be low although they are unknown for most fisheries.

Changes to the catch series: There have been no major revisions to the catch series of narrow-barred Spanish mackerel since the WPNT meeting in 2013 (Fig. 43).

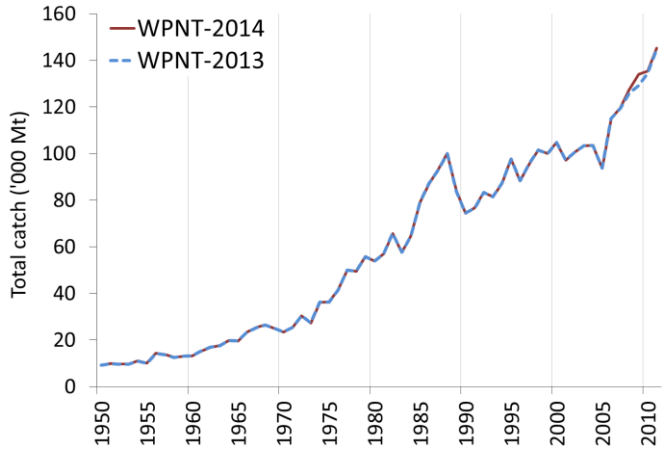


Fig. 43: Narrow-barred Spanish mackerel: Catches used by the WPNT in 2013 versus those estimated for the WPNT in 2014 (1950–2011).

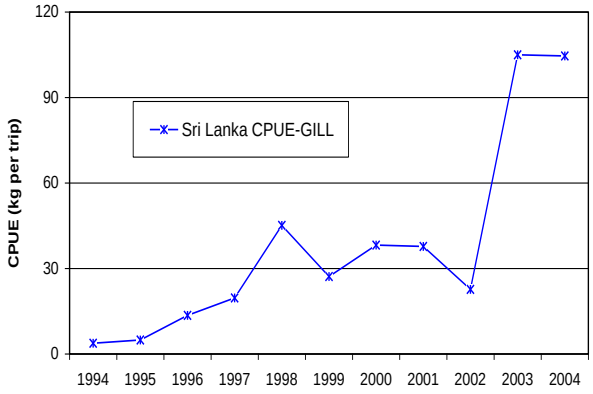


Fig. 44: Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004).

CPUE Series: Catch-and-effort series are available from some fisheries but they are considered highly incomplete (Fig. 45). In most cases catch-and-effort data are only available for short periods. Reasonably long catch-and-effort

data series (extending for more than 10 years) are only available for Sri Lanka gillnets (Fig. 44). The catches and effort recorded are, however, thought to be unrealistic due to the dramatic changes in CPUE recorded in 2003 and 2004.

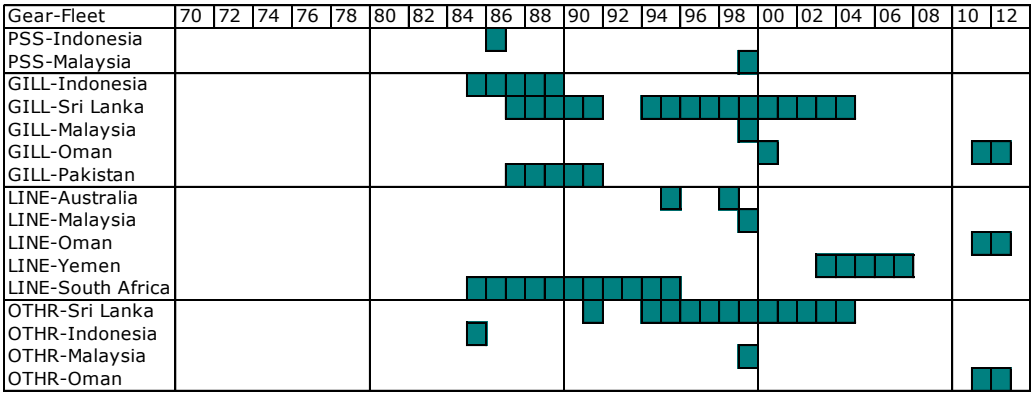


Fig. 45: Narrow-barred Spanish mackerel: Availability of catches and effort series, by fishery and year (1970–2012)[19]. Note that no catches and effort are available at all for 1950–84, and 2008–10.

Trends in average weight can only be assessed for Sri Lankan gillnets (from the late-1980s until the early 1990s), and Iranian gillnets from the late 2000s (Fig. 46). The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme); unfortunately, data collection did not continue after the IPTP activities came to an end.

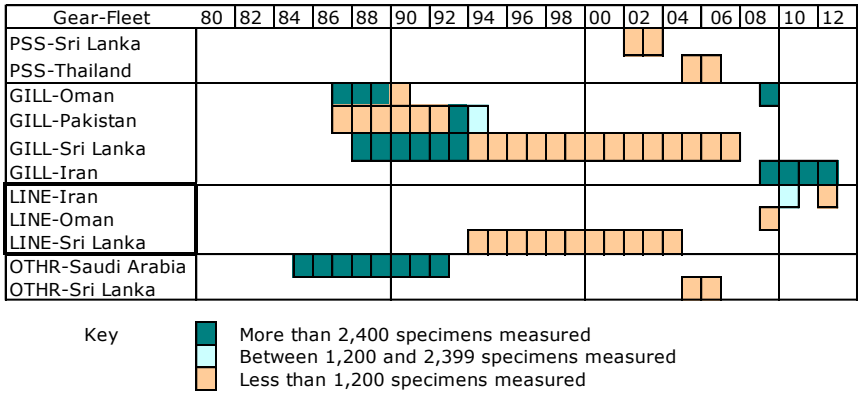


Fig. 46: Narrow-barred Spanish mackerel: Availability of length frequency data, by fishery and year (1980–2012)[20]. Note that no length frequency data are available at all for 1950–84.

Catch-at-Size(Age) table: Catch-at-Size data are not available for the narrow-barred Spanish mackerel due to the paucity of size data available from most fleets (Fig. 46) and the uncertain status of the catches for this species (Fig. 42). Length distributions derived from the data available for gillnet fisheries are shown in Fig. 47. No data available for all other fisheries.

Other biological data: The equations available for Spanish mackerel are shown below

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Spanish mackerel	*Fork length – Round WeightA*	*RND=a*L^b*	*a= 0.00001176* *b= 2.9002*		*Min:20* *Max:200*

[19] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

[20] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

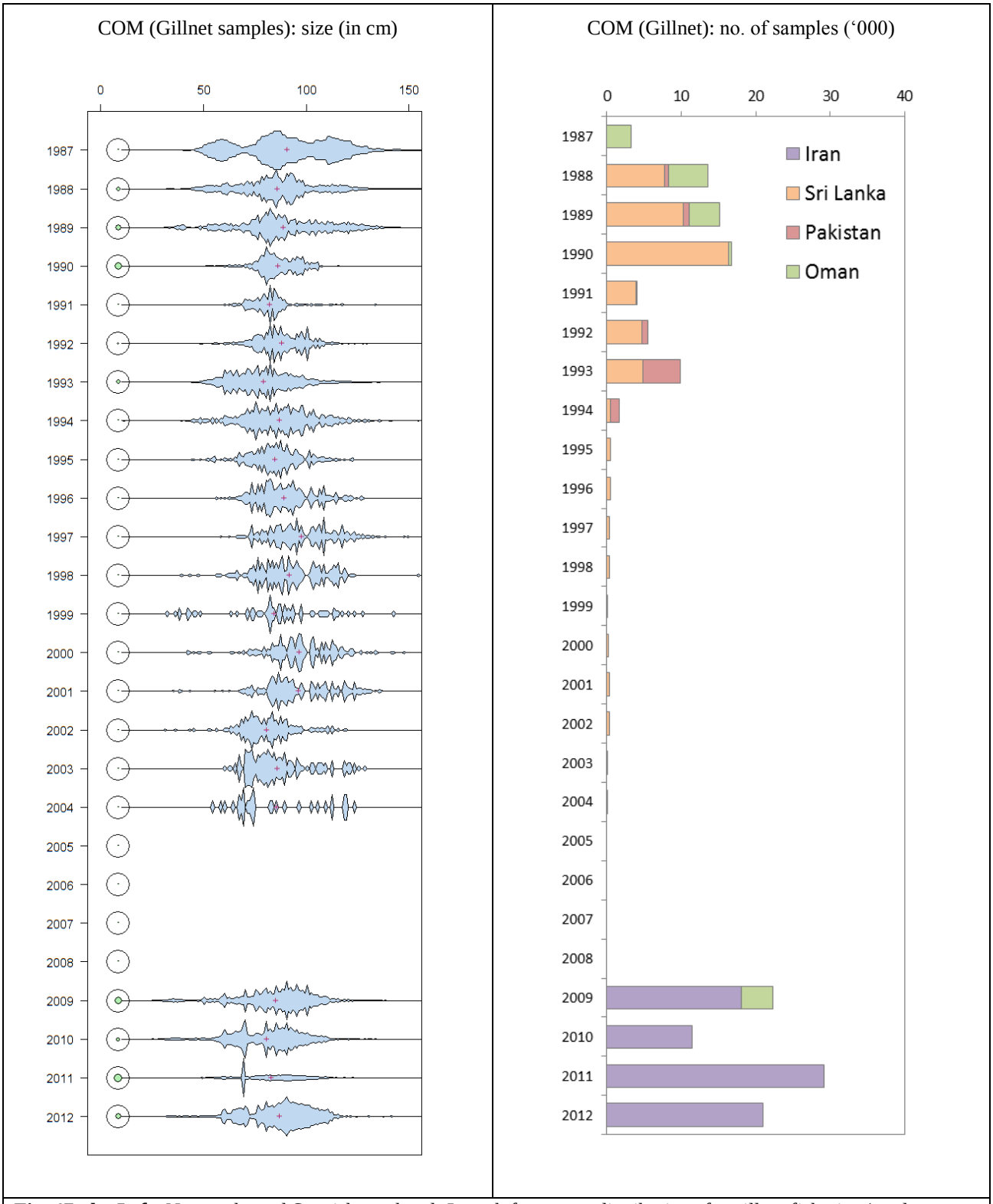


Fig. 47a-b. Left: Narrow-barred Spanish mackerel: Length frequency distributions for gillnet fisheries (total amount of fish measured by 1cm length class) derived from data available at the IOTC Secretariat. The black outline circles (to the left of each distribution) indicate the minimum sampling standard set by IOTC of one fish per metric tonne; the green proportional circles indicate the relative sampling coverage in each year (i.e., circles with areas greater than the minimum sampling standard indicate relatively high sampling coverage in a given year).

Right: Number of narrow-barred Spanish mackerel specimens sampled for lengths, by fleet (gillnet only).

Indo-Pacific king mackerel (GUT)

Fisheries and catch trends

The Indo-Pacific king mackerel[21] is mostly caught by gillnet fisheries in the Indian Ocean but significant numbers are also caught trolling (Fig. 48). The catch estimates for Indo-Pacific king mackerel were derived from very small amounts of information and are therefore highly uncertain[22] (Fig. 51).

TABLE 8. Indo-Pacific king mackerel: Best scientific estimates of the catches of Indo-Pacific king mackerel by type of fishery for the period 1950–2012 (in metric tonnes). Data as of May 2014.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Purse seine	0	0	35	589	781	930	857	788	693	704	1,068	1,276	1,610	1,129	1,263	1,268
Gillnet	4,213	6,748	13,533	16,559	21,254	23,065	21,007	21,846	18,054	20,249	26,173	31,969	31,744	26,113	28,337	29,044
Line	404	500	1,184	1,880	2,286	2,608	2,219	2,346	2,116	2,085	3,027	3,635	3,945	3,197	3,447	3,419
Other	13	21	48	3,879	5,110	9,319	7,743	8,195	7,873	8,127	10,627	12,193	15,768	11,642	12,587	12,700
Total	**4,630**	**7,269**	**14,801**	**22,907**	**29,431**	**35,922**	**31,826**	**33,176**	**28,736**	**31,164**	**40,895**	**49,072**	**53,068**	**42,082**	**45,634**	**46,430**

The catches provided in Table 8 are based on the information available at the IOTC Secretariat and the following observations on the catches cannot currently be verified. Estimated catches have increased steadily since the mid 1960's, reaching around 24,000 t in the late 1970's and over 30,000 t by the mid-1990's when catches remained stable until around 2006. Since the late-2000s catches have increased sharply, to over 40,000 t, with the highest catches recorded in 2009 at around 53,000 t.

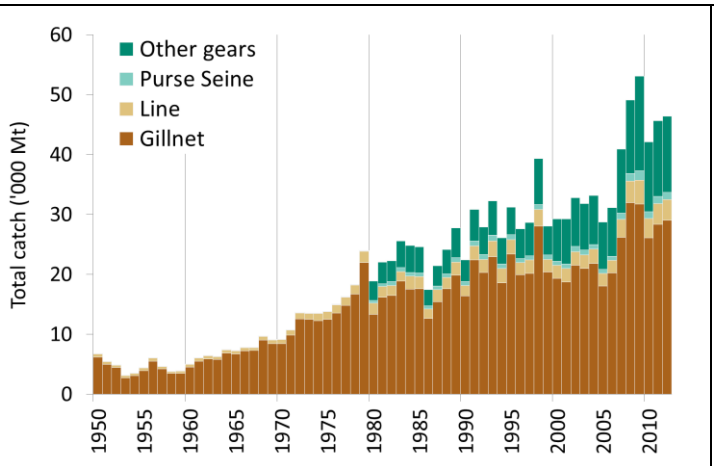


Fig. 48. Indo-Pacific king mackerel: Annual catches of Indo-Pacific king mackerel by gear recorded in the IOTC database (1950–2012).

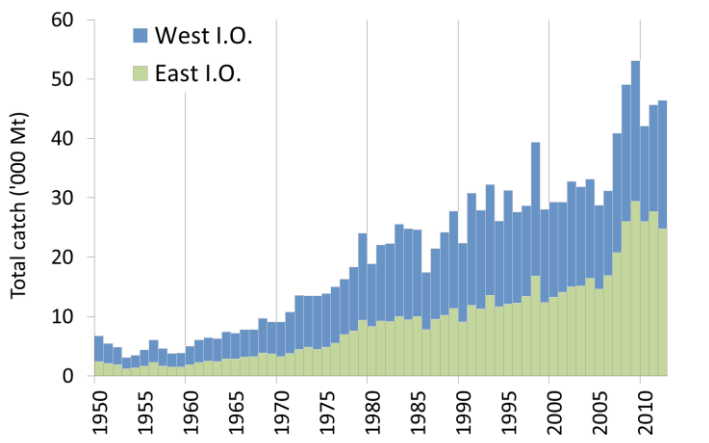


Fig. 49. Indo-Pacific king mackerel: Annual catches of Indo-Pacific king mackerel by IOTC area recorded in the IOTC database (1950–2012).

In recent years, the countries attributed with the highest catches are India (40%) and Indonesia (27%) and, to a lesser extent, Myanmar and Iran (19%) (Table 6, Fig. 50), accounting for over 85% of the total catches of king mackerel. Catches of king mackerel in the eastern Indian Ocean have been higher in recent years (Fig 49).

Status of Fisheries Statistics at the IOTC

Retained catches are highly uncertain for all fisheries (Fig. 51) due to:

- Aggregation: Indo-Pacific king mackerels are usually not reported by species being aggregated with narrow-barred Spanish mackerel or, less frequently, other small tuna species.

[21] Hereinafter referred to as King mackerel.

[22] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

- Mislabelling: Indo-Pacific king mackerels are usually mislabelled as narrow-barred Spanish mackerel, their catches reported under the latter species.
- Underreporting: the catches of Indo-Pacific king mackerel may be not reported for some fisheries catching them as a bycatch.

It is for the above reasons that the catches of Indo-Pacific king mackerel in the IOTC database are thought to represent only a small fraction of the total catches of this species in the Indian Ocean.

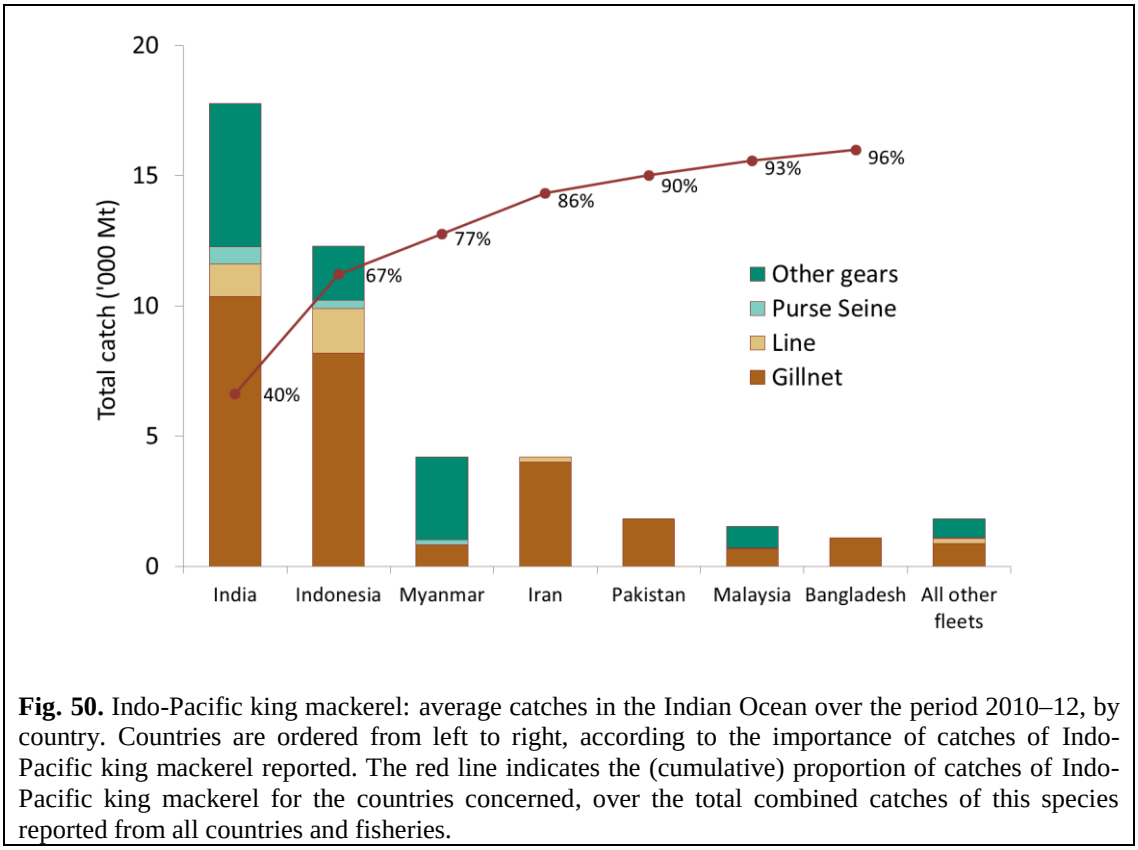


Fig. 50. Indo-Pacific king mackerel: average catches in the Indian Ocean over the period 2010–12, by country. Countries are ordered from left to right, according to the importance of catches of Indo-Pacific king mackerel reported. The red line indicates the (cumulative) proportion of catches of Indo-Pacific king mackerel for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

Discard levels are believed to be low although they are unknown for most fisheries.

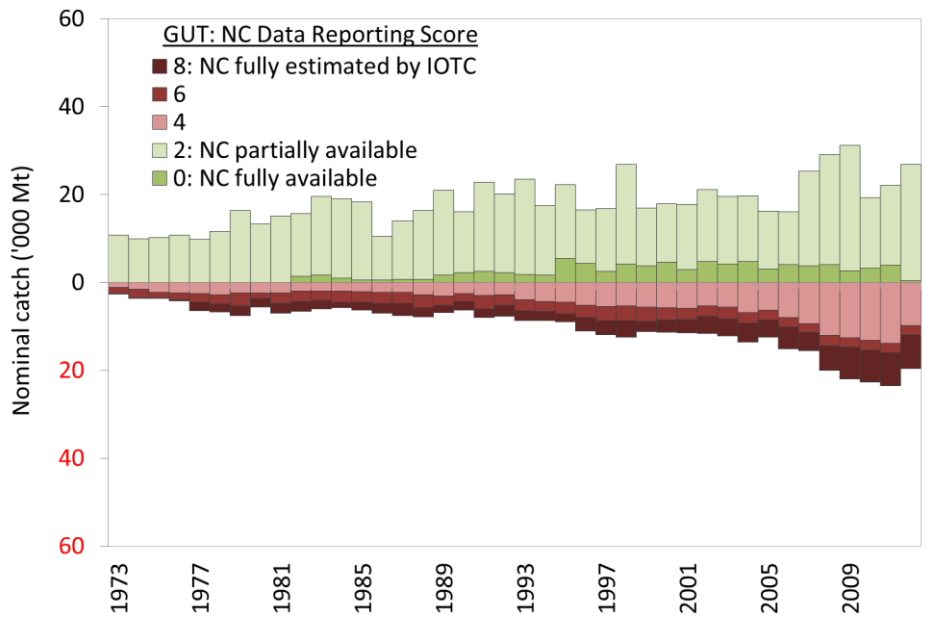


Fig. 51. Indo-Pacific king mackerel: uncertainty of annual catch estimates (1950–2012).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2014.

Changes to the catch series: There have not no major changes to the catches of king mackerel since the WPNT in 2012 (Fig. 52).

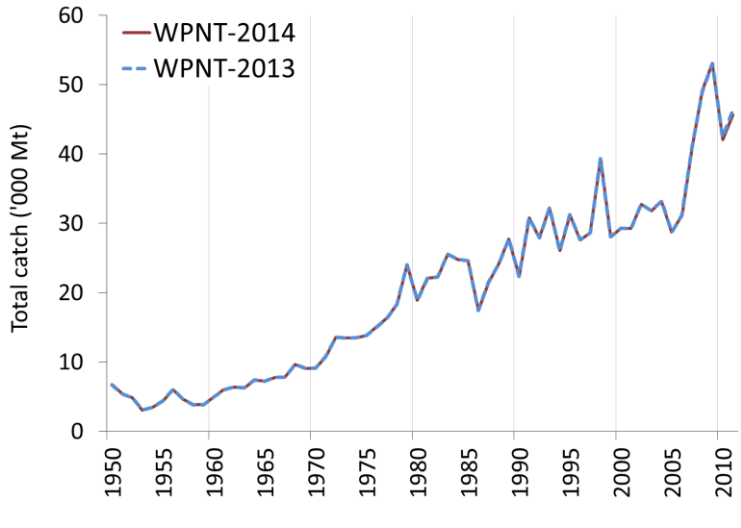


Fig. 52. Indo-Pacific king mackerel: Catches used by the WPNT in 2013 versus those estimated for the WPNT in 2014 (1950–2011).

CPUE Series: Catch-and-effort series are not available for most fisheries and, when available, they refer to very short periods (Fig. 53). This makes it impossible to derive any meaningful CPUE from the existing data.

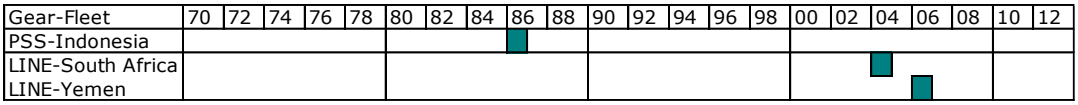


Fig. 53. Indo-Pacific king mackerel: Availability of catches and effort series, by fishery and year (1970–2012)[23]. Note that no catches and effort are available at all for 1950–85

Trends in average weight cannot be assessed for most fisheries. Samples of Indo-Pacific king mackerel are only available for the coastal purse seiners of Thailand and gillnets of Sri Lanka but they refer to very short periods and the numbers sampled are very small (Fig. 54).

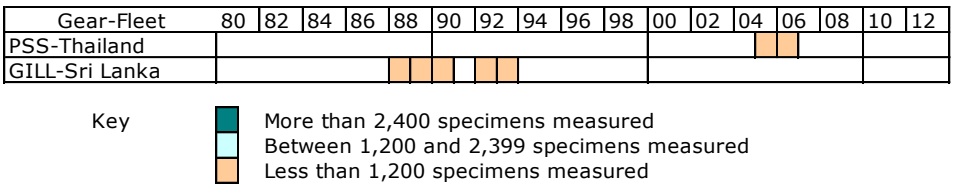


Fig. 54. Indo-Pacific king mackerel: Availability of length frequency data, by fishery and year (1980–2012)[24]. Note that no length frequency data are available at all for 1950–82).

Catch-at-Size(Age) table: Catch-at-Size data are not available for the Indo-Pacific king mackerel due to the paucity of size data available from most fleets (Fig. 54) and the uncertain status of the catches for this species (Fig. 51).

Other biological data: The equations available for King mackerel are shown below

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Indo-pacific king mackerel	*Fork length – Round WeightA*	*RND=a*L^b*	*a= 0.00001176* *b= 2.9002*		*Min:20* *Max:80*

[23] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

[24] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

APPENDIX I

OVERVIEW OF CURRENT CAPACITY-BUILDING ACTIVITIES BY THE IOTC SECRETARIAT

In 2012 major reviews of the historical catch series for India, Indonesia, and Sri Lanka were conducted by an independent consultant on behalf of the IOTC Secretariat. The results of the reviews and summary of the revisions to the data were presented to the WPNT in 2013[25].

In 2013–14 the IOTC Secretariat initiated a number of new capacity-building activities in coastal states in the IOTC region, in collaboration with BOBLME, COI-SmartFish, OFCF, and national fisheries organizations, with particular emphasis on improving the collection and reporting of fisheries data to the IOTC Secretariat. Several of the activities are due to report data during 2014–15 and which are likely to have implications on current and historical catch estimates of neritic species.

SRI LANKA: Data collection and management (IOTC-BOBLME) (March 2013-January 2014)

- Collaboration of the IOTC Secretariat with the Bay of Bengal Large Marine Ecosystems Project (BOBLME) to strengthen data collection in Sri Lanka, in particular species of pelagic sharks.
- Outputs: Strengthening of sampling activities (training in sampling, increase in field enumerators and sites sampled, including landing sites in northern Sri Lanka), development of database and data processing training.
- Progress: provisional 2013 catch estimates are currently being processed by the Sri Lanka Ministry of Fisheries and Aquatic and the IOTC Secretariat, incorporating data from the revised sampling scheme (i.e., additional sampling of landing sites and increase in data collected by enumerators) which is expected to improve the accuracy of catch estimates.
- Sri Lanka has also maintained sampling activities, under the revised sampling scheme, following the termination of support and end of project funding in early 2014.

COMOROS/MADAGASCAR (IOTC & COI-SmartFish) (September 2013-March 2014)

- Collaboration of the IOTC Secretariat and COI-SmartFish aimed at capacity building and strengthening of implementation of IOTC Measures related to collection and reporting of fisheries data in Comoros and Madagascar.
- Outputs: Preparation of a Sampling Design and Catch Estimation Manual, development of a catch and boat vessel database, improvements to catch sampling.
- Progress:
  - Madagascar: estimates for some landing sites in have been received by the IOTC Secretariat. A national consultant is currently looking into the data collected and feasibility of providing national catch estimates.
  - Comoros: the IOTC Secretariat is currently assisting Comoros in developing catch estimates for 2012 and 2013, to be reported in due course.

INDONESIA: Pilot sampling project (IOTC-BOBLME-OFCF) (June 2014-March 2015)

- Implementation of a pilot sampling project in the Provinces of West Sumatra and North Sumatra to monitor the activities of coastal fisheries and assess catches of neritic tuna species and juvenile tunas, in commercial categories containing more than one species, in particular the categories Tongkol and Tuna.
- Addresses recommendations from the IOTC SC concerning catches of juvenile tunas in Indonesia and verification of neritic tuna species not reported by species in Indonesia.
- Outputs: Review and improve estimates of catch series for coastal fisheries of Indonesia.

MALAYSIA/THAILAND: Data mining of neritic tunas (IOTC-OFCF) (2014)

- A number of IOTC Contracting Parties, including Malaysia and Thailand, have collected large data sets on neritic tuna species, but have either not reported data to the IOTC according to standards set by Resolution 10/02 or have not assessed the value of using the data collected to estimate indices of abundance for neritic tuna species. The

[25] IOTC-2013-WPNT03-07 Rev_1, available at http://www.iotc.org/documents/review-statistical-data-available-neritic-tuna-species-secretariat.

mission directly addresses previous recommendations of the IOTC WPNT, and Plan of Work agreed by the WPNT[26].

- The mission objectives are to review the nominal catch and operational catch-and-effort data collected from the coastal purse seine fisheries operated in Malaysia and Thailand and actions required to improve the quality of the data collected from those fisheries.
- Outputs: Improve the quality of data collected, revise the catch-and-effort series of kawakawa and longtail tuna for coastal purse seine fisheries of Malaysia and Thailand to improve future abundance estimates derived from these datasets.
- Progress: The data mining mission to Malaysia was successfully conducted in January 2014, and the mission to Thailand has been scheduled for June 2014.
- The data series for the main neritic species in Malaysia/Thailand are currently under review, based on the mission findings. Proposals for a joint paper to review the historical catch series and improvements to the CPUE series have also been drafted by the IOTC Secretariat and Malaysia; with timings for the work still to be decided.
- Revisions to IOTC datasets for Malaysia and Thailand will be conducted in due course, and the results presented at an IOTC Working Party in the near future.

[26] IOTC–2013–WPNT03–R. Report of the Third Session of the IOTC Working Party on Neritic Tunas. Bali, Indonesia, 2–5 July 2013. IOTC–2013–WPNT03–R[E]:75 pp. Appendix XII: Workplan: Working Party on Neritic Tunas, p.70-72.