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REVIEW OF THE STATISTICAL DATA AVAILABLE FOR THE NERITIC TUNA SPECIES

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PURPOSE

To provide the Working Party on Neritic Tunas (WPNT) with a review of the status of the information available on neritic tuna species in the databases at the IOTC Secretariat as of June 2013, 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)*[1]. 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 about major reviews to catch series for neritic tuna species is 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] 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 (decline), and after the onset of piracy, in recent years (increase). Hence, in recent years (2009-11), the catches of neritic tunas in the Indian Ocean have accounted for 37% of the combined catches of all IOTC species (29% over the period 1950-2011). Among the neritic tuna species longtail tuna, kawakawa, and narrow-barred Spanish mackerel dominate, with catches of each species accounting for 24% of the total catches of the combined catches of neritic tunas in recent years (2009-11; Fig. 1c.). While the catch levels of frigate tuna were also high during the same period (17%), the catches of Indo-Pacific king mackerel and bullet tuna were at lower levels.

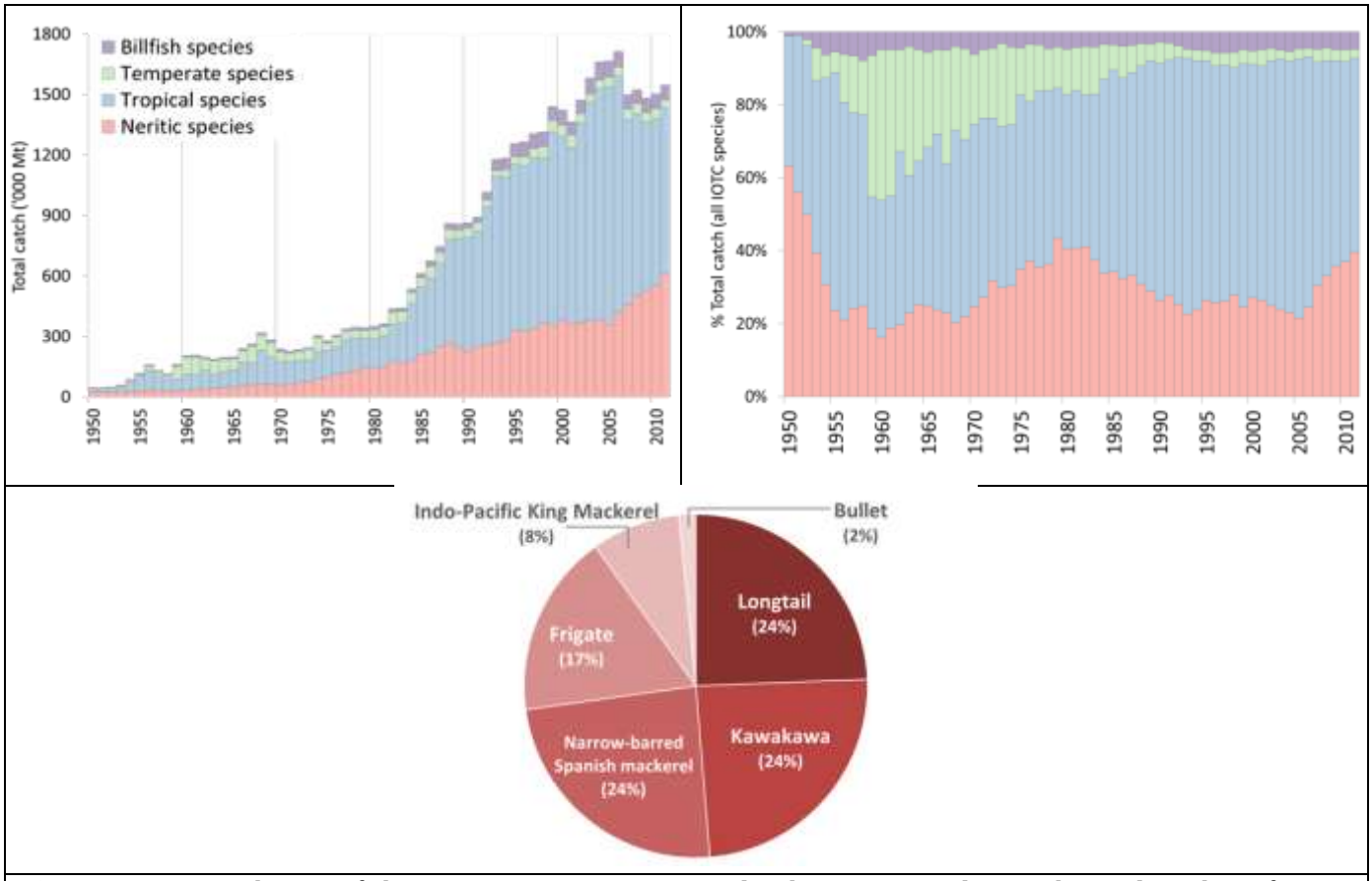


Fig. 1. Top: Contribution of the six neritic tuna species under the IOTC mandate to the total catches of IOTC species in the Indian Ocean, over the period 1950-2011 (a. Top left: total catch; b. Top right percentage); **1c.** Contribution of each species of neritic tuna to the total combined catches of neritic tunas recorded in recent years (2009-11) (same colour key as Fig. 1a).

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% (from 2009-11; Fig. 2-3) of the of the total catches of neritic tuna species from all countries and species 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.).

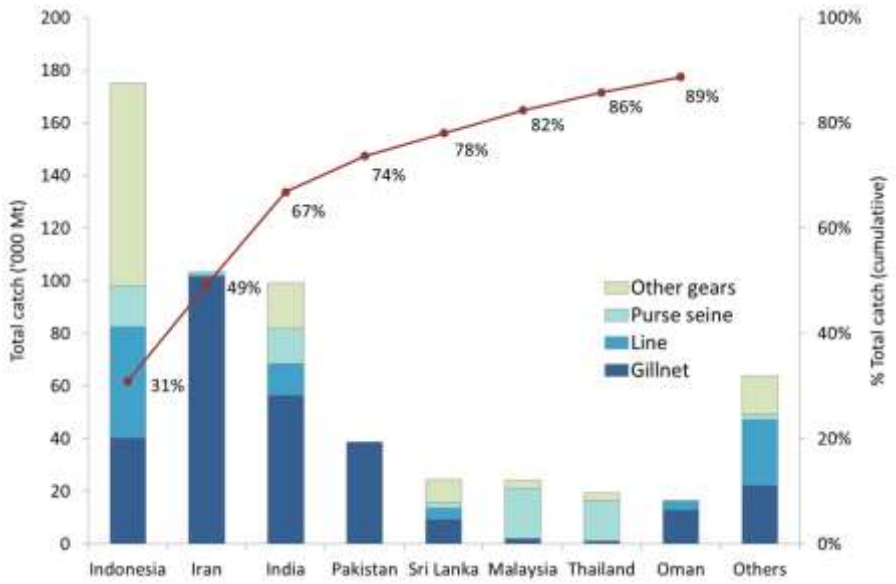


Fig. 2. Average catches of neritic tunas in the Indian Ocean over the period 2009–11, by country.
Countries are ordered from left to right, according to the importance of catches of neritic tunas reported. The red line indicates the (cumulative) proportion of catches of neritic tunas for the countries concerned, over the total combined catches of neritic tunas reported from all countries and fisheries.

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. 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.

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)	EC, Iran, Seychelles, Thailand	Low-Medium

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

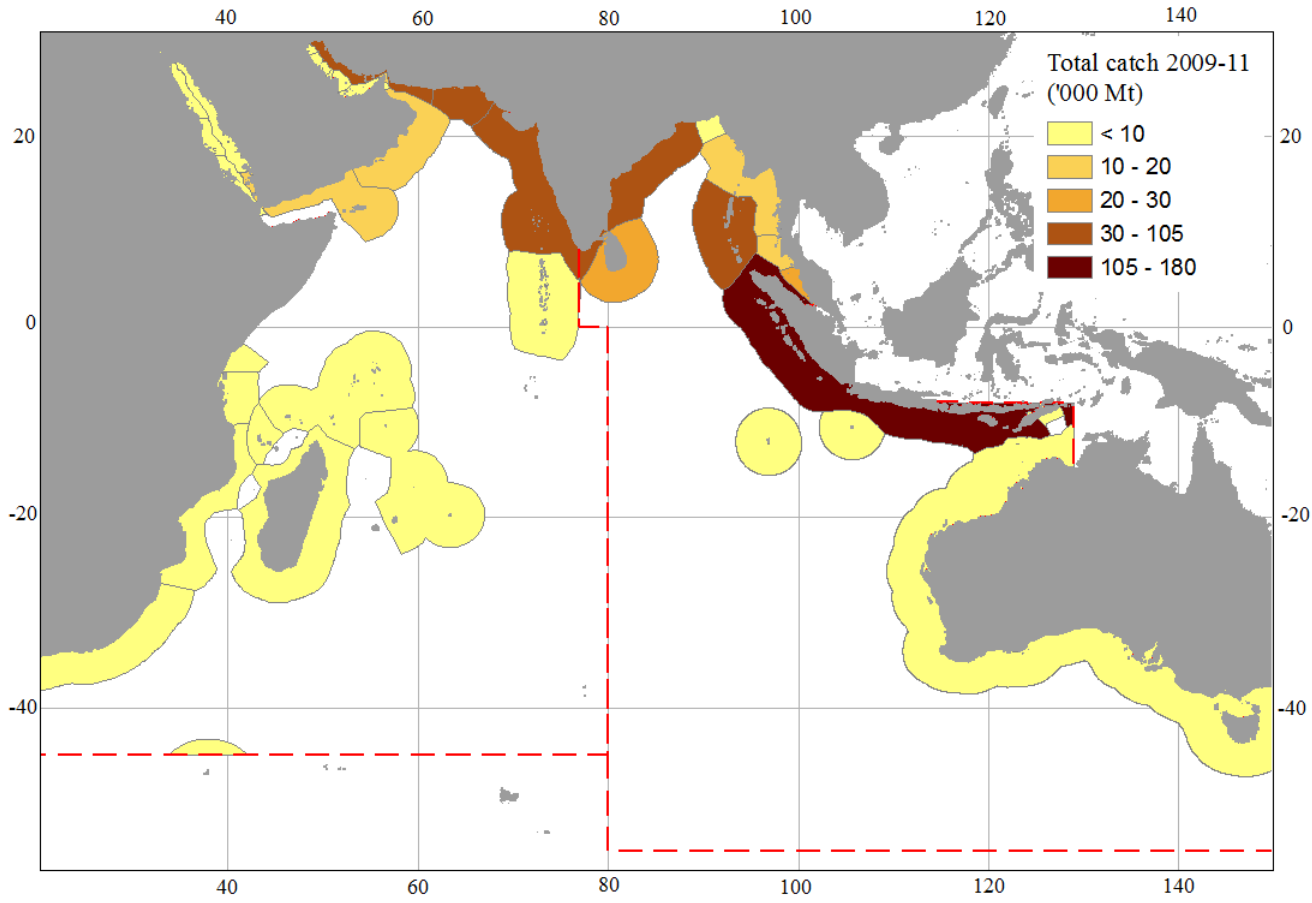


Fig. 3. Average catches of neritic tunas in the Indian Ocean over the period 2009–11, by country EEZ. The intensity of the shading of EEZs represent the importance of catches of all IOTC neritic species in each country (refer to the key at the top right of the map for details). Boundaries separating the IOTC east and west Indian Ocean areas are denoted by the red dashed line. Definition of EEZ from 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.

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

- **Drifting gillnet** fisheries of **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[2]. 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 **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 seiners, 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 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.

[2] 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[3] (Fig. 7).

TABLE 3. Longtail tuna: Best scientific estimates of the catches of longtail tuna by type of fishery for the period 1950–2011 (in metric tonnes). Data as of June 2013.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Purse seine	44	204	1,036	4,398	8,106	11,513	14,233	11,591	9,326	7,720	11,145	15,464	11,339	13,390	12,475	21,989
Gillnet	2,593	5,849	8,826	23,613	36,563	54,140	47,085	51,660	42,622	40,188	47,899	55,538	61,937	77,616	95,445	114,524
Line	909	1,160	2,676	6,443	9,799	15,672	13,239	12,724	15,524	15,474	18,034	19,440	17,629	18,032	19,084	20,571
Other	0	0	236	1,899	3,135	3,977	2,884	2,951	3,490	3,100	3,838	4,883	6,004	5,877	6,613	7,453
Total	**3,547**	**7,213**	**12,773**	**36,352**	**57,603**	**85,302**	**77,442**	**78,924**	**70,962**	**66,482**	**80,916**	**95,325**	**96,909**	**114,915**	**133,617**	**164,537**

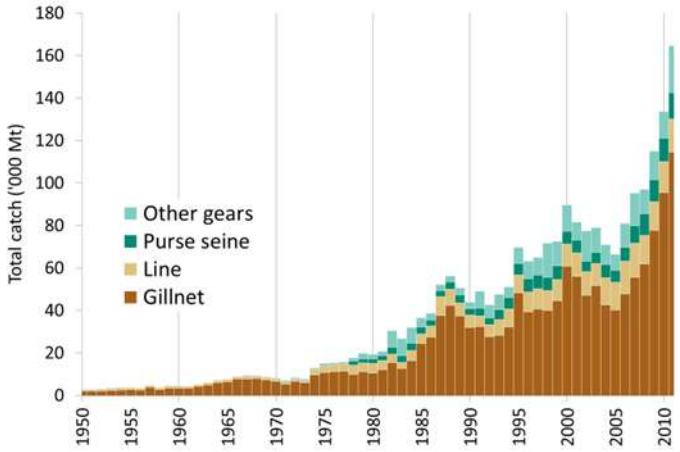


Fig. 4. Longtail tuna: Annual catches of longtail tuna by gear recorded in the IOTC Database (1950–2011)

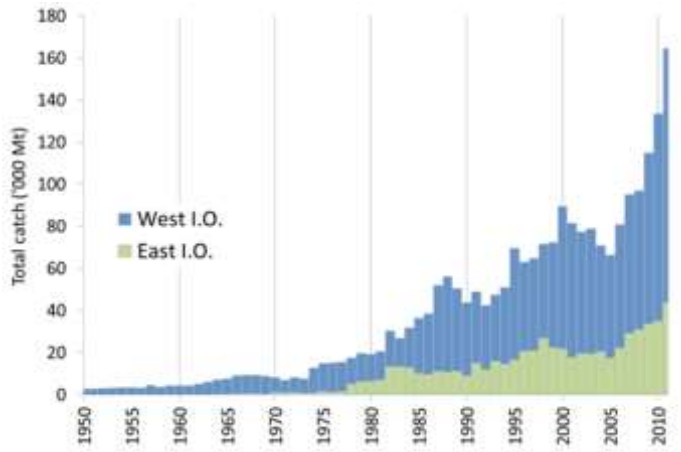


Fig. 5. Longtail tuna: Annual catches of longtail tuna by IOTC area recorded in the IOTC Database (1950–2011)

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, over 35,000 t by the mid-1980's, and over 85,000 t in 2000. Catches dropped after 2000, up to 66,000 t in 2005 and have increased since then, with the highest catches ever recorded in 2011, at around 165,000 t.

In recent years (2009–11), the countries attributed with the highest catches of longtail tuna are Iran (47%), Indonesia (16%) and Pakistan (10%) and, to a lesser extent, Oman, Malaysia, India and Thailand (25%) (Fig. 6). In particular, Iran has reported large increases in the catch of longtail tuna since 2009. The increase in catches of longtail tuna coincides with a decrease in the catches of skipjack tuna and is thought to be the 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

[3] 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.

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).

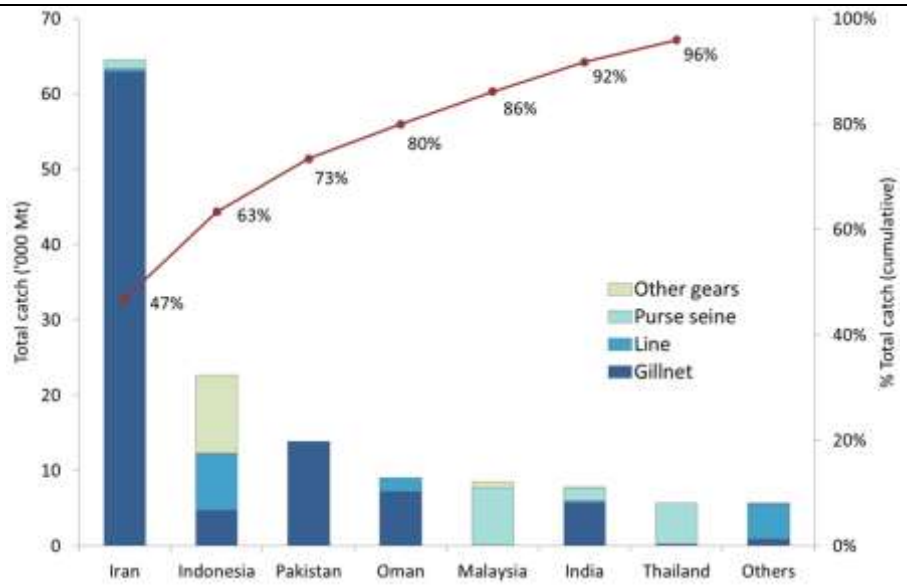


Fig. 6: Longtail tuna: Average catches in the Indian Ocean over the period 2009–11, by country. Countries are ordered from left to right, according to the importance of catches of longtail reported. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, 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, in a recent review conducted by an independent consultant in 2012 he indicated that the catches of longtail tuna had been severely overestimated by Indonesia (more information about the review can be found in Appendix I). 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 and assigned by gear on the basis of official reports and information from various alternative sources (see Appendix I). The catches of longtail tuna from Oman and India represented 12% of the total catches of this species in recent years (2009-11).
- Artisanal fisheries of Mozambique, 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 Malaysia (catches not reported by species). The catches estimated for the longtail tuna represent 9% of the total catches of this species in recent years.

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

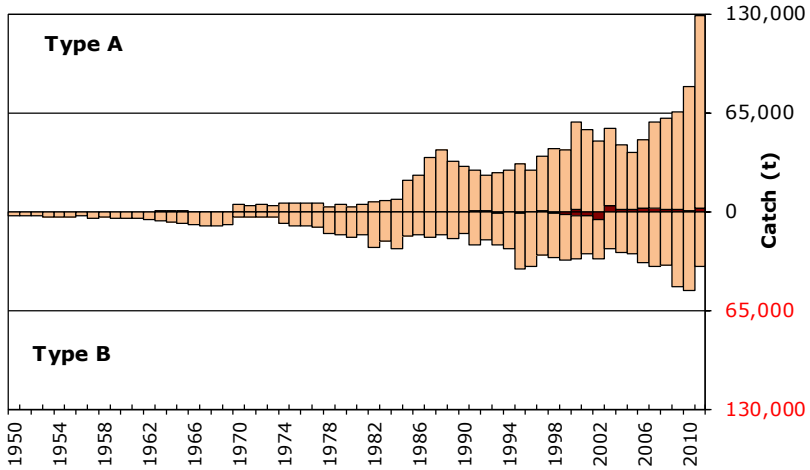


Fig. 7. Uncertainty of annual catch estimates for longtail tuna (1950–2011). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of June 2013

Changes to the catch series: There have been significant changes to the catches of longtail tuna since the WPNT meeting in 2012 (Fig. 8), following major reviews of catch time series for Indonesia, India, and Sri Lanka (Appendix I).

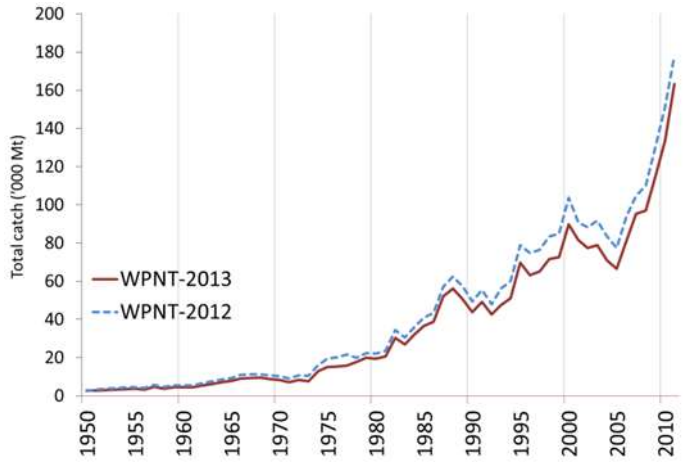


Fig. 8. Longtail tuna: Catches used by the WPNT in 2012 versus those estimated for the WPNT in 2013 (1950–2011)

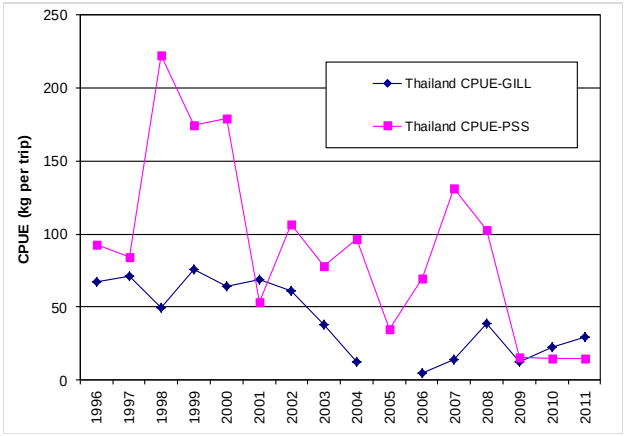


Fig. 9. Longtail tuna: Nominal CPUE series for the gillnet (GILL) and coastal purse seine (PSS) fisheries of Thailand derived from the available catches and effort data (1996–2011)

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 seines and gillnets (Fig. 9).

Trends in average weight can only be assessed for Iranian gillnets but the amount of specimens measured has been very low in recent years (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, data collection did not continue after the end of the IPTP activities.

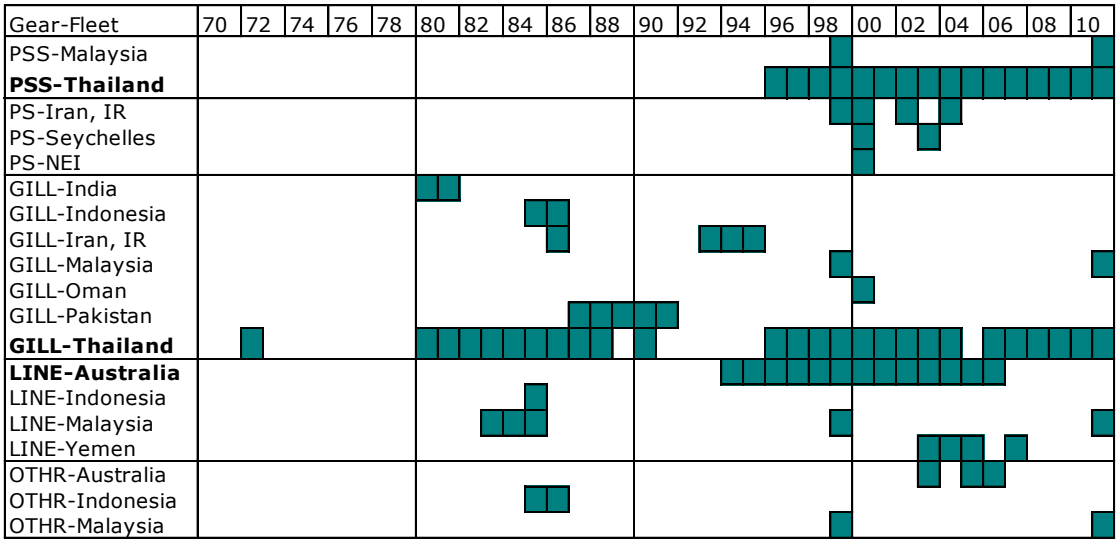


Fig. 10. Longtail tuna: Availability of catches and effort series, by fishery and year (1970–2011)[4]. Note that no catches and effort are available at all for 1950–1971

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 some selected fisheries are shown in Fig. 12.

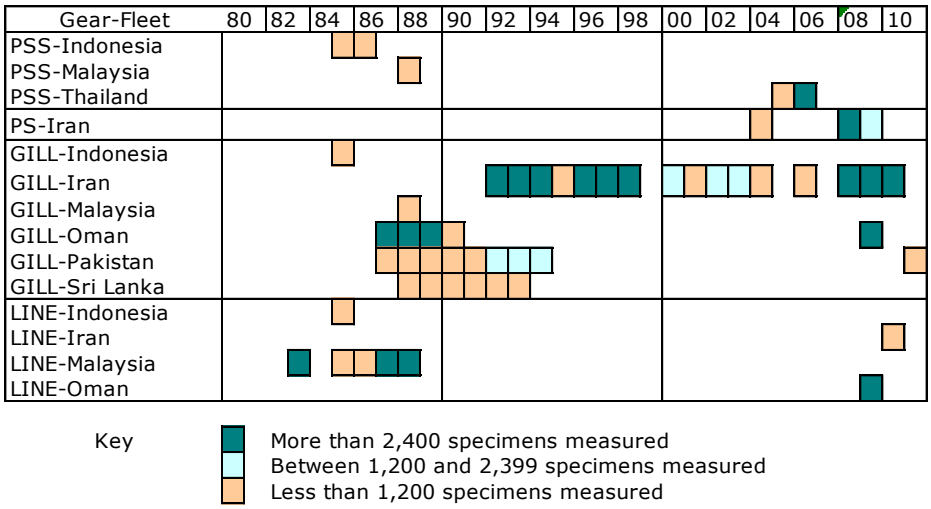


Fig. 11. Longtail tuna: Availability of length frequency data, by fishery and year (1980–2011)[5]. Note that no length frequency data are available at all for 1950–1982

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

[4] 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.

[5] 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

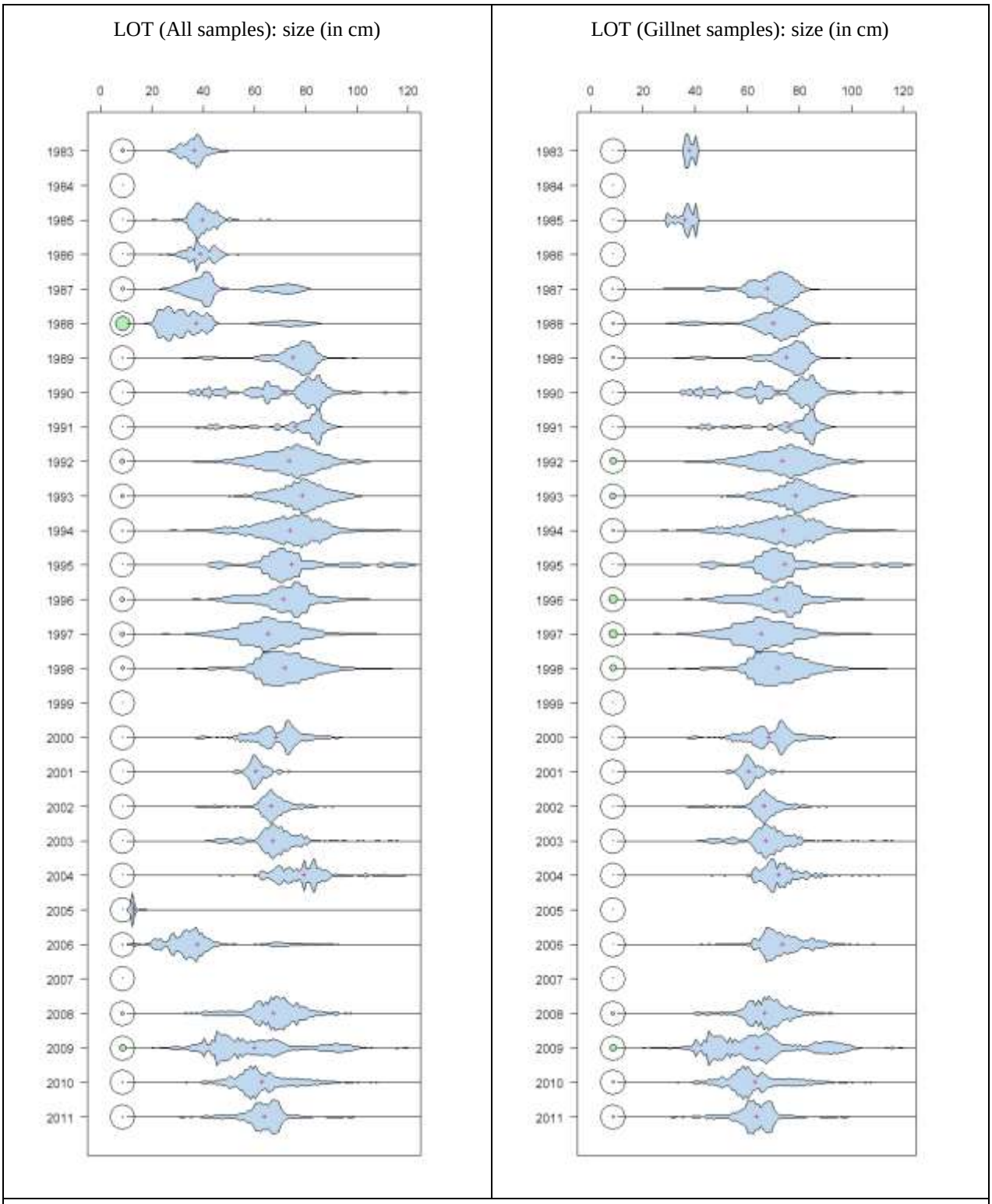


Fig. 12: Longtail tuna: Length frequency distributions (total amount of fish measured by 1cm length class) derived from the data available at the IOTC Secretariat for selected fisheries, by gear and year. The black outline circles (to the left of each chart) indicate the minimum sampling standard set 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).

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 seiners 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[6] (Fig. 16).

TABLE 4. Frigate tuna: Best scientific estimates of the catches of frigate tuna by type of fishery for the period 1950–2011 (in metric tonnes). Data as of June 2013.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Purse seine	13	32	904	4,136	6,190	8,014	7,704	8,836	8,698	8,695	9,281	7,783	7,371	6,666	9,387	8,585
Gillnet	479	1,234	2,696	5,685	11,847	15,907	12,872	15,729	15,795	15,288	17,863	17,661	19,669	17,768	25,006	24,081
Line	1,270	2,413	4,952	11,806	21,651	29,858	23,906	25,684	29,149	25,618	29,648	32,148	39,204	39,725	43,735	44,985
Other	1,429	1,989	2,444	4,653	10,763	16,767	14,806	14,856	15,380	14,933	15,307	17,714	21,825	23,329	24,065	25,069
Total	**3,190**	**5,668**	**10,997**	**26,280**	**50,451**	**70,546**	**59,289**	**65,105**	**69,023**	**64,534**	**72,098**	**75,306**	**88,069**	**87,488**	**102,194**	**102,720**

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 early 1980's and over 60,000 t by the mid-1990's, and remaining at the same level in the following ten years. The catches have increased since 2005, with current catches at around 100,000 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).

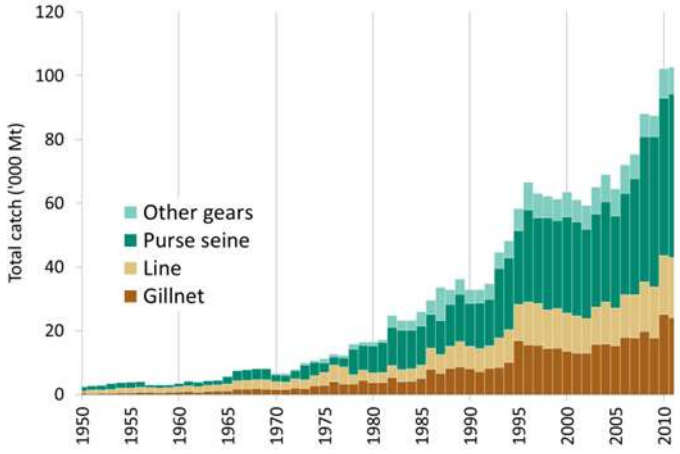


Fig. 13. Frigate tuna: Annual catches of frigate tuna by gear recorded in the IOTC Database (1950–2011)

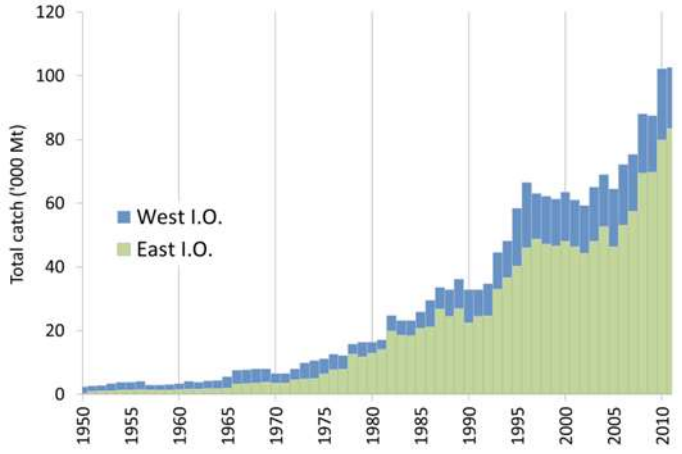


Fig. 14. Frigate tuna: Annual catch of frigate tuna by IOTC area recorded in the IOTC Database (1950–2011)

In recent years, the countries attributed with the highest catches are Indonesia (64%), India (10%) Sri Lanka (10%), and Iran (6%) (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

[6] 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.

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).

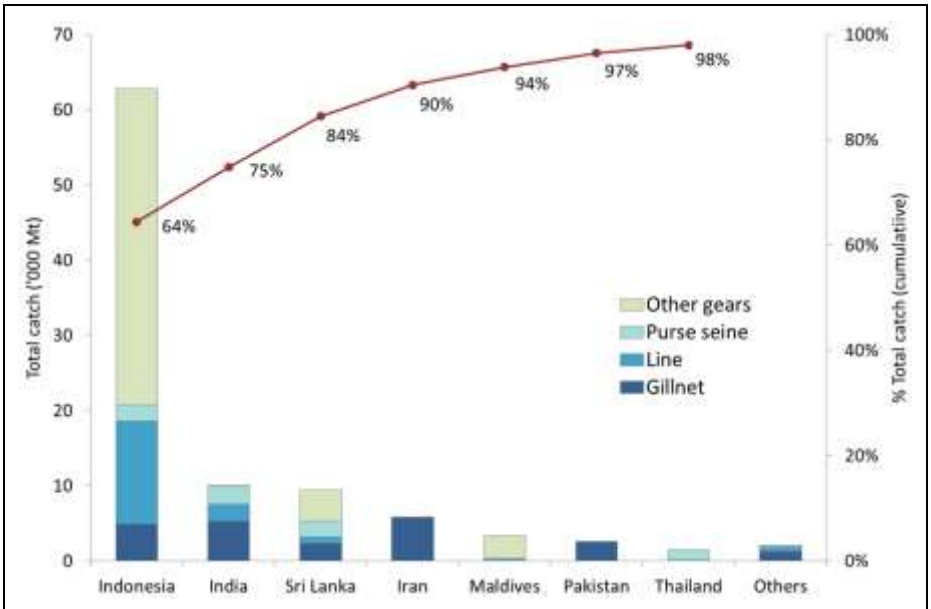


Fig. 15. Frigate tuna: average catches in the Indian Ocean over the period 2009-2011, by country. Countries are ordered from left to right, according to the importance of catches of frigate tuna reported. The red line indicates the (cumulative) proportion of catches of frigate for the countries concerned, 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 conducted by an independent consultant in 2012 he indicated that the catches of frigate tuna had been underestimated by Indonesia (more information about the review can be found in Appendix I). While the new catches estimated for the frigate tuna in Indonesia remain uncertain, representing around 65% 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 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 and assigned by gear on the basis of official reports and information from various other alternative sources (see Appendix I). The new catches estimated for Sri Lanka are as much as three times higher than previous estimates (See Appendix I). In recent years, the combined catches of frigate tuna for both countries have represented 20% 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 reported by species, they usually refer to both species (due to mislabelling, 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, 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.

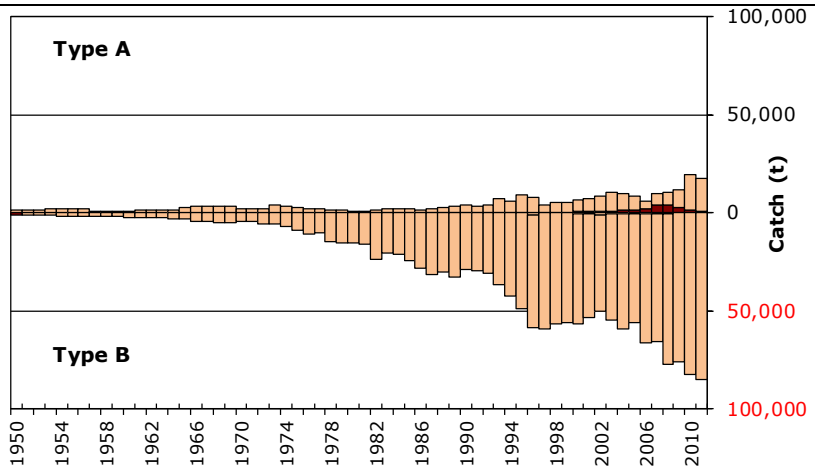


Fig. 16. Frigate tuna: Uncertainty of annual catch estimates for frigate tuna (1950–2011). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of October 2012

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 catch series of frigate tuna has changed substantially since the WPNT meeting in 2012 (Fig. 17), following major reviews of catch time series for Indonesia, India, and Sri Lanka (Appendix I).

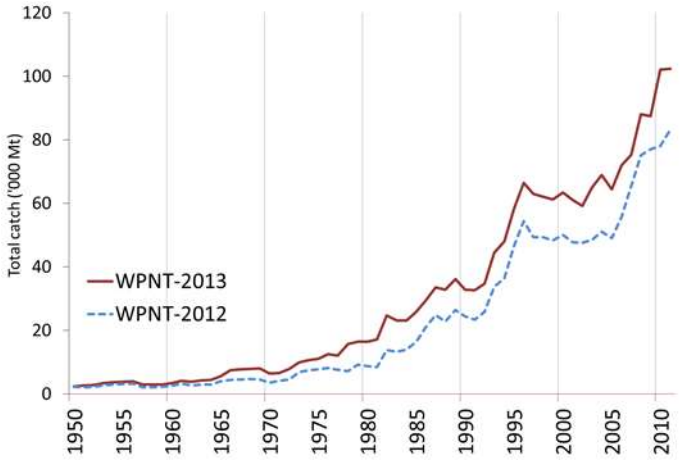


Fig. 17. Frigate tuna: Catches used by the WPNE 2012 *versus* those estimated for the WPNE in 2013 (1960–2010)

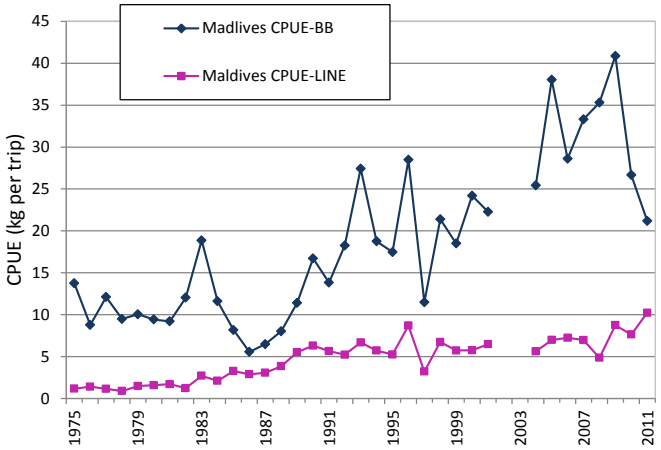


Fig. 18. Frigate tuna: Nominal CPUE series for the baitboat (BB using mechanized boats) and line (LINE, including handlines and trolling using mechanized boats) fisheries of Maldives derived from the available catches and effort data (1975–2011)

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.

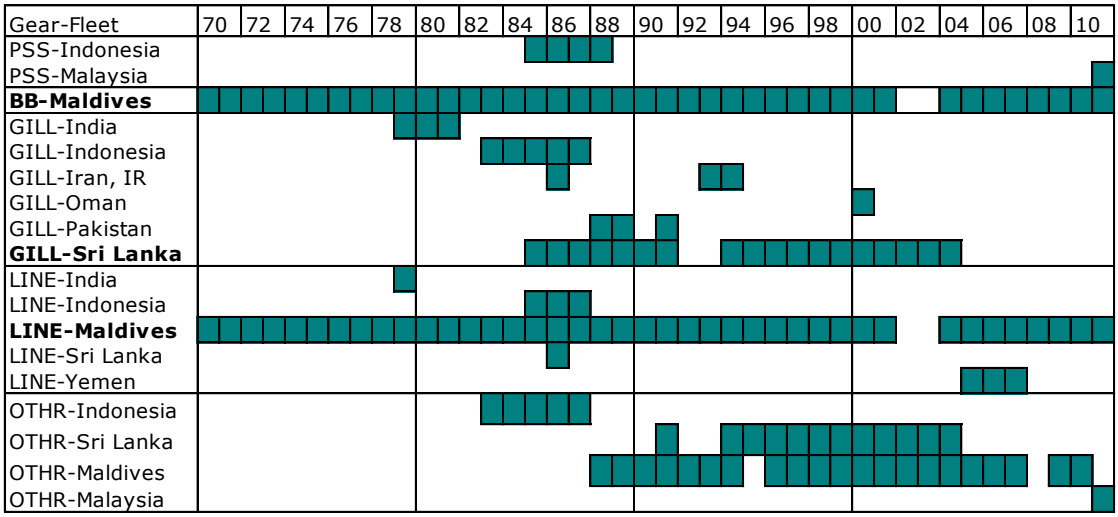


Fig. 19: Frigate tuna: Availability of catches and effort series, by fishery and year (1970–2011)[7]. Note that no catches and effort are available at all for 1950–69

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, data collection did not continue in most countries after the end of the IPTP activities.

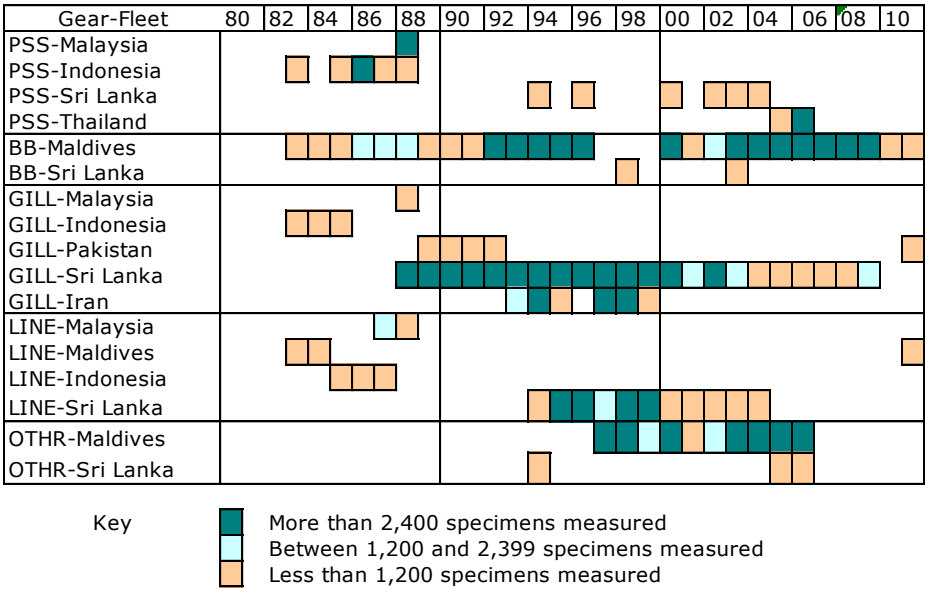


Fig. 20: Frigate tuna: Availability of length frequency data, by fishery and year (1980–2011)[8]. Note that no length frequency data are available at all for 1950–82

[7] 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

[8] 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

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 some selected fisheries are shown in Fig. 21.

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*

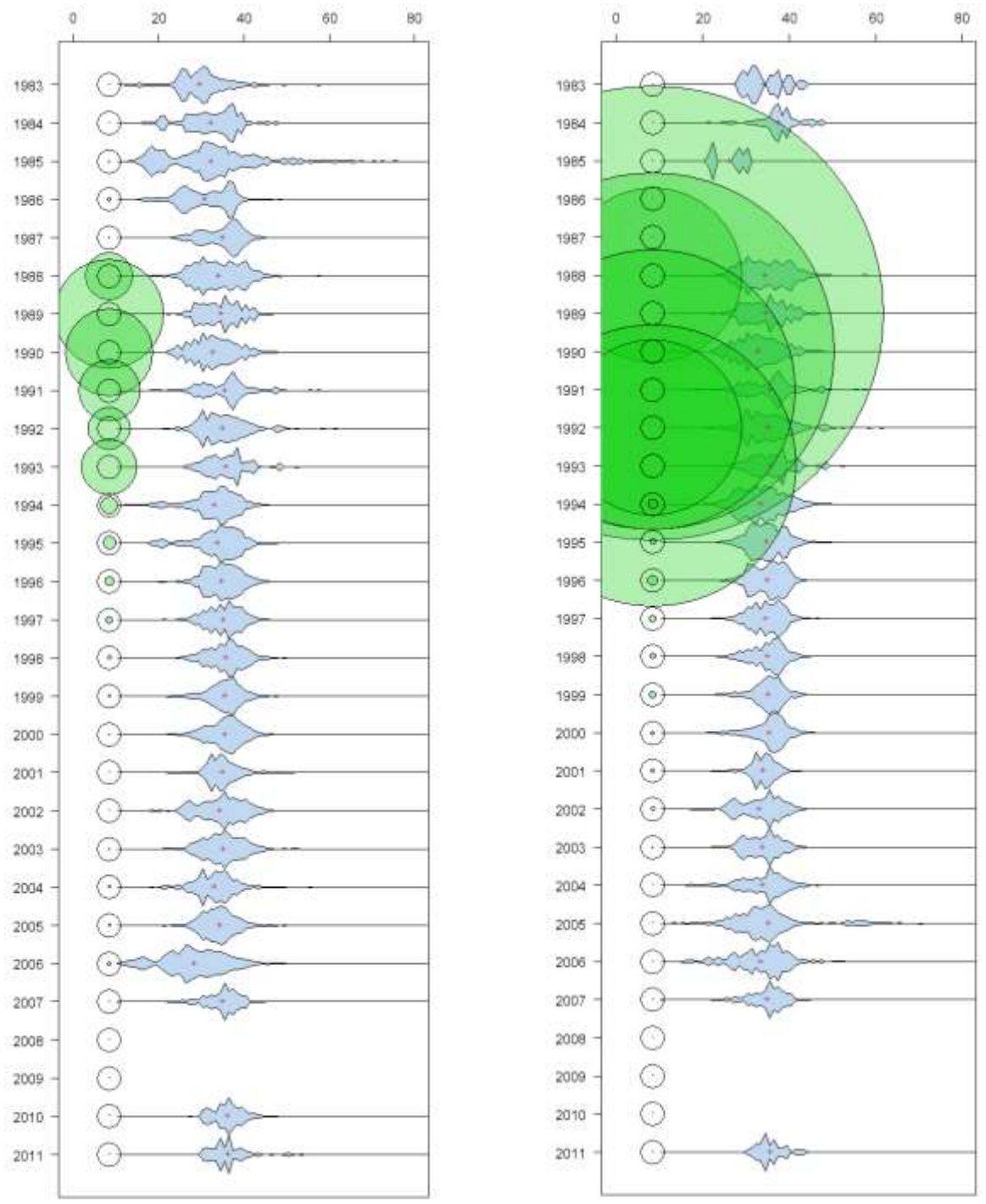


Fig. 21. Frigate tuna: Length frequency distributions (total amount of fish measured by 1cm length class) derived from the data available at the IOTC Secretariat for selected fisheries, by gear and year. The black outline circles (to the left of each chart) indicate the minimum sampling standard set 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).

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[9] (Fig. 25).

TABLE 5. Bullet tuna: Best scientific estimates of the catches of bullet tuna by type of fishery for the period 1950–2011 (in metric tonnes). Data as of June 2013.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Purse seine	0	3	23	223	467	555	430	543	519	490	547	442	804	918	1,239	493
Gillnet	41	153	289	469	1,091	1,529	1,323	1,377	1,525	1,347	1,655	1,406	2,012	2,290	3,046	2,412
Line	113	193	317	322	687	1,178	837	1,031	1,000	996	1,148	1,108	1,875	2,172	2,897	1,167
Other	5	13	53	314	890	1,600	1,498	1,021	1,531	1,137	1,698	2,109	2,236	2,476	3,237	4,475
Total	**159**	**362**	**683**	**1,329**	**3,135**	**4,862**	**4,089**	**3,973**	**4,575**	**3,969**	**5,048**	**5,065**	**6,926**	**7,856**	**10,419**	**8,547**

The catches provided in Table 5 are based on the information available at the 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 1998, at around 4,600 t. The catches decreased slightly in the following years and remained at values of around 3,000 t until the mid-2000's, to increase again sharply up to the 10,000 t recorded in 2010, the highest catches ever recorded for this species. Bullet tunas have been caught in both Indian Ocean basins in recent years (Fig. 23).

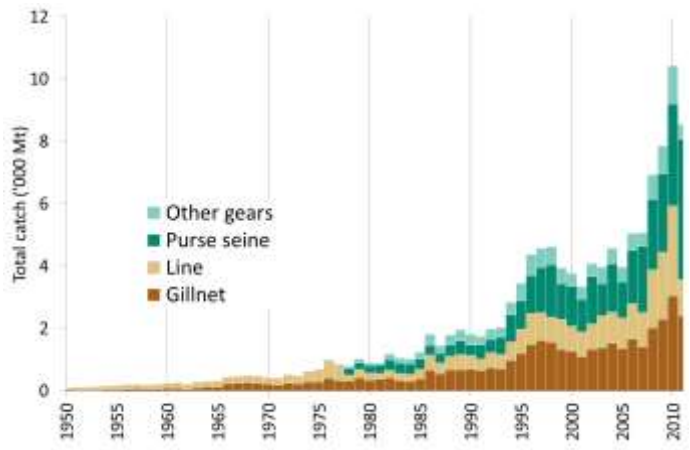


Fig. 22. Bullet tuna: Annual catches of bullet tuna by gear recorded in IOTC Database (1950–2011)

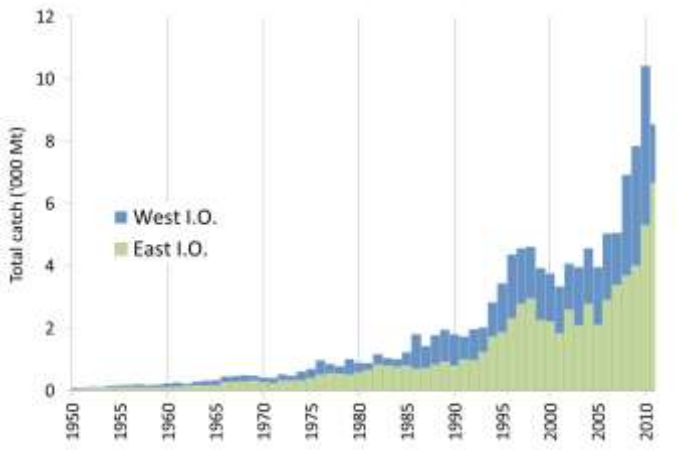


Fig. 23. Bullet tuna: Annual catches of bullet tuna by IOTC area recorded in IOTC Database(1950–2011)

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

[9] 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.

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..

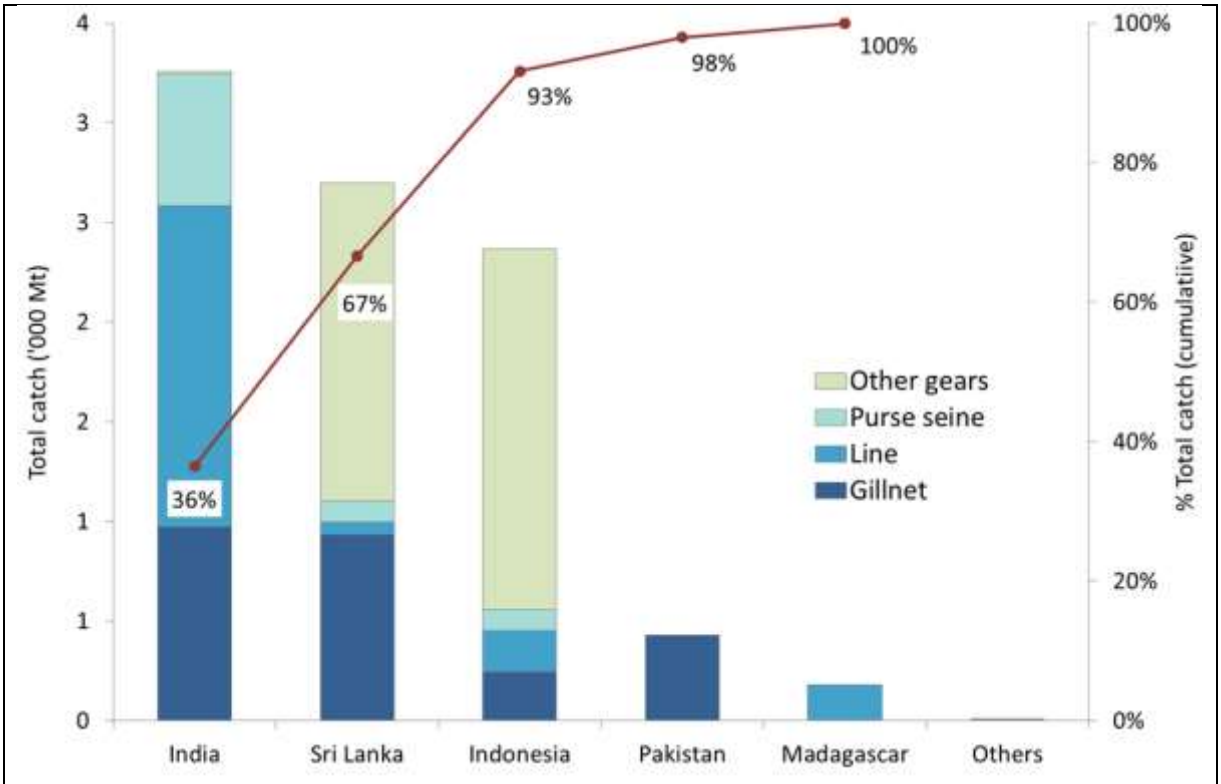


Fig. 24. Bullet tuna: average catches in the Indian Ocean over the period 2009-2011, by country. Countries are ordered from left to right, according to the importance of catches of bullet tuna reported. The red line indicates the (cumulative) proportion of catches of bullet tuna for the countries concerned, 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 being aggregated with frigate tunas or, less frequently, other small tuna species.
- Mislabelling: Bullet tunas are usually mislabelled as frigate tuna, 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 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 changed substantially since the WPNT meeting in 2012, with catches more than doubling over the entire time series (Fig. 26), following major reviews of catch time series for Indonesia, India, and Sri Lanka (Appendix I).

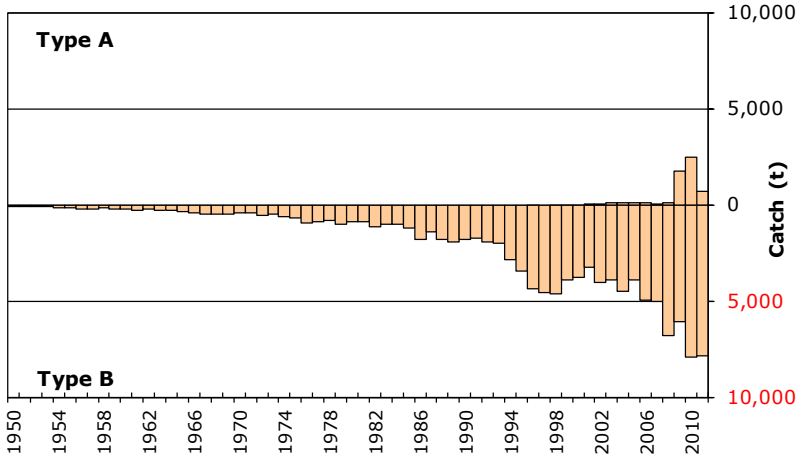


Fig. 25. Uncertainty of annual catch estimates for bullet tuna (1950–2011). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of June 2013

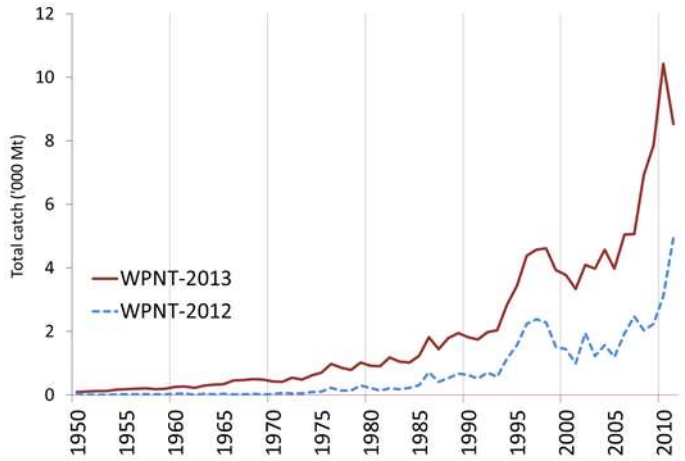


Fig. 26. Bullet tuna: Catches used by the WPNT in 2012 versus those estimated for the WPNT in 2013 (1950–2011)

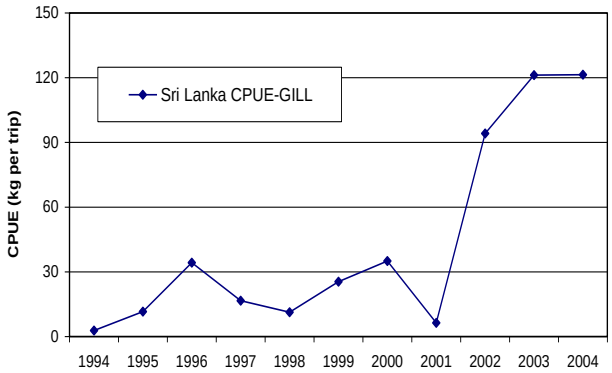


Fig. 27. Bullet tuna: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004)

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 it is the case with the gillnet fisheries of Sri Lanka (Fig. 27).

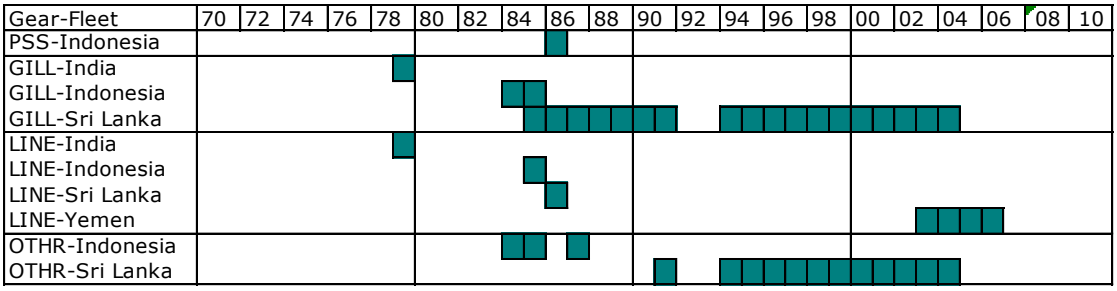


Fig. 28. Bullet tuna: Availability of catches and effort series, by fishery and year (1970–2011)[10]. Note that no catches and effort are available at all for 1950–78

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).

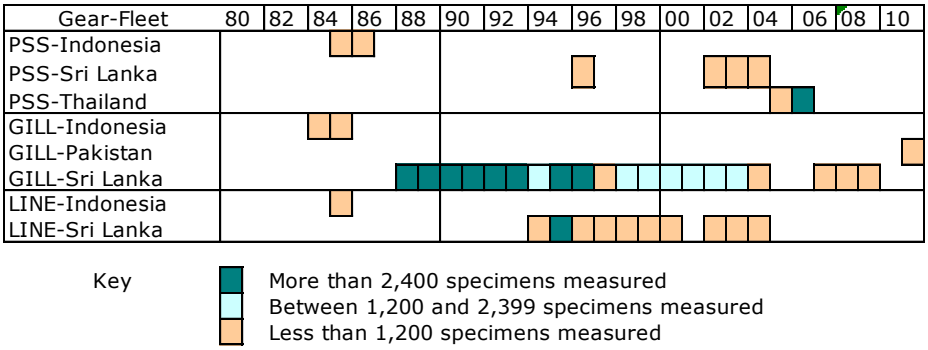


Fig. 29. Bullet tuna: Availability of length frequency data, by fishery and year (1980–2011)[11]. Note that no length frequency data are available at all for 1950–83

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*

[10] 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

[11] 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 by-catch of the industrial purse seiners. The catch estimates for kawakawa were derived from very small amounts of information and are therefore highly uncertain[12] (Fig. 34).

TABLE 6. Kawakawa: Best scientific estimates of the catches of kawakawa by type of fishery for the period 1950–2011 (in metric tonnes). Data as of June 2013.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Purse seine	307	807	2,880	10,235	20,544	30,338	26,881	27,283	29,042	30,239	35,195	34,123	34,729	36,774	36,180	35,639
Gillnet	2,179	4,098	9,085	15,708	27,800	47,526	41,791	41,918	43,240	43,788	49,929	52,280	62,071	59,390	53,920	65,379
Line	2,102	3,642	7,145	11,732	18,742	24,036	20,206	20,539	24,224	22,061	23,635	25,196	31,429	31,659	31,981	33,867
Other	88	297	612	1,411	3,515	6,250	4,785	4,815	5,635	5,880	6,109	8,120	8,257	9,065	9,475	8,767
Total	**4,676**	**8,844**	**19,722**	**39,085**	**70,601**	**108,149**	**93,663**	**94,554**	**102,140**	**101,968**	**114,868**	**119,719**	**136,486**	**136,888**	**131,557**	**143,652**

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 40,000 t mark in the mid-1980's and 143,000 t in 2011, the highest catches ever recorded for this species. In recent years the catches of kawakawa have been at similar levels in in the two Indian Ocean basins (Fig. 31).

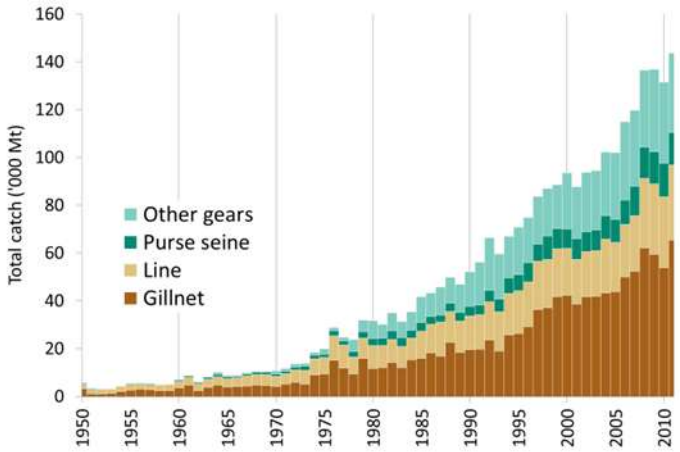


Fig. 30. Kawakawa: Annual catches of kawakawa by gear recorded in the IOTC database (1950–2011)

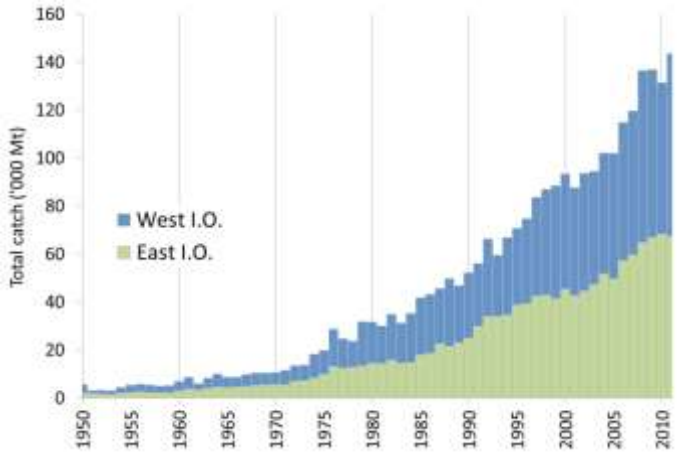


Fig. 31. Kawakawa: Annual catches of kawakawa by IOTC area recorded in the IOTC database (1950–2011)

In recent years, the countries attributed with the highest catches are Indonesia (23%), India (20%), Iran (14%), and Pakistan (10%) and Malaysia (9%) (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

[12] 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.

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).

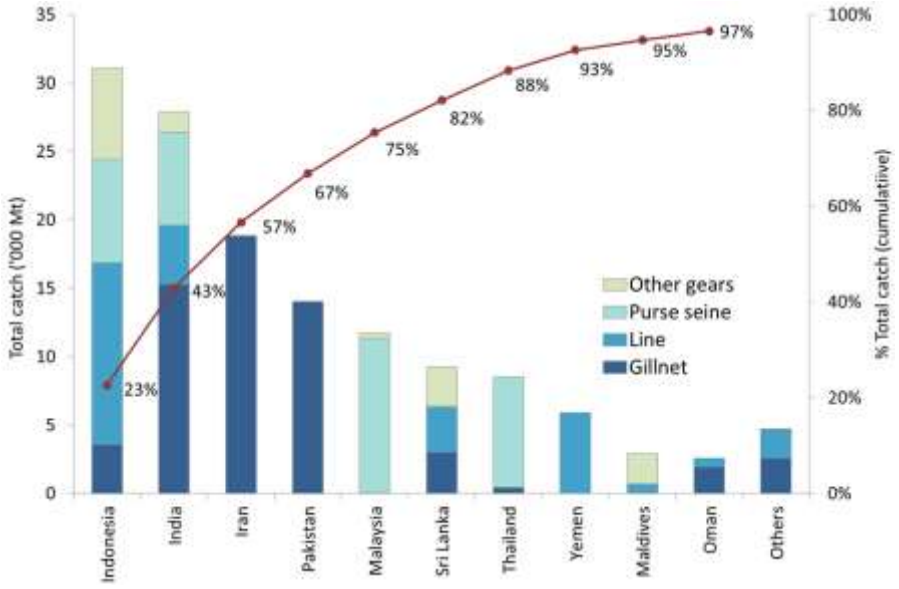


Fig. 32. Kawakawa: average catches in the Indian Ocean over the period 2009-2011, by country. Countries are ordered from left to right, according to the importance of catches of kawakawa reported. The red line indicates the (cumulative) proportion of catches of kawakawa for the countries concerned, over 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, in a recent review conducted by an independent consultant in 2012 he indicated that the catches of kawakawa had been overestimated by Indonesia (more information about the review can be found in Appendix I). While the new catches estimated for the kawakawa in Indonesia remain uncertain, representing around 23% (38% 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 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 an independent consultant and assigned by gear on the basis of official reports and information from various other alternative sources (see Appendix I). The catches of kawakawa in India have represented 20% (17% in the past) of the total catches of this species in the Indian Ocean in recent years.
- 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 Malaysia and Thailand).

- 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.

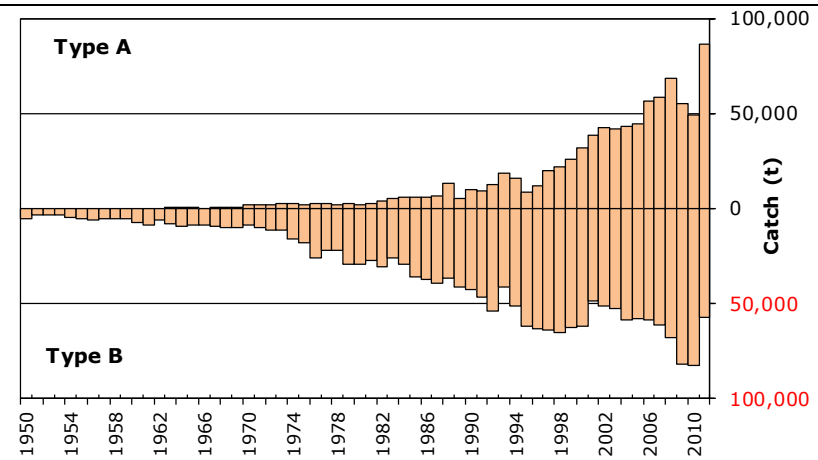


Fig. 33. Kawakawa: Uncertainty of annual catch estimates for kawakawa (1950–2011). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of June 2013

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: Overall, the catch series of kawakawa has not changed substantially since the WPNT meeting in 2012 (Fig. 34a.). While the reviews in India, Indonesia, and other countries led to changes in the total catch of kawakawa and breakdown by gear in each country (Fig. 34b.), as a whole, the total catches of kawakawa remain at similar levels when compared to previous estimates.

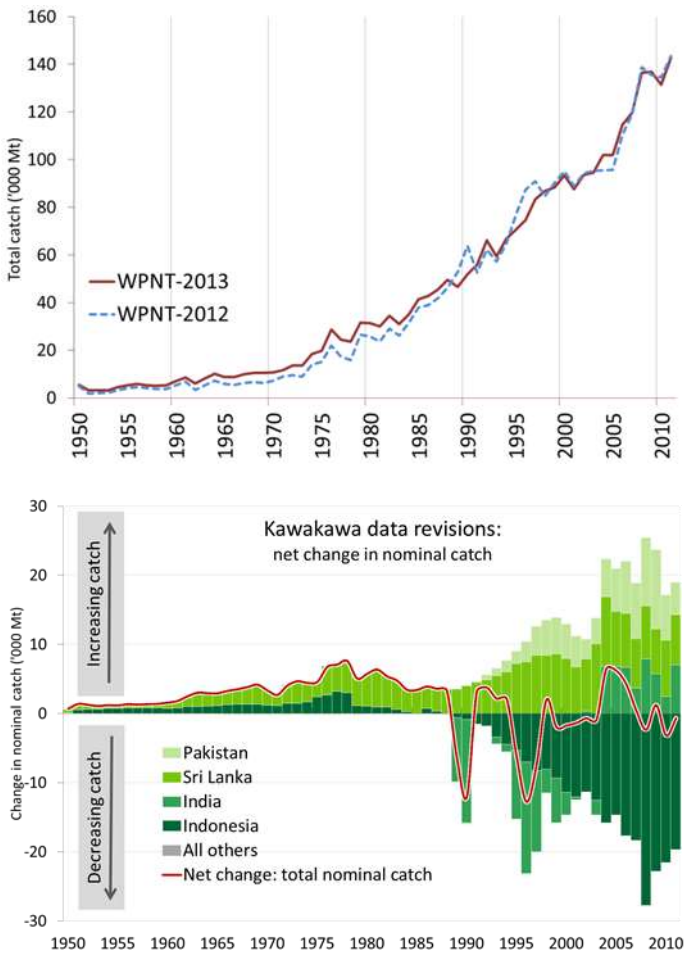


Fig. 34. Kawakawa: Catches used by the WPNT in 2012 versus those estimated for the WPNT in 2013 (1950–2011):
Top: Total catch 2012 *vs.* 2013 (a.)
Bottom: Net change in total catch, by year and flag country (b.)

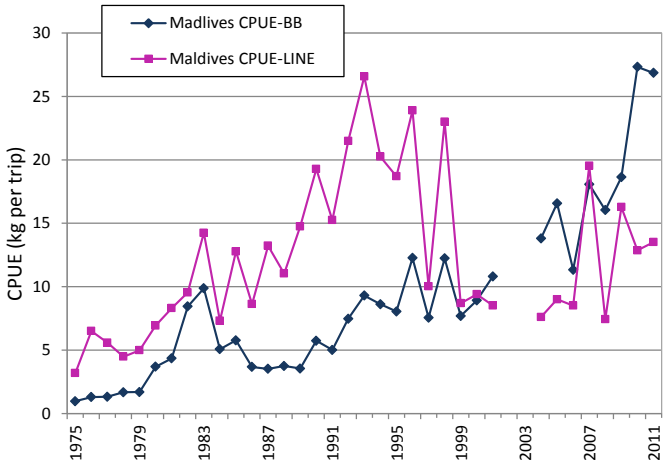


Fig. 35. Kawakawa: Nominal CPUE series for the baitboat (BB) and troll line (TROL) fisheries of Maldives (1975–2011) derived from the available catches and effort data

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 only 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, data collection did not continue after the end of the IPTP activities.

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*

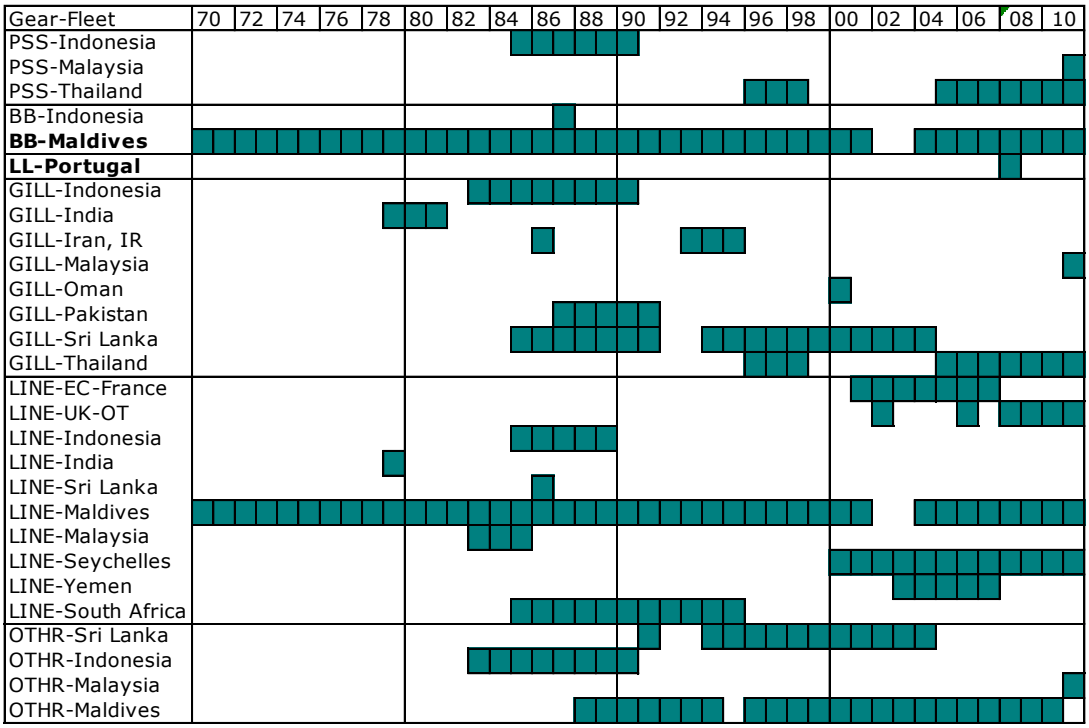


Fig. 36. Kawakawa: Availability of catches and effort series, by fishery and year (1970-2011)[13]. Note that no catches and effort are available at all for 1950–69

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 some selected fisheries are shown in Fig. 38.

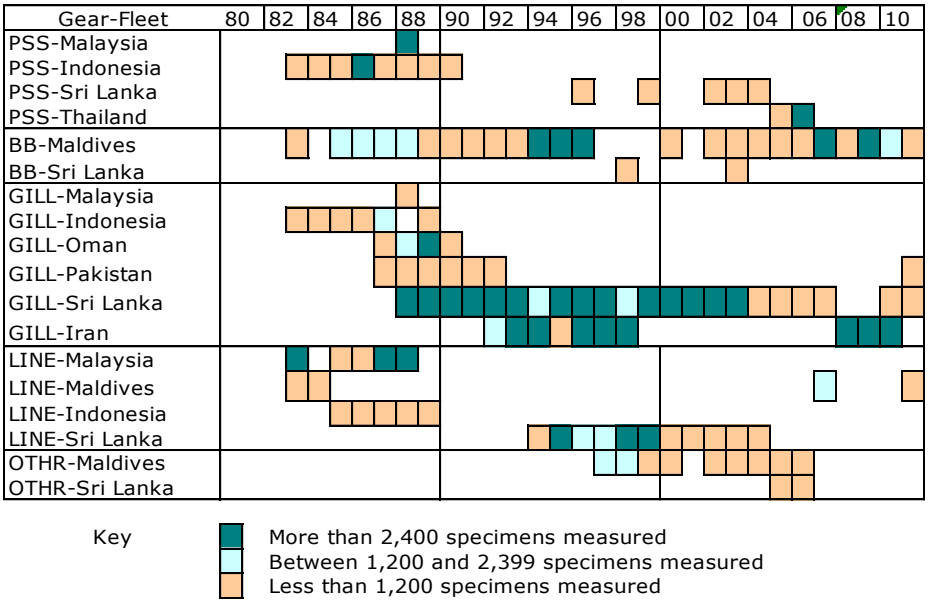


Fig. 37. Kawakawa: Availability of length frequency data, by fishery and year (1980-2011)[14]. Note that no length frequency data are available at all for 1950–82

[13] 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

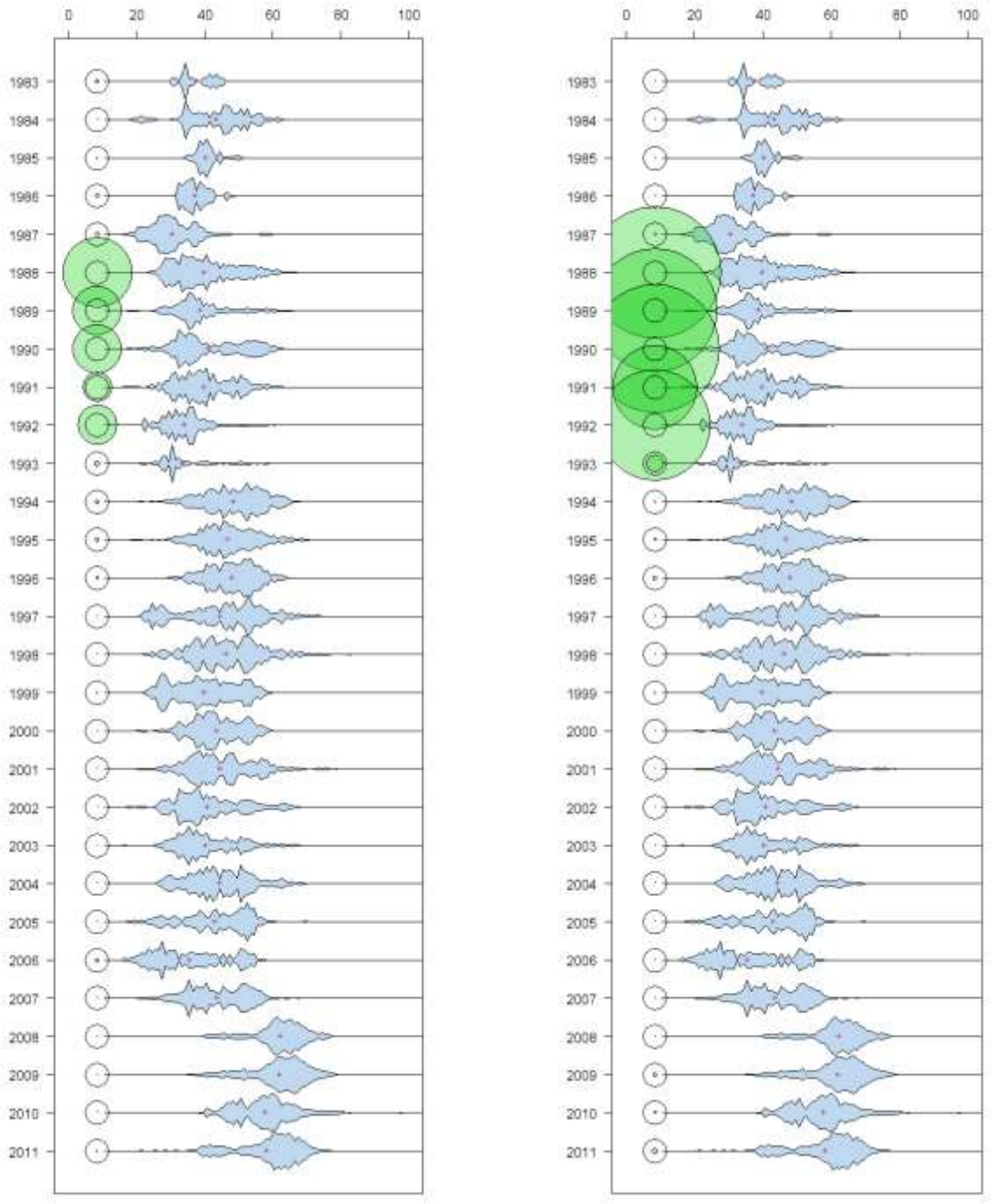


Fig. 38. Kawakawa: Length frequency distributions (total amount of fish measured by 1cm length class) derived from the data available at the IOTC Secretariat for selected fisheries and periods, by gear and year. The black outline circles (to the left of each chart) indicate the minimum sampling standard 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).

[14] 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

Narrow-barred Spanish mackerel (COM)

Fisheries and catch trends

Narrow-barred Spanish mackerel[15] 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 1950–2011 (in metric tonnes). Data as of June 2013.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Purse seine	41	69	425	2,613	4,668	6,487	4,925	5,456	5,500	5,550	8,404	7,189	8,279	10,063	11,121	11,083
Gillnet	8,681	16,863	29,734	51,768	60,018	64,082	60,964	63,080	61,989	53,776	65,159	69,222	73,119	69,189	75,133	81,663
Line	2,581	3,300	7,106	14,463	14,741	18,767	15,976	17,366	17,397	16,950	19,272	20,048	22,537	23,580	23,870	25,662
Other	16	27	326	5,352	9,205	19,935	18,715	17,516	18,585	17,466	22,223	22,993	22,008	26,215	24,220	26,593
Total	**11,318**	**20,259**	**37,592**	**74,196**	**88,632**	**109,271**	**100,580**	**103,417**	**103,472**	**93,741**	**115,059**	**119,453**	**125,943**	**129,047**	**134,344**	**145,001**

The catch estimates for Spanish mackerel were derived from very small amounts of information and are therefore highly uncertain[16] (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 Spanish mackerel increased from around 50,000 t the late-1970's to over 100,000 t by the mid-1990's. The highest catches of Spanish mackerel were recorded in 2011, amounting to 145,000 t. Spanish mackerel is caught in both Indian Ocean basins, with higher catches recorded in the East in recent years (Fig. 40).

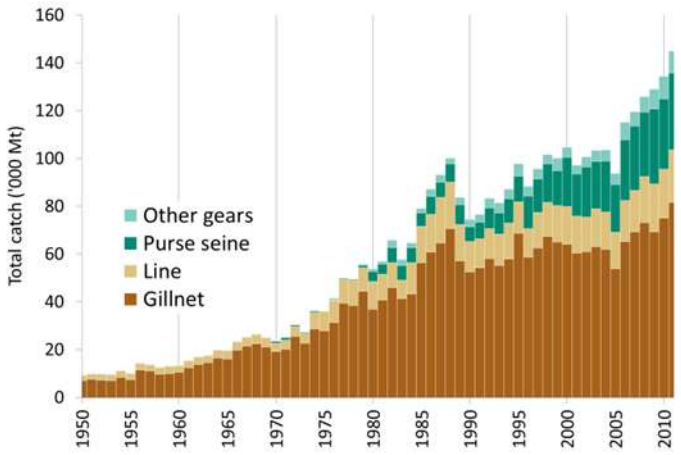


Fig. 39. Narrow-barred Spanish mackerel: Annual catches of narrow-barred Spanish mackerel by gear recorded in the IOTC database (1950–2011)

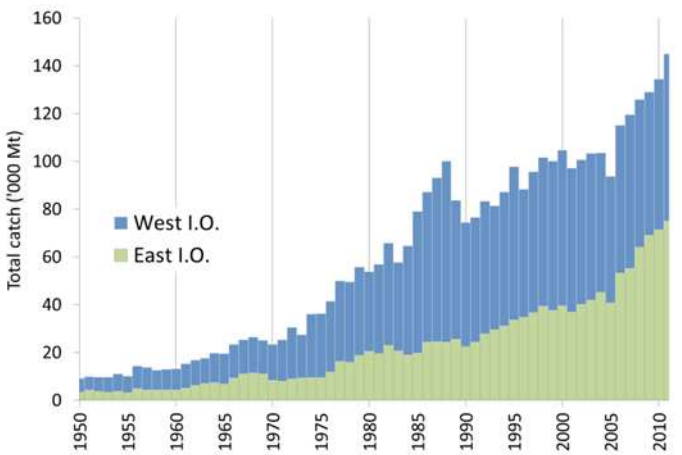


Fig. 40. Narrow-barred Spanish mackerel: Annual catches of narrow-barred Spanish mackerel by IOTC area recorded in the IOTC database (1950–2011)

In recent years, the countries attributed with the highest catches of Spanish mackerel are Indonesia (31%) and India (22%) and, to a lesser extent, Iran, Myanmar, Pakistan, and the UAE (24%) (Fig. 41).

The size of 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 Spanish mackerel taken varies by location with 32–119 cm fish taken in the Eastern Peninsular Malaysia area, 17–139 cm fish taken in the East

[15] Hereinafter referred to as Spanish mackerel

[16] 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

Malaysia area and 50-90 cm fish taken in the Gulf of Thailand. Similarly, Spanish mackerel caught in the Oman Sea are typically larger than those caught in the Persian Gulf.[17]

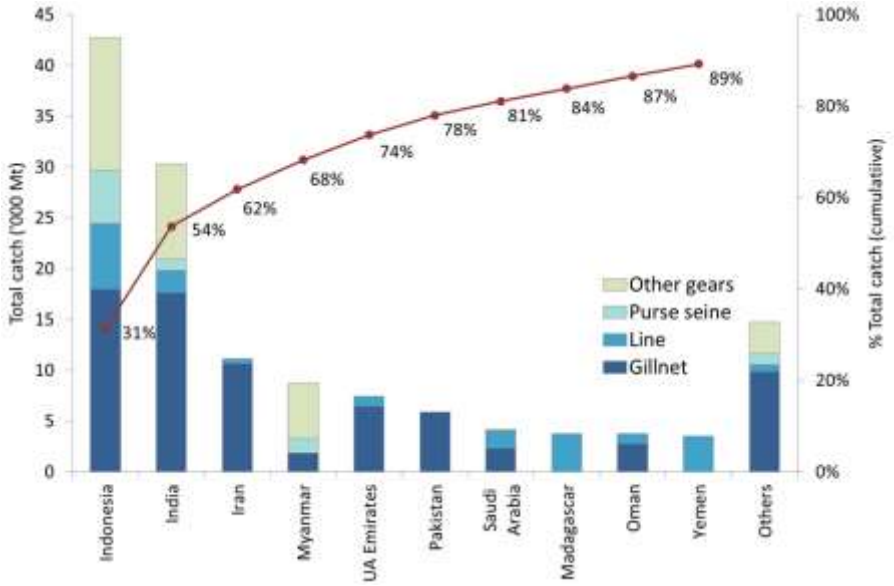


Fig. 41. Narrow-barred Spanish mackerel: average catches in the Indian Ocean over the period 2009-2011, by country. Countries are ordered from left to right, according to the importance of catches of narrow-barred Spanish mackerel reported. The red line indicates the (cumulative) proportion of catches 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 India and Indonesia: India and Indonesia 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 recent review conducted by an independent consultant in 2012 the catches of narrow-barred Spanish mackerel were reassigned by gear (more information about the review can be found in Appendix I). The catches of narrow-barred Spanish mackerel estimated for this component represent around 55% 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 Spanish mackerel. Similarly, the catches

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

of wahoo in some longline fisheries are thought to be mislabelled as Spanish mackerel. This mislabelling is thought to have little impact in the case of the Spanish mackerel but may be important for other seerfish species.

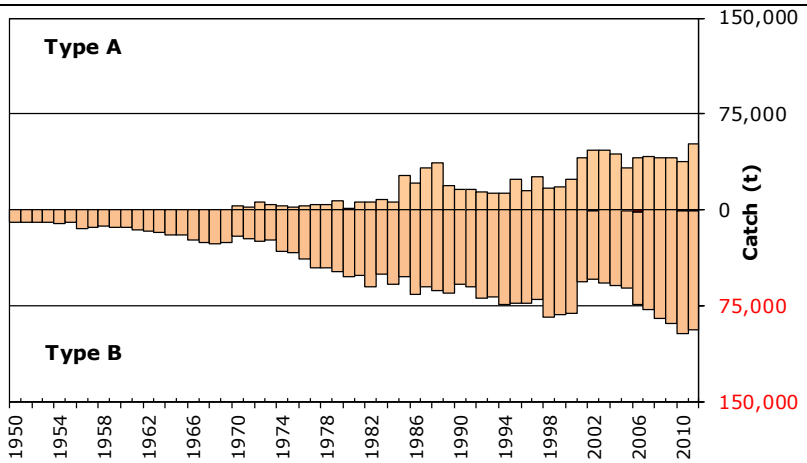


Fig. 42. Narrow-barred Spanish mackerel: Uncertainty of annual catch estimates for narrow-barred Spanish mackerel (1950–2011). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (Type A) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of June 2013

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

Changes to the catch series: The catch series of narrow-barred Spanish mackerel has not changed substantially since the WPNT meeting in 2012 (Fig. 43). The catch series estimated for the WPNT in 2013show lower catches of Spanish mackerel between the mid-1990's and early 2000's, following a review of the catch series in India.

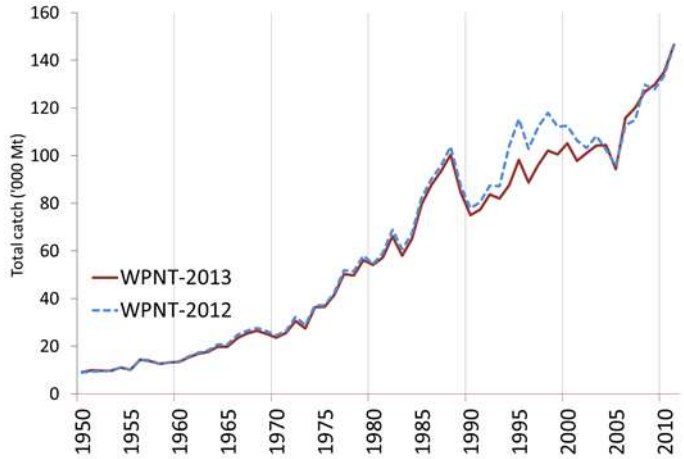


Fig. 43: Narrow-barred Spanish mackerel: Catches used by the WPNE in 2012 versus those estimated for the WPNT in 2013 (1950–2011)

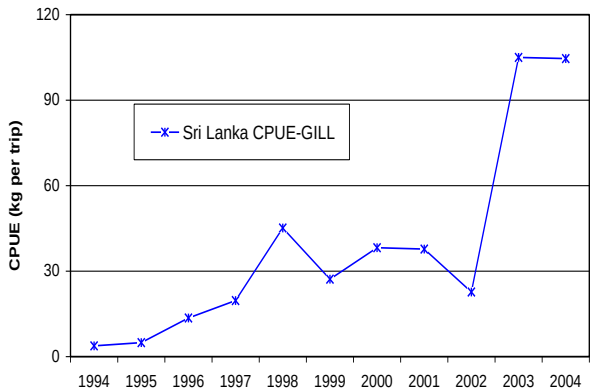


Fig. 44: Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004)

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.

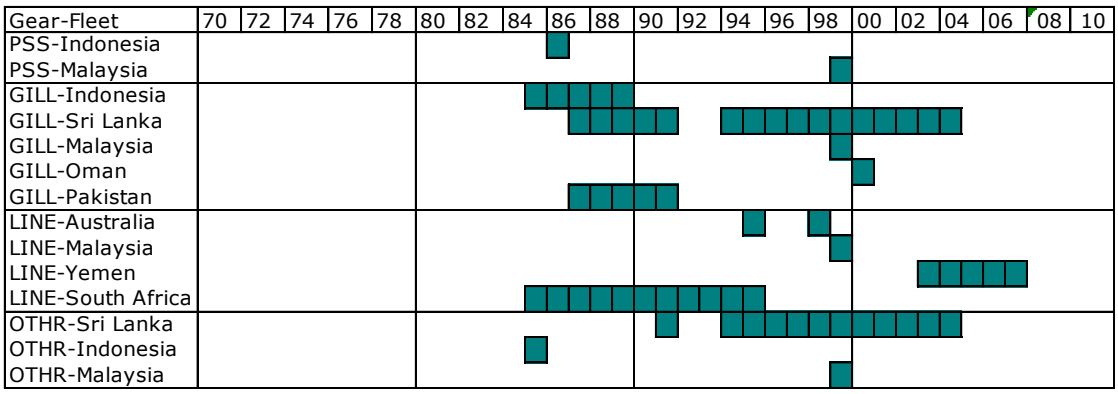


Fig. 45: Narrow-barred Spanish mackerel: Availability of catches and effort series, by fishery and year (1970–2011)[18]. Note that no catches and effort are available at all for 1950–84, and 2008–11

Trends in average weight can only be assessed for Sri Lankan gillnets but the amount of specimens measured has been very low in recent years (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.

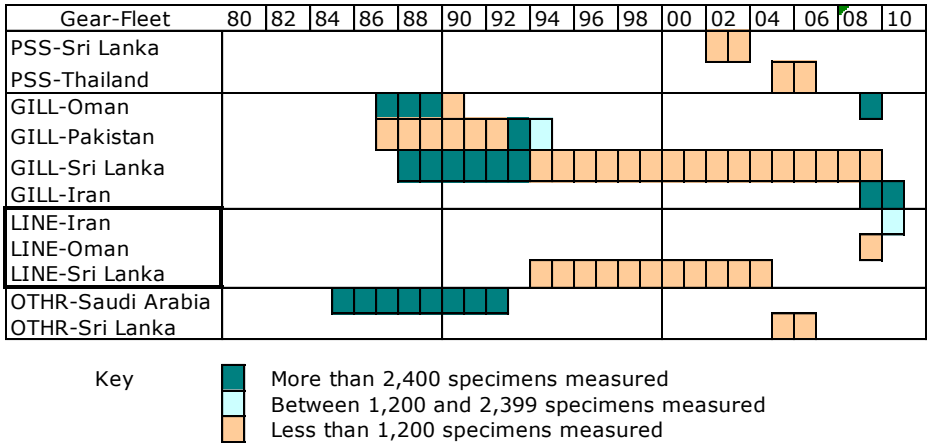


Fig. 46: Narrow-barred Spanish mackerel: Availability of length frequency data, by fishery and year (1980–2011)[19]. Note that no length frequency data are available at all for 1950–84

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 some selected fisheries are shown in Fig. 47.

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*

[18] 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

[19] 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

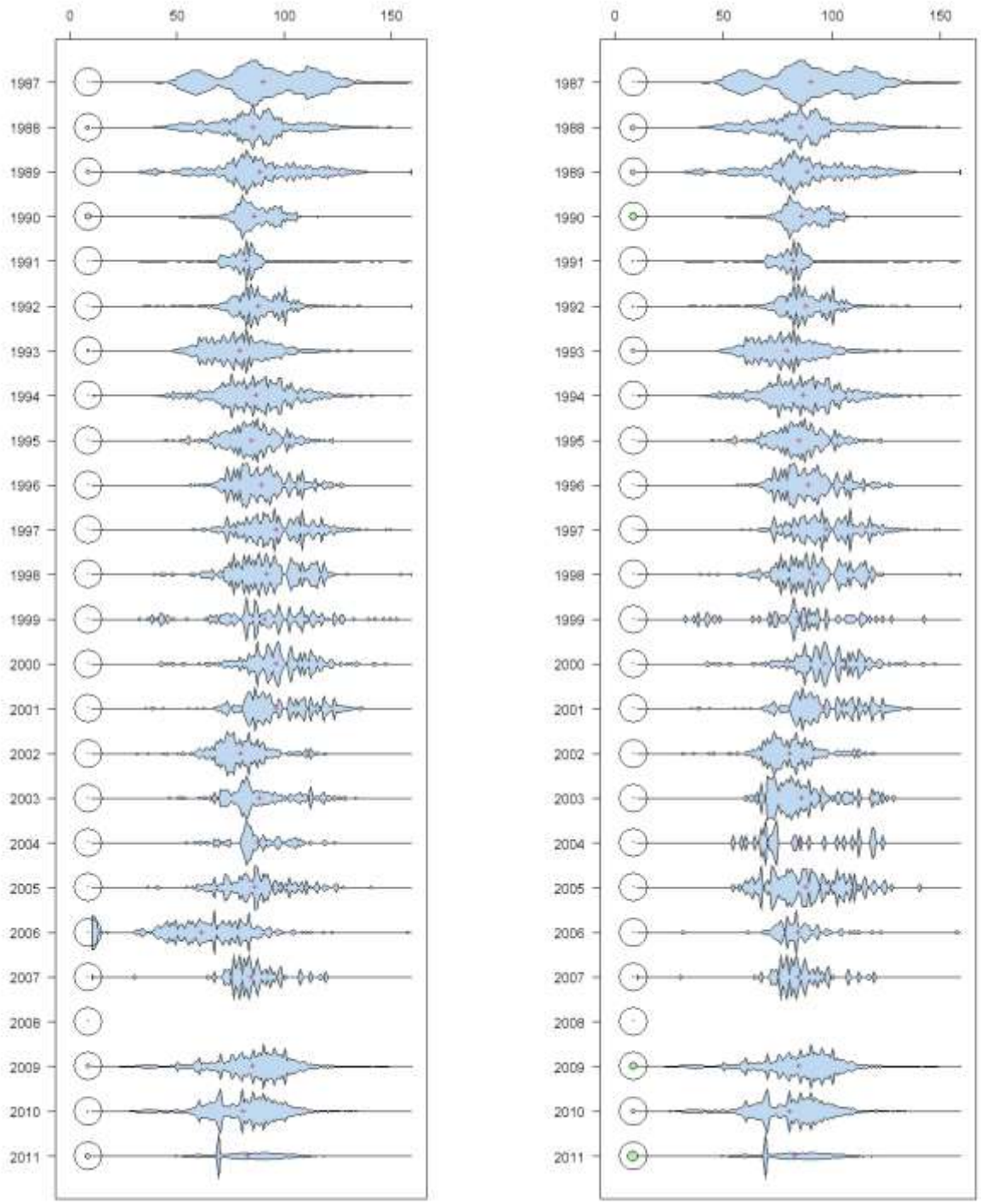


Fig. 47. Narrow-barred Spanish mackerel: Length frequency distributions (total amount of fish measured by 1cm length class) derived from the data available at the IOTC Secretariat for selected fisheries and periods, by gear and year. The black outline circles (to the left of each chart) indicate the 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).

Indo-Pacific king mackerel (GUT)

Fisheries and catch trends

The Indo-Pacific king mackerel[20] 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[21] (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 1950–2011 (in metric tonnes). Data as of June 2013.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Purse seine	5	9	53	623	850	1,067	933	956	910	804	844	1,233	1,487	1,832	1,416	1,528
Gillnet	4,213	6,747	13,532	16,556	21,251	23,065	21,525	21,008	21,848	18,055	20,252	26,176	31,968	31,744	26,126	28,513
Line	404	500	1,184	1,881	2,286	2,610	2,280	2,220	2,347	2,117	2,085	3,032	3,639	3,950	3,201	3,468
Other	7	12	30	3,845	5,042	9,189	8,024	7,648	8,079	7,768	7,993	10,467	12,001	15,557	11,670	12,765
Total	**4,630**	**7,268**	**14,799**	**22,904**	**29,430**	**35,931**	**32,762**	**31,831**	**33,183**	**28,743**	**31,174**	**40,907**	**49,094**	**53,083**	**42,413**	**46,274**

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 since the mid-1990's. Catches increased steadily since then until 2007, in which catches reached around 40,000 t. The catches of king mackerel between 1997 and 2005 were more or less stable, estimated at around 30,000 t. Current catches have been higher, close to 50,000 t. The highest catches were recorded in 2009, at around 53,000 t.

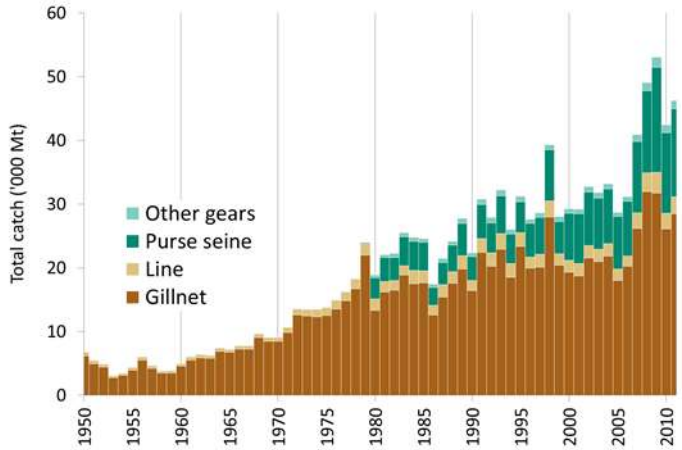


Fig. 48. Indo-Pacific king mackerel: Annual catches of Indo-Pacific king mackerel by gear recorded in the IOTC database (1950–2011)

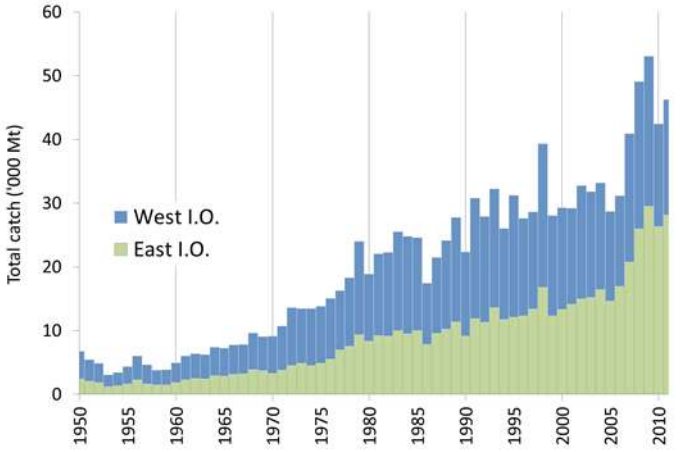


Fig. 49. Indo-Pacific king mackerel: Annual catches of Indo-Pacific king mackerel by IOTC area recorded in the IOTC database (1950–2011)

In recent years, the countries attributed with the highest catches are India (42%) and Indonesia (28%) and, to a lesser extent, Myanmar and Iran (16%) (Table 6, Fig. 50). Catches of king mackerel in the eastern Indian Ocean have been higher in recent years (Fig 49).

[20] Hereinafter referred to as King mackerel.

[21] 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.

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.
- 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.

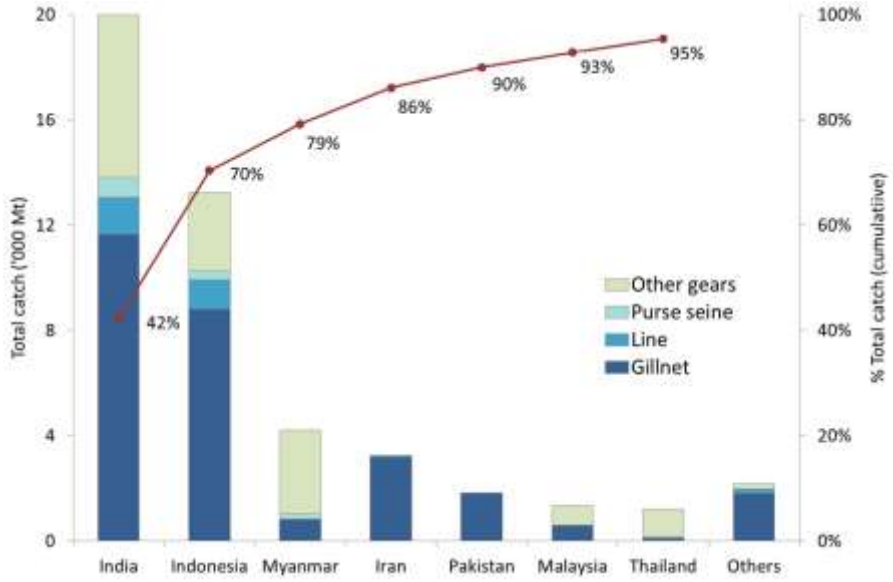


Fig. 50. Indo-Pacific king mackerel: average catches in the Indian Ocean over the period 2009-2011, by country. Countries are ordered from left to right, according to the importance of catches of Indo-Pacific king mackerel reported. The red line indicates the (cumulative) proportion of catches of Indo-Pacific 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.

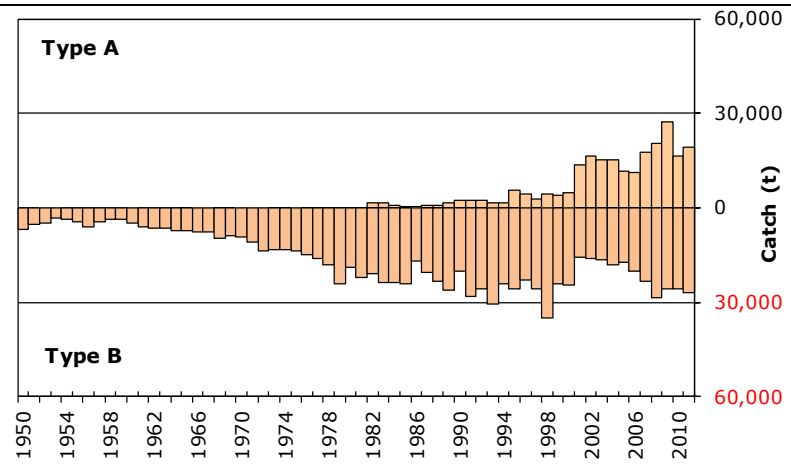


Fig. 51. Indo-Pacific king mackerel: Uncertainty of annual catch estimates for Indo-Pacific king mackerel (1950–2011). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of June 2013

Changes to the catch series: There have not been major changes to the catches of king mackerel since the WPNT in 2012 (Fig. 52). Changes over the catch series originated from reviews of catches in India, Indonesia, Pakistan, and Iran (Appendix I).

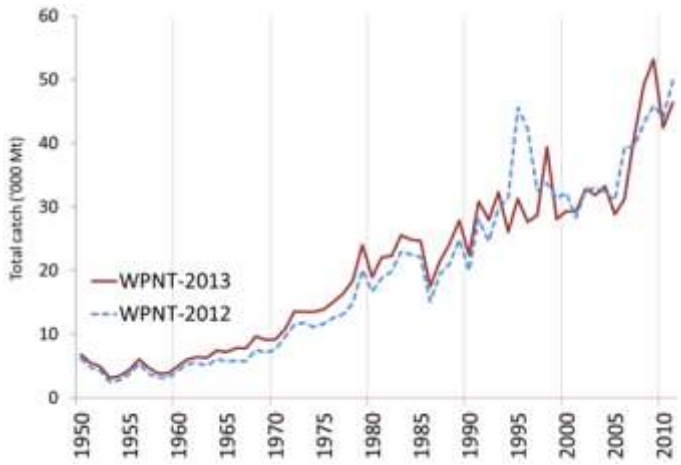


Fig. 52. Indo-Pacific king mackerel: Catches used by the WPNT in 2012 versus those estimated for the WPNT in 2013(1950–2011)

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.

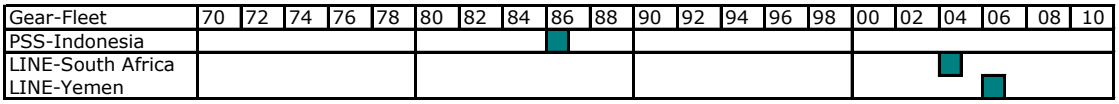


Fig. 53. Indo-Pacific king mackerel: Availability of catches and effort series, by fishery and year (1970–2011)[22]. Note that no catches and effort are available at all for 1950–85

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).

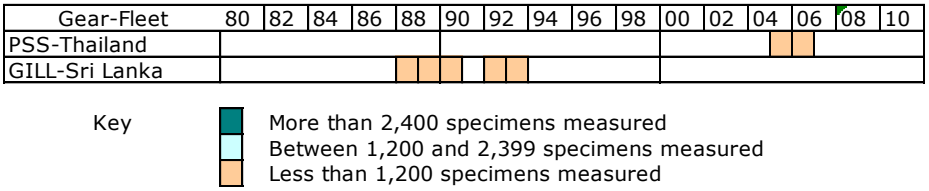


Fig. 54. Indo-Pacific king mackerel: Availability of length frequency data, by fishery and year (1980–2011)[23]. Note that no length frequency data are available at all for 1950–82).

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*

[22] 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

[23] 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

SUMMARY OF MAIN REVISIONS TO CATCH SERIES

India – Artisanal Fisheries

Artisanal Fisheries –

- The artisanal data series for India has been revised to take account of new data published by the Central Marine Fisheries Research Institute (CMFRI), as well as research by an IOTC consultant conducted in 2012[24].
- A new artisanal fishery – shrimp trawlers converted to longline and troll vessels – which started in early 2000 has also been added to the total artisanal catch for India. Details of the fishery were provided to the IOTC Scientific Committee in December 2011; although main targets of the fishery are yellowfin tuna and skipjack tuna. Vessels have been in operation from early 2000, and catches from 2002 to 2009 have been estimated based on the information of catch reported for 2010.
- The revised data updates previous IOTC estimates, largely based on the results of the historical series published by Bhatal[25].
- Research by the IOTC consultant indicates catch levels and fishing activities are lower than those previously reported by India official sources[26], and also lower than revisions to the historical series published by Bhatal[9], particularly for the period 1990 to 2000.

Main findings

- The largest revisions relate to years 1989-1990 and 1995-2000 which report large discrepancies between figures published by CMRFI and estimates by Bhatal. Substantially higher catches have previously been estimated by Bhatal for these years, with no explanation on the rationale for the sharp increases in catch. In light of the latest data published by CMFRI, the decision was made by to follow the (lower) official catch series reported by CMRFI for this period.
- Due to lack of information on data for earlier years, minimal changes have been made to data for years prior to 1988.

Frigate and Bullet tuna

- The main issue with frigate and bullet tuna are the similarity between the two species, which often leads to misidentification of species and misreporting of catch. Previously, the two species have been grouped together and reported as *Auxis spp.* by India.
- The data series for both species have been revised as part of the independent review by IOTC, using the latest catch data published by CMFRI, as well as fixed ratios from CMRFI reports to assign the catch to each species (using an average proportion of 0.89 for frigate tuna and 0.11 for bullet tuna).
- Revised estimates of change for a number of years by up to +/-50% (e.g., in 2009 from 10,700t to 5,200 t, and 2010 from 9,300 t to 14,000 t) from improvements in the allocation of the catch by species.
- The revisions have also generally increased the nominal catch for bullet tuna through changes to the species disaggregation. Again, the largest changes are in the last few years (e.g., in 2009 catch has increased from 940 t to 3,500 t, while 2010 catch has increased from 800 to 4,000 t).

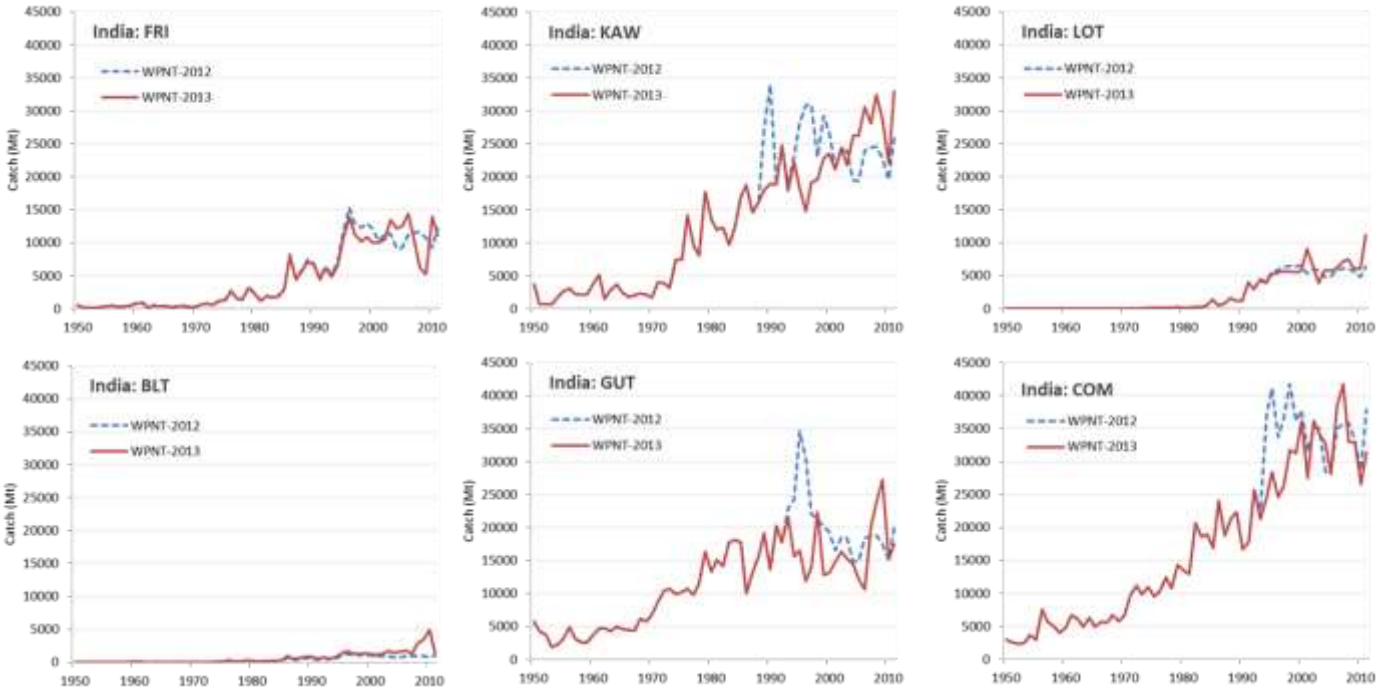
Kawakawa and Longtail

- Although India has previously reported catches of longtail tuna and kawakawa, until recently the catches have not been reported by gear. The catches of India were also similarly reviewed by the IOTC consultant and assigned by gear on the basis of official reports from CMRI.

[24] Research findings and data collated by Moreno, G. published by (IOTC) in 2012.
[25] Bhatal, B. (2005), 'Historical reconstruction of Indian marine fisheries catches, 1950-2000, as a basis for testing the Marine Tropical Index', Fisheries Centre, University of British Columbia, Canada.
[26] Previous data published by the Ministry of Animal Husbandry, Dairying, and Fisheries.

- In the case of both species the catch has generally been reduced for the mid-1990s, reflecting lower catch estimates in the revised data than previously reported by Bhatal, while catch has been revised upwards from the mid-2000s based on the latest data from CMFRI.
- Of the two species, the revisions to kawakawa are the greatest, which change by up to +/-30% for selected years between the mid-1990s to the mid-2000s.

Fig. 55 (a-f). India: comparison of catch series for Working Party on Neritic Tunas (WPNT) 2012 and 2013.



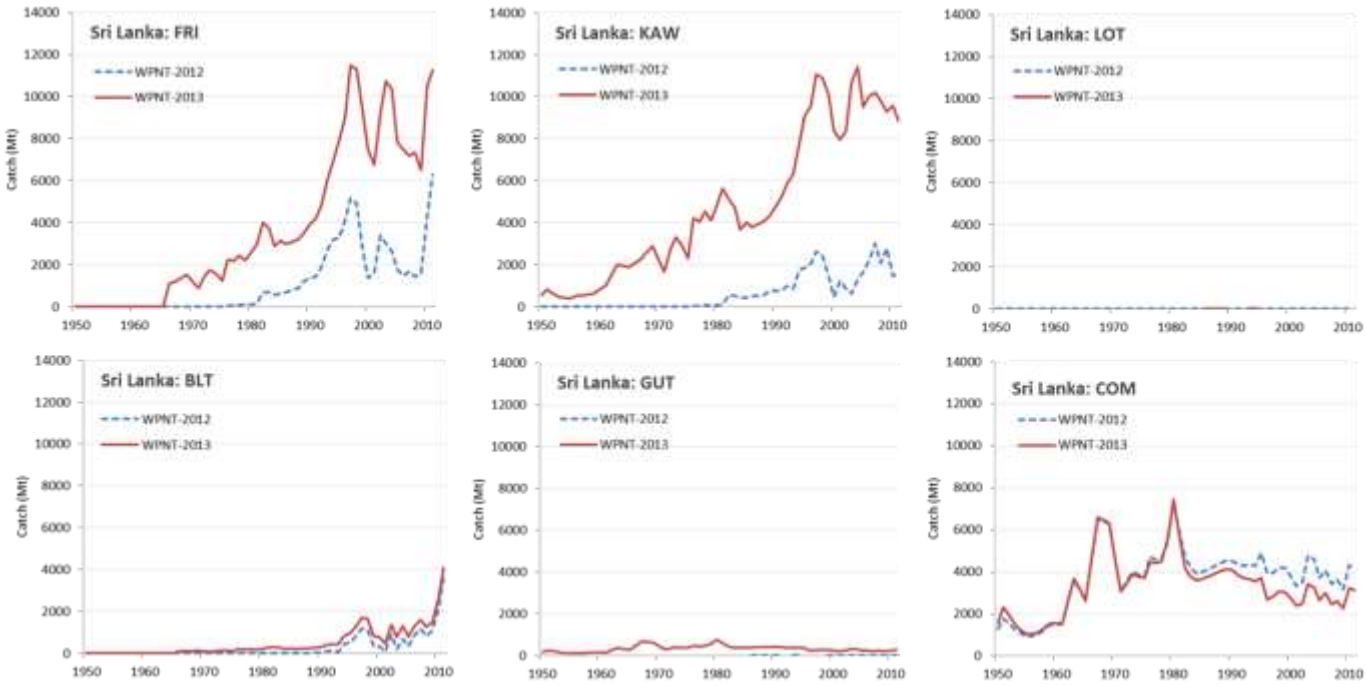
Sri Lanka – Artisanal catch

- Catch estimates for neritic tuna species of Sri Lankan coastal fisheries from 2006 have previously been estimated by assigning a fixed proportion of the total coastal catch reported by the Statistical Unit of Sri Lanka.
- As with India, an independent review of Sri Lanka was conducted in 2012 by a consultant working for IOTC[27].
- A substantial increase in coastal catch has been reported by Sri Lanka relative to the number of coastal boats, which prompted a reassessment of the accuracy of catch estimates.
- In 2012 a new estimation method was introduced which takes 1995 as the baseline for the catch. The average catch from the one-day boats reported in 1995 was applied to the total number of one-day boats reported from 1996–2011. The assumption is that these vessels are mainly catching tuna and tuna-like species. Species and gear type have been assigned based on proportions taken from the IOTC database.

Main findings –

- A key issue of the review was the allocation of catch to species classified as unknown tunas (TUX). Catch reported in this category has previously been assumed to be mostly skipjack, while the findings of the review concluded the catch to be more likely kawakawa and frigate juveniles.
- Consequently, the data series across most tuna species has been revised – with the majority of catch reported as TUX reassigned as kawakawa and frigate.
- Changes in the revised catch series of these two species are considerable; for example, from the mid-1990s revised estimates of frigate are as much as five times higher than previous estimates (from around 1,5000 t to 6,000 t), while estimates of kawakawa are up to seven time higher (from around 1,500 t to over 10,000 t).

Fig. 56 (a-f). Sri Lanka: comparison of catch series for Working Party on Neritic Tunas (WPNT) 2012 and 2013.



[27] Research findings and data collated by Moreno, G. published by (IOTC) in 2012.

Indonesia – Artisanal fisheries

In addition to India and Sri Lanka, Indonesia was the third country that was subject to an independent review by an IOTC consultant in 2012 given the importance of the fishery as the largest tuna and tuna-like coastal country in the Indian Ocean[28].

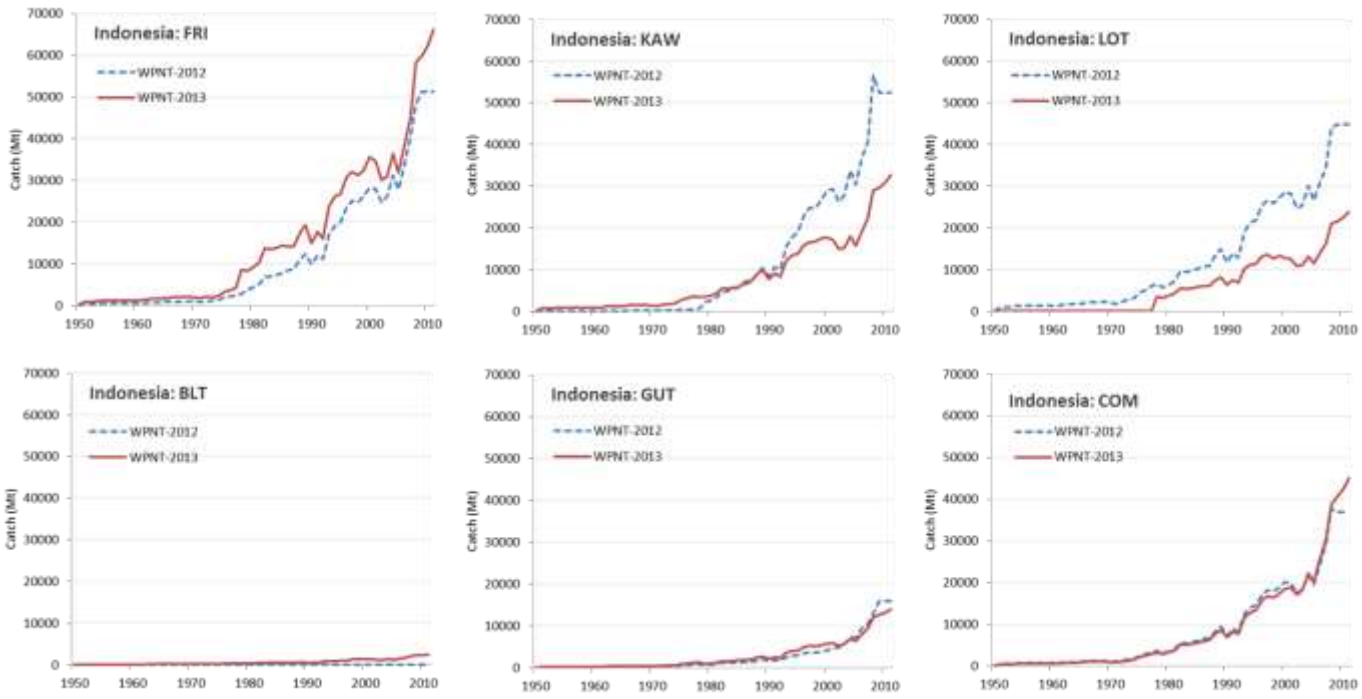
Narrow-barred Spanish mackerel

- Indonesia has only recently reported catches of narrow-barred Spanish mackerel by species and gear. In the past, the IOTC Secretariat used the most recent gear breakdown to assign aggregates for previous years, by gear and species.
- However in the recent review conducted by an independent consultant in 2012, the catches of Spanish mackerel were reassigned using a range of species-gear ratios at different points to reflect changes in the fishery and found that the catches for India up to the early 2000s have been overestimated by around 10-15%.

Kawakawa and longtail

- 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 as species aggregates for this period. In the past, the IOTC Secretariat has used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species.
- However, in a recent review conducted by an independent consultant in 2012 indicated that the catches of kawakawa had been overestimated by Indonesia.
- While the new catches estimated for the kawakawa in Indonesia remain uncertain, representing around 23% (38% 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 previously recorded in the IOTC database.

Fig. 57 (a-f). Indonesia: comparison of catch series for Working Party on Neritic Tunas (WPNT) 2012 and 2013.



[28] Research findings and data collated by Moreno, G. published by (IOTC) in 2012.

Frigate and bullet

- 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 as species aggregates for this period.
- In the past, similar to other species, 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 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 64% 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 estimated in the past.

Pakistan

- Pakistan has recently reported to IOTC revised estimates of nominal catch (from 2006 onwards), based on results of WWF-funded sampling. The sampling is the first formal update of nominal catch estimates from Pakistan since Indo-Pacific Tuna Programme (IPTP) sampling conducted in the late 1980s/early 1990.
- Improvements to the catch-series for Pakistan have been made in three areas:

1.) Updated catch estimates from 2006
The revised nominal catch estimates reported by Pakistan substantially increase the catch for the main neritic tuna species from 2006. For example, for 2006:

- Kawakawa: revised from 2,1000Mt to 10,600Mt;
- Longtail: revised from 4,700Mt to 9,000Mt;
- Frigate: revised from 45Mt to over 3,100Mt;

2.) Revisions of historical time-series in line with catch sampling surveys
The catch series for earlier years has also been adjusted by IOTC Data Section in line with catch levels reported by the latest sampling to avoid a break in the data series, while also respecting the catch estimates derived from IPTP sampling in the early 1990s.

3.) Disaggregation of species composition
The results of the latest sampling also provide greater detail on the species composition. In addition, IOTC Data Section have reallocated catch reported under species aggregates (e.g., KGX and FRZ) using information on species ratios from India as a proxy fleet.

- The biggest revisions in changes to the species composition are figures for seerfish nei (KGX), which have been aggregated with narrow-barred Spanish mackerel (COM) and then reallocated as COM and Indo-Pacific king mackerel (GUT) (based on the species ratio from India).
- Figures for Longtail (LOT) have been aggregated with FRZ and then reallocated to LOT and Bullet Tuna (BLT), similarly using the species ratio from India.

Fig. 58 (a-f). Pakistan: comparison of catch series for Working Party on Neritic Tunas (WPNT) 2012 and 2013.