# REVIEW OF THE STATISTICAL DATA AVAILABLE FOR NERITIC TUNA SPECIES

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## PURPOSE

To provide participants at the 5th Working Party on Neritic Tunas (WPNT05) with a review of the status of the information available on neritic tuna species in the databases at the IOTC Secretariat, as of May 2015, as well as a range of fishery indicators, including catch-and-effort trends, for fisheries catching neritic tunas in the IOTC area of competence. The paper summarises data on retained (nominal) catches, catch-and-effort, size-frequency and other related 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 the neritic tuna species under the IOTC Mandate (Table 1), in accordance with IOTC Resolution 10/02 *Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)[2]*.

The report is split into the following sections:

- **Section 1**: Overview of data for neritic species in the Indian Ocean.

- **Section 2 & Appendix I**: Data issues related to the statistics reported to the IOTC for neritic species.

- **Section 3:** Main fisheries and catch data available for each species.

- **Appendix II:** Overview of current capacity building activities by the IOTC Secretariat

### *Major data categories covered by the report*

**Nominal catches:** Total annual retained catches and discards (in live weight) by fleet, IOTC Area, species, and gear. If these data are not reported the IOTC Secretariat, estimates of total retained catch are made 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, or data reported by parties on the activity of vessels under their flag (IOTC Resolution 10/08; IOTC Resolution 14/06) or other flags (IOTC Resolution 12/07; IOTC Resolution 05/03).

**Catch-and-effort data:** Refers to 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 area.

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[2] This Resolution superseded IOTC Resolutions 98/01, 05/01 and 08/01.
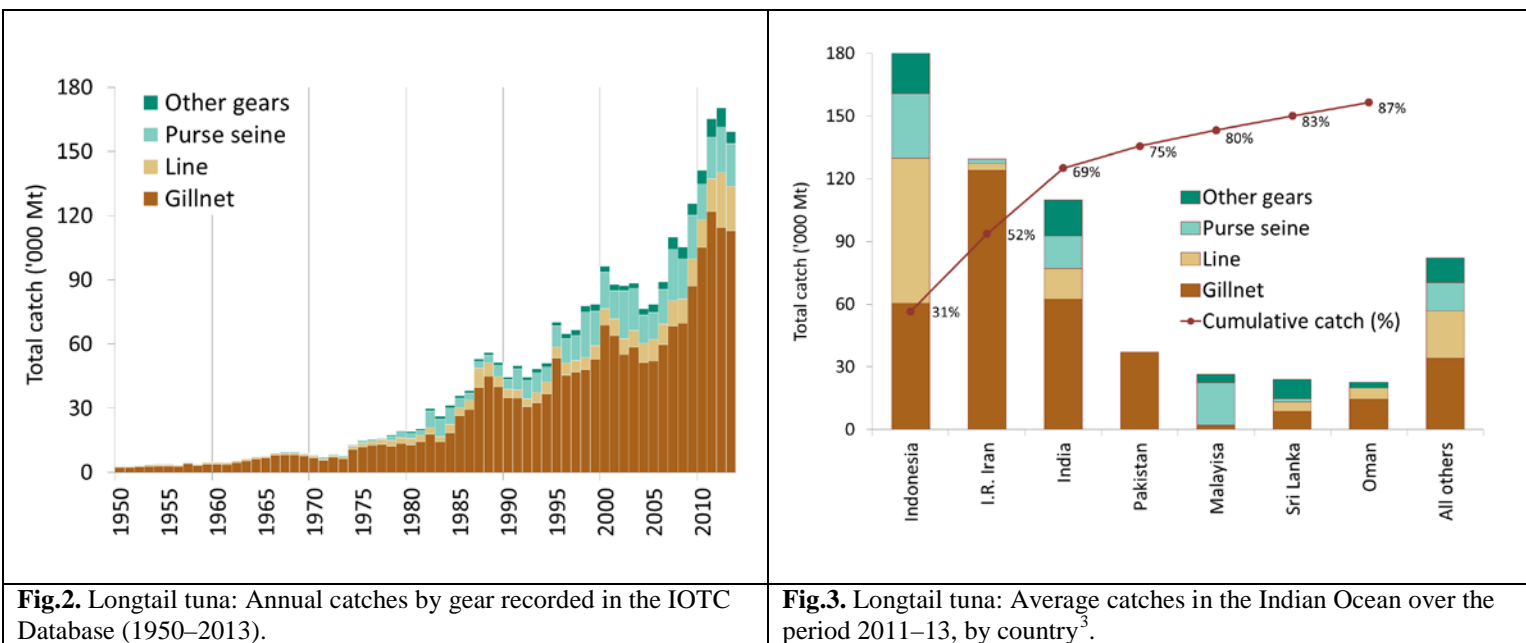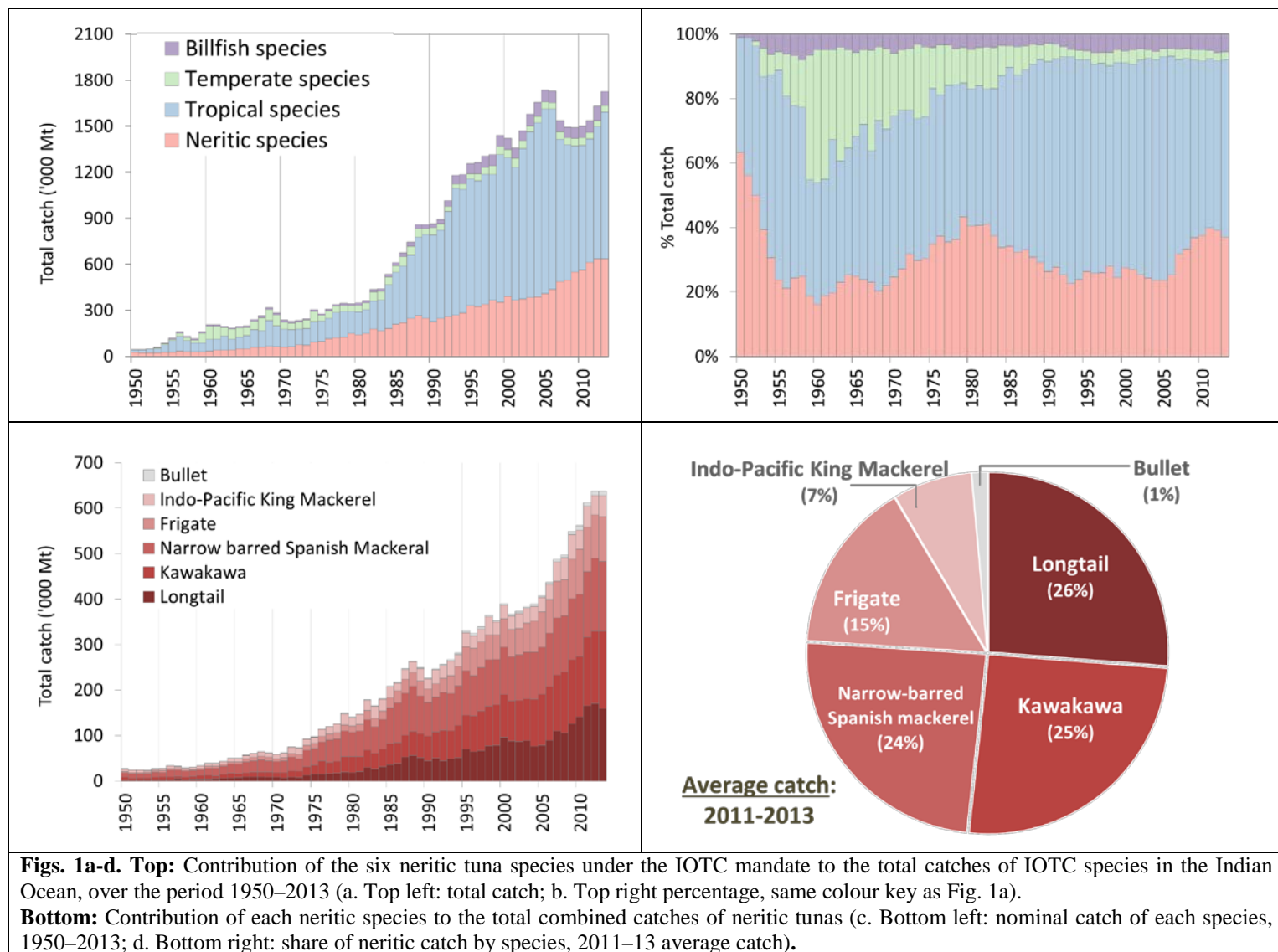
**TABLE 1.** Neritic tuna species under the IOTC mandate

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

## SECTION 1: OVERVIEW OF DATA FOR NERITIC SPECIES IN THE INDIAN OCEAN

**Fisheries and catch trends for neritic species**

- Main species: Longtail tuna, kawakawa, and narrow-barred Spanish mackerel are the main neritic species, accounting for around 75% of the total catches of neritic species in recent years (Fig.1c-d).

- Main fisheries: Neritic tunas are caught mainly using drifting gillnets and purse seine nets in coastal waters – although some species are also caught using industrial purse seines, hand lines, troll lines or other gears both in coastal waters and on the high seas (Fig.2).

- Main fleets (i.e., highest catches in recent years):
  Although neritic species are caught in the EEZ of most coastal states in the Indian Ocean, total catches are highly concentrated amongst – currently around 75% of total catches of neritic species are accounted for by four countries: Indonesia, I.R. Iran, India and Pakistan (Figs.3 & 4).

- Retained catch trends:
  The importance of catches of neritic tunas to total catches of IOTC species in the Indian Ocean has changed substantially over the last 30 years - in particular with the arrival of industrial purse seine fleets to the Indian Ocean in the early-1980s which saw increased targeting of tropical tunas, relative to neritic species.

  With the onset of piracy in the late-2000s, the fishing effort of fleets operating in the north-west Indian Ocean have been displaced or reduced – particularly the Asian longline fleet targeting tropical tunas – leading to an increase in the proportion of catches from neritic species (Figs.1a-b).

- Economic markets:
  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.).

**Figs. 1a-d. Top:** Contribution of the six neritic tuna species under the IOTC mandate to the total catches of IOTC species in the Indian Ocean, over the period 1950–2013 (a. Top left: total catch; b. Top right percentage, same colour key as Fig. 1a).
**Bottom:** Contribution of each neritic species to the total combined catches of neritic tunas (c. Bottom left: nominal catch of each species, 1950–2013; d. Bottom right: share of neritic catch by species, 2011–13 average catch).



**Fig.2.** Longtail tuna: Annual catches by gear recorded in the IOTC Database (1950–2013).

**Fig.3.** Longtail tuna: Average catches in the Indian Ocean over the period 2011–13, by country[3].

**Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, danish seine, liftnet, longline, longline fresh, trawling.

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[3] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2011-2013. 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 for 2011-2013.
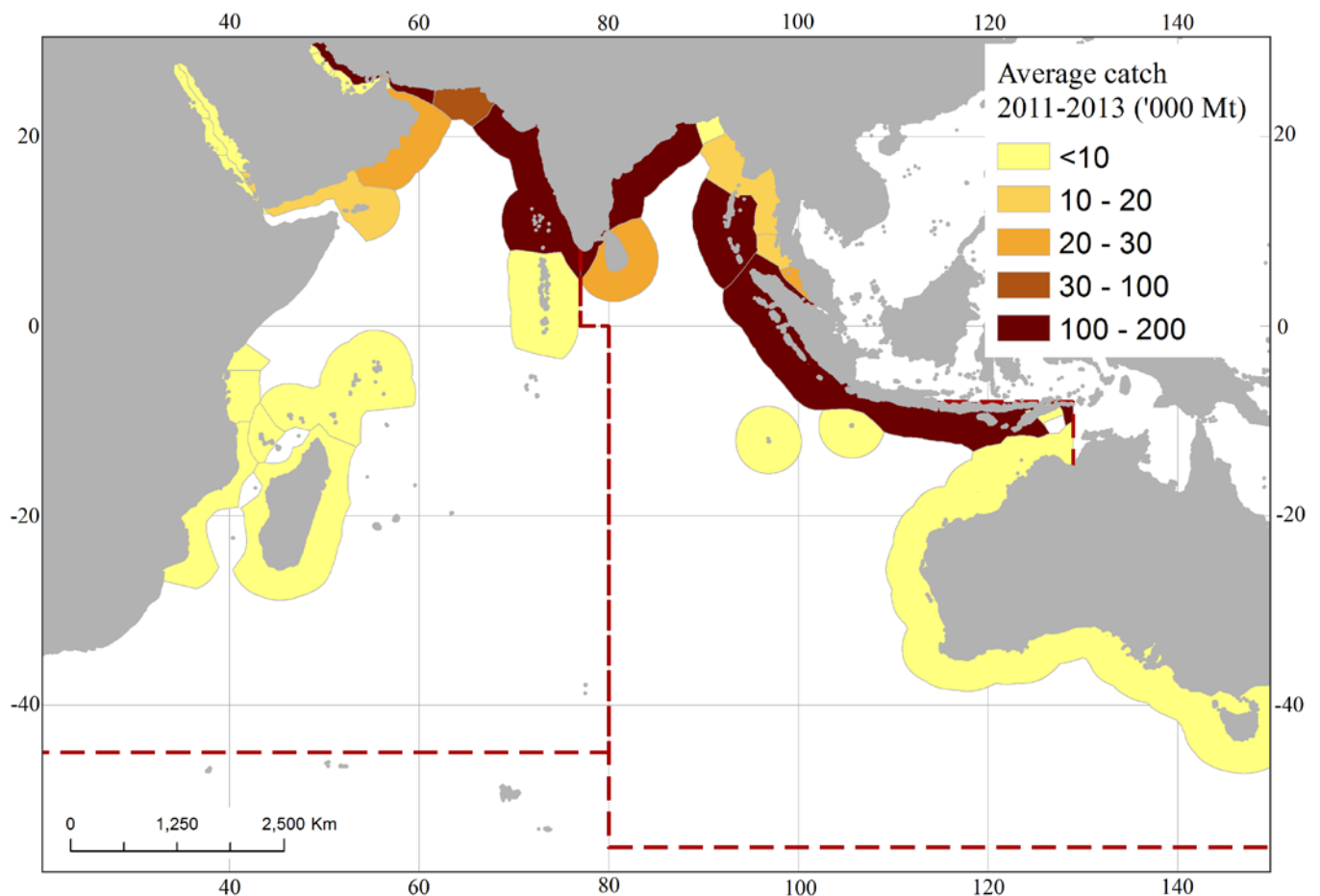
**Fig. 4.** Average catches of all neritic species in the Indian Ocean over the period 2011–13, by country EEZ.

The intensity of the shading of EEZs represents the importance of catches of all IOTC neritic species in each country. Boundaries separating the IOTC east and west Indian Ocean areas are denoted by the red dashed line. Definition of EEZ taken from the Flanders Marine Institute (http://www.vliz.be/vmdcdata/marbound/download.php).

**SECTION 2: SUMMARY OF DATA ISSUES RELATED TO THE STATISTICS OF NERITIC TUNAS REPORTED TO THE IOTC**

The following section provides a summary of the main issues that the IOTC Secretariat considers to negatively affect the quality of the statistics available at the IOTC, by type of dataset. A detailed list of issues, by dataset and fishery can be found in Appendix 1.

*Nominal (retained) catches*

Coastal fisheries
- The majority of catches of neritic species in the Indian Ocean are caught within the EEZ of coastal states, typically by small-scale or artisanal fisheries, which creates considerable challenges in terms of collecting reliable information from the diversity of vessels and fisheries operating in coastal waters.
- Difficulties in data collection are further compounded by species misidentification, particularly of juvenile tunas, that can lead dramatic changes in catches by species between years.
- In addition, a common problem through the region is the aggregation of neritic species under a common label. Small or juvenile neritic tunas are often also treated commercially as the same species – particularly in the case of frigate and bullet tuna – which are reported to the Secretariat as species aggregates or commercial categories then require disaggregation in order to produce estimates by species. Likewise, catches of Narrow-barred Spanish mackerel and Indo-Pacific King Mackerel are often combined and reported as species aggregates of seerfish.

Industrial fisheries
- In the case of industrial fisheries, catches of neritic tunas recorded by purse seiners are thought to be a fraction of those retained on board. Due to the species being a bycatch, catches are seldom recorded in the logbooks, nor can they be monitored in port.

*Hence total estimated catches for neritic species in the Indian Ocean are considered to be highly uncertain.*

*Catch-and-effort & derived CPUE*

- For most of the important fisheries catching neritic species in the Indian Ocean, catch-and-effort is either:
  - not available (e.g., coastal fisheries of Indonesia, India, Pakistan, Sri Lanka);
  - or partially reported, but of limited value in deriving indices of abundance (e.g., I.R. Iran – no units of effort reported).
- In addition, many of the CPUE series that are available for neritic species are:
  - available for only selected years or short time periods (e.g., less than 10 years);
  - or considered unreliable due to large fluctuations in the CPUE between years (e.g., Thailand & Malaysia coastal purse seiners during the mid/late 2000s; Sri Lanka gillnets, during the early-2000s).

*Size data*

- Size data is also highly incomplete for most neritic species, with data only available for selected years and/or fisheries.

- For most fisheries where samples have been collected, the number of specimens are also generally below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight – with the exception of samples from Sri Lankan gillnets collected in the 1980s through IPTP funding.

- Thailand has collected one of the longest time series of size data for neritic tunas (coastal purse seines) from the 1980s, but has only reported size data for 2005 and 2006 in recent years.

*Data issues: priorities for consideration of the WPNT*

1. Indonesia & India: account for over half of total catches of neritic species in the Indian Ocean in recent years, but also represent two of the most complex fleets due to the scale and diversity of the artisanal fisheries, number of landing sites, and types of vessels in operation. Both countries and have not reported catch-and-effort since the

late-1980s, and in the case of Indonesia, nominal catch estimates of neritic tunas are also considered highly uncertain.

2. <u>I.R. Iran</u>: accounts for second largest catches of neritic species in the Indian Ocean in recent years, but has only partially reported catch-and-effort according to IOTC Resolution 10/02 standards.

3. <u>Thailand and Malaysia</u>: in both cases the data collection systems are generally methodologically sound, and collect detailed information to potentially inform the indices of abundance by mode of fishing (e.g., FAD fishing, fishing with lights, etc.). However issues with the processing and quality assurance of data submitted to the Secretariat limit the value of the datasets available for use by the WPNT. Both countries have recently reported large – unexplained – fluctuations in the derived CPUE in recent years that require verification, while in the case of Malaysia estimates of the species composition for the historical time series are rudimentary using a simple fixed ratio that does not take into account changes in the fisheries.

4. <u>Thailand (size data)</u>: has collected of the longest time-series of size data available for neritic tunas (coastal purse seiners) (stored in electronic format from 2004 onwards; in paper copy from the 1980s). However size data have only been reported to the IOTC Secretariat for 2005 and 2006. No data for the historical time series has been received to date by the Secretariat, despite requests from the IOTC Secretariat and Scientific Committee.

**SECTION 3: STATUS OF FISHERIES STATISTICS FOR NERITIC TUNAS**

*Longtail tuna (LOT: Thunnus tonggol)*

*Fisheries and main catch trends*

- Main fisheries: longtail tuna are caught mainly using gillnets and, to a lesser extent, coastal purse seine nets and trolling (Table 2; Fig. 5).

- Main fleets (i.e., highest catches in recent years):
  Nearly half of catches of longtail in the Indian Ocean are accounted for by I.R. Iran (gillnet), followed by Indonesia (gillnet, trolling), Malaysia (coastal purse seine) and Pakistan (gillnet) (Fig.6).

- Retained catch trends:
  Estimates catches of longtail tuna have increased steadily from the mid-1950s, reaching around 15,000t in the mid-1970's, over 35,000t by the mid-1980's, and more than 96,000 t in 2000. Between 2000 and 2005, catches declined, but have since recovered and reached the highest levels recorded – over 170,000 t in 2011.

  Since 2009 I.R. Iran has reported large increases catches of longtail tuna in coastal waters in the Arabian Sea, as a result of the threat of piracy and displacement of fishing effort (and change of targeting) by gillnet vessels formerly operating in the North-West Indian Ocean.

- Discard levels: are thought to be very low, although estimates of discards are unknown for most fisheries.

*Changes to the catch series*: no major changes to the catch series of longtail tuna since WPNT in 2014.

*Longtail tuna: estimation of catches – data related issues*

**Retained catches** for longtail tuna were derived from incomplete information, and are therefore uncertain[4] (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 as aggregated for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. However, a recent review by the IOTC Secretariat conducted by an independent consultant in 2012 indicated that catches of longtail tuna had been severely overestimated by Indonesia. While the new catches estimated for the longtail tuna in Indonesia remain uncertain, the new figures are considered more reliable than those existing in the past.

- Artisanal fisheries of India and Oman: Although these countries report catches of longtail tuna, until recently the catches have not been reported by gear. The IOTC Secretariat used alternative information to assign the catches reported by Oman by gear. The catches of India were also reviewed by the independent consultant in 2012 and assigned by gear on the basis of official reports and information from various alternative sources.

- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches of longtail tuna to the IOTC Secretariat. While catch levels are unknown they are unlikely to be substantial.

- Other artisanal fisheries: The IOTC Secretariat had to estimate catches of longtail tuna for the artisanal fisheries of Yemen (no data reported to the IOTC Secretariat) and until recently Malaysia (with catches of the main neritic tunas aggregated and reported as longtail).

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

**T A B L E  2.** Longtail tuna: latest scientific estimates of the catches of longtail tuna by type of fishery for the period 1950–2013 (in metric tonnes).  Data as of May 2015.

| Fishery | By decade (average) | | | | | | By year (last ten years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| Purse seine | 41 | 204 | 1,012 | 4,862 | 10,933 | 17,719 | 13,313 | 12,388 | 16,128 | 23,838 | 18,885 | 20,649 | 16,531 | 19,771 | 21,114 | 19,739 |
| Gillnet | 2,985 | 6,229 | 10,026 | 25,839 | 41,648 | 63,485 | 51,413 | 52,092 | 59,802 | 68,398 | 69,708 | 87,159 | 105,094 | 121,801 | 114,402 | 113,080 |
| Line | 548 | 807 | 1,560 | 4,323 | 5,016 | 9,502 | 8,754 | 10,268 | 9,514 | 11,929 | 11,206 | 12,494 | 12,977 | 15,288 | 25,759 | 20,706 |
| Other | 0 | 0 | 125 | 1,090 | 1,992 | 3,732 | 2,912 | 3,751 | 3,638 | 5,686 | 5,460 | 5,300 | 6,513 | 8,467 | 9,073 | 5,787 |
| **Total** | **3,574** | **7,240** | **12,723** | **36,115** | **59,590** | **94,437** | **76,392** | **78,498** | **89,081** | **109,851** | **105,260** | **125,601** | **141,115** | **165,327** | **170,348** | **159,313** |

**Definition of fishery:** <u>Gillnet</u>: gillnet, including offshore gillnet; <u>Line</u>: coastal longline, hand line, troll line; <u>Purse seine</u>: coastal purse seine, purse seine, ring net; <u>Other gears</u>: baitboat, danish seine, liftnet, longline, longline fresh, trawling.
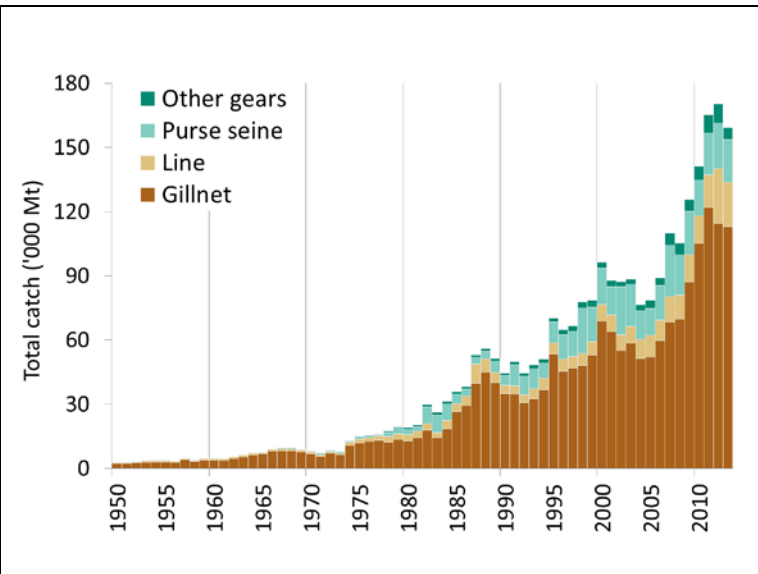


**Fig.5.** Longtail tuna: Annual catches by gear recorded in the IOTC Database (1950–2013).
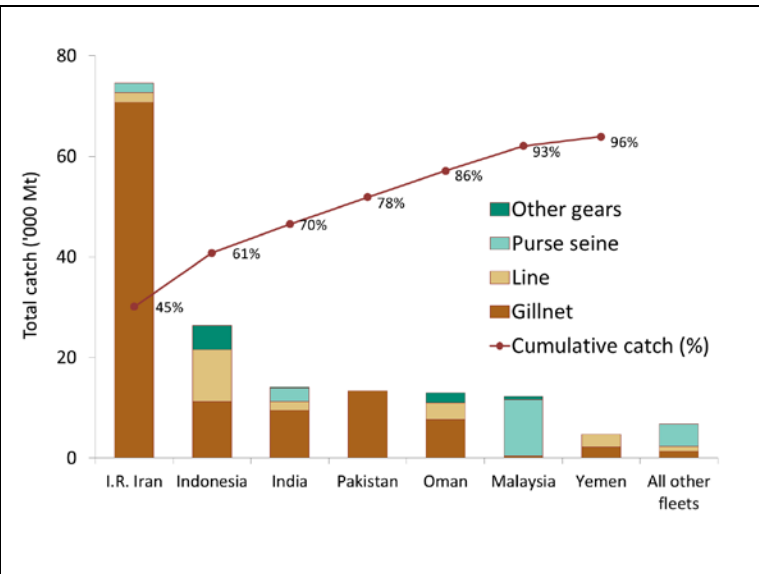
**Fig.6.** Longtail tuna: Average catches in the Indian Ocean over the period 2011–13, by country[5].
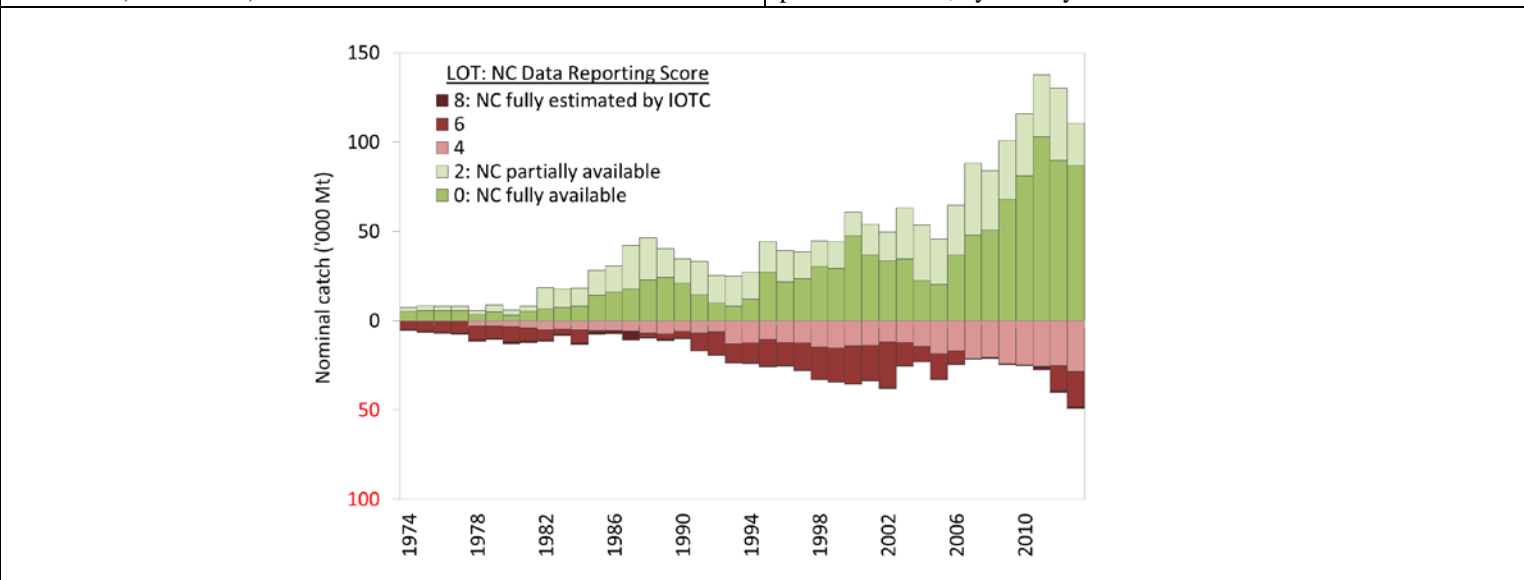


**Fig. 7.** Longtail tuna: nominal catch; uncertainty of annual catch estimates (1974–2013).

*Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat).  Data as of May 2015.*

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[5] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2011-2013. 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 for 2011-2013.

*Longtail tuna – Effort trends*

- Availability: Effort trends are unknown for longtail tuna in the Indian Ocean due to a lack of catch-and-effort data.

*Longtail tuna – Catch-per-unit-effort (CPUE) trends*

- Availability: highly incomplete, with data available for only short periods of time and selected fisheries (Fig.8).
- Main CPUE series available: Thailand coastal purse seine and gillnet vessels (i.e., available over 10 years) (Fig.9).

| Gear-Fleet | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 00 | 02 | 04 | 06 | 08 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PSS-Malaysia | | | | | | | | | | | | | | | ■ | | | | | | ■ | |
| **PSS-Thailand** | | | | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| PS-Iran, IR | | | | | | | | | | | | | | | ■ | | | | | | | |
| PS-Seychelles | | | | | | | | | | | | | | | | | ■ | | | | | |
| PS-NEI | | | | | | | | | | | | | | | | ■ | | | | | | |
| GILL-India | | | | | | ■ | | | | | | | | | | | | | | | | |
| GILL-Indonesia | | | | | | | | ■ | | | | | | | | | | | | | | |
| GILL-Iran, IR | | | | | | | | | | | ■ | | | | | | | | | | ■ | |
| GILL-Malaysia | | | | | | | | | | | | | | | ■ | | | | | | ■ | |
| GILL-Oman | | | | | | | | | | | | | | | ■ | | | | | | | |
| GILL-Pakistan | | | | | | | | | ■ | ■ | | | | | | | | | | | | |
| **GILL-Thailand** | ■ | | | | ■ | ■ | ■ | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **LINE-Australia** | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | |
| LINE-Indonesia | | | | | | | | ■ | | | | | | | | | | | | | | |
| LINE-Malaysia | | | | | | | ■ | ■ | | | | | | ■ | | | | | | | ■ | |
| LINE-Oman | | | | | | | | | | | | | | | | | | | | | ■ | |
| LINE-Yemen | | | | | | | | | | | | | | | | | ■ | ■ | ■ | | | |
| OTHR-Australia | | | | | | | | | | | | | | | | | | | | | ■ | |
| OTHR-Indonesia | | | | | | | | ■ | | | | | | | | | | | | | | |
| OTHR-Malaysia | | | | | | | | | | | | | | | ■ | | | | | | ■ | |
| OTHR-Oman | | | | | | | | | | | | | | | | | | | | | ■ | |

**Fig. 8.** Longtail tuna: Availability of catches and effort series, by fishery and year (1970–2013)[6]. No catch-and-effort is available for 1950–1971.
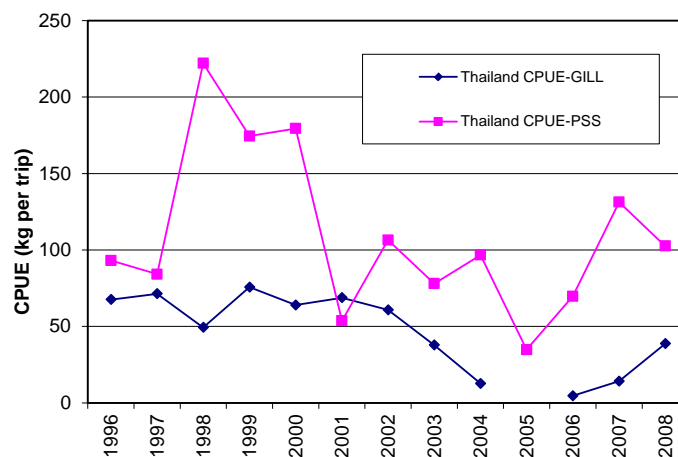


**Fig. 9.** Longtail tuna: Nominal CPUE series for gillnet (GILL) and coastal purse seine (PSS) fisheries of Thailand derived from available catch-and-effort data (1996–2013).

*Longtail tuna – Fish size or age trends (e.g., by length, weight, sex and/or maturity)*

- Sizes: longtail tunas taken by Indian Ocean fisheries typically range between 20 – 100 cm depending on the type of gear used, season and location (Fig.10). Fisheries operating in the Andaman Sea (coastal purse seines and

[6] 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.

trolling) tend to catch smaller sized longtail tuna (e.g., 20–45cm), while gillnet fisheries of I.R. Iran and Pakistan (Arabian Sea) catch larger specimens (e.g., 50–100cm).

- Size frequency data: highly incomplete, with data available only for selected fisheries.

  Main sources for size samples: I.R. Iran (gillnet) and Oman (gillnet).

  Length distributions derived from data available for gillnet fisheries are shown in Fig.11. Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.

- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.

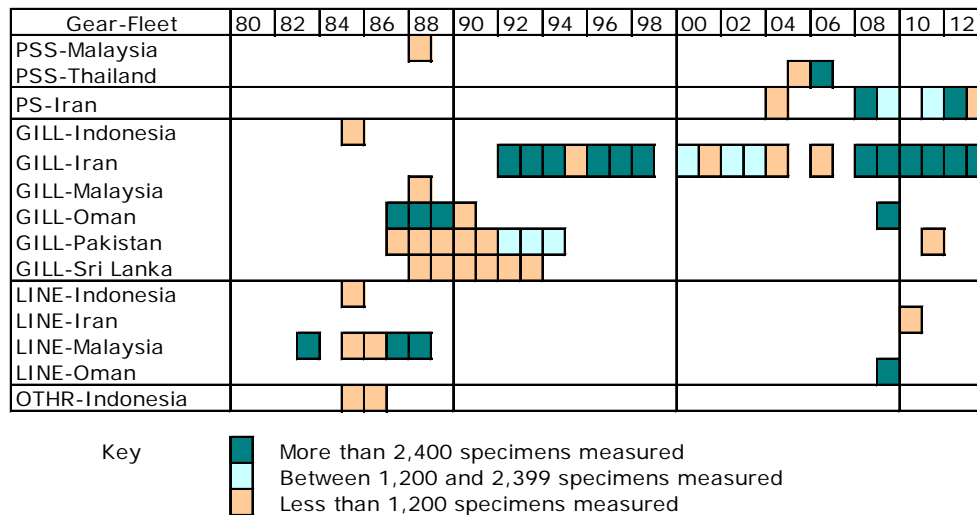- Sex ratio data: have not been provided to the Secretariat by CPCs.



**Fig. 10.** Longtail tuna: Availability of length frequency data, by fishery and year (1980–2013)[7]. Note that no length frequency data are available at all for 1950–1982.

**Other biological data**: 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 |

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[7] 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. 11a-b.  Left:** Longtail tuna (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat.

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

*Frigate tuna (FRI: Auxis thazard)*

*Fisheries and main catch trends*

- Main fisheries: mainly caught using gillnets, coastal longline and trolling, handlines and trolling, and to a lesser extent coastal purse seine nets (Table 3; Fig. 12). The species is also an important bycatch for industrial purse seine vessels and is the target of some ring net fisheries (recorded as purse seine in Table 3).

- Main fleets (i.e., highest catches in recent years):

   Catches of frigate tuna are highly concentrated: Indonesia accounts for around two-thirds of catches, while 90% of catches are accounted for by four countries (Indonesia, India, Sri Lanka and I.R. Iran) (Fig.13).

- Retained catch trends:
   Estimated catches have increased steadily since the late-1970's, reaching around 30,000 t in the late-1980's, to between 55,000 and 60,000 t by the mid-1990's, and remaining at the same level in the following ten years. Since 2006 catches have increased, rising to the highest levels recorded at nearly 100,000 t in 2010 and 2011, with current catches at around 83,000 t.

- 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***:** no major changes to the catch series of frigate tuna since WPNT in 2014.

*Frigate tuna: estimation of catches – data related issues*

**Retained catches** for frigate tuna were derived from incomplete information, and are therefore uncertain[8] (Fig.14), notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of frigate tuna by species or by gear for 1950–2004; catches of frigate tuna, bullet tuna and other species were reported aggregated for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. However, in a recent review by the IOTC Secretariat conducted by an independent consultant in 2012 he indicated that the catches of frigate tuna had been underestimated by Indonesia. While the new catches estimated for the frigate tuna in Indonesia remain uncertain, the new figures are considered more reliable than those existing in the past.

- Artisanal fisheries of India and Sri Lanka: Although these countries report catches of frigate tuna until recently the catches have not been reported by gear. The catches of both countries were also reviewed by an independent consultant in 2012 and assigned by gear on the basis of official reports and information from various other alternative sources. The new catch series was previously presented to the WPNT in 2013, in which the new catches estimated for Sri Lanka are as much as three times higher than previous estimates.

- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches of frigate tuna to the IOTC Secretariat. Catch levels are unknown.

- Other artisanal fisheries: The catches of frigate tuna and bullet tuna are seldom reported by species and, when they are reported by species, usually refer to both species (due to misidentification, with all catches assigned to the frigate tuna).

- Industrial fisheries: The catches of frigate tuna recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, 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.

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[8] 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.

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

| Fishery | By decade (average) | | | | | | By year (last ten years) | | | | | | | | | |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| Purse seine | - | 15 | 824 | 4,664 | 7,550 | 10,021 | 10,341 | 11,384 | 11,320 | 10,337 | 9,501 | 9,663 | 12,044 | 10,935 | 10,328 | 10,566 |
| Gillnet | 483 | 1,238 | 2,837 | 6,948 | 14,519 | 20,189 | 19,484 | 21,189 | 22,181 | 23,322 | 24,082 | 23,750 | 30,908 | 30,410 | 30,382 | 29,834 |
| Line | 1,266 | 2,409 | 4,419 | 7,432 | 13,753 | 27,151 | 25,640 | 29,987 | 27,813 | 31,820 | 30,806 | 34,923 | 38,209 | 37,688 | 36,579 | 39,400 |
| Other | 1,441 | 2,007 | 2,349 | 3,683 | 9,276 | 13,670 | 12,229 | 15,253 | 12,715 | 15,382 | 15,193 | 18,112 | 18,550 | 18,934 | 17,649 | 18,766 |
| **Total** | **3,191** | **5,670** | **10,428** | **22,728** | **45,098** | **71,031** | **67,693** | **77,812** | **74,030** | **80,862** | **79,582** | **86,448** | **99,710** | **97,966** | **94,938** | **98,565** |

**Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, danish seine, liftnet, longline, longline fresh, trawling.
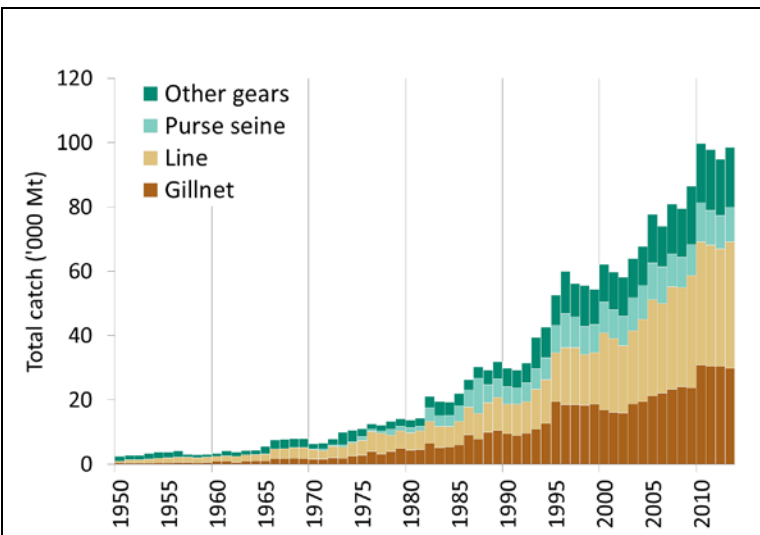


**Fig.12.** Frigate tuna: Annual catches by gear recorded in the IOTC Database (1950–2013).
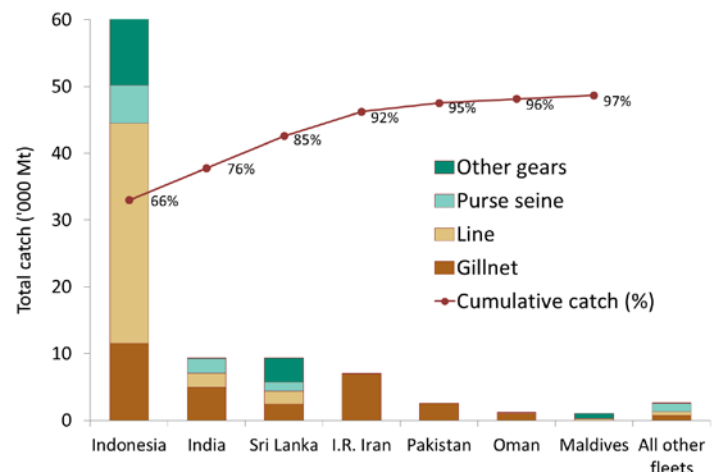


**Fig.13.** Frigate tuna: Average catches in the Indian Ocean over the period 2011–13, by country[9].
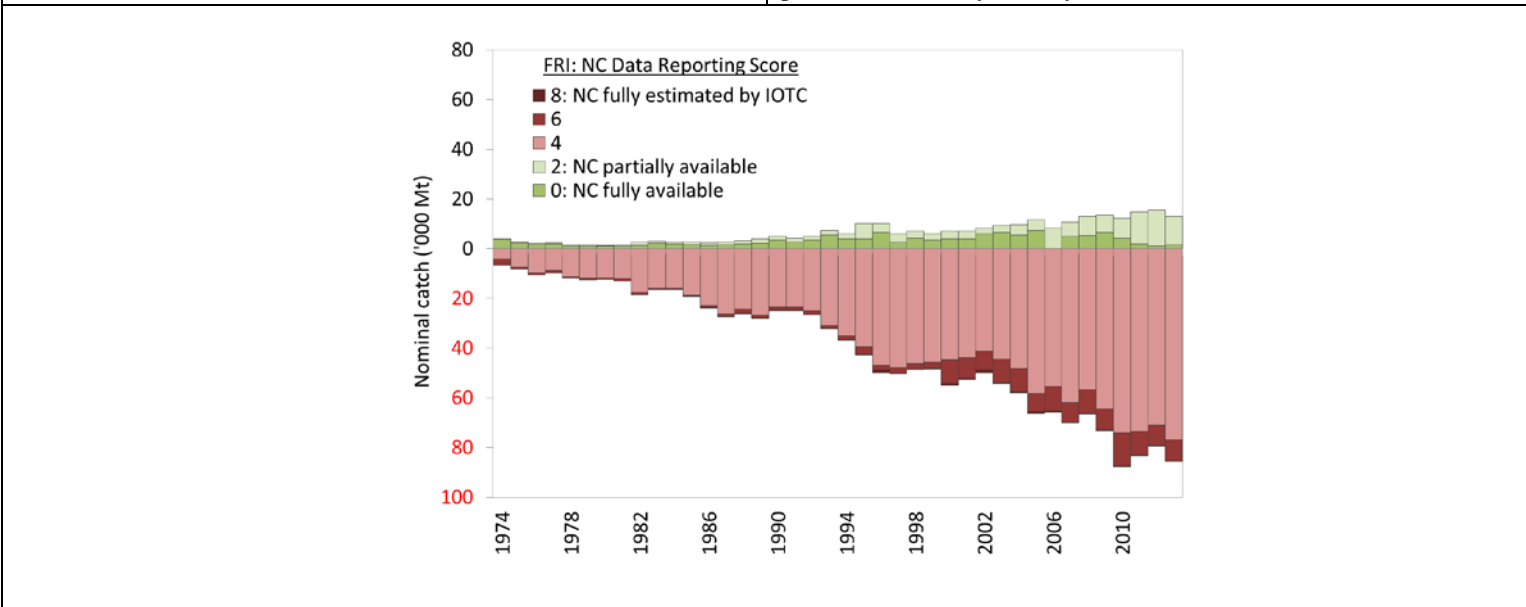


**Fig. 14.** Frigate tuna: nominal catch; uncertainty of annual catch estimates (1974–2013).

*Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2015.*

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[9] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2011-2013. 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 for 2011-2013.

*Frigate tuna – Effort trends*

- Availability: Effort trends are unknown for frigate tuna in the Indian Ocean, due to a lack of catch-and-effort data.

*Frigate tuna – Catch-per-unit-effort (CPUE) trends*

- Availability: highly incomplete, although data are available for short periods of time (i.e., more than 10 years) for selected fisheries (Fig.15).
- Main CPUE series available: Sri Lanka (gillnets), and Maldives (pole and line, hand and troll lines) (Fig.16). However the quality of catch-and-effort recorded for Sri Lankan gillnets are thought to be low due to dramatic changes in the CPUE between consecutive years.

| Gear-Fleet | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 00 | 02 | 04 | 06 | 08 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PSS-Indonesia | | | | | | | | ▉ | ▉ | | | | | | | | | | | | | |
| PSS-Malaysia | | | | | | | | | | | | | | | | | | | | | ▉ | |
| **BB-Maldives** | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ |
| GILL-India | | | | | | ▉ | | | | | | | | | | | | | | | | |
| GILL-Indonesia | | | | | | | ▉ | ▉ | | | | | | | | | | | | | | |
| GILL-Iran, IR | | | | | | | | | | | | ▉ | | | | | | | | | | |
| GILL-Oman | | | | | | | | | | | | | | | | ▉ | | | | | ▉ | ▉ |
| GILL-Pakistan | | | | | | | | | ▉ | ▉ | | | | | | | | | | | | |
| **GILL-Sri Lanka** | | | | | | | | ▉ | ▉ | | | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | | | | | |
| LINE-India | | | | | ▉ | | | | | | | | | | | | | | | | | |
| LINE-Indonesia | | | | | | | | ▉ | | | | | | | | | | | | | | |
| **LINE-Maldives** | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | | | | ▉ | ▉ | ▉ | ▉ | ▉ |
| LINE-Oman | | | | | | | | | | | | | | | | | | | | | | |
| LINE-Sri Lanka | | | | | | | | ▉ | | | | | | | | | | | | | | |
| LINE-Yemen | | | | | | | | | | | | | | | | | | ▉ | ▉ | | | |
| OTHR-Indonesia | | | | | | | ▉ | ▉ | | | | | | | | | | | | | | |
| OTHR-Sri Lanka | | | | | | | | | | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | | | | | |
| OTHR-Maldives | | | | | | | | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | ▉ | | | | |
| OTHR-Malaysia | | | | | | | | | | | | | | | | | | | | | ▉ | |
| OTHR-Oman | | | | | | | | | | | | | | | | | | | | | ▉ | ▉ |

**Fig. 15:** Frigate tuna: Availability of catches and effort series, by selected fishery and year (1970–2013)[10]. Note that no catch-and-effort data are available for 1950–69.
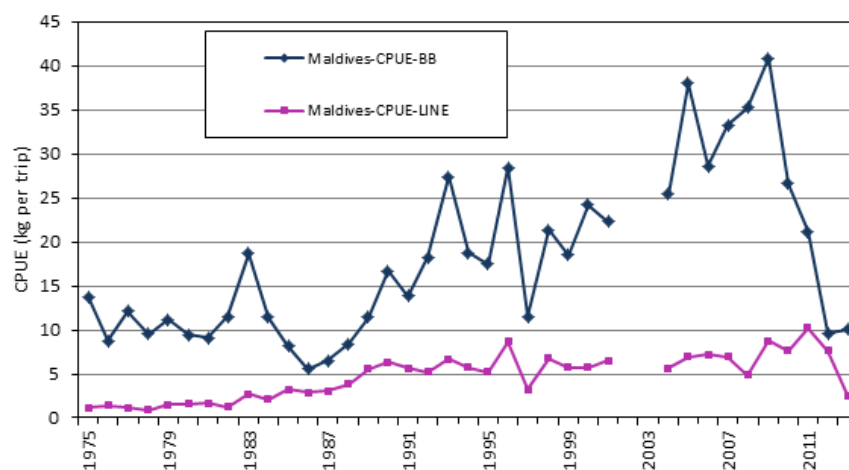


**Fig. 16.** *Frigate tuna: Nominal CPUE series for the baitboat (BB using mechanized boats) and line (LINE, including handlines and trolling using mechanized boats) fisheries of Maldives derived from the available catches and effort data (1975–2013).*

*Frigate tunas – Fish size or age trends (e.g., by length, weight, sex and/or maturity)*

- Sizes: the sizes of frigate tunas taken by Indian Ocean fisheries typically range between 20 – 50 cm depending on the type of gear used, season and location. Fisheries operating in the Andaman Sea (coastal purse seines and troll

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[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

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).

- <u>Size frequency data</u>: highly incomplete, with data only available for selected years and/or fisheries (Fig.17).

  <u>Main sources for size samples</u>: Sri Lanka (gillnet), and Maldives (pole-and-line).

  Length distributions derived from data available for gillnet fisheries are shown in Fig.18. Generally speaking total numbers of samples are below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight – with the exception of samples recorded for Sri Lanka gillnets during the mid-1980s to early-1990 which were obtained with the support of IPTP funding.

- <u>Catch-at-Size (Age) table</u>: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.

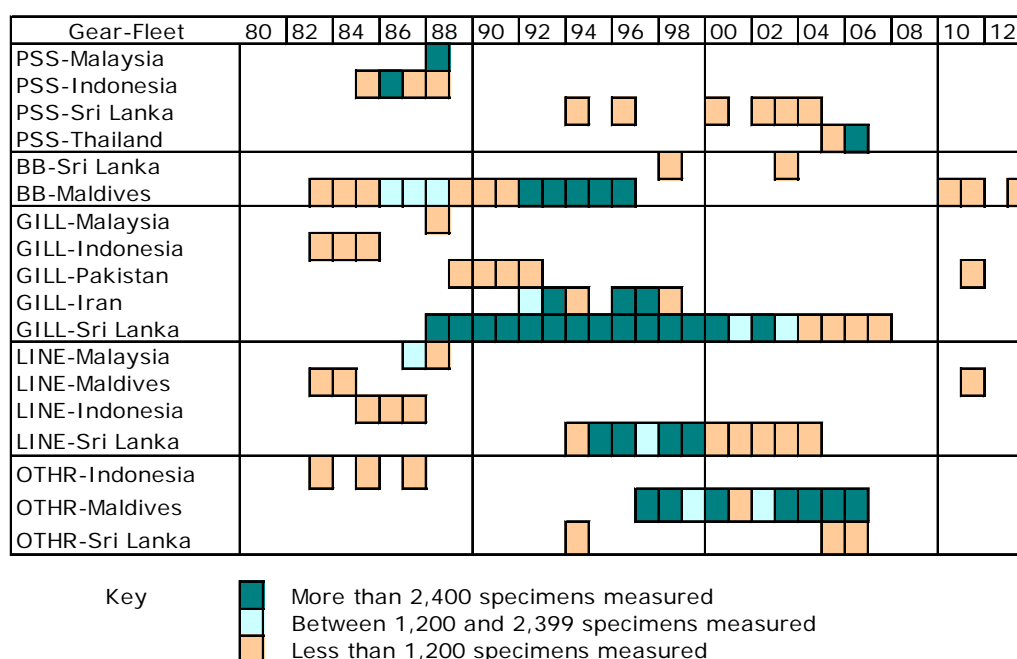- <u>Sex ratio data</u>: have not been provided to the Secretariat by CPCs.



**Fig. 17.** Frigate tuna: Availability of length frequency data, by fishery and year (1980–2013)[11]. Note that no length frequency data are available at all for 1950–82.

**Other biological data**: 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 |

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[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
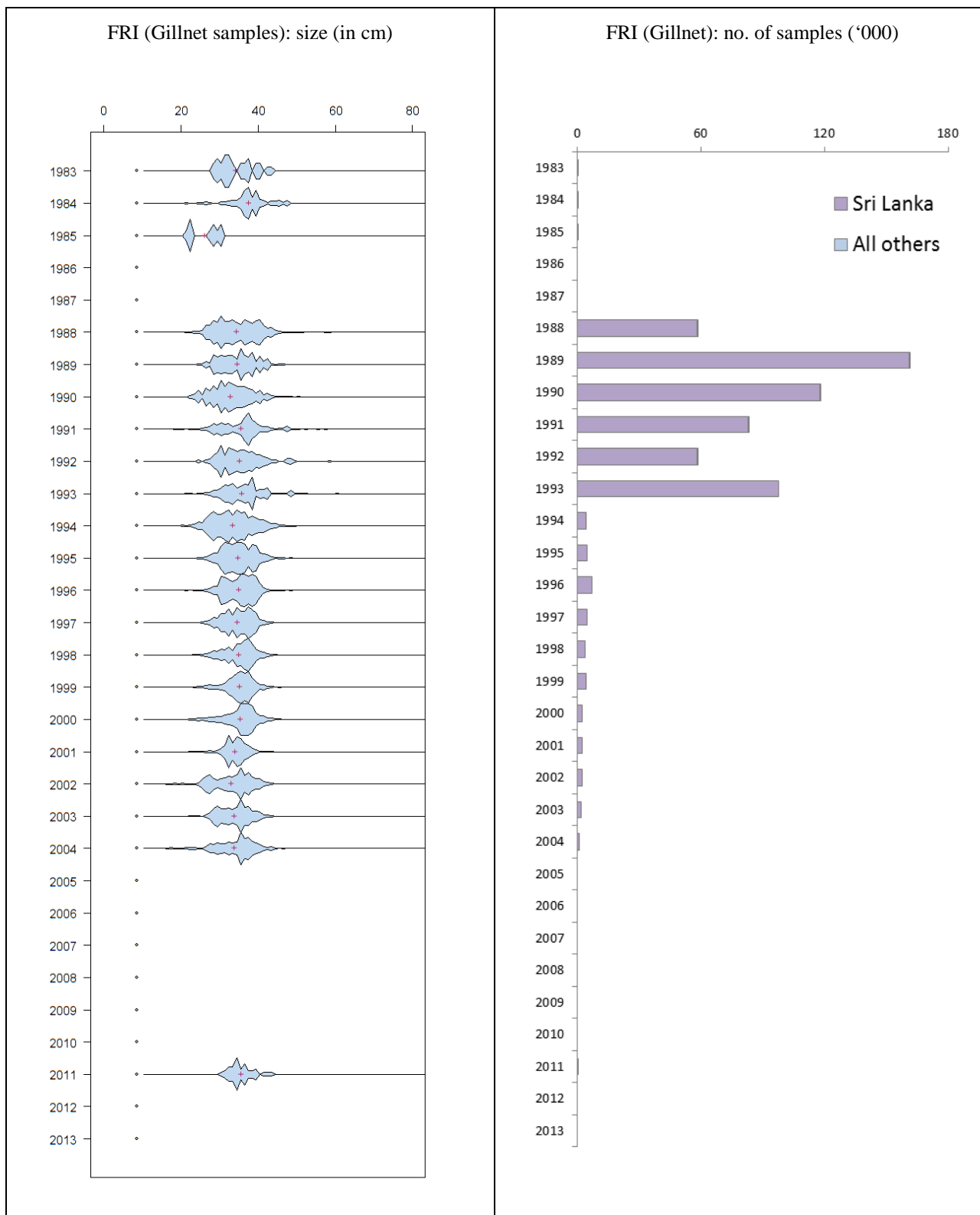
**Fig. 18a-b.  Left:** Frigate tuna (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat.

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

## Bullet tuna (BLT: *Auxis rochei*)

### Fisheries and main catch trends

- Main fisheries: bullet tuna is mainly caught using gillnets, handlines and trolling, across the broader Indian Ocean area. This species is also an important catch for coastal purse seiners (Table 4; Fig.19).

- Main fleets (i.e., in terms of highest catches in recent years):
  Catches are highly concentrated: in recent years over 90% of catches in the Indian Ocean have been accounted for by fisheries in Sri Lanka, Indonesia and India (Fig.20).

- Retained catch trends

  Estimated catches of bullet tuna reached around 2,000 t in the early 1990's, increasing markedly in the following years to reach a peak in 1997, at around 4,900 t. The catches decreased slightly in the following years and remained at values of between 3,700 t and 4,000 t until the late-2000's, increasing sharply again up to the 10,000 t recorded in 2010, the highest catch ever recorded for this species in the Indian Ocean.

- 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*: No major changes to the catch series of bullet tuna since the WPNT meeting in 2014.

### Bullet tuna – estimation of catches: data related issues

**Retained catches** for bullet tuna were derived from incomplete information, and are therefore uncertain[12] (Fig.21), due to:

- Aggregation: Bullet tunas are usually not reported by species, but are instead aggregated with frigate tunas or, less frequently, other small tuna species.

- Mislabelling: Bullet tunas are usually mislabelled as frigate tuna, with their catches reported under the latter species.

- Underreporting: the catches of bullet tuna by industrial purse seiners are rarely, if ever, reported.

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

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[12] 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.

**TABLE 4.** Bullet tuna: scientific estimates of catches of bullet tuna by type of fishery for the period 1950–2013 (in metric tonnes).

| Fishery | By decade (average) | | | | | | By year (last ten years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| Purse seine | - | - | 28 | 278 | 552 | 655 | 603 | 625 | 650 | 581 | 908 | 1,055 | 1,372 | 635 | 549 | 513 |
| Gillnet | 41 | 153 | 296 | 531 | 1,222 | 1,741 | 1,699 | 1,631 | 1,872 | 1,692 | 2,236 | 2,587 | 3,347 | 2,692 | 2,830 | 2,759 |
| Line | 113 | 193 | 325 | 393 | 780 | 1,190 | 1,004 | 1,052 | 1,165 | 1,141 | 1,858 | 2,182 | 2,903 | 1,162 | 1,078 | 1,056 |
| Other | 5 | 13 | 44 | 242 | 755 | 1,322 | 1,239 | 1,188 | 1,465 | 1,908 | 1,638 | 2,022 | 2,748 | 3,905 | 4,503 | 4,597 |
| **Total** | **159** | **360** | **693** | **1,444** | **3,309** | **4,907** | **4,545** | **4,496** | **5,152** | **5,323** | **6,640** | **7,847** | **10,370** | **8,394** | **8,960** | **8,925** |

**Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, danish seine, liftnet, longline, longline fresh, trawling.
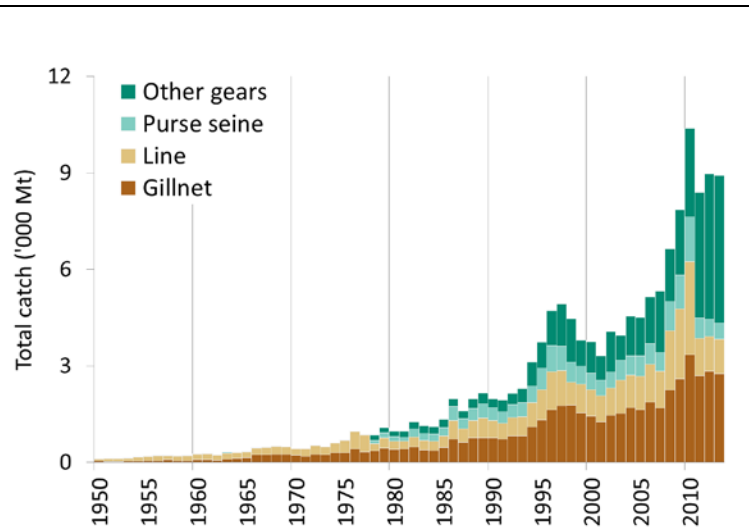


**Fig.19.** Bullet tuna: Annual catches by gear recorded in the IOTC Database (1950–2013).
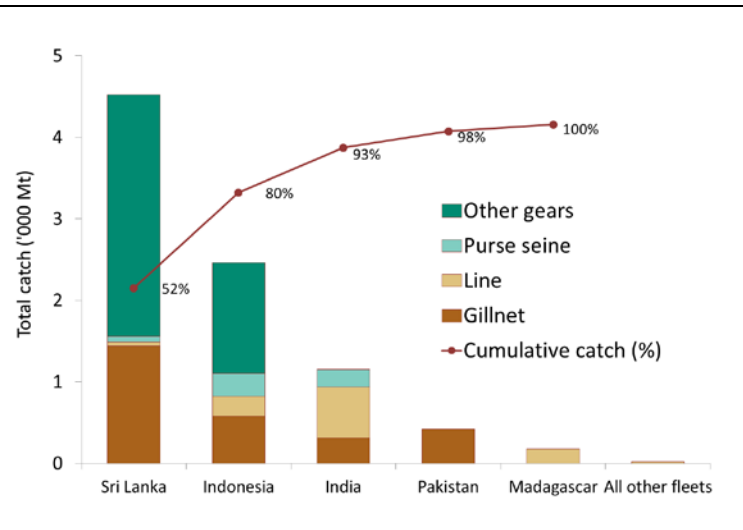


**Fig.20.** Bullet tuna: Average catches in the Indian Ocean over the period 2011–13, by country[13].
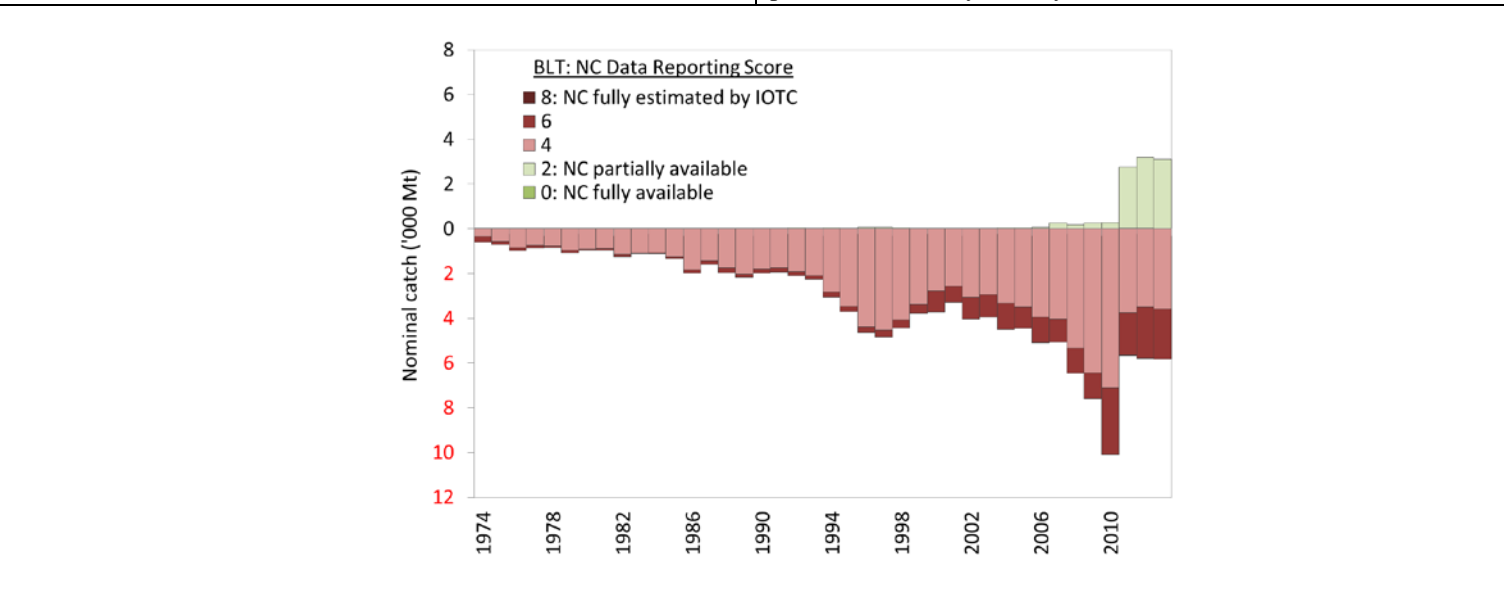


**Fig. 21.** Bullet tuna: nominal catch; uncertainty of annual catch estimates (1974–2013).

*Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2015.*

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[13] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2011-2013. 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 for 2011-2013.

*Bullet tuna – Effort trends*

- Availability: Effort trends are unknown for bullet tuna in the Indian Ocean, due to a lack of catch-and-effort data.

*Bullet tuna – Catch-per-unit-effort (CPUE) trends*

- Availability: highly incomplete, and, when available, are considered to be of poor quality for the fisheries having reasonably long catch-and-effort data series – as is the case with the gillnet fisheries of Sri Lanka (Fig. 22).
- Main CPUE series available: Sri Lanka (gillnets) (Fig.23).

| Gear-Fleet | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 00 | 02 | 04 | 06 | 08 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PSS-Indonesia | | | | | | | | | ■ | | | | | | | | | | | | | |
| GILL-India | | | | | ■ | | | | | | | | | | | | | | | | | |
| GILL-Indonesia | | | | | | | | ■ | ■ | | | | | | | | | | | | | |
| GILL-Sri Lanka | | | | | | | | | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| LINE-India | | | | | ■ | | | | | | | | | | | | | | | | | |
| LINE-Indonesia | | | | | | | | ■ | | | | | | | | | | | | | | |
| LINE-Sri Lanka | | | | | | | | | ■ | | | | | | | | | | | | | |
| LINE-Yemen | | | | | | | | | | | | | | | | | ■ | ■ | ■ | | | |
| OTHR-Indonesia | | | | | | | | ■ | ■ | | | | | | | | | | | | | |
| OTHR-Sri Lanka | | | | | | | | | | | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | | | | |

**Fig. 22**. Bullet tuna: Availability of catches and effort series, by fishery and year (1970–2013)[14]. Note that no catches and effort are available at all for 1950–78.
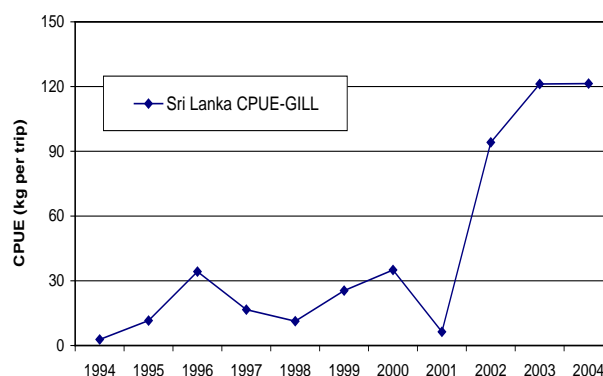


**Fig. 23.** Bullet tuna: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004).

*Bullet tunas – Fish size or age trends (e.g., by length, weight, sex and/or maturity)*

- Sizes: Fisheries catching bullet tuna in the Indian Ocean tend to catch specimens ranging between 15 and 35 cm.
- Size frequency data: highly incomplete, with data only available for selected years and/or fisheries (Fig.24).

  Main sources for size samples: Sri Lanka (gillnet and trolling).

  Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.

- Catch-at-Size(Age) table: Not available due to lack of size samples and uncertainty over the reliability of retained catch estimates.
- Sex ratio data: have not been provided to the Secretariat by CPCs.

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[14] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods
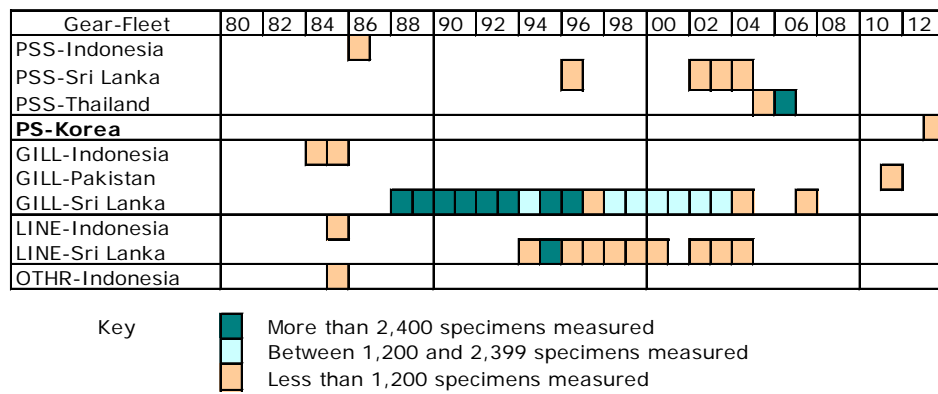
| Gear-Fleet | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 00 | 02 | 04 | 06 | 08 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Fig. 24.** Bullet tuna: Availability of length frequency data, by fishery and year (1980–2013)[15]. Note that no length frequency data are available at all for 1950–83.

**Other biological data**: 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 |

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

## Kawakawa (KAW: Euthynnus affinis)

### Fisheries and main catch trends

- Main fisheries: Kawakawa are caught mainly by coastal purse seines, gillnets, handlines and trolling (Table 6 and Fig. 30), and may be also an important bycatch of the industrial purse seiners (Table 5; Fig.25).

- Main fleets (i.e., highest catches in recent years): Indonesia, India, I.R. Iran, and Pakistan (Fig.26).

- Retained catch trends:
  Annual estimates of catches for the kawakawa increased markedly from around 20,000 t in the mid-1970's to reach the 45,000 t mark in the mid-1980's and 156,000 t in 2012, the highest catches ever recorded for this species.

- 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***:** No major revisions to the catch series since the WPNT meeting in 2014 (Fig. 43).

### Kawakawa tuna – estimation of catches: data related issues

**Retained catches** for kawakawa were derived from incomplete information, and are therefore uncertain[16] (Fig.27), notably for the following fisheries:
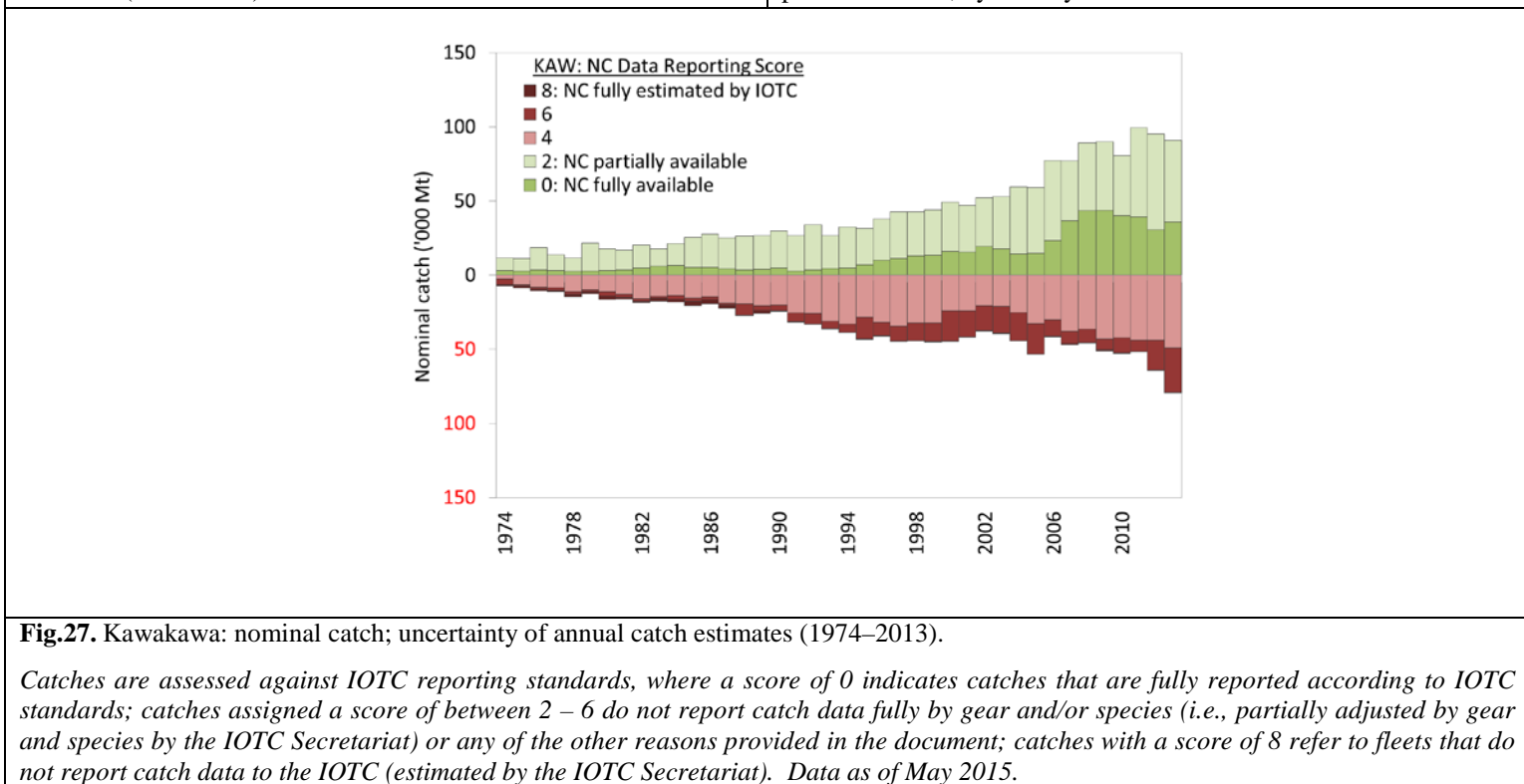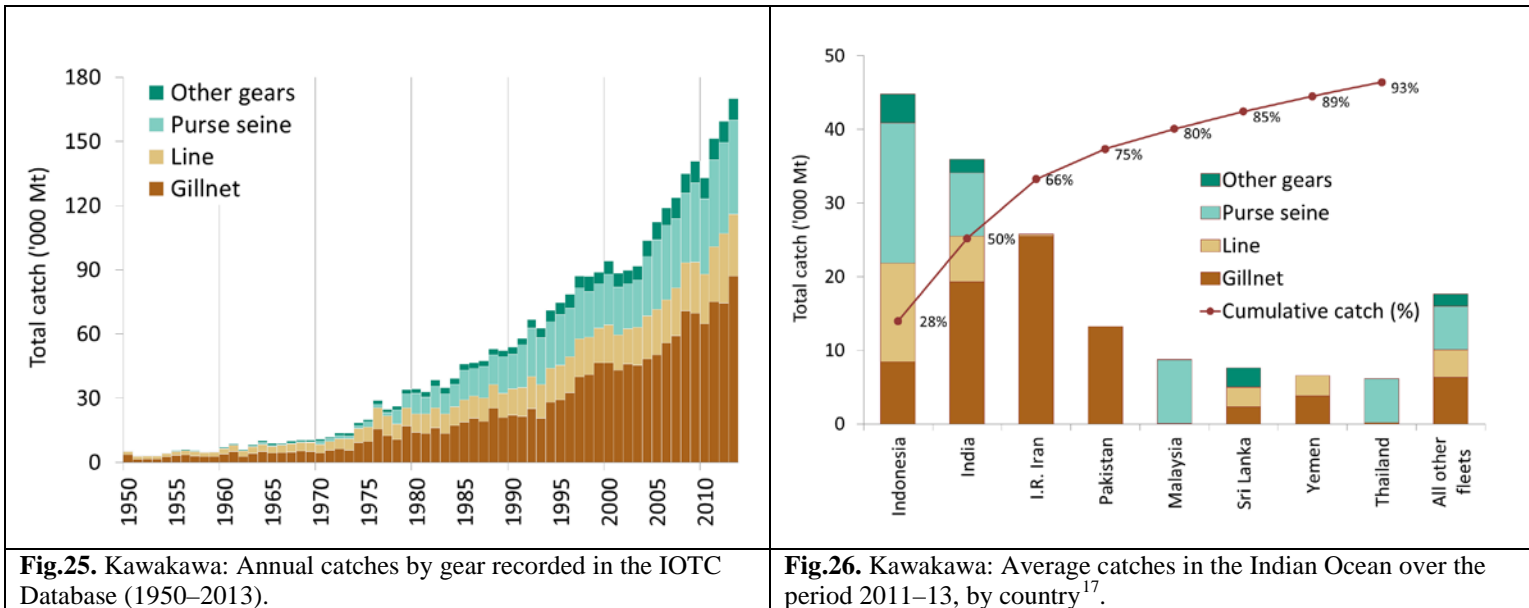
- Artisanal fisheries of Indonesia: Indonesia did not report catches of kawakawa by species or by gear for 1950–2004; catches of kawakawa, longtail tuna and, to a lesser extent, other species were reported aggregated for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. However, a review by the IOTC Secretariat conducted by an independent consultant in 2012 indicated that the catches of kawakawa had been overestimated by Indonesia. While the new catches estimated for kawakawa in Indonesia remain uncertain, the new figures are considered more reliable than those previously recorded in the IOTC database.

- Artisanal fisheries of India: Although India reports catches of kawakawa they are not always reported by gear. The catches of kawakawa in India were also reviewed by the IOTC Secretariat in 2012 and assigned by gear on the basis of official reports and information from various other alternative sources.

- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches to the IOTC Secretariat. Catch levels are unknown.

- Other artisanal fisheries: The catches of kawakawa are usually not reported by species, being combined with catches of other small tuna species like skipjack tuna and frigate tuna (e.g., coastal purse seiners of Thailand, and until recently Malaysia).

- Industrial fisheries: The catches of kawakawa recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, its catches are seldom recorded in the logbooks, nor are they monitored in port. The EU recently reported catch levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.

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[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.

**TABLE 5.** Kawakawa: Best scientific estimates of the catches of kawakawa by type of fishery for the period 1950–2012 (in metric tonnes). Data as of May 2015.

| Fishery | By decade (average) | | | | | | By year (last ten years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| Purse seine | 100 | 385 | 2,616 | 12,070 | 21,396 | 28,613 | 27,812 | 32,393 | 34,785 | 32,586 | 32,441 | 37,051 | 35,064 | 40,582 | 42,492 | 43,984 |
| Gillnet | 2,575 | 4,485 | 9,691 | 17,958 | 30,709 | 53,547 | 48,413 | 50,443 | 55,651 | 59,138 | 70,971 | 69,772 | 64,713 | 75,074 | 74,523 | 87,165 |
| Line | 1,715 | 3,264 | 6,642 | 9,867 | 15,673 | 19,874 | 19,952 | 21,154 | 20,409 | 22,299 | 22,524 | 23,804 | 23,356 | 25,707 | 32,443 | 28,774 |
| Other | 295 | 719 | 1,357 | 2,690 | 5,127 | 7,819 | 7,511 | 8,383 | 8,027 | 9,629 | 9,015 | 10,129 | 9,994 | 10,007 | 9,974 | 10,257 |
| **Total** | **4,685** | **8,853** | **20,306** | **42,585** | **72,905** | **109,853** | **103,687** | **112,374** | **118,871** | **123,652** | **134,952** | **140,756** | **133,127** | **151,370** | **159,433** | **170,181** |

**Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, danish seine, liftnet, longline, longline fresh, trawling.



**Fig.25.** Kawakawa: Annual catches by gear recorded in the IOTC Database (1950–2013).



**Fig.26.** Kawakawa: Average catches in the Indian Ocean over the period 2011–13, by country[17].



**Fig.27.** Kawakawa: nominal catch; uncertainty of annual catch estimates (1974–2013).

*Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2015.*

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[17] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2011-2013. 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 for 2011-2013.

*Kawakawa tuna – Effort trends*

- <u>Availability</u>: Effort trends are unknown for longtail tuna in the Indian Ocean.

*Kawakawa tuna – Catch-per-unit-effort (CPUE) trends*

- <u>Availability</u>: highly incomplete, with data available for only short periods of time and selected fisheries (Fig.28).
- <u>Main CPUE series available</u>: Maldives (baitboats and troll lines) (Fig.29), and Sri Lanka (gillnets).  However the catch-and-effort data recorded for Sri Lankan gillnets are thought to be unreliable, due to the dramatic changes in CPUE recorded between consecutive years.



**Fig. 28.** Kawakawa: Availability of catches and effort series, by fishery and year (1970-2013)[18]. Note that no catches and effort are available at all for 1950–69.

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[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
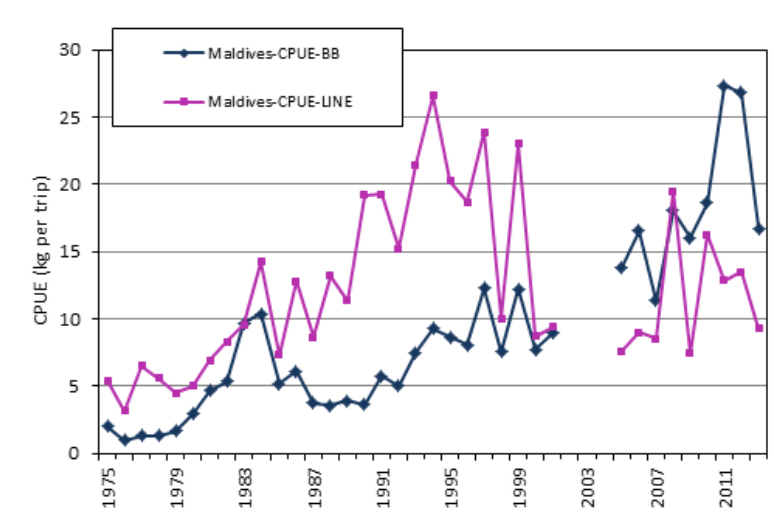
**Fig. 29.** Kawakawa: Nominal CPUE series for baitboat (BB) and troll line (TROL) fisheries of Maldives (1975–2013) derived from the available catch-and-effort data.

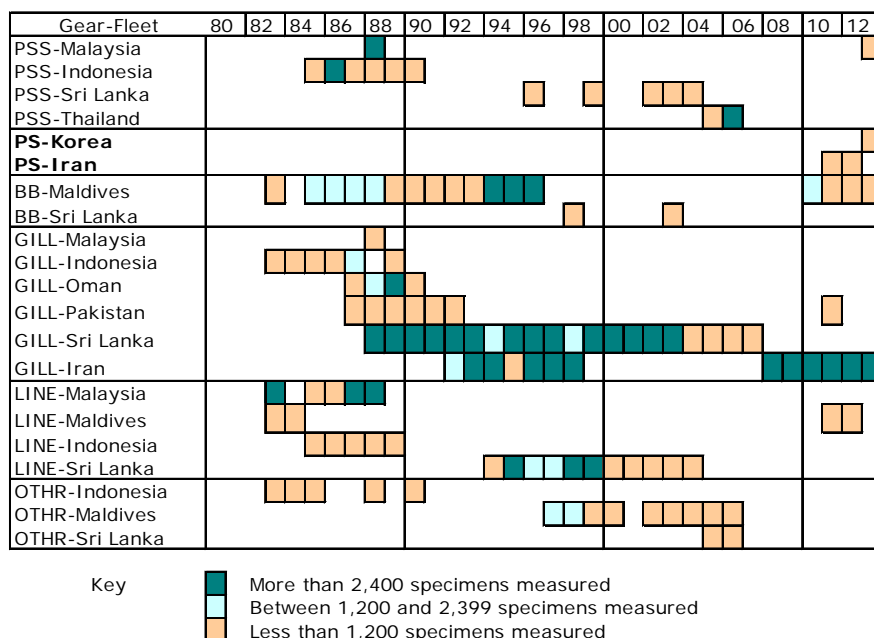*Kawakawa tuna – Fish size or age trends (e.g., by length, weight, sex and/or maturity)*

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

- Size frequency data: overall highly incomplete, with data only available for selected years and/or fisheries (Fig.30).

  Main sources for size samples: Sri Lanka (gillnet), and I.R. Iran (gillnets).

  Trends in average weight can be assessed for Sri Lankan gillnets from the mid-1980s to early-1990s, but the amount of specimens measured has been very low in recent years (Fig. 37). Since 1998 there has also been some sampling of lengths from Iranian gillnets – although average lengths are significantly larger than specimens reported by other fleets which reflect differences in the selectivity of offshore gillnets operating in the Arabian Sea, rather than an actual change in average sizes in the underlying population.

  Length distributions derived from the data available for gillnet fisheries are shown in Fig.31. No data are available in sufficient numbers for all other fisheries.

- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.

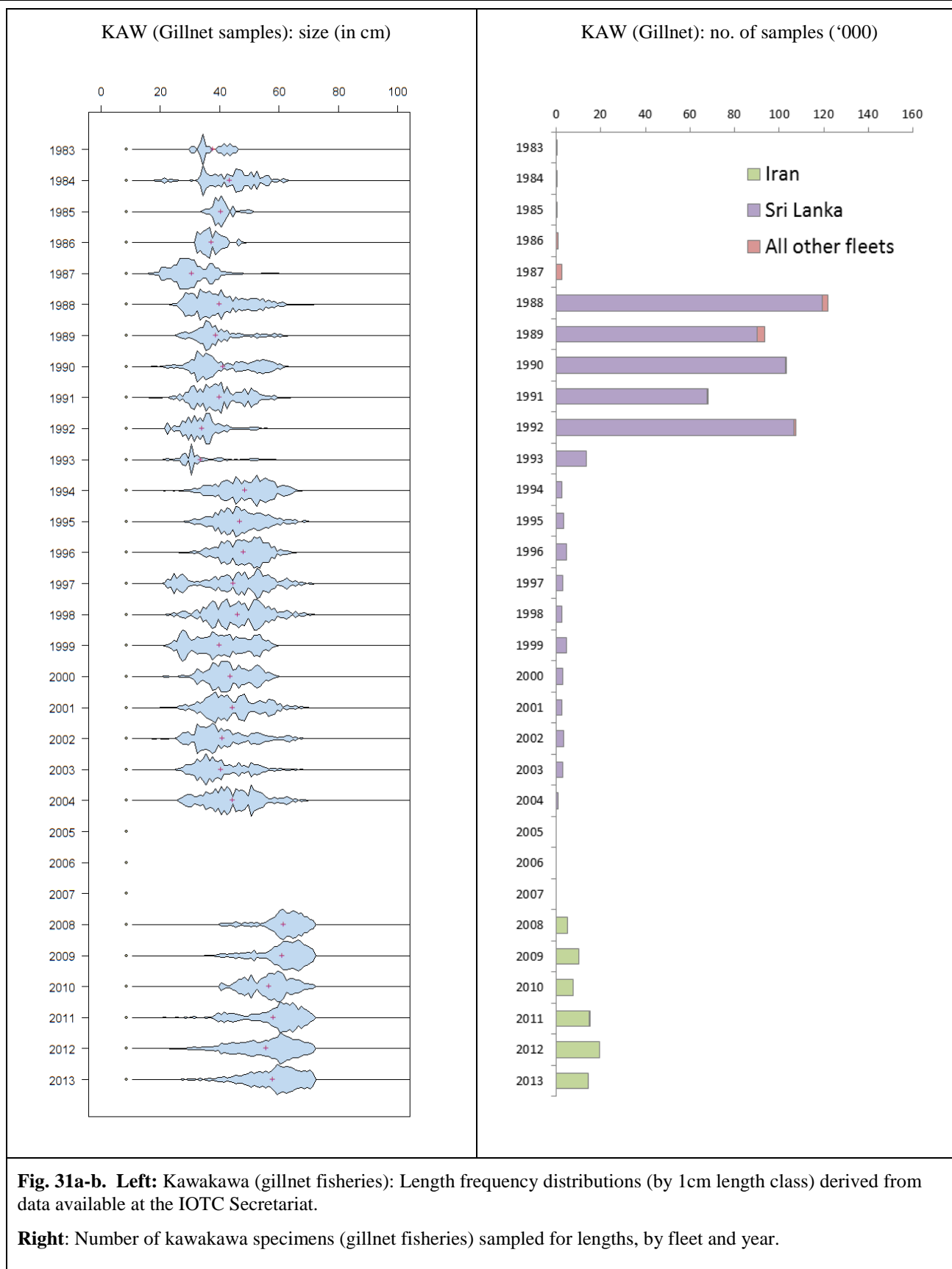- Sex ratio data: have not been provided to the Secretariat by CPCs.

| Gear-Fleet | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 00 | 02 | 04 | 06 | 08 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PSS-Malaysia | | | | | | | | | | | | | | | | | |
| PSS-Indonesia | | | | | | | | | | | | | | | | | |
| PSS-Sri Lanka | | | | | | | | | | | | | | | | | |
| PSS-Thailand | | | | | | | | | | | | | | | | | |
| **PS-Korea** | | | | | | | | | | | | | | | | | |
| **PS-Iran** | | | | | | | | | | | | | | | | | |
| BB-Maldives | | | | | | | | | | | | | | | | | |
| BB-Sri Lanka | | | | | | | | | | | | | | | | | |
| GILL-Malaysia | | | | | | | | | | | | | | | | | |
| GILL-Indonesia | | | | | | | | | | | | | | | | | |
| GILL-Oman | | | | | | | | | | | | | | | | | |
| GILL-Pakistan | | | | | | | | | | | | | | | | | |
| GILL-Sri Lanka | | | | | | | | | | | | | | | | | |
| GILL-Iran | | | | | | | | | | | | | | | | | |
| LINE-Malaysia | | | | | | | | | | | | | | | | | |
| LINE-Maldives | | | | | | | | | | | | | | | | | |
| LINE-Indonesia | | | | | | | | | | | | | | | | | |
| LINE-Sri Lanka | | | | | | | | | | | | | | | | | |
| OTHR-Indonesia | | | | | | | | | | | | | | | | | |
| OTHR-Maldives | | | | | | | | | | | | | | | | | |
| OTHR-Sri Lanka | | | | | | | | | | | | | | | | | |

Key:
More than 2,400 specimens measured
Between 1,200 and 2,399 specimens measured
Less than 1,200 specimens measured

- **Fig. 30.** Kawakawa: Availability of length frequency data, by fishery and year (1980-2013)[19]. Note that no length frequency data are available for 1950–82.

**Other biological data**: 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 |

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[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. 31a-b. Left:** Kawakawa (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat.

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

### Narrow-barred Spanish mackerel (COM: Scomberomorus commerson)

#### Fisheries and main catch trends

- Main fisheries: Narrow-barred Spanish mackerel[20] are caught mainly using gillnet, however significant numbers are also caught using troll lines (Table 6; Fig.32).

- Main fleets (i.e., highest catches in recent years):
  Fisheries in Indonesia, India, and to a lesser extent I.R. Iran, Myanmar, the UAE and Pakistan (Fig.33). Spanish mackerel is also targeted throughout the Indian Ocean by artisanal and recreational fisheries.

- Retained catch trends:
  Catches of Spanish mackerel increased from around 50,000 t in the late-1970's to over 100,000 t by the late-1990's. The highest catches of Spanish mackerel have been recorded in recent years, at 145,000 t in 2011.

- Discard levels: are thought to be very low, although estimates of discards are unknown for most fisheries.

*Changes to the catch series*: No major revisions to the catch series since the WPNT meeting in 2014 (Fig.34).

#### Narrow-barred Spanish mackerel: estimation of catches – data related issues

**Retained catches** for Spanish mackerel were derived from incomplete information, and are therefore uncertain[21] (Fig.42), notably for the following fisheries:

- Artisanal fisheries of Indonesia and India: Indonesia and India have only recently reported catches of Spanish mackerel by gear, including catches by gear for the years 2005–08 and 2007–08, respectively. In the past, the IOTC Secretariat used the catches reported in recent years to break the aggregates for previous years, by gear and species. However, in a review conducted by the IOTC Secretariat by an independent consultant in 2012 the catches of narrow-barred Spanish mackerel were reassigned by gear. In recent years, the catches of narrow-barred Spanish mackerel estimated for Indonesia and India component represent around 50% of the total catches of this species in recent years.

- Artisanal fisheries of Madagascar: To date, Madagascar has not reported catches of narrow-barred Spanish mackerel to the IOTC. During 2012 the IOTC Secretariat conducted a review aiming to break the catches recorded in the FAO database as narrow-barred Spanish mackerel by species, on the assumption that all catches of tunas and tuna-like species had been combined under this name (the review used data from various sources including a reconstruction of the total marine fisheries catches of Madagascar (1950–2008), undertaken by the Sea Around Us Project). However the new catches estimated are thought to be very uncertain.

- Artisanal fisheries of Somalia: Catch levels are unknown.

- Other artisanal fisheries UAE do not report catches of narrow-barred Spanish mackerel by gear. Although most of the catches are believed to be taken by gillnets, some narrow-barred Spanish mackerel may be also caught by using small surrounding nets, lines or other artisanal gears. In addition, Thailand report catches of narrow-barred Spanish mackerel and Indo-Pacific king mackerel aggregated.

- All fisheries: In some cases the catches of seerfish species are mislabelled, the catches of Indo-Pacific king mackerel and, to a lesser extent, other seerfish species, labelled as narrow-barred Spanish mackerel. Similarly, the catches of wahoo in some longline fisheries are thought to be mislabelled as narrow-barred Spanish mackerel. This mislabelling is thought to have little impact in the case of the narrow-barred Spanish mackerel but may be important for other seerfish species.

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[20] Hereinafter referred to as Spanish 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.

**TABLE 6.** Narrow-barred Spanish mackerel: Best scientific estimates of the catches of narrow-barred Spanish mackerel by type of fishery for the period 1950–2013 (in metric tonnes). Data as of May 2015.

| Fishery | By decade (average) | | | | | | By year (last ten years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| Purse seine | - | 0 | 285 | 2,355 | 4,145 | 5,611 | 4,567 | 5,877 | 7,631 | 6,588 | 6,133 | 8,459 | 8,929 | 8,895 | 8,809 | 9,407 |
| Gillnet | 9,532 | 17,706 | 32,168 | 54,918 | 62,712 | 67,281 | 63,735 | 59,611 | 67,804 | 73,041 | 75,700 | 77,041 | 80,499 | 80,345 | 90,554 | 88,286 |
| Line | 1,729 | 2,475 | 4,672 | 11,334 | 12,071 | 17,139 | 15,681 | 17,392 | 18,259 | 19,755 | 18,747 | 21,328 | 20,767 | 27,539 | 30,057 | 26,981 |
| Other | 57 | 96 | 468 | 5,603 | 9,741 | 21,351 | 19,568 | 20,523 | 23,915 | 25,530 | 22,741 | 28,170 | 25,672 | 27,611 | 31,067 | 28,668 |
| Total | 11,318 | 20,277 | 37,593 | 74,210 | 88,669 | 111,382 | 103,551 | 103,404 | 117,609 | 124,914 | 123,322 | 134,998 | 135,868 | 144,390 | 160,487 | 153,342 |

**Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, danish seine, liftnet, longline, longline fresh, trawling.
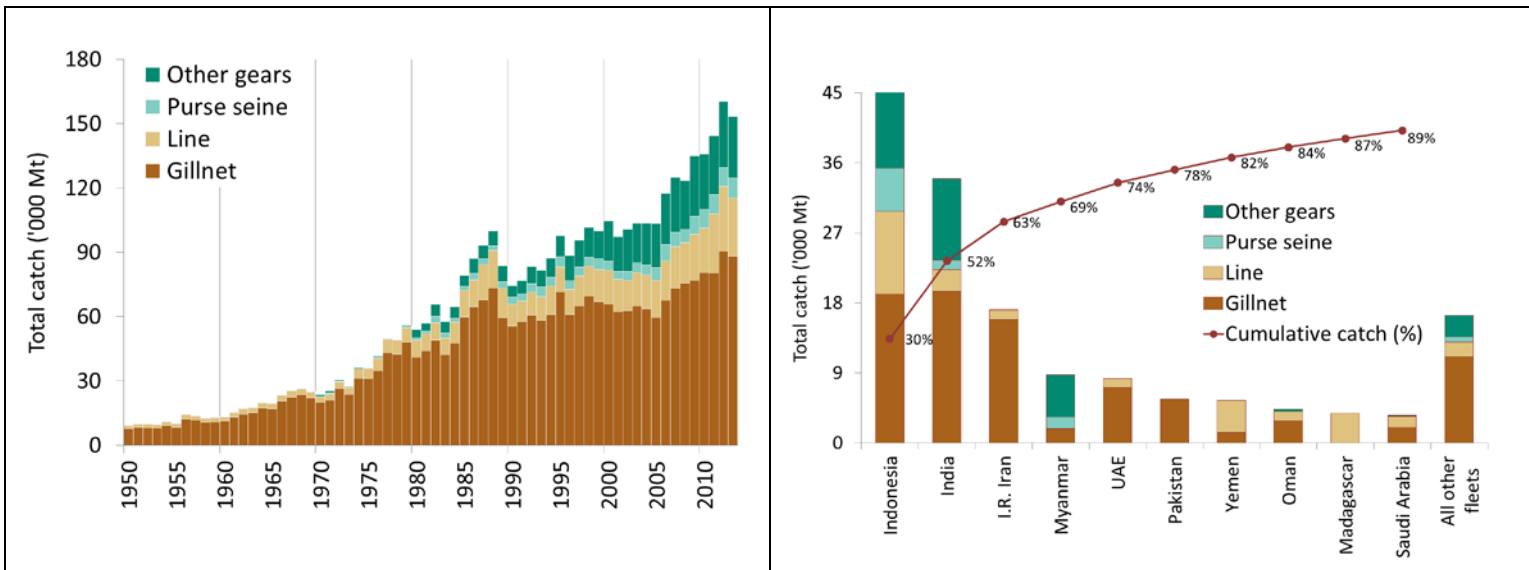


**Fig.32.** Narrow-barred spanish mackerel: Annual catches by gear recorded in the IOTC Database (1950–2013).

**Fig.33.** Narrow-barred spanish mackerel: Average catches in the Indian Ocean over the period 2011–13, by country[22].
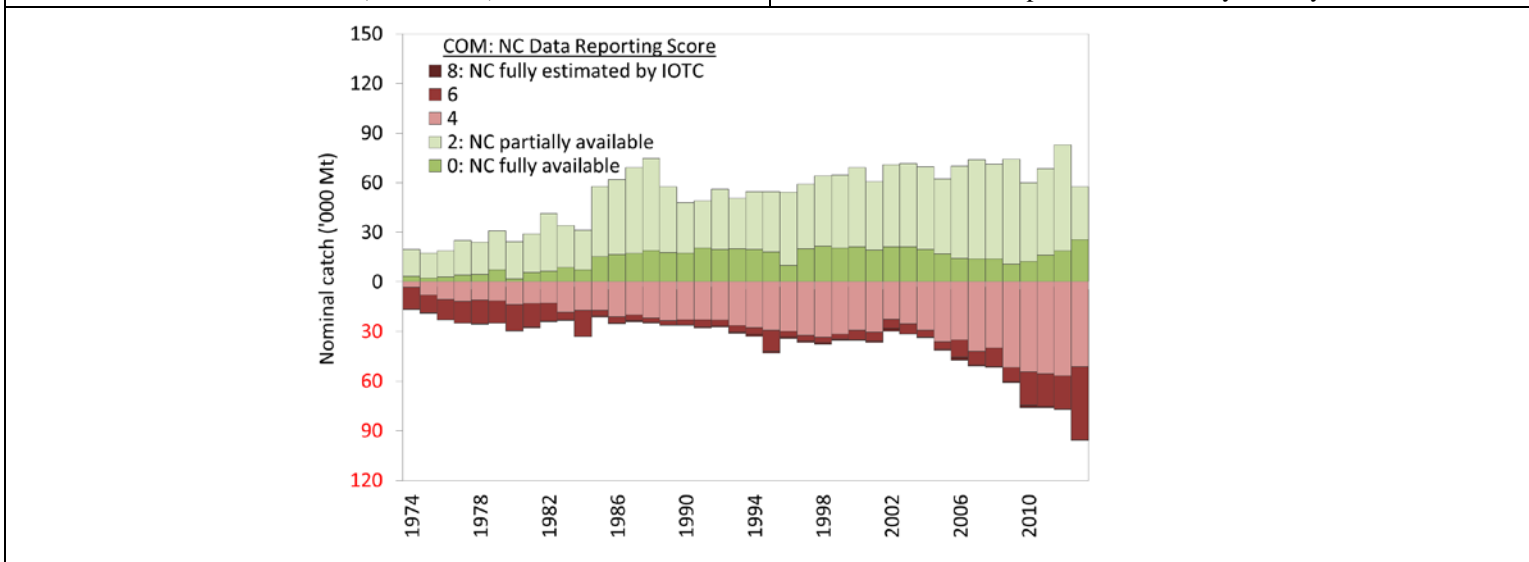


**Fig. 34.** Narrow-barred spanish mackerel: nominal catch; uncertainty of annual catch estimates (1974–2013).

*Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2015.*

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[22] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2011-2013. 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 for 2011-2013.

*Narrow-barred Spanish mackerel – Effort trends*

- Availability: Effort trends are unknown for Spanish mackerel in the Indian Ocean, due to a lack of catch-and-effort data.

*Narrow-barred Spanish mackerel – Catch-per-unit-effort (CPUE) trends:*

- Availability: highly incomplete data, available only for selected years and/or fisheries (Fig.35).
- Main CPUE series available (i.e., over 10 years or more):
  Sri Lanka (gillnets) – however the catches and effort recorded are thought to be unreliable due to the dramatic changes in CPUE recorded in 2003 and 2004 (Fig.36).

| Gear-Fleet | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 00 | 02 | 04 | 06 | 08 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PSS-Indonesia | | | | | | | | | ▥ | | | | | | | | | | | | | |
| PSS-Malaysia | | | | | | | | | | | | | | | ▥ | | | | | | | |
| GILL-Indonesia | | | | | | | | ▥ | ▥ | ▥ | | | | | | | | | | | | |
| GILL-Sri Lanka | | | | | | | | | ▥ | ▥ | ▥ | | ▥ | ▥ | ▥ | ▥ | ▥ | | | | | |
| GILL-Malaysia | | | | | | | | | | | | | | | ▥ | | | | | | | |
| GILL-Oman | | | | | | | | | | | | | | | | ▥ | | | | | ▥ | ▥ |
| GILL-Pakistan | | | | | | | | ▥ | ▥ | ▥ | | | | | | | | | | | | |
| LINE-Australia | | | | | | | | | | | | | ▥ | | | | | | | | | |
| LINE-Malaysia | | | | | | | | | | | | | | | ▥ | | | | | | | |
| LINE-Oman | | | | | | | | | | | | | | | | | | | | | ▥ | ▥ |
| LINE-Yemen | | | | | | | | | | | | | | | | | ▥ | ▥ | ▥ | | | |
| LINE-South Africa | | | | | | | | ▥ | ▥ | ▥ | ▥ | ▥ | ▥ | | | | | | | | | |
| OTHR-Sri Lanka | | | | | | | | | | | ▥ | ▥ | ▥ | ▥ | ▥ | ▥ | ▥ | | | | | |
| OTHR-Indonesia | | | | | | | | ▥ | | | | | | | | | | | | | | |
| OTHR-Malaysia | | | | | | | | | | | | | | | ▥ | | | | | | | |
| OTHR-Oman | | | | | | | | | | | | | | | | | | | | | ▥ | ▥ |

**Fig.35.** Narrow-barred Spanish mackerel: Availability of catches and effort series, by fishery and year (1970–2013)[23]. No catches and effort are available at for 1950–84, and 2008–10.
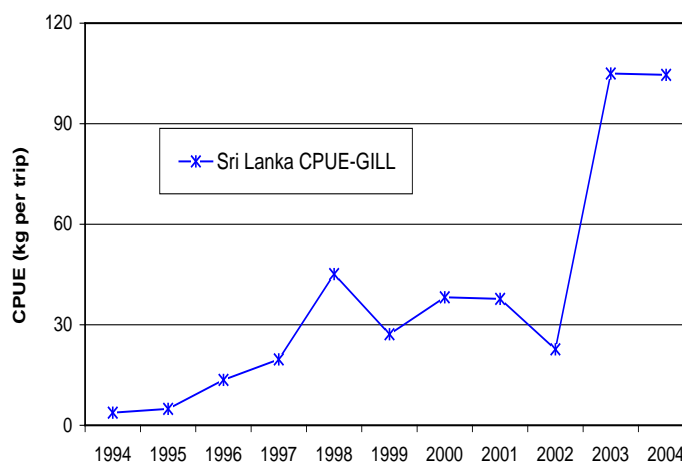


**Fig.36**. Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004).

*Narrow-barred Spanish mackerel – Fish size or age trends (e.g., by length, weight, sex and/or maturity)*

- Sizes: the sizes of narrow-barred Spanish mackerel taken by the Indian Ocean fisheries typically ranges between 30 and 140 cm depending on the type of gear used, season and location – with 32–119 cm fish taken in the Eastern Peninsular Malaysia area, 17–139 cm fish taken in the East Malaysia area and 50-90 cm fish taken in the Gulf of Thailand. Similarly, narrow-barred Spanish mackerel caught in the Oman Sea are typically larger than those caught in the Persian Gulf.[24]

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

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

- Size frequency data: highly incomplete data, available only for selected years and/or fisheries (Fig.37).

  Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.

  Main sources for size samples: Sri Lankan (gillnet) (from late-1980s until early-1990s), and I.R. Iran (gillnet) (from the late-2000s). Length distributions derived from the data available for gillnet fisheries are shown in Fig.38. No data are available in sufficient numbers for all other fisheries.

- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.

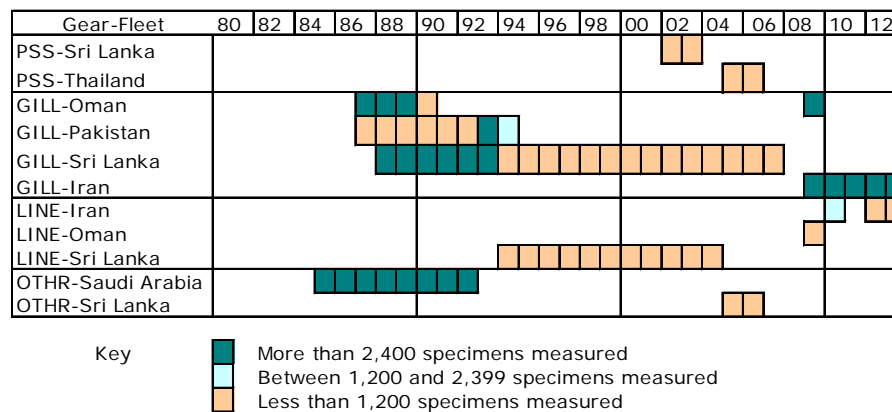- Sex ratio data: have not been provided to the Secretariat by CPCs.



**Fig. 37:** Narrow-barred Spanish mackerel: Availability of length frequency data, by fishery and year (1980–2013)[25]. Note that no length frequency data are available prior to 1984.

**Other biological data**: 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 |

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[25] 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
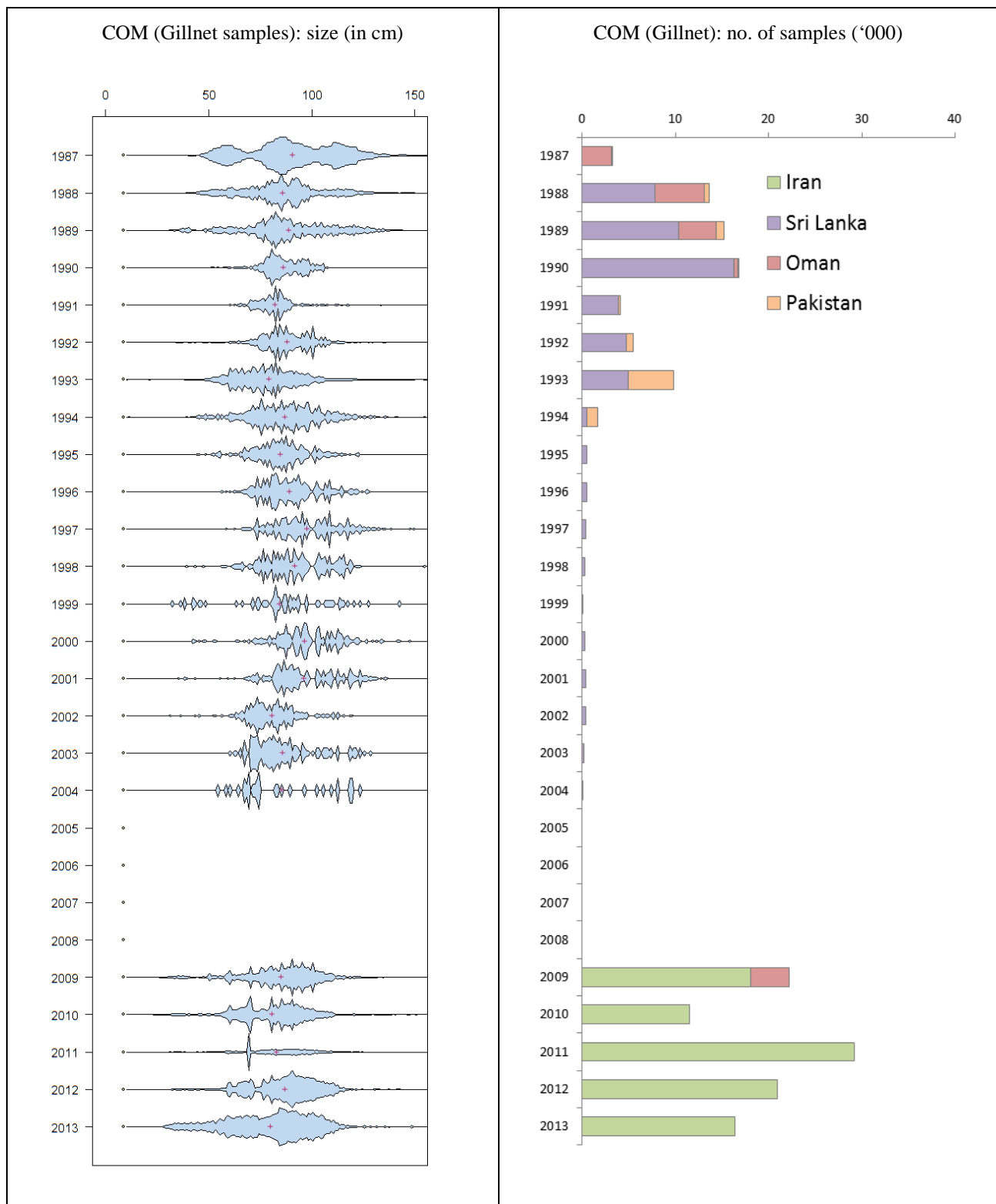
**Fig. 38a-b. Left:** Narrow-barred Spanish Mackerel (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat.

**Right**: Number of narrow-barred Spanish Mackerel specimens (gillnet fisheries) sampled for lengths, by fleet and year.

### Indo-Pacific king mackerel (GUT: Scomberomorus guttatus)

#### Fisheries and main catch trends

- Main fisheries: Indo-Pacific king mackerel[26] are caught mainly by gillnet fisheries in the Indian Ocean, however significant numbers are also caught trolling (Table7; Fig.39).

- Main fleets (i.e., in terms of highest catches in recent years):
  Fisheries in India, Indonesia, and, to a lesser extent, Myanmar, I.R. Iran and Pakistan (Fig.40).

- Retained catch trends:
  Estimated catches have increased steadily since the mid 1960's, reaching around 24,000 t in the late 1970's and over 30,000 t by the mid-1990's, when catches remained stable until around 2006. Since the late-2000s catches have increased sharply, to over 40,000 t, with the highest catches recorded in 2009 at around 53,000 t.

- Discard levels: are thought to be very low, although estimates of discards are unknown for most fisheries.

***Changes to the catch series***: there have been no major revisions to the catch series for King mackerel since the WPNT meeting in 2014.

#### Indo-Pacific King mackerel: estimation of catches – data related issues

**Retained catches** for King mackerel were derived from incomplete information, and are therefore uncertain[27] (Fig.41), notably for the following fisheries:

- Species aggregation: Indo-Pacific king mackerels are often not reported by species but are aggregated with narrow-barred Spanish mackerel or, less frequently, other small tuna species.

- Mislabelling: Indo-Pacific king mackerels are often 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.

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[26] Hereinafter referred to as King mackerel.

[27] 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.

**TABLE 7.** *Indo-Pacific king mackerel: Best scientific estimates of the catches of Indo-Pacific king mackerel by type of fishery for the period 1950–2013 (in metric tonnes). Data as of May 2015.*

| Fishery | By decade (average) | | | | | | By year (last ten years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| Purse seine | - | - | 34 | 584 | 772 | 938 | 786 | 768 | 720 | 1,109 | 1,239 | 1,605 | 1,122 | 1,241 | 1,092 | 1,243 |
| Gillnet | 4,367 | 6,898 | 13,948 | 17,097 | 21,709 | 23,628 | 22,143 | 20,347 | 20,915 | 27,450 | 31,193 | 32,007 | 26,252 | 28,300 | 27,593 | 29,268 |
| Line | 250 | 349 | 768 | 1,333 | 1,834 | 2,504 | 2,056 | 2,240 | 2,046 | 3,493 | 3,520 | 4,041 | 3,215 | 3,362 | 3,345 | 3,429 |
| Other | 13 | 21 | 48 | 3,879 | 5,101 | 9,353 | 8,159 | 8,334 | 8,208 | 10,872 | 11,929 | 15,733 | 11,578 | 12,371 | 11,024 | 12,413 |
| **Total** | **4,630** | **7,268** | **14,798** | **22,893** | **29,416** | **36,422** | **33,144** | **31,689** | **31,889** | **42,923** | **47,881** | **53,386** | **42,166** | **45,274** | **43,054** | **46,354** |

**Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, danish seine, liftnet, longline, longline fresh, trawling.
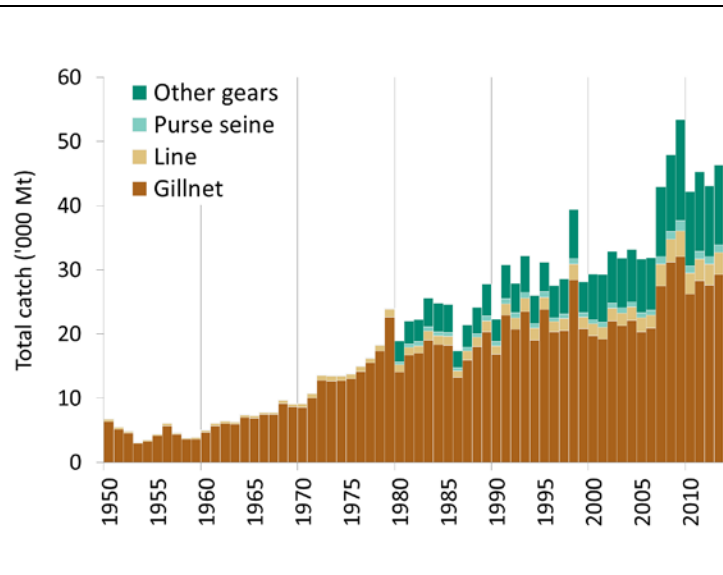


**Fig.39.** Indo-Pacific king mackerel: Annual catches by gear recorded in the IOTC Database (1950–2013).
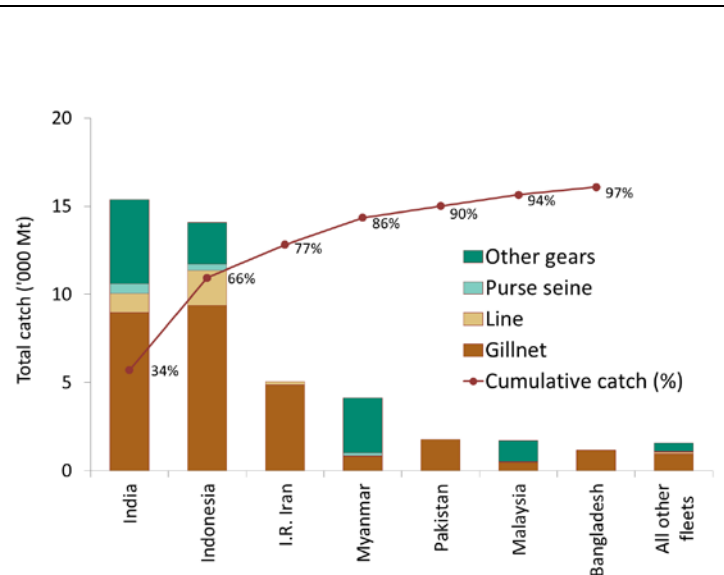
**Fig.40.** Indo-Pacific king mackerel: Average catches in the Indian Ocean over the period 2011–13, by country[28].
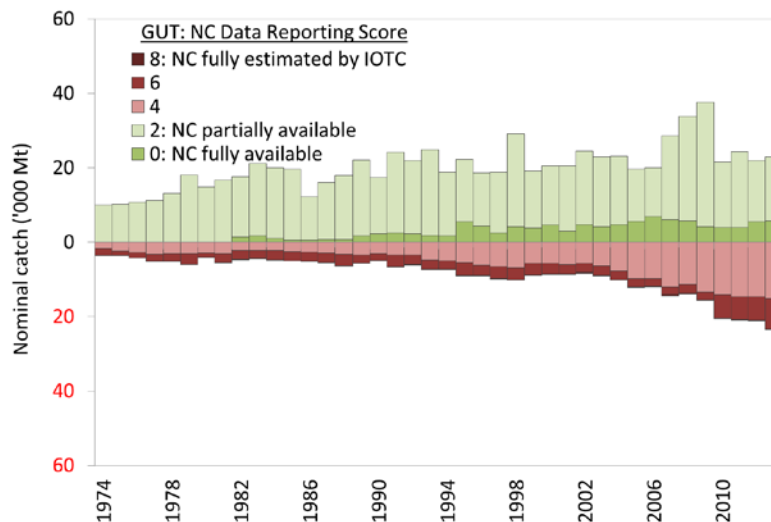


**Fig. 41.** Indo-Pacific king mackerel: nominal catch; uncertainty of annual catch estimates (1974–2013).

*Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). Data as of May 2015.*

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[28] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2011-2013. 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 for 2011-2013.

*Indo-Pacific King Mackerel – Effort trends*

- Availability: Effort trends are unknown for King Mackerel in the Indian Ocean, due to a lack of catch-and-effort data.

*Indo-Pacific King Mackerel – Catch-per-unit-effort (CPUE) trends*

- Availability: no data available for most fisheries, and where available, data refer to very short periods (Fig. 42). This makes it impossible to derive any meaningful CPUE from the existing data.

| Gear-Fleet | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 00 | 02 | 04 | 06 | 08 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PSS-Indonesia | | | | | | | | | ■ | | | | | | | | | | | | | |
| LINE-South Africa | | | | | | | | | | | | | | | | | | ■ | | | | |
| LINE-Yemen | | | | | | | | | | | | | | | | | | | ■ | | | |

**Fig. 42.** Indo-Pacific king mackerel: Availability of catches and effort series, by fishery and year (1970–2013)[29]. Note that no catches and effort are available at all for 1950–85

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

- Size frequency data: trends in average weight cannot be assessed for most fisheries due to lack of data.

  Main sources for size samples: Thailand (coastal purse seiner) and Sri Lankan (gillnet) – however the number of samples is very small and the data refer to very short periods (Fig.43).

- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.

- Sex ratio data: have not been provided to the Secretariat by CPCs.

| Gear-Fleet | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 00 | 02 | 04 | 06 | 08 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PSS-Thailand | | | | | | | | | | | | | ▨ | | | | |
| GILL-Sri Lanka | | | | | ▨ | ▨ | | ▨ | | | | | | | | | |

Key  ▨ More than 2,400 specimens measured
▨ Between 1,200 and 2,399 specimens measured
▨ Less than 1,200 specimens measured

**Fig. 43.** Indo-Pacific king mackerel: Availability of length frequency data, by fishery and year (1980–2013)[30]. Note that no length frequency data are available for 1950–82.

**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* <br> *b= 2.9002* | | *Min:20* <br> *Max:80* |

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[29] 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.

[30] 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: DESCRIPTION OF DATA ISSUES RELATED TO NERITIC TUNAS**

| Data type(s) | Fisheries | Issue | Progress |
|---|---|---|---|
| Nominal catch, catch-and-effort, size data | Coastal fisheries of Madagascar, Myanmar, and Yemen | Non-reporting countries<br>Catches of neritic tunas for these fisheries have been entirely estimated by the IOTC Secretariat in recent years – however the quality of estimates is thought to be poor due to a lack of reliable information on the fisheries operating in these countries. | • Madagascar: no regular data collection system exists for recording catches from coastal fisheries. Pilot sampling, funded by COI-SmartFish and assistance from the IOTC Secretariat, was conducted in selected provinces in 2013. Since then Smartfish have agreed to provide Madagascar with additional support for data collection and management.<br><br>• Myanmar (non-reporting, non-member): no update. Catches based on estimates published by SEAFDEC.<br><br>• Yemen: no update. No catch information provided; catches estimated based on FAO FishStat. |
| Nominal catch, catch-and-effort, size data | Coastal fisheries of India, Indonesia, I.R. Iran, Kenya, Malaysia, Mozambique; Oman, Tanzania, and Thailand | Partially-reported data<br>These fisheries do not fully report catches of neritic tunas by species and/or gear, as per IOTC Res.10/02 standards.<br><br>Nominal catches have been partially allocated by gear and species by the IOTC Secretariat, where necessary.<br><br>Catch and-effort and size data may also be missing. | • India: no update. No catch-and-effort, or size data, reported for coastal fisheries.<br><br>• Indonesia: no update. No catch-and-effort, or size data, reported for coastal fisheries.<br><br>• Kenya: data based on National Report submitted to SC. Kenya has recently undertaken a Catch Assessment Survey to improve catch estimates for artisanal fisheries, and has requested support for technical assistance from the IOTC Secretariat in 2015 (TBC).<br><br>• Mozambique: data based on National Report submitted to SC. A Data Compliance mission is planned by the IOTC Secretariat in June 2014 to assess current levels of reporting and the status of fisheries data collection.<br><br>• Oman: no update. No size data submitted, although data has been collected.<br><br>• Sri Lanka: no update. No catch-and-effort submitted for coastal fisheries (offshore only).<br><br>• Tanzania: no update. Catch data (aggregated by species) based on data from the National Report submitted to SC.<br><br>• Thailand: has collected one of the longest time series of size data for neritic tunas (coastal purse seiners) (from 1980s; data in electronic format from 1994 onwards). However size data have only been reported to the IOTC Secretariat for 2005 and 2006. A follow-up data mining mission, funded by the IOTC-OFCF Project has been proposed for 2015 to assist Thailand with the processing of the historical size data. |

| | Coastal fisheries of Indonesia, Malaysia, and Thailand | Reliability of catch estimates<br>The a number of issues following fisheries have been identified | • Indonesia (nominal catch): catch estimates for neritic tunas are considered highly uncertain due to issues of species misidentification and aggregation of juvenile neritic and tropical tunas species reported as commercial category *tongkol*. The IOTC Secretariat is currently coordinating a pilot sampling project of artisanal fisheries in North and West Sumatra to improve estimates of neritic tunas and juvenile tuna species in particular – with results expected end-2015.<br><br>• Malaysia (catch-and-effort): issues regarding the reliability of catch-and-effort reported in recent years have been raised by the IOTC Secretariat and, to date, remain unresolved (e.g., large fluctuations in the derived CPUE, and inconsistencies between different units of effort recorded in recent years). The catch-and-effort data remaining pending upload to the IOTC database until inconsistencies in the data are satisfactorily resolved.<br><br>• Thailand (catch-and-effort): catch-and-effort shows large increases for longtail in recent years, despite a *decrease* in effort. Clarification has been requested from Thailand by the IOTC Secretariat, but no response has been received as yet. The catch-and-effort data remain pending upload to the IOTC database until the inconsistencies with the level of fishing effort have been resolved. |
| Catch and effort, size data | (Offshore) Surface and longline fisheries: I.R. Iran and Pakistan | Non-reporting or partially-reported data<br>A substantial component of these fisheries operates in offshore waters, including waters beyond the EEZs of the flag countries concerned.<br><br>Although the fleets have reported total catches of neritic tunas, they have not reported catch-and-effort data as per IOTC Res.10/02 standards. | • I.R. Iran – drifting gillnets: no update. Catch-and-effort is not fully reported (i.e., no effort, only monthly catches by landing site).<br><br>• Pakistan – drifting gillnets: no update. No catch-and-effort or size data reported. |
| Nominal catch, catch-and-effort, size data | All industrial 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 or include amounts of neritic tunas discarded. The same applies to catch-and-effort data. | No update. There is a general lack of information on retained catches, catch-and-effort, and size data for neritic tunas retained by all purse seine fleets – in particular frigate tuna, bullet tuna, and kawakawa. Discard levels of neritic tunas by purse seiners are also only available for the EU purse seine fisheries during 2003-07. |
| Discards | All fisheries | Although discard levels of neritic species are believed to be low for most fisheries, with the exception of industrial purse seiners, very little information is available on the level of discards. | No update. 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. |

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| Biological data | All fisheries | There is a general lack of biological data for neritic tuna species in the Indian Ocean, in particular basic data that can be used to establish length-weight-age keys, non-standard measurements-fork length keys and processed weight-live weight keys. | No update.  Collection of biological information, including size data, remains very low for most neritic species. |
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**APPENDIX II**

**OVERVIEW OF CURRENT CAPACITY-BUILDING ACTIVITIES
BY THE IOTC SECRETARIAT**

In 2015 the IOTC Secretariat initiated a number of capacity-building activities in coastal states in the IOTC region, in collaboration with BOBLME, the IOTC-OFCF Project, and national fisheries organizations, with particular emphasis on improving the collection and reporting of fisheries data to the IOTC Secretariat.

Several of the activities are due to report during 2015–16 and which are likely to have implications on current and historical catch estimates of neritic tuna species.

SRI LANKA: Data collection and management (IOTC-OFCF Project, BOBLME) (2015)
- Collaboration of the IOTC Secretariat with the Bay of Bengal Large Marine Ecosystems Project (BOBLME) to strengthen the data collection in Sri Lanka, in particular for coastal fisheries and species of pelagic sharks.
- Outputs:
  - Strengthening of sampling activities (e.g., training in sampling and data collection, increase in the number of field enumerators and sites sampled – including landing sites in northern Sri Lanka) and improvements in catch estimates of IOTC species for coastal fisheries in particular.
  - Development of PELAGOS database; training in data validation and catch estimation.
- Progress:
  - Sampling activities have been maintained, under the revised sampling scheme, following the termination of support and end of project funding in early 2014 – however questions have been raised by Sri Lanka over the capacity for long-term funding of the additional enumerators.
  - Sri Lanka has already provided the IOTC Secretariat with 2013, which partially incorporate the new sampling data.
  - Catch estimates for 2014 data are currently being processed, with the assistance of the IOTC Secretariat and BOBLME.
  - In 2015 the IOTC Secretariat and BOBLME provided further support for the PELAGOS database (assistance on the data processing and validation of data), with plans for a catch estimation workshop in late-2015.

INDONESIA: Pilot sampling project (IOTC-BOBLME-OFCF) (June 2014-March 2015)
- Implementation of a pilot sampling project in the Provinces of West Sumatra and North Sumatra to monitor the activities of coastal fisheries and assess catches of neritic tuna species and juvenile tunas in commercial categories containing more than one species, in particular the categories Tongkol and Tuna.
- Addresses recommendations from the IOTC Scientific Committee concerning catches of juvenile tunas in Indonesia and verification of neritic tuna species not reported by species in Indonesia.
- Outputs:
  - A blueprint document of sampling data collection and management protocols specific to Indonesian coastal fisheries to enable continuation of sampling activities by DGCF upon completion of the pilot project and ensure sustainability of the new data collection system.
  - Collection and processing of sampling data over a complete 12 month period. Based on the results of the pilot sampling, review and improve current and historical catch estimates for coastal fisheries of Indonesia.
  - Evaluation report of implementation of sampling activities.
  - Develop the methodology for catch estimation based on sample data collection.
- Progress:
  - Continuation of sampling activities in 2015 (up to Oct 2015).
  - IOTC Secretariat and DGCF to conduct a catch-estimation workshop in late-2015/early-2016 and present results of the sampling in North and West Sumatra.

INDONESIA – Data compliance mission (longline fisheries and Regional Observer Scheme) (TBC)
- Provide assistance to data processing for data collected from the longline fishery, in particular length frequency data, which Indonesia has not reported since 2010, in addition to Regional Observer Scheme data.
- The proposal is to send an IOTC Secretariat Officer to Indonesia to assist in the preparation of datasets and procedures to facilitate reporting of data to the IOTC Secretariat in the future.
- Outputs:
    - Improve compliance of Indonesia in terms of IOTC Resolution 10/02; submission of data to enable the Working Parties to help develop stock status indicators and increase the amount of data available for comprehensive stock assessments of IOTC species in the future.


THAILAND – Data compliance mission (size frequency data) (TBC)
- Following a data mining mission to Thailand by the IOTC-OFCF Project in 2014, a number of follow-up actions were identified including the recommendation that Thailand provide the IOTC Secretariat with length frequency data collected by the Andaman Sea Fisheries Research and Development Center (AFRDEC) – as per the mandatory statistical requirements of IOTC Resolution 10/02.
- Thailand has collected one of the longest time series of length frequency data for IOTC neritic tunas, but has not submitted data to the IOTC Secretariat since 2006.
- A follow-up data mining mission has been proposed to assist Thailand in the processing of the length frequency data in the format requested by the IOTC Secretariat, to improve the quality and abundance of data available for future Working Party stock assessments.
- Outputs:
    - Training of staff in the data reporting requirements of the IOTC Secretariat, and submission of length frequency data to improve the data available for future IOTC stock assessments.