REVIEW OF THE STATISTICAL DATA AVAILABLE FOR NERITIC TUNA SPECIES

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PURPOSE

To provide participants at the 10th Working Party on Neritic Tunas (WPNT10) with a review of the status of the information available on neritic tuna species in the databases at the IOTC Secretariat, as of May 2020, 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 15/02 *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 14/05; 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: Kawakawa, longtail tuna and narrow-barred Spanish mackerel are the main neritic species, accounting for over 74% 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 to the point that over 77% of total catches of neritic species are accounted for by four countries: Indonesia, I.R. Iran, India and Pakistan (**Fig. 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, 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 (**Fig. 1a-b**). While the threat of piracy has declined in recent years, and some fleets have resumed fishing close to Somali waters, overall catches of neritic tunas have not declined to pre-piracy levels (neither in absolute nor in relative terms) suggesting a longer-term change in the targeting of species by some fleets.
- 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.).

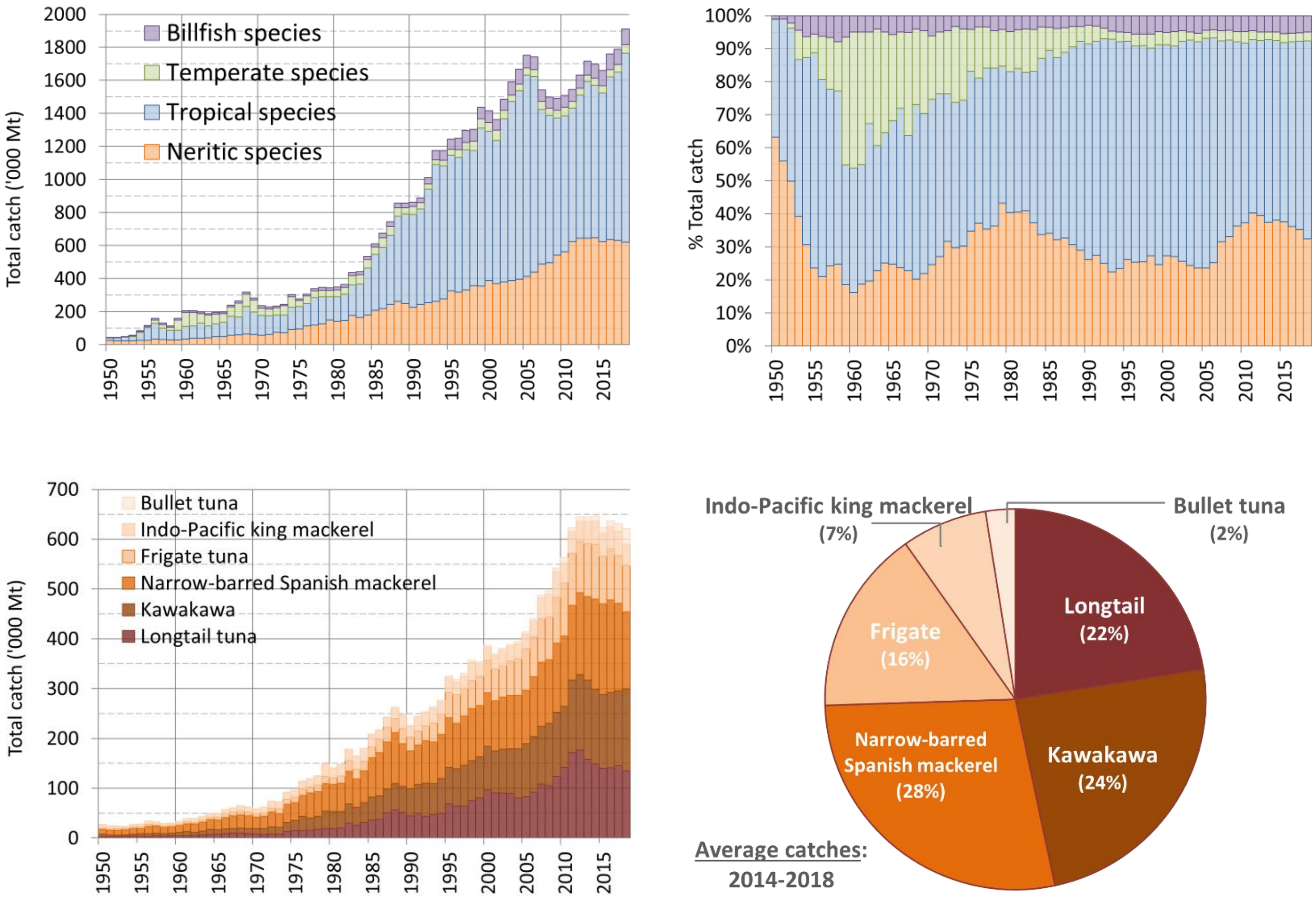


Fig. 1a-d: Top: Contribution of the six neritic tuna species under the IOTC mandate to the total catches of IOTC species in the Indian Ocean, over the period 1950–2018 (**a.** top-left: total catch; **b.** top-right percentage, same colour key as Fig. 1a) - **Bottom:** Contribution of each neritic species to the total combined catches of neritic tunas (Fig. 2: nominal catch of each species, 1950–2018; Fig. 3: share of neritic tunas average catch by species, 2014-18)

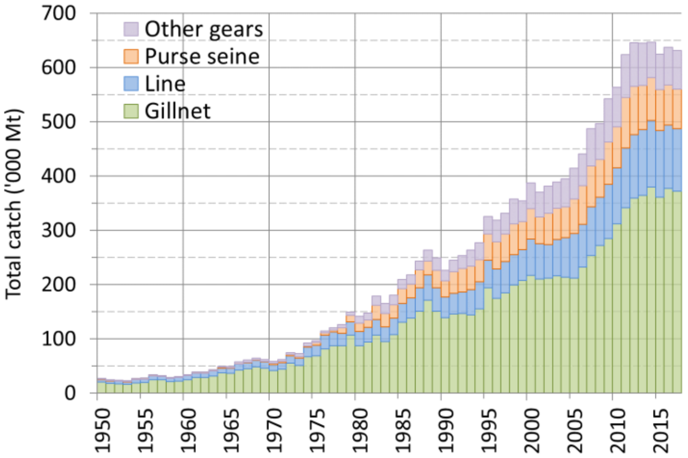


Fig. 2: All IOTC neritic species: annual catches by gear recorded in the IOTC Database (1950–2018)

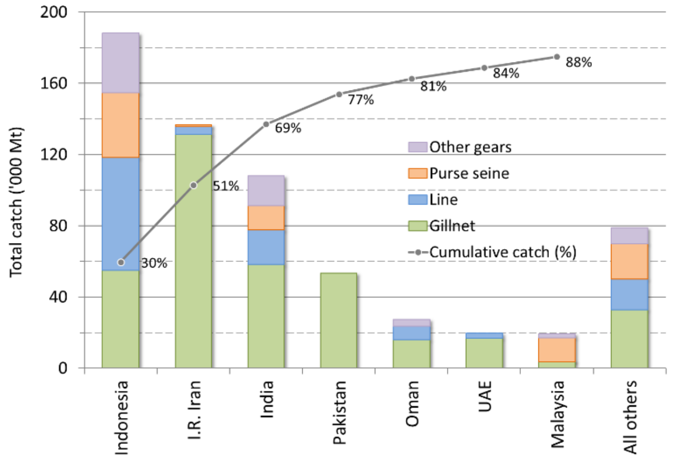


Fig. 3: All IOTC neritic species: average catches in the Indian Ocean over the period 2014-18, by country[3]

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.

[3] Countries are ordered from left to right, according to the importance of catches of neritic tuna species reported for 2014-2018. The gray line indicates the (cumulative) proportion of catches of all neritic tunas for the countries concerned, over the total combined catches of all neritic tunas species reported from all countries and fisheries for 2014-2018.

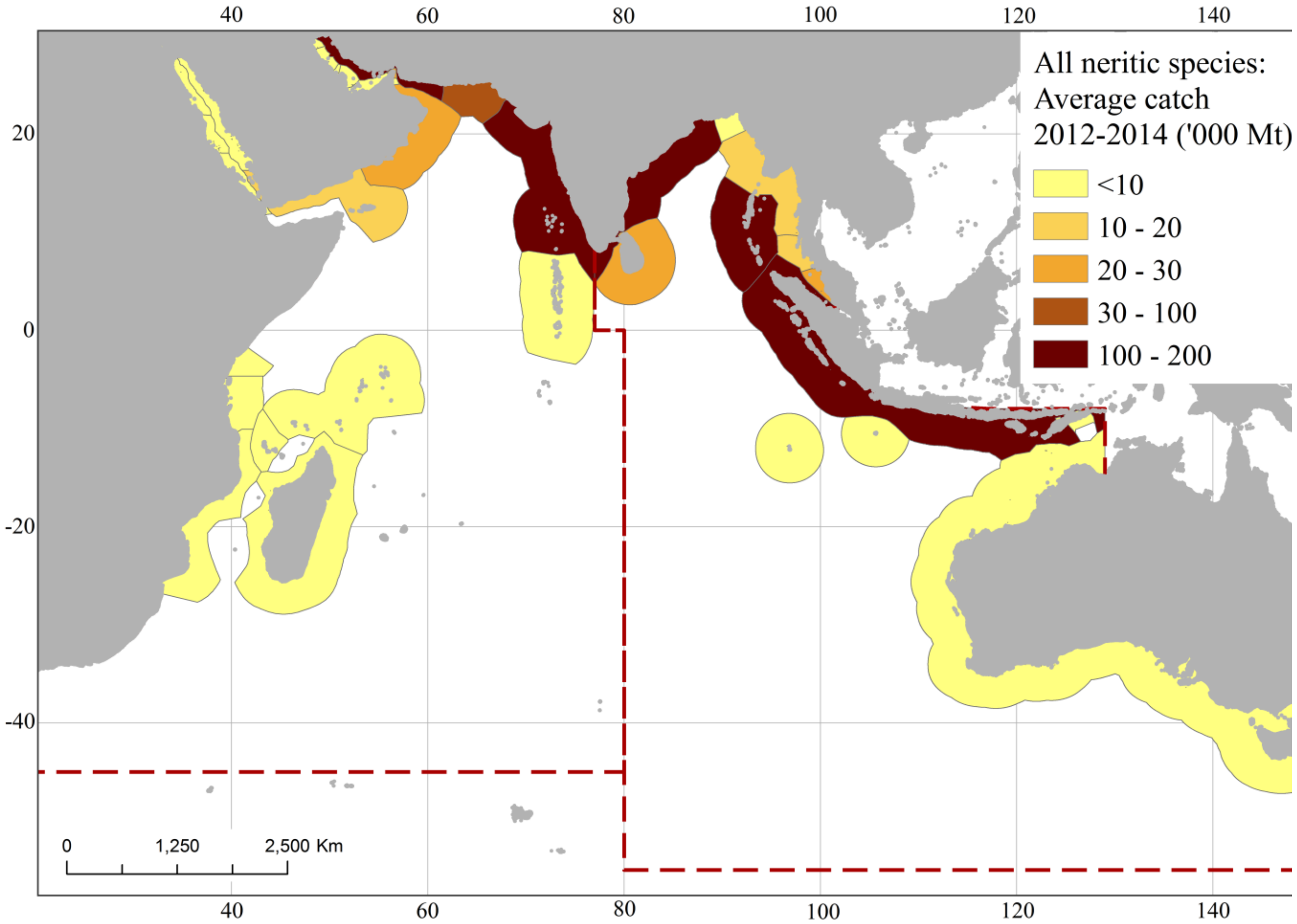


Fig. 4: Average catches of all neritic species in the Indian Ocean over the period 2012–14, by country EEZ. The intensity of the shading of EEZs represents the importance of catches of all IOTC neritic species in each country. Boundaries separating the IOTC east and west Indian Ocean areas are denoted 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 more detailed list of issues, by dataset and fishery can be found in **Appendix I**.

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 to 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 often reported to the Secretariat as species aggregates or commercial categories and therefore 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 to the IOTC Secretariat 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, and there are also difficulties in monitoring catches of these species in port. In recent years, development in the industrial purse-seine fishery of Indonesia targeting neritic tunas resulted in an increase of reported catches, particularly evident for bullet tuna.

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

CATCH-AND-EFFORT & DERIVED NOMINAL CPUE

- For most of the major fisheries reporting catches of neritic species in the Indian Ocean, catch-and-effort are not available (e.g. India, and Pakistan) or only available for a very limited timeframe (coastal and/or small-scale fisheries of Indonesia).

  Following an IOTC Data Compliance mission conducted in late-2017, I.R. Iran has begun to report catch-and-effort data in accordance with the requirements of Resolution 15/02, which lead to an improvement in the availability of time-area catches for Iranian gillnetters – one of the main fisheries accounting for catches of neritic tunas. Also, improvement in the adoption of logbook for the purse seine fishery as well as for some other coastal fisheries of Indonesia (gillnet, liftnets and coastal purse seiners) resulted in time-area catches being reported again by the fleet for the first time in 2018.

- Many of the nominal 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).

  I.R. Iran has collected a relatively long time series of catch and fishing effort through a port sampling program for their coastal and offshore gillnet fishery, which could potentially be used to develop a standardized CPUE series for some neritic species (e.g., longtail tuna and kawakawa).

  The IOTC Secretariat conducted a mission to I.R. Iran in June 2019 to evaluate the feasibility of this dataset for its potential use in CPUE standardisations. During the mission, the IOTC Secretariat collaborated with SHILAT and developed a preliminary standardised CPUE index for longtail tuna, narrowed-barred Spanish mackerel, kawakawa, and frigate tuna for the Iranian coastal gillnet fishery (see IOTC-WPNT09-14 for more details).

SIZE DATA

- Size data are also highly incomplete for most neritic species, with data only available for a limited number of years and/or fisheries.
- For most fisheries where samples have been collected, the number of specimens is also generally below the minimum sampling standard of 1 fish per metric ton of catch (as recommended by the IOTC Secretariat) to reliably

assess changes in average weight. The exception are samples from Sri Lankan gillnets collected in the 1980s through IPTP funding, albeit for a limited number of years.

DATA ISSUES: PRIORITIES FOR CONSIDERATION OF THE WPNT

1. Indonesia & India (catch-and-effort): account for around half of the 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 have not reported catch-and-effort (for coastal fleets) since the late-1980s. In 2019 (2018 as reference year) Indonesia started reporting time-area catches for some of its artisanal and industrial fleets according to Resolution 15/02. Still, in the case of Indonesia, nominal catch estimates of neritic tunas are considered highly uncertain: in particular, a sharp increase in captures of bullet tuna is recorded by the Indonesian purse seine fleet in 2018 (around 16,000 t over a total – for the species – of 32,000 t reported by all fleets for the same year) which might only be partially explained with the development of the fleet and should require further investigation. Catch-and-effort for industrial (i.e., offshore) fisheries for India is also considered to be under-reported.

2. Indonesia (nominal catches: coastal fisheries): catches by species associated with coastal fisheries are considered highly uncertain due to a number of factors. Until 2004, catches of neritic tunas were reported as an aggregate reporting, which were then estimated by species and gear by the IOTC Secretariat.

   In more recent years, the issue of misclassification of juvenile tunas (*tongkol*) as longtail tuna (*Thunnus tonggol*) by District authorities in Indonesia has been identified as an issue which is believed to have led to over-estimates of catches of longtail in previous IOTC catch estimates for Indonesia. Between 2014-2017 the IOTC Secretariat conducted a pilot sampling project of artisanal fisheries in North and West Sumatra to improve estimates of catch by species for coastal fisheries. DGCF has continued the sampling since the end of the project activities, albeit for a very small number of landing sites: based on the results of the pilot sampling and on-going sampling activities, the IOTC Secretariat is working with Indonesia to improve the estimates of neritic species and catches of longtail tuna in particular. For the time being, the actual species composition of artisanal catches for all neritic tuna species reported by Indonesia is still fully estimated by the IOTC Secretariat.

3. I.R. Iran (catch-and-effort): accounts for second largest catches of neritic species in the Indian Ocean (21% in recent years) and, until recently, reported only partial catch-and-effort according the standards of IOTC Resolution 15/02. Following a successful IOTC Data Compliance and Support mission in late-2017, I.R. Iran is now reporting catch-and-effort in accordance with the requirements of Resolution 15/02, and the IOTC Secretariat is continuing to provide *ad-hoc* assistance to facilitate the reporting of catch-and-effort for the historical time-series from the early-2000s.

   The IOTC Secretariat also visited I.R. Iran in 2019 to evaluate the potential of producing a standardized CPUE series for their gillnet fisheries and the results were presented during the WPNT09 meeting, to accompany paper IOTC–2019–WPNT09–14.

4. Thailand and Malaysia (nominal catch, catch-and-effort): in both cases the data collection systems are generally methodologically sound, and collect detailed information to potentially inform 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 catch-and-effort trends in recent years that require further verification before upload to the IOTC database. In the case of Malaysia, the species composition for the historical time series has been estimated using a simple fixed ratio that does not appear to take into account changes in the fisheries.

5. Pakistan (nominal catch): In December 2019, the WPDCS and SC endorsed the revised nominal catch series produced by the Pakistan government for their gillnet fleet and referring to years between 1987 and 2018 included: these revised catch series significantly change the level of captures for a number of IOTC species, including several neritic tuna species (see the paragraphs relative to each species for an overview of the changes introduced by these revisions).

SECTION 3: STATUS OF FISHERIES STATISTICS FOR NERITIC TUNAS

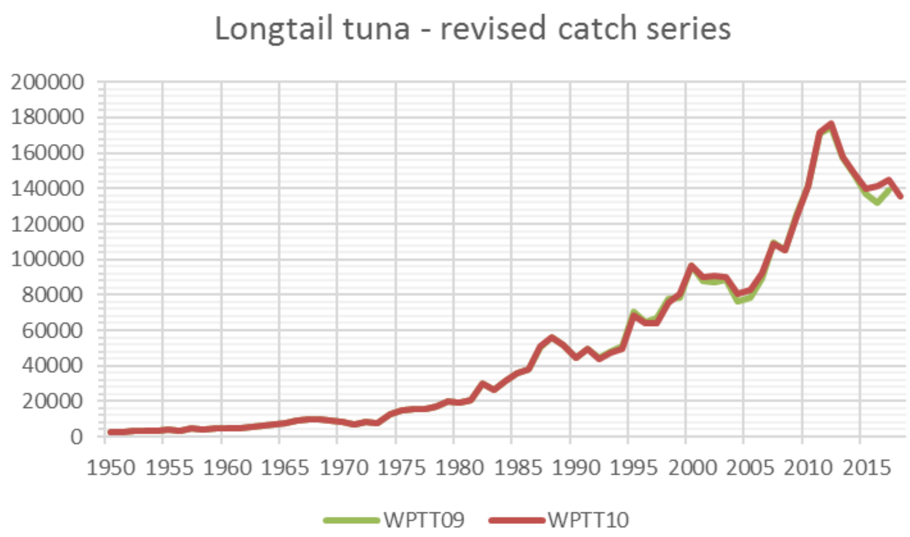
LOT - LONGTAIL TUNA (*THUNNUS TONGGOL*)

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):
  Over 40% of the catches of longtail in the Indian Ocean are accounted for by I.R. Iran (gillnetters), followed by Indonesia (gillnet and trolling), Pakistan (gillnetters) (**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 in recent years at over 170,000 t in 2011. Since 2011 catches levels have generally fluctuated between 130,000 – 160,000 t.

  Around the late-2000s 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. Since 2013 lower catches have been reported – albeit not to pre-piracy levels – in response to the reduced threat of piracy, and resumption of fishing activity in offshore waters and (potentially) high seas.
- Discard levels**:** are thought to be very low, although estimates of discards are unknown for most fisheries.

Changes to the catch series



There were relatively small revisions (i.e., between -4% and +7%, depending on the year) to the catches between 1987 and 2017, almost exclusively due to the revised catch series of Pakistan gillnetters introduced during late 2019. Overall, the revised catches of Longtail tuna until 2017 are now 31,408 t **higher** than what reported at the previous WPNT in 2019.

Estimation of catches – data related issues

Retained catches for longtail tuna were derived from incomplete information – due to deficiencies in port sampling for many of the main fleets – 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; instead 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 una had been severely overestimated by Indonesia. While the new catches

[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.

estimated for the longtail tuna in Indonesia remain uncertain, the new figures are considered more reliable than those existing in the past.

Between 2014-2016 the IOTC Secretariat conducted a pilot sampling project of artisanal fisheries in North and West Sumatra to improve estimates of catch by species for coastal fisheries. One of the key issues is the misclassification of juvenile tunas (*tongkol*) as longtail tuna (*Thunnus tonggol*) by District authorities in Indonesia, which is believed to have led to over-estimates of catches of longtail for a number of years. Based on the results of the pilot sampling, the IOTC Secretariat is working with Indonesia to further improve the estimates of longtail tuna.

- 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. In the case of Myanmar, catches are taken from FAO and SEAFDEC (various years).
- Industrial fisheries: longtail tuna is not generally targeted by industrial fleets, and only in recent years (from 2011 onward) evidences of captures exceeding 20,000 t were recorded, mostly from the offshore gillnet fisheries of I.R. Iran and with the notable exception of the Indonesian industrial purse seine fleet, that reported around 5,000 t of captures for the species in 2018 (suggesting that the fleet is actually targeting neritic tuna species)

Table 2: Best scientific estimates of the catches of longtail tuna by type of fishery for the period 1950–2018 (in metric tonnes). Data as of May 2020

Fishery	By decade (average)						By year (last ten years)									
	1950s	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Purse seine	65	204	1,012	4,863	10,933	17,719	85,253	105,597	120,878	120,381	114,993	108,186	104,891	105,879	106,619	98,194
Gillnet	2,941	6,209	10,026	25,892	40,923	65,081	12,494	12,977	15,989	21,874	19,959	22,578	18,254	16,527	19,546	15,569
Line	557	816	1,519	4,056	5,003	9,497	5,300	6,513	8,467	9,079	5,880	5,040	6,256	7,284	9,989	7,596
Other	0	0	125	1,090	1,992	3,731	20,649	16,531	26,062	25,218	17,227	12,772	10,497	11,566	8,814	13,922
Total	**3,564**	**7,230**	**12,681**	**35,901**	**58,852**	**96,028**	**123,696**	**141,618**	**171,396**	**176,551**	**158,058**	**148,577**	**139,899**	**141,256**	**144,968**	**135,282**

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.

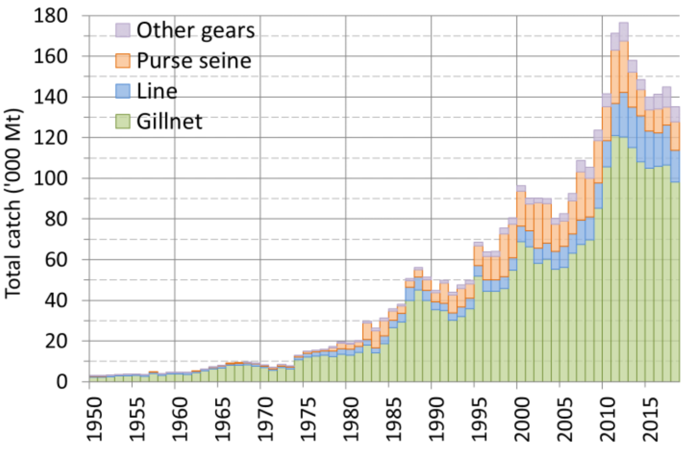


Fig. 5: Longtail tuna: annual catches by gear recorded in the IOTC Database (1950–2018)

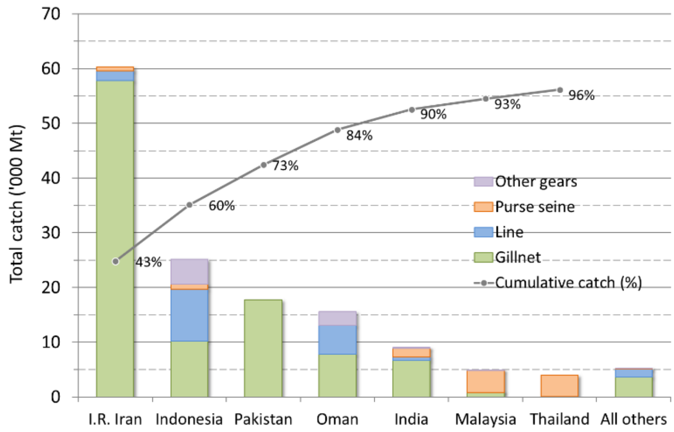


Fig. 6: Longtail tuna: average catches in the Indian Ocean over the period 2014-18, by country[5]

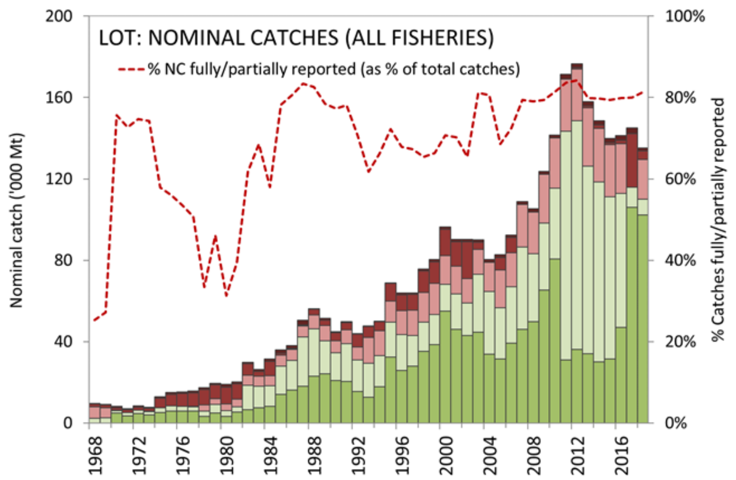


Fig. 7: Longtail tuna: nominal catch; uncertainty of annual catch estimates for all fisheries (1968–2018)

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).

[5] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2014-2018. The gray 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 2014-2018

Effort trends

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

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 for over 10 years, although the effort unit switched from trips to fishing hours then fishing days in recent years). I.R. Iran has also recently reported catch and effort for their coastal fisheries from 2007 to 2017. (**Fig. 9**).

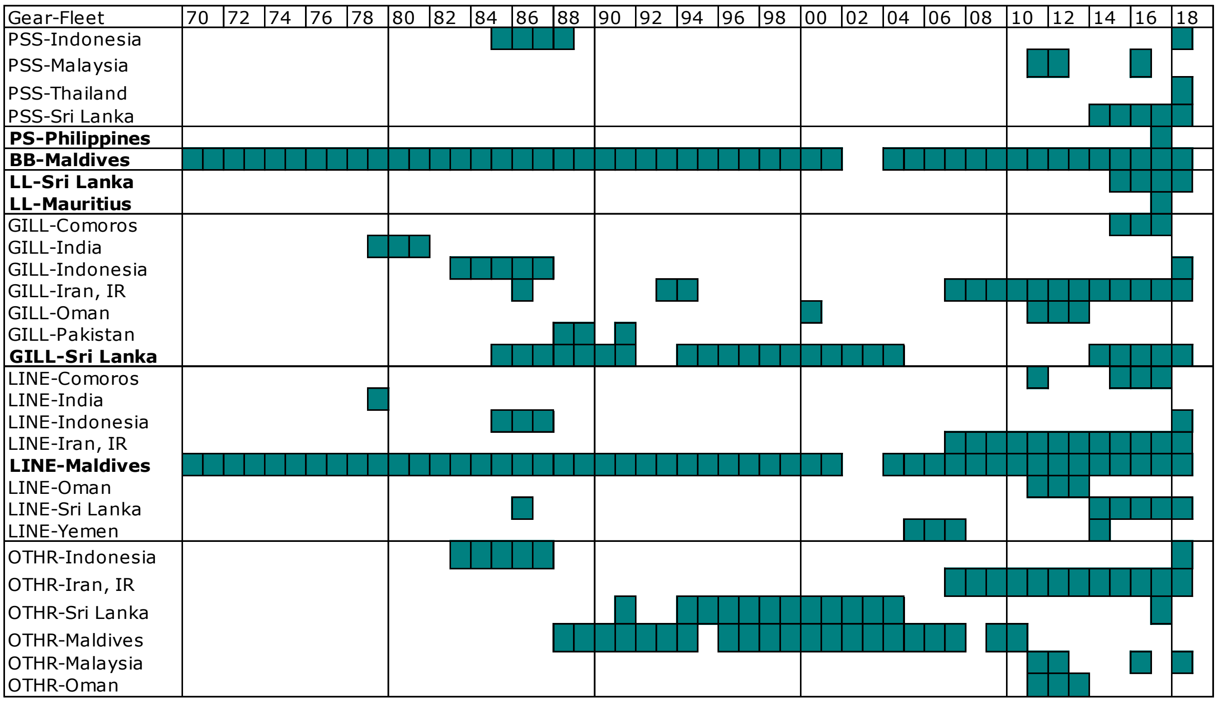


Fig. 8: Longtail tuna: Availability of catches and effort series, by fishery and year (1970–2018)[6]. No catch-and-effort is available for 1950–1971

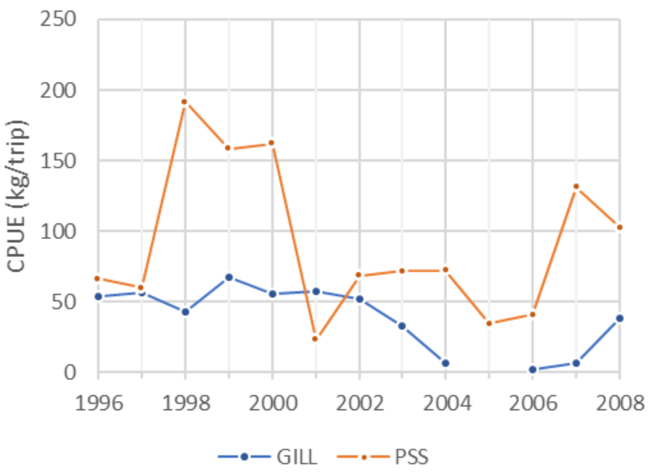


Fig. 9(a): Longtail tuna: Nominal CPUE series for gillnet (GILL) and coastal purse seine (PSS) fisheries of Thailand derived from available catch-and-effort data (1996–2008)

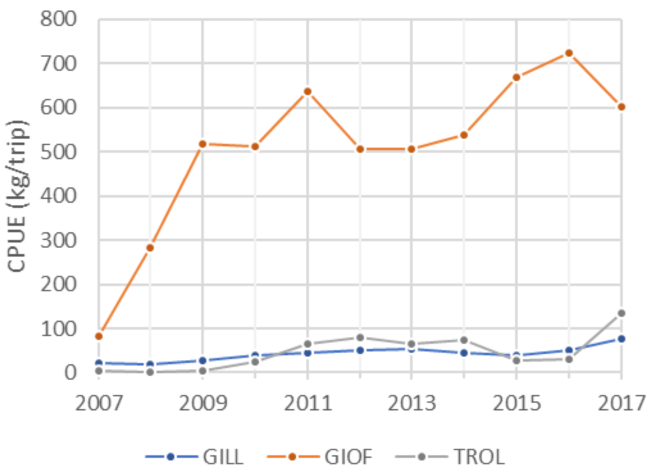


Fig. 9(b): Longtail tuna: Nominal CPUE series: for gillnet (coastal - GILL & offshore - GIOF) and trolling (TROL) fisheries of Iran derived from available catch-and-effort data (2007-2017)

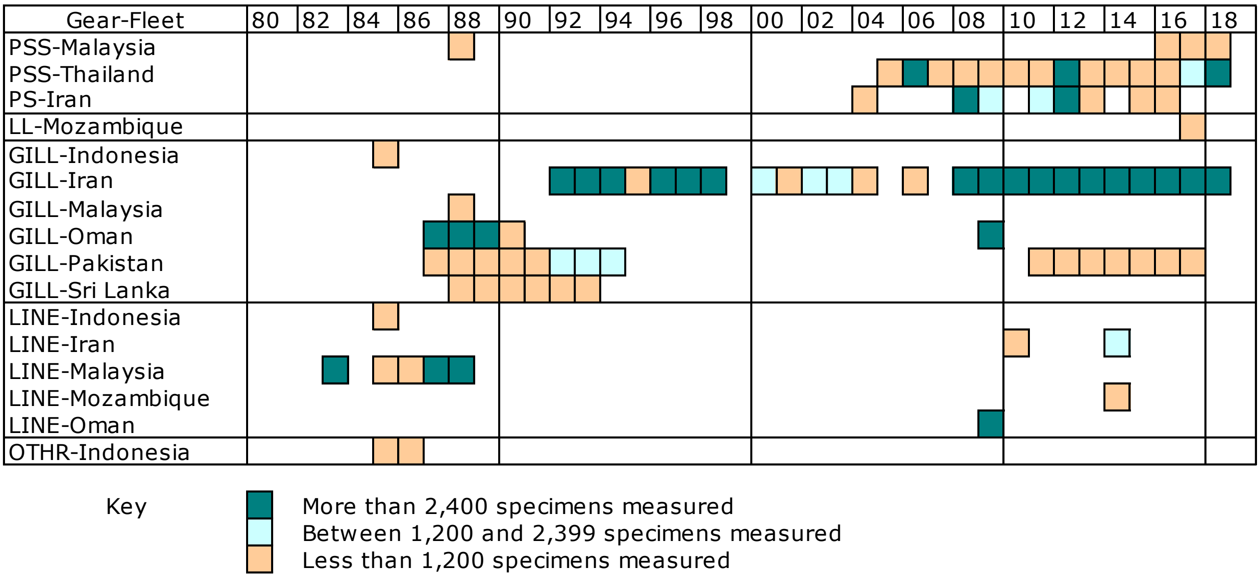
[6] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, catch-and-effort data are sometimes incomplete for a given year, existing only for short periods.

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 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), Oman (gillnet), Pakistan (gillnet), and Thailand (coastal purse seiners).

  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 (1980–2017)[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	RND=a*L^b	a= 0.00002 b= 2.83		Min:29 Max:128

Source: Data from Indian Ocean: IOTC-2011-WPNT01-18 Population dynamic parameters of Thunnus tonggol in the north of the Persian Gulf and Oman Sea; F.Kaymaram, M. Darvishi, F. Parafkandeh, Sh. Ghasemi & S.A. Talebzadeh

[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

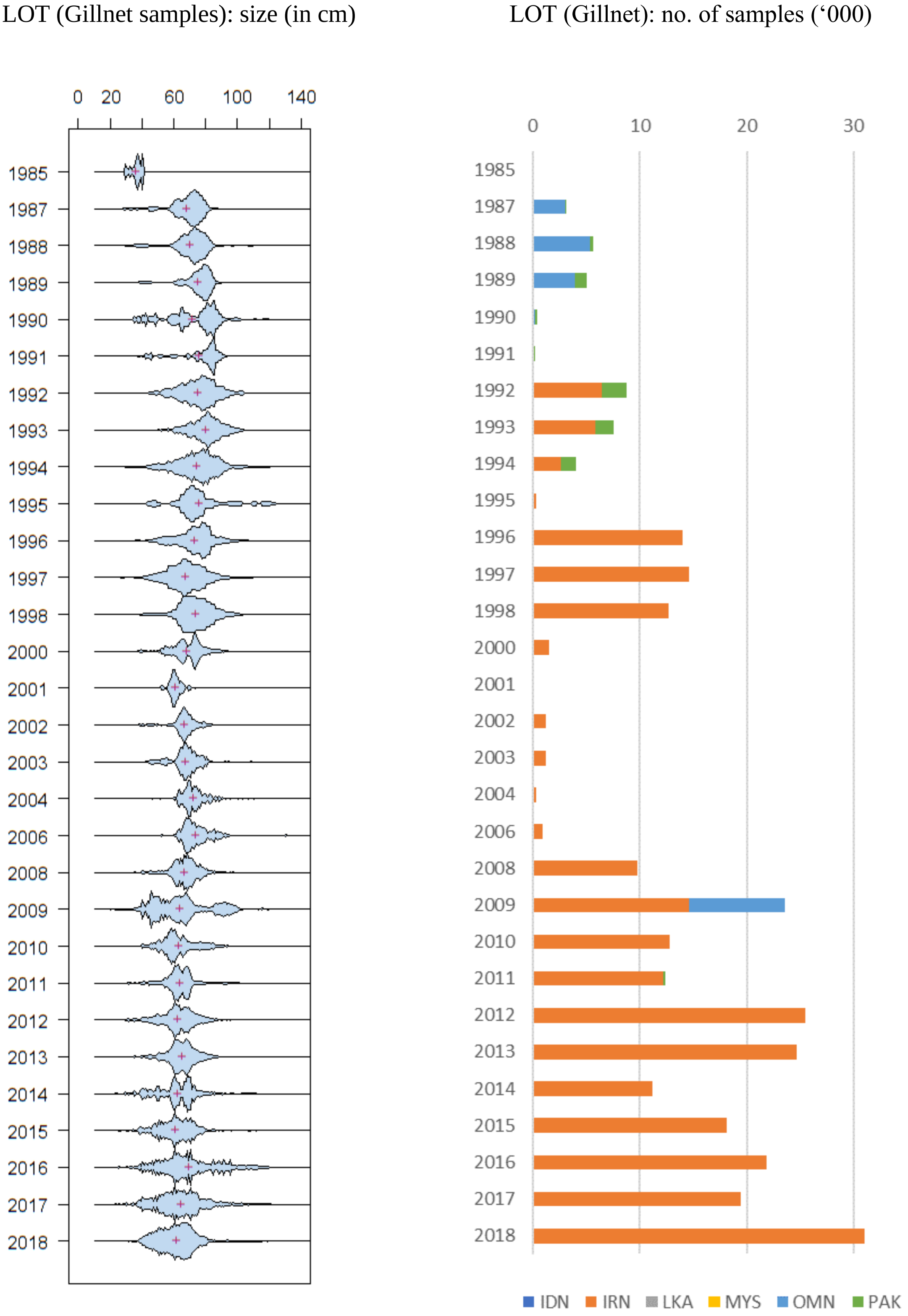


Fig. 11a-b: Left: Longtail tuna (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat, 1985-2018 - **Right**: Number of longtail tuna specimens (gillnet fisheries) sampled for lengths, by fleet and year

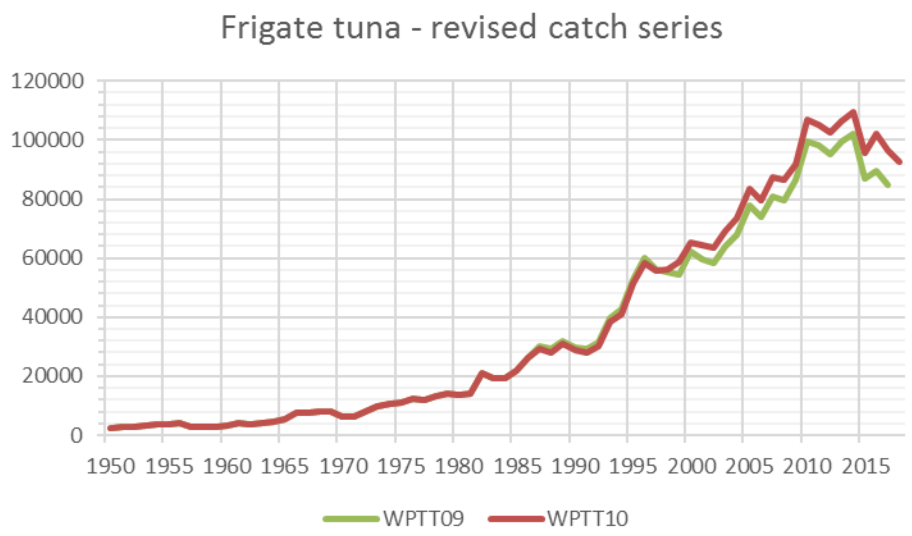
FRI - FRIGATE TUNA (*AUXIS THAZARD*)

Fisheries and main catch trends

- Main fisheries: frigate tuna is 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 59% of catches, while around 90% of catches are accounted for by four countries (Indonesia, Pakistan, I.R. Iran and India) (**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. Between 2010 and 2014 catches have increased to over 110,000 t, rising to the highest levels recorded; although catches have since decline marginally to between 90,000 – 100,000 t since 2014.
- Discard levels**:** are moderate for industrial purse seine fisheries. In previous years the EU has reported discard levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.

Changes to the catch series



There were relatively small revisions (i.e., between -8% and +14%, depending on the year) to the catches between 1987 and 2017 and almost exclusively due to the revised catch series of Pakistan gillnetters introduced during late 2019. Overall, the revised catches of Frigate tuna until 2017 are now 116,093 t **higher** than what reported at the previous WPNT in 2019.

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, a recent review by the IOTC Secretariat conducted by an independent consultant in 2012 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

[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.

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 compared to previous estimates.

- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches of frigate tuna to the IOTC Secretariat, and catch levels are highly uncertain. In the case of Myanmar, catches are taken from FAO and SEAFDEC (various years).
- Other artisanal fisheries: The catches of frigate tuna and bullet tuna are seldom reported by species and, when they are, they usually refer to both species combined (due to species misidentification or commercial categories used within countries, with all catches often assigned as 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, catches of frigate tuna are seldom recorded in the logbooks, nor can they be monitored in port. Currently the only discards data for frigate tuna reported to the IOTC Secretariat refer to the EU purse seine fleet, for 2003–07, estimated using observer data. Recent improvements in reporting of observer data for the industrial purse seine fleet of the EU and Seychelles might support a more accurate reconstruction of total discard levels for the species from these fleets.

Table 3: Best scientific estimates of the catches of frigate tuna by type of fishery for the period 1950–2018 (in metric tonnes). Data as of May 2020

Fishery	By decade (average)						By year (last ten years)									
	1950s	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Purse seine	-	13	824	4,666	7,552	10,021	9,663	12,044	11,636	10,369	10,371	13,153	9,639	11,109	9,158	17,061
Gillnet	492	1,247	2,837	6,633	14,147	25,707	29,415	38,476	37,042	38,288	37,069	44,369	37,102	42,818	40,615	38,254
Line	1,262	2,406	4,419	7,430	13,733	27,063	34,570	37,808	37,544	36,239	39,933	37,394	35,193	34,533	32,831	25,750
Other	1,441	2,007	2,349	3,683	9,276	13,670	18,112	18,550	18,934	17,665	19,024	14,630	13,837	13,725	13,869	11,660
Total	**3,196**	**5,673**	**10,428**	**22,411**	**44,709**	**76,461**	**91,760**	**106,877**	**105,155**	**102,560**	**106,398**	**109,546**	**95,771**	**102,185**	**96,473**	**92,725**

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.

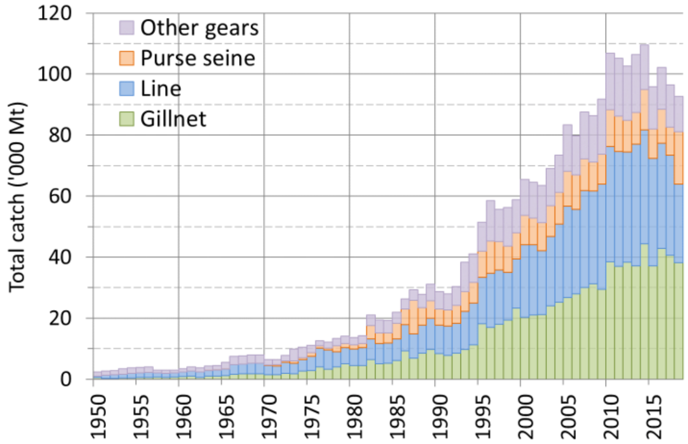


Fig.12: Frigate tuna: annual catches by gear recorded in the IOTC Database (1950–2018)

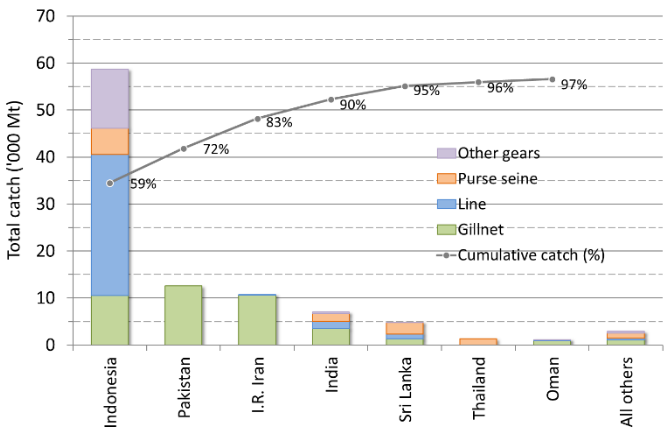


Fig. 13: Frigate tuna: average catches in the Indian Ocean over the period 2014-18, by country[9]

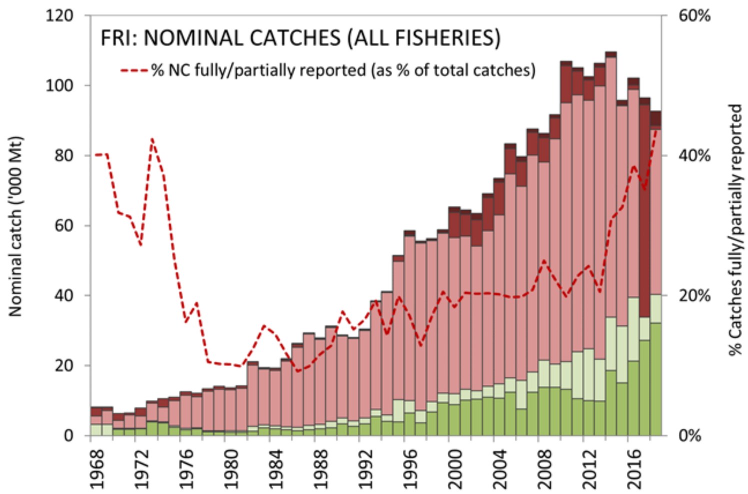


Fig. 14: Frigate tuna: nominal catch; uncertainty of annual catch estimates for all fisheries (1968–2018)

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).

[9] Countries are ordered from left to right, according to the importance of catches of frigate tuna reported for 2014-2018. The gray line indicates the (cumulative) proportion of catches of frigate tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2014-2018

Effort trends

- Availability: Effort trends are unknown or inaccurate due to a general lack of catch-and-effort data for the species.

Catch-per-unit-effort (CPUE) trends

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

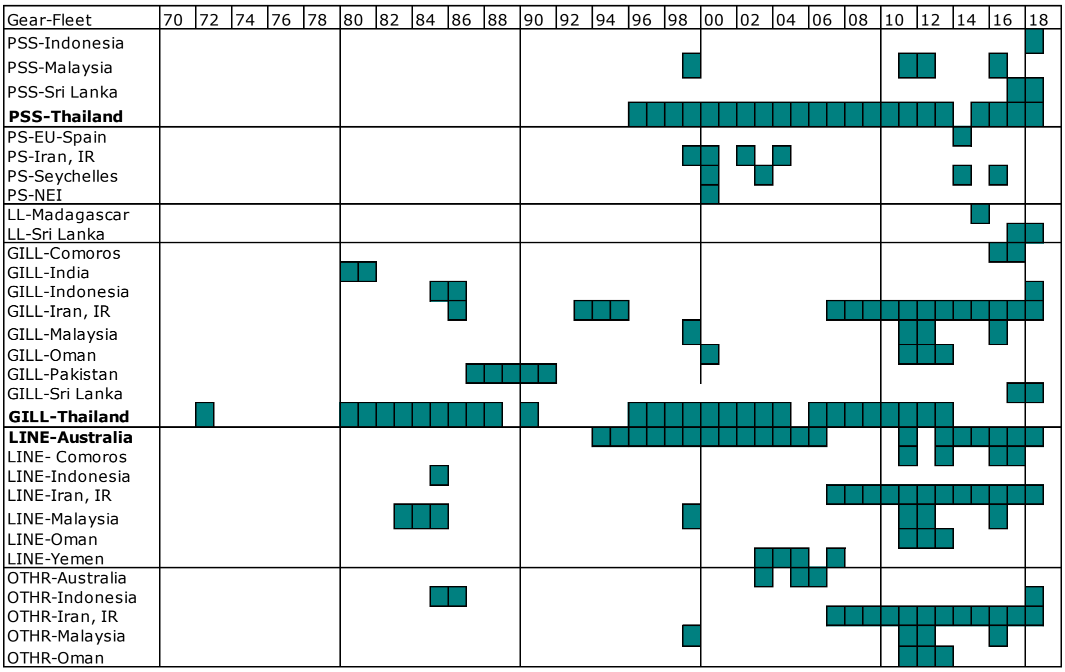


Fig. 15: Frigate tuna: Availability of catches and effort series, by selected fishery and year (1970–2018)[10]. Note that no catch-and-effort data are available for 1950–69

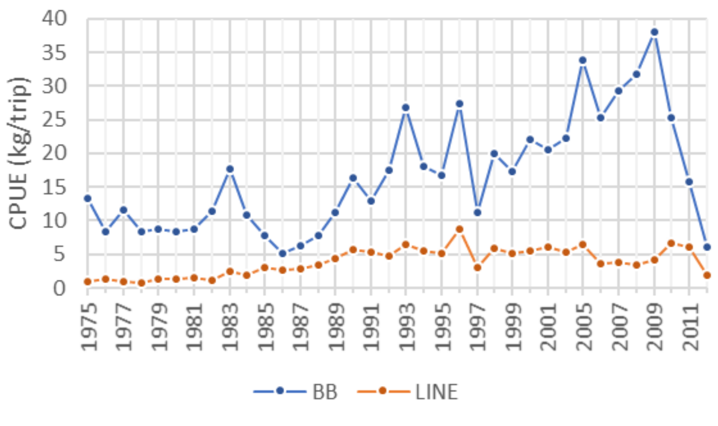


Fig. 16(a): Frigate tuna: Nominal CPUE series for the baitboat (BB using mechanized boats) and line (LINE, including handlines and trolling using mechanized boats) fisheries of Maldives derived from the available catches and effort data (1975–2018). Data since 2013 has been reported as fishing days (rather than as fishing trips for data up to 2013)

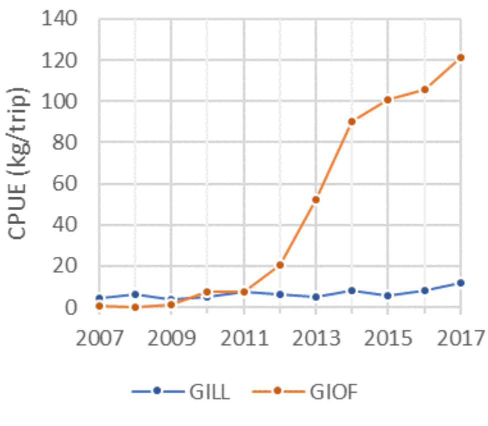


Fig. 16(b): Frigate tuna Nominal CUE series for gillnet coastal (GILL) and offshore (GIOF) fisheries of Iran from available catch and effort data (2007-2017)

[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

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 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).

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

  Main sources for size samples: Sri Lanka (gillnet, until 2007 and from 2016 onward) and Thailand (coastal purse seiners, from 2005), EU,ESP (purse seine, 2014 and 2018).

  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.

- 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.

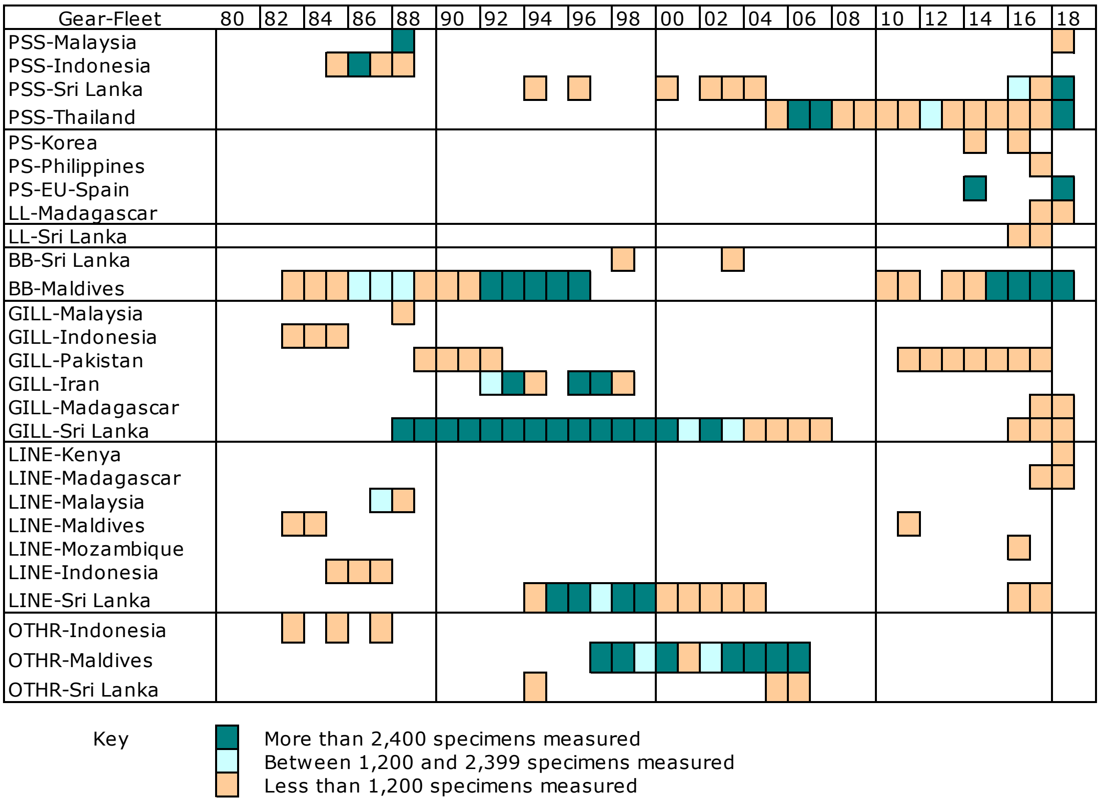


Fig. 17: Frigate tuna: Availability of length frequency data, by fishery and year (1980–2018)[11]. Note that no length frequency data are available at all for 1950–82

Other biological data

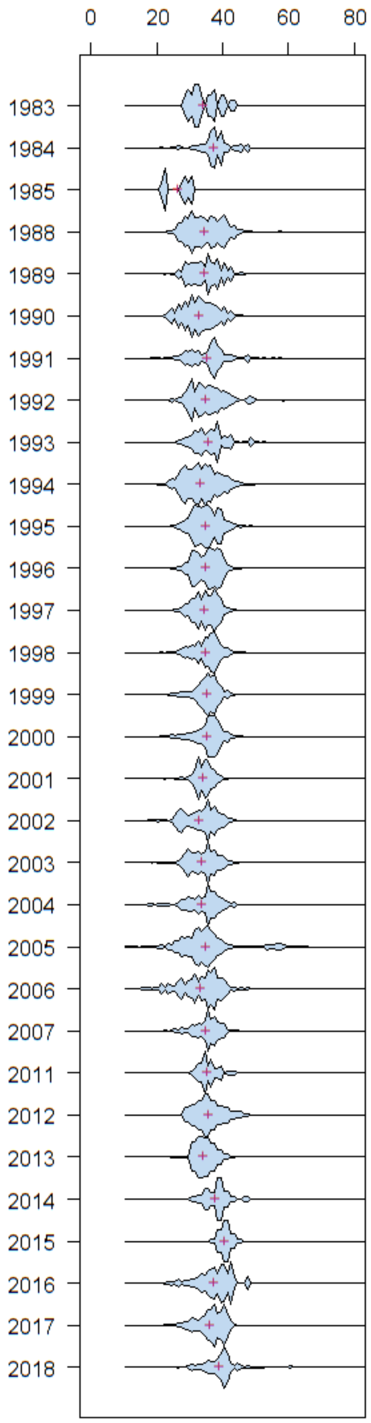
Equations available for frigate tuna are shown below:

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

Source: Data from Indian Ocean: IOTC-2011-WPNT01-10 Tuna Fishery of India with Special Reference to Biology and Population Characteristics of Neritic Tunas Exploited from Indian EEZ

[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

FRI (Gillnet samples): size (in cm)



FRI (Gillnet): no. of samples (‘000)

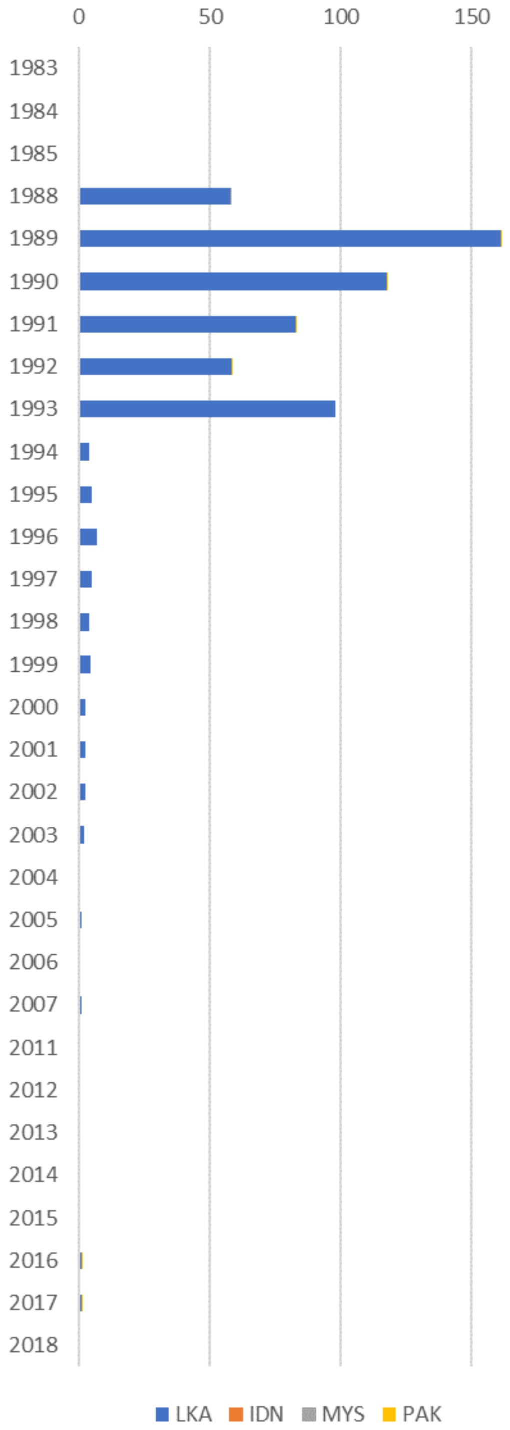


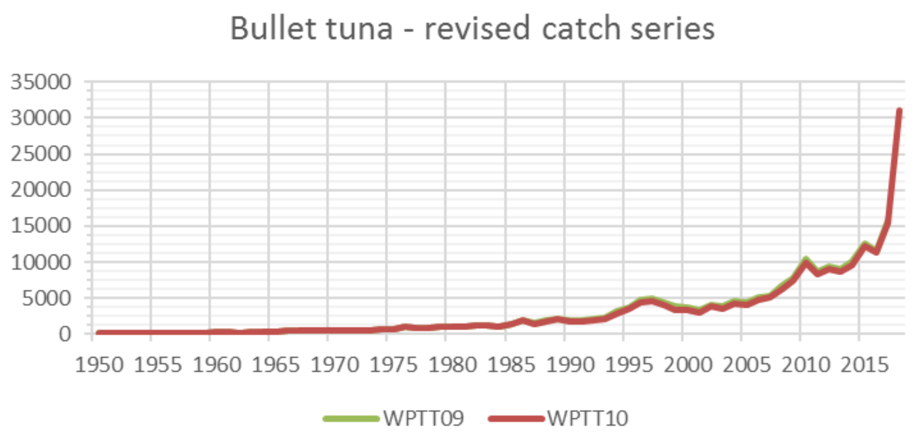
Fig. 18a-b: **Left:** Frigate tuna (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat, 1983-2018 - **Right:** Number of frigate tuna specimens (gillnet fisheries) sampled for lengths, by fleet and year

BLT - BULLET TUNA (*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 nearly 90% of catches in the Indian Ocean have been accounted for by fisheries in India, Indonesia and Sri Lanka (**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 4,600 t. The catches decreased slightly in the following years and remained at values of between 3,000 t and 4,000 t until the late-2000's, increasing sharply again up to the 10,000 t recorded in 2010. Since 2014 catches have increased from 10,000 t to almost 16,000 t – mostly due to an increase in catches reported by India (handline, gillnet and trolling fisheries), with a peculiar peak in reported catches for 2018 (31,000 t) due to a large reporting of captures for the species from industrial (i.e. non-coastal) purse seiners from Indonesia, reaching over 16,000 t.
- 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



There were relatively small revisions (i.e., between -11% and -3%, depending on the year) to the catches between 1987 and 2017 and almost exclusively due to the revised catch series of Pakistan gillnetters introduced during late 2019. The sharp increase in catches reported for 2018 (around +110%) is almost exclusively attributed to the data reported by Indonesia for what appears to be a newly developed industrial component of their purse seiners fleet. Overall, the revised catches of Bullet tuna until 2017 are now 9,897 t **lower** than what reported at the previous WPNT in 2019.

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.

For the reasons listed above 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.

[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: Best scientific estimates of the catches of bullet tuna by type of fishery for the period 1950–2018 (in metric tonnes). Data as of May 2020

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Purse seine	-	2	28	278	552	655	1,055	1,372	635	549	518	2,539	3,023	2,207	2,982	21,574
Gillnet	41	153	296	476	971	1,379	2,132	2,923	2,293	2,417	2,348	2,777	2,596	2,406	3,791	3,614
Line	113	193	325	393	780	1,190	2,182	2,903	1,471	1,512	1,228	2,895	5,191	4,680	6,674	4,422
Other	5	13	44	242	755	1,322	2,022	2,748	3,905	4,510	4,623	1,387	1,402	1,965	1,999	1,442
Total	**159**	**362**	**693**	**1,390**	**3,058**	**4,545**	**7,392**	**9,946**	**8,303**	**8,989**	**8,717**	**9,598**	**12,212**	**11,258**	**15,446**	**31,052**

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.

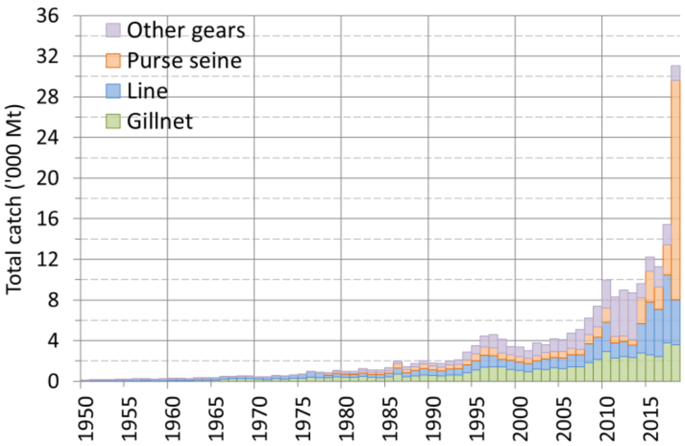


Fig. 19: Bullet tuna: annual catches by gear recorded in the IOTC Database (1950–2018)

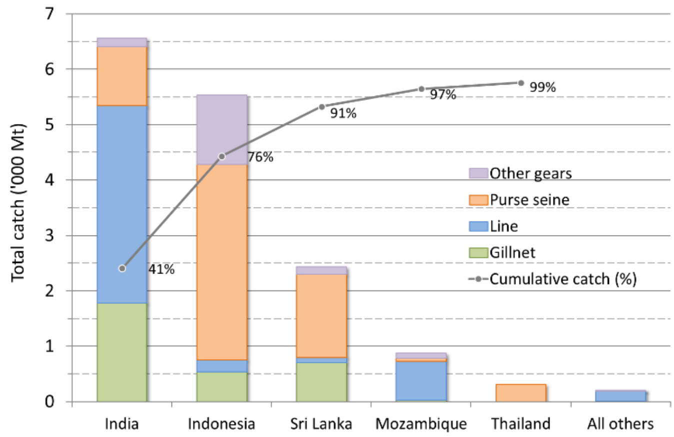


Fig. 20: Bullet tuna: average catches in the Indian Ocean over the period 2014-18 by country[13]

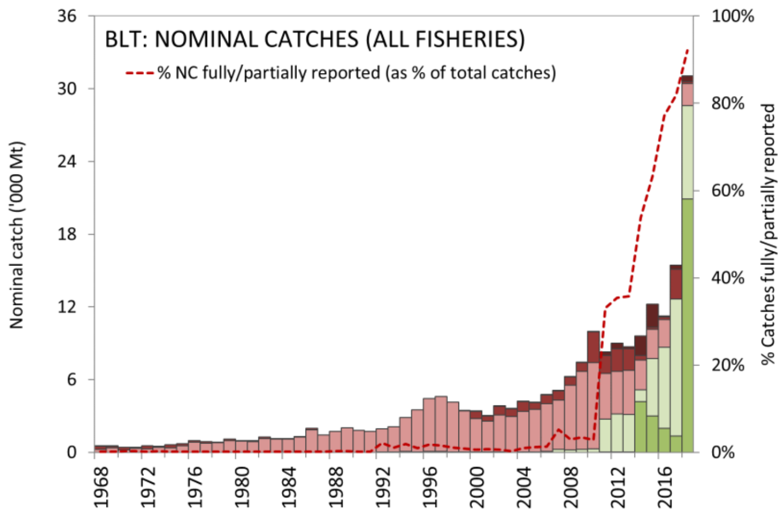


Fig. 21: Bullet tuna: nominal catch; uncertainty of annual catch estimates for all fisheries (1968–2018)

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).

[13] Countries are ordered from left to right, according to the importance of catches of bullet tuna reported for 2014-2018. The gray line indicates the (cumulative) proportion of catches of bullet tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2014-2018

Effort trends

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

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**).

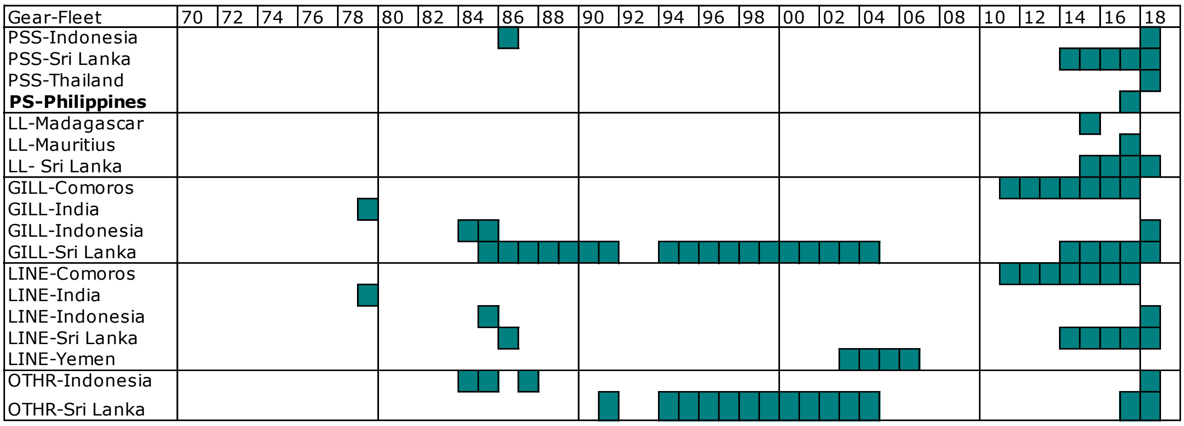


Fig. 22: Bullet tuna: Availability of catches and effort series, by fishery and year (1970–2018)[14]. Note that no catches and effort are available at all for 1950–78

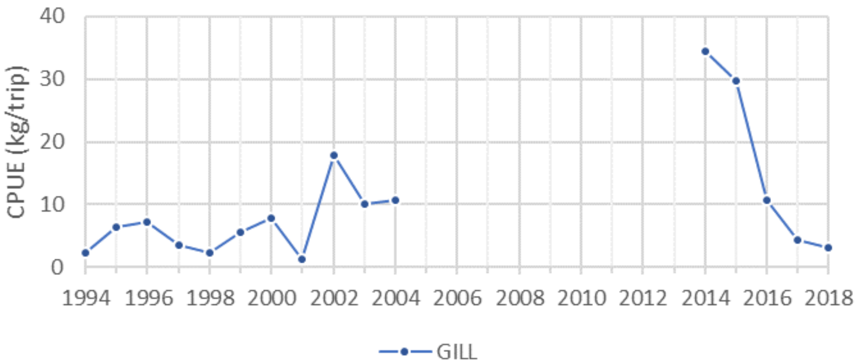


Fig. 23: Bullet tuna: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004 and 2014-2018)

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 until 2007, gillnet and ringnet – both coastal and offshore – from 2016 onward).

  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.

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

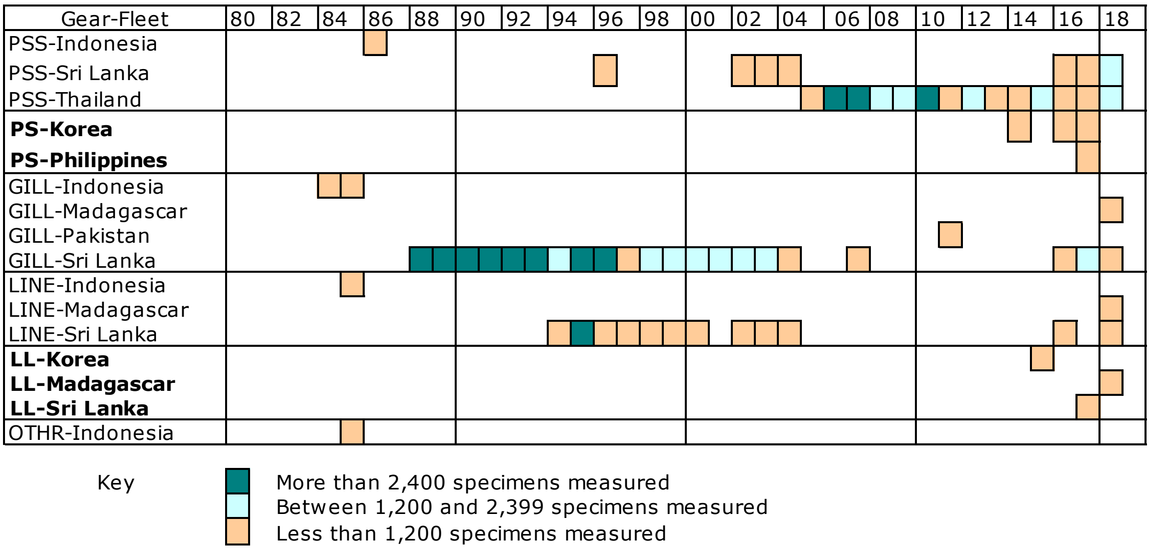


Fig. 24: Bullet tuna: Availability of length frequency data, by fishery and year (1980–2018)[15]. Note that no length frequency data are available at all for 1950–83

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 Weight	RND=a*L^b	a= 0.00001700 b= 3.0		Min:10 Max:40

Source: Data from North Indian Ocean: IPTP Sampling Programme in Sri Lanka (1989)

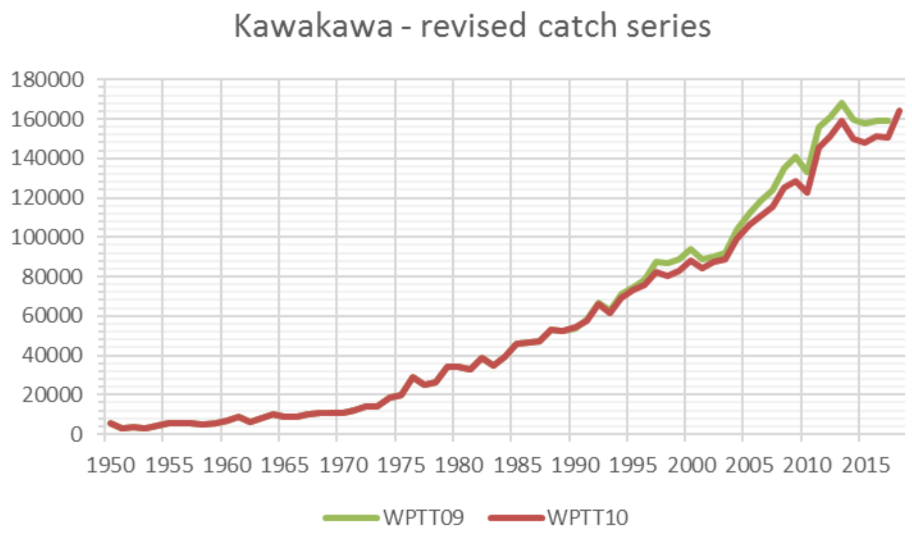
15 Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

KAW - KAWAKAWA (*EUTHYNNUS AFFINIS*)

Fisheries and main catch trends

- Main fisheries: Kawakawa are caught mainly by gillnets, coastal purse seiners, handline and trolling, and may also be 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 Malaysia (**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 to over 145,000 t in recent years (since 2011). Since 2011 catches have fluctuated between 145,000 t and 165,000 t – the highest catches ever recorded for this species in the Indian Ocean.
- Discard levels: are moderate for industrial purse seine fisheries. In recent years the EU has reported discard levels of kawakawa for its purse seine fleet, for 2003–07, estimated using observer data.

Changes to the catch series



There were relatively small revisions (i.e., between -1% and -7%, depending on the year) to the catches between 1987 and 2017 and almost exclusively due to the revised catch series of Pakistan gillnetters introduced during late 2019. Overall, the revised catches of Kawakawa until 2017 are now 163,988 t **lower** than what reported at the previous WPNT in 2019.

Estimation of catches: data related issues

Retained catches for kawakawa were derived from incomplete information, and are therefore considered to be highly 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 as species aggregates 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. 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, although fundamental issues remain with the quality of official catches reported by Indonesia to the IOTC Secretariat (e.g., unexplained fluctuations in catches by species between years, as well as large revisions in catches).
- Artisanal fisheries of India: Although India reports catches of Kawakawa, these 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.

[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.

- 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 highest captures for the species from any industrial fishery were reported in 2018 by Indonesian purse seiners with around 17,000 t in total (corroborating the idea that the fishery is actually targeting neritic species). The EU recently reported catch levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data: same considerations about the possibility of using ROS data to estimate total catches and discards for the EU and Seychelles purse seiners fleet apply here as in the case of frigate tuna.

Table 5: Best scientific estimates of the catches of kawakawa by type of fishery for the period 1950–2018 (in metric tonnes). Data as of May 2020

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Purse seine	111	385	2,616	12,070	21,398	28,613	37,051	35,064	44,892	42,722	42,479	40,438	42,351	39,124	42,590	57,370
Gillnet	2,552	4,473	9,691	18,002	28,450	47,186	57,591	54,034	64,159	71,880	77,684	75,302	70,899	77,939	78,431	80,334
Line	1,721	3,270	6,642	9,854	15,270	19,848	24,003	23,583	26,641	26,860	28,772	26,073	27,572	26,043	22,853	19,981
Other	295	719	1,357	2,690	5,127	7,819	10,129	9,994	10,007	9,986	10,329	8,436	7,428	8,337	6,648	6,448
Total	**4,679**	**8,847**	**20,306**	**42,615**	**70,245**	**103,466**	**128,774**	**122,675**	**145,699**	**151,449**	**159,264**	**150,248**	**148,251**	**151,443**	**150,522**	**164,133**

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.

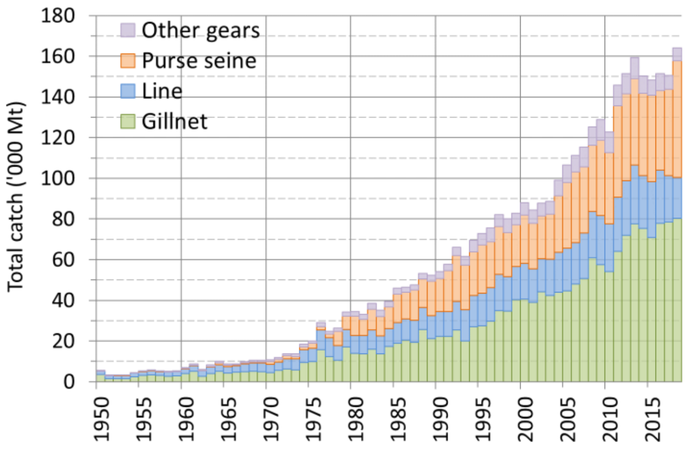


Fig. 25: Kawakawa: annual catches by gear recorded in the IOTC Database (1950–2018)

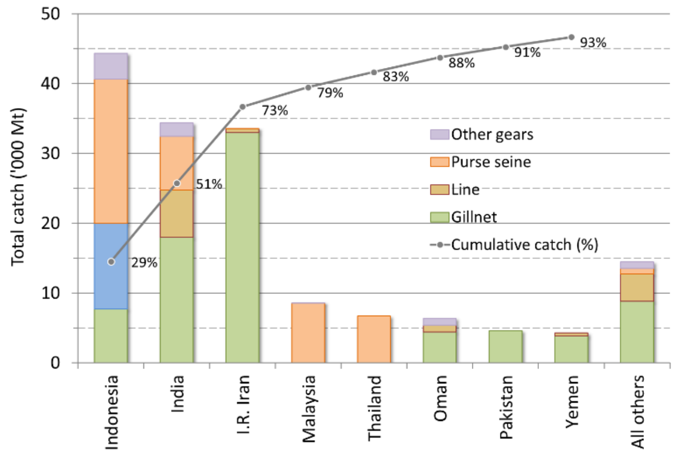


Fig. 26: Kawakawa: average catches in the Indian Ocean over the period 2014-18, by country[17]

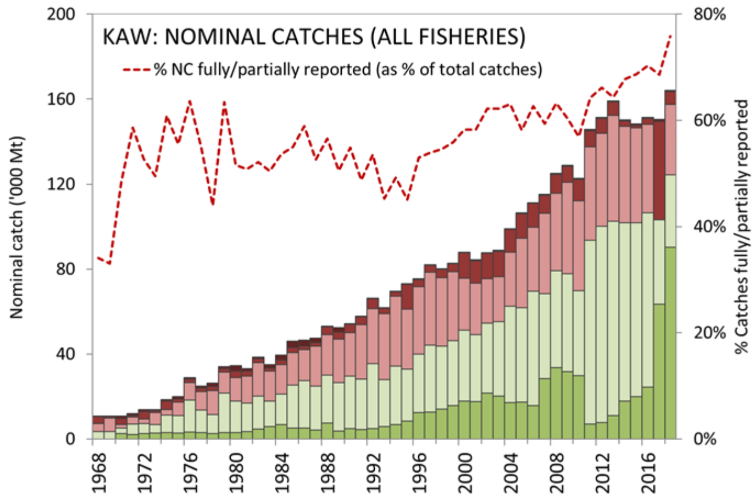


Fig. 27: Kawakawa: nominal catch; uncertainty of annual catch estimates for all fisheries (1968–2018)

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).

Effort trends

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

[17] Countries are ordered from left to right, according to the importance of catches of kawakawa reported for 2014-2018. The gray line indicates the (cumulative) proportion of catches of kawakawa for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2014-2018

Catch-per-unit-effort (CPUE) trends

- Availability: highly incomplete, with data available for only short periods of time and selected fisheries (**Fig. 28**)
- Main CPUE series available: 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. Also, the fishing effort unit reported by Maldives has changed from trips to fishing days from 2013 onwards.

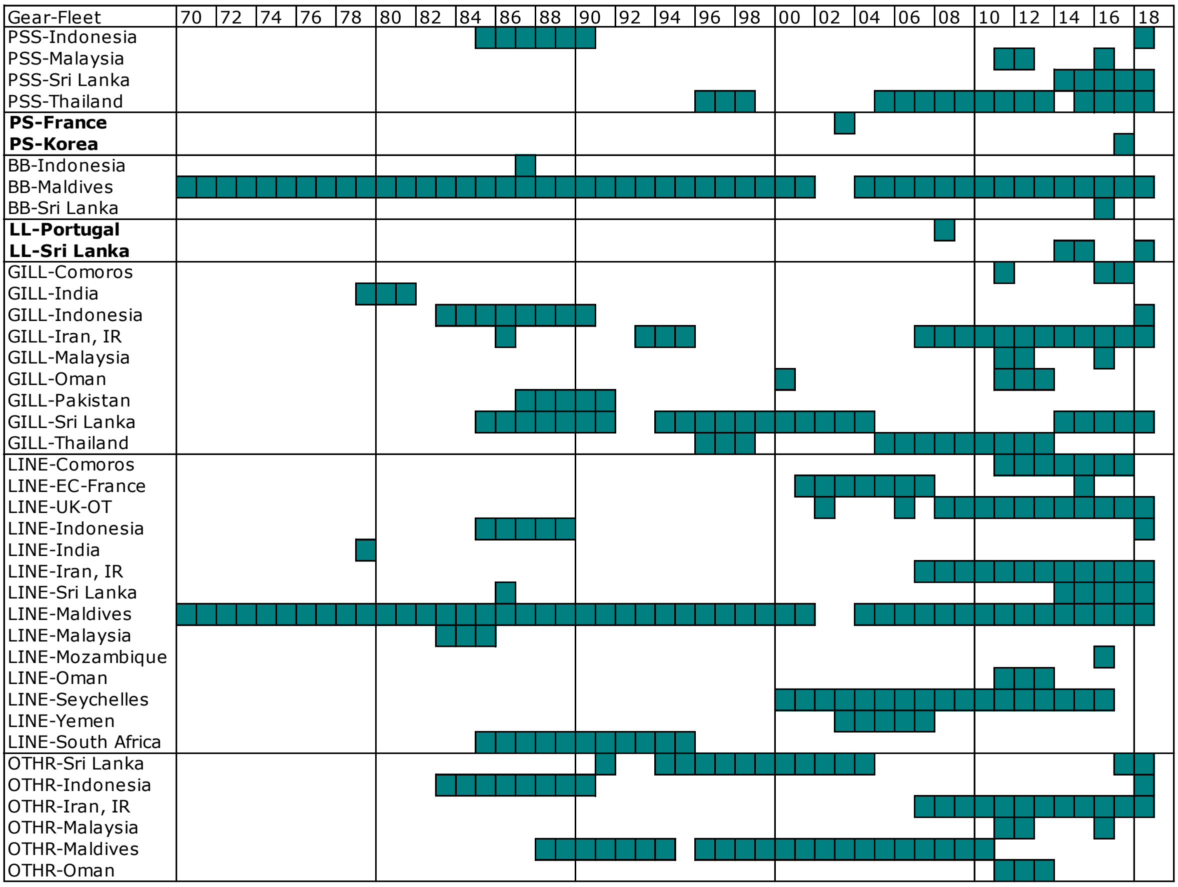


Fig. 28: Kawakawa: Availability of catches and effort series, by fishery and year (1970-2018)[18]. Note that no catches and effort are available at all for 1950–69

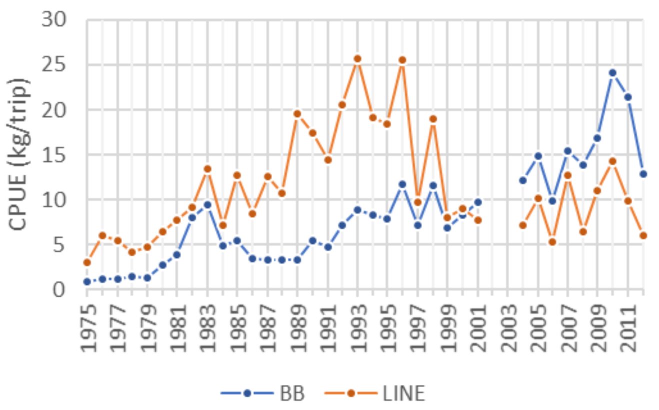


Fig. 29(a): Kawakawa: Nominal CPUE series for baitboat (BB) and troll line (TROL) fisheries of Maldives (1975–2018) derived from the available catch-and-effort data. Data since 2013 has been reported as fishing days (rather than as fishing trips as for data up to 2012)

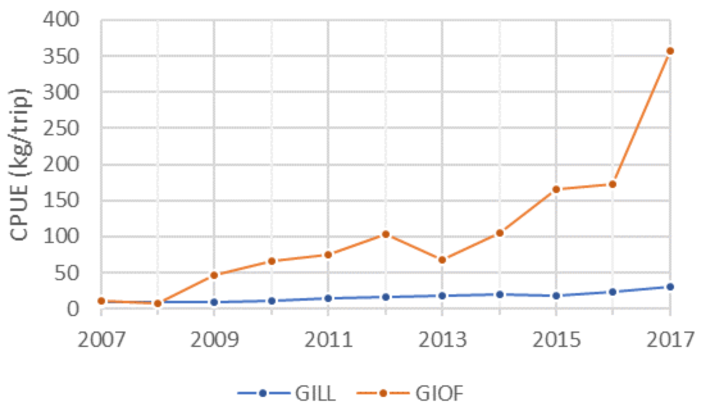


Fig. 29(b): Kawakawa: Nominal CPUE series for the gillnet fishery (coastal and offshore) of I.R. Iran derived from the available catches and effort data (2007-2017)

[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

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. 31a**). The coastal purse seine fisheries operating in the Andaman Sea tend to catch kawakawa of a relatively small size (15–30 cm) while 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: I.R. Iran (gillnets), Thailand (coastal purse seiners), Sri Lanka (gillnets), Malaysia (troll lines and coastal purse seiners)

  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. 31b**). 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. 31a**. Data are not 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.

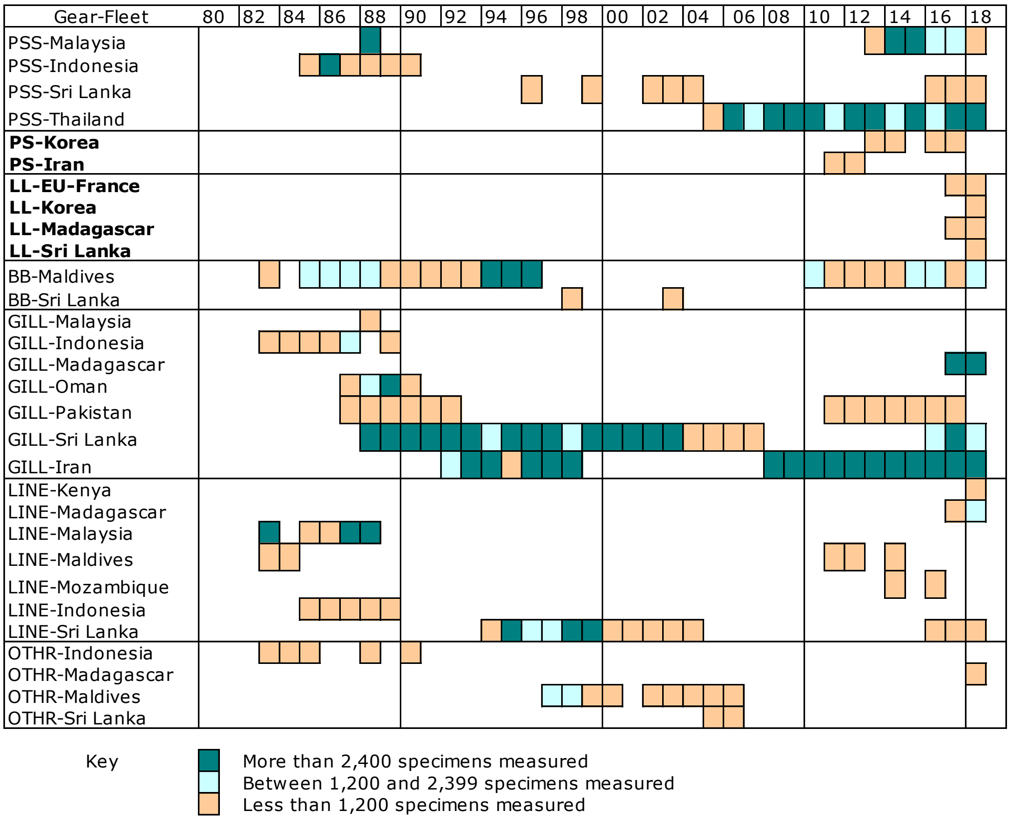


Fig. 30: Kawakawa: Availability of length frequency data, by fishery and year (1980-2018)[19]. Note that no length frequency data are available for 1950–82

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 Weight*	*RND=a*L^b*	*a= 0.0000260 b= 2.9*		*Min: 20 Max: 65*

[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

Source: Data from North Indian Ocean: IPTP Sampling Programme in Sri Lanka (1989)

KAW (Gillnet samples): size (in cm) KAW (Gillnet): no. of samples (‘000)

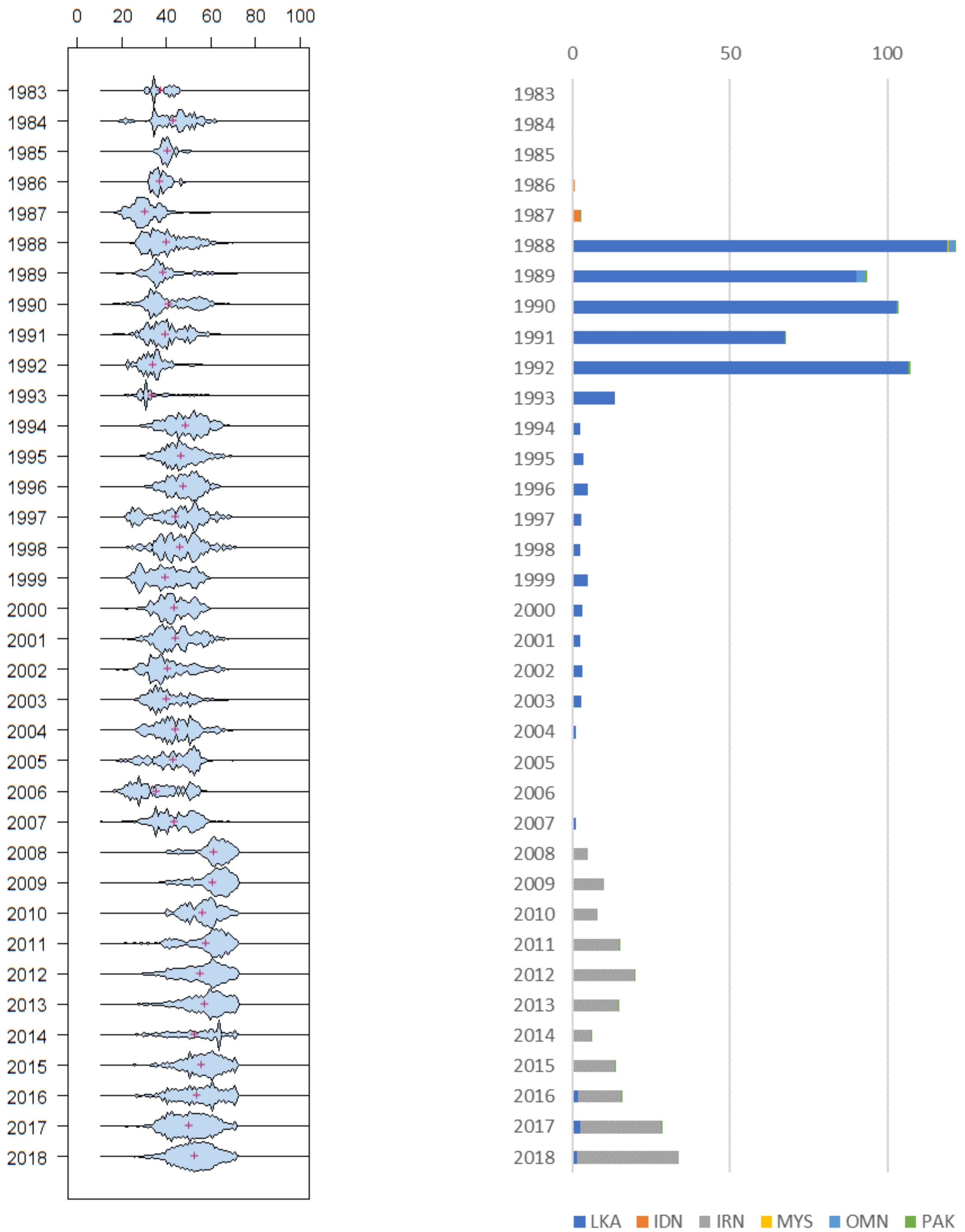


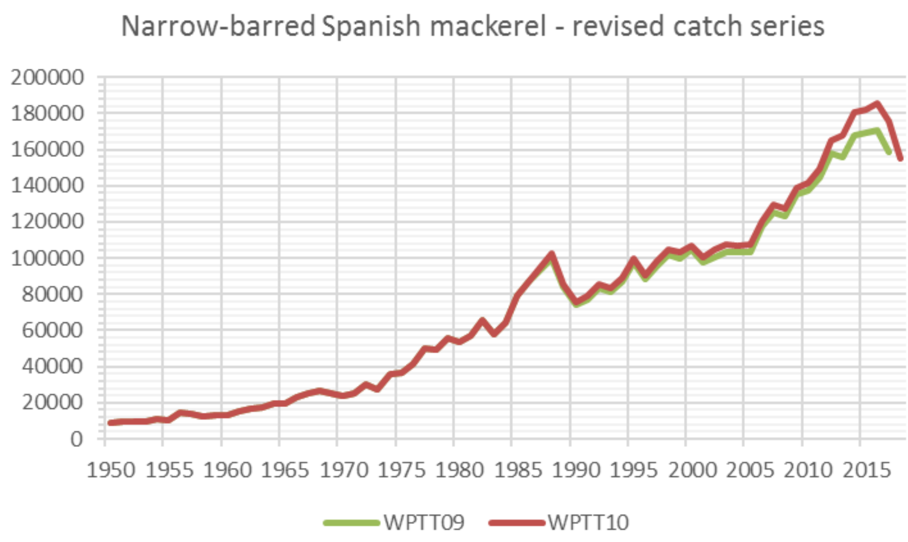
Fig. 31a-b: Left: Kawakawa (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat, 1983-2018 - **Right:** Number of kawakawa specimens (gillnet fisheries) sampled for lengths, by fleet and year

COM - NARROW-BARRED SPANISH MACKEREL (*SCOMBEROMORUS COMMERSON*)

Fisheries and main catch trends

- Main fisheries: Narrow-barred Spanish mackerel 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, I.R. Iran and Pakistan account for around 70% of catches in recent years (**Fig. 33**). Spanish mackerel is also targeted throughout the Indian Ocean by artisanal and sports/recreational fisheries.
- Retained catch trends:
  Catches of narrow-barred Spanish mackerel increased from around 50,000 t in the late-1970's to over 100,000 t by the late-1990's. Since 2011, some of the highest catches for this species have been recorded, with catches fluctuating beween 145,000 and 185,000 t.
- Discard levels**:** are thought to be very low, although estimates of discards are unknown for most fisheries.

Changes to the catch series



There were relatively small revisions (i.e., between 2% and 11%, depending on the year) to the catches between 1987 and 2017 and almost exclusively due to the revised catch series of Pakistan gillnetters introduced during late 2019. Overall, the revised catches of narrow-barred Spanish mackerel until 2017 are now 152,169 t **higher** than what reported at the previous WPNT in 2019.

Estimation of catches – data related issues

Retained catches for Spanish mackerel were derived from incomplete information, and are therefore uncertain[20] (**Fig. 34**), 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 for both India and Indonesia. In recent years, the catches of narrow-barred Spanish mackerel estimated for their Indonesia and India component represent around 45% of the total catches of this species in the Indian Ocean.
- Artisanal fisheries of Madagascar: Madagascar started reporting catches from 2018. However, the data is still under reviewed as its coverage is very low: for this reason, the catches currently available through the IOTC database are still those estimated following the 2012 review. In fact, 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

[20] 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.

(1950–2008), undertaken by the Sea Around Us Project). However, the new catches estimated are still considered to be highly 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, until 2017, Thailand reported catches of narrow-barred Spanish mackerel and Indo-Pacific king mackerel aggregated.
- All fisheries: Catches of seerfish species are misreported in some cases, with catches of Indo-Pacific king mackerel and, to a lesser extent, other seerfish species reported as narrow-barred Spanish mackerel. Similarly, the catches of wahoo in some longline fisheries are thought to be misreported as narrow-barred Spanish mackerel –although this is thought to have little impact in the case of the narrow-barred Spanish mackerel but may be important for other seerfish species.

Table 6: Best scientific estimates of the catches of narrow-barred Spanish mackerel by type of fishery for the period 1950–2018 (in metric tonnes). Data as of May 2020

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Purse seine	-	0	285	2,354	4,141	5,440	8,459	8,100	8,829	8,900	9,419	8,534	8,169	8,505	8,133	7,202
Gillnet	9,526	17,709	32,168	55,524	65,049	70,952	80,062	85,345	89,981	100,331	103,500	117,455	115,626	118,432	111,078	98,842
Line	1,735	2,471	4,672	11,334	12,032	17,318	22,279	23,250	25,029	26,420	27,788	29,898	32,457	30,879	29,222	26,870
Other	57	96	468	5,603	9,746	21,353	28,170	24,551	25,802	29,358	26,842	25,065	25,996	27,971	27,253	21,871
Total	**11,318**	**20,276**	**37,593**	**74,815**	**90,968**	**115,064**	**138,970**	**141,245**	**149,641**	**165,010**	**167,549**	**180,952**	**182,247**	**185,786**	**175,686**	**154,785**

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.

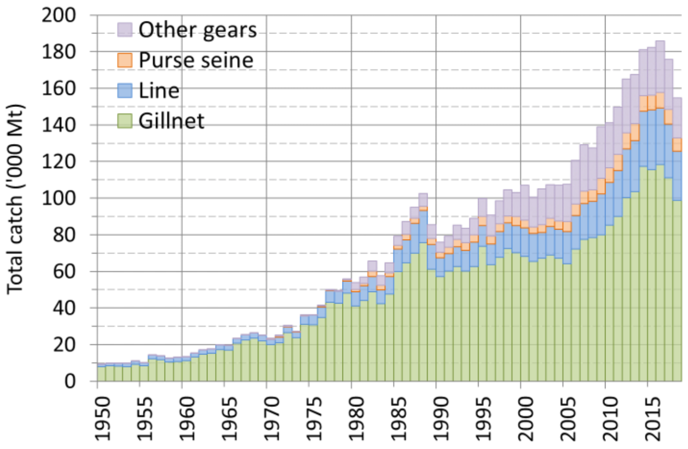


Fig. 32: Narrow-barred spanish mackerel: annual catches by gear recorded in the IOTC Database (1950–2018)

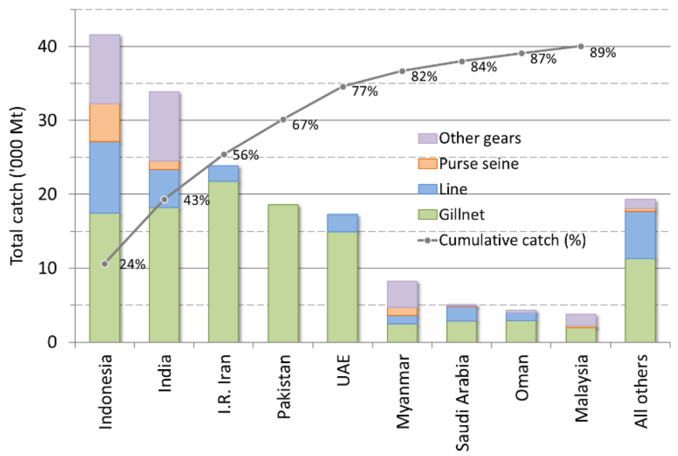


Fig. 33: Narrow-barred spanish mackerel: average catches in the Indian Ocean over the period 2014-18, by country[21]

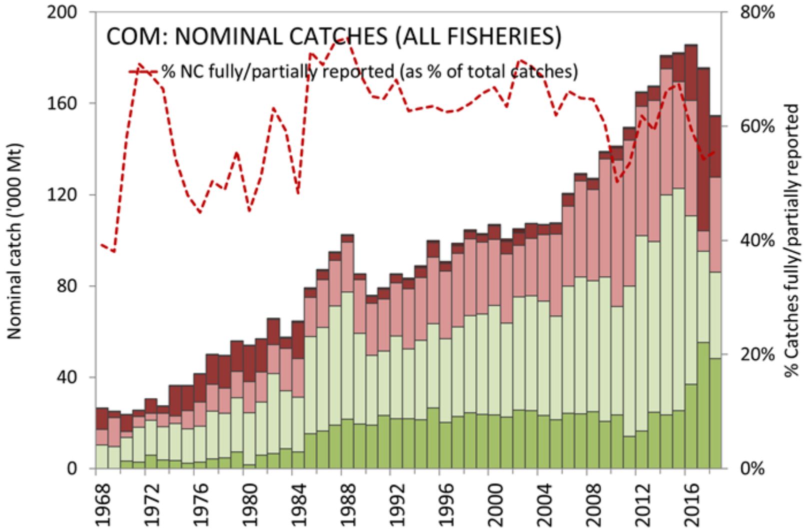


Fig. 34: Narrow-barred spanish mackerel: nominal catch; uncertainty of annual catch estimates for all fisheries (1968–2018)

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).

Effort trends

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

[21] Countries are ordered from left to right, according to the importance of catches of narrow-barred Spanish mackerel reported for 2014-2018. The gray line indicates the (cumulative) proportion of catches of narrow-barred Spanish mackerel for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2014-2018

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 are not available for years between 2005 and 2013 and in recent years are thought to be unreliable due to the dramatic changes in CPUE recorded in 2015 and 2016 (**Fig. 36a**).

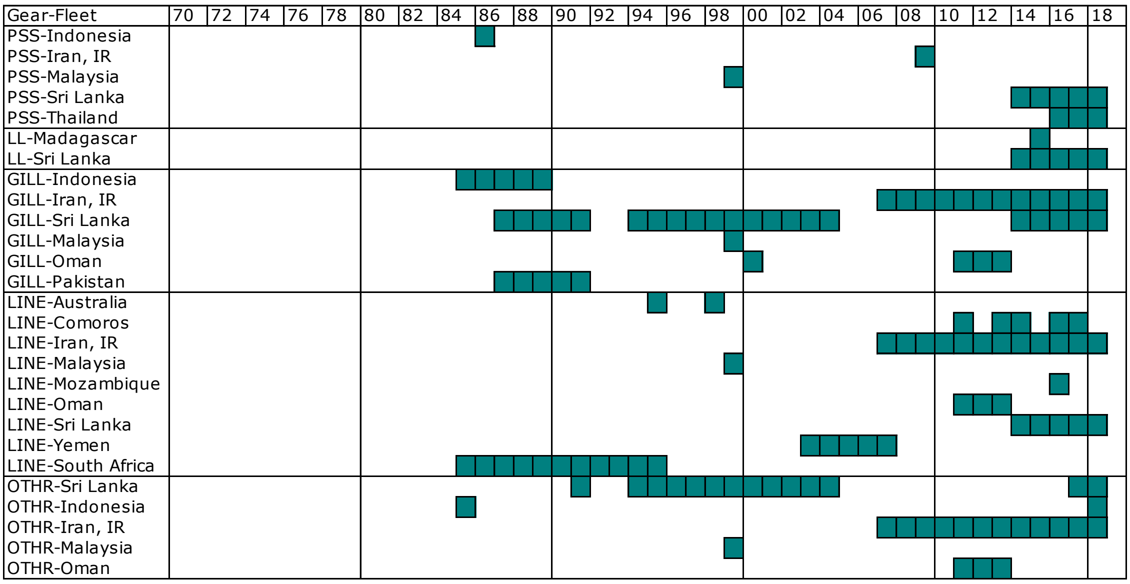


Fig. 35: Narrow-barred Spanish mackerel: Availability of catches and effort series, by fishery and year (1970–2018)[22]. No catches and effort are available at for 1950–84, and 2008–10

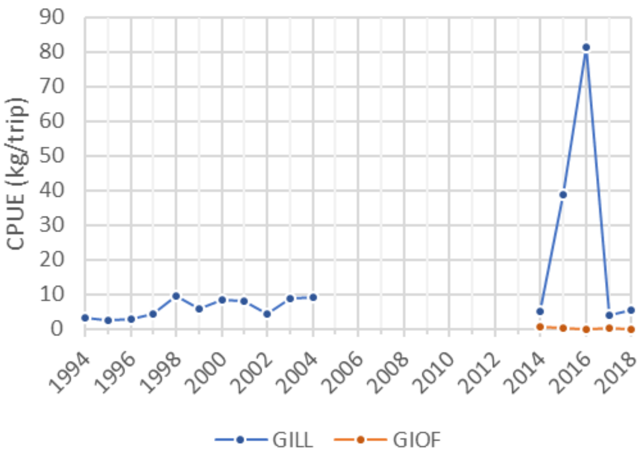


Fig. 36(a): Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet fishery (coastal – GILL and offshore – GIOF) of Sri Lanka derived from the available catches and effort data (1994–2004 and 2014-2018)

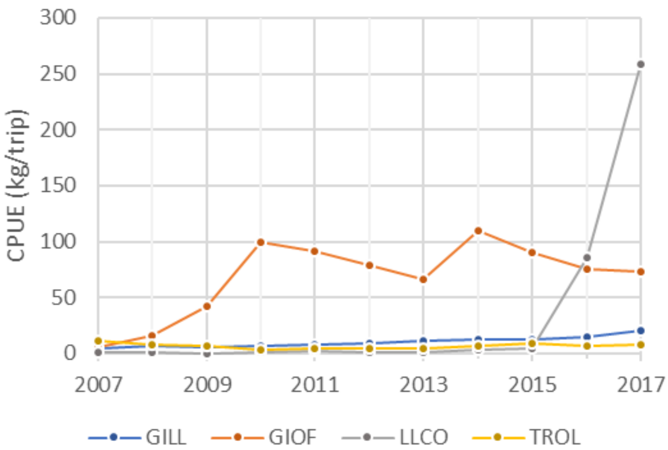


Fig.36(b): Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet (coastal – GILL and offshore – GIOF), trolling and coastal longline fisheries of Iran derived from the available catches and effort data (2007-2017)

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.[23]
- Size frequency data: highly incomplete data, available only for selected years and/or fisheries (**Fig. 37**).

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

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

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 and lines from 2012 onwards) (**Fig. 38b**). Length distributions derived from the data available for gillnet fisheries are shown in (**Fig. 38a)**. No data are available in sufficient numbers for 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.

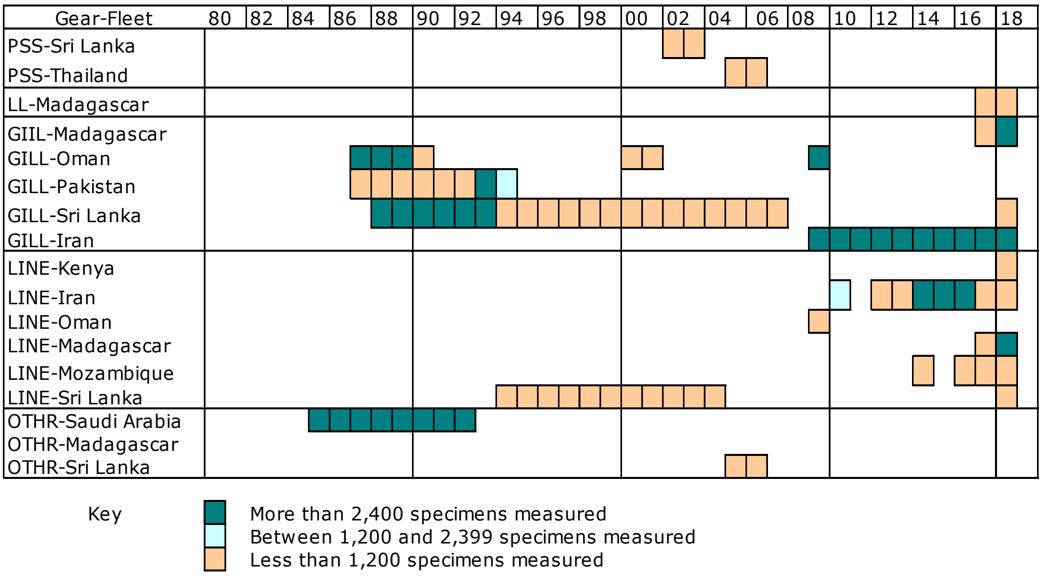


Fig. 37: Narrow-barred Spanish mackerel: Availability of length frequency data, by fishery and year (1980–2018)[24]. Note that no length frequency data are available prior to 1984

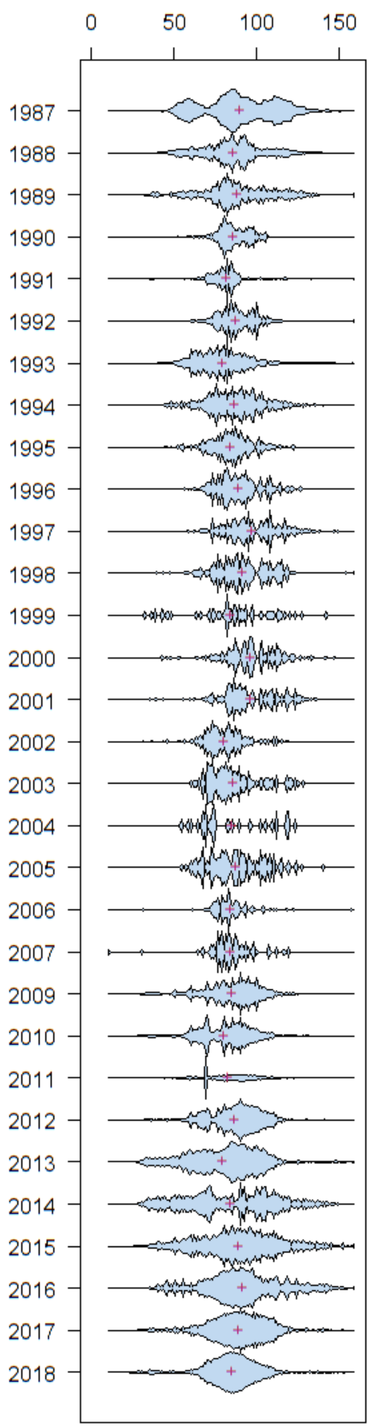
Other biological data

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 Weight	RND=a*L^b	a= 0.00001176 b= 2.9002		Min:20 Max:200

Source: Data from North Indian Ocean: IPTP Sampling Programme in Sri Lanka (1989)

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



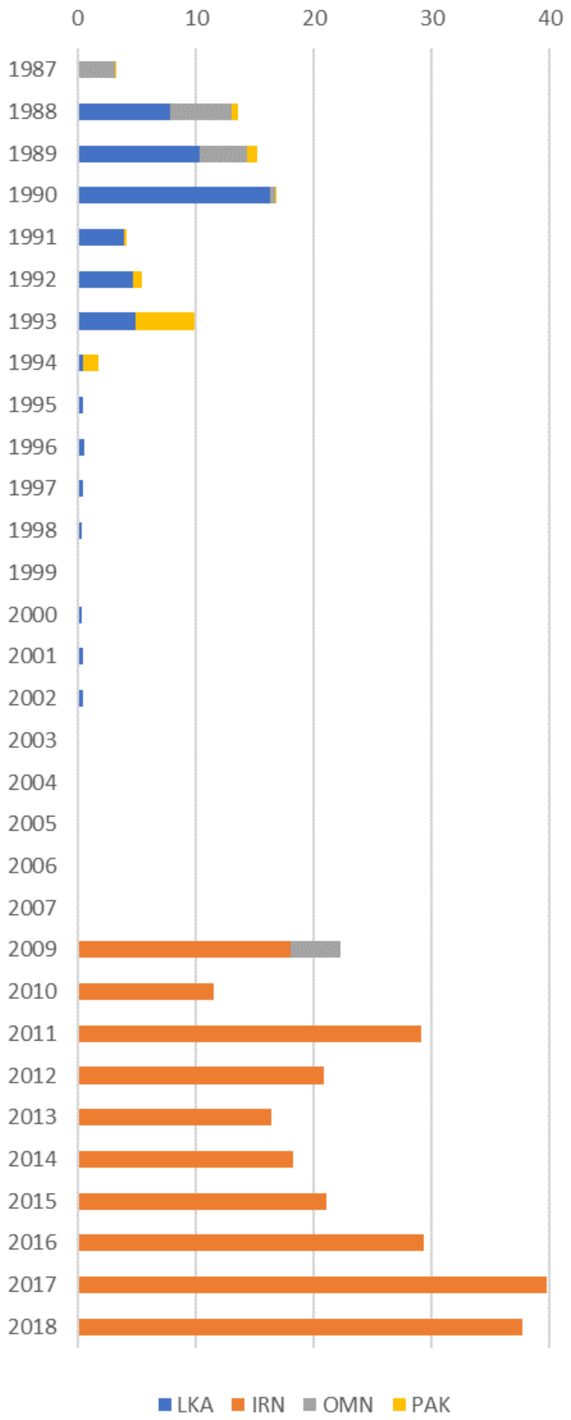


Fig. 38a-b: Left: Narrow-barred Spanish Mackerel (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat, 1987-2018 - **Right:** Number of narrow-barred Spanish mackerel specimens (gillnet fisheries) sampled for lengths, by fleet and year.

GUT - INDO-PACIFIC KING MACKEREL (*SCOMBEROMORUS GUTTATUS*)

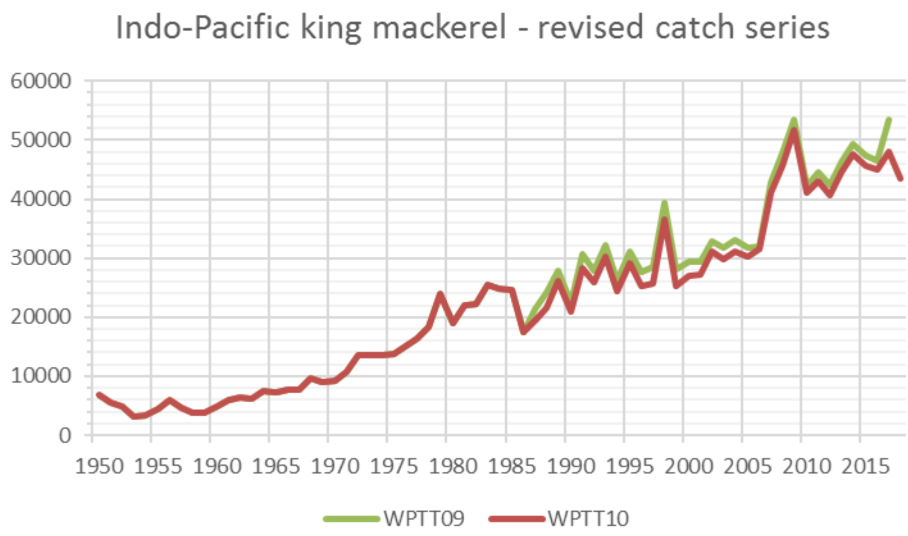
Fisheries and main catch trends

- Main fisheries: Indo-Pacific king mackerel[25] are caught mainly by gillnet fisheries in the Indian Ocean, however significant numbers are also caught trolling (**Table 7; Fig. 39**).

[25] Hereinafter referred to as King mackerel.

- Main fleets (i.e., in terms of highest catches in recent years):
  Almost two-thirds of catches are accounted for by fisheries in India and Indonesia; with important catches also reported by I.R. Iran (**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 52,000 t.
- Discard levels**:** are thought to be very low, although estimates of discards are unknown for most fisheries.

Changes to the catch series



There were relatively small revisions (i.e., between -10% and -1%, depending on the year) to the catches between 1987 and 2017 and almost exclusively due to the revised catch series of Pakistan gillnetters introduced during late 2019. Overall, the revised catches of narrow-barred Spanish mackerel until 2017 are now 63,261 t **lower** than what reported at the previous WPNT in 2019.

Estimation of catches – data related issues

Retained catches for King mackerel were derived from incomplete information, and are therefore uncertain[26] (**Fig. 41**), notably for the following fisheries:

- Species aggregation: King mackerels are often not reported by species but are aggregated with narrow-barred Spanish mackerel or, less frequently, other small tuna species.
- Mislabelling: King mackerels are often mislabelled as narrow-barred Spanish mackerel, their catches reported under the latter species.
- Underreporting: the catches of King mackerel may be not reported for some fisheries catching them as a bycatch.

It is for the above reasons that the catches of 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.

[26] 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: Best scientific estimates of the catches of Indo-Pacifick king mackerel by type of fishery for the period 1950–2018 (in metric tonnes). Data as of May 2020

Fishery	By decade (average)						By year (last ten years)									
	1950s	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Purse seine	-	1	34	585	776	1,108	1,605	1,793	1,552	1,103	1,237	1,265	1,153	1,161	1,190	1,816
Gillnet	4,365	6,896	13,943	16,489	19,435	21,687	30,251	24,878	26,602	25,922	28,246	31,489	29,822	28,940	31,237	28,987
Line	252	351	772	1,335	1,834	2,504	4,041	3,497	3,677	3,670	3,781	3,838	4,209	4,394	4,312	4,371
Other	13	21	48	3,879	5,105	9,355	15,733	10,859	11,268	9,967	11,303	10,978	10,463	10,437	11,357	8,293
Total	**4,630**	**7,269**	**14,798**	**22,288**	**27,150**	**34,654**	**51,631**	**41,027**	**43,100**	**40,662**	**44,566**	**47,570**	**45,647**	**44,932**	**48,096**	**43,468**

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.

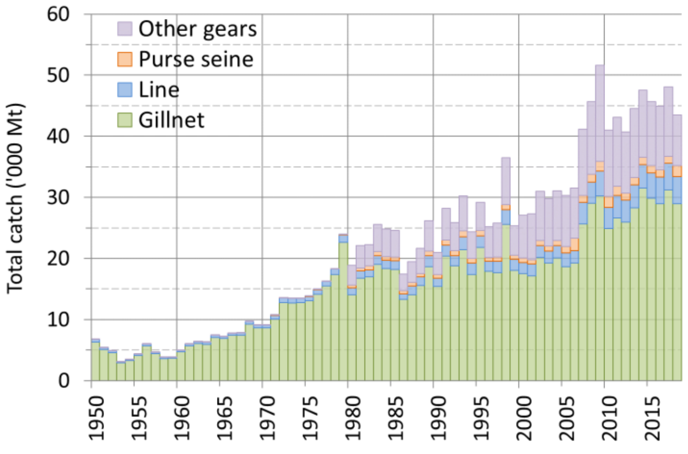


Fig. 39: Indo-Pacific king mackerel: annual catches by gear recorded in the IOTC Database (1950–2018)

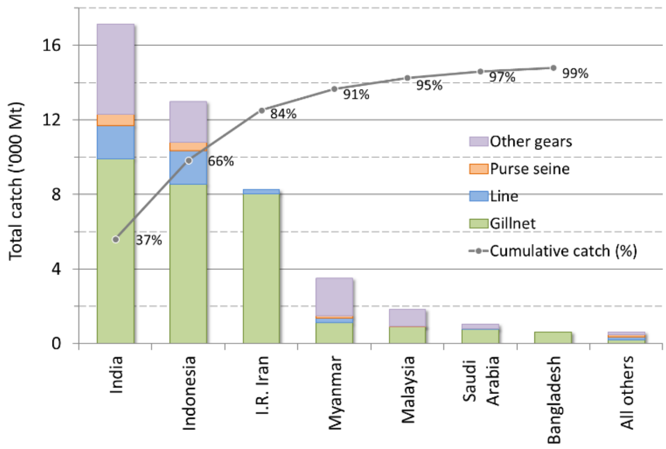


Fig. 40: Indo-Pacific king mackerel: average catches in the Indian Ocean over the period 2014-18, by country[27]

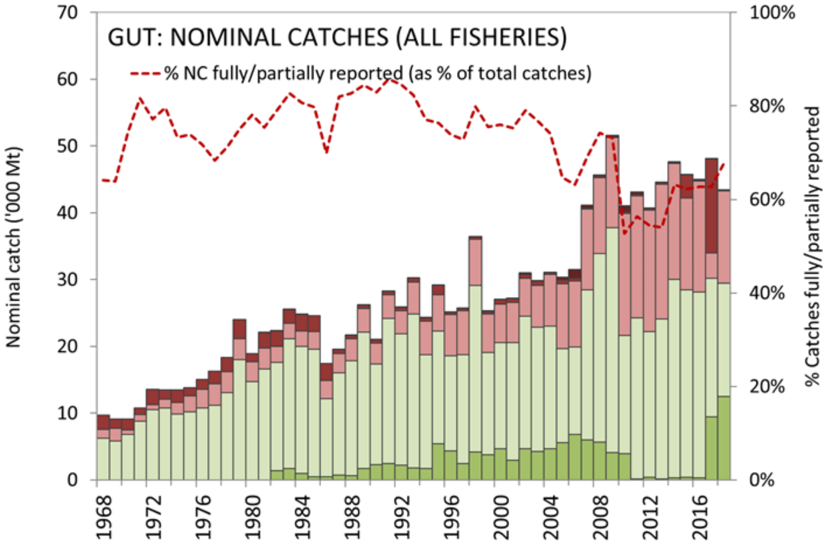


Fig. 41: Indo-Pacific king mackerel: nominal catch; uncertainty of annual catch estimates (1968–2018)

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).

[27] Countries are ordered from left to right, according to the importance of catches of Indo-Pacific king mackerel 2014-2018. The gray line indicates the (cumulative) proportion of catches of Indo-Pacific king mackerel for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2014-2018

Effort trends

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

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.

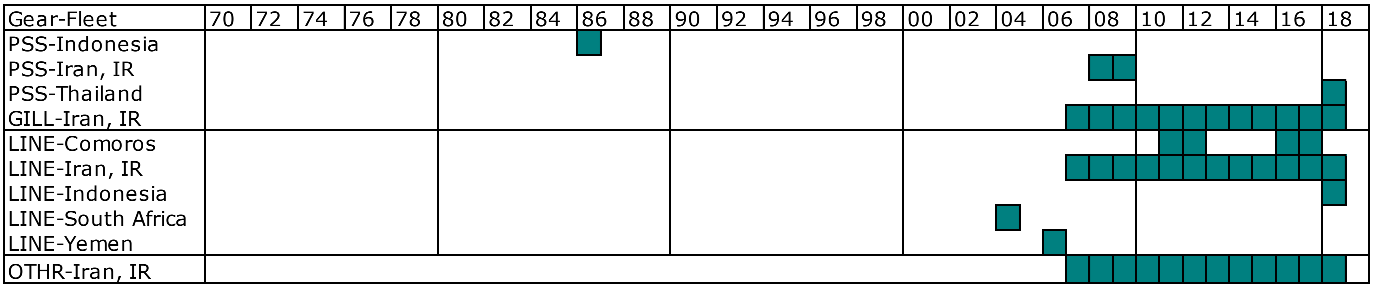


Fig. 42: Indo-Pacific king mackerel: Availability of catches and effort series, by fishery and year (1970–2018)[28]. Note that no catches and effort are available at all for 1950–85

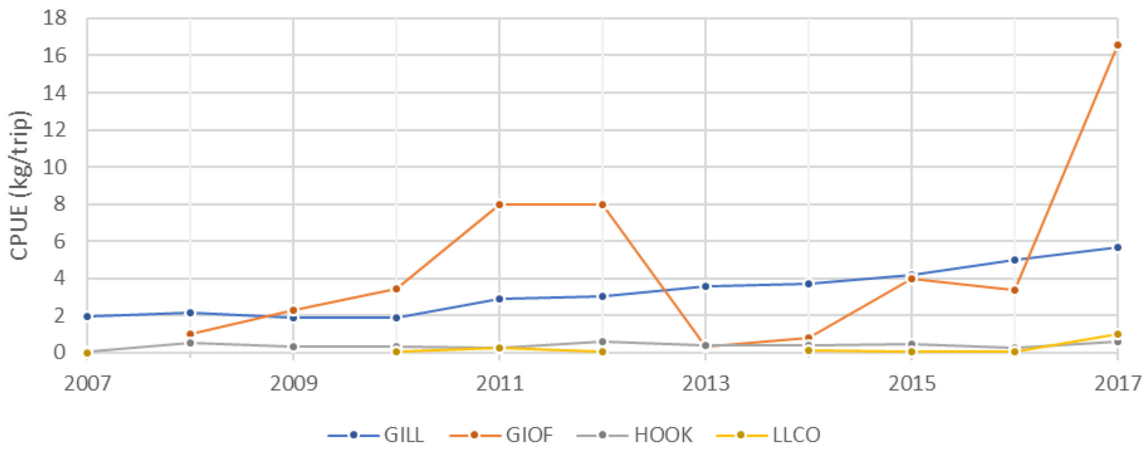


Fig. 43: Indo-Pacific king mackerel: Nominal CPUE series for the gillnet (coastal – GILL and offshore - GIOF), coastal longline and hook fisheries of I.R. Iran derived from the available catches and effort data (2007-2017)

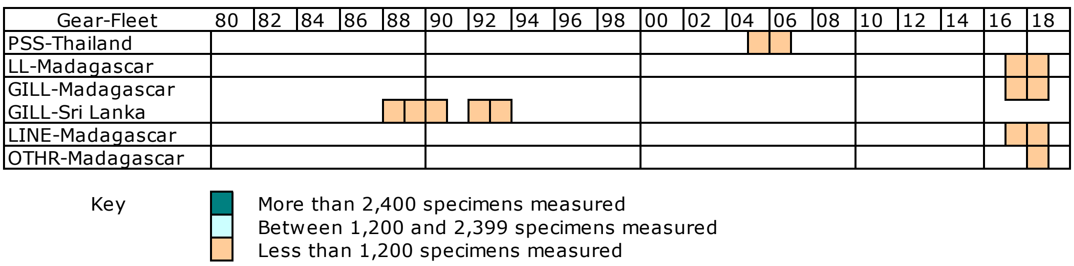
Fish size or age trends (e.g., by length, weight, sex and/or maturity)

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

  Main sources of 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.



[28] 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. 44: Indo-Pacific king mackerel: Availability of length frequency data, by fishery and year (1980–2018)[29]. 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 Weight*	*RND=a*L^b*	*a= 0.0000100000* *b= 2.89400*		*Min:20* *Max:80*

Source: Data from North Indian Ocean: IPTP Sampling Programme in Sri Lanka (1989)

[29] 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 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: A new sampling programme is in place in Madagascar since 2017. The country submitted nominal catch, catch and effort and size data for the years 2017 and 2018. However, the sampling level is very low and the data does not cover all fishing regions: for this reason, the information is still pending incorporation in the IOTC database as it cannot be adequately raised by the Secretariat. • Myanmar (non-reporting, non-IOTC member): no update. Catches in the IOTC database are based on estimates published by SEAFDEC and FAO FishStat (various years). • Yemen: Catches are estimated based on information provided by FAO FishStat. In 2018 there were revisions to the catch series for Yemen, which affects some species more than others (e.g., narrow-barred Spanish mackerel). Before incorporating revisions to the data for all species, the IOTC Secretariat is currently seeking clarification on the rationale for the scale of the revisions.
Nominal catch, catch-and-effort, size data	Coastal fisheries of India, Indonesia, Kenya, Malaysia, Mozambique; Oman, Tanzania, and Thailand	Partially-reported data These fisheries do not fully report catches of neritic tunas by species and/or gear, as per the reporting standards of IOTC Res.15/02. For example: • Nominal catches may have been partially allocated by gear and species by the IOTC Secretariat, where necessary. • Catch and-effort and size data may also be missing, or not fully reported to Res.15/02 standards.	• India: Catch-and-effort and size data for coastal fisheries have not been reported at all or are not reported according to standards. • Indonesia: Catch-and-effort, and size data, reported for coastal fisheries – albeit for a very small number of landing sites (i.e., less than 10) covered by the IOTC-OFCF pilot sampling project. In 2019 (2018 as reference data) catch-and-effort from logbooks was reported for the first time by Indonesia for several semi-industrial and coastal fisheries (coastal purse seiners, gillnetters, handline, troll-line and liftnet vessels) although with a coverage of 5% or less. • Kenya: Kenya has recently undertaken a Catch Assessment Survey to improve catch estimates for artisanal fisheries and is currently in the process of finalizing the estimates, with support from the IOTC Secretariat, prior to submission of the revised data to IOTC. • Mozambique: An IOTC Data Compliance mission was conducted by the IOTC Secretariat in June 2014 to assess current levels of reporting and the status of fisheries data collection. Following the mission, Mozambique reported catch and effort data; however, there are still issues on the classification of the different fleets. Size frequency data was also reported by species, for sport and recreational fisheries. Request for clarifications on several isues related to recent data submissions was sent to Mozambique and the IOTC Secretariat is still awaiting feedback • Oman: no update. No size data submitted, although it is understood that data has been collected. Biological information for some neritic species is known to have been collected in the past by national research institutions and could potentially be shared with the IOTC Secretariat.

			• Sri Lanka: while catch-and-effort are submitted as offshore and within the EEZ, it is unclear whether catches within the EEZ refer to the semi-industrial/industrial fisheries • Tanzania: a data compliance mission was conducted in February 2016, to try and address several outstanding issues and issue recommendations to improve levels of compliance. Catch data (aggregated by species) are based on data from the National Report submitted to SC and also appear to be underreported for some years (i.e., excluding catches from Zanzibar). Another follow-up data compliance mission was conducted in 2019 with the following findings: Tanzania is in the process of implementing a new data collecton system using mobile phones, that needs to be extended to incorporate all species under IOTC mandate as well as all the requirements from IOTC Resolution 15/02. Harmonization of data between mainland Tanzania and Zanzibar is still an internal issue as of today.
	Coastal fisheries of Indonesia, Malaysia, and Thailand	Reliability of catch estimates A number of issues have been identified for the following fisheries, which compromise the quality of the data in the IOTC database.	• 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*. Between 2014-2017 the IOTC Secretariat supported a pilot sampling project of artisanal fisheries in North and West Sumatra to improve estimates of neritic tunas and juvenile tuna species in particular. • Malaysia (catch-and-effort): no update. 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 nominal CPUE, and inconsistencies between different units of effort recorded in recent years). The catch-and-effort data is still pending upload to the IOTC database until inconsistencies in the data have been resolved: among other things, Malaysia reported difficulties in assigning efforts to specify fishing regions / grids according to the requirements of Resolution 15/02, to the point that data is often georeferenced generically as belonging to the Eastern Indian Ocean region. • Thailand (catch-and-effort): no update. 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 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 A substantial component of these fisheries is thought to operate in offshore waters, including waters beyond the EEZs of the flag countries concerned: although the fleets have reported total catches of neritic tunas, they	• I.R. Iran – drifting gillnets (coastal / offshore): Following an IOTC Data Compliance mission in November 2017, I.R. Iran started submitting catch-and-effort data in accordance with the reporting requirements of Resolution 15/02 leading to substantial improvements in the data available for the Iranian fisheries in the IOTC database also for what concerns the newly developed coastal-longliners fleet. • Pakistan – drifting gillnets: Update: Since 2018 Pakistan began reporting size data for some neritic tuna species (e.g., frigate tuna and kawakawa). However, no catch-and-effort has been

		have not reported catch-and-effort data as per the reporting standards of IOTC Res.15/02.	reported to date, due to deficiencies in port sampling and absence of logbooks on-board vessels. WWF-Pakistan has been a coordinating a crew-based data collection programme for over four years, which includes information on total enumeration of catches and fishing location (for sampled vessels) that could potentially be used to estimate catch-and-effort for Pakistan gillnet vessels in the absence of a national logbook program for its gillnet fleet. The information collected through this programme has been used to re-estimate the total catches of several species from 1987 onwards, and the IOTC Secretariat is currently liaising with WWF-Pakistan to evaluate the quality of the fine-grained data collected by the programme to determine whether it could be effectively used to officially provide C-E data according to Resolution 15/02.
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 or include amounts of neritic tunas discarded. The same applies to catch-and-effort data.	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. Update: reporting coverage of the Regional Observer Scheme is increasing and this might trigger an improvement in the estimates of catches for neritic species (both retained and discarded). In 2019 (with 2018 as reference year) Indonesia started reporting nominal catches as well as catch-and-effort data for a new industrial purse seine component of their fleet that seems to explicitly target neritic tunas (leading to remarkable increases in catches of bullet tuna reported for the year). Considering the relatively small dimensions (on average) of the Indonesian purse seine vessels listed in the IOTC Record of Authorised Vessels, it is still questionable whether this component of the fleet (as well as its associated catches) shall be properly considered as 'industrial' purse seiners rather than small, coastal ones; in any case, further clarification is required to properly attribute these catches to the originating fishery and determine the correctness of the reported estimates.
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.	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. Update: No update, although as reporting coverage of the Regional Observer Scheme improves, there is the potential for an improvement in the estimates of catches of neritic species (retained and discarded).
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.	Collection of biological information, including size data, remains very low for most neritic species. Update: The IOTC has been coordinating a Stock Structure Project, which commenced in 2016 and was completed in 2020. The project aimed to supplement gaps in the existing knowledge on biological data and provide an insight on whether neritic tuna and tuna like species should be considered as a single Indian Ocean stock. The draft report has been submitted to the IOTC Secretariat and is currently pending review: it will be shared with the scientific community before the end of the year.

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

During 2019, the IOTC Secretariat continued delivering a number of capacity-building activities to coastal states in the IOTC region, in collaboration with the IOTC-OFCF Project as well as with national fisheries organizations, with funding provided by EU-DG Mare and SIOTI and a particular emphasis on improving the collection and reporting of fisheries data to the IOTC Secretariat.

A number of the activities consolidate, or are a continuation of technical assistance provided by the Secretariat in previous years and may have implications on current and historical catch estimates of neritic tuna species, including:

- **IOTC Data Compliance and technical assistance missions**: A number of technical assistance activities have been scheduled for 2019/20, aimed at improving levels of data compliance of CPC's in the IOTC region and also the assessment of the status of current data collection and reporting systems. At the time of writing the following missions have been conducted / proposed for the biennium considered:

  - **I.R. Iran (June 2019)**: assistance in compilation of a standardized CPUE for the gillnet fishery:

    Following a successful Data Compliance and Support mission by the IOTC Secretariat in November 2017, Iran – as one of the principle fleets accounting for catches of neritic tunas – has agreed to collaborate with the IOTC Secretariat in developing a standardized gillnet CPUE series, in response to recommendations from the WPNT and Scientific Committee. Specifically:

    1) Explore the feasibility and options for developing a standardized CPUE series for the Iranian gillnet fleet, utilizing vessel-level operational data collected from the port sampling over the last 10 years, and also vessel licensing statistics.
    2) Develop methods for standardized abundance indices for key neritic tuna species (e.g., longtail tuna and kawakawa), identifying a suitable measures of effort (i.e., using fishing days as a substitute for gear-specific units of effort), potential proxies for targeting effects (e.g. mesh size), and other variables in relation to fishing operations important to explain changes in catch rates.
    3) Explore spatial and temporal effort patterns and operational characteristics of the gillnet fleet, to identify subsets of the data that represent relatively homogeneous fleets with consistent fishing operations.
    4) Estimate annual time series of relative abundance derived from appropriate Generalized Linear Model (GLM), to investigate different error assumptions, and alternative models to account for zero catches (e.g. delta-lognormal compared to zero-inflated models).

    A mission was conducted in June 2019 by the IOTC Stock Assessment Officer, and a preliminary standardized CPUE for neritic tunas has been developed. See paper IOTC-2019-WPNT09-14 for more details.

  - **Republic of Tanzania (July 2019)**: this activity was delivered in collaboration with MRAG, and was aimed at discussing with national research institutions (Ministry of Fisheries and DSFA) about Tanzania's current arrangements for the monitoring, collection and reporting of artisanal fisheries to the IOTC.

    This task falls within the context of the FAO / IOTC project for the "*Monitoring of artisanal fisheries in the Indian Ocean*" whose objective is to improve the capacity for IOTC member countries to collect, store, utilize and report data for their artisanal fisheries to assist the management of tuna and tuna-like species.

    The mission acknowledged that while the country is still facing difficulties in combining data on artisanal tuna catches from the Ministry of fisheries of Zanzibar and mainland Tanzania, at the same time a web-interface / database system based on the CAS survey usually done to collect fisheries data at landing sites is being extended to improve the quality of the data collected and eventually reported to the IOTC secretariat, although the need to harmonize data collected from the different statistical units still exists.

- **Sultanate of Oman (September 2019)**: with support from FAOR Oman, the IOTC Secretariat organized a technical workshop with the purpose of increasing knowledge of the IOTC process and IOTC reporting requirements, providing technical support on the actual report creation and sharing experience on discard / by-catch reporting in the artisanal fleet of Oman.

  Alternative sources of information, in particular for what concerns provisions of biological data and standardized CPUE for neritic and other tuna species, were also identified during the visit and the IOTC Secretariat is expected to follow up with national institutions (MSFC - Marine Science and Fisheries Centre) to ensure the information at their availability could effectively be shared with the IOTC Scientific community.

- **Pakistan (December 2018 – December 2019)**: WWF-Pakistan has been a coordinating a crew-based data collection programme in recent years, which includes information on total enumeration of catches, and fishing location (for sampled vessels) and could be used to estimate catch-and-effort for Pakistan gillnet vessels in the absence of a national logbook program.

  The IOTC Secretariat has been liaising with WWF-Pakistan and with the Government of Pakistan, through a series of Data Compliance missions that were concluded in December 2019, to assess the quality of the reconstructed total catches for the national gillnet fishery (from 1987 to 2018) as well as the quality of the data collected through the crew-based data collection programme.

- **IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME: ROS E-TOOLS AND E-MONITORING PILOT PROJECTS:**

- **ROS e-tools**: Regional Observer Scheme (ROS) data continues to be submitted to the IOTC Secretariat in a number of formats, including data tables embedded within .pdf, .doc, and scanned hard-copy forms. The Project aims to facilitate improvements in the data capture, processing and reporting of ROS data to the IOTC Secretariat by the development of e-Reporting tools (composed of an electronic data entry interface, national database for storage and processing of data, and regional ROS database hosted by the IOTC Secretariat).

  Updates:

  - A consultant was hired in 2018 (with support from SIOTI) to input historical ROS data reported to the IOTC Secretariat in various non machine-readable formats (.pdf, .doc, etc.) into the IOTC ROS database using the ROS e-tools. This contributed to improve the availability and quality of observer data available to IOTC scientists to complement the routine IOTC datasets such as nominal catches and catch-and-effort data.
  - The revised ROS e-tools implementing the new data fields specifications (see: ROS expert consultation workshop, September 2018) were finalized in late-2019. Training workshops have been conducted in Sri Lanka, Indonesia, Mauritius and Kenya – either independently or as part of the ROS Pilot Project training programme – with target countries agreeing to submit future reports using the new e-tools. Training in additional countries are also planned during 2020/21.

- **e-monitoring**: the project is aimed at improving observer coverage of fisheries where there are practical difficulties placing scientific observers on-board vessels (e.g., due to safety issues, lack of space, logistics, etc.) particularly in the case of the smaller-scale fisheries under 24m LOA. The proposal is to trial electronic monitoring system (EMS) on-board 6 coastal longline/gillnet vessels in Sri Lanka (e.g., between 15m up to 24 m LOA), to test the feasibility for collecting scientific information to support the Regional Observer Scheme.

  Updates:

  The project has been initially delayed due to issues identifying vessels suitable for the EMS and the recent (Q2 2019) security concerns in Sri Lanka. With the outbreak of the SARS CoViD-2 pandemic, the installation and testing of the EMS equipment has been temporarily halted but is now in the process of being resumed again and the provision of data from the first EMS trips is scheduled for Q3-Q4 2020.

Both the ROS e-tools and e-Monitoring pilot project are components of Resolution 16/04 *On the implementation of a pilot project in view of promoting the regional observer scheme of IOTC.*