REVIEW OF THE STATISTICAL DATA AND FISHERY TRENDS FOR TROPICAL TUNAS

PREPARED BY: IOTC SECRETARIAT[1], 16 OCTOBER 2018

PURPOSE

To provide the Working Party on Tropical Tunas (WPTT) with a review of the status of the information available on tropical tuna species in the databases at the IOTC Secretariat as of **September 2018**, as well as a range of fishery indicators, including catch and effort trends, for fisheries catching tropical tunas in the IOTC area of competence. It covers data on nominal catches, catch-and-effort, size-frequency and other data, in particular release and recapture (tagging).

BACKGROUND

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

This document summarises the standing of a range of information received for the tropical 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], for the period 1950–2017.

The document also provides: summaries of any important reviews to series of historical catches for tropical tuna species; a range of fishery indicators, including catch and effort trends, for fisheries catching tropical tunas in the IOTC area of competence.

The report is split into the following sections:

- **Section 1**: Overview of data for tropical tuna species in the Indian Ocean
- **Section 2**: Data issues related to the statistics reported to the IOTC for tropical tunas
- **Section 3**: Main fisheries and catch data available for each tropical tunas, including:
    - Catch trends
    - Status of fisheries statistics for tropical tunas
    - Status of tagging data
- **Appendix I**: Estimation of catches of non-reporting fleets
- **Appendix II**: IOTC standard length and weight equations for tropical tunas
- **Appendix III**: IOTC standard length and weight equations for tropical tunas

Major data categories covered by the report

Nominal catches: Total annual retained catches (in live weight) and discards (in live weight and number), estimated per fleet, IOTC Area, gear and year for a large area. If these data are not reported the Secretariat estimates a total catch from a range of sources (including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; and data reported by parties on the activity of vessels under their flag (IOTC Resolution 10/08; IOTC Resolution 12/05) or other flags (IOTC Resolution 14/05; IOTC Resolution 05/03); data on imports of bigeye tuna from vessels under the flag concerned (IOTC Resolution 01/06); and data on imports of tropical tunas from canning factories collaborating with the International Seafood Sustainability Foundation[3].

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[2] This Resolution superseded IOTC Resolutions 10/02, 98/01, 05/01 and 08/01.
[3] With catch imports by vessel, trip, species and commercial category forwarded to the IOTC Secretariat on each quarter.

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

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

Tagging data: release and recovery data gathered in the framework of the Indian Ocean Tuna Tagging Programme (IOTTP), which encompass data gathered during the Regional Tuna Tagging Project – Indian Ocean (RTTP-IO) and data gathered during a series of Small-scale tuna tagging projects in Maldives, India, Mayotte, Indonesia and by other institutions, e.g., SEAFDEC, NRIFSF, with the support of IOTC. In 2012, the data from past projects implemented in Maldives in the 1990s was added to the tagging database at the Secretariat, and as of September 2018 this database contains 219,121 releases and 34,352 recoveries.

Tropical tuna species and main fisheries in the Indian Ocean

Table 1 below shows the three species of tropical tunas under IOTC management.

Table 1. Tropical tuna species under the IOTC mandate

IOTC code	English name	Scientific name
BET	Bigeye tuna	*Thunnus obesus*
SKJ	Skipjack tuna	*Katsuwonus pelamis*
YFT	Yellowfin tuna	*Thunnus albacares*

SECTION 1: OVERVIEW OF DATA FOR TROPICAL TUNA SPECIES IN THE INDIAN OCEAN

Fisheries and catch trends for tropical tuna species

- Main species: Skipjack tuna accounts for 48% of total catches of tropical tunas, followed closely by yellowfin tuna (42%), while catches of bigeye tuna account for the remaining 10% of catches (**Fig. 1d**).

- Main fishing gear (2013-17): purse seiners account for 40% of total catches of tropical tunas, with important catches also reported by handlines and trolling (19%), gillnets (18%), pole-and-line (11%), and longliners (9%), with catches occurring in both coastal waters and the high seas.

  Tropical tunas are the target species of many industrial and artisanal fisheries throughout the Indian Ocean, although they are also a bycatch of fisheries targeting other tunas, small pelagic species, or other non-tuna species.

- Main fleets (i.e., highest catches in recent years): Tropical tunas are caught by both coastal countries in the Indian Ocean and distant water fishing nations (**Fig. 2**).

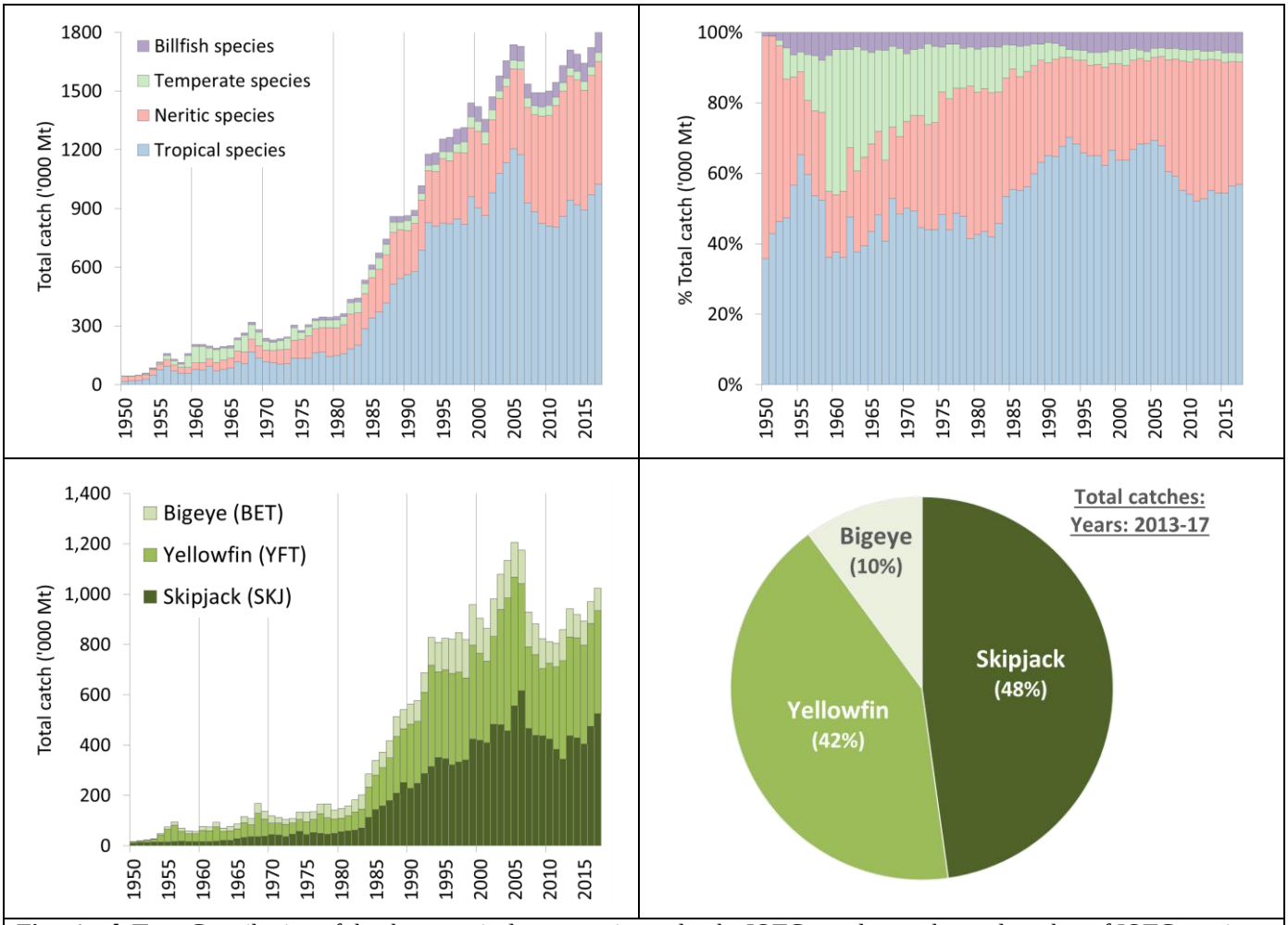
  In recent years the coastal fisheries of five countries (Indonesia, Maldives, Sri Lanka, I.R. Iran, and India) have accounted for 53% of the total catches of tropical tuna species in the Indian Ocean, while the industrial purse seiners and longliners flagged as EU-Spain, Seychelles and EU-France reported a further 31% of total catches of these species.

- Retained catch trends: The importance of tropical tunas to the total catches of IOTC species in the Indian Ocean has changed over the years (**Figs. 1a-b.**), in particular following the arrival of industrial purse seine fleets to the Indian Ocean in the early-1980s targeting tropical tunas. With the onset of piracy in the late-2000s, the activities of fleets operating in the north-west Indian Ocean have been displaced or reduced – particularly the Asian distant-water longline fleet – leading to a relative decline in the proportion of catches from tropical tunas (i.e., currently around 57% of total catches of all IOTC species, compared to ≈68% over the (pre-piracy) period 1950-2008).

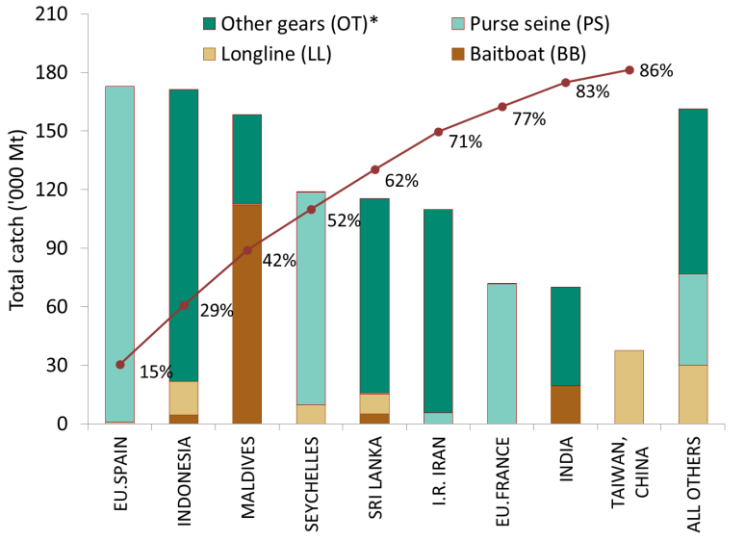
  Since 2012 catches of tropical tunas appear to show signs of recovery – in particular catches from the distant water longline fleets (e.g., Taiwan,China) – as a result of the reduction of the threat of piracy and return of fleets and to the north-west Indian Ocean. Total catches of tropical tunas have increased from < 820,000 t during the years of piracy in the late 2000s, to >940,000 t in 2013 and >100,000 t in 2017.

- Economic markets: The majority of catches of tropical tuna species are sold to international markets, including the *sashimi* market in Japan (large specimens of yellowfin tuna and bigeye tuna in fresh or deep-frozen condition), and processing plants in the Indian Ocean region or abroad (small specimens of skipjack tuna and, to a lesser

extent, yellowfin tuna and bigeye tuna). A component of the catches of tropical tunas, in particular skipjack tuna caught by some coastal countries in the region, is sold in local markets or retain by the fishermen for direct consumption.



Figs. 1a-d. Top: Contribution of the three tropical tuna species under the IOTC mandate to the total catches of IOTC species in the Indian Ocean, over the period 1950-2017 (a. Top left: total catch; b. Top right percentage, same colour key as Fig. 1a).; **Bottom:** Contribution of each tropical tuna species to the total combined catches of tropical tunas (c. Bottom left: nominal catch of each species, 1950-2016; d. Bottom right: share of tropical tuna catch by species, 2013-17)



** Other gears includes handline, gillnet, gillnet-longline, trawling.*

Fig. 2. All tropical tunas: average catches in the Indian Ocean over the period 2013–17, by country. Countries are ordered from left to right, according to the importance of catches of tropical tunas reported. The red line indicates the (cumulative) proportion of catches of tropical tunas for the countries concerned, over the total combined catches of species reported from all countries and fisheries.

SECTION 2: SUMMARY OF DATA ISSUES RELATED TO THE STATISTICS OF TROPICAL TUNA SPECIES 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 tropical tuna statistics available at the IOTC, by type of dataset and fishery, for the consideration of the WPTT.

1. Nominal (retained) catches

- Taiwan,China (longline): inconsistencies have been noted between catches of bigeye tuna originating from the Indian Ocean by the Taiwanese longline fleet – as reported by the nominal catches compared to the Bigeye Statistical Document – as a result of possible of misreporting of catches between the Atlantic and Indian Oceans. Between 2001-2004 the Bigeye Statistical Document has recorded higher catches of Indian Ocean bigeye tuna compared to nominal catches – even after the official nominal catches were been revised upwards by around 3,000 t – 6,000 t per annum. While current bigeye nominal catches in the IOTC database are closer to those reported to the Bigeye Statistical Document, discrepancies still remain and the issue has still not been fully resolved.
- Sri Lanka (gillnet-longline fishery): Although Sri Lanka has reported catches of bigeye tuna for it's gillnet/longline fishery, catches are considered to be too low, possibly due to the mislabelling of catches of bigeye tuna as yellowfin tuna.
- I.R. Iran (drifting gillnet): In 2013 I.R. Iran reported catches of bigeye tuna for its drifting gillnet fishery for the first time (i.e., data for year 2012). The IOTC Secretariat has estimated caches of bigeye tuna for I.R. Iran for years prior to 2012 by assuming various levels of activity of vessels using driftnets on the high seas, depending on the year, and catch ratios between bigeye tuna and yellowfin tuna recorded for industrial purse seiners on free-swimming tuna schools in the northwest Indian Ocean. Catches of bigeye tuna have been estimated for the period 2005–2011 (at around 700 t per year), however estimates remain uncertain.
- Pakistan (drifting gillnet): Up to 2016, Pakistan has not reported catches of bigeye tuna for it's gillnet fishery, although a component of the fleet is known to operate on the high seas, where catches of bigeye tuna are reported by other fleets operating the same area.

  Since 2016-2017 Pakistan has begun to report official catches on a more regular basis, however the IOTC Secretariat has noted large revisions to some of the catches for individual species. The IOTC Secretariat is currently liaising with Pakistan Ministry of Fisheries and WWF to understand, and resolve, the recent inconsistencies in catches reported to the IOTC.
- Coastal fisheries of Indonesia, Madagascar, Sri Lanka[4] (other than gillnet/longline) and Yemen: The catches of tropical tunas for these fisheries have been estimated by the IOTC Secretariat in recent years – although the quality of the estimates is thought to be very poor due to the lack of information available about the fisheries operating in these countries. Currently IOTC estimates are based on FAO data – however the quality of catches remains highly uncertain. A more substantial review of catches is still required.
- Indonesia (longline): has not reported catches for longliners under their flag that are not based in their ports.
- Comoros (coastal fisheries): In 2011-12 the IOTC and the OFCF provided support to the strengthening of data collection for the fisheries of Comoros, including a Census of fishing boats and the implementation of sampling to monitor the catches unloaded by the fisheries in selected locations over the coast. The IOTC Secretariat and the *Centre National de resources Halieutiques* of Comoros derived estimates of catch using the data collected and the new catches estimated are at around half the values reported in the past by Comoros (around 5,000 t per year instead of 9,000 t). The IOTC Secretariat revised estimates of catch for the period 1995-2010 using the new estimates.

2. Discards – all fisheries

The total amount of tropical tunas discarded at sea remains unknown for most fisheries and time periods prior to 2013 (i.e., prior to the introduction of Resolution 13/11, superseded by Resolutions 15/06 and 17/04[5]). Discards of tropical

[4] In 2012-13 the Ministry of Fisheries and Aquatic Resources Development of Sri Lanka received support from IOTC, the OFCF and BOBLME to strengthen its data collection and processing system, which should lead to improvements in the estimate of catch for the coastal fisheries of Sri Lanka for 2012 and subsequent years.

[5] Resolution 17/03 *On a ban on discards of bigeye tuna, skipjack tuna, yellowfin tuna, and non-targeted species caught by purse seine vessels in the IOTC area of competence*.

tunas are thought to be significant during some earlier periods of industrial purse seine fisheries using fish aggregating devices (FADs) and may also be high due to depredation of catches of longline fisheries, by sharks or marine mammals, in tropical areas.

3. Catch-and-effort

For a number of fisheries important for catches of tropical tuna, catch-and-effort remains either unavailable, incomplete (e.g., missing catches by species or gear), or only partially reported according to the standards of IOTC Resolution 15/02 *IOTC Mandatory statistical requirements* and of limited value in deriving indices of abundance:

- I.R. Iran (coastal and offshore fisheries): I.R. Iran ranks sixth largest in terms of total catches of tropical tunas (accounted for mostly by drifting gillnets), however until recently, catch-and-effort have not been reported according to IOTC standards, in particular for vessels operating outside of its EEZ. Following an IOTC Data Compliance mission in November 2017, I.R. Iran has now begun to submit catch-and-effort data in a new data reporting format, in accordance to the reporting requirements of Resolution 15/02. This should lead to substantial improvements in the data available for the Iranian fisheries in the IOTC database in the near future.
- Sri Lanka (gillnet-longline): Until 2014 Sri Lanka has not reported catch-and-effort data as per the IOTC standards, including separate catch-and-effort data for gillnet-longline and catch-and-effort data for those vessels that operate outside its EEZ. For this reason, time-area catches prior to 2014 are considered to be uncertain.
- Indonesia (longline): To date, Indonesia has not reported catch-and-effort data for its longline fishery. An IOTC-OFCF mission was conducted in November 2015 to assist Indonesia with reporting of catch-and-effort, size frequency data and Regional Observer data collected on-board longline vessels. However catch-and-effort has still not been reported for longliners to date.
- Pakistan (drifting gillnet): no catch-and-effort reported for the gillnet fishery, in particular for vessels that operate outside the EEZ of Pakistan. WWF-Pakistan has been a implementing a crew-based observer programme for over two 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 is currently liaising with WWF-Pakistan to evaluate the quality of the observer data collected.
- India (longline): catches and catch-and-effort data have been reported for its commercial longline fishery for activities inside of the EEZ of India. However, India has not reported catches of tropical tunas or other species for longline vessels under its flag, operating offshore.

4. Size data (all fisheries)

- Japan and Taiwan,China (longline fisheries): In 2010, the IOTC Scientific Committee identified several issues concerning the size frequency statistics available for Japan and Taiwan,China, which remain unresolved. In 2013 the IOTC Secretariat presented a paper to WPTT-15 documenting the current data quality issues and inconsistences between the length frequency data and catch-and-effort reported in particular by Taiwan,China since the mid-2000s[6].

  A consultancy is planned for 2019 to work directly the individual national fisheries organizations concerned to resolve the current issues with longline issues.
- In addition, the number of specimens sampled for length on-board longliners flagged in Japan in recent years remains below the minimum 1 fish per metric ton of catch recommended by the IOTC – although size data is now being reported as part of Japan's Regional Observer Scheme data submissions.
- I.R. Iran and Pakistan (gillnet): although both countries have reported size frequency data gillnet fisheries in recent years, data have not been reported by area and the number of samples are below the minimum sample size recommended by the IOTC.
- Sri Lanka (gillnet-longline): Although Sri Lanka has reported length frequency data for tropical tunas in recent years, sampling coverage is below recommended levels and lengths are not available by gear type or fishing area[7]. In 2014 Sri Lanka provided more detailed catch-and-effort for the first time, which the IOTC Secretariat is currently reviewing.

[6] See IOTC Secretariat, IOTC-2013-WPTT15-41 Rev_1, for more details.

[7] In 2012-13 the Ministry of Fisheries and Aquatic Resources Development of Sri Lanka received support from IOTC, the OFCF and BOBLME to strengthen its data collection and processing system, including collection of more length frequency data from the fisheries.

- Indonesia (longline): size frequency data have been reported for its fresh-tuna longline fishery in previous years (e.g., 2002-2003), however samples cannot be fully broken fishing area (i.e., 5° degree grid) and they refer exclusively to longliners based in ports in those countries. An IOTC-OFCF mission was conducted in November 2015 to assist Indonesia with reporting of catch-and-effort, size frequency data and Regional Observer data collected on-board longline vessels. Size data collected by the observers was submitted for the first time in 2016.
- To date, these countries have not reported size frequency data for their fisheries:
  - Longline: India, Oman and the Philippines (longline);
  - Coastal fisheries: India, Indonesia and Yemen (coastal fisheries).

5. Biological data for all tropical tuna species

- Surface and longline fisheries, in particular Taiwan,China, Indonesia, Japan, and China:

  The IOTC database does not contain enough data to allow for the estimation of statistically robust length-weight keys or non-standard size to standard length keys for tropical tuna species, due to the general lack of biological data available from the Indian Ocean.

  A summary of the current biological length-weight equations and availability of alternative sources are documented in Appendix II for the consideration of the WPTT, following the recommendation of the WPDCS.

3. STATUS OF FISHERIES STATISTICS FOR TROPICAL TUNAS

Bigeye tuna (BET)

Fisheries and main catch trends

- Main fishing gear (2013–17): industrial fisheries account for the majority of catches of bigeye tuna, i.e., deep-freezing and fresh longline (≈48%) and purse seine (≈26%) (**Table 2; Fig. 3**).

  In recent years catches by gillnet fisheries have also been increasing, due to major changes some fleets (e.g., Sri Lanka and I.R. Iran); notably increases in boat size, developments in fishing techniques and fishing grounds, with vessels using deeper gillnets on the high seas in areas important for bigeye tuna targeted by other fisheries.

- Main fleets (and primary gear associated with catches): percentage of total catches (2013–16):
  Indonesia (fresh longline/coastal longline, and coastal purse seine): 27%; Taiwan,China (longline): 18%; Seychelles (longline and purse seine): 13%; EU-Spain (purse seine): 12% (**Fig. 5**).

- Main fishing areas: Primary: Western Indian Ocean, in waters off Somalia (West A1), although in recent years fishing effort has moved eastwards due to piracy. Secondary: Eastern Indian Ocean (East A2) (**Table 3; Fig.4**).

  In contrast to yellowfin tuna and skipjack tuna – where the majority catches are taken in the western Indian Ocean – bigeye tuna is also exploited in the eastern Indian Ocean, particularly since the late 1990's due to increased activity of small longliners fishing tuna to be marketed fresh (e.g., Indonesia). However, in recent years catches of bigeye tuna in the eastern Indian Ocean have shown a decreasing trend, as some vessels have moved south to target albacore.

- Retained catch trends:

  Total catches of bigeye tuna in the Indian Ocean increased steadily from the 1970's, from around 20,000 t in the 1970s, to over 150,000 t by the late 1990s with the development of the industrial longline fisheries and arrival of European purse seiners during the 1980s. Since 2007 catches of bigeye tuna by longliners have been relatively low - less than half the catch levels recorded - before the onset of piracy in the Indian Ocean (e.g., ≈50,000 t).

  Longline fisheries:

  Bigeye tuna have been caught by industrial longline fleets since the early 1950's, but before 1970 only represented incidental catches. After 1970, the introduction of fishing practices that improved catch rates of bigeye tuna, and emergence of a sashimi market, resulted in bigeye tuna becoming a primary target species for the industrial longline fleets. Large bigeye tuna (averaging just above 40 kg) are primarily caught by longliners, in particular deep-freezing longliners.

Since the late 1980's Taiwan,China has been the major longline fleet targeting bigeye tuna in the Indian Ocean, accounting for as much as 40-50% of the total longline catch in the Indian Ocean (**Fig. 5**).

Between 2007 and 2011 catches have fallen sharply, largely due to the decline in the number of Taiwanese longline vessels active in the north-west Indian Ocean in response to the threat of piracy. Since 2012 catches appear to show some signs of recovery as a consequence of improvements in security in the area off Somalia and return of fleets (mostly Taiwan,China longline vessels) resuming activities in their main fishing grounds (West (A1)). However current catches (at around 90,000 t) still remain far below levels recorded in 2003 and 2004.

Purse seine fisheries:

Since the late 1970's, bigeye tuna has been caught by purse seine vessels fishing on tunas aggregated on floating objects and, to a lesser extent, associated to free swimming schools (**Fig. 3**) of yellowfin tuna or skipjack tuna. Purse seiners under flags of EU countries and Seychelles account for the majority of purse seine catches of bigeye tuna in the Indian Ocean (**Fig. 5**) – mainly small juvenile bigeye (averaging around 5 kg) compared to longliners which catch much larger sized fish. While purse seiners take lower tonnages of bigeye tuna compared to longliners, they take larger numbers of individual fish.

While the activities of purse seiners have also been affected by piracy in the Indian Ocean, the decline in catches of tropical tunas have not been as marked as for longline fleets. The main reason is the presence of security personnel onboard purse seine vessels of the EU and Seychelles, which has made it possible for vessels under these flags to continue operating in the northwest Indian Ocean (**Fig. 6**).

- Discard levels: Low, although estimates of discards are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–07.

***Changes to the catch series*:** There have been no major changes to the catch series since the WPTT meeting in 2017.

Table 2. Bigeye tuna: Best scientific estimates of the catches of bigeye tuna (*Thunnus obesus*) by gear and main fleets [or type of fishery] by decade (1950–2009) and year (2008–2017), in tonnes. Catches by decade represent the average annual catch, noting that some gears were not in operation since the beginning of the fishery. Data as of September 2018.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
BB	21	50	266	1536	2968	5069	6,109	6,874	6,789	6,880	6,885	7,386	6,717	6,477	6,851	6,306
FS	0	0	0	2340	4824	6196	9,646	5,301	3,792	6,222	7,180	4,662	5,000	9,633	2,489	10,242
LS	0	0	0	4852	18315	20273	19,874	24,708	18,486	16,386	10,434	22,806	14,868	15,547	19,330	19,424
LL	6488	21861	30413	43077	62230	71346	51,703	51,835	32,041	35,259	66,268	45,617	35,214	33,683	30,814	25,877
FL	0	0	218	3066	26282	23490	23,323	15,810	9,782	12,031	16,816	16,725	13,650	12,401	7,658	8,891
LI	43	295	658	2385	4325	6478	7,856	9,576	9,540	11,784	11,388	10,656	12,685	13,904	13,613	13,734
OT	38	64	164	860	1475	3339	4,005	4,697	4,937	5,812	5,788	5,337	4,913	4,751	6,088	6,026
Total	**6,589**	**22,269**	**31,720**	**58,118**	**120,418**	**136,191**	**122,516**	**118,801**	**85,368**	**94,374**	**124,759**	**113,188**	**93,047**	**96,396**	**86,842**	**90,500**

Gears: Pole-and-Line (**BB**); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Deep-freezing longline (**LL**); Fresh-tuna longline (**FL**); Line (handline, small longlines, gillnet & longline combine) (**LI**); Other gears nei (gillnet, trolling & other minor artisanal gears) (**OT**).

Table 3. Bigeye tuna: Best scientific estimates of the catches of bigeye tuna (*Thunnus obesus*) by area [as used for the assessment] by decade (1950–2009) and year (2008–2017), in tonnes. Catches by decade represent the average annual catch. Data as of September 2018.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
A1	2,496	12,077	17,712	35,056	59,011	78,193	68,381	58,717	39,305	42,001	74,097	64,095	51,589	56,707	52,364	54,443
A2	3,889	7,171	10,168	18,445	43,964	43,802	47,673	55,339	40,184	44,376	42,086	41,549	34,444	31,667	28,629	27,791
A3	204	3,021	3,839	4,617	17,443	14,196	6,462	4,745	5,879	7,997	8,576	7,545	7,014	8,022	5,849	8,266
Total	6,589	22,269	31,719	58,118	120,418	136,191	122,516	118,801	85,368	94,374	124,759	113,188	93,047	96,396	86,842	90,500

Areas: West Indian Ocean, including Arabian sea (A1); East Indian Ocean, including Bay of Bengal (A2); Southwest and Southeast Indian Ocean, including southern (A3). Catches in Areas (**0**) were assigned to the closest neighbouring area for the assessment.

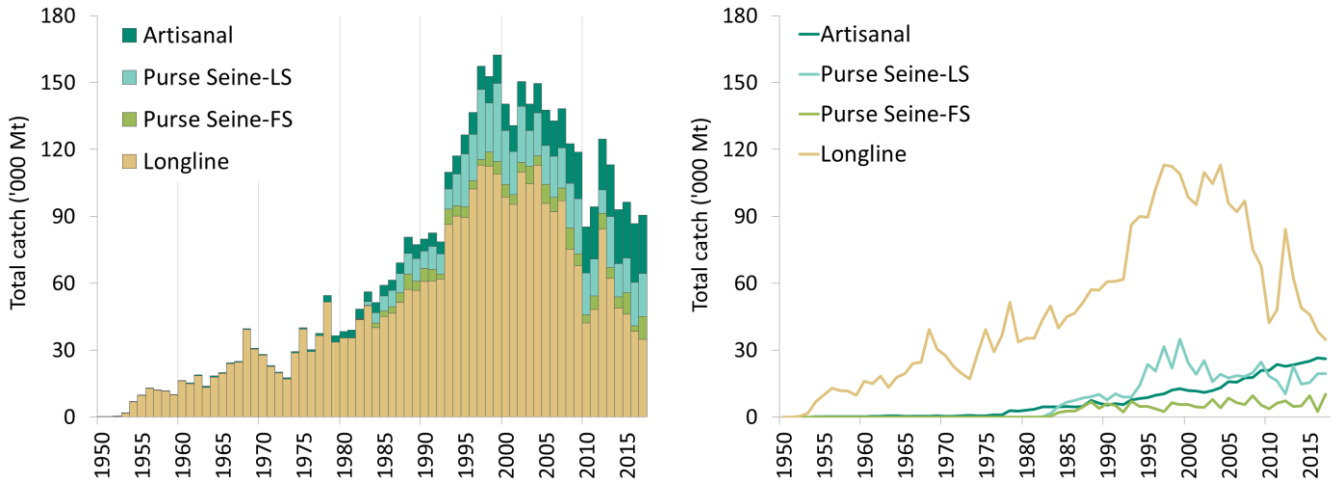
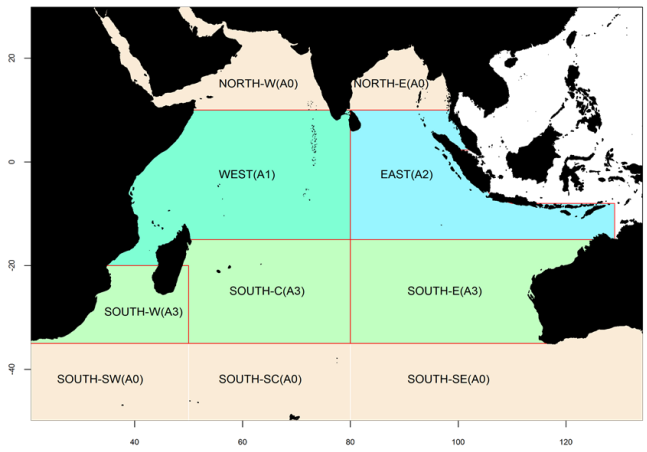


Fig. 3a & b. Annual catches of bigeye tuna by gear (1950–2017). Data as of September 2018.

Gear definitions: Longline (fresh and deep-freezing); Purse seine free-school (FS); Purse seine associated school (LS); Artisanal (pole-and-Line, handline, small longlines, gillnet, trolling & other minor artisanal gears).



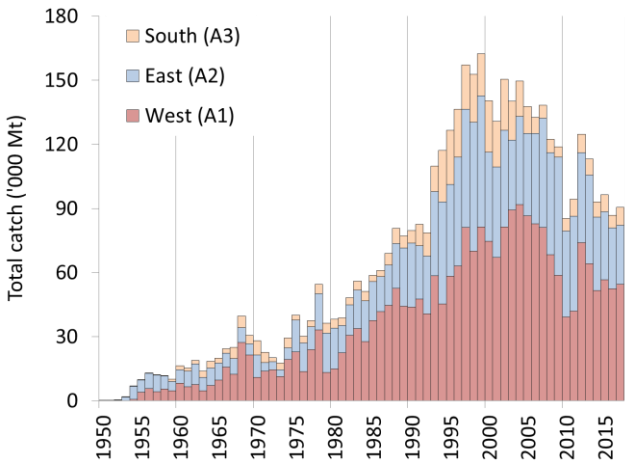


Fig. 4(a-b). Bigeye tuna: Catches of bigeye tuna by (SS3) stock assessment area by year (1950–2017). Catches outside the areas presented in the map were assigned to the closest neighbouring area for the assessment. Data as of September 2017.

Areas: West Indian Ocean (**A1**); East Indian Ocean (**A2**); Southwest and Southeast Indian Ocean (**A3**). Catches in Areas (**0**) were assigned to the closest neighbouring area for the assessment.

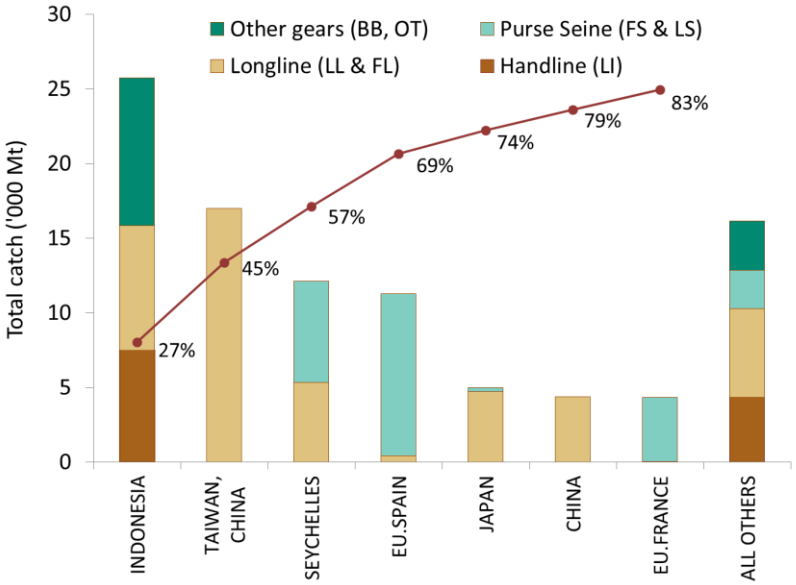


Fig. 5. Bigeye tuna: average catches in the Indian Ocean over the period 2013–17, by country. Countries are ordered from left to right, according to the importance of catches of bigeye reported. The red line indicates the (cumulative) proportion of catches of bigeye for the countries concerned, over the total combined catches of this species reported from all countries and fisheries. Data as of September 2018.

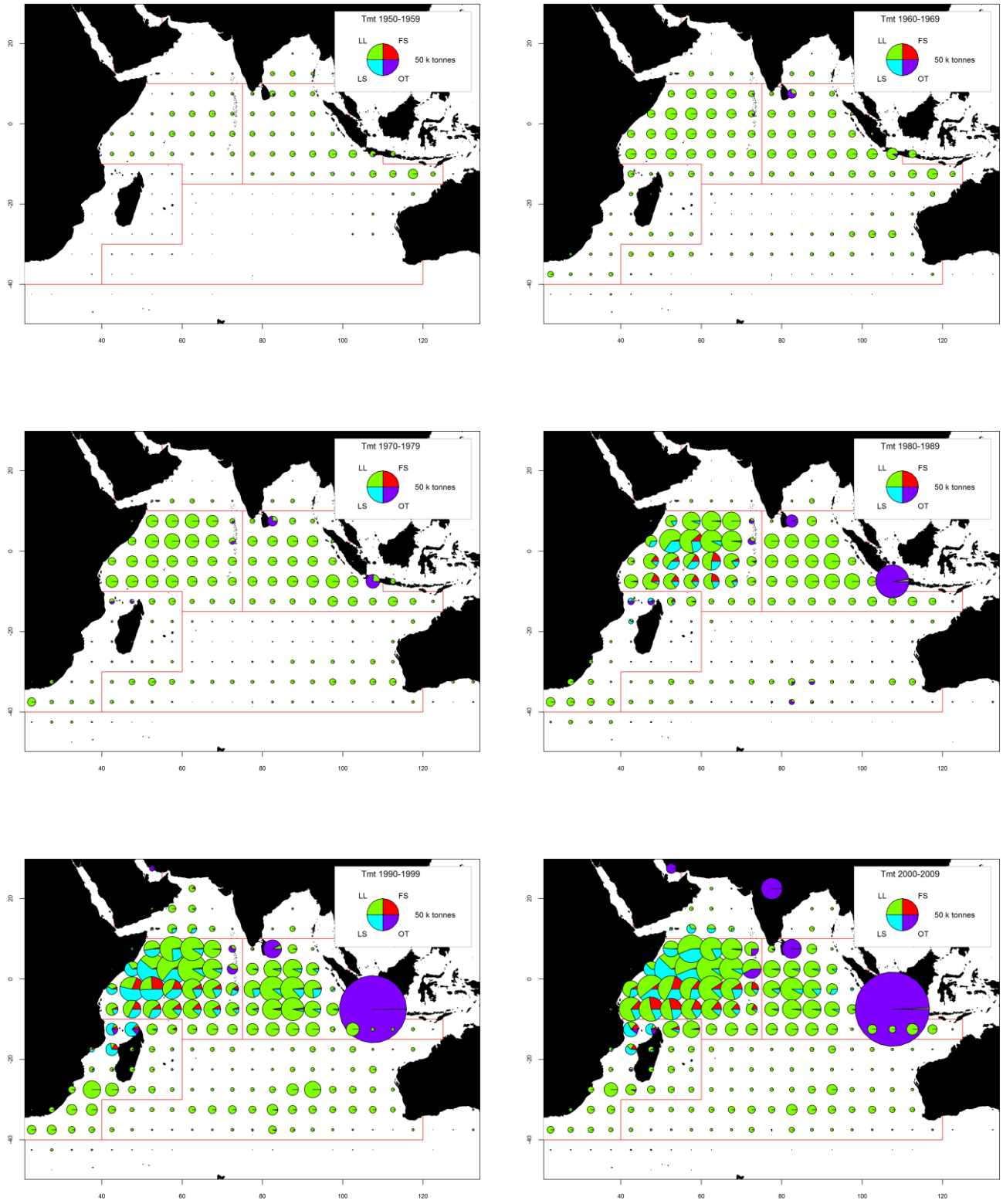


Fig. 6(a-f). Time-area catches (total combined in tonnes) of bigeye tuna estimated for the period 2007–2011 by type of gear and for 2012–16, by year and type of gear. Longline (**LL**), Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), and other fleets (**OT**), including pole-and-line, drifting gillnets, and various coastal fisheries.

Note that the catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned (as OT), in particular driftnets of I.R. Iran, gillnet and longline fishery of Sri Lanka, and longline and coastal fisheries of Indonesia.

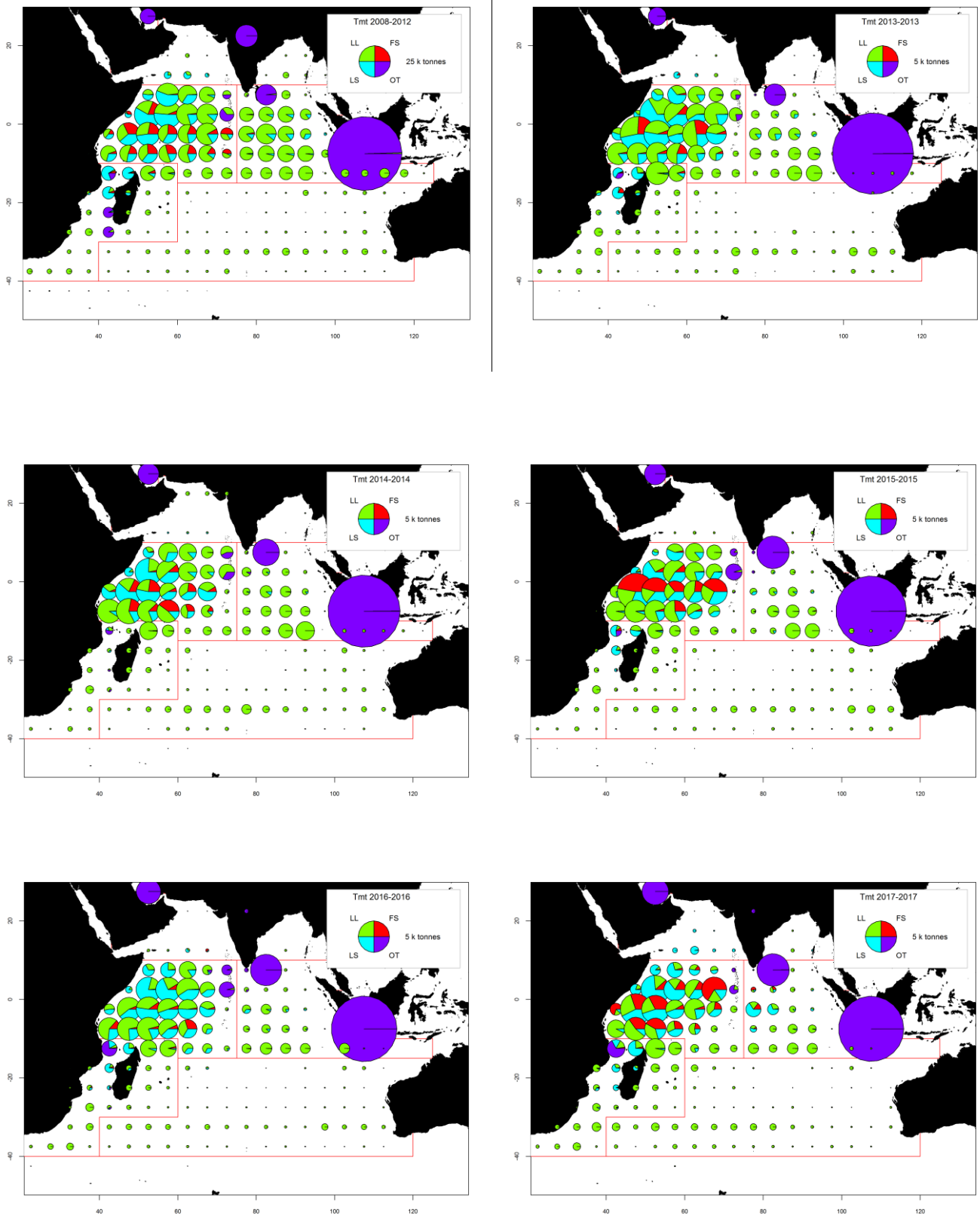


Fig. 7(a-f). Time-area catches (total combined in tonnes) of bigeye tuna estimated for the period 2008–2012 by type of gear and for 2013–17, by year and type of gear. Longline (**LL**), Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), and other fleets (**OT**), including pole-and-line, drifting gillnets, and various coastal fisheries.

Note that the catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned (as OT), in particular driftnets of I.R. Iran, gillnet and longline fishery of Sri Lanka, and longline and coastal fisheries of Indonesia.

Bigeye tuna: data availability and related data quality issues

Retained catches

- Data are considered to be relatively reliable for the main industrial fleets targeting bigeye tuna, with the proportion of catches estimated or adjusted by the IOTC Secretariat relatively low (**Fig. 8a**).
- Catches are less certain for the following fisheries/fleets:
  - Non-reporting industrial purse seiners and longliners (NEI) and other industrial fisheries (e.g. longliners of India).
  - Some artisanal fisheries, including: pole-and-line fishery in Maldives, drifting gillnet fisheries of I.R. Iran (before 2012) and Pakistan, Sri Lanka (gillnet-longline fishery) (before 2014), and the artisanal fisheries in Indonesia, Comoros (before 2011) and Madagascar.

Catch-per-unit-effort (CPUE) trends

- Availability: Standardized CPUE series are available for the major industrial longline fisheries (i.e., Japan, Rep. of Korea, Taiwan,China).

  For most other fisheries, catch-and-effort are either not available (**Fig. 8b**), or are considered to be of poor quality – especially since the early-1990s and for the following fisheries/fleets:
  - NEI purse seine and longliners: no data available.
  - Fresh-tuna longline fisheries: no data are available for the fresh-tuna longline fishery of Indonesia, while data for the fresh-tuna longline fishery of Taiwan,China are only available since 2006;
  - Other industrial fisheries: uncertain data from significant fleets of industrial purse seiners from I.R. Iran, and longliners from India, Indonesia, Malaysia, Oman, and Philippines;
  - Artisanal/coastal fisheries: incomplete or missing data for the driftnet fisheries of I.R. Iran and Pakistan, and the gillnet-longline fishery of Sri Lanka, especially in recent years.

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

- Average fish weight: can be assessed for several industrial fisheries although they are incomplete (**Fig. 8c**) or of poor quality for most fisheries before the mid-1980s and for some fleets in recent years (e.g. Japan and Taiwan,China longline).
- Catch-at-Size (Age) table: data are available, but the estimates are more uncertain for some years and some fisheries due to:
  i. lack of size data available from industrial longliners before the mid-60s, from the early-1970s up to the mid-1980s and in recent years (Japan and Taiwan,China).
  ii. lack of size data available for some industrial fleets (NEI, India, Indonesia, I.R. Iran, Sri Lanka).

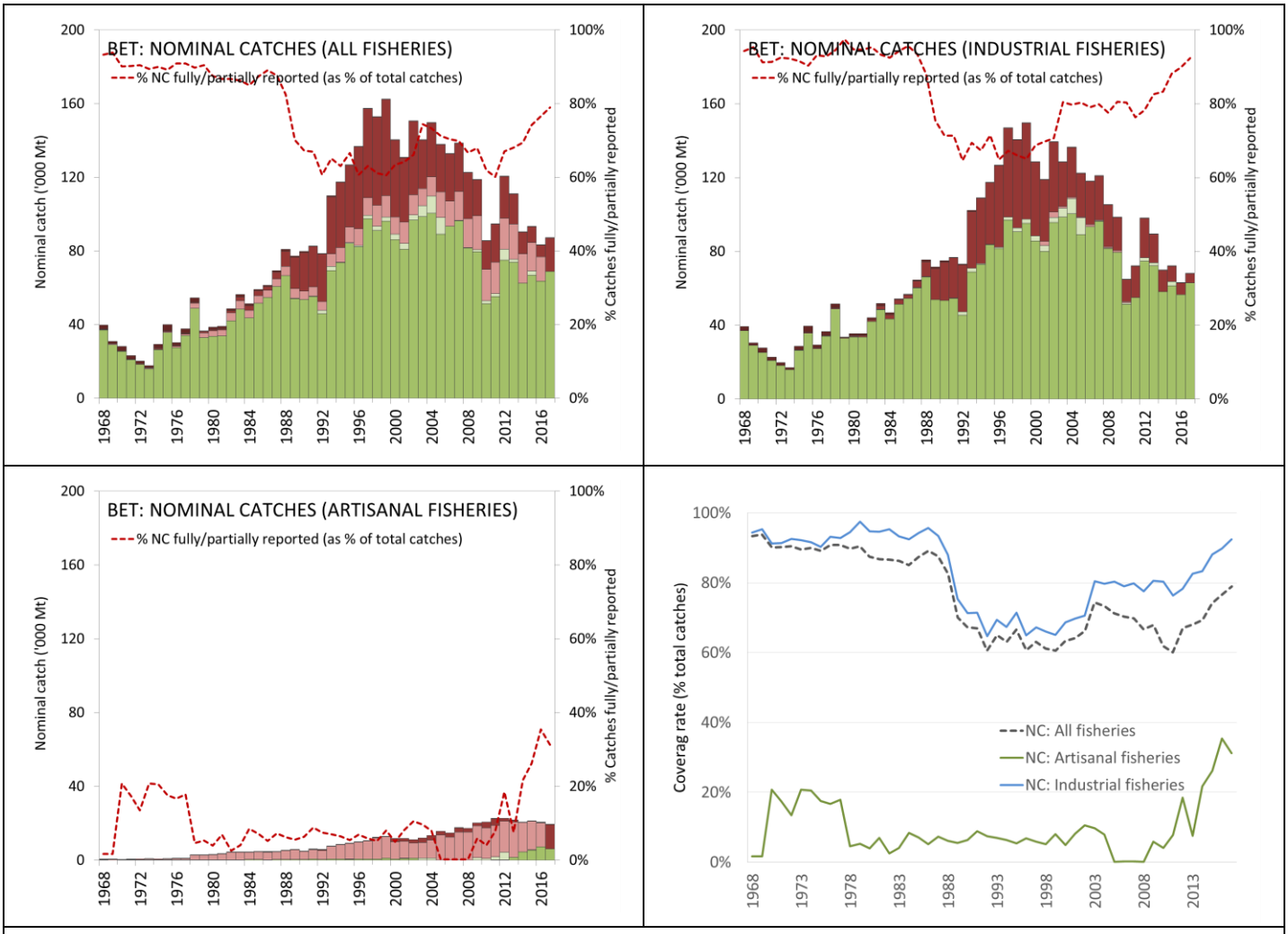


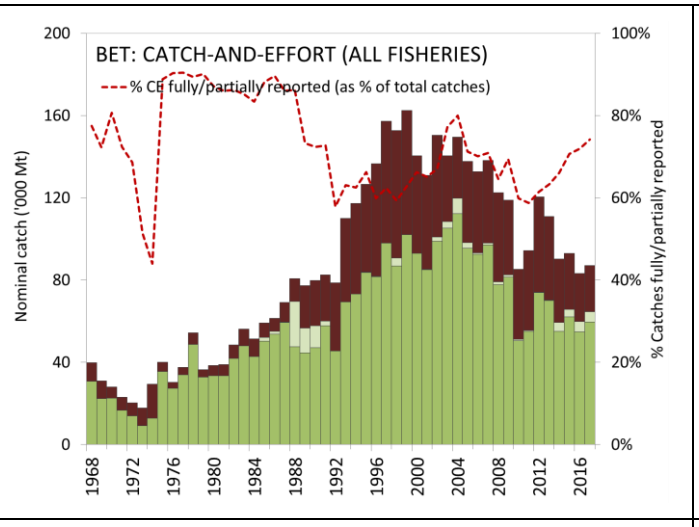
Fig. 8a-c. Bigeye tuna: nominal catches data reporting coverage (1968–2017). Data as of September 2018.

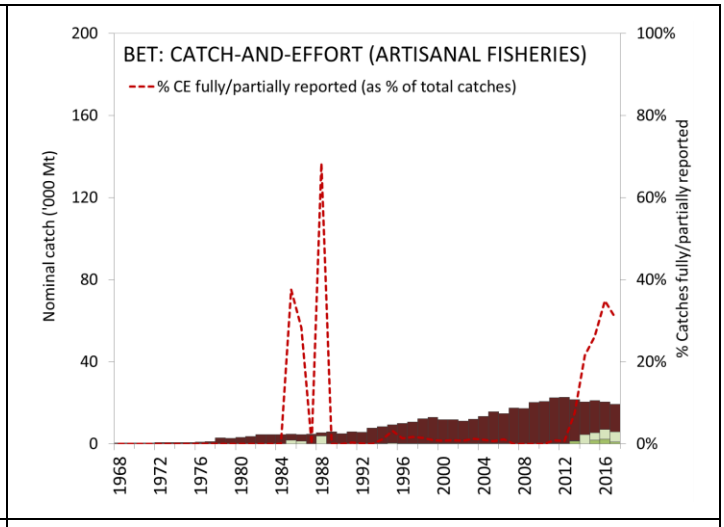
Data reporting scores:

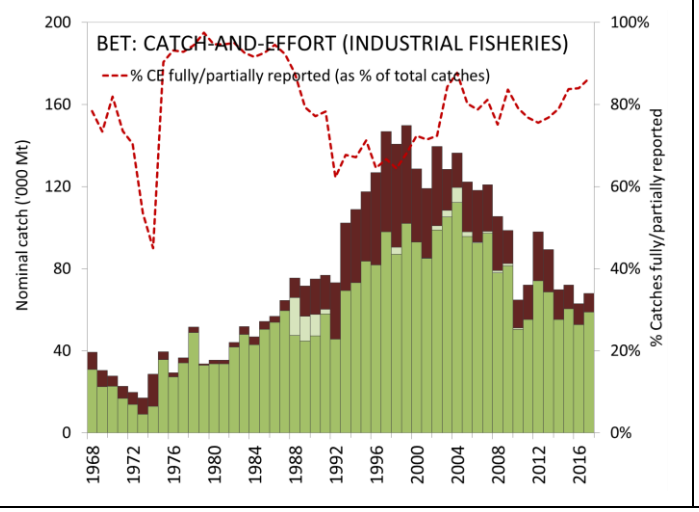
	0
	2
	4
	6
	8

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

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







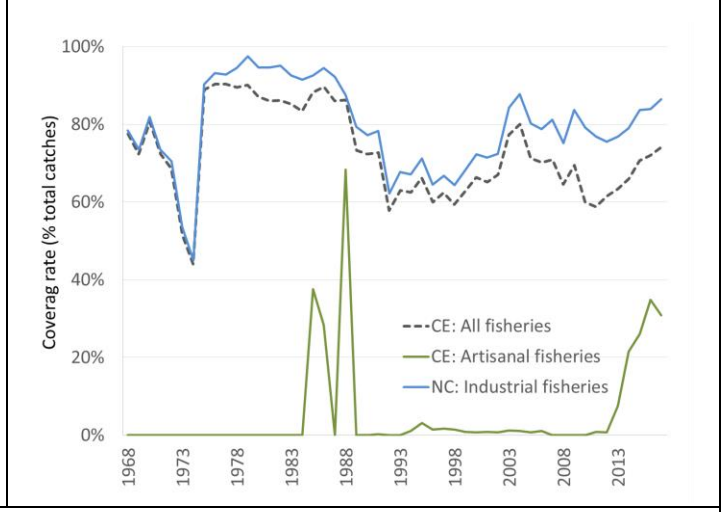


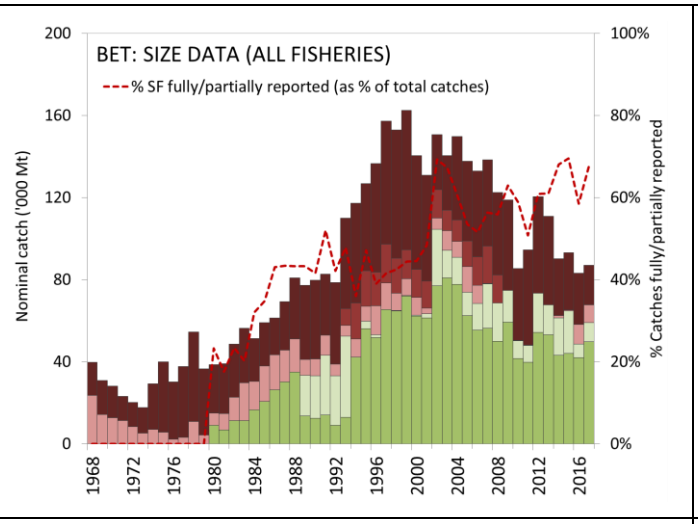
Fig. 8d-f. Bigeye tuna: catch-and-effort data reporting coverage (1968–2017). Data as of September 2018.

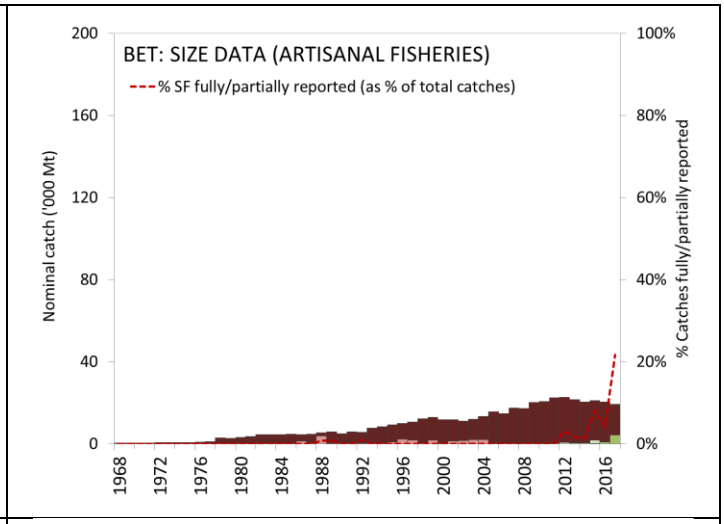
Data reporting scores:

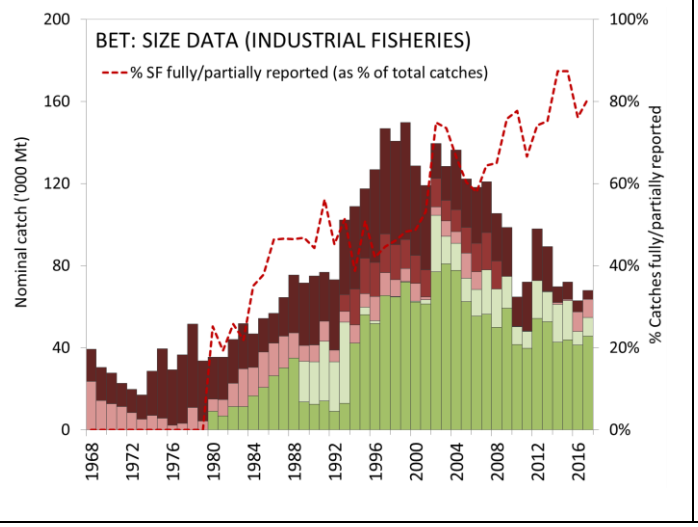
	0
	2
	4
	6
	8

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

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







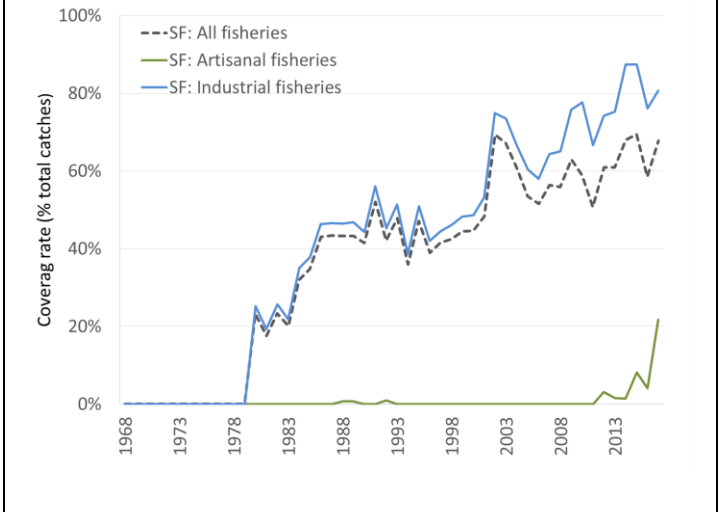


Fig. 8g-i. Bigeye tuna: size frequency data reporting coverage (1968–2017). Data as of September 2018.

Data reporting scores:

	0
	2
	4
	6
	8

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

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

Bigeye tuna: Tagging data

- A total of 36,001 bigeye tuna (representing 16% of the total number of fish tagged) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP), of which ≈96.0% were tagged during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and released off the coast of Tanzania in the western Indian Ocean, between May 2005 and September 2007 (**Fig. 9**). The remaining were tagged during small-scale projects, and by other institutions with the support of the IOTC Secretariat, in the Maldives, Indian, and in the south west and the eastern Indian Ocean.
- To date, 5,833 specimens (16% of releases for this species) have been recovered and reported to the IOTC Secretariat[8]. These tags were mainly reported from the purse seine fleets operating in the Indian Ocean (91%), while 5% were recovered from longline vessels.

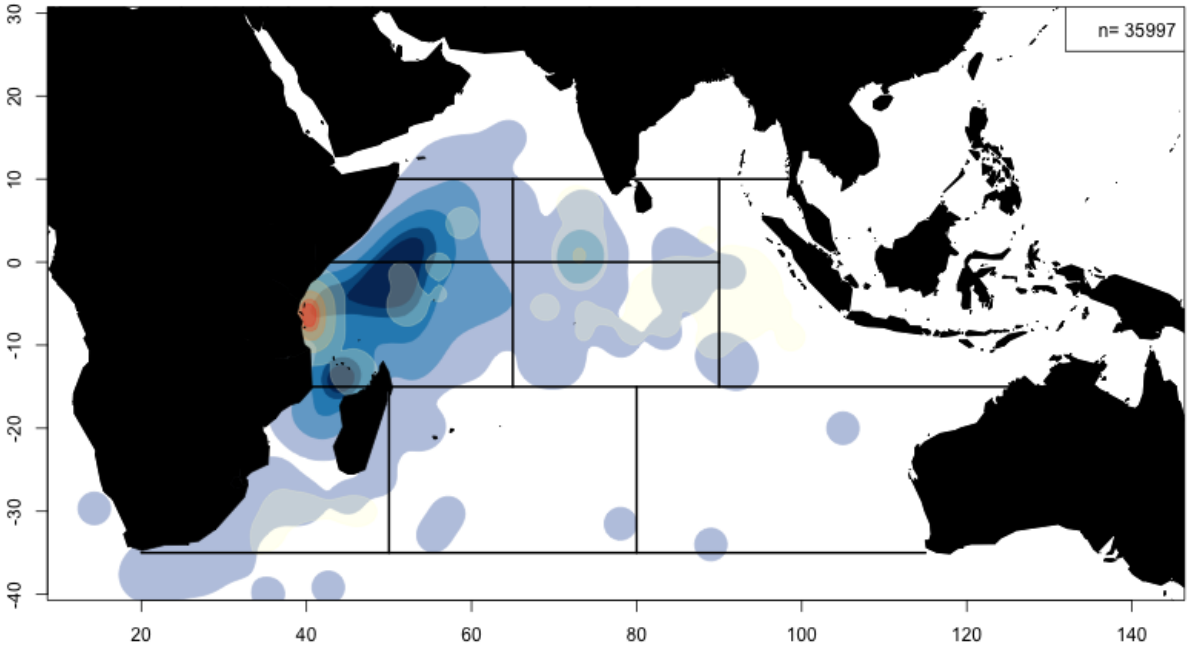


Fig. 9. Bigeye tuna: densities of releases (in red) and recoveries (in blue). The black line represents the stock assessment areas. Includes specimens tagged during the IOTTP and also Indian Ocean (Maldivian) tagging programmes during the 1990s.

[8] Recoveries by species based on species ID recorded during tagging, prior to release.

Skipjack tuna (SKJ)

Fisheries and main catch trends

- Main fishing gear (2013–17): skipjack tuna are mostly caught by industrial purse seiners (≈34%), gillnet (≈22%) and pole-and-line (≈21%) (**Table 4; Fig. 10**).

- Main fleets (and primary gear associated with catches): percentage of total catches (2012–15):
  Over 70% of catches are accounted for by four fleets (**Fig. 12**):

  - Indonesia (coastal purse seine, troll line, gillnet): 19%; Maldives (pole-and-line): 16%; EU-Spain (purse seine): 15%; Sri Lanka (gillnet-longline): 12%; Seychelles (purse seine): 10%.

- Main fishing areas:

  Primary: Western Indian Ocean (West R2), in waters off Somalia (**Table 5; Fig.11**)

  - In recent years catches of skipjack in this area have dropped considerably as fishing effort has been displaced or reduced due to piracy – particularly catches from industrial purse seiners and fleets using driftnets flagged under I.R. Iran and Pakistan.

  Secondary: Maldives (Area R2b)

  - Since the mid-2000s decreases in skipjack catches have also been reported by the Maldivian pole-and-line fishery – although the reasons remain unclear, but may possibly be related to a change in targeting to yellowfin tuna.

- Retained catch trends:

  Purse seine fisheries:

  The increase in catches of skipjack tuna in the last 30 years have largely been driven by the arrival of purse seiners in the early 1980s, and the development of the fishery in association with Fish Aggregating Devices (FADs) since the 1980s. In recent years, well over 90% of the skipjack tuna caught by purse seine vessels are taken from around FADs.

  Annual catches peaked at over 600,000 t in 2006. The constant increase in catches and catch rates of purse seiners until 2006 are believed to be associated with increases in fishing power and also an increase in the number of FADs (and technology associated with them) used in the fishery.

  Since 2006 total catches (across all fisheries) have declined to around 340,000 t in 2012 – the lowest catches recorded since 1998 – although since 2013 catches have increased sharply to over 520,000 t mostly driven by the purse seine (log-school) fisheries.

  Pole-and-line fisheries:

  The Maldivian pole-and-line fishery effectively increased its fishing effort with the mechanisation of its fleet since 1974, including an increase in boat size and power, as well as the use of anchored FADs since 1981. Skipjack tuna represents around 80% of the total catch of Maldives, where catches of skipjack tuna increased regularly between 1980 and 2006 – from around 20,000 t to over 130,000 t.

  Catches of skipjack tuna reported by Maldives pole-and-line have since declined in recent years to as low as 55,000t - less than half the catches taken in 2006 - although the reasons for the decline remain unclear. One explanation may be improvements in the data collection with the introduction of logbooks and more accurate, albeit lower, estimates of skipjack landed; while the introduction of handlines and a shift in targeting from skipjack tuna to yellowfin tuna may also be a contributing factor.

  Gillnet fisheries:

  Several fisheries using gillnets have reported large catches of skipjack tuna in the Indian Ocean, including the gillnet/longline fishery of Sri Lanka, driftnet fisheries of I.R. Iran and Pakistan, and gillnet fisheries of Indonesia. In recent years gillnet catches have represented as much as 20% to 30% of the total catches of skipjack tuna in the Indian Ocean. Although it is known that vessels from I.R. Iran and Sri Lanka have been using gillnets on the high seas in recent years, reaching as far as the Mozambique Channel, the activities of these fleets are poorly understood, as no time-area catch-and-effort series have been made available for those fleets to date.

- Discard levels: Low, although estimates of discards are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–07.

***Changes to the catch series*:** There have been no major changes to the catch series since the WPTT meeting in 2017.

Table 4. Skipjack tuna: Best scientific estimates of the catches of skipjack tuna (*Katsuwonus pelamis*) by gear and main fleets [or type of fishery] by decade (1950–2009) and year (2008–2017), in tonnes. Catches by decade represent the average annual catch, noting that some gears were not used since the beginning of the fishery. Data as of September 2018.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
BB	9,000	12,800	19,275	35,459	67,760	100,496	85,584	65,018	71,585	52,489	51,134	72,583	67,301	68,965	68,712	88,617
FS	0	0	0	13,658	25,197	24,342	14,863	9,498	8,708	8,930	2,924	5,625	6,467	7,535	6,560	5,735
LS	0	0	0	30,673	107,845	153,298	117,835	135,797	139,770	120,115	77,992	117,046	118,856	118,785	175,716	195,201
OT	6,015	14,067	27,642	50,290	118,867	198,114	220,143	227,486	203,928	201,557	212,304	242,609	236,118	209,929	223,424	234,730
Total	**15,015**	**26,867**	**46,918**	**130,080**	**319,670**	**476,251**	**438,425**	**437,799**	**423,991**	**383,091**	**344,354**	**437,862**	**428,742**	**405,214**	**474,412**	**524,282**

Gears: Pole-and-Line (**BB**); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Other gears nei (**OT**) (e.g., troll line, handline, beach seine, Danish seine, liftnet).

Table 5. Skipjack tuna: Best scientific estimates of the catches of skipjack tuna (*Katsuwonus pelamis*) by area [as used for the assessment] by decade (1950–2009) and year (2008–2017), in tonnes. Catches by decade represent the average annual catch. Data as of September 2018.

	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
R1	4,524	9,951	19,330	34,877	80,744	118,318	139,937	151,486	154,434	153,882	155,406	171,217	149,052	131,236	116,968	115,262
R2	1,492	4,116	8,313	59,744	171,166	257,437	212,903	221,295	197,972	176,720	137,814	194,062	212,388	205,014	288,732	320,404
R2b	9,000	12,800	19,275	35,459	67,760	100,496	85,584	65,018	71,585	52,489	51,134	72,583	67,301	68,965	68,712	88,617
Total	**15,015**	**26,867**	**46,918**	**130,080**	**319,670**	**476,251**	**438,425**	**437,799**	**423,991**	**383,091**	**344,354**	**437,862**	**428,742**	**405,214**	**474,412**	**524,282**

Areas: East Indian Ocean (**R1**); West Indian Ocean, (**R2**); Maldives baitboat (R2b).

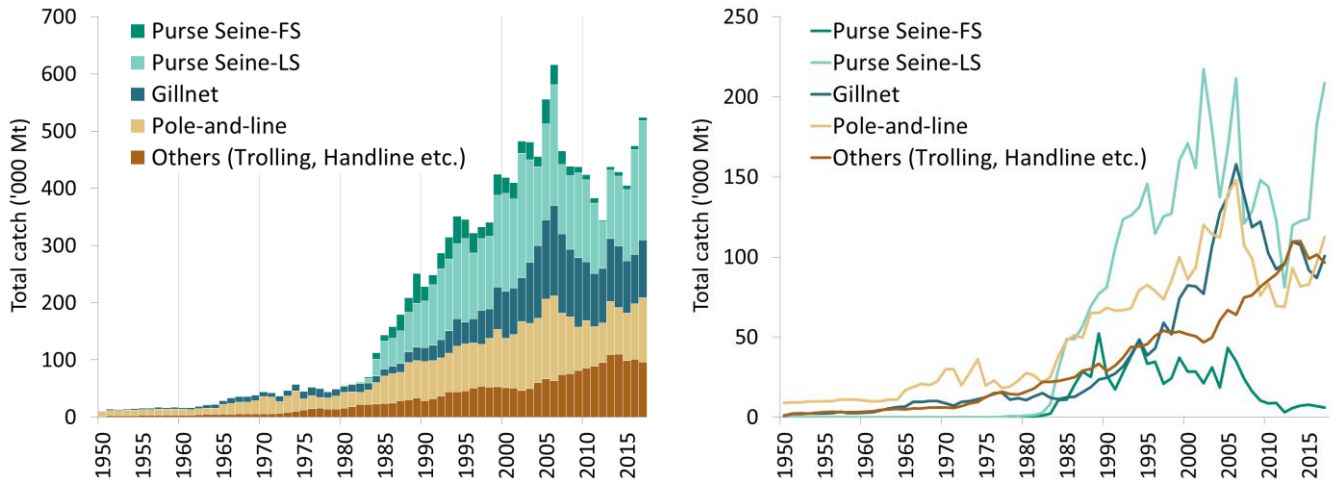


Fig. 10. Annual catches of skipjack tuna by gear (1950–2017). Data as of September 2018.

Gear definitions: Pole-and-Line (**BB**); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Other gears nei (**OT**) (e.g., troll line, handline, beach seine, Danish seine, liftnet).

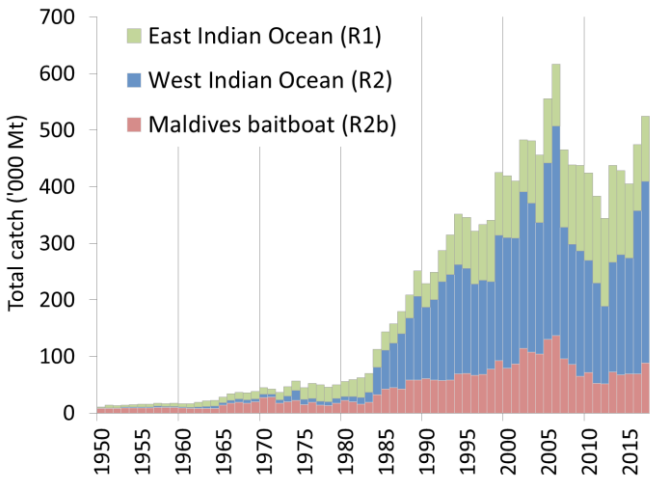


Fig. 11. Skipjack tuna: Catches of skipjack tuna by area by year estimated for the WPTT (1950–2017). **Areas**: East Indian Ocean (**R1**); West Indian Ocean (**R2**); Maldives baitboat (**R2b**). Data as of September 2018.

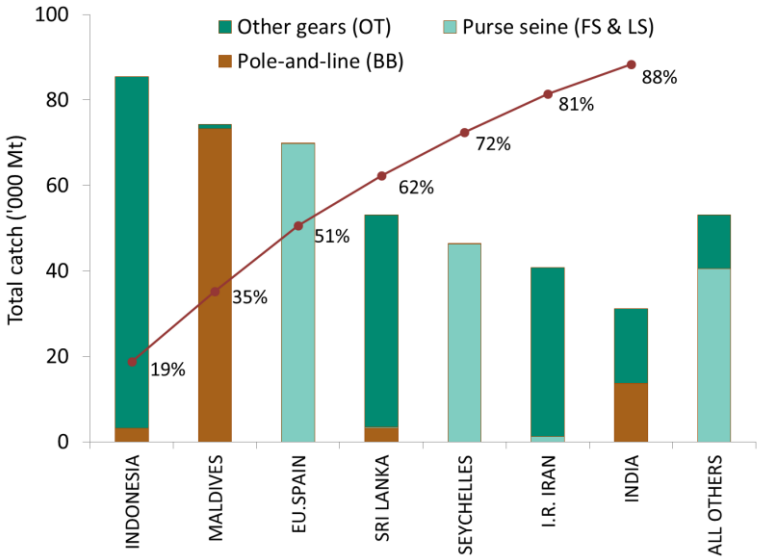


Fig. 12. Skipjack tuna: average catches in the Indian Ocean over the period 2013–17, by country. Countries are ordered from left to right, according to the importance of catches of skipjack reported. The red line indicates the (cumulative) proportion of catches of skipjack for the countries concerned, over the total combined catches of this species reported from all countries and fisheries. Data as of September 2018.

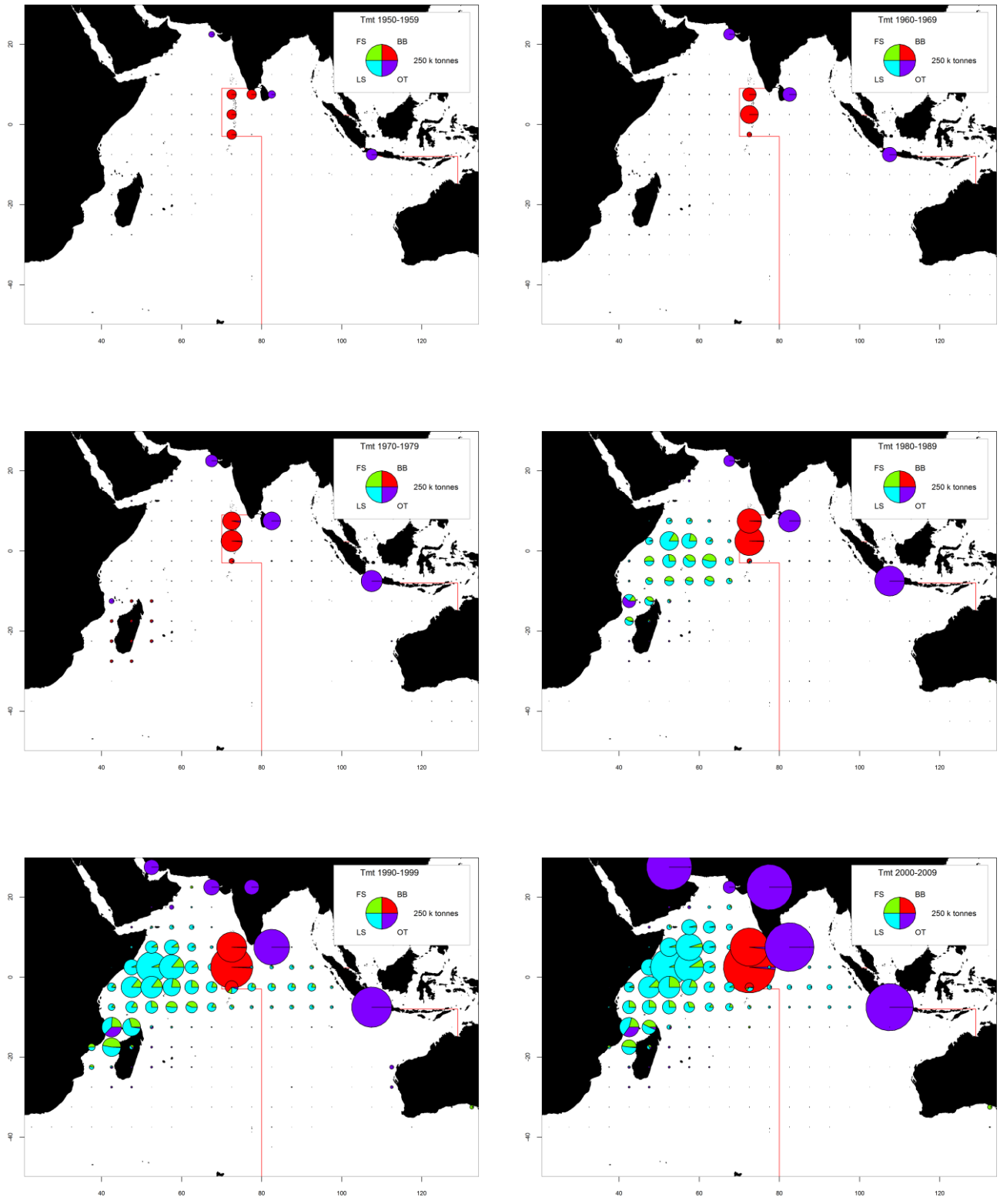


Fig. 13(a-f). Skipjack tuna: Time-area catches (total combined in tonnes) of skipjack tuna estimated for the period 1950–2009, by decade and type of gear. Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (**BB**), and other fleets (**OT**), including longline, drifting gillnets, and various coastal fisheries.

Note that the catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned (as OT), in particular driftnets of I.R. Iran, gillnet and longline fishery of Sri Lanka, and longline and coastal fisheries of Indonesia.

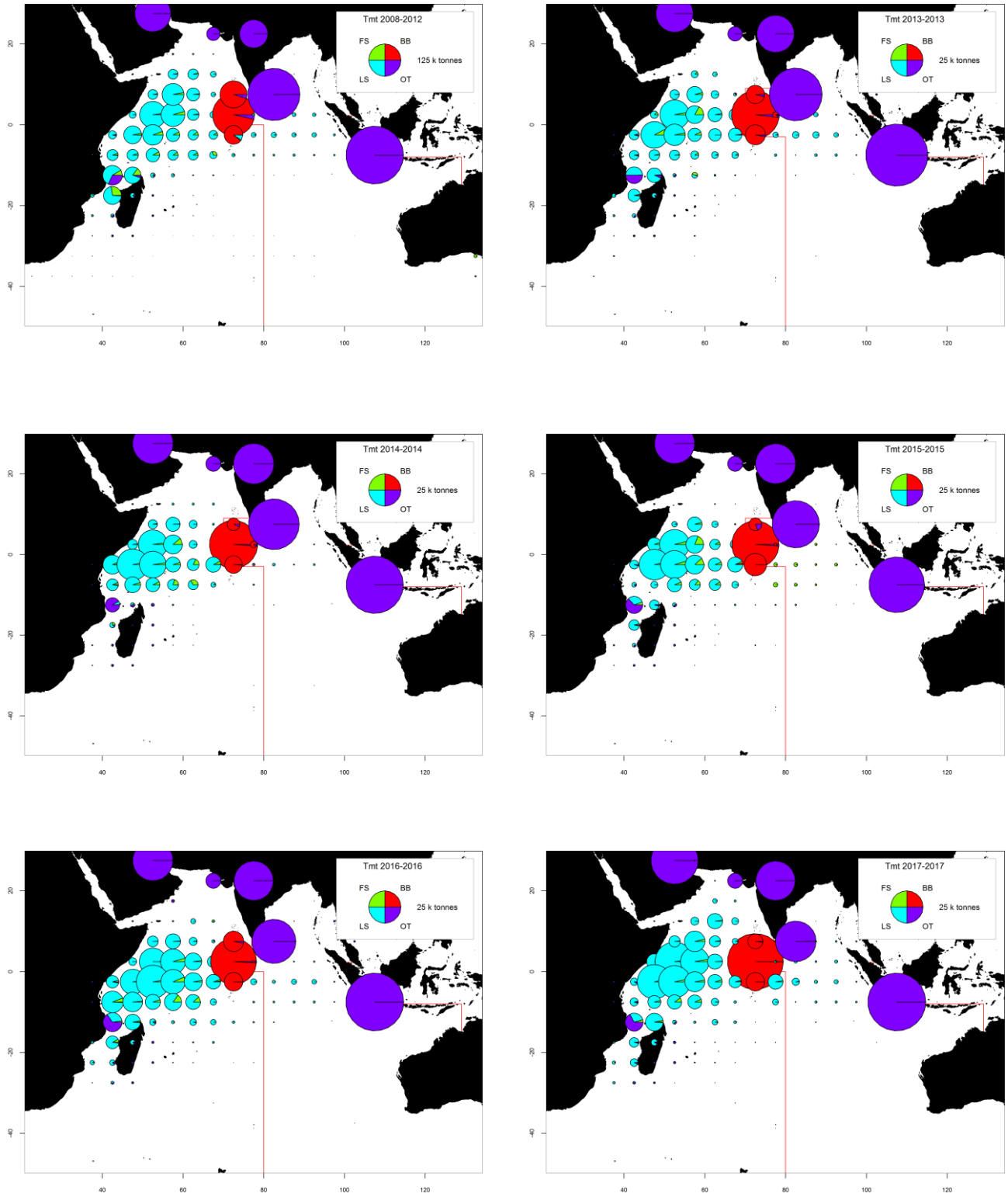


Fig. 14(a-f). Skipjack tuna: Time-area catches (total combined in tonnes) of skipjack tuna estimated for the period 2008–12 by type of gear and for 2013–17, by year and type of gear. Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (**BB**), and other fleets (**OT**), including longline, drifting gillnets, and various coastal fisheries.

Note that the catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned (as OT), in particular driftnets of I.R. Iran, gillnet and longline fishery of Sri Lanka, and longline and coastal fisheries of Indonesia.

Skipjack tuna: data availability and related data quality issues

Retained catches

- Retained catches are considered to be generally well known for the major industrial fleets, with the proportion of catches estimated, or adjusted, by the IOTC Secretariat relatively low (**Fig. 15a**). Catches are less certain for many artisanal fisheries for a number of reasons, including:
  - catches not fully reported by species;
  - uncertainty in the catches from some significant fleets including the Sri Lankan coastal fisheries, and coastal fisheries of Comoros and Madagascar.

Catch-per-unit-effort (CPUE) trends

- Catch-and-effort series are available for the various industrial and artisanal fisheries (e.g., Maldives pole-and-line fishery, EU-France purse seine).

  However for a number of other important fisheries catch-and-effort are either not available (**Fig. 15b**), or are considered to be of poor quality, notably:
  - insufficient data available for the gillnet fisheries of I.R. Iran and Pakistan;
  - poor quality effort data for the gillnet-longline fishery of Sri Lanka. In previous years catch-and-effort has not been reported fully by area, or disaggregated by gear (i.e., gillnet-longline) according to the IOTC reporting standards – however in 2014 detailed information by EEZ area (for coastal fisheries) and grid area (for offshore fisheries) and gear was submitted to the IOTC Secretariat for the first time;
  - no catch-and-effort data are available for important coastal fisheries using hand and/or troll lines, in particular Indonesia, India and Madagascar.

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

- Average fish weight: trends in average weights cannot be assessed before the mid-1980s and are also incomplete for most artisanal fisheries, namely hand lines, troll lines and many gillnet fisheries (e.g., Indonesia) (**Fig. 15c**).
- Catch-at-Size (Age) table: are available but the estimates are uncertain for some years and fisheries due to:
  - a general lack of size data before the mid-1980s, for all fleets/fisheries;
  - lack of size data available for some artisanal fisheries, notably most hand lines and troll line fisheries (e.g., Madagascar) and many gillnet fisheries (e.g., Indonesia, Sri Lanka) – although from 2014 Sri Lanka reported size information for its offshore fisheries.

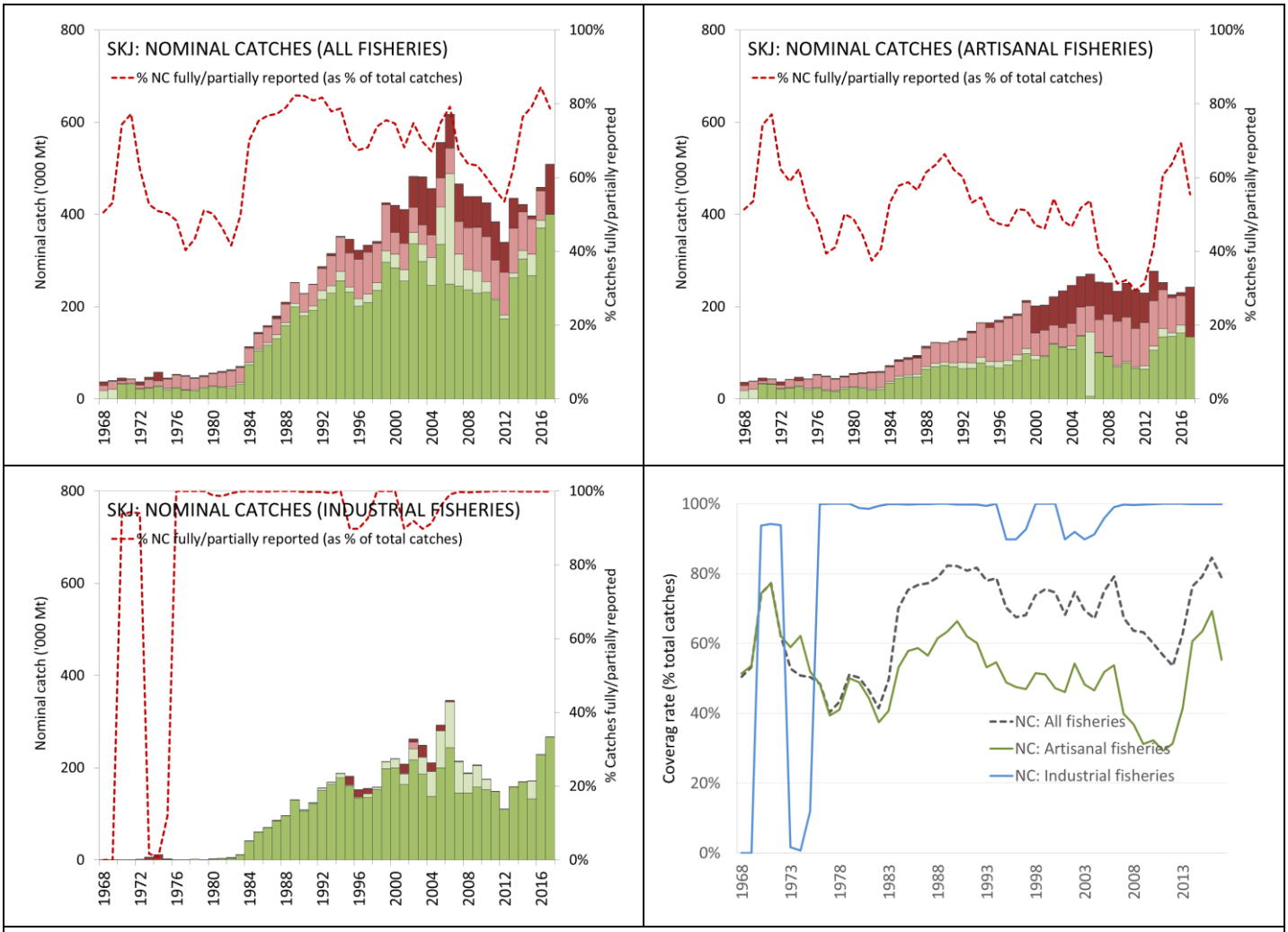


Fig. 15a-c. Skipjack tuna: nominal catches data reporting coverage (1968–2017). Data as of September 2018.

Data reporting scores:

	0
	2
	4
	6
	8

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

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

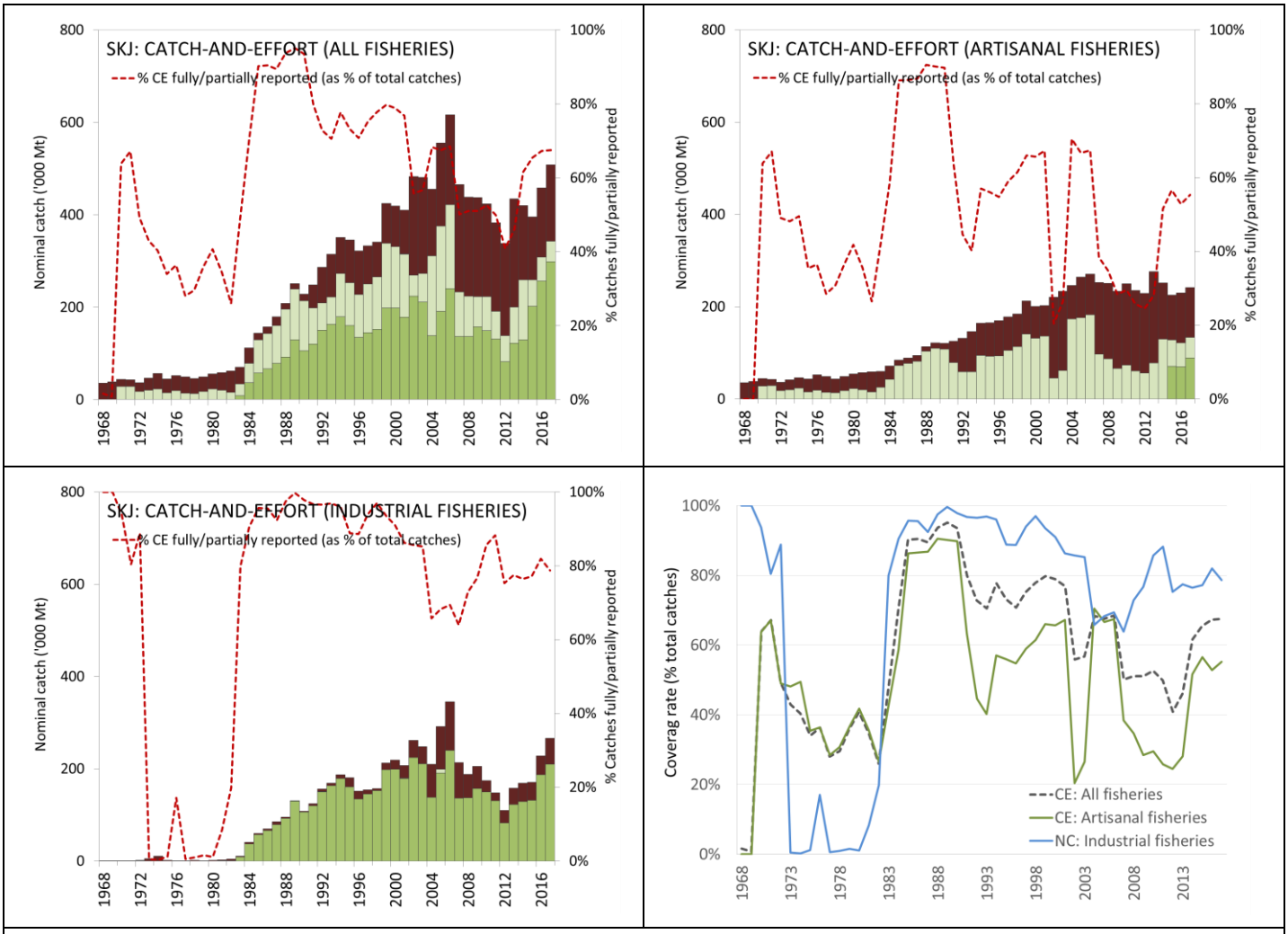


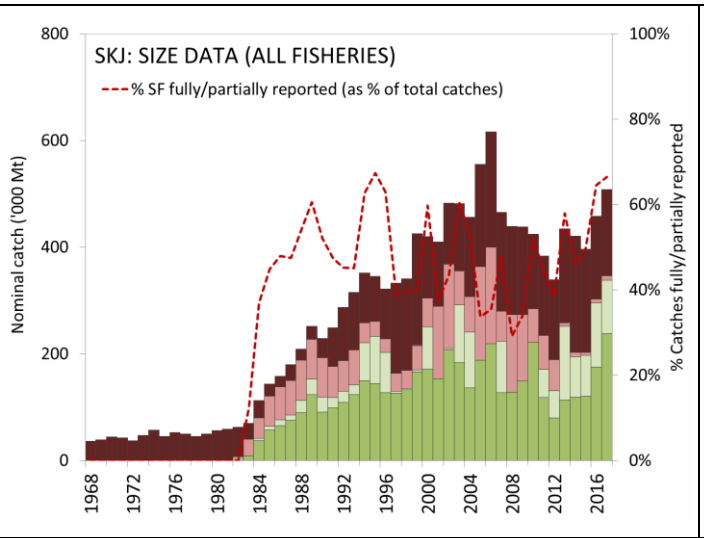
Fig. 15d-f. Skipjack tuna: catch-and-effort data reporting coverage (1968–2017). Data as of September 2018.

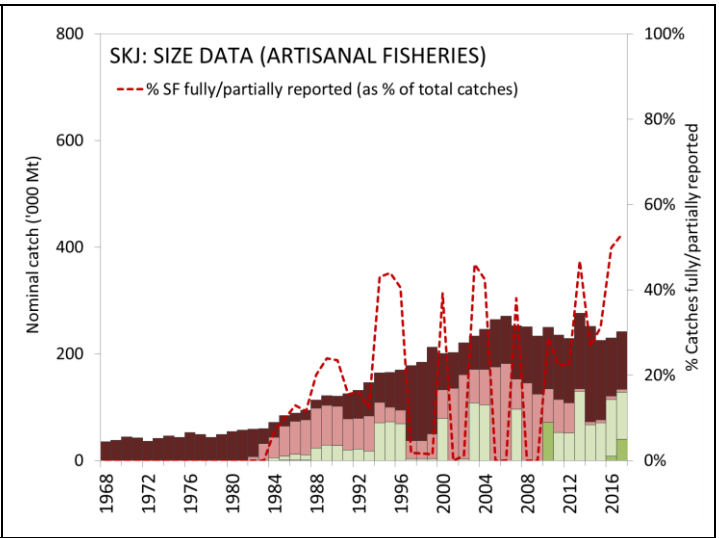
Data reporting scores:

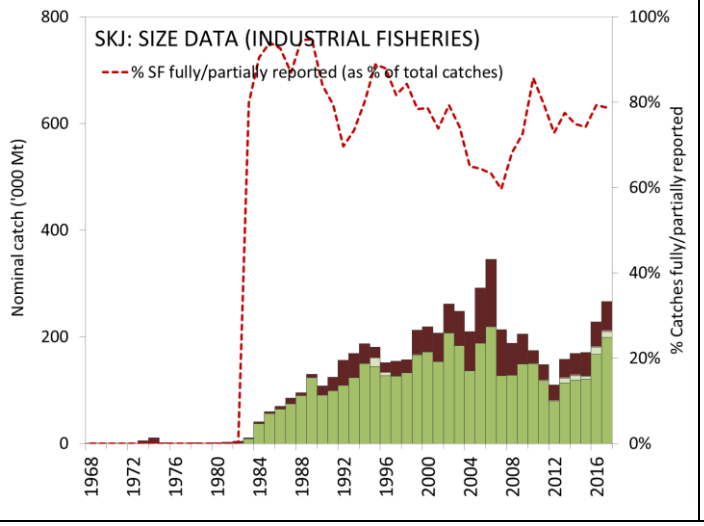
	0
	2
	4
	6
	8

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

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







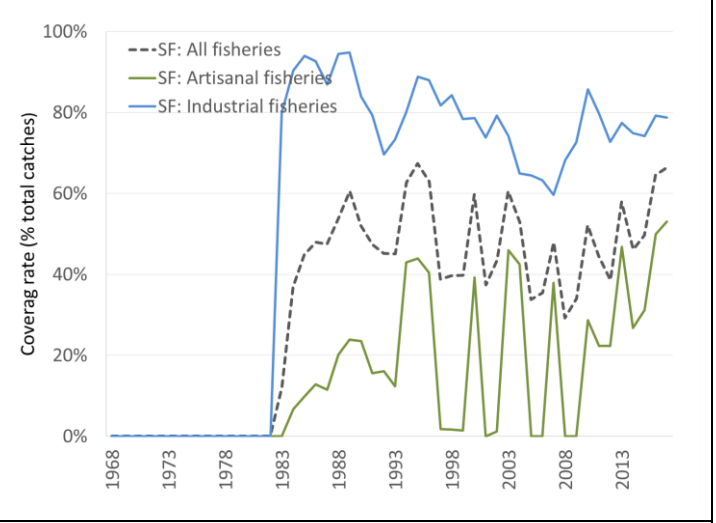


Fig. 15g-i. Skipjack tuna: size frequency data reporting coverage (1968–2017). Data as of September 2018.

Data reporting scores:

	0
	2
	4
	6
	8

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

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

Skipjack tuna: Tagging data

- A total of 115,693 skipjack (representing 53% of the total number of fish tagged) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP), of which ≈68% were released during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) around Seychelles, in the Mozambique Channel and off the coast of Tanzania, between May 2005 and September 2007 (**Fig. 16**). The remaining were tagged during small-scale tagging projects, and by other institutions with the support of IOTC around the Maldives, India, and in the south west and the eastern Indian Ocean.
- To date, 17,669 specimens (15% of releases for this species), have been recovered and reported to the IOTC Secretariat. Around 70% of the recoveries were from the purse seine fleets operating from the Seychelles, and around 29% by the pole-and-line vessels mainly operating from the Maldives. The addition of the data from the past projects in the Maldives (in 1990s) added 14,506 tagged skipjack tuna to the databases, or which 1,960 were recovered mainly in the Maldives.

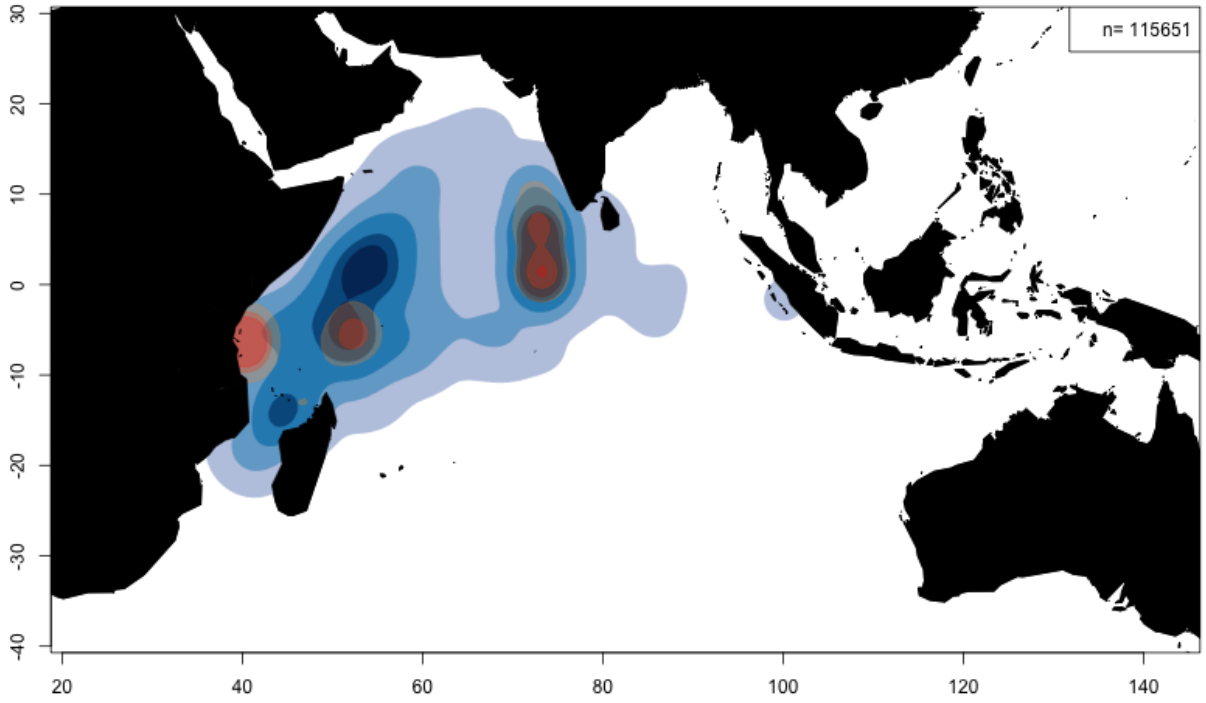


Fig. 16. Skipjack tuna: Densities of releases (in red) and recoveries (in blue). Includes specimens tagged during the IOTTP and also Indian Ocean (Maldivian) tagging programmes during the 1990s.

Yellowfin tuna (YFT)

Fisheries and main catch trends

- Main fishing gear: In recent years catches have been evenly split between industrial and artisanal fisheries. Purse seiners (free and associated schools) and longline fisheries still account for around 50% of total catches, while catches from artisanal gears – namely handline, gillnet, and pole-and-line – have steadily increased since the 1980s (**Table 6**; **Fig. 17**).

  Contrary to other oceans, the artisanal fishery component of yellowfin catches in the Indian Ocean are substantial, accounting for catches of over 200,000 t per annum since 2012. Moreover, the proportion of yellowfin catches from artisanal fisheries has increased from around 30% in 2000 to nearly 50% in recent years.

- Main fleets (and primary gear associated with catches): percentage of total catches (2013–17):
  EU-Spain (purse seine): 14%; Maldives (handline, pole-and-line): 13%; I.R. Iran (gillnet): 11%; Seychelles (purse seine): 11%; Sri Lanka (gillnet, coastal longliners): 10% (**Fig. 19**).

- Main fishing areas: Primary: Western Indian Ocean, around Seychelles and waters off Somalia (Area R2), and Mozambique Channel (Area R3) (**Fig.18**).

- Retained catch trends:
  Catches of yellowfin tuna remained stable between the mid-1950s and the early-1980s, ranging between 30,000 t and 70,000 t, with longliners and gillnetters the main fisheries. Catches increased rapidly in the early-1980s with the arrival of the purse seiners and increased activity of longliners and other fleets, reaching over 400,000 t by 1993.

  Exceptionally high catches were recorded between 2003 and 2006 – with the highest catches ever recorded in 2004 at over 525,000 t – while catches of bigeye tuna which are generally associated with the same fishing grounds as yellowfin tuna remained at average levels.

  Between 2007 and 2011 catches dropped considerably (around ≈40% compared to 2004) as longline fishing effort in the western Indian Ocean have been displaced eastwards or reduced due to the threat of piracy. Catches by purse seiners also declined over the same period – albeit not to the same extent as longliners – due to the presence of security personnel onboard purse seine vessels of the EU and Seychelles which has enabled fishing operations to continue.

  Since 2012 catches have once again been increasing, with current catches over 400,000 t recorded.

  Purse seine fishery:

  Although some Japanese purse seiners have fished in the Indian Ocean since 1977, the purse seine fishery developed rapidly with the arrival of European vessels between 1982 and 1984. Since then, there has been an increasing number of yellowfin tuna caught, with a larger proportion of the catches consisting of adult fish, as opposed to catches of bigeye tuna, which are mostly composed of juvenile fish.

  The purse seine fishery is characterized by the use of two different fishing modes. The fishery on floating objects (FADs) catches large numbers of small yellowfin tuna in association with skipjack tuna and juvenile bigeye tuna, compared to the fishery on free swimming schools, which catches larger yellowfin tuna on multi-specific or mono-specific sets.

  Longline fishery:

  The longline fishery started in the early 1950's and expanded rapidly over throughout the Indian Ocean. The longline fishery targets several tuna species in different parts of the Indian Ocean, with yellowfin tuna and bigeye tuna being the main target species in tropical waters. The longline fishery can be subdivided into a deep-freezing longline component (i.e., large scale deep-freezing longliners operating on the high seas from Japan, Korea and Taiwan,China) and a fresh-tuna longline component (i.e., small to medium scale fresh tuna longliners from Indonesia and Taiwan,China).

- Discard levels: Low, although estimates of discards are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–07.

***Changes to the catch series*:** No major changes to the catch series since the WPTT meeting in 2016.

Table 6. Yellowfin tuna: Best scientific estimates of the catches of yellowfin tuna (*Thunnus albacares*) by gear and main fleets [or type of fishery] by decade (1950–2009) and year (2008–2017), in tonnes. Catches by decade represent the average annual catch, noting that some gears were not used since the beginning of the fishery. Data as of September 2018.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
FS	0	0	18	31552	64938	89204	74986	36048	32136	36453	64594	34472	47427	63962	49460	50700
LS	0	0	17	17597	56279	61890	41539	51352	73382	76658	66165	101886	86418	78394	99267	94424
LL	21990	41352	29589	33968	66318	56878	26039	20003	18746	20668	19671	16010	15608	17854	19359	17941
LF	166	1258	2374	7960	58987	55608	58102	49884	50485	43455	44695	47271	50594	40486	46278	54377
BB	2111	2318	5810	8295	12803	16072	18279	16826	14105	14010	15512	24055	20541	17642	12392	20298
GI	1567	4109	7928	12005	39539	49393	47871	41908	51118	49278	63460	56167	71390	71153	64723	75136
HD	619	636	2915	7373	18996	34337	30558	28373	34083	59401	79672	70501	71418	73769	85920	68568
TR	1012	1834	4239	7337	12287	16508	17328	15184	19982	19567	28585	32604	22256	16614	22063	14560
OT	80	193	454	1871	3379	5402	6557	7359	7703	7870	8223	8983	11402	11709	9957	13146
Total	**27,544**	**51,699**	**53,344**	**127,958**	**333,525**	**385,291**	**321,259**	**266,937**	**301,740**	**327,360**	**390,577**	**391,949**	**397,054**	**391,583**	**409,419**	**409,150**

Gears: Purse seine free-school (**FS**); Purse seine associated school (**LS**); Deep-freezing longline (**LL**); Fresh-tuna longline (**FL**); Pole-and-Line (**BB**); Gillnet (**GI**); Hand line (**HD**); Trolling (**TR**); Other gears nei (**OT**).

Table 7. Yellowfin tuna: Best scientific estimates of the catches of yellowfin tuna (*Thunnus albacares*) by area by decade (1950–2009) and year (2008–2017), in tonnes. Catches by decade represent the average annual catch. The areas are presented in Fig. 18(a). Data as of September 2018.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
R1	1,992	4,480	8,630	19,792	74,590	84,934	71,256	59,847	70,900	100,769	131,930	119,195	129,995	135,073	144,017	139,202
R2	12,260	24,036	22,127	73,396	142,289	180,674	134,831	99,730	115,121	121,166	145,359	155,445	162,341	164,542	167,331	164,063
R3	658	7,350	4,283	7,357	21,776	23,604	19,871	18,426	18,263	18,988	17,090	20,664	8,769	14,404	18,588	20,059
R4	918	1,800	1,356	1,085	3,411	2,485	571	810	1,356	517	586	779	487	1,466	514	416
R5	11,716	14,034	16,949	26,329	91,459	93,593	94,730	88,124	96,100	85,920	95,612	95,866	95,462	76,098	78,969	85,410
Total	**27,544**	**51,699**	**53,344**	**127,958**	**333,525**	**385,291**	**321,259**	**266,937**	**301,740**	**327,360**	**390,577**	**391,949**	**397,054**	**391,583**	**409,419**	**409,150**

Areas: Arabian Sea (**R1**); Off Somalia (**R2**); Mozambique Channel including southern (**R3**); South Indian Ocean including southern (**R4**); East Indian Ocean including Bay of Bengal(**R5**).

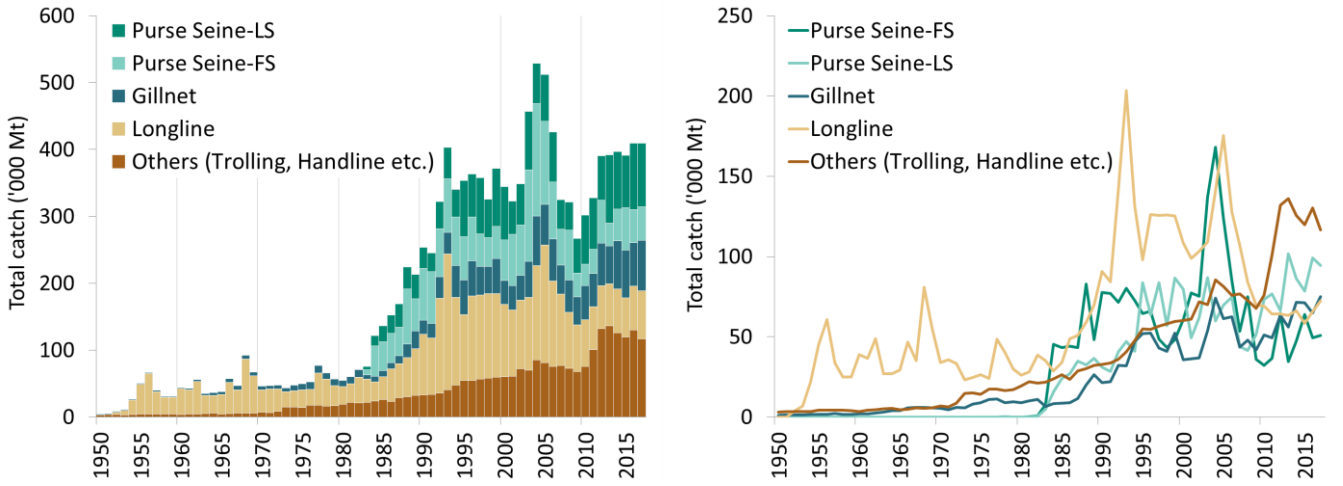


Fig. 17. Annual catches of yellowfin tuna by gear (1950–2017). Data as of September 2018.

Gears: Purse seine free-school (**FS**); Purse seine associated school (**LS**); Deep-freezing longline (**LL**); Fresh-tuna longline (**FL**); Pole-and-Line (**BB**); Gillnet (**GI**); Hand line (**HD**); Trolling (**TR**); Other gears nei (**OT**).

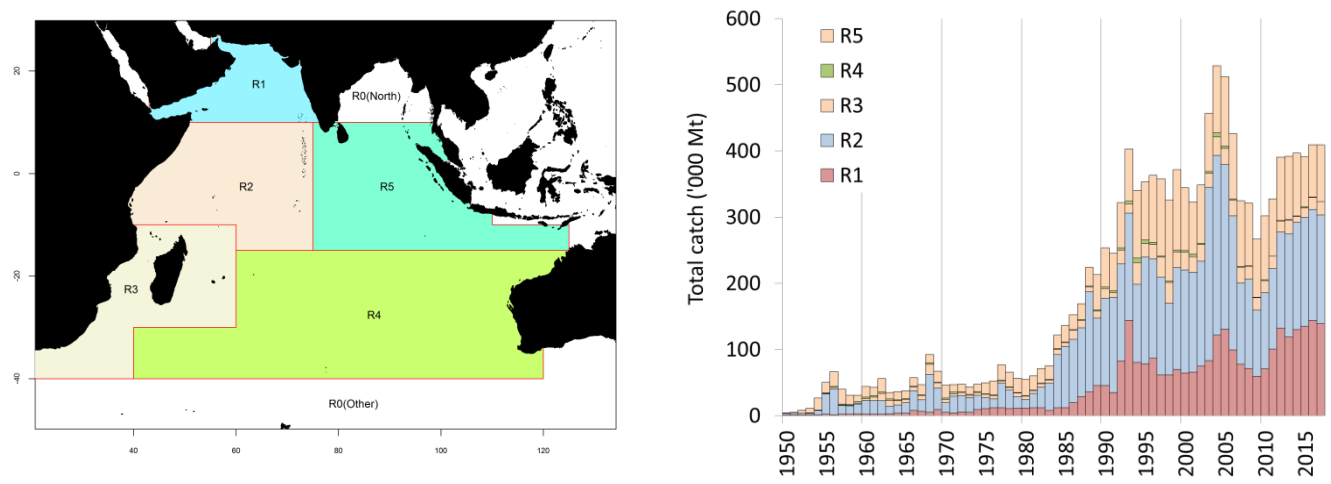


Fig. 18(a-b). Yellowfin tuna: Catches of yellowfin tuna by area by year estimated for the WPTT (1950–2016). Catches in areas R0 were assigned to the closest neighbouring area for the assessment. Data as of September 2018.

Areas: Arabian Sea (**R1**); Off Somalia (**R2**); Mozambique Channel, including southern (**R3**); South Indian Ocean including southern (**R4**); East Indian Ocean, including Bay of Bengal(**R5**).

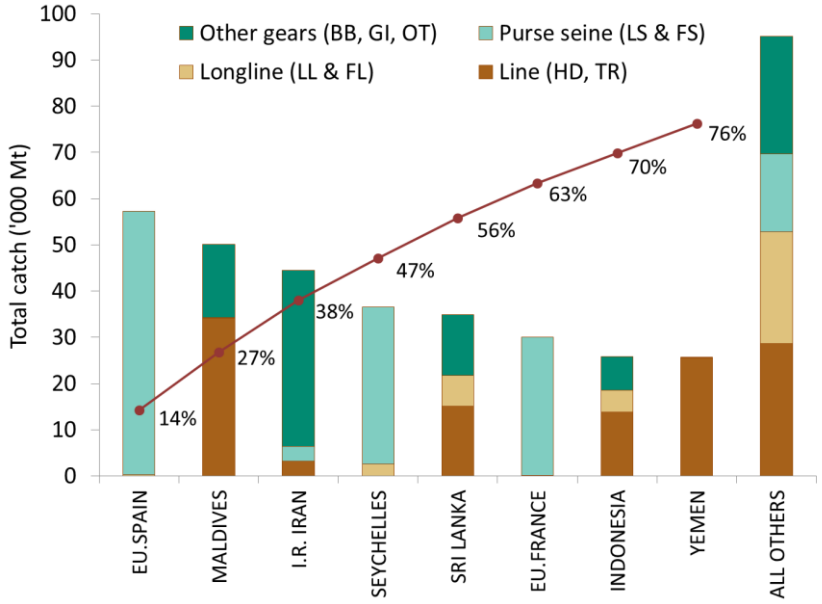


Fig. 19. Yellowfin tuna: average catches in the Indian Ocean over the period 2013–17, by country. Countries are ordered from left to right, according to the importance of catches of yellowfin reported. The red line indicates the (cumulative) proportion of catches of yellowfin for the countries concerned, over the total combined catches of this species reported from all countries and fisheries. Data as of September 2018.

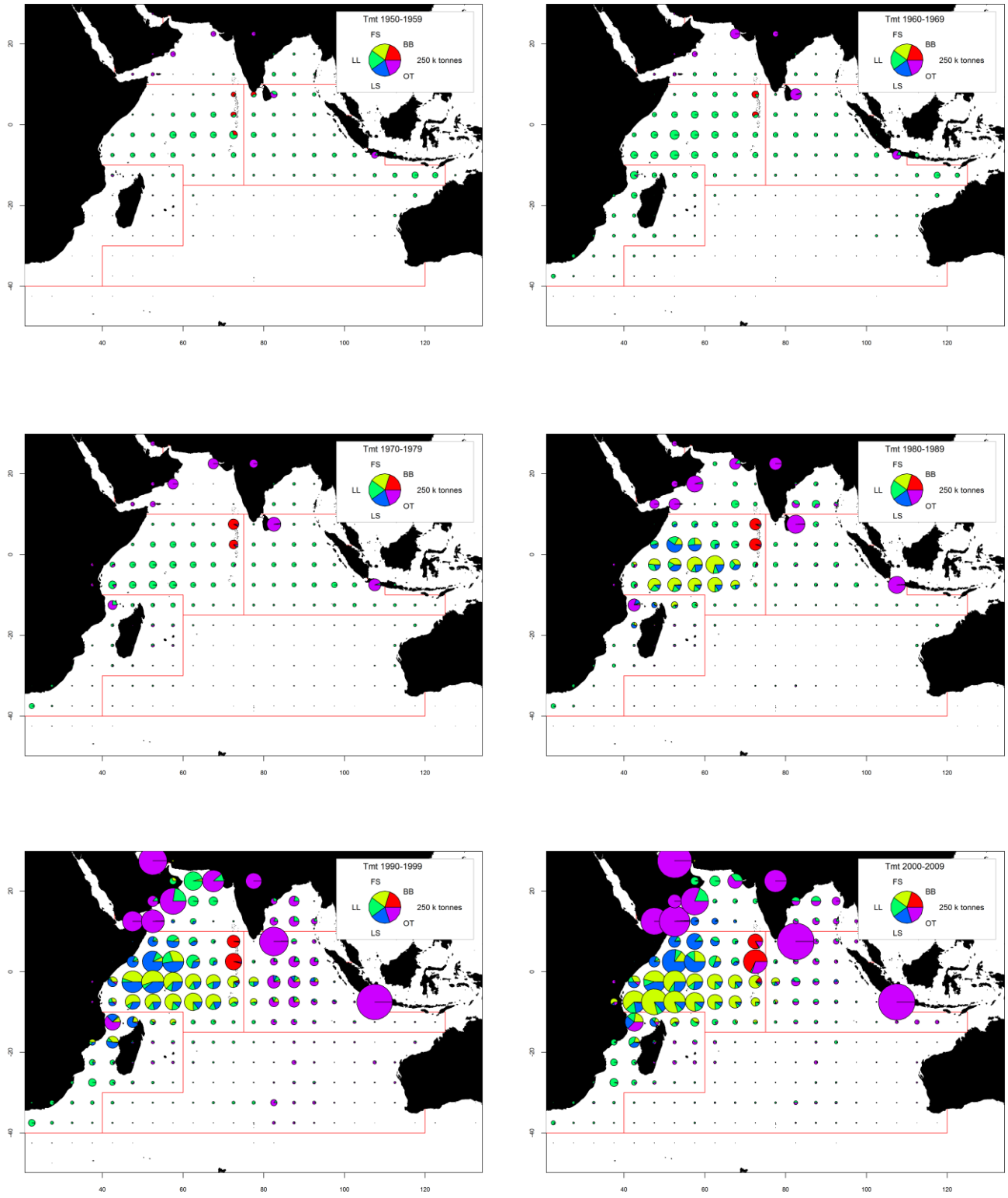


Fig. 20(a-f). Yellowfin tuna: Time-area catches (total combined in tonnes) of yellowfin tuna estimated for the period 1950–2009, by decade and type of gear. Longline (**LL**), Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (**BB**), and other fleets (**OT**), including drifting gillnets, and various coastal fisheries.

Note that the catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned (as OT), in particular driftnets of I.R. Iran, gillnet and longline fishery of Sri Lanka, and longline and coastal fisheries of Indonesia.

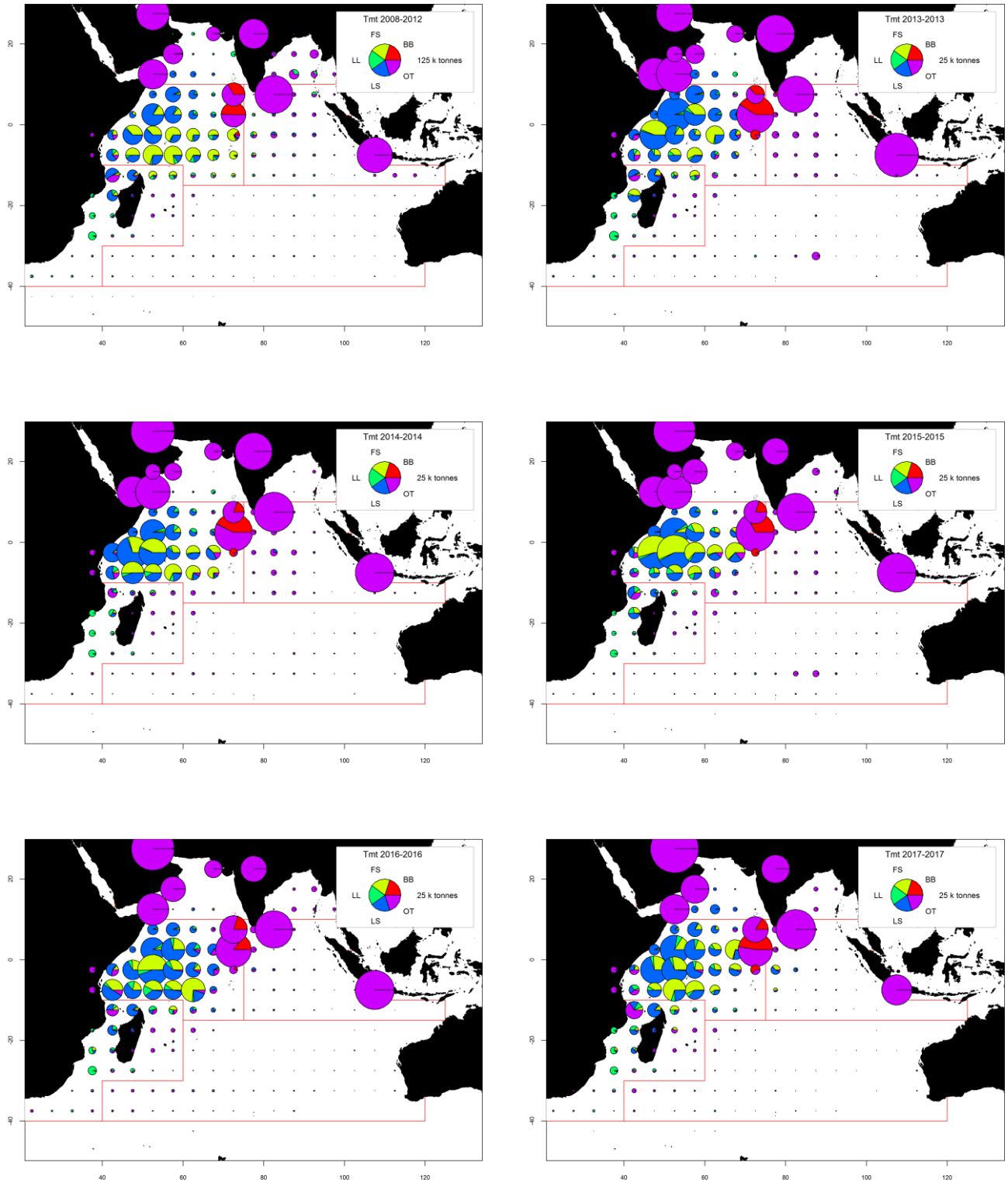


Fig. 21(a-f). Time-area catches (total combined in tonnes) of yellowfin tuna estimated for the period 2008–2012 by type of gear and for 2013–2017, by year and type of gear. Longline (**LL**), Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (**BB**), and other fleets (**OT**), including drifting gillnets, and various coastal fisheries.

Note that the catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned (as OT), in particular driftnets of I.R. Iran, gillnet and longline fishery of Sri Lanka, and longline and coastal fisheries of Indonesia.

Yellowfin tuna: data availability and related data quality issues

Retained catches

- Data are considered to be generally well known for the major industrial fisheries, with the proportion of catches estimated, or adjusted, by the IOTC Secretariat relatively low (**Fig. 22a**). Catches are less certain for the following fisheries/fleets:
  - many coastal fisheries, notably those from Indonesia, Sri Lanka, Yemen, and Madagascar;
  - the gillnet fishery of Pakistan;
  - Non-reporting industrial purse seiners and longliners (NEI), and longliners of India.

Catch-per-unit-effort (CPUE) trends

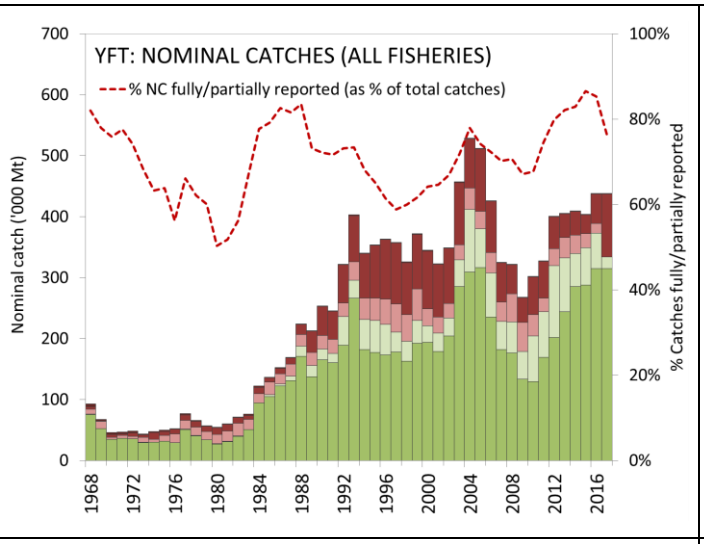
- Availability: Catch-and-effort series are available for the major industrial and artisanal fisheries (e.g., Japan longline, Taiwan,China) (**Fig. 22b**).

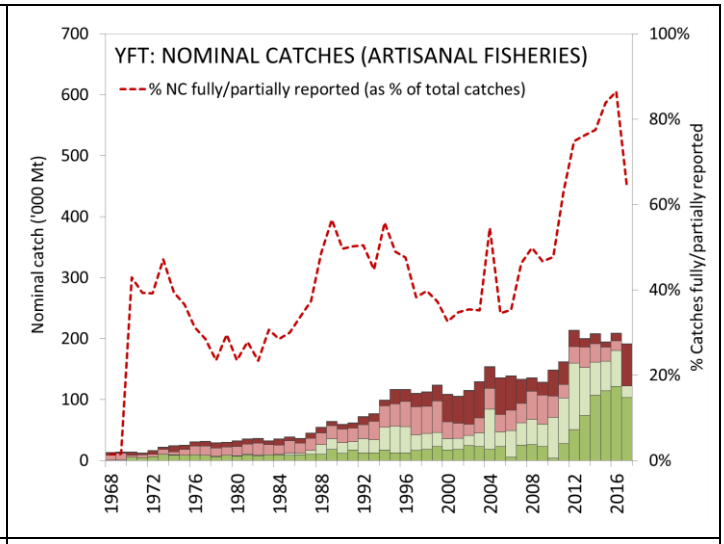
  However, for other important fisheries catch-and-effort are either not available, or are considered to be of poor quality for the following reasons:
  - no data are available for the fresh-tuna longline fishery of Indonesia, over the entire time series, and data for the fresh-tuna longline fishery of Taiwan,China are only available since 2006;
  - insufficient data for the gillnet fisheries of I.R., Iran and Pakistan;
  - poor quality effort data for the significant gillnet-longline fishery of Sri Lanka;
  - no data are available from important coastal fisheries using hand and/or troll lines, in particular Yemen, Indonesia, and Madagascar.

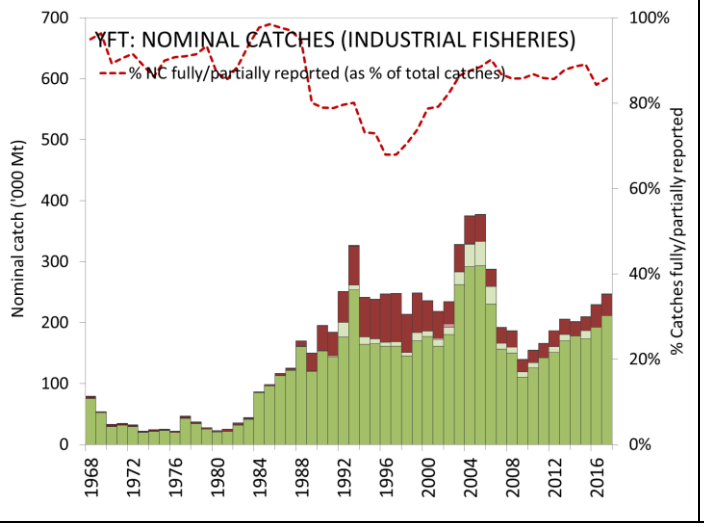
Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Average fish weight: trends in average weight can be assessed for several industrial fisheries but they are very incomplete or of poor quality for some fisheries, namely hand lines (Yemen, Comoros, Madagascar), troll lines (Indonesia) and many gillnet fisheries (**Fig. 22c**).
  - Purse seine vessels typically take fish ranging from 40 to 140 cm fork length (FL), while smaller fish are more common in catches taken north of the equator.
  - Longline gear mainly catches large fish, from 80 to 160 cm FL, although smaller fish in the size range 60 cm – 100 cm (FL) have been taken by longliners from Taiwan,China since 1989 in the Arabian Sea.

- Catch-at-Size (Age) table: data are available, although the estimates are more uncertain in some years and some fisheries due to:
  - size data not being available from important fisheries, notably Yemen, Pakistan, Sri Lanka and Indonesia (lines and gillnets) and Comoros and Madagascar (lines)
  - the paucity of size data available from industrial longliners from the late-1960s up to the mid-1980s, and in recent years (Japan and Taiwan,China)
  - the paucity of catch by area data available for some industrial fleets (NEI fleets, I.R. Iran, India, Indonesia, Malaysia).







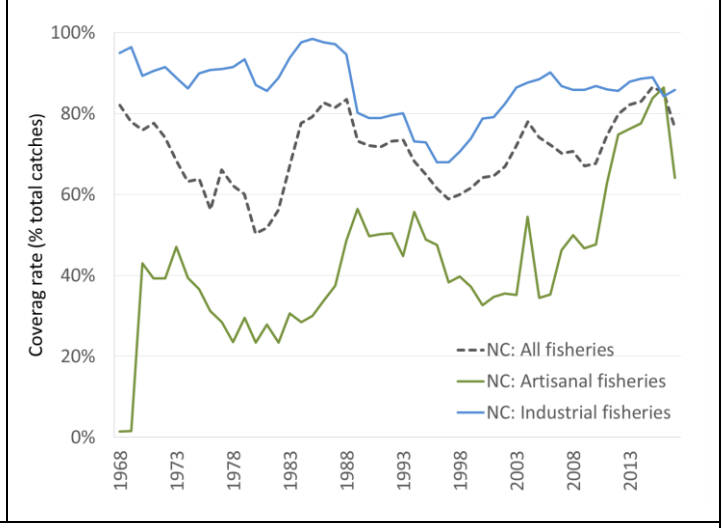


Fig. 22a-c. Yellowfin tuna: nominal catches data reporting coverage (1968–2017). Data as of September 2018.

Data reporting scores:

	0
	2
	4
	6
	8

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

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

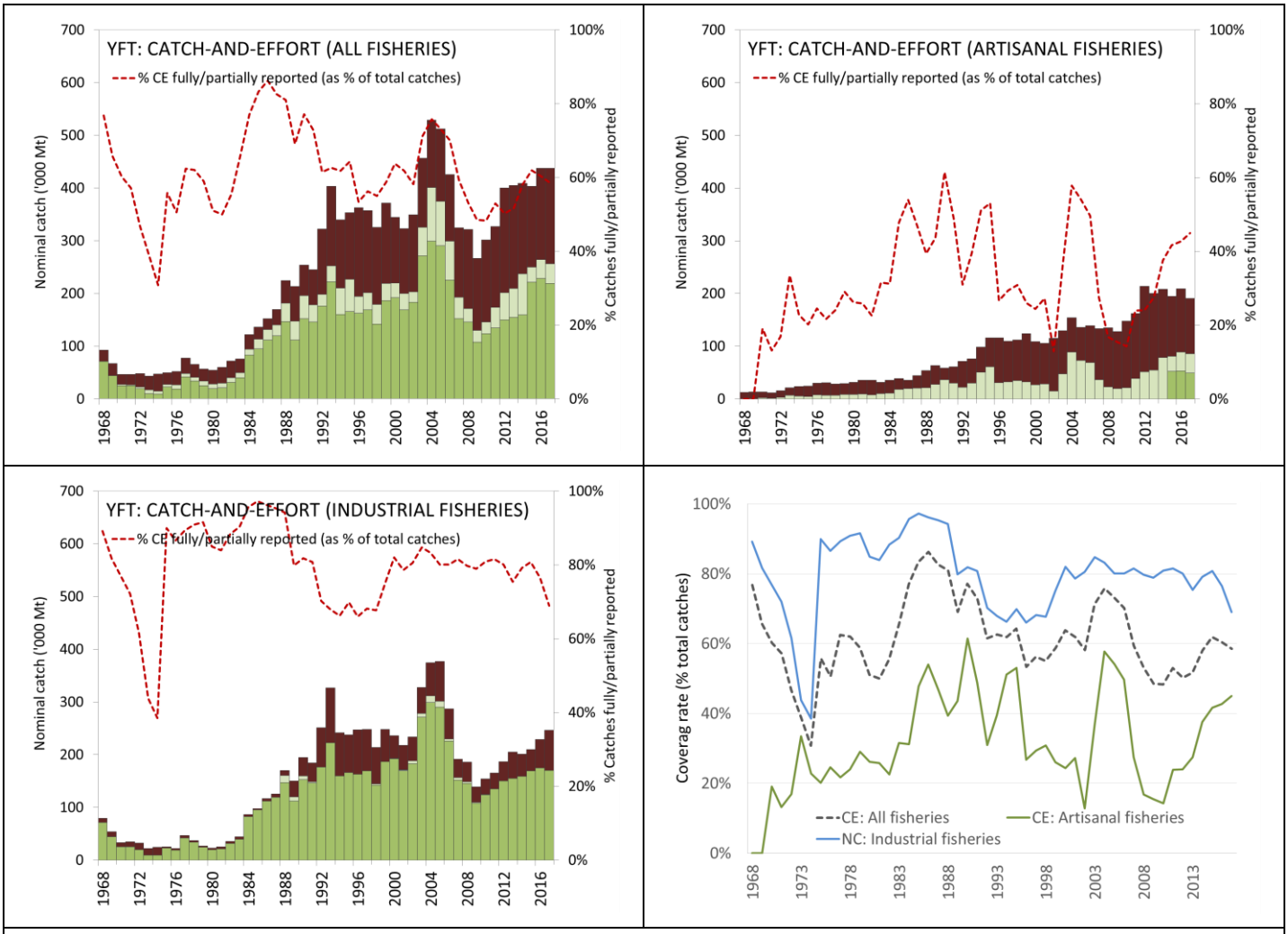


Fig. 22d-f. Yellowfin tuna: catch-and-effort data reporting coverage (1968–2017). Data as of September 2018.

Data reporting scores:

	0
	2
	4
	6
	8

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

- **Score: 0** indicates the amount of nominal catch associated with each dataset fully reported according to IOTC standards.
- **Score: 2 – 6** indicates the amount of nominal catches associated with each dataset partially reported by gear and/or species (i.e., adjusted by gear and species by the IOTC Secretariat or for any of the other reasons provided in the document).
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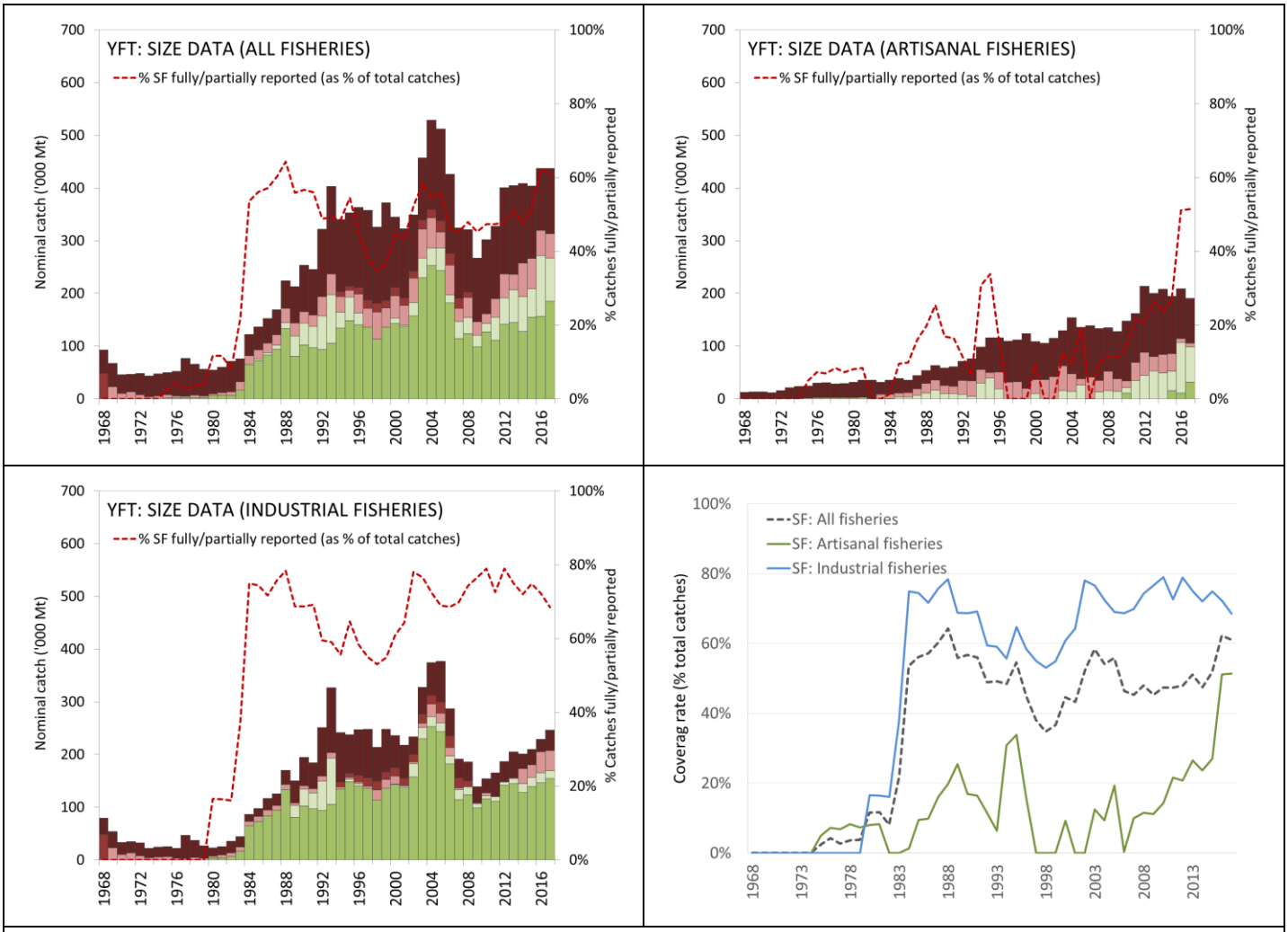


Fig. 22g-i. Yellowfin tuna: size frequency data reporting coverage (1968–2017). Data as of September 2018.

Data reporting scores:

	0
	2
	4
	6
	8

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

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

Yellowfin tuna: tagging data

- A total of 66,543 yellowfin tuna (representing 30% of the total number of fish tagged) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of the tagged specimens (82%) were released during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and were released around Seychelles, in the Mozambique Channel, along the coast of Oman and off the coast of Tanzania, between May 2005 and September 2007 (**Fig. 23**). The remaining specimen were tagged during small-scale tagging projects, and by other institutions with the support of IOTC Secretariat, in Maldives, India, and in the south west and the eastern Indian Ocean.
- To date, around 10,842 specimens (16% of releases for this species), have been recovered and reported to the IOTC Secretariat. More than 86% of these recoveries we made by the purse seine fleets operating in the Indian Ocean, while around 9% were made by pole-and-line and less than 1% by longline vessels. The addition of the data from the past projects in the Maldives (in 1990s) added 3,211 tagged yellowfin tuna to the databases, or which 151 were recovered, mainly from the Maldives.

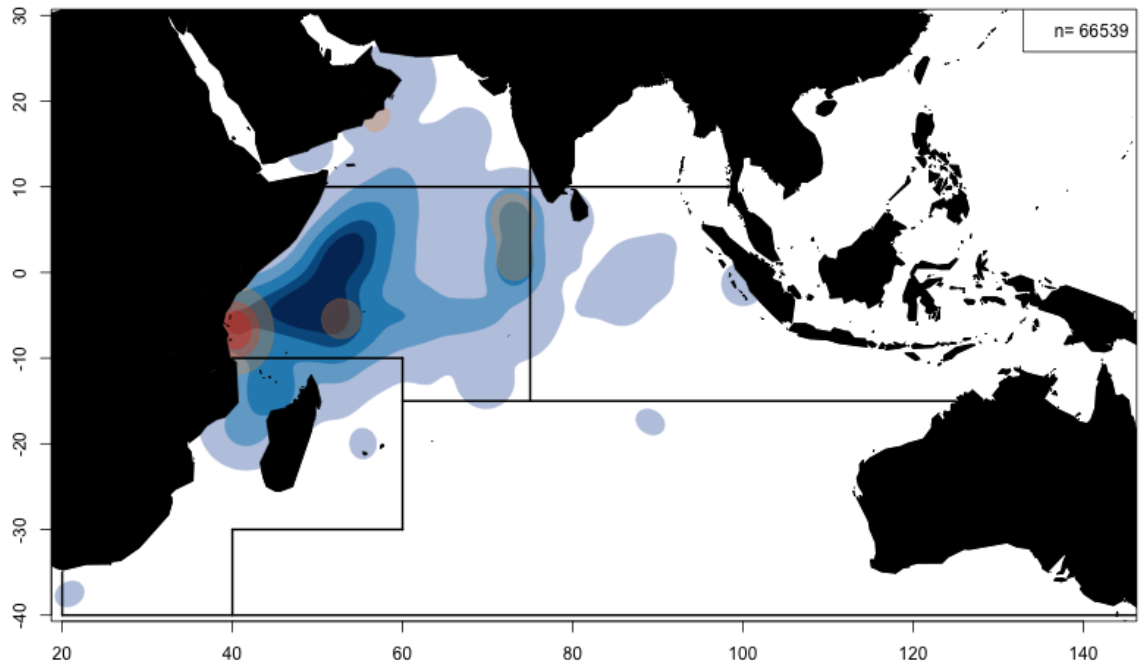


Fig. 23. Yellowfin tuna: Densities of releases (in red) and recoveries (in blue). The black line represents the stock assessment areas. Includes specimens tagged during the IOTTP and also Indian Ocean (Maldivian) tagging programmes during the 1990s.

APPENDIX I

ESTIMATION OF CATCHES OF NON-REPORTING FLEETS

IOTC estimates of catches of non-reporting fleets were updated in 2018:

The high number of non-reporting fleets (i.e., vessels belonging to both IOTC CPCs and non-IOTC parties) operating in the Indian Ocean between the mid-1980's to late-1990's led to large increases in the amount of catches that required to be estimated for that period. This in turn raises questions over the reliability of catches estimated for yellowfin tuna and bigeye tuna, and to a lesser extent, skipjack tuna during those years.

While the number of fleets from non-IOTC parties operating in the Indian Ocean has decreased significantly in recent years, this has been offset by an increase in the number of vessels fishing under flags of some IOTC CPCs, including coastal countries in the IOTC region (e.g., India, Indonesia, I.R. Iran, Kenya, Malaysia, Oman, Seychelles, Tanzania and Thailand) and deep-water fishing nations (e.g., Belize, Guinea and Senegal) – many of which have varying levels of quality of statistics collected for their fisheries.

- **Purse seine** (**Fig. 24**): Catches for the six former Soviet Union purse seiners, registered under the Thailand flag, were estimated for January-August 2005, and also for one remaining purse seiner (Equatorial Guinea) for 2005–2006. Total catches were estimated using the number of vessels available and the average catches of former Soviet Union purse seiners in previous years. Comparisons were also made to the average catches for other purse seine fleets (for 2005–2006) for purposes of validation of IOTC's estimates. Total catches were then assigned by species and type of school fished according to data available for Thailand purse seiners during the same period.

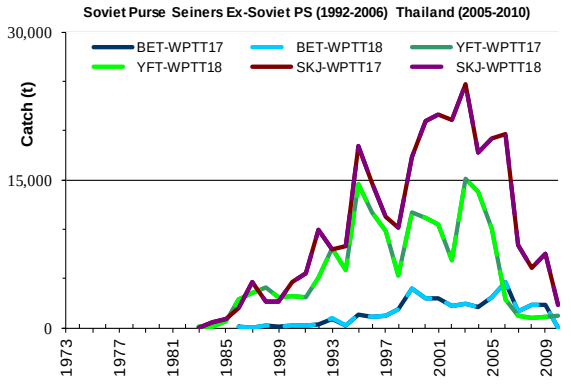


Fig. 24. Catches of Soviet, ex-Soviet and Thai purse seiners estimated in 2012 versus previous catches estimated in 2011 (1983–2010).

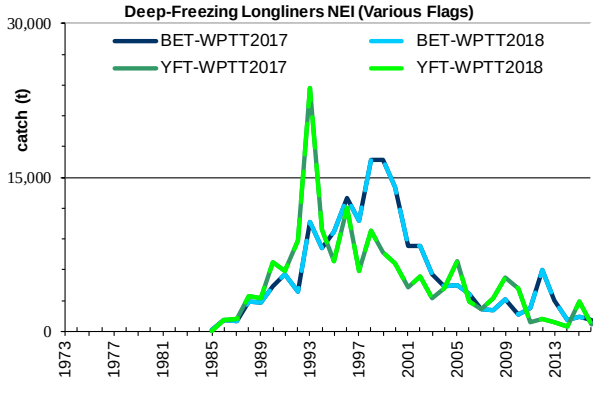


Fig. 25. Catches of deep-freezing longline vessels in the Indian Ocean estimated in 2018 versus catches estimated in 2017 (for the period 1985–2016).

- **Deep-freezing longline** (**Fig. 25**): The catches by large longliners from several non-reporting countries were estimated using IOTC vessel records and the catch data from Taiwanese, Japanese or Spanish longliners, based on the assumption that most of the vessels operate similar fishing patterns to the longliners from Taiwan,China, Japan, or EU-Spain. The collection of new information on the activities of non-reporting fleets, in particular the numbers and characteristics of non-reporting longliners, has led to improvements in the estimates of catches. Since 1999 the number of non-reporting longliners in the Indian Ocean has decreased considerably leading to a marked decrease in catch levels however – as noted above – such decreases have coincided with an increase in the numbers of vessels operated by some IOTC CPC's. Although these countries usually report catches to the IOTC Secretariat, the data reported are, in some cases, considered incomplete.
- **Fresh tuna longline** (**Figs. 26-27**): Fresh tuna longline vessels, mainly from China, Taiwan,China, India, Malaysia, Belize and Indonesia, have been operating in the Indian Ocean since the early 1970's. The catches of these fleets have been estimated by the IOTC Secretariat by using information from the following three sources:
    - Catches reported by the flag countries: Although China reported total catches for its longline fleet they were not reported by type of longline until 2006 (fresh-tuna longline or deep-freezing longline). The Secretariat estimated the catches of fresh-tuna longliners for 1999–2005 by using the total catches

reported, the numbers of fresh-tuna longline vessels provided by China and catch rates for fresh-tuna longliners available from other years.

- Information on catches and vessel activity collected through several catch monitoring schemes implemented in the main ports of landing for these vessels, involving the IOTC-OFCF[9] and/or institutions in the countries where the fleets are based and/or foreign institutions. This applies to Indonesia (2002–2006), Thailand (1998–2006), Sri Lanka (2002–03), Malaysia (2000–2006), Oman (2004–2005) and Seychelles (2000–2002). Since 2007 Indonesia and Malaysia have reported catches for their longline fleets, however in the case of Indonesia the catches reported are thought to be incomplete as they do not monitor the activities of vessels under their flags based in other countries. The Secretariat estimated the catches of this component, also for the countries indicated in the next paragraph below.
- Information available on the number of fresh-tuna longline vessels operating in other ports or on the activity of those vessels (e.g., the number of vessel unloading or total catches unloaded). This applies to India (2005-16), Indonesia (1973–2001), Thailand (1994–2013), Sri Lanka (1990–2001; 2004–15), Malaysia (1989–2016), Singapore, Mauritius and Maldives (recent years). The catches in these ports and years were estimated from the known/presumed levels of activity of the vessels and the average catches obtained in ports that were covered through sampling.

In 2006 Taiwan,China provided total catches for its longline tuna fleet operating in the Indian Ocean for the period 2000 to 2005. The catches for 2006-12 have also been provided, including time area catches and effort for 2007-16. The catches published by Taiwan,China were slightly higher than those that the IOTC Secretariat had estimated from the data collected through port sampling. The new catches provided for 2001-05 were used to replace those in the IOTC database. This was done on the assumption that vessels from Taiwan,China had operated in ports of non-reporting countries, and that their catches had not been accounted for in previous estimates made by the IOTC Secretariat. Since 2006, the Secretariat has been using the catches published by Taiwan,China.

The catches for fleets other than Taiwan,China for 1973–2016 and for Taiwan,China in years prior to 2001 were estimated according to estimation methodologies detailed in the three bullet points above.

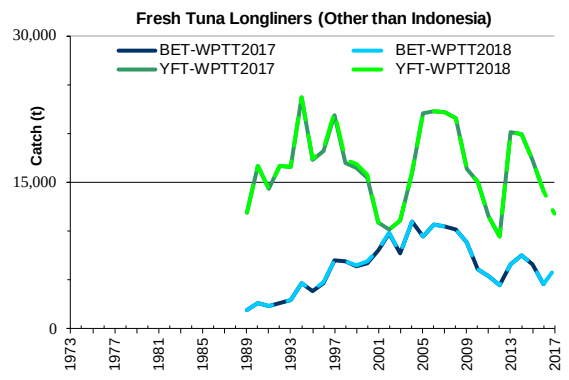


Fig. 26. Catches of fresh-tuna longline vessels based in India, Malaysia, Maldives, Mauritius, Oman, Seychelles, Singapore, Sri Lanka, Thailand and Yemen (mainly registered in China, Taiwan,China and Indonesia) estimated in 2018 versus catches estimated in 2017 (1989–2017).

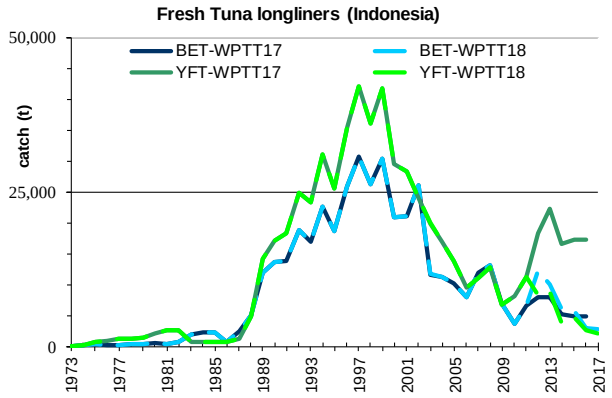


Fig. 27. Catches of fresh-tuna longline vessels based in Indonesia (domestic and foreign) estimated in 2018 versus catches estimated in 2017 (1973–2016).

[9] Overseas Fishery Cooperation Foundation of Japan.

APPENDIX II

ESTIMATION OF CATCHES AT SIZE FOR IOTC TROPICAL TUNA SPCIES

Table 1: Current IOTC equations to convert from non-standard measurements into standard length (fork length), by species

Species: Yellowfin tuna — ***Standard length: Tip of snout to fork of tail***

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size*	*Variance*	*Covariance ab*	*Mean Residual*	*Gradient*
Weight gilled and gutted[A]	a*W^b	a= 44.28699 b= 0.3008591	2,361	Min:14 Max:71	a=0.00752476509 b=2.86244E-07	-4.626246E-05	4.095958	a=3.033852 b=495.6385
Length to the base of the 1st dorsal fin[B]	a*L^ b	a=2.0759 b=1.1513	7,036	Min: 29 Max: 164				

Species: Bigeye tuna — ***Standard length: Tip of snout to fork of tail***

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size*	*Variance*	*Covariance ab*	*Mean Residual*	*Gradient*
Weight gilled and gutted[A]	a*W^ b	a= 42.2186 b= 0.3012349	316	Min:12 Max:107	a=0.0321755341 b=1.299934E-06	-0.0002034041	3.98137	a=3.03806 b=473.1455
Length to the base of the 1st dorsal fin[C]	$\frac{(L+a)^2}{(b)^2}$	a=21.45108 b=5.28756	2,858	Min:13 Max:48				

Sources:

A: Data from Penang Sampling Programme (1992-93)

B: Data from the Indian Ocean (Marsac, F. et al in IOTC-2006-WPTT-09)

C: Data from the Atlantic Ocean, Champagnat et Pianet (1974) (ibid. B)

Table 2: Current IOTC equations used to convert from standard length into round weight, per species

Species	*Gear Type/s*	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Yellowfin tuna	Purse seine Pole and Line Gillnet	Fork length – Round Weight(kg)[A]	RND=a*L^b	a=0.00002459 b= 2.96670	25,386	n/a
	Longline Line Other Gears	Fork length(cm) – Gilled and gutted weight(kg)[B] Gilled and gutted weight(kg) - Round Weight(kg)[C]	GGT=a*L^b RND=GGT*1.13	a= 0.0000094007 b= 3.126843987	15,133	Min:72 Max:177
Bigeye tuna	Purse seine Pole and Line Gillnet Trolling	Fork length(cm) – Round Weight(kg)[A]	RND=a*L^b	a=0.00002217 b= 3.01211	2,156	n/a
	Longline Line Other Gears	Fork length(cm) – Gilled and gutted weight(kg)[B] Gilled and gutted weight(kg) - Round Weight(kg)[C]	GGT=a*L^b RND=GGT*1.13	a= 0.0000159207 b= 3.0415414023	12,047	Min:70 Max:187
Skipjack tuna	All gears	Fork length(cm) – Round Weight(kg)[A]	RND=a*L^b	a=0.00000497 b= 3.39292	1,762	n/a

Sources:

A: Length-weight relationships for tropical tunas caught with purse seine in the Indian Ocean: Update and lessons learned (Chassot, E. et al in IOTC-2016-WPDSC12-INF05)

B: Multilateral catch monitoring Benoa (2002-04)

C: ICCAT Field Manual (Appendix 4: Population parameters for key ICCAT species. Product Conversion Factors)

Figure i: Charts showing standard length and weigh conversion equations for tropical tuna species.

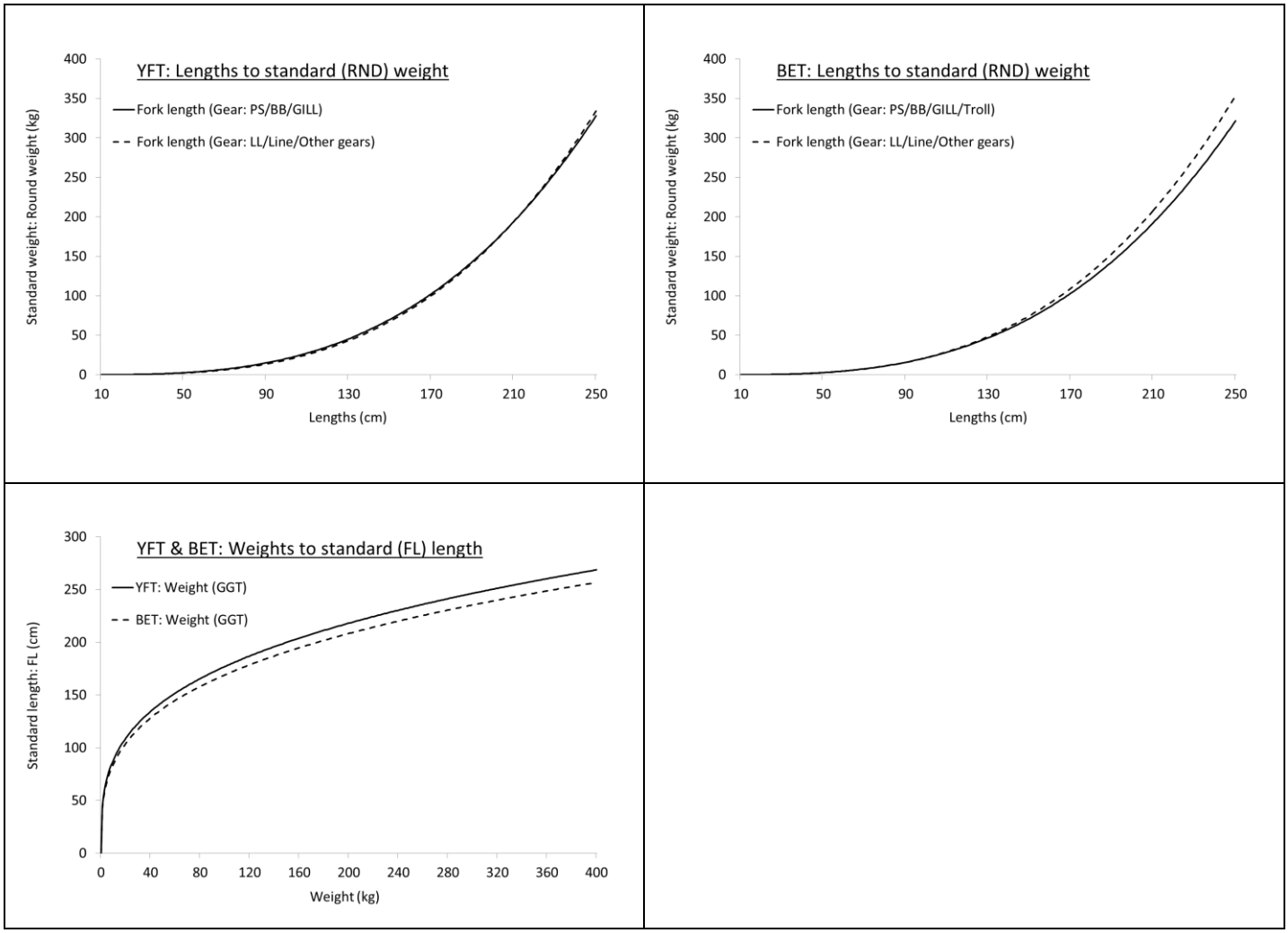
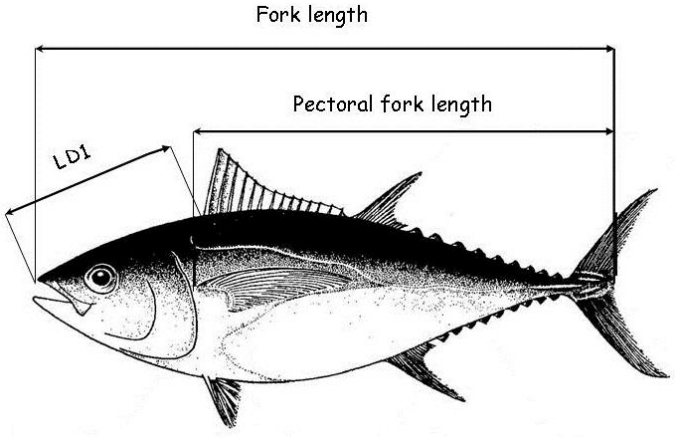


Fig ii. Types of measurements used for tuna



APPENDIX III

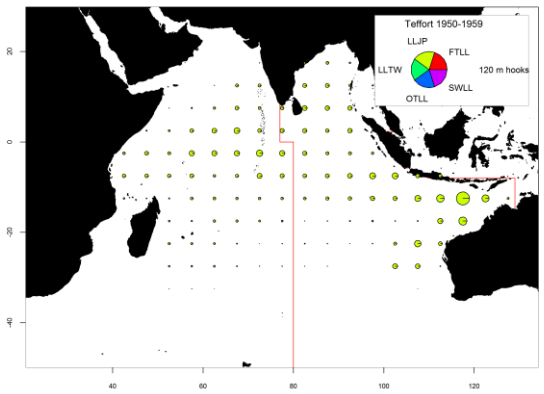
REVIEW OF FISHERIES TRENDS FOR TROPICAL TUNAS

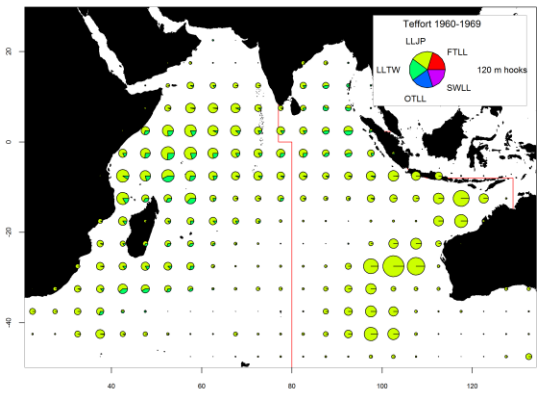
1. EFFORT

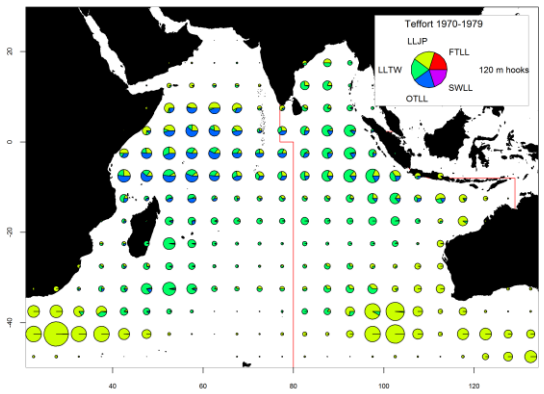
a) Longline

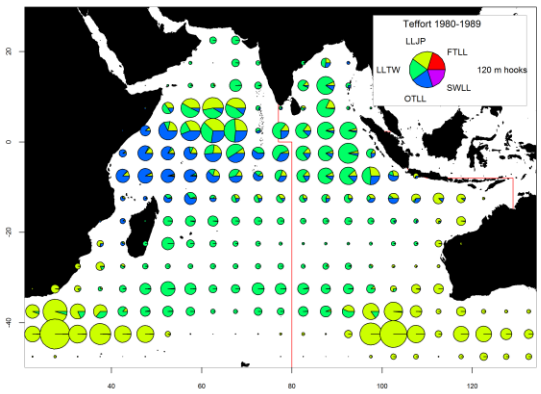
Effort exerted by LONGLINE fleets in the Indian Ocean, in millions (M) of hooks set, by decade (1950-2009) and main fleet:

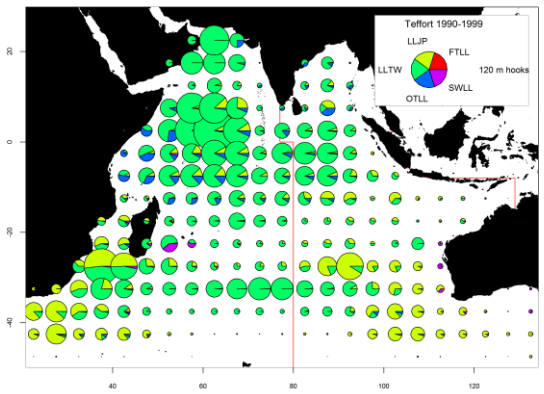
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, South Korea and various other fleets)

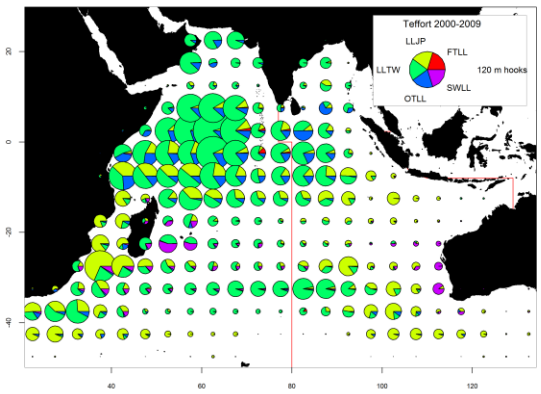






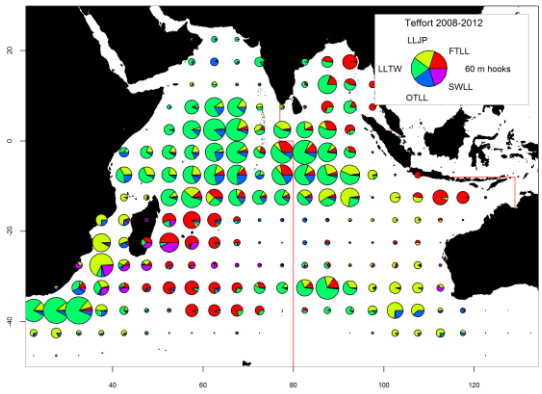


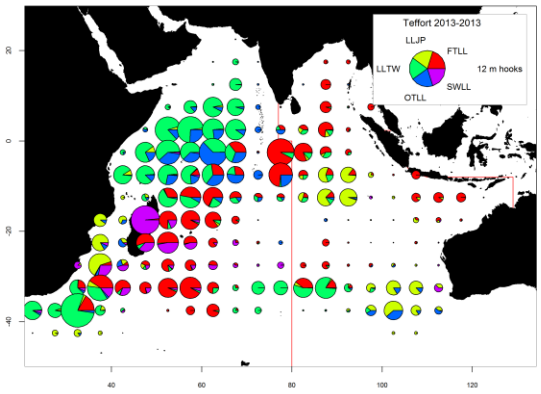


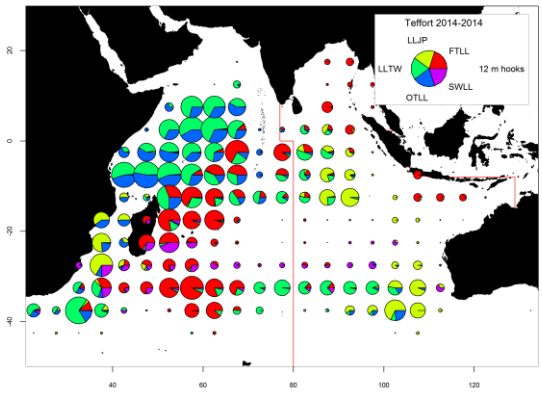


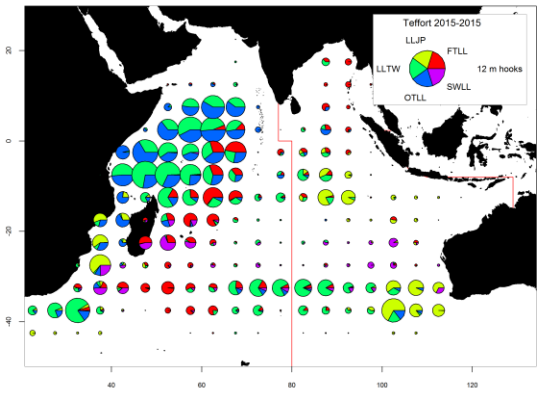
Effort exerted by LONGLINE fleets in the Indian Ocean, in millions (M) of hooks set, and main fleet for 2006-2010, and 2012 to 2016:

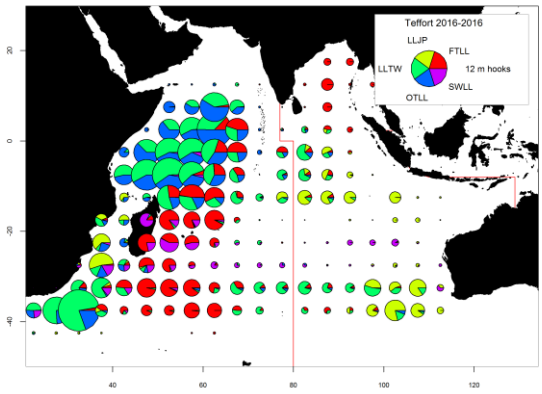
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, South Korea and various other fleets)

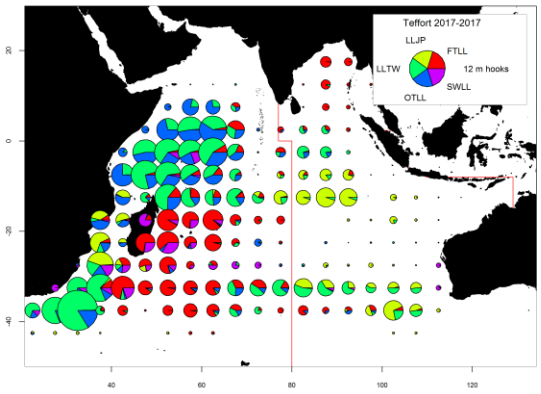












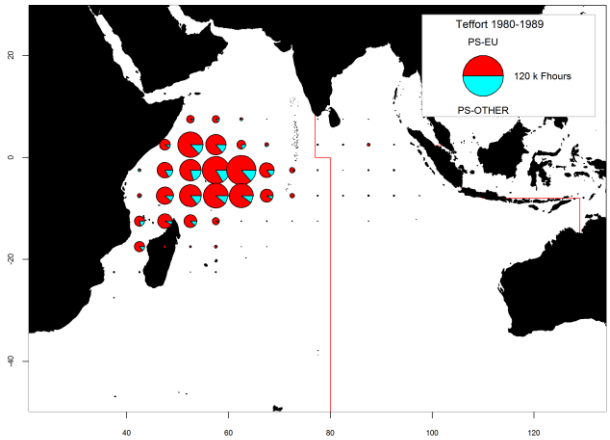
Purse seine

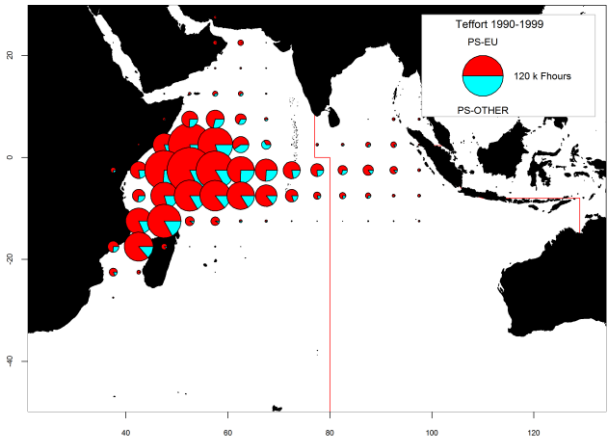
Effort exerted by industrial PURSE SEINE fleets in the Indian Ocean, in thousands (k) of fishing hours (Fhours), by decade (1980-2009) and main fleet:

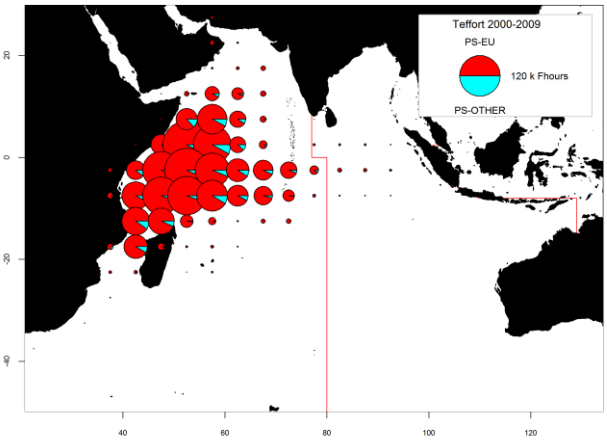
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)

PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin)

(excludes effort data for purse seiners of Iran and Thailand, and days-at-sea recorded for Australia)





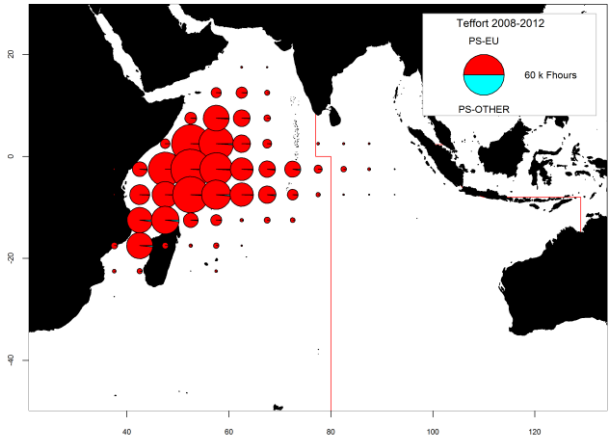


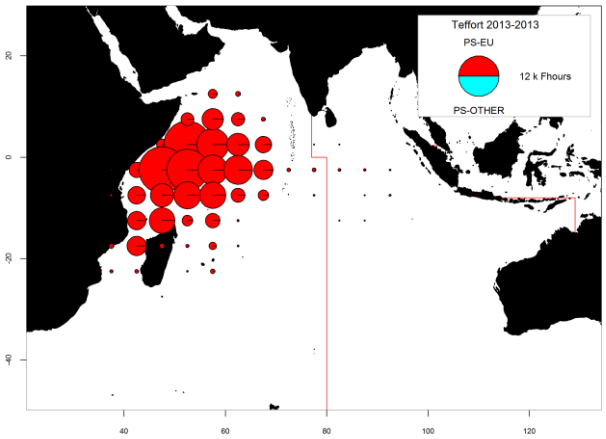
Effort exerted by industrial PURSE SEINE fleets in the Indian Ocean, in thousands (k) of fishing hours (Fhours), for 2008-12 and 2013-17, by year, and main fleet:

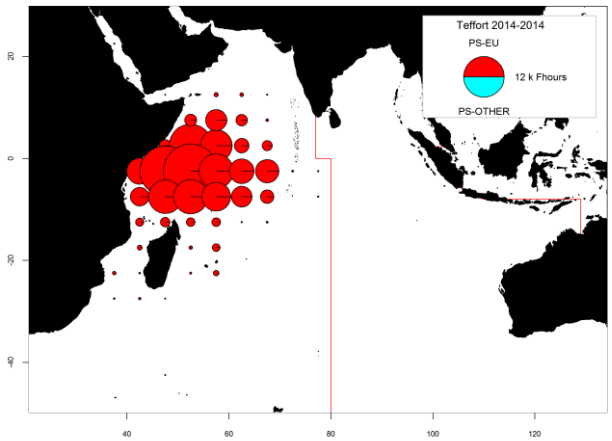
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)

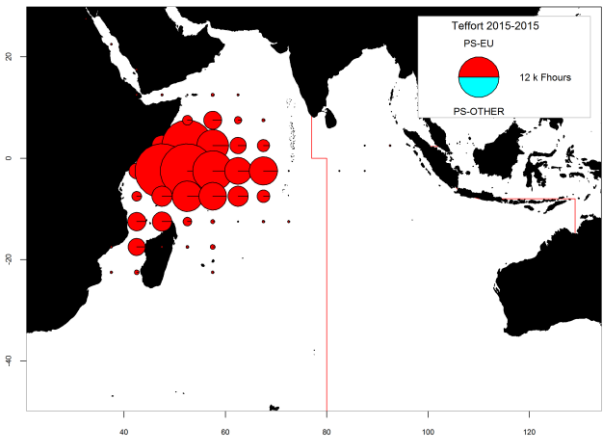
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin)

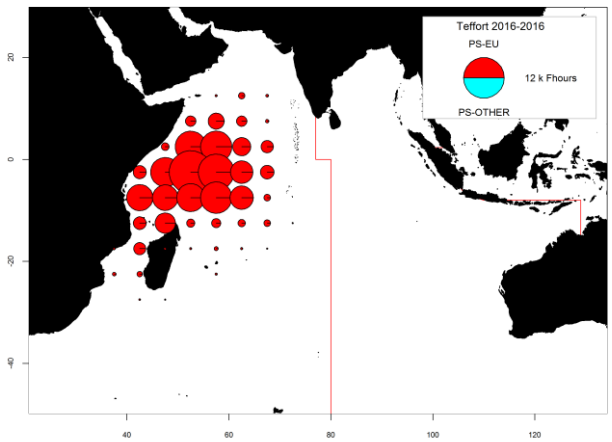
(excludes effort data for purse seiners of Iran and Thailand, and days at sea recorded for Australia)

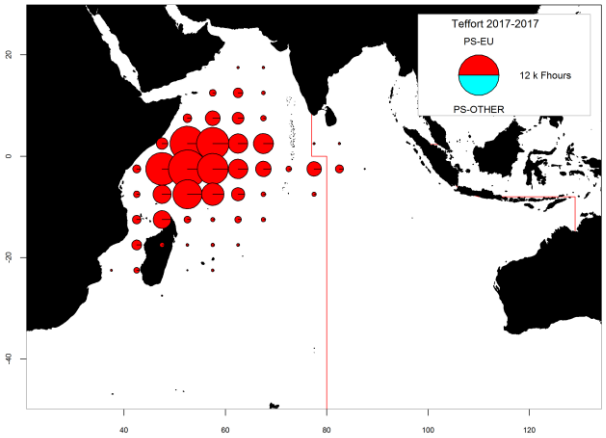










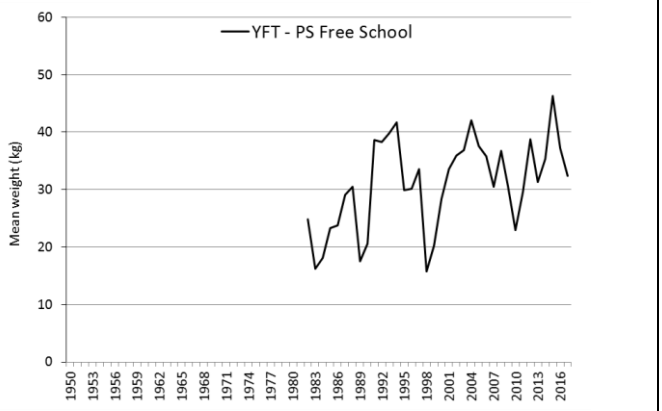


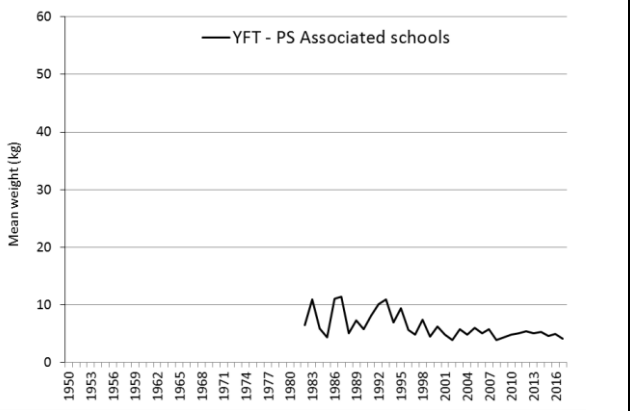
2. AVERAGE WEIGHT

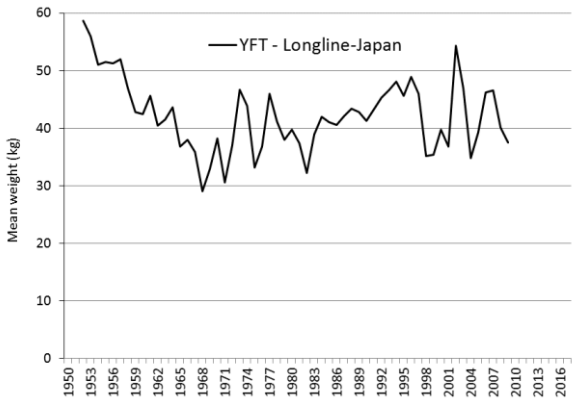
a. Yellowfin tuna (YFT)

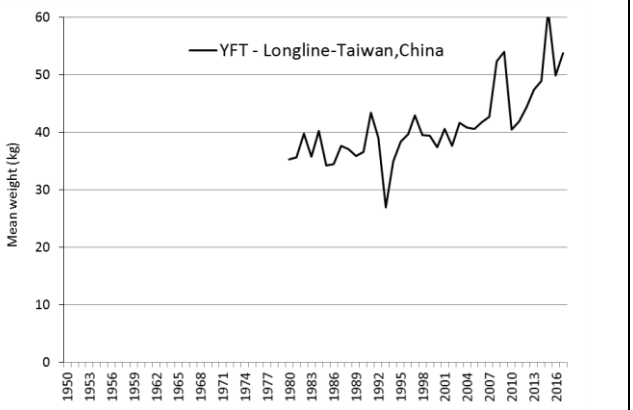
Average weight of yellowfin tuna (YFT) taken by:

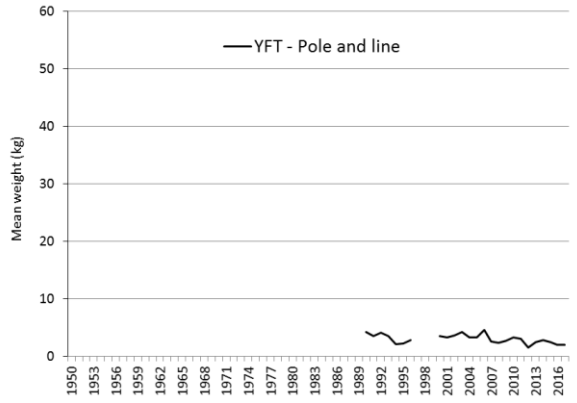
- Purse seine on free (top left) and associated (top right) schools,
- Longlines from Japan (second row left) and Taiwan,China (second row right)
- Pole-and-line from Maldives and India (third row left), and gillnets from Sri Lanka, Iran, and other countries (third row right)
- All fisheries (bottom row left), and all fisheries and main gears (bottom row left)

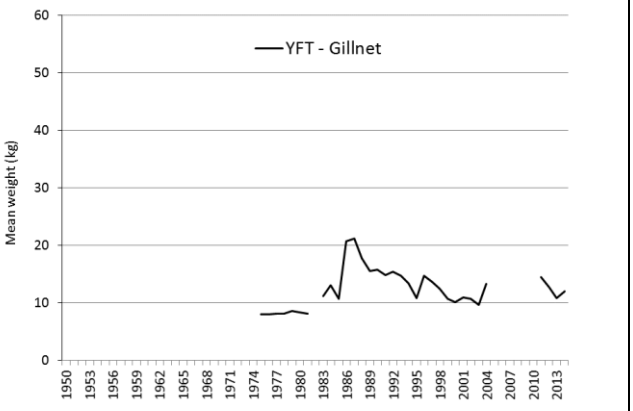


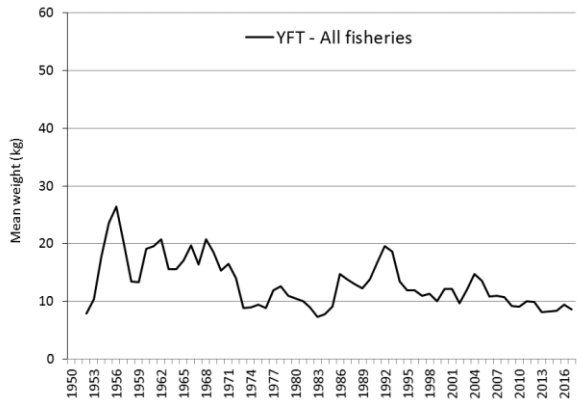


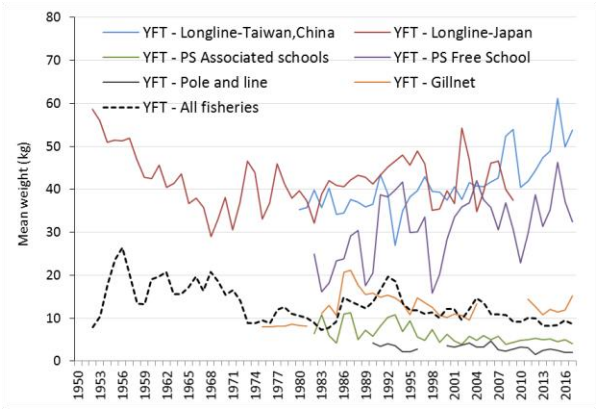




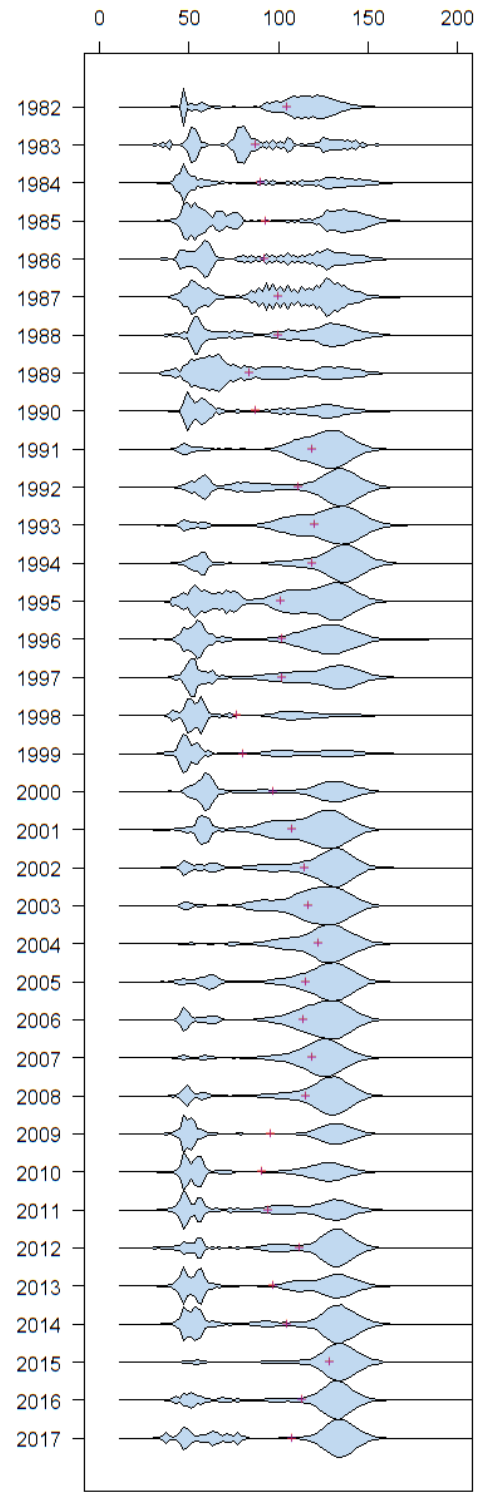




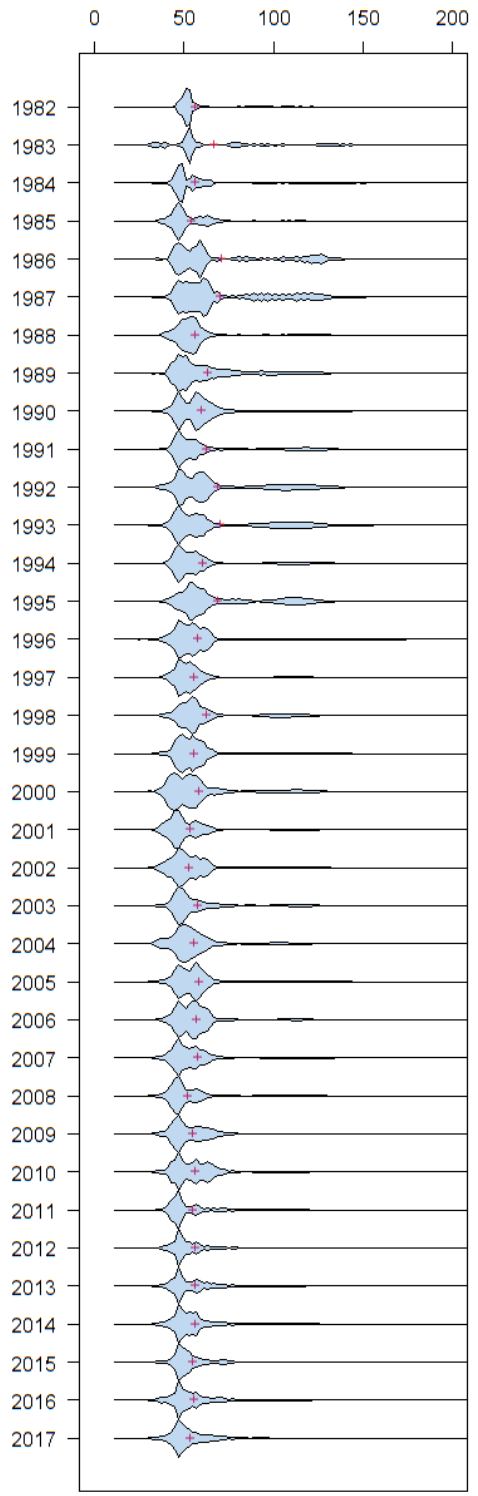

YFT - All fisheries
Mean weight (kg)
0
10
20
30
40
50
60
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013
2016


YFT - Longline-Taiwan,China
YFT - Longline-Japan
YFT - PS Associated schools
YFT - PS Free School
YFT - Pole and line
YFT - Gillnet
YFT - All fisheries
Mean weight (kg)
0
10
20
30
40
50
60
70
80
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013
2016

YFT (PS Free-school): size (in cm)

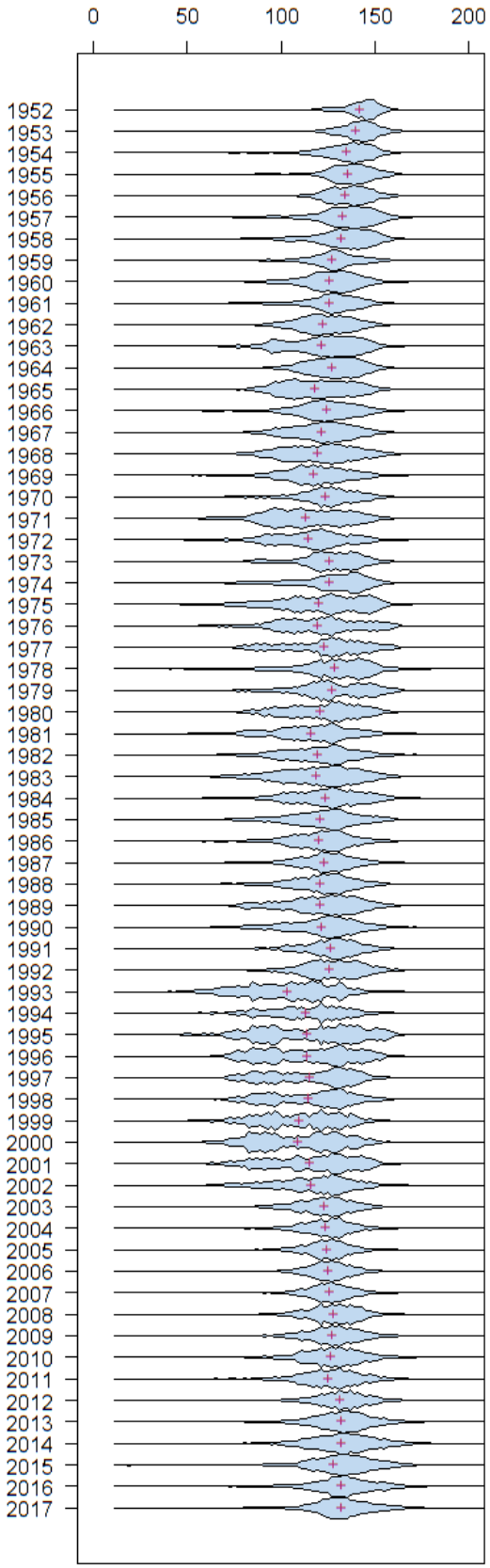


YFT (PS Log-school): size (in cm)



Yellowfin tuna (purse seine): **Left:** length frequency distributions for YFT PS Free school fisheries (by 2 cm length class). **Right**: Length frequency distributions for YFT PS Associated (log) school fisheries (by 2 cm length class). Source: IOTC database.

YFT (LL samples): size (in cm)

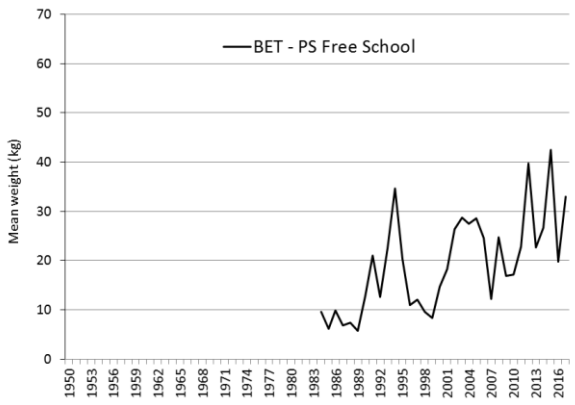


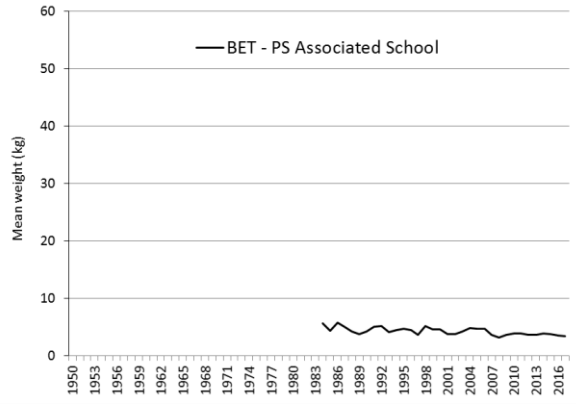
Yellowfin tuna (longline): Length frequency distributions for longline fisheries (total amount of fish measured by 2 cm length class) derived from data available at the IOTC Secretariat. Source: IOTC database.

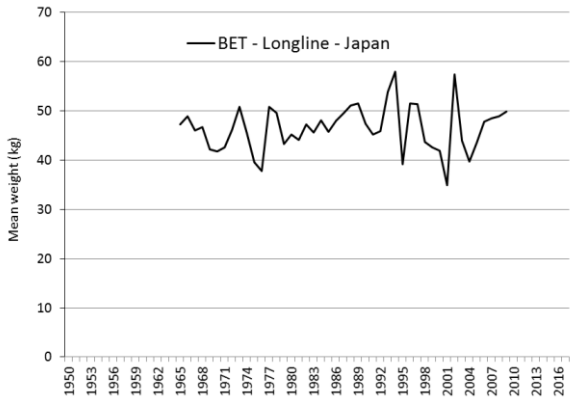
b. Bigeye tuna (BET)

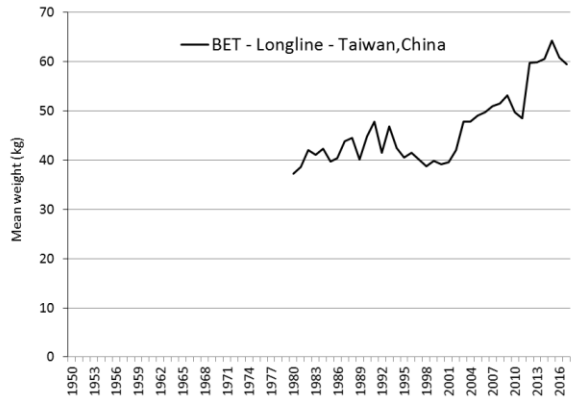
Average weight of bigeye tuna (BET) taken by:

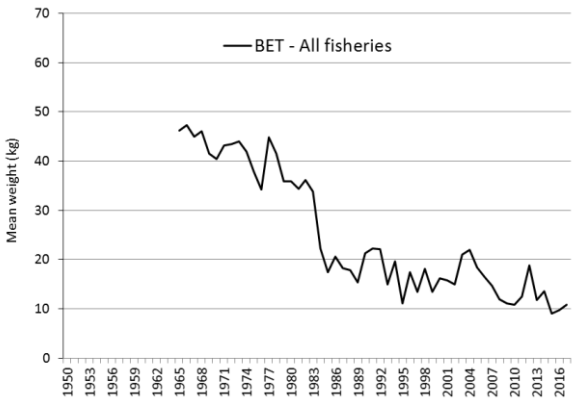
- Purse seine on free (top left) and associated (top right) schools,
- Longlines from Japan (second row left) and Taiwan,China (second row right)
- All fisheries (bottom row left), and all fisheries and main gears (bottom row left)

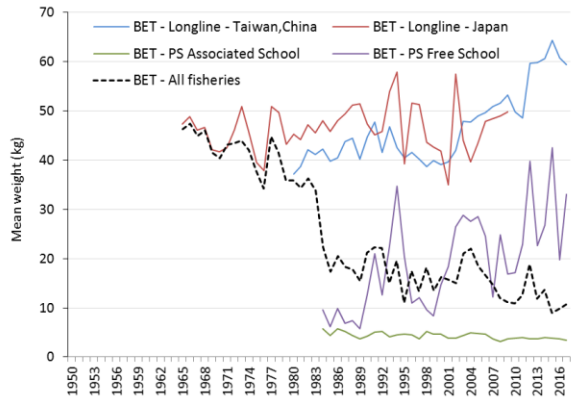




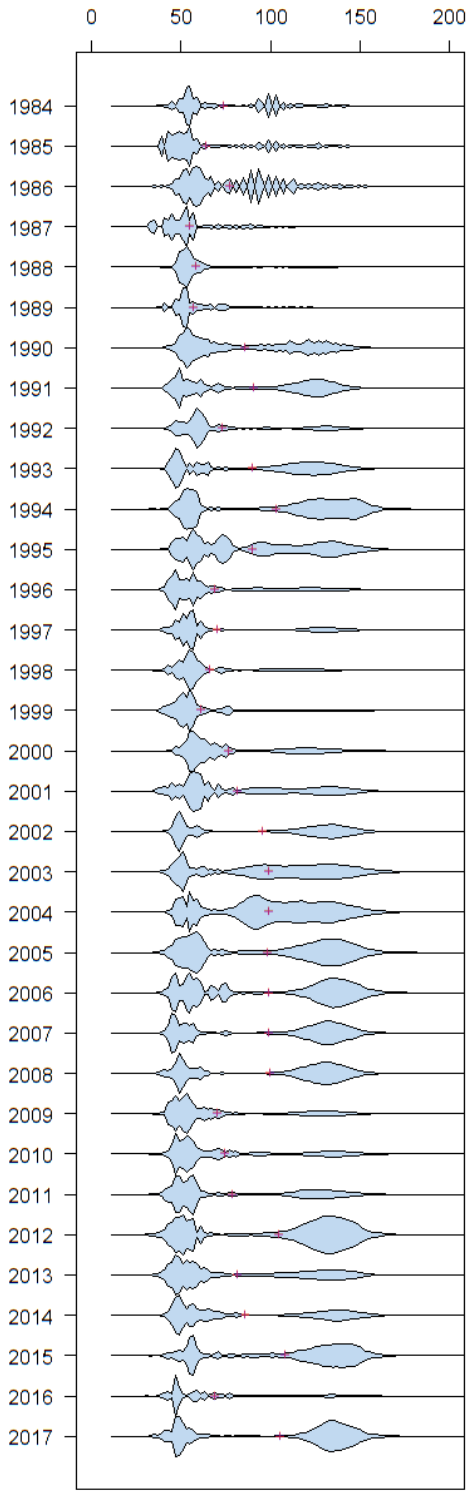




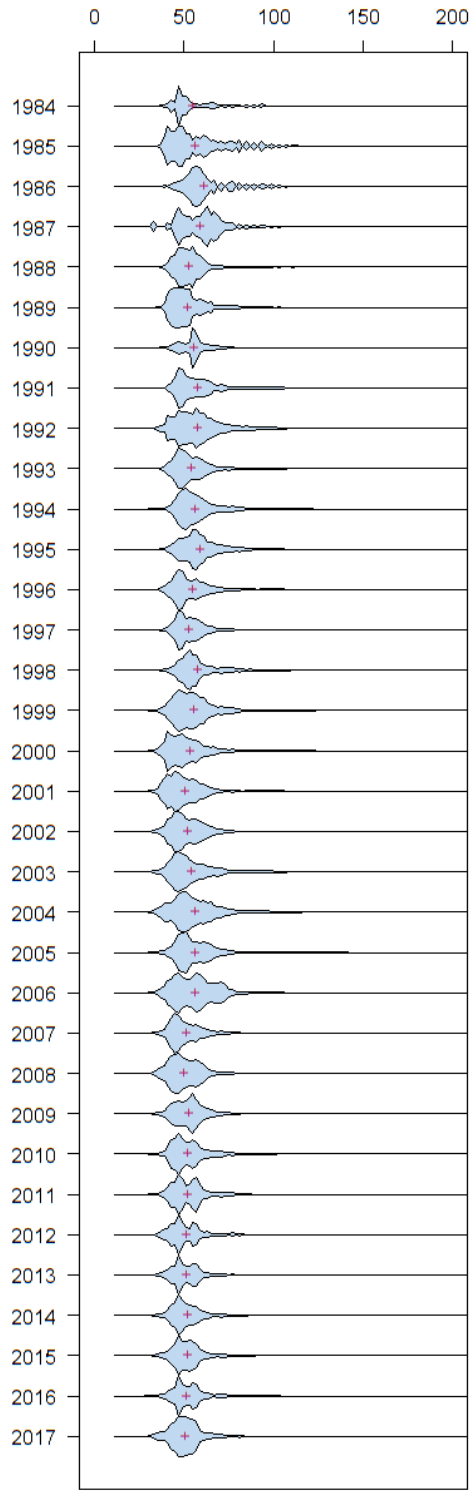




BET (PS Free-school): size (in cm)

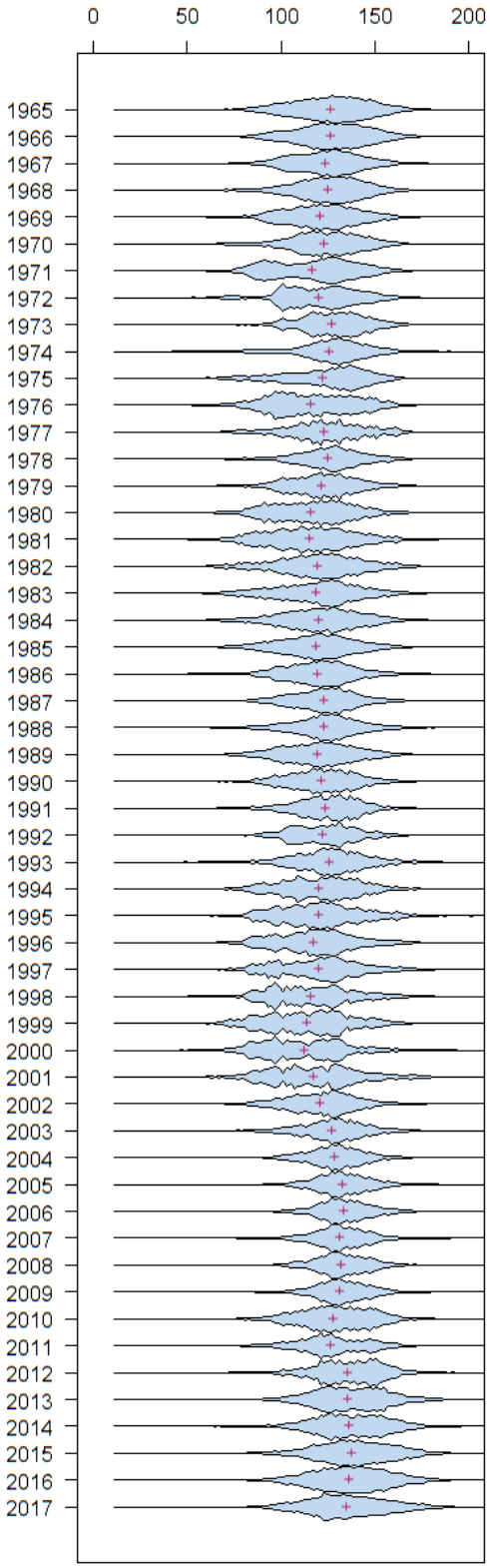


BET (PS Log-school): size (in cm)



Bigeye tuna (purse seine): **Left:** length frequency distributions for BET PS Free school fisheries (by 2 cm length class). **Right**: Length frequency distributions for BET PS Associated (log) school fisheries (by 2 cm length class). Source: IOTC database.

BET (LL samples): size (in cm)

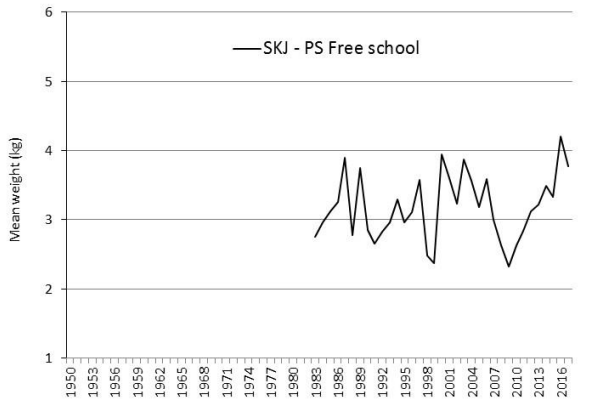


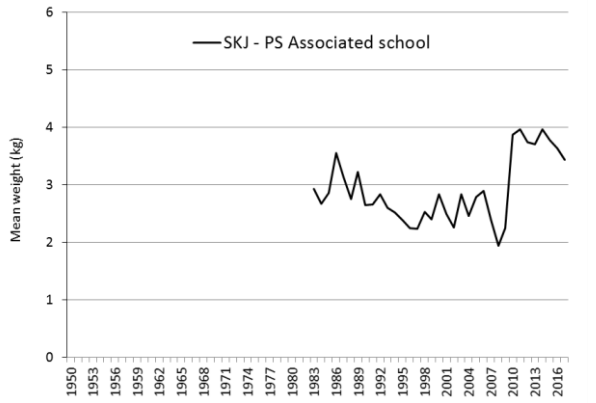
Bigeye tuna (longline): Length frequency distributions for longline fisheries (by 2 cm length class) derived from data available at the IOTC Secretariat. Source: IOTC database.

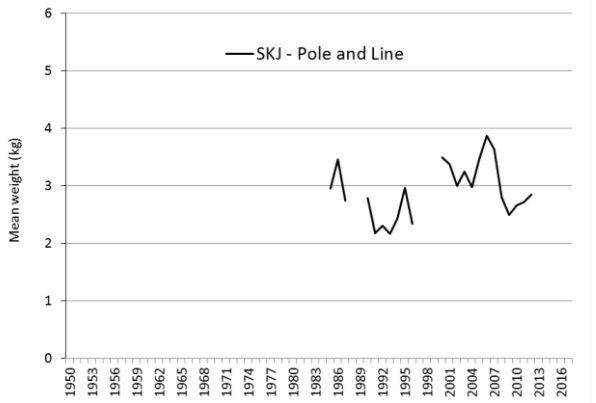
c. Skipjack tuna (SKJ)

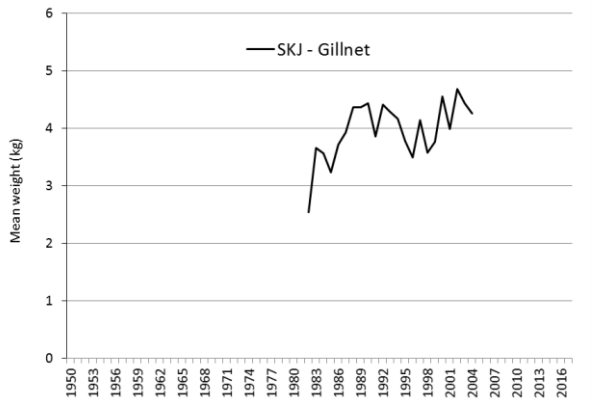
Average weight of skipjack tuna (SKJ) taken by:

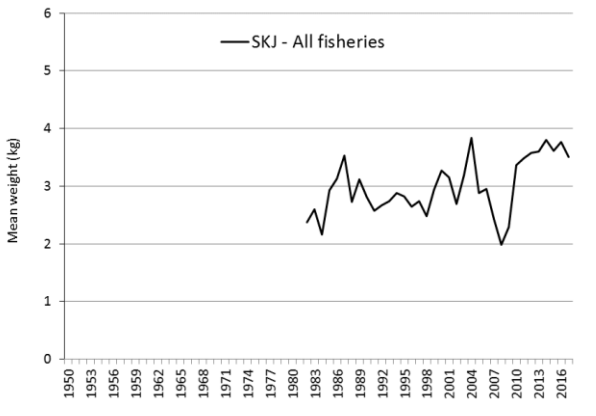
- Purse seine on free (top left) and associated (top right) schools,
- Pole-and-line from Maldives and India (second row left), and gillnets from Sri Lanka, Iran, and other countries (second row right)
- All fisheries (bottom row left), and all fisheries and main gears (bottom row left)

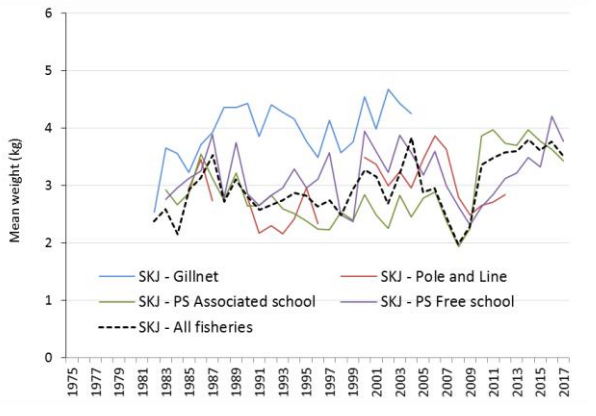


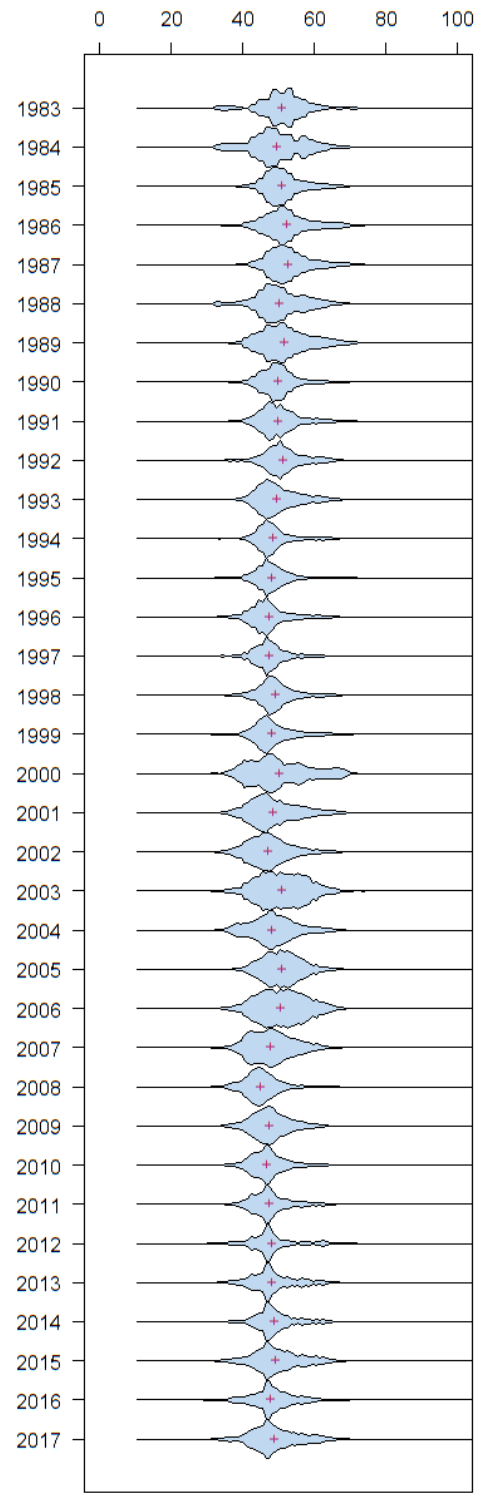


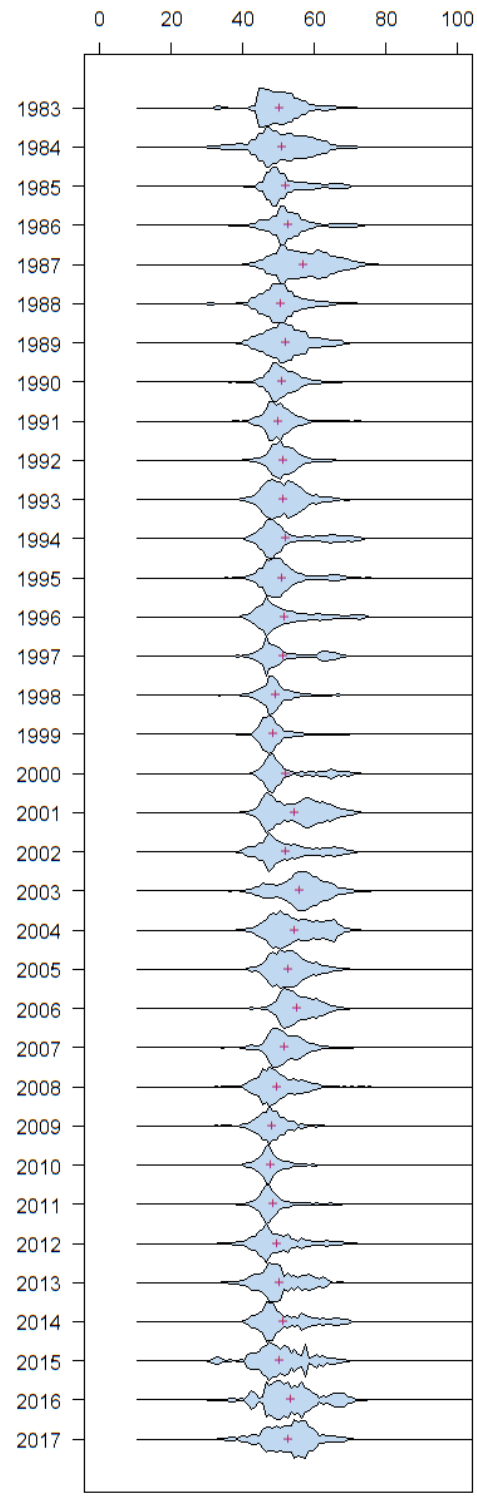












Skipjack tuna (purse seine): **Left:** length frequency distributions for SKJ PS Free school fisheries (by 2 cm length class). **Right**: Length frequency distributions for SKJ PS Associated (log) school fisheries (by 2 cm length class). Source: IOTC database.