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REVIEW OF THE STATISTICAL DATA AND FISHERY TRENDS FOR TROPICAL TUNAS

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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 2013, 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 tropical tuna species, in accordance with IOTC Resolution 10/02 *Mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*[1].

Section 2 identifies problem areas relating to the statistics of tropical tuna species. Section 3 looks into the main fisheries, catch trends and tag release and recovery data available for each species; and main issues identified concerning the statistics available at the IOTC Secretariat for each species.

The report covers the following areas:

- Overview
- Main issues relating to the data available on tropical tunas
- Overview of tropical tuna fisheries in the Indian Ocean:
  - Catch trends
  - Status of fisheries statistics for tropical tuna species
  - Status of tagging data

Major data categories covered by the report

Nominal catches which are highly aggregated statistics for each species estimated per fleet, gear and year for a large area. If these data are not reported the Secretariat estimates a total catch from a range of sources (including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; and data reported by parties on the activity of vessels under their flag (IOTC Resolution 10/08; IOTC Resolution 12/05) or other flags (IOTC Resolution 12/07; IOTC Resolution 05/03); 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[2].

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

[1] This Resolution superseded IOTC Resolutions 98/01, 05/01 and 08/01

[2] With catch imports by vessel, trip, species and commercial category forwarded to the IOTC Secretariat on each quarter

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 today this database contains 219,143 releases and 34,318 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*

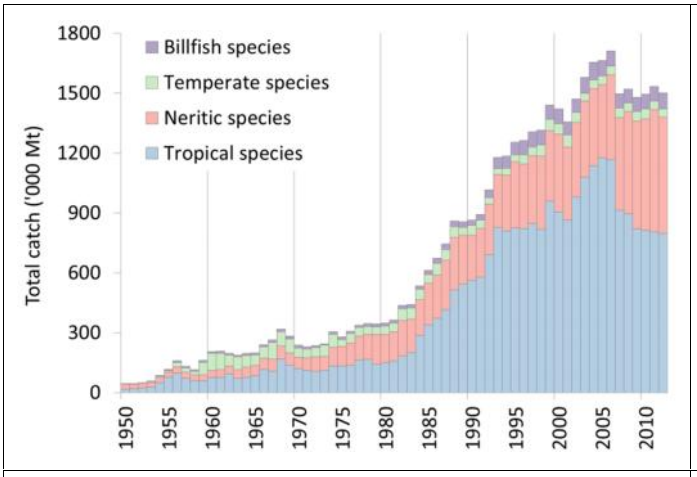
DISCUSSION

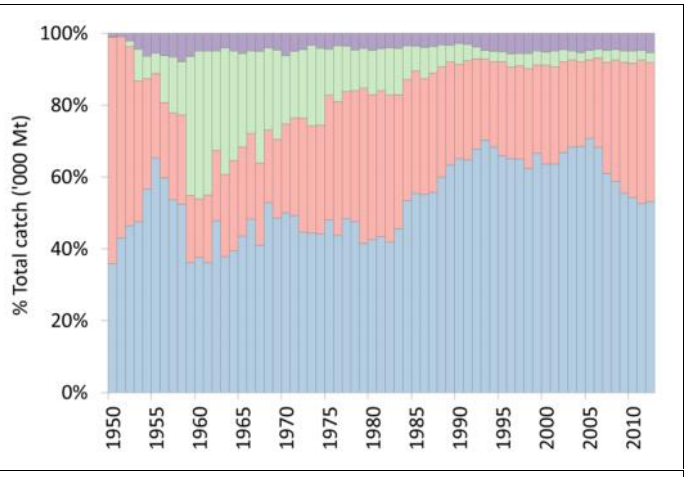
The contribution of tropical tunas to the total catches of IOTC species in the Indian Ocean has changed over the years (Fig. 1a.b.), in particular following the arrival of industrial purse seine fleets to the Indian Ocean, in the early-1980s (increase), and after the onset of piracy, in recent years (decrease). Hence, in recent years (2010-12), the catches of tropical tunas in the Indian Ocean have accounted for 53% of the combined catches of all IOTC species (60% over the period 1950-2012). Among the tropical tuna species skipjack tuna dominate, with catches that account for 47% of the total catches of the combined catches of tropical tunas in recent years (2010-12; Fig. 1c.). While the catch levels of yellowfin tuna were also high during the same period (41%), the catches of bigeye tuna were at lower levels (12%).

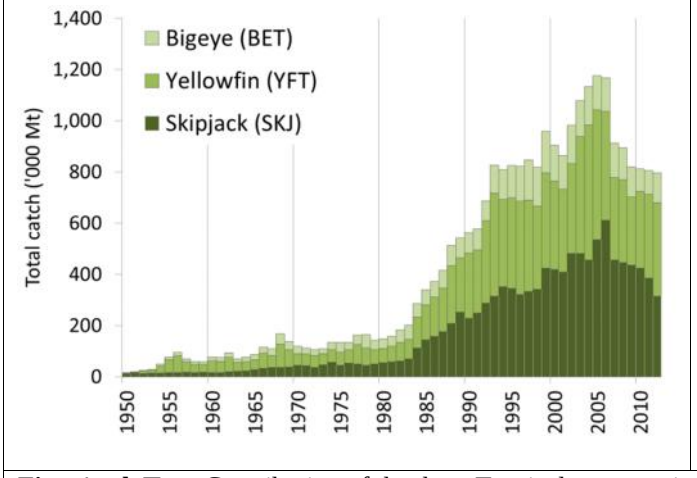
Tropical tunas are caught by both coastal countries and distant water fishing nations (Fig. 2): in recent years the coastal fisheries of five countries (Indonesia, Sri Lanka, Maldives, Iran, and India) have reported as much as 54% of the of the total catches of tropical tuna species from all countries and species combined, while the industrial purse seiners from and longliners flagged in EU-Spain and Seychelles reported around 24% of the total catches of these species (from 2010-12; Fig. 2).

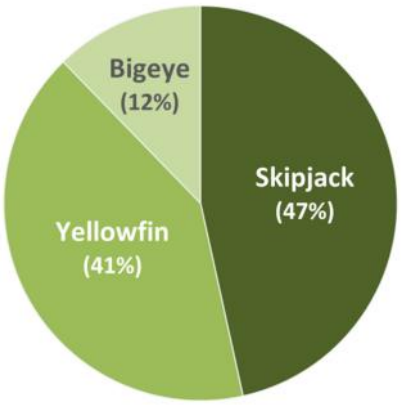
The majority of the catches of tropical tuna species are sold to international markets, including the *sashimi* market in Japan (large specimens of yellowfin tuna and bigeye tuna in fresh or deep-frozen condition), and processing plants in the Indian Ocean region or abroad (small specimens of skipjack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

Tropical tunas are mainly caught using purse seines (38% of the total catches of tropical tunas for 2010-12), with important catches also reported by gillnets (19%), several types of handlines and trolling (16%), longlines (15%), and pole-and-lines (11%), in both coastal waters and the high seas. Tropical tunas are the target of many fisheries although they are also caught as a bycatch of fisheries targeting other tunas, small pelagic species, or other non-tuna species (e.g. sharks).









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 1950-2012 (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, 1950-2012; d. Bottom right: share of Billfish catch by species, 2009-12)

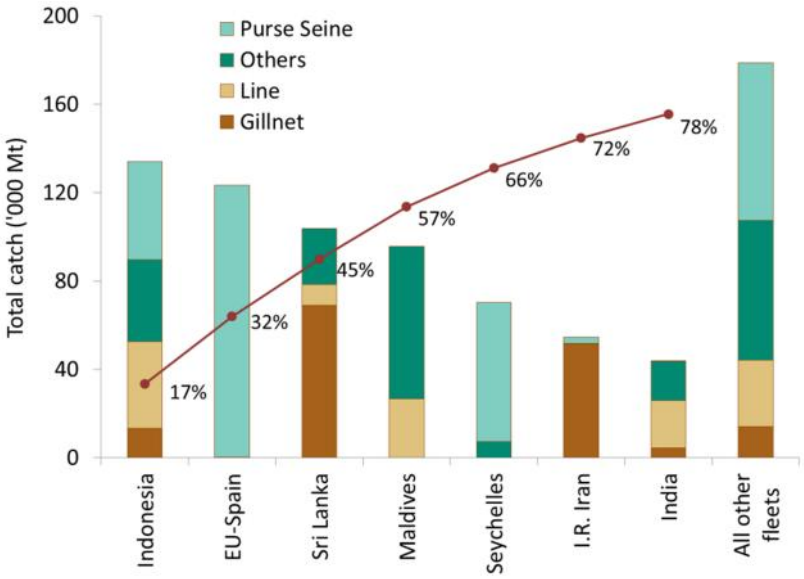


Fig. 2: All tropical tunas: average catches in the Indian Ocean over the period 2009–11, by country. Countries are ordered from left to right, according to the importance of catches of tropical tunas reported. The red line indicates the (cumulative) proportion of catches of tropical tunas for the countries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

MAIN ISSUES IDENTIFIED RELATING TO THE STATISTICS OF TROPICAL TUNAS

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

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

- **Drifting gillnet** fishery of **Iran**: In 2013 Iran reported catches of bigeye tuna for its drifting gillnet fishery for the first time, for the year 2012. Although Iran has reported catches of yellowfin tuna and skipjack tuna (average catches at around 60,000 t during 2008–12) it has not reported catch-and-effort data as per the IOTC standards, in particular for those vessels that operate outside of its EEZ. The IOTC Secretariat estimated caches of bigeye tuna for Iran for years before 2012, assuming various levels of activity of vessels using driftnets on the high seas, depending on the year, and catch ratios bigeye tuna:yellowfin tuna recorded for industrial purse seiners on free-swimming tuna schools in the northwest Indian Ocean. Catches of bigeye tuna were estimated for the period 2005–11, with average catches estimated at around 700 t per year.
- **Drifting gillnet** fishery of **Pakistan**: To date, Pakistan have not reported catches of bigeye tuna for its 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. In addition, Pakistan has not reported catch-and-effort data for its drifting gillnet fishery, in particular for those vessels that operate outside its EEZ. The IOTC Secretariat did not estimate catches of bigeye tuna for Pakistan. Pakistan reported catches of yellowfin tuna and skipjack tuna at around 9,000 t per year during 2008–12.
- **Gillnet/longline** fishery of **Sri Lanka**: Although Sri Lanka has reported catches of bigeye tuna for its gillnet/longline fishery the catches are considered to be too low (average catches at around 560 t during 2008–12). This is probably due to the mislabelling of catches of bigeye tuna as yellowfin tuna. The IOTC Secretariat estimated caches of bigeye tuna for Sri Lanka in 2012 with recent catches estimated at around 2,100 t per year[3]. In addition, Sri Lanka has not reported catch-and-effort data as per the IOTC standards, including separate catch-and-effort data for longline and gillnet and catch-and-effort data for those vessels that operate outside its EEZ.
- **Pole-and-line** fishery of **Maldives**: Although the pole-and-line fishery of Maldives does catch bigeye tuna, both yellowfin tuna and bigeye tuna are reported aggregated, as yellowfin tuna. The IOTC Secretariat used the proportion of bigeye tuna in samples collected in the Maldives in the past to break the catches of yellowfin tuna, which in fact represent the combined catches of the two species, into yellowfin tuna and bigeye tuna, per year, with average catches of bigeye tuna estimated at around 850 t per year. Maldives has not reported catch-and-effort data by gear type and geographic area for 2002–03[4].
- **Coastal** fisheries of **Indonesia, Madagascar, Sri Lanka**[5] (other than gillnet/longline) and **Yemen**: The catches of tropical tunas for these fisheries have been estimated by the IOTC Secretariat in recent years (total average catches of tropical tunas for the period 2008-12 amount to over 140,000 t per year, especially skipjack tuna). The quality of the estimates is thought to be very poor due to the paucity of the information available about the fisheries operating in these countries.
- **Coastal** fisheries of **Comoros:** 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

[3] More details about this review are provided in Appendix II.

[4] It is important to note that Maldives has used the available catch-and-effort data to derive CPUE indices for its pole-and-line fishery, and have undertaken preliminary assessments of skipjack tuna in cooperation with the IOTC Secretariat, presented at the WPTT in 2011. In addition, in October 2012 Maldives provided catch-and-effort data for its pole-and-line fishery for the period 2004-11.

[5] 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 will make it possible to derive estimates of catch for the coastal fisheries of Sri Lanka for 2012 and following years.

instead of 9,000 t). The IOTC Secretariat revised estimates of catch for the period 1995-2010 using the new estimates[6].

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

- **Longline** fishery of **India**: India has reported catches and catch-and-effort data 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 vessels under its flag, which the IOTC Secretariat had to estimate, with total catches of tropical tunas at around 4,000 t per year (2008-12).
- **Longline** fisheries of **Indonesia** and **Malaysia**: Indonesia and Malaysia have not reported catches for longliners under their flag that are not based in their ports. In addition Indonesia has not reported catch-and-effort data for its longline fishery to date.
- **Industrial tuna purse seine** fishery of **Iran**: Although Iran has reported catch-and-effort data for its purse seine fishery in recent years, data are not as per the IOTC standards.
- **Discard levels for all fisheries**: The total amount of tropical tunas discarded at sea remains unknown for most fisheries and time periods. Discards of tropical tunas are thought to be significant during some periods on 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. Size data from All Fisheries:

- **Longline** fisheries of **Japan** and **Taiwan,China:** In 2010, the IOTC Scientific Committee identified several issues concerning the size frequency statistics available for Japan and Taiwan,China, which remain unresolved. In addition, the number of specimens sampled for length onboard longliners flagged in Japan in recent years remains under the minimum recommended by the IOTC, which is at least 1 fish per metric ton of catch measured for length (0.06 fish per metric ton of catch for all tropical tuna species combined).
- **Gillnet** fisheries of **Iran** and **Pakistan:** Even though both countries have reported size frequency data for its gillnet fisheries in recent years, data are not reported by geographic area and the numbers measured are under the minimum sample size recommended by the IOTC (0.16 fish measured per metric ton of catch for Iran and 0.02 for Pakistan).
- **Longline** fisheries of **India, Oman** and the **Philippines:** To date, these countries have not reported size frequency data for their longline fisheries.
- **Gillnet/longline** fishery of **Sri Lanka:** Although Sri Lanka has reported length frequency data for tropical tunas in recent years, sampling coverage is below recommended levels (0.17 fish measured per metric ton of catch) and lengths are not available by gear type or fishing area[7].
- **Longline** fisheries of **Indonesia** and **Malaysia**: Indonesia and Malaysia have reported some size frequency data for its fresh-tuna longline fishery in recent years. However, the samples cannot be fully broken by month and fishing area (5x5 grid) and they refer exclusively to longliners based in ports in those countries.
- **Coastal** fisheries of **India, Indonesia** and **Yemen**: To date, these countries have not reported size frequency data for their coastal fisheries.

4. 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 or non-standard size to standard length keys for tropical tuna species due to the general paucity of biological data available from the Indian Ocean.

[6] More details about this review are provided in Appendix II.

[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.

STATUS OF FISHERIES STATISTICS FOR TROPICAL TUNAS

Bigeye tuna (BET)

Fisheries and catch trends

Bigeye tuna is mainly caught by industrial longline (70% in 2012) and purse seine (19% in 2012) fisheries, with the remaining 11% of the catch taken by other fisheries (**Table 2**). However, in recent years the catches of bigeye tuna by gillnet fisheries are likely to be higher, due to the major changes experienced in some of these fleets, notably changes in boat size, fishing techniques and fishing grounds, with vessels using deeper gillnets on the high seas, in areas where catches of bigeye tuna by other fisheries are important.

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 (2003–2012), in tonnes. Data as of September 2013. Catches by decade represent the average annual catch, noting that some gears were not used since the beginning of the fishery (refer to Fig. 3).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
BB	21	50	266	1,536	2,968	4,864	4,103	4,519	4,119	4,822	5,274	6,731	6,770	6,782	6,963	5,217
FS	0	0	0	2,341	4,823	6,216	7,915	4,097	8,484	6,406	5,672	9,646	5,301	3,792	6,222	7,180
LS	0	0	0	4,855	18,317	20,253	15,918	19,295	17,557	18,521	18,104	19,876	24,708	18,486	16,386	10,434
LL	6,488	21,979	30,270	42,887	62,311	71,273	85,203	90,621	75,863	72,932	74,170	51,591	51,553	32,252	35,794	65,655
FL	0	0	218	3,066	26,307	23,471	19,431	22,366	19,637	18,788	22,451	23,323	15,810	12,759	14,667	15,774
LI	43	294	658	2,384	4,278	5,560	5,037	5,595	4,735	5,372	5,898	7,323	7,231	7,796	7,692	5,583
OT	38	63	164	859	1,407	3,725	2,768	3,136	3,098	4,581	4,203	5,121	6,294	5,368	5,985	5,950
Total	**6,589**	**22,387**	**31,577**	**57,930**	**120,411**	**135,362**	**140,377**	**149,629**	**133,493**	**131,422**	**135,772**	**123,611**	**117,667**	**87,235**	**93,709**	**115,793**

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 (2003–2012), in tonnes. Data as of September 2013. Catches by decade represent the average annual catch.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
A1	2,436	11,824	17,359	34,731	57,127	76,920	88,763	91,531	85,659	80,428	79,588	65,565	56,210	38,626	39,411	68,721
A2	3,586	6,872	9,844	18,071	43,292	42,178	31,162	40,377	33,543	40,150	48,055	48,918	53,948	41,316	47,113	38,540
A3	199	2,614	2,876	2,679	15,033	12,040	16,318	13,298	10,100	5,533	4,007	4,570	3,716	4,447	4,711	4,967
A0	368	1,077	1,499	2,448	4,960	4,224	4,134	4,423	4,189	5,311	4,121	4,559	3,794	2,846	2,473	3,565
Total	**2,436**	**11,824**	**17,359**	**34,731**	**57,127**	**76,920**	**140,377**	**149,629**	**133,493**	**131,422**	**135,772**	**123,611**	**117,667**	**87,235**	**93,709**	**115,793**

Areas: West Indian Ocean (**A1**); East Indian Ocean (**A2**); Southwest and Southeast Indian Ocean(**A3**); Other Area(A0)

Total annual catches have increased steadily since the start of the fishery, reaching the 100,000 t level in 1993 and peaking at over 160,000 t in 1999 (**Fig. 3**). Catches dropped since then to values between 130,000–150,000 t (2000–07), further dropping in recent years, to values under 90,000 t in recent years (2010–11), and increasing in 2012 to over 115,000 t. The SC believes that the recent drop in catches could be related, at least in part, with the expansion of piracy in the northwest Indian Ocean (Area R1, **Table 3**), which led to a marked drop in the levels of longline effort in the core fishing area of these species in 2010-11 (**Table 3**; **Fig. 6**).

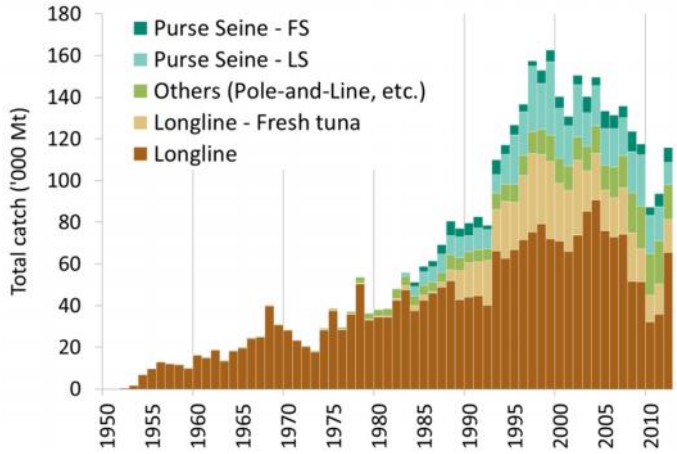
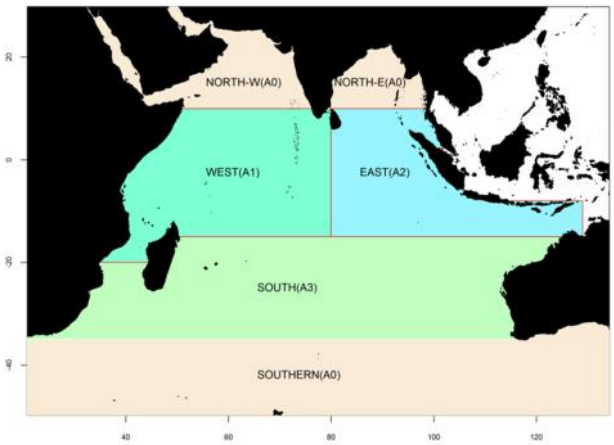


Fig. 3. Annual catches of bigeye tuna by gear (1950–2012). Data as of September 2013.

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



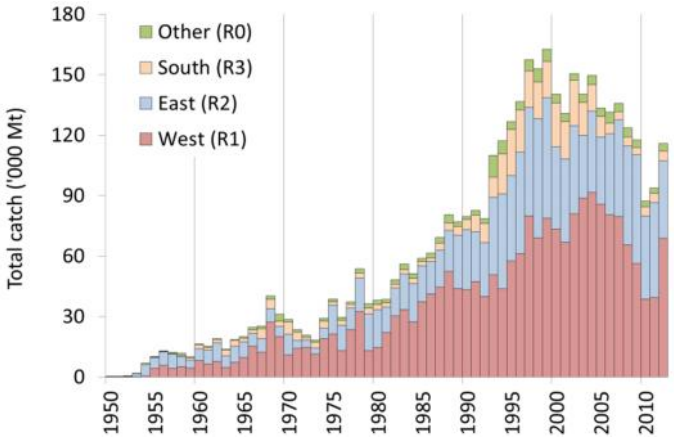


Fig. 4(a-b). Bigeye tuna: Catches of bigeye tuna by area by year estimated for the WPTT (1950–2012). Data as of September 2013. Catches outside the areas presented in the Map were assigned to the closest neighbouring area for the assessment.

Areas: West Indian Ocean (**A1**); East Indian Ocean (**A2**); Southwest and Southeast Indian Ocean (**A3**); Other Areas (**A0**)

Bigeye tuna have been caught by industrial **longline** fleets since the early 1950's, but before 1970 they only represented an incidental catch. After 1970, the introduction of fishing practices that improved catchability of the bigeye tuna resource, combined with the emergence of a *sashimi* market, resulted in bigeye tuna becoming a primary target species for the main industrial longline fleets. Total catch of bigeye tuna by longliners in the Indian Ocean increased steadily from the 1970's attaining values over 90,000 t between 1996 and 2007, and dropping markedly thereafter (**Fig. 3**). With the exception of 2012, bigeye tuna catches in recent years have been low representing less than half the catches of bigeye tuna recorded before the onset of piracy in the Indian Ocean. Since the late 1980's Taiwan,China has been the major longline fleet fishing for bigeye tuna in the Indian Ocean, taking as much as 40% of the total longline catch in the Indian Ocean (**Fig. 5**). However, the catches of longliners from Taiwan,China between 2007 and 2011 decreased markedly (≈20,000 t), to values three times lower than those in 2003. Catches in 2012 are higher though still far from those in 2003. Large bigeye tuna (averaging just above 40 kg) are primarily caught by longlines, in particular deep longlines.

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. The highest catch of bigeye tuna by purse seiners in the Indian Ocean was recorded in 1999 (≈40,000 t). Catches since 2000 have been between 20,000 and 30,000 t. Purse seiners under flags of EU countries and Seychelles take the majority of purse seine caught bigeye tuna in the Indian Ocean (**Fig. 5**). Purse seiners mainly take small juvenile bigeye (averaging around 5 kg) whereas longliners catch much larger and heavier fish; and while purse seiners take lower tonnages of bigeye tuna compared to longliners, they take larger numbers of individual fish. Even though the

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

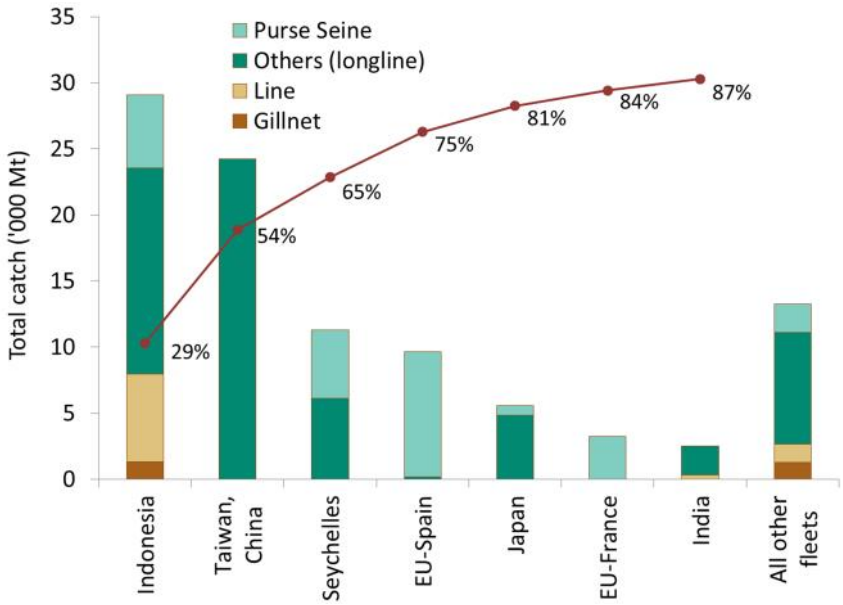


Fig. 5. Bigeye tuna: average catches in the Indian Ocean over the period 2009–12, by country. Countries are ordered from left to right, according to the importance of catches of bigeye reported. The red line indicates the (cumulative) proportion of catches of bigeye for the countries concerned, over the total combined catches of this species reported from all countries and fisheries. Data as of Sept. 2013.

By contrast with yellowfin tuna and skipjack tuna, for which the major catches are taken in the western Indian Ocean, bigeye tuna is also exploited in the eastern Indian Ocean (**R2** in **Fig. 4** and **Table 3**). The relative increase in catches in the eastern Indian Ocean in the late 1990's was mostly due to increased activity of small longliners fishing tuna to be marketed fresh. This fleet started its operation in the mid 1970's. However, the catches of bigeye tuna in the eastern Indian Ocean have shown a decreasing trend in recent years, as some of the vessels moved south to target albacore.

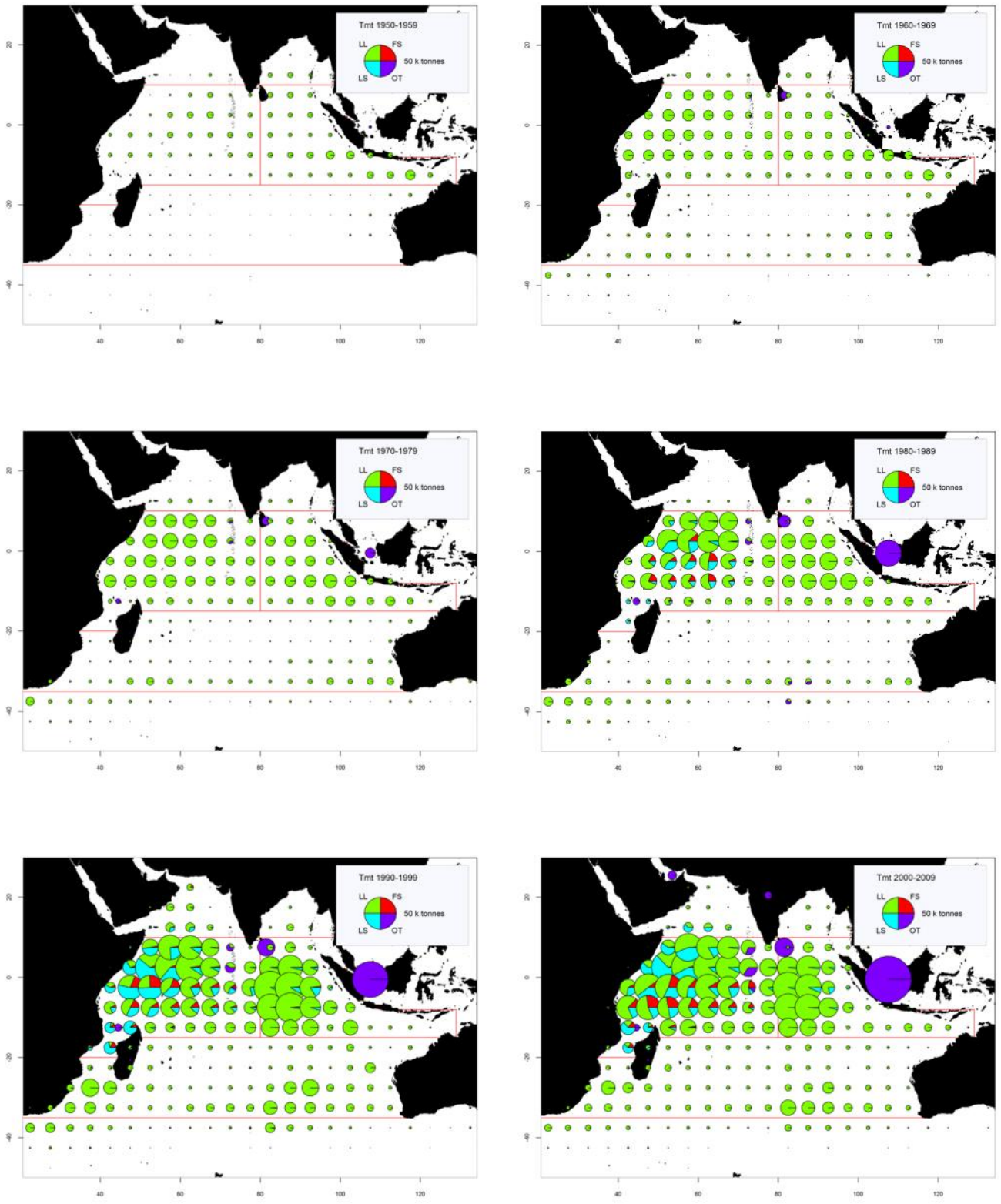


Fig. 6(a-f). Bigeye tuna: Time-area catches (total combined in tonnes) of bigeye tuna estimated for the period 1950–2009, by decade and type of gear.Longline (**LL**), Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), and other fleets (**OT**), including pole-and-line, drifting gillnets, and various coastal fisheries; Data as of September 2013.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, in particular driftnets from Iran, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Indonesia.

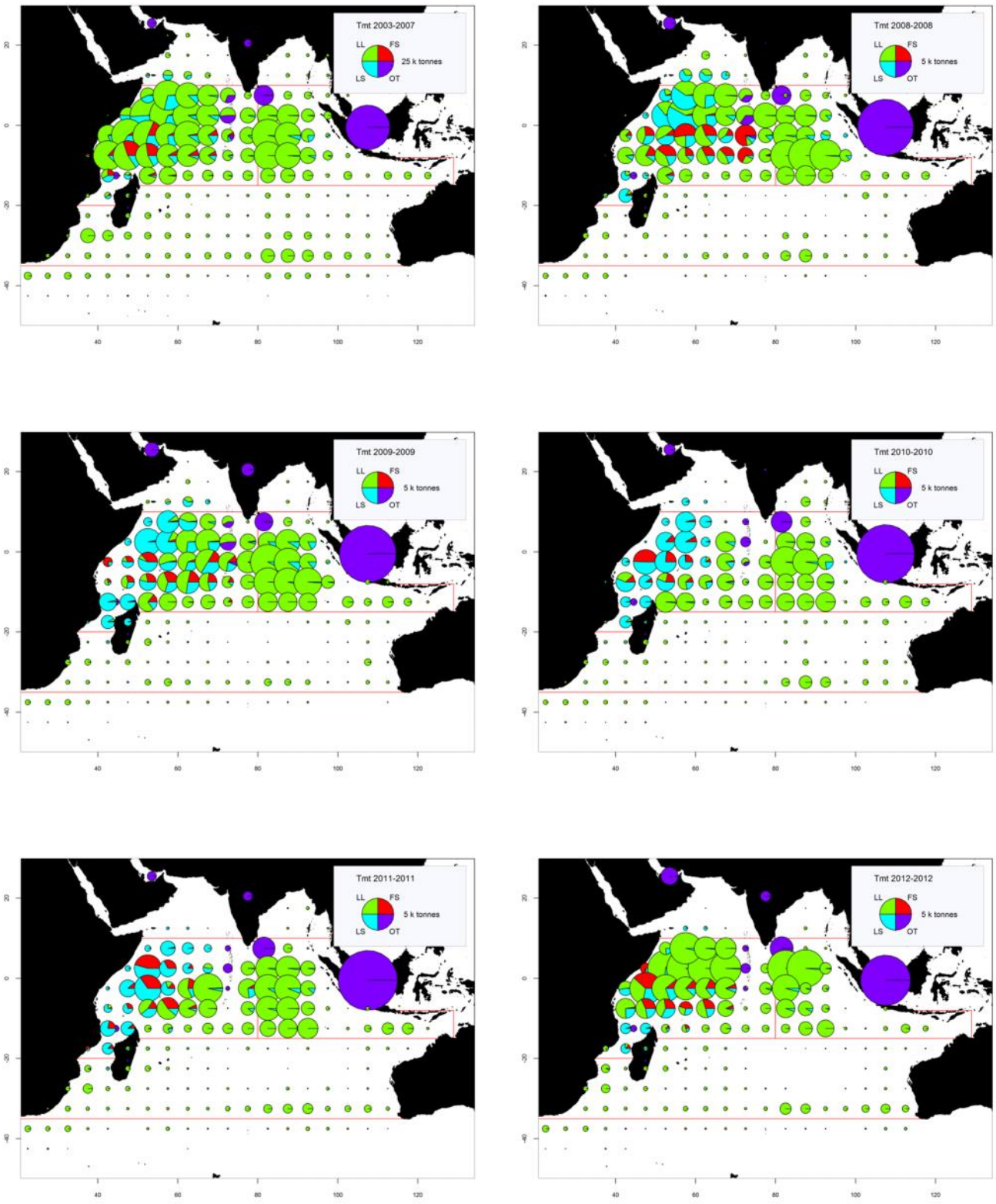


Fig. 7(a-f). Time-area catches (total combined in tonnes) of bigeye tuna estimated for the period 2003–2007 by type of gear and for 2008–12, by year and type of gear. Longline (**LL**), Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), and other fleets (**OT**), including pole-and-line, drifting gillnets, and various coastal fisheries; Data as of September 2013. 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, in particular driftnets from Iran, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Indonesia.

Bigeye tuna: Status of Fisheries Statistics at the IOTC

Retained catches are thought to be well known for the major fleets (**Fig. 8**); but are less certain for non-reporting industrial purse seiners and longliners (NEI) and for other industrial fisheries (e.g. longliners of India). Catches are also uncertain for some artisanal fisheries including the pole-and-line fishery in the Maldives, the gillnet fisheries of Iran (before 2012) and Pakistan, the gillnet and longline combination fishery in Sri Lanka and the artisanal fisheries in Indonesia, Comoros (before 2011) and Madagascar.

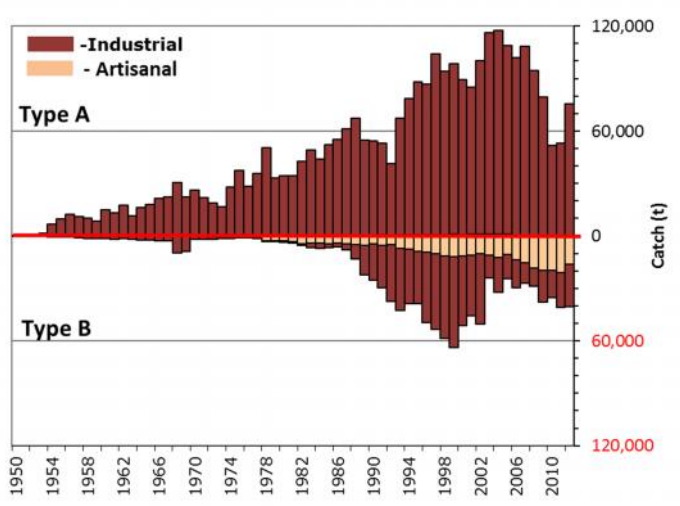


Fig. 8. Bigeye tuna: Uncertainty of annual catch estimates for bigeye tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Discard levels are believed to be low although they are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–07.

Changes to the catch series (Fig 9): The catches of bigeye tuna changed (**Fig. 9a**) following reviews of the catches of Indonesia, Sri Lanka, and, to a lesser extent, other fisheries (EU-France, India, Pakistan) (**Fig. 9b**). Overall, the best estimates of catch for the bigeye tuna are higher in 2013 than those used for the WPTT in 2012, with marked increases to the catches since the early 1990s. More details about the reviews are provided in Appendix II.

CPUE Series: Catch-and-effort data are generally available from the major industrial fisheries. However, these data are not available from some fisheries or they are considered to be of poor quality, especially throughout the 1990s and in recent years (**Fig. 10**), for the following reasons:

- non-reporting by industrial purse seiners and longliners (NEI)
- 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
- uncertain data from significant fleets of industrial purse seiners from Iran and longliners from India, Indonesia, Malaysia, Oman, and Philippines.
- incomplete data for the driftnet fisheries of Iran and Pakistan and the gillnet/longline fishery of Sri Lanka, especially in recent years.

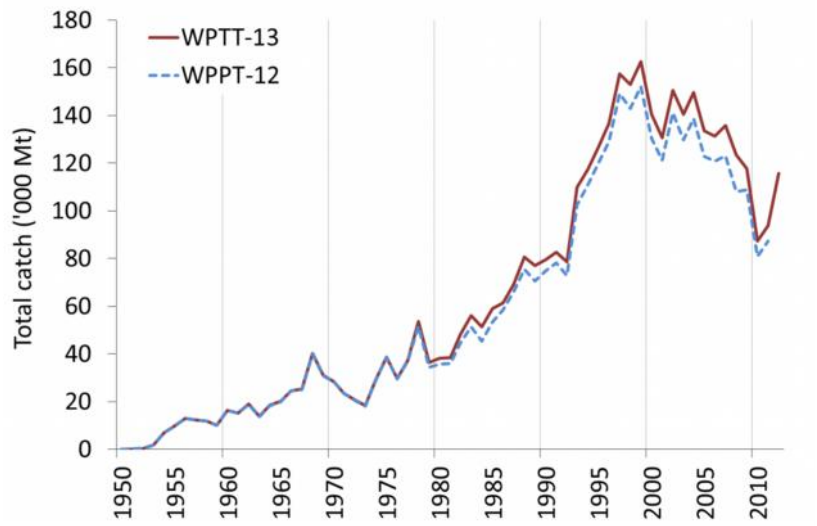


Fig. 9a. Bigeye tuna: Catches used by the WPTT in 2012 *versus* those estimated for the WPTT in 2013 (1950–2012).

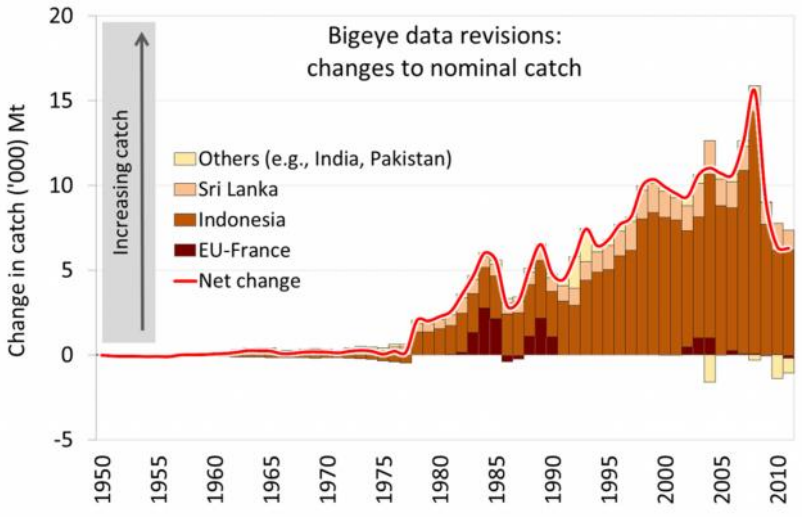


Fig. 9b. Bigeye tuna: net change in total catch, by year and flag country.

Trends in average weight can be assessed for several industrial fisheries although they are incomplete 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 table: This is available but the estimates are more uncertain for some years and some fisheries due to (**Fig. 11**):

- the paucity 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)
- the paucity of catch by area data available for some industrial fleets (NEI, India, Indonesia, Iran, Sri Lanka)

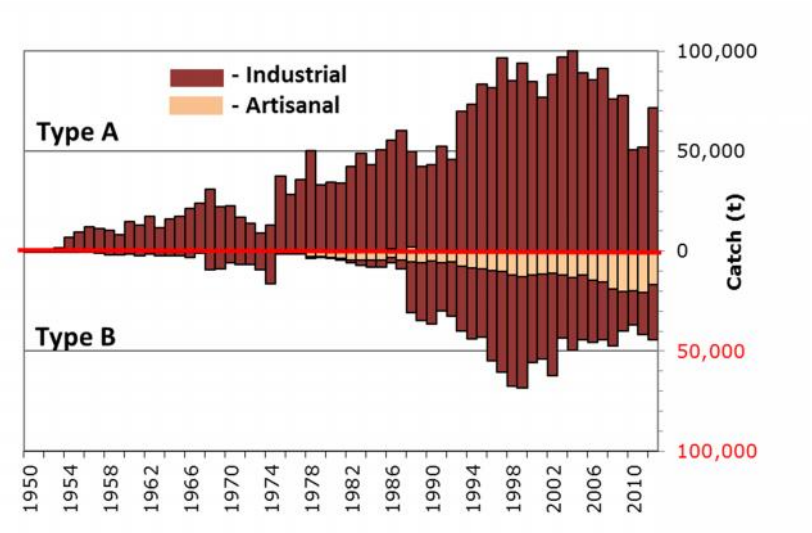


Fig. 10. Uncertainty of time-area catches for bigeye tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report catch-and-effort data to the IOTC, do not report catch-and-effort data by gear and/or species or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

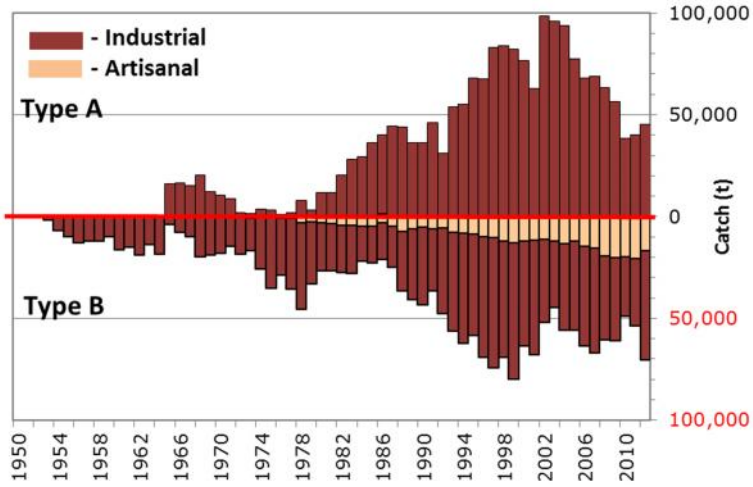


Fig. 11. Bigeye tuna: Uncertainty of catch-at-size data for bigeye tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report length data to the IOTC, do not report length data by gear, species, month, fishing area or any of the other reasons given in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Bigeye tuna: Tagging data

A total of 35,997 bigeye tuna (17.9%) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them (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. 12**). 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, 5,789 specimens (16.1%) have been recovered and reported to the IOTC Secretariat. These tags were mainly reported from the purse seine fleets operating in the Indian Ocean (90.9%), while 5.2% were recovered from longline vessels.

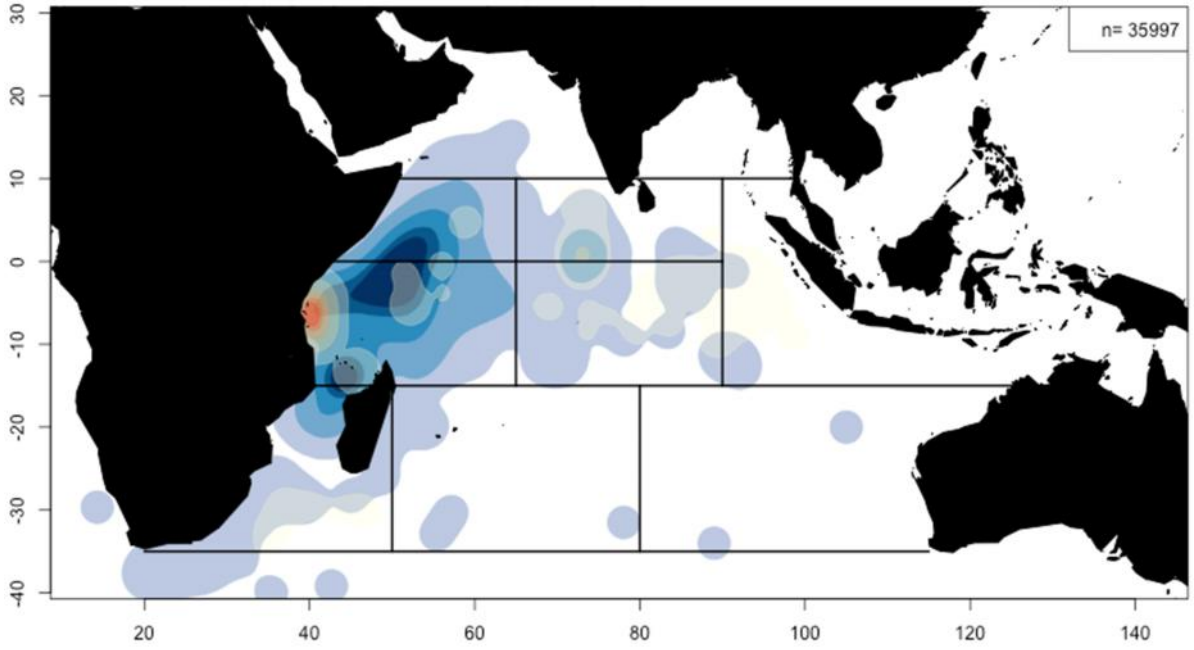


Fig. 12. Bigeye tuna: Densities of releases (in red) and recoveries (in blue). Data as of September 2012.

Skipjack tuna (SKJ)

Fisheries and catch trends

Catches of skipjack tuna increased slowly from the 1950s, reaching around 50,000 t during the mid-1970s, mainly due to the activities of fleets using pole-and-lines and gillnets (**Table 4**; **Fig. 11**). The catches increased rapidly with the arrival of the purse seiners in the early 1980s, and skipjack became one of the most important commercial tuna species in the Indian Ocean. Annual catches peaked at over 600,000 t in 2006 (**Table 4**; **Fig. 13**). Though preliminary, the catch levels estimated for 2012, at around 315,000 t, represent the lowest catches recorded since 1998.

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 (2003–2012), in tonnes. Data as of September 2013. Catches by decade represent the average annual catch, noting that some gears were not used since the beginning of the fishery (refer to Fig. 13).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
BB	10,007	15,148	24,684	41,705	77,079	109,081	114,060	111,833	138,652	147,428	106,605	98,923	75,199	82,971	68,886	67,573
FS	0	0	41	15,253	30,598	25,868	30,975	18,516	43,166	34,930	24,199	16,274	10,433	8,774	9,000	2,984
LS	0	0	125	34,472	124,032	163,656	179,930	137,282	168,018	211,509	120,951	128,448	148,135	144,097	123,056	80,989
OT	4,999	11,712	21,952	38,281	87,731	174,498	155,952	187,840	185,989	217,275	203,428	202,986	201,415	188,172	183,594	162,990
Total	**15,006**	**26,860**	**46,801**	**129,712**	**319,440**	**473,102**	**480,916**	**455,470**	**535,825**	**611,143**	**455,183**	**446,631**	**435,182**	**424,013**	**384,537**	**314,537**

Gears: Pole-and-Line (**BB**); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Other gears nei (**OT**).

The increase in skipjack tuna catches by **purse seiners** (**Fig. 13**) is due to the development of a fishery in association with Fish Aggregating Devices (FADs) (**Table 4**). In recent years, over 90% of the skipjack tuna caught by purse seine vessels is taken from around FADs (**Table 4**; **Fig. 13**). Catches by purse seiners increased steadily since 1984 with the highest catches recorded in 2002 and 2006 (>240,000 t). The catches dropped in the years 2003 and 2004, probably as a consequence of high purse seine catch rates on free schools of yellowfin tuna during those years. In 2007 purse seine catches declined by around 100,000 t, from those taken 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 in the number of FADs (and the technology associated with them) used in the fishery. The sharp decline in purse seine catches since 2007coincided with a similar decline in the catches by Maldivian baitboats.

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 (2003–2012), in tonnes. Data as of September 2013. Catches by decade represent the average annual catch.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R1	4,524	9,951	19,291	34,587	80,757	115,572	110,103	119,042	94,897	104,270	127,329	148,270	150,091	154,588	155,333	124,950
R2	10,483	16,910	27,511	95,126	238,683	357,530	370,814	336,428	440,928	506,873	327,853	298,361	285,091	269,426	229,205	189,586
Total	**15,006**	**26,860**	**46,801**	**129,712**	**319,440**	**473,102**	**480,916**	**455,470**	**535,825**	**611,143**	**455,183**	**446,631**	**435,182**	**424,013**	**384,537**	**314,537**

Areas: East Indian Ocean plus Maldives (**R1**); West Indian Ocean excluding Maldives (**R2**)

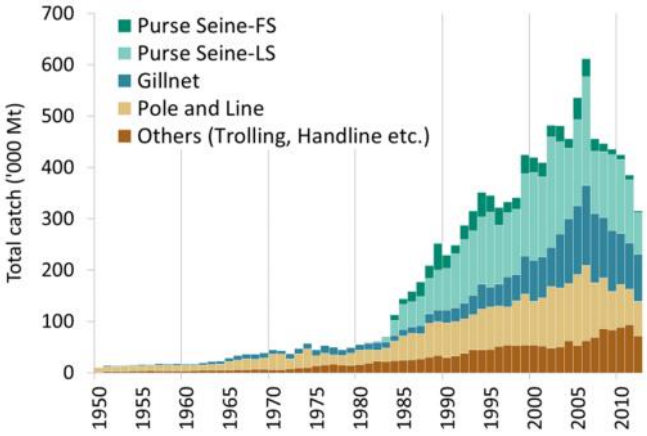
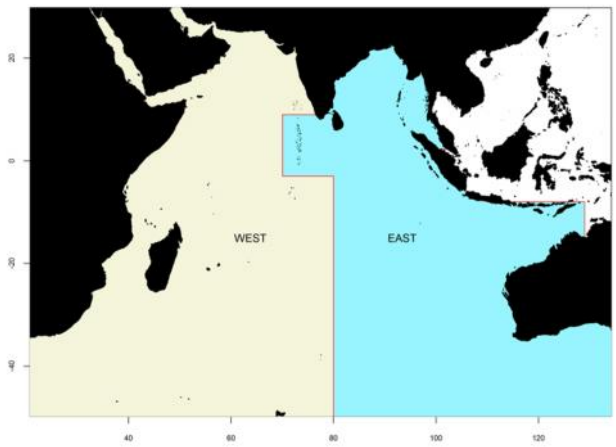


Fig. 13. Annual catches of skipjack tuna by gear (1950–2012). Data as of Sept. 2013.



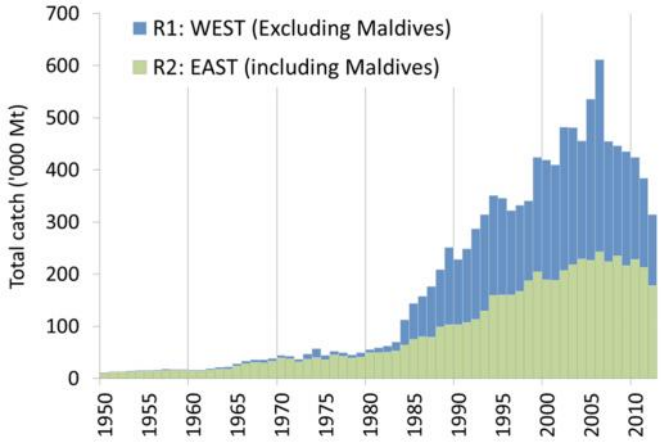


Fig. 14(a-b). Skipjack tuna: Catches of skipjack tuna by area by year estimated for the WPTT (1950–2012). Data as of September 2013.

Areas: East Indian Ocean plus Maldives (**R1**); West Indian Ocean excluding Maldives (**R2**)

The Maldivian fishery (**Fig. 16**) has effectively increased its fishing effort with the mechanisation of its **pole-and-line** fleet since 1974, including an increase in boat size and power and the use of anchored FADs since 1981. Skipjack tuna represents some 80% of its total catch, and catch rates regularly increased between 1980 and 2006, the year in which the maximum catch was recorded for this fishery (≈140,000 t). The catches of skipjack tuna have declined since, with catches in recent years estimated to be at around 55,000 t, representing less than half the catches taken in 2006 and just 58% of the total catches of tropical tunas. In 2011 and 2012 Maldives reported high catches of yellowfin tuna following the development of handline fisheries for yellowfin tuna in the Maldives.

Several fisheries using **gillnets** have reported large catches of skipjack tuna in the Indian Ocean (**Fig. 14**), including the gillnet/longline fishery of Sri Lanka, driftnet fisheries of Iran and Pakistan, and gillnet fisheries of India and 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 Iran and Sri Lanka (**Fig. 15**) 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.

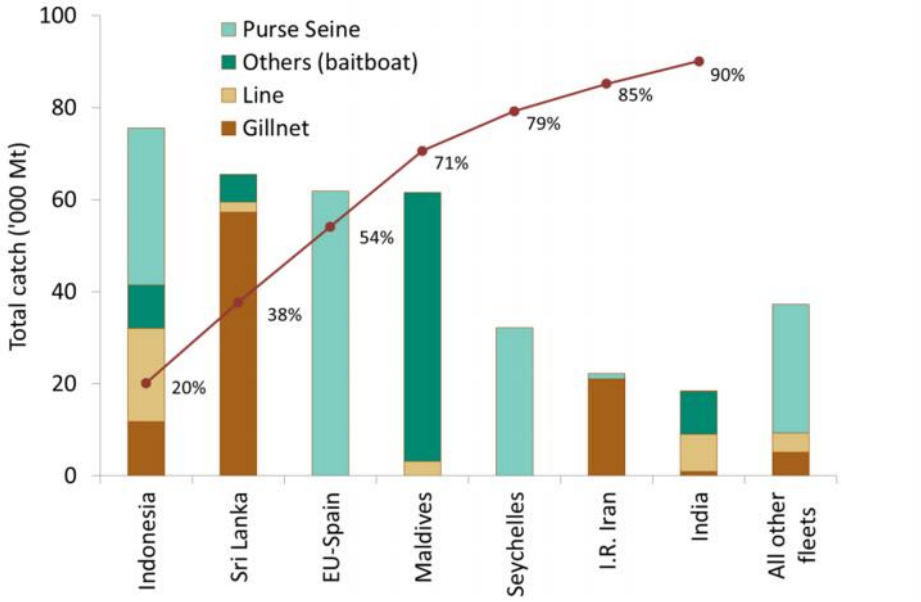


Fig. 15. Skipjack tuna: average catches in the Indian Ocean over the period 2009–11, by country. Countries are ordered from left to right, according to the importance of catches of skipjack reported. The red line indicates the (cumulative) proportion of catches of skipjack for the countries concerned, over the total combined catches of this species reported from all countries and fisheries. Data as of Sept. 2013.

The majority of the catches of skipjack tuna originate from the western Indian Ocean (**Figs. 12, 14 and 15**). Since 2007 (**Fig. 15**) the catches of skipjack tuna in the western Indian Ocean have dropped considerably, especially in areas off Somalia, Kenya, Tanzania and around the Maldives. The drop in catches are considered by the SC to be be partially explained by the drop in catch rates and fishing effort by some fisheries due to the effects of piracy in the western Indian Ocean region, including all industrial purse seiners and fleets using driftnets from Iran (**Fig. 13**) and Pakistan; and the drop in the catches of skipjack tuna by Maldives baitboats (**Fig. 13**) following the introduction of handlines to target large specimens of yellowfin tuna.

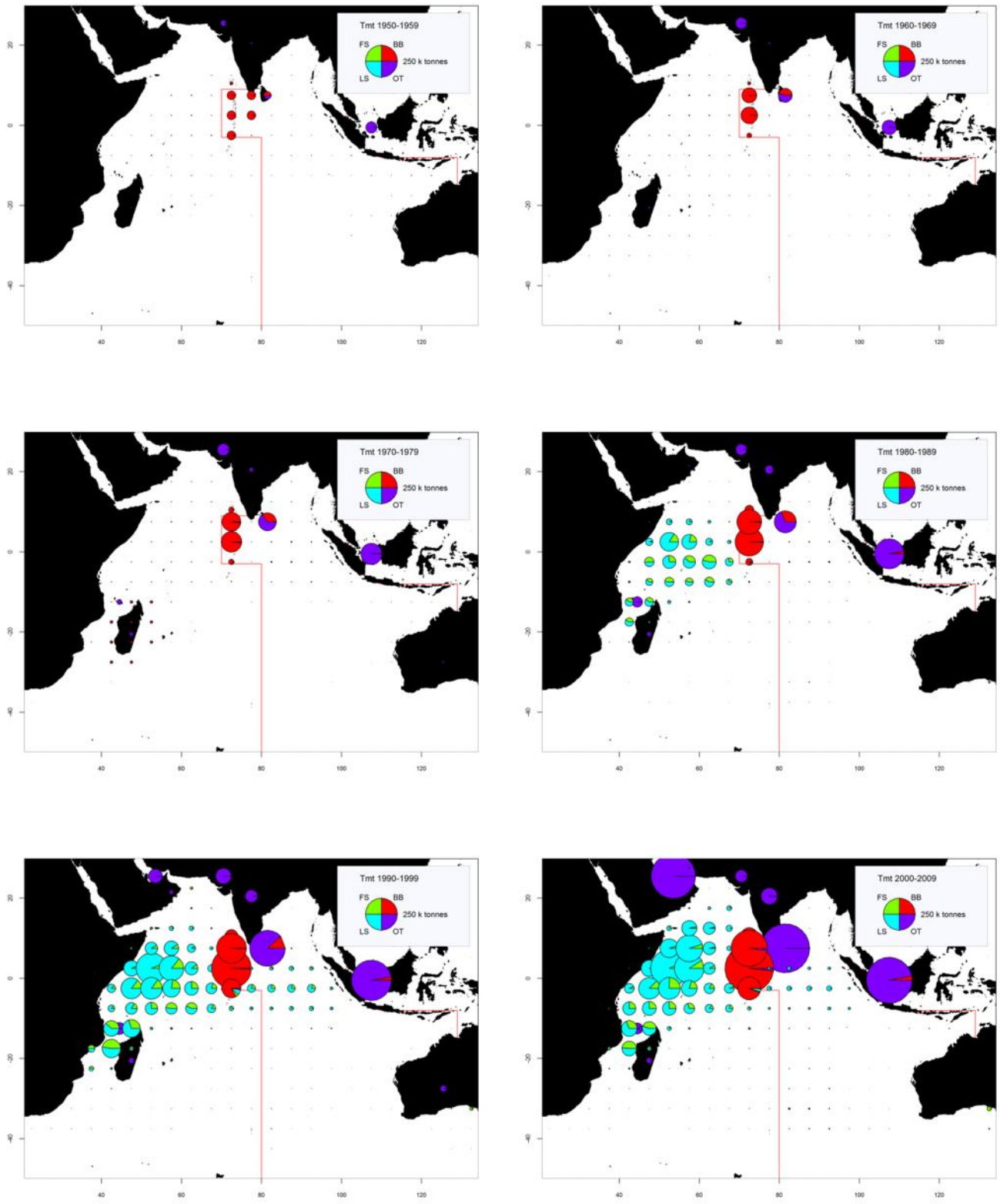


Fig. 16(a-f). Skipjack tuna: Time-area catches (total combined in tonnes) of skipjack tuna estimated for the period 1950–2009, by decade and type of gear. Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (**BB**), and other fleets (**OT**), including longline, drifting gillnets, and various coastal fisheries. Data as of September 2013. 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, in particular driftnets from Iran and Pakistan, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Comoros, Indonesia and India.

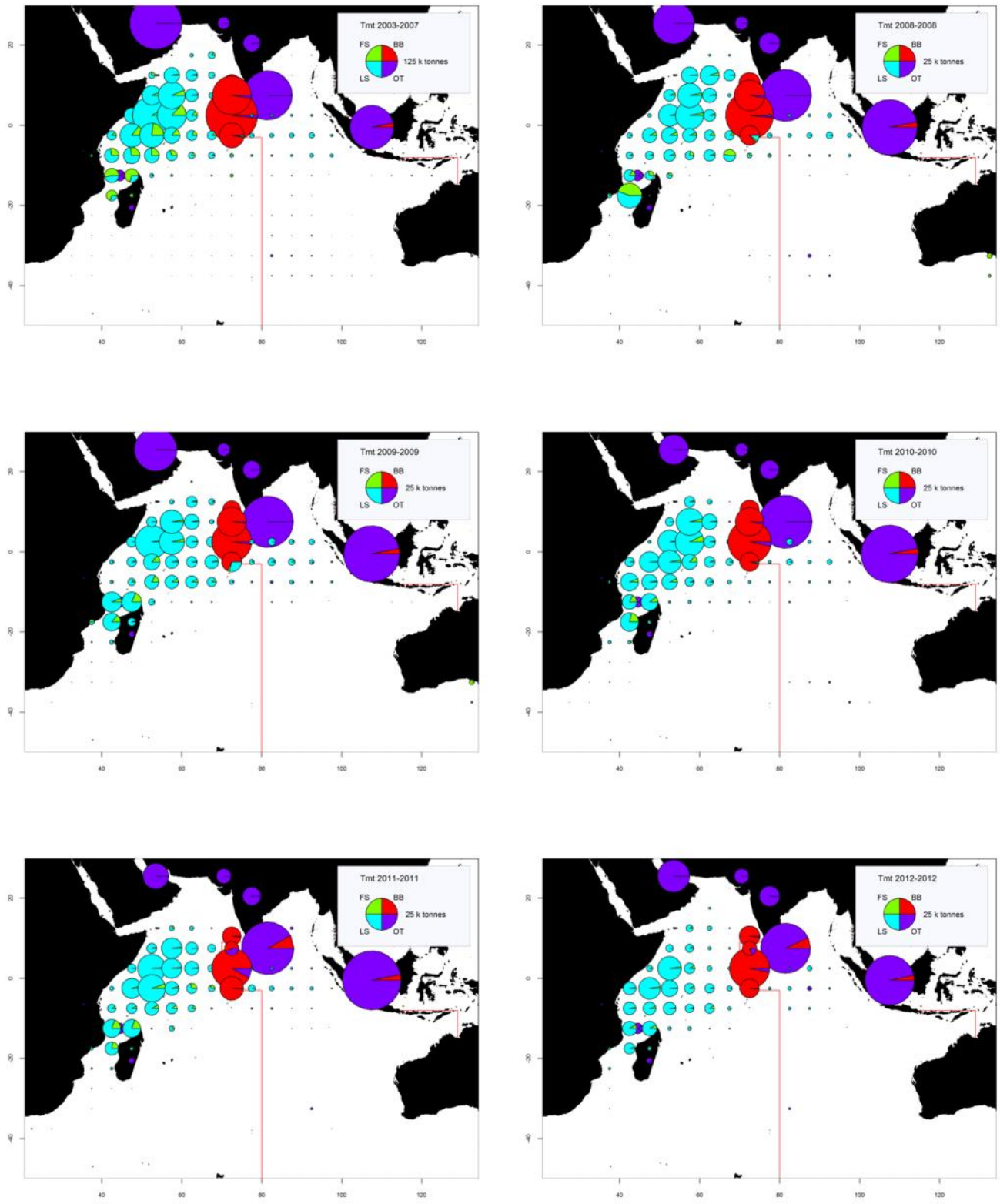


Fig. 17(a-f). Skipjack tuna: Time-area catches (total combined in tonnes) of skipjack tuna estimated for the period 2003–07 by type of gear and for 2008–12, by year and type of gear. Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (BB), and other fleets (**OT**), including longline, drifting gillnets, and various coastal fisheries. Data as of September 2013. 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, in particular driftnets from Iran and Pakistan, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Comoros, Indonesia and India.

Skipjack tuna: Status of Fisheries Statistics at the IOTC

Retained catches are generally well known for the industrial fisheries but are less certain for many artisanal fisheries (**Fig. 18**), notably because:

- catches are not being reported by species
- there is uncertainty about the catches from some significant fleets including the Sri Lankan coastal fisheries, and the coastal fisheries of Comoros and Madagascar.

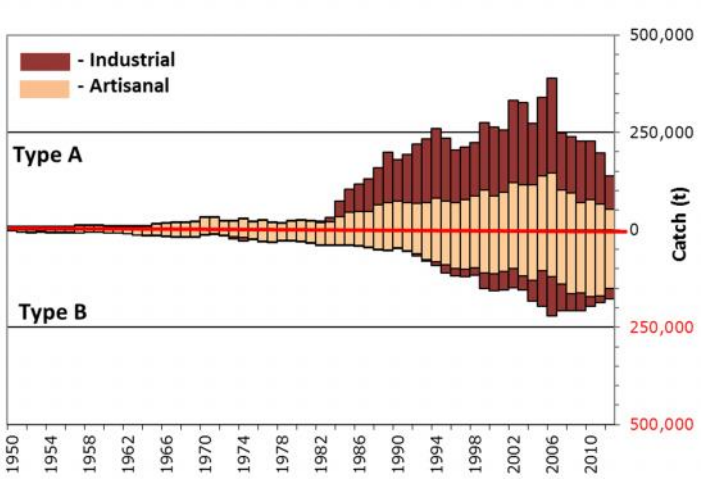


Fig. 18. Skipjack tuna: Uncertainty of annual catch estimates for skipjack tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Discard levels are believed to be low although they are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–2007.

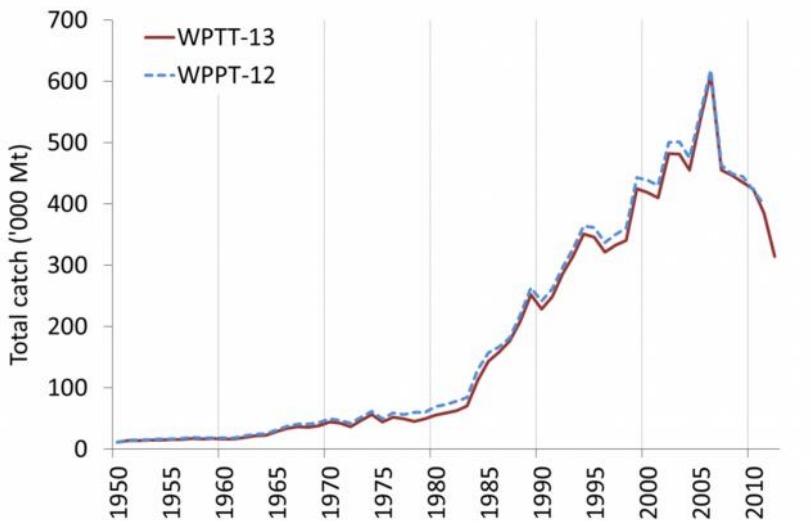


Fig. 19a. Skipjack tuna: Catches used by the WPTT in 2012 versus those estimated for the WPTT in 2013 (1950–2013).

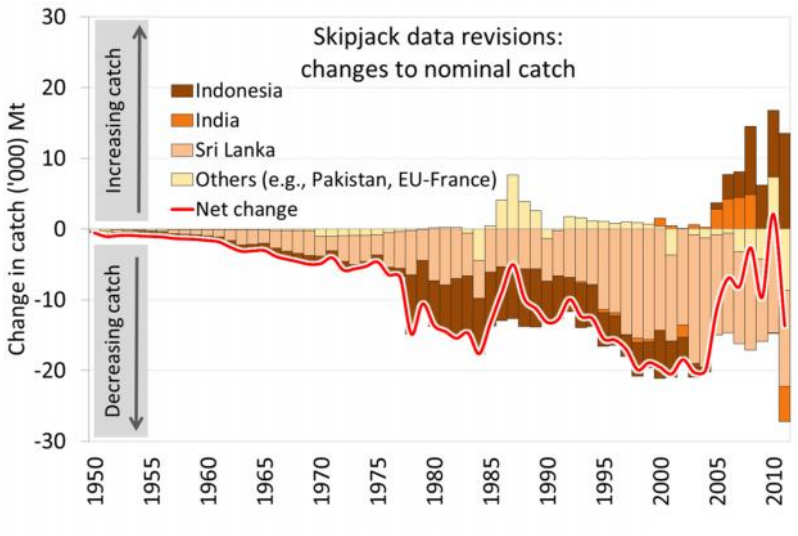


Fig. 19b. Skipjack tuna: net change in total catch, by year and flag country.

Changes to the catch series: There have been no major changes to the catches of skipjack tuna, as a whole, since the WPTT in 2012 (**Fig. 19a**). However, the IOTC Secretariat used new information compiled during 2012-13 to rebuild the catch series for the coastal fisheries operated in some countries, in particular Indonesia and India (**Fig. 19b**). In general, the new catches of skipjack tuna estimated by the IOTC Secretariat are lower than those used in the past by the WPTT. More details about these reviews can be found in **Appendix 2**.

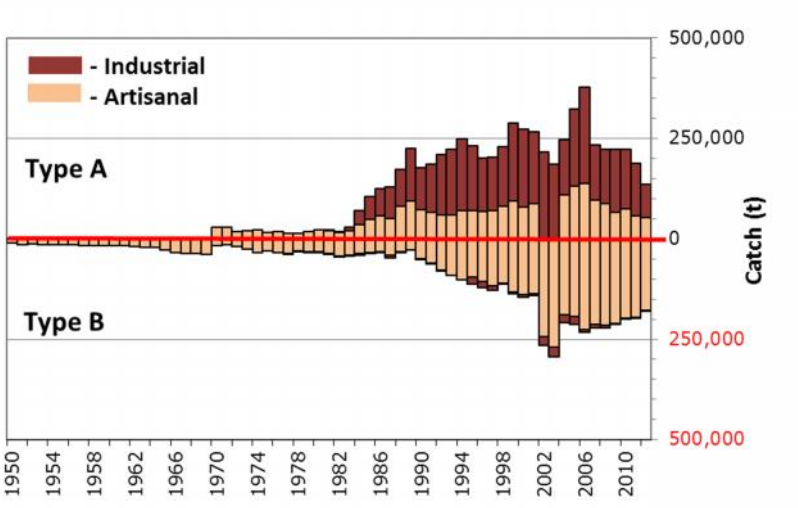


Fig. 20. Skipjack tuna: Uncertainty of time-area catches for skipjack tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report catch-and-effort data to the IOTC, do not report catch-and-effort data by gear and/or species or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

CPUE Series: Catch and effort data are available from various industrial and artisanal fisheries (**Fig. 21**). However, these data are not available from some important fisheries or they are considered to be of poor quality for the following reasons:

- insufficient data available for the gillnet fisheries of Iran and Pakistan

- the poor quality effort data for the gillnet/longline fishery of Sri Lanka
- no data are available from important coastal fisheries using hand and/or troll lines, in particular Indonesia, India and Madagascar.

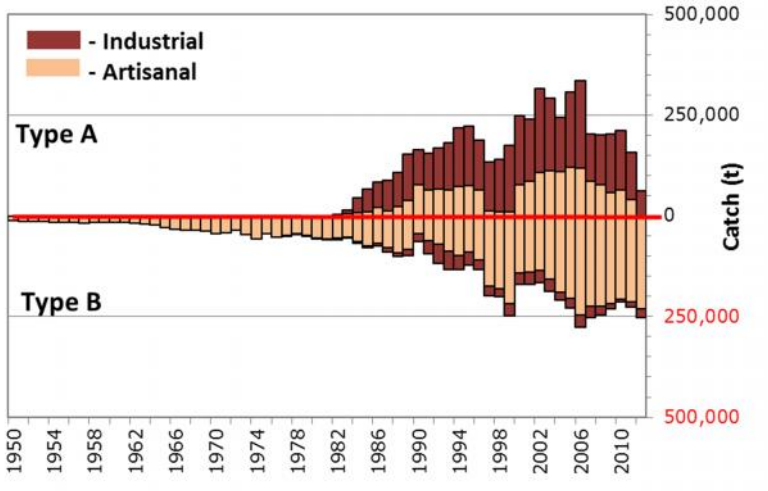


Fig. 21. Skipjack tuna: Uncertainty of catch-at-size data for skipjack tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report length data to the IOTC, do not report length data by gear, species, month, fishing area or any of the other reasons given in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Trends in average weight cannot be assessed before the mid-1980s and are incomplete for most artisanal fisheries thereinafter, namely hand lines, troll lines and many gillnet fisheries (Indonesia).

Catch-at-Size table: CAS are available but the estimates are uncertain for some years and fisheries due to (**Fig. 21**):

- the lack of size data before the mid-1980s
- the paucity of size data available for some artisanal fisheries, notably most hand lines and troll lines (Madagascar, Comoros) and many gillnet fisheries (Indonesia, Sri Lanka).

Skipjack tuna: Tagging data

A total of 101,212 skipjack (representing 50.2% of the total number of fish tagged) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them, 77.4%, were released during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and were released around Seychelles, in the Mozambique Channel and off the coast of Tanzania, between May 2005 and September 2007 (**Fig. 22**). 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, 17,688 specimens (17.5%), have been recovered and reported to the IOTC Secretariat. Around 69.5% of the recoveries were from the purse seine fleets operating from the Seychelles, and around 28.9% 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.

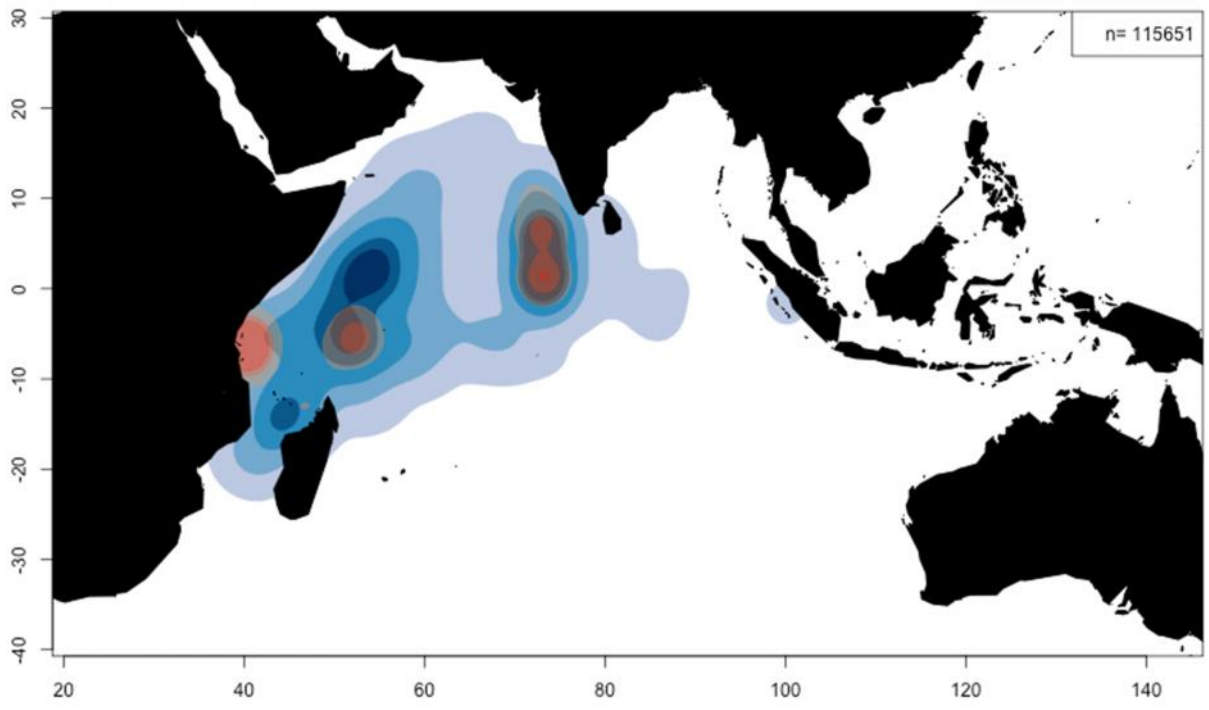


Fig. 22. Skipjack tuna: Densities of releases (in red) and recoveries (in blue). Data as of September 2012.

Yellowfin tuna (YFT)

Fisheries and catch trends

Catches by gear, area, country and year from 1950 to 2012 are shown in **Figs. 23**, **24** and **25**. Contrary to the situation in other oceans, the artisanal fishery component in the Indian Ocean is substantial, taking 20–30% of the total catch. Catches of yellowfin tuna (**Table 6**; **Fig. 23**) remained more or less stable between the mid-1950s and the early-1980s, ranging between 30,000 and 70,000 t, owing to the activities of longliners and, to a lesser extent, gillnetters. The catches increased rapidly with the arrival of the purse seiners in the early 1980s and increased activity of longliners and other fleets, reaching over 400,000 t in 1993. Catches of yellowfin tuna between 1994 and 2002 remained stable, between 330,000 and 350,000 t. Yellowfin tuna catches during 2003, 2004, 2005 and 2006 were much higher than in previous years with the highest catches ever recorded in 2004 (over 525,000 t) and average annual catch for the period at around 480,000 t. Yellowfin tuna catches dropped markedly after 2006, with the lowest catches recorded in 2009. Catch levels in 2012 are estimated to be at around 370,000 t, although they represent preliminary figures.

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 (2003–2012), in tonnes. Data as of September 2013. Catches by decade represent the average annual catch, noting that some gears were not used since the beginning of the fishery (refer to Fig. 23).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
FS	-	-	18	31,561	64,974	89,377	136,881	168,392	123,998	85,044	53,526	74,985	36,049	32,135	36,453	64,593
LS	-	-	17	17,610	56,275	61,719	87,015	59,655	69,878	74,612	43,778	41,546	51,351	73,383	76,659	66,166
LL	21,990	41,250	29,493	34,090	71,557	70,227	70,225	99,768	130,993	88,365	65,490	39,354	36,552	37,073	33,957	40,756
LF	-	-	615	4,286	47,571	34,150	31,162	32,938	35,949	31,752	33,302	34,342	23,125	21,501	21,267	23,366
BB	2,111	2,318	5,810	8,295	12,805	16,061	17,277	15,876	16,734	18,017	16,268	18,326	16,819	14,105	14,016	15,386
GI	1,572	4,116	7,838	11,899	39,421	49,388	53,769	74,160	61,257	62,601	43,412	48,011	42,822	50,772	50,448	59,902
HD	728	1,779	4,772	11,488	26,073	42,737	43,768	52,447	47,288	40,898	40,961	41,163	37,160	43,398	66,347	70,797
TR	1,102	1,981	4,335	6,946	11,628	16,124	12,979	20,929	16,793	18,235	19,715	18,814	16,822	19,968	20,424	21,444
OT	80	193	453	1,844	3,318	5,055	4,012	4,631	4,220	5,294	5,897	7,060	7,071	7,665	7,919	6,253
Total	**27,583**	**51,637**	**53,351**	**128,019**	**333,622**	**384,838**	**457,089**	**528,797**	**507,111**	**424,819**	**322,349**	**323,602**	**267,771**	**300,000**	**327,490**	**368,663**

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 (2003–2012), in tonnes. Data as of September 2013. Catches by decade represent the average annual catch. The areas are presented in Fig. 2(a).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R1	2,146	4,715	6,951	16,783	74,549	86,730	82,305	125,641	129,465	108,572	80,564	74,481	59,642	65,334	77,905	89,020
R2	11,226	23,066	21,208	71,695	138,278	180,825	262,313	271,608	248,766	199,399	128,041	137,320	104,423	124,456	146,643	178,394
R3	844	7,516	5,892	9,592	23,974	24,750	22,968	27,389	25,591	24,770	24,617	21,297	20,063	19,565	20,159	19,365
R4	917	1,785	1,415	1,257	8,298	6,244	10,032	9,079	7,121	4,485	1,682	1,755	1,438	1,981	1,123	3,087
R5	11,253	13,226	16,074	22,606	67,947	61,369	54,882	69,154	65,387	67,863	62,446	57,492	66,764	62,458	57,007	57,978
R0 (North)	1,195	1,305	1,796	6,053	20,533	24,896	24,554	25,898	30,730	19,726	24,996	31,253	15,433	26,196	24,639	20,817
R0 (Other)	1	24	15	32	43	24	34	29	51	5	2	5	7	10	13	2
Total	**27,583**	**51,637**	**53,351**	**128,019**	**333,622**	**384,838**	**457,089**	**528,797**	**507,111**	**424,819**	**322,349**	**323,602**	**267,771**	**300,000**	**327,490**	**368,663**

Areas: Arabian Sea (**R1**); Off Somalia (**R2**); Mozambique Channel (**R3**); South Indian Ocean (**R4**); East Indian Ocean (**R5**); Bay of Bengal (**R0(North)**); Other Area (**R0(Other)**)

Although some Japanese purse seiners have fished in the Indian Ocean since 1977, the **purse seine (Fig. 23)** 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 made of adult fish, as opposed to bigeye tuna catches, of which the majority refers to juvenile fish. Purse seine vessels typically take fish ranging from 40 to 140 cm fork length (FL) and smaller fish are more common in the catches taken north of the equator. Catches of yellowfin tuna increased rapidly to around 130,000 t in 1993, and subsequently they fluctuated around that level, until 2003–05 when they were substantially higher (over or close to 200,000 t). The amount of effort exerted by the EU purse seine vessels (fishing for yellowfin tuna and other tunas) varies seasonally and from year to year.

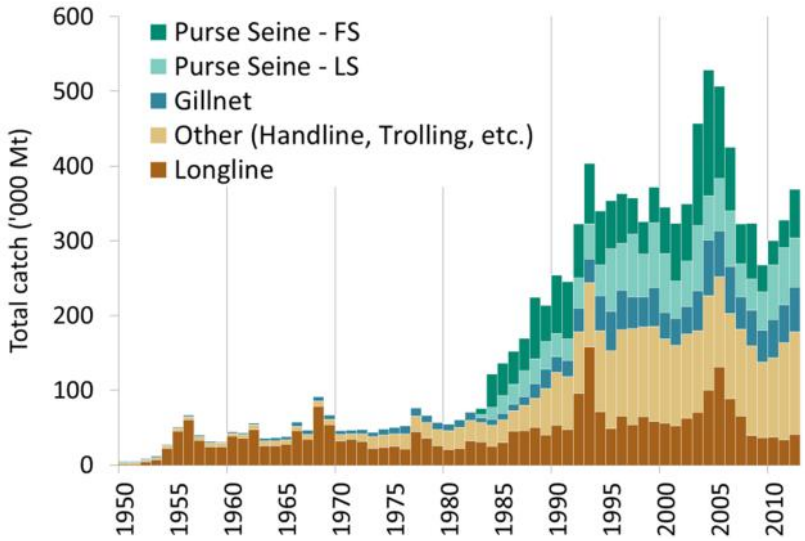
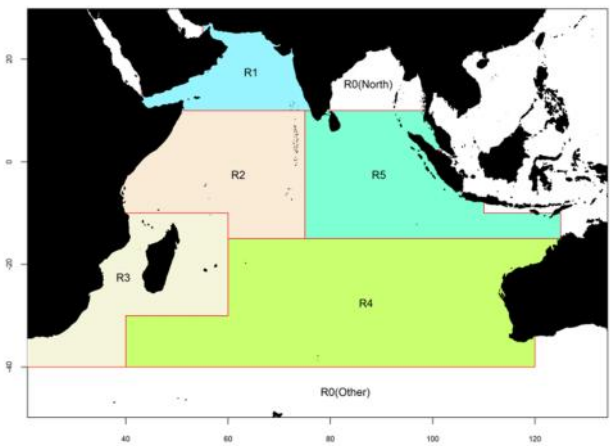


Fig. 23. Annual catches of yellowfin tuna by gear (1950–2012). Data as of Sept. 2013.

The purse seine fishery is characterized by the use of two different fishing modes (**Table 6**; **Figs. 23, 25 and 26**). The fishery on floating objects (FADs), which catches large numbers of small yellowfin tuna in association with skipjack tuna and juvenile bigeye tuna, and a fishery on free swimming schools, which catches larger yellowfin tuna on multi-specific or mono-specific sets. Between 1995 and 2003, the FAD component of the purse seine fishery represented 48–66% of the sets undertaken (60–80% of the positive sets) and accounted for 36–63% of the yellowfin tuna catch by weight (59–76% of the total catch). The proportion of yellowfin tuna caught (in weight) on free-schools during 2003–06 (64%) was much higher than in previous or following years (at around 50%).



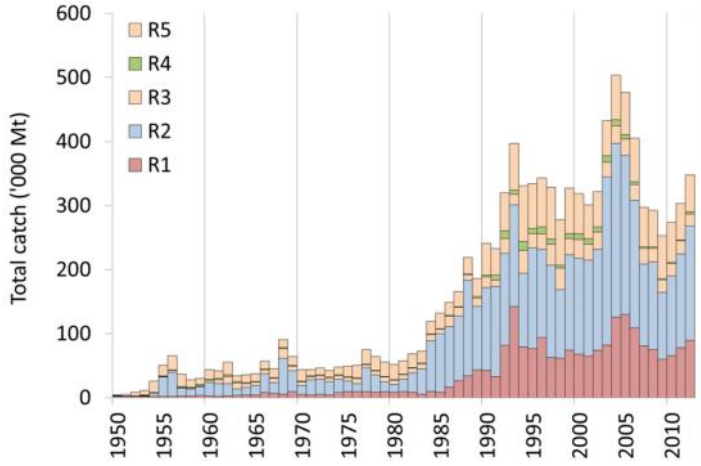


Fig. 24(a-b). Yellowfin tuna: Catches of yellowfin tuna by area by year estimated for the WPTT (1950–2012). Data as of September 2013. Catches in areas R0 were assigned to the closest neighbouring area for the assessment.

Areas: Arabian Sea (**R1**); Off Somalia (**R2**); Mozambique Channel (**R3**); South Indian Ocean (**R4**); East Indian Ocean (**R5**); Bay of Bengal (**R0(North)**); Other Area (**R0(Other)**)

The **longline** fishery (**Table 6**; **Fig. 23**) started in the early 1950's and expanded rapidly over throughout the Indian Ocean. 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. 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 (large scale deep-freezing longliners operating on the high seas from Japan, Korea and Taiwan,China) and a fresh-tuna longline component (small to medium scale fresh tuna longliners from Indonesia and Taiwan,China). The total longline catch of yellowfin tuna reached a maximum in 1993 (≈200,000 t). Catches between 1994 and 2004 fluctuated between 85,000 t and 130,000 t. The second highest catches of yellowfin tuna by longliners were recorded in 2005 (≈165,000 t). As was the case for the purse seine fleets, since 2005 longline catches have declined with current catches estimated to be at around 60,000 t, representing a two-fold decrease from the catches taken in 2005. The SC believes that the recent drop in longline catches could be related, at least in part, with the expansion of piracy in the northwest Indian Ocean, which led to a marked drop in the levels of longline effort in one of the core fishing areas of the species (**Fig. 27**).

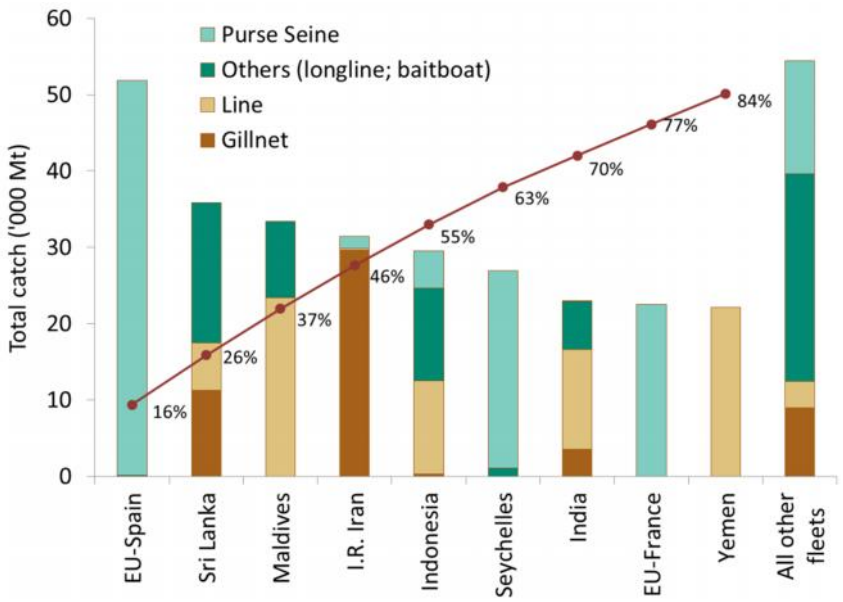


Fig. 25. Yellowfin tuna: average catches in the Indian Ocean over the period 2009–11, by country. Countries are ordered from left to right, according to the importance of catches of yellowfin reported. The red line indicates the (cumulative) proportion of catches of yellowfin for the countries concerned, over the total combined catches of this species reported from all countries and fisheries. Data as of Sept. 2013.

Catches by **other gears**, namely pole-and-line, gillnet, troll, hand line and other minor gears, have increased steadily since the 1980s (**Table 6**; **Figs. 23** and **25**). In recent years the total artisanal yellowfin tuna catch has been around 140,000–160,000 t, with the catch by gillnets (the dominant artisanal gear) at around 50,000 t. During the years 2004 and then in 2012 the catches by artisanal gears attained its maximum over the time series, peaking at 165,000 t and 170,000 t, respectively.

Yellowfin tuna catches in the Indian Ocean during 2003, 2004, 2005 and 2006 were much higher than in previous years (**Fig. 23**), while bigeye tuna catches remained at their average levels. Purse seiners currently take the bulk of the yellowfin tuna catch, mostly from the western Indian Ocean, around Seychelles (**Table 6-7**; **Fig. 24;** Off Somalia (R2) and Mozambique Channel (R3); **Figs. 26** and **27**). In 2003 and 2004, total catches by purse seine vessels in this area were around 225,000 t — about 50% more than the previous largest purse seine catch, which was recorded in 1995. Similarly, artisanal yellowfin tuna catches have been near their highest levels and longliners have reported higher than normal catches in the tropical western Indian Ocean during this period.

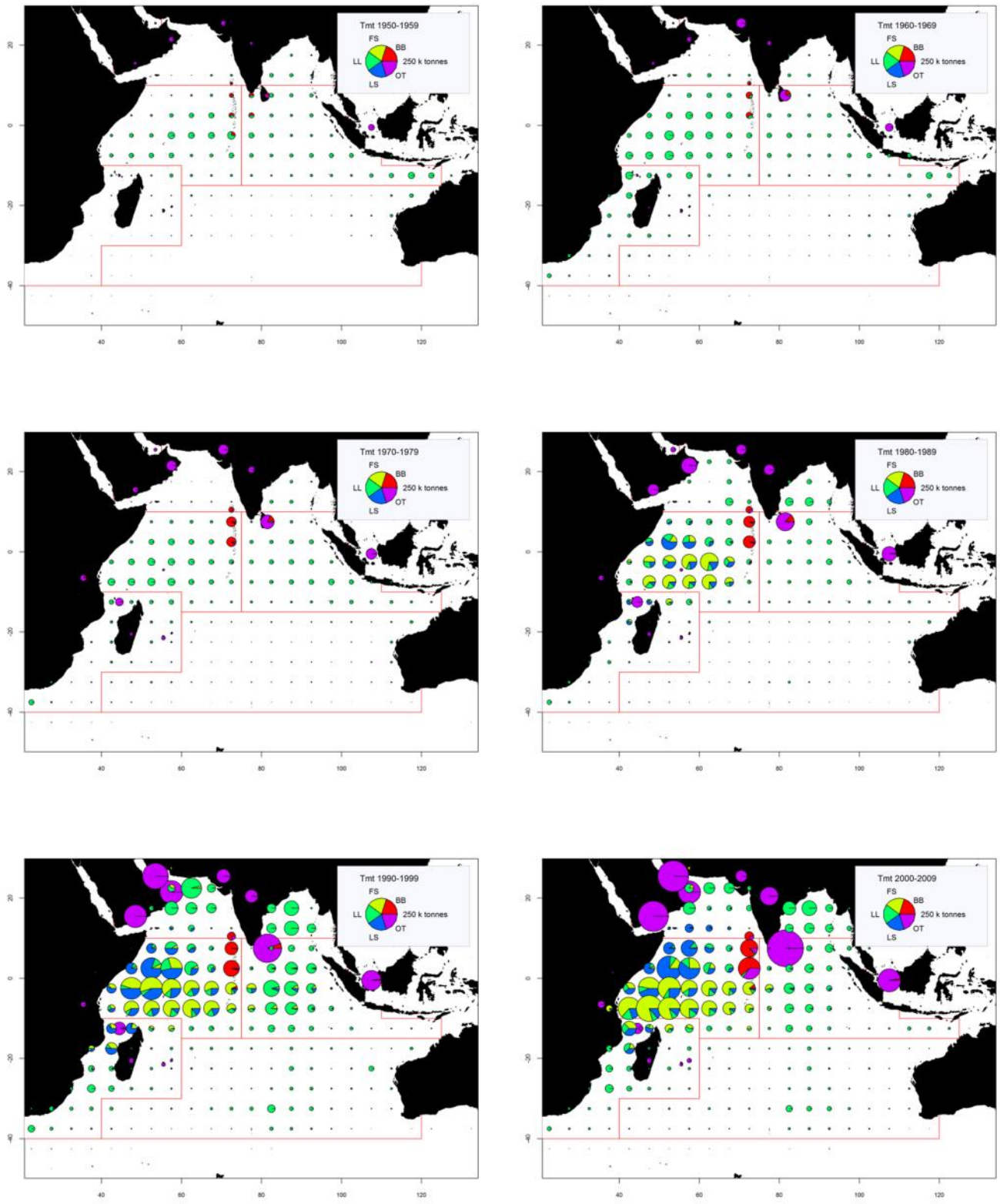


Fig. 26(a-f). Yellowfin tuna: Time-area catches (total combined in tonnes) of yellowfin tuna estimated for the period 1950–2009, by decade and type of gear. Longline (**LL**), Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (**BB**), and other fleets (**OT**), including drifting gillnets, and various coastal fisheries. Data as of September 2013. 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, in particular driftnets from Iran and Pakistan, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Yemen, Oman, Comoros, Indonesia and India.

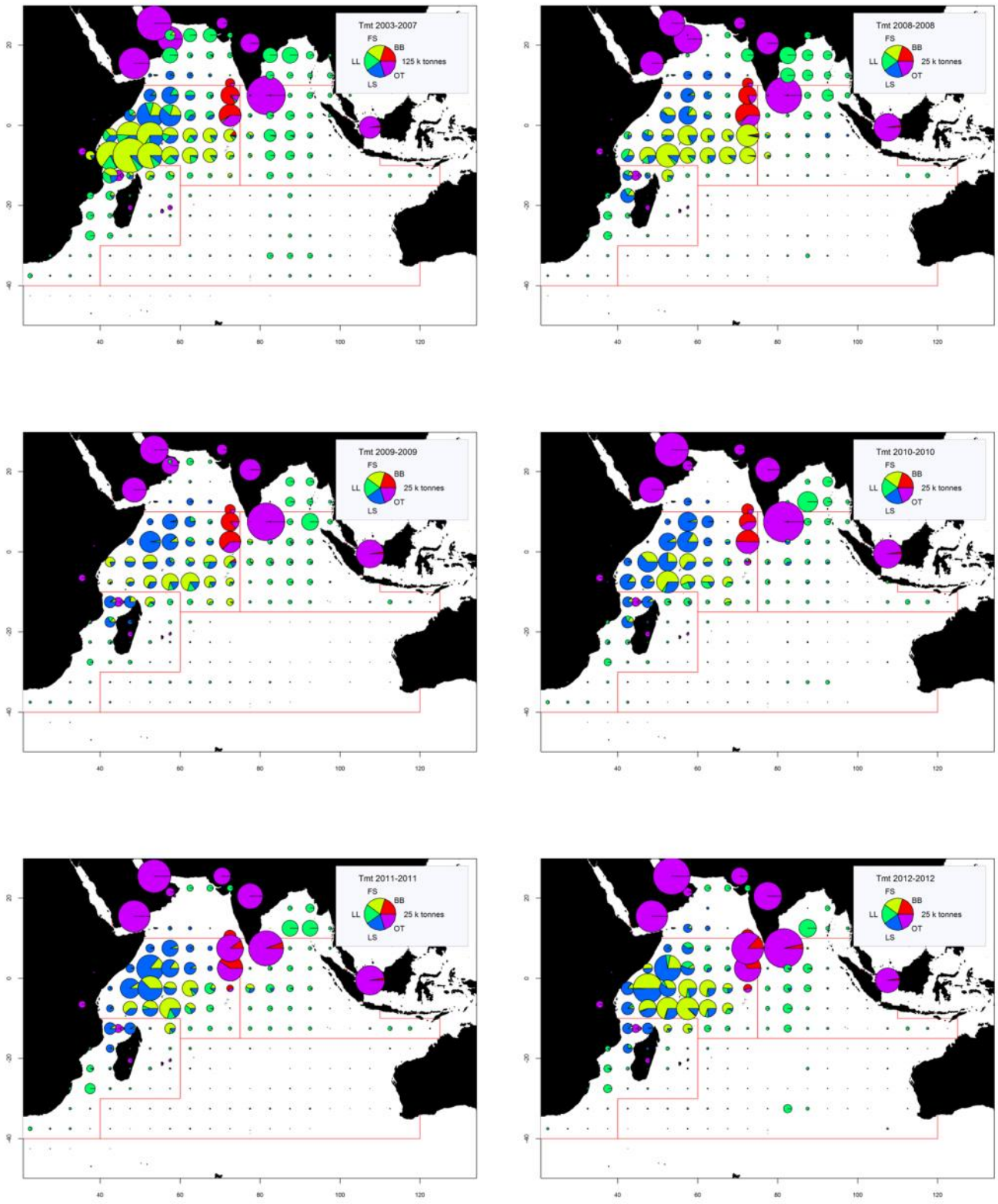


Fig. 27(a-f). Time-area catches (total combined in tonnes) of yellowfin tuna estimated for the period 2003–2007 by type of gear and for 2008–2012, by year and type of gear. Longline (**LL**), Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (**BB**), and other fleets (**OT**), including drifting gillnets, and various coastal fisheries. Data as of September 2013. 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, in particular driftnets from Iran and Pakistan, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Yemen, Oman, Comoros, Indonesia and India.

In recent years the catches of yellowfin tuna in the western Indian Ocean have dropped considerably, especially in areas off Somalia, Kenya and Tanzania and in particular between 2007 and 2011 (**Figs. 25** and **27**). The drop in catches is the consequence of a drop in fishing effort due to the effect of piracy in the western Indian Ocean region. Even though the activities of purse seiners have been affected by piracy in the Indian Ocean, the effects have not been as marked as with longliners, for which current levels of effort are close to nil in the area impacted by piracy. The main reason for this is the presence of security personnel onboard purse seine vessels of the EU and Seychelles, which has made it possible for purse seiners under these flags to continue operating in the northwest Indian Ocean. Longline effort levels in the western tropical area have increased in 2012, as a consequence of increased security in the region.

Yellowfin tuna: Status of Fisheries Statistics at the IOTC

Retained catches are generally well known (**Fig. 28**); however, catches are less certain for:

- 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.

Discard levels are believed to be low although they are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–2007.

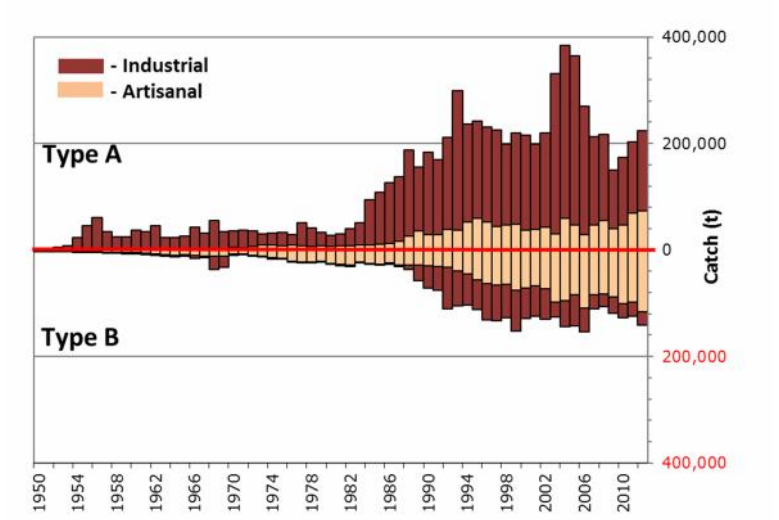


Fig. 28. Yellowfin tuna: Uncertainty of annual catch estimates for yellowfin tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Changes to the catch series: There have not been significant changes to the total catches of yellowfin tuna since the WPTT in 2011 (**Fig. 29a**). However, the IOTC Secretariat used new information compiled during 2012–13 to rebuild the catch series for the coastal fisheries operated in some countries, in particular Pakistan, Indonesia, Sri Lanka, and India. In general, the new catches of yellowfin tuna estimated by the IOTC Secretariat are slightly higher than those used in the past by the WPTT. More details about these reviews can be found in **Appendix 2**.

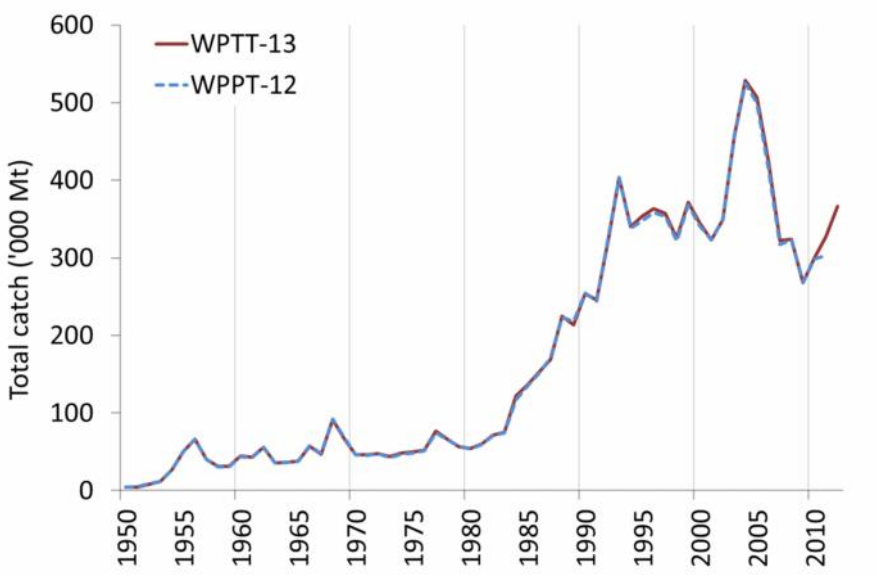


Fig. 29a. Yellowfin tuna: Catches used by the WPTT in 2012 versus those estimated for the WPTT in 2013 (1950–2012).

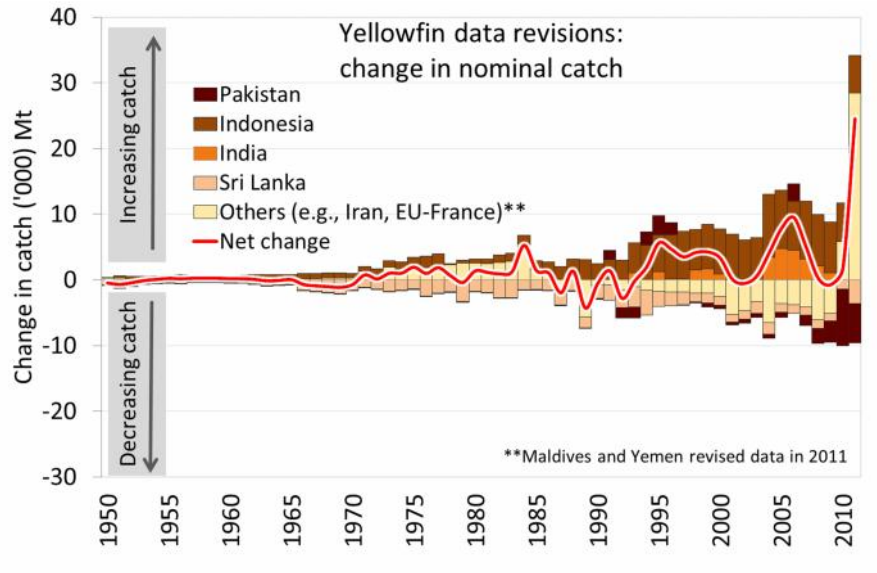


Fig. 29b. Yellowfin tuna: net change in total catch, by year and flag country.

CPUE Series: Catch-and-effort data are available from the major industrial and artisanal fisheries (**Fig. 30**). However, these data are not available for some important fisheries or they 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 Iran and Pakistan
- the 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.

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.

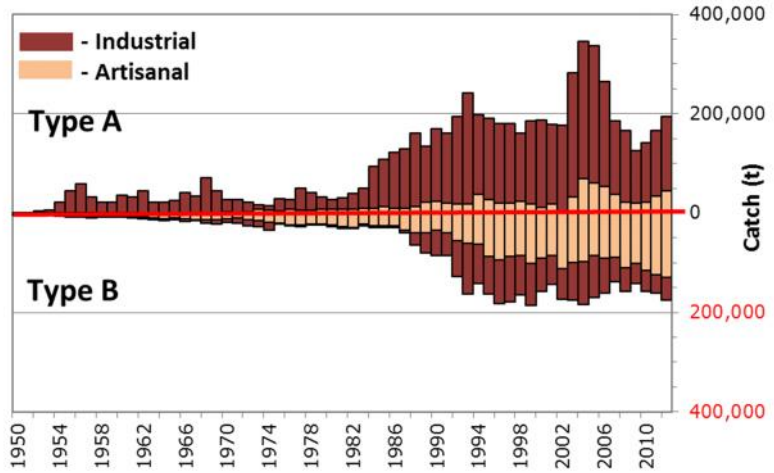


Fig. 30. Yellowfin tuna: Uncertainty of time-area catches for yellowfin tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report catch-and-effort data to the IOTC, do not report catch-and-effort data by gear and/or species or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

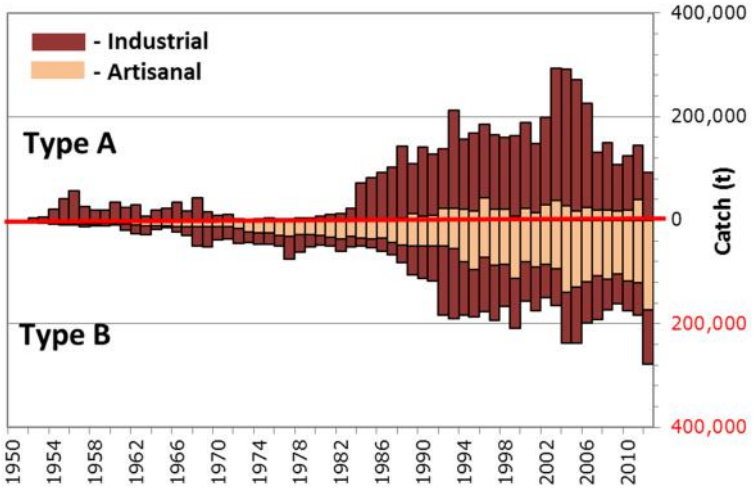


Fig. 31. Yellowfin tuna: Uncertainty of catch-at-size data for yellowfin tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report length data to the IOTC, do not report length data by gear, species, month, fishing area or any of the other reasons given in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Catch-at-Size table: This is available (**Fig. 30**) 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, Iran, India, Indonesia, Malaysia).

Yellowfin tuna: tagging data

A total of 63,328 yellowfin tuna (representing 31.4% of the total number of specimens tagged) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them (86.4%) 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. 30**). The remaining 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, 10,834 specimens (17.1%), have been recovered and reported to the IOTC Secretariat. More than 85.9% of these recoveries we made by the purse seine fleets operating in the Indian Ocean, while around 9.1% 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.

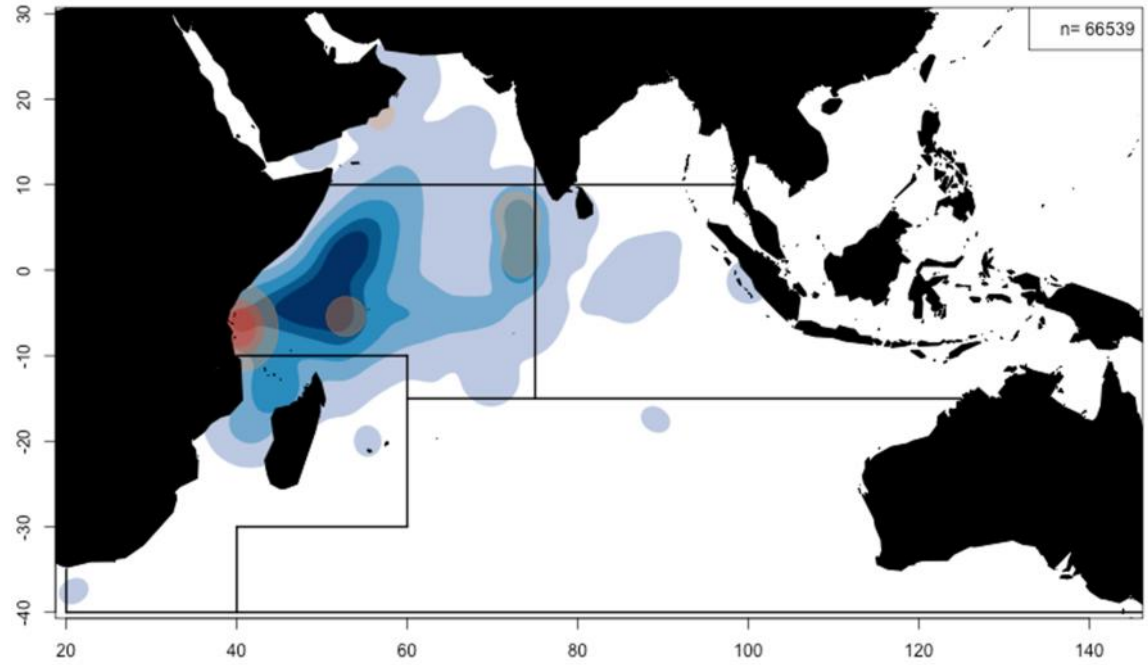


Fig. 32. Yellowfin tuna: Densities of releases (in red) and recoveries (in blue). The black line represents the stock assessment areas. Data as of September 2012.

APPENDIX I

ESTIMATION OF CATCHES OF NON-REPORTING FLEETS

The estimates of catches of non-reporting fleets were updated in 2013:

The high number of non-reporting fleets operating in the Indian Ocean between the mid-1980's and the late 1990's led to large increases in the amount of catch that had to be estimated for that period. This reduced confidence in the catch estimates for yellowfin tuna and bigeye tuna, and to a lesser extent, skipjack tuna during those years. In recent years the number of fleets from non-IOTC Parties has decreased significantly. However, the decrease in the numbers of industrial vessels fishing in the Indian Ocean from non-IOTC parties has coincided with an increase in the numbers of vessels fishing under flags of some IOTC parties, including coastal countries in the IOTC region (India, Indonesia, Iran, Kenya, Malaysia, Oman, Seychelles, Tanzania and Thailand) and deep-water fishing nations (Belize, Guinea and Senegal), the quality of the statistics collected by these countries varying depending on the case.

- **Purse seine** (**Fig. 33**): Catches for the six former Soviet Union purse seiners, currently under the Thailand flag, were estimated for January-August 2005 and those for the remaining purse seiner (Equatorial Guinea) for 2005–2006. Total catches were estimated using the number of vessels available, the average catches of the former Soviet Union purse seiners in previous years, and average catches available for other fleets for 2005–2006. Total catches were assigned to species and type of school fished according to data available for Thailand purse seiners during the same period (2005–2006). The amount of catch that the Secretariat has to estimate for this fleet has decreased considerably in recent years. It is thought that there are no longer purse seiners operating under flags of non-reporting countries.

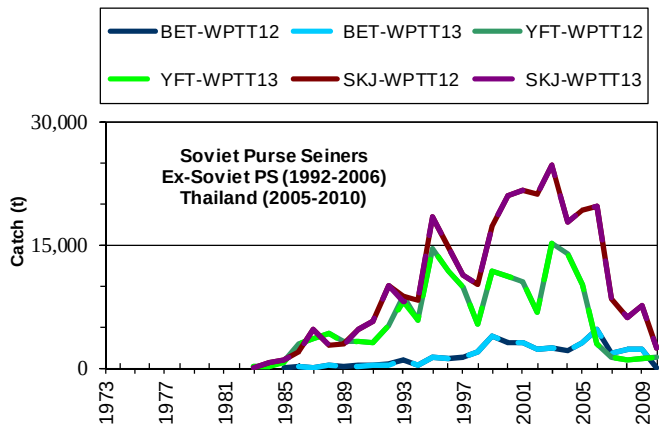


Fig. 33. Catches of Soviet, ex-Soviet and Thai purse seiners estimated in 2012 versus previous catches estimated in 2011 (1983–2010)

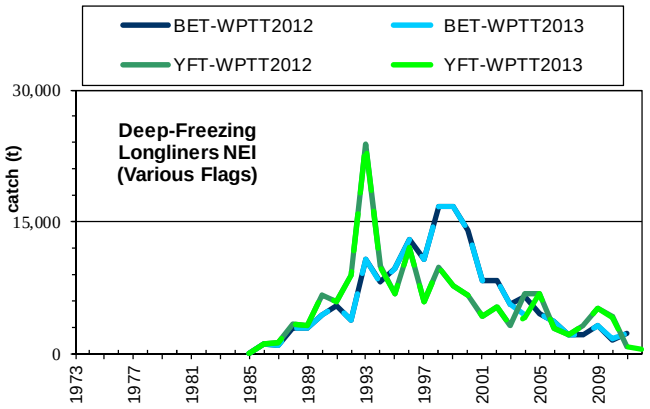


Fig. 34. Catches of deep-freezing longline vessels in the Indian Ocean estimated in 2013 versus catches estimated in 2012 (1985–2012)

- **Deep-freezing longline** (**Fig. 34**): 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 in a way similar to the longliners from Taiwan,China, Japan, or EU-Spain. The collection of new information on the activities of non-reporting fleets during the last year, in particular the numbers and characteristics of non-reporting longliners, led to improved 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. Such decrease has coincided with an increase in the numbers of vessels operated by some IOTC CPC's. Although these countries usually report catches to the Secretariat, the data reported are, in some cases, considered incomplete (as indicated in Section 3)
- **Fresh tuna longline** (**Fig. 35-36**): 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-OFC[8] 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, the catches reported are thought to be incomplete as Indonesia and Malaysia do not monitor the activities of vessels under their flags based in other countries. The Secretariat estimated the catches of this component as for the countries indicated 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 (2005-12), Indonesia (1973–2001), Thailand (1994–2012), Sri Lanka (1990–2001; 2004–12), Malaysia (1989–2012), 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 2007-12. 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, their catches not accounted for in estimates made by the Secretariat. The Secretariat has been using the catches published by Taiwan,China since 2006.

The catches for fleets other than Taiwan,China for 1973–2012 and for Taiwan,China in years prior to 2001 were estimated as explained in the three bullet points above.

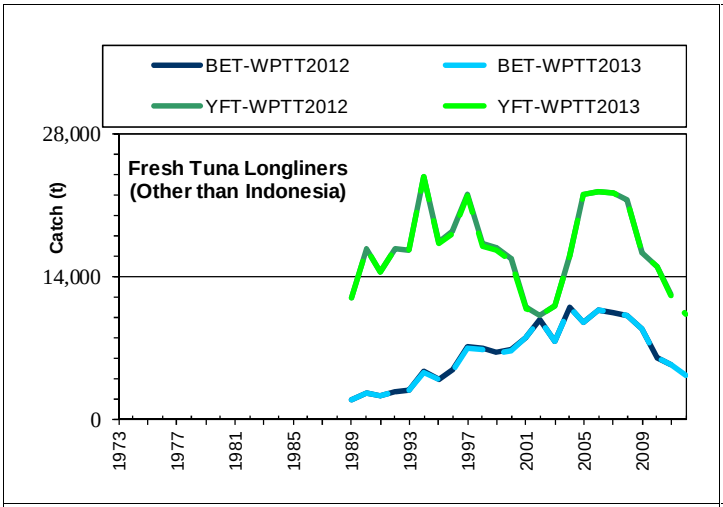


Fig. 35. Catches of fresh-tuna longline vessels based in India, Malaysia, Maldives, Mauritius, Oman, Seychelles, Singapore, Sri Lanka, Thailand and Yemen (mainly registered in China, Taiwan,China and Indonesia) estimated in 2012 versus catches estimated in 2013 (1989–2012)

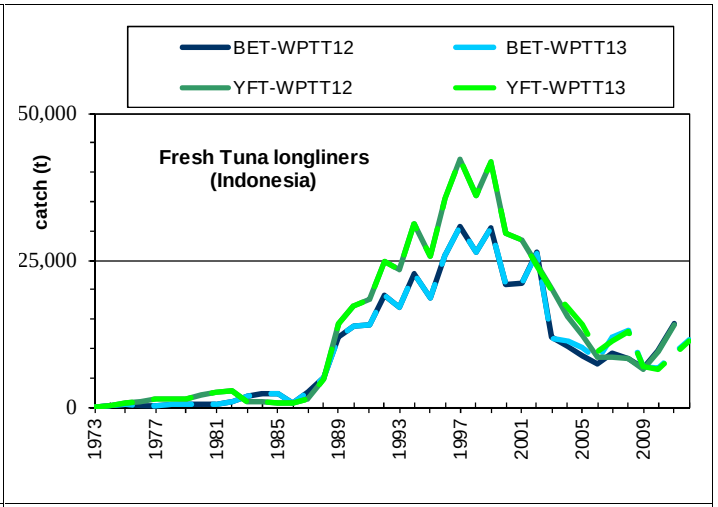


Fig. 36. Catches of fresh-tuna longline vessels based in Indonesia (domestic and foreign) estimated in 2012 versus catches estimated in 2013 (1973–2012)

[8] Overseas Fishery Cooperation Foundation of Japan

APPENDIX II

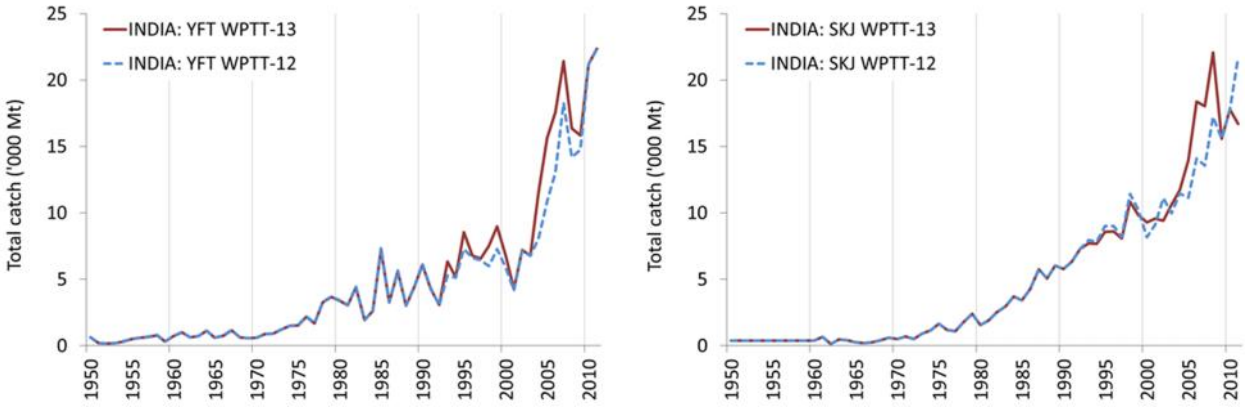
SUMMARY OF MAIN REVISIONS TO CATCH SERIES

In 2012 a comprehensive review of the historical catch series for India, Sri Lanka and Indonesia was conducted by an IOTC consultant[9]. The report included a number of recommendations to changes in the catch series, and which were partially entered in the IOTC database prior to WPTT-12, mostly related to India. Data revision activities in 2013 have focused on implementing the remainder of the report's recommendations, as well as further improvements to the quality of catch estimates for each of the three countries by the Data Section of the IOTC Secretariat.

India – Artisanal Fisheries

- Data published by the Central Marine Fisheries Research Institute (CMFRI) and research indicates catch levels and fishing activities are lower than those previously reported by India official sources[10], and also lower than revisions to the historical series published by Bhatal[11], particularly for the period 1990 to 2000.
- Secondly, a new artisanal fishery – shrimp trawlers converted to longline and troll vessels – which started in early 2000 has also been added to the total artisanal catch for India. Details of the fishery were provided to the IOTC Scientific Committee in December 2011; the main targets of the fishery are yellowfin tuna and skipjack tuna. Vessels have been in operation from early 2000, and (higher) catches from 2002 to 2009 have been estimated based on the information of catch reported for 2010.
- The artisanal data series has subsequently been revised to take account of the new data sourced from CMFRI publications, research by IOTC consultant and additional fishery data. Revisions to the historical catch series in 2012 and 2013 relate mainly to data from 1990 onwards (Fig. 36).

Fig. 36 (a-b). India: comparison of catch series for Working Party on Tropical Tunas (WPNT) 2012 and 2013.



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

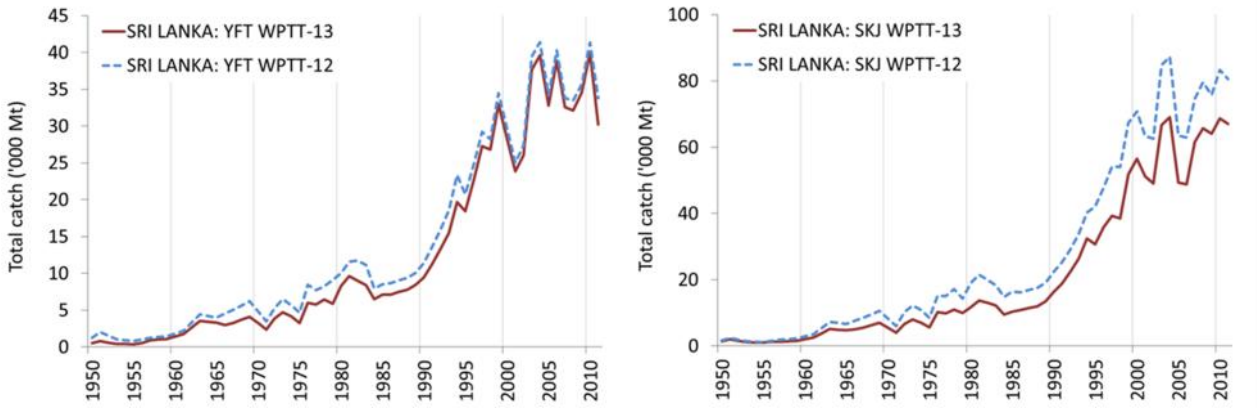
Sri Lanka – Artisanal Fisheries

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

Main findings –

- A key issue of the review was the allocation of catch to species classified as unknown tunas (TUX). Catch reported in this category has previously been assumed to be mostly skipjack, while the findings of the review concluded the catch to be more likely kawakawa and frigate juveniles.
- Consequently, the data series across most tuna species has been revised – with the majority of catch reported as TUX reassigned as kawakawa and frigate.
- Changes to the data series of tropical tunas in Sri Lanka mostly affect catches of skipjack which have been reallocated to neritic tuna species (Fig. 37).

Fig. 37 (a-b). Sri Lanka: comparison of catch series for Working Party on Tropical Tunas (WPNT) 2012 and 2013.



Indonesia – Artisanal Fisheries

- Indonesia was the third country (in addition to India and Sri Lanka) that was the subject of an independent review by an IOTC consultant in 2012, given the importance of the fishery as the largest tuna and tuna-like coastal country in the Indian Ocean.
- The main aim of the review was to quality assure and re-estimate the catch-by-species and gear breakdown, ensuring greater consistency in the time series and that changes to the fishery (including the introduction of new gears) are reflected more accurately in the revised data series. The revised data series is based on information combined from a number of documents including IOTC, IPTP and DGCF.
- Indonesia's total catch estimates for IOTC species have not been altered, but the composition by species and gears were reassigned based on a variety of documents including IOTC, IPTP and other related publications (Fig. 38).
- The main issues with previous catch series for Indonesia include:

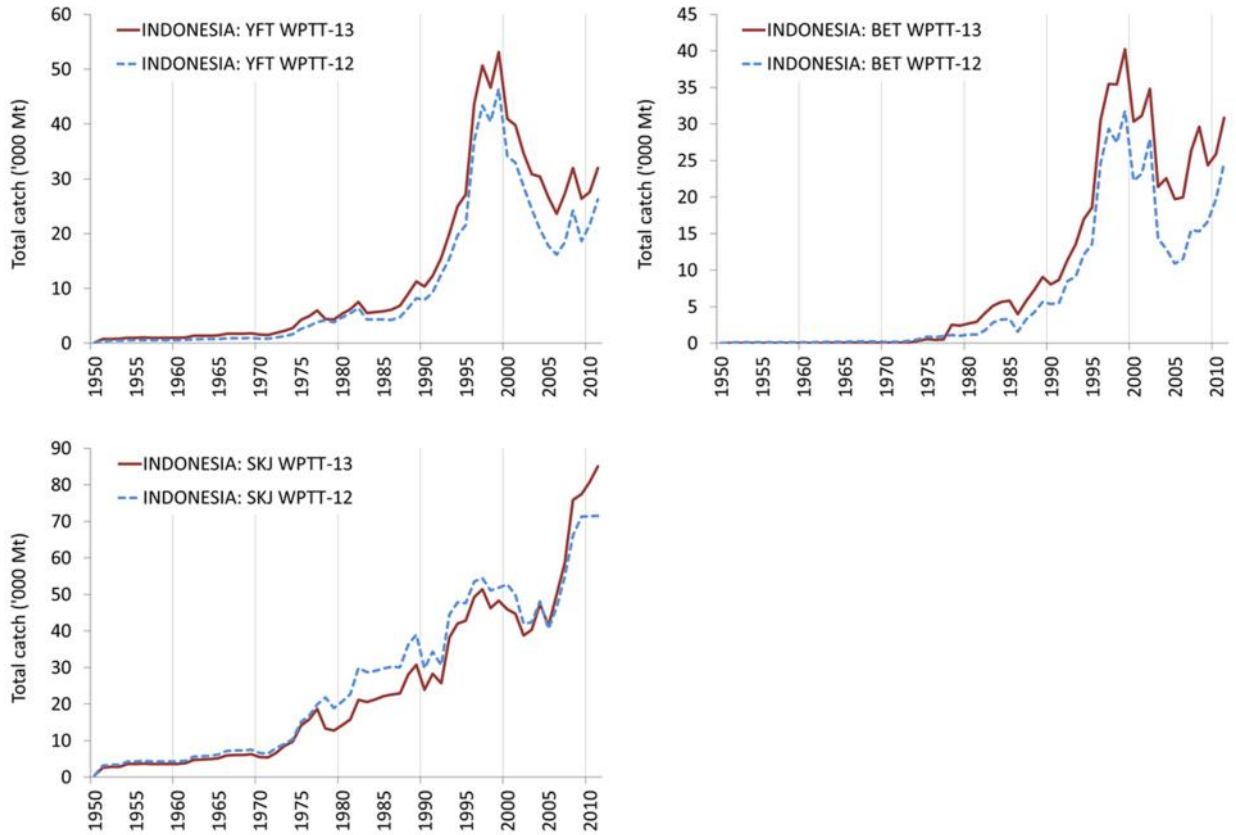
  i.) Lack of historical catch time series: Indonesia only officially began reporting catches by IOTC species and gears in 2004; prior to 2004, data has largely been reported as species aggregates (e.g., *Tongkol*, or TUX).

  ii.) Reliability of data post-2004: Official data from 2005 reports species that appear and disappear apparently at random, while catches fluctuate wildly that suggest issues with the quality of the data reported.

  iii.) Conflicting data from national institutions: More than one institution is responsible for collecting fisheries data in Indonesia (e.g., Directorate General of Capture Fisheries (DGCF), Department of Oceans and Fisheries (DINAS), but poor communications between the institutions compromises the quality of reporting and often leads to conflicting and contradictory data being reported to IOTC.

  iv.) Estimation methodology: In the past, the IOTC Secretariat has used the catches reported since 2005 to break the aggregates for 1950–2004 by gear and species – however fluctuations in the species and gear breakdown reported in recent years undermine IOTC estimates for earlier years.

Fig. 38 (a-c). Indonesia: comparison of catch series for Working Party on Tropical Tunas (WPNT) 2012 and 2013.



Other countries:

EU-France-PS

- Updated catch-and-effort and nominal catch reported to the IOTC Secretariat for the period (1981-2011). No changes to the overall catch, however catches have been were reassigned by species. The revisions mainly affect early-late 1980s and early 2000s.

Comoros

- The historical catch series has been revised by the Data Section of the IOTC Secretariat, following an appraisal of the existing data sources (e.g., IPTP) and the latest results of sampling and vessel census conducted in 2011/12 funded by the OFCF-IOTC project.
- The new catch series substantially revise previous (FAO) estimates of total catches of IOTC species – which assumed an incremental increase in catch levels since the last catch assessment survey in the mid-1990s. Overall catch levels have been revised downwards from 1995 (from around 20,000Mt in recent years to ≈8,000Mt), based on results of the latest catch survey in 2011, as well as reports of a decline in FAD-based fishing and decrease in vessel activity rates (currently estimated at ≈40%) reported by the 2011/12 fishing vessel census.
- The revisions mainly affect estimates of skipjack and yellowfin tuna:
  - between 1950s–1980s catches of skipjack have been reassigned as yellowfin, given handline is the principal gear (targeting skipjack), and prior to motorization of the fleet in the mid-1970s and start of trolling and skipjack targeted fishery;
  - mid-1990s–present: catches of yellowfin have been revised downwards, having been overestimated from a baseline of 1994 Catch Assessment Survey which reported an unusually high catch of yellowfin.

Yemen and Maldives

- Updated catch estimates for Yemen (YFT) and Maldives (SKJ & YFT) have been received by the IOTC Secretariat for 2010 and 2012, and which have revised catch levels upwards by between two to three times compared to the previous catch estimates.

APPENDIX III

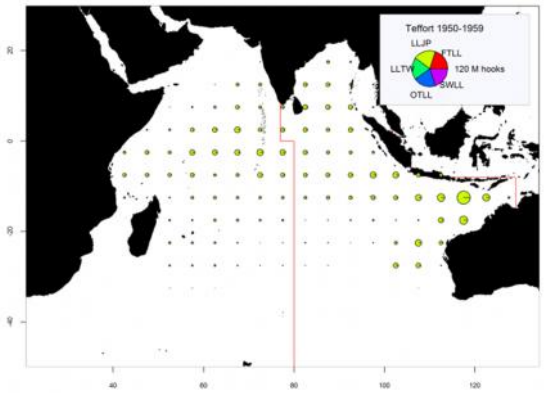
REVIEW OF FISHERIES TRENDS FOR TROPICAL TUNAS

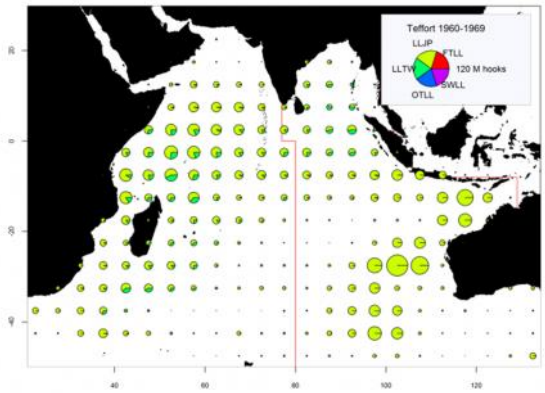
1. EFFORT

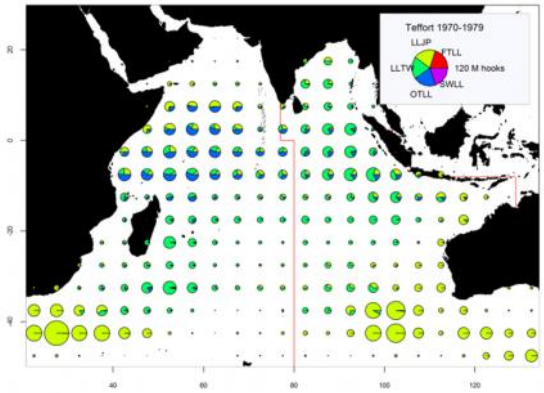
a) Longline

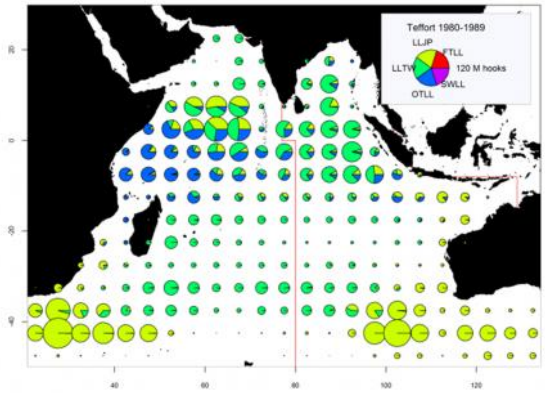
Effort exerted by LONGLINE fleets in the Indian Ocean, in millions (M) of hooks set, by decade (1950-2009) and main fleet:

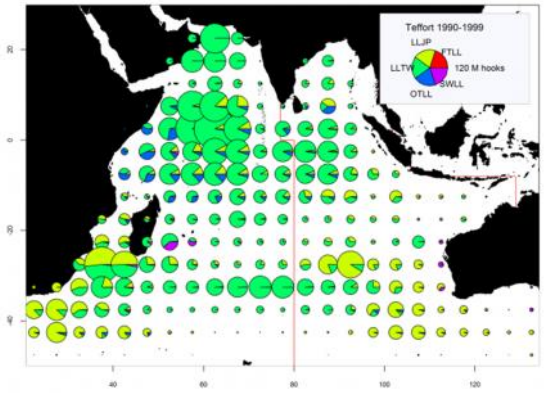
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners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

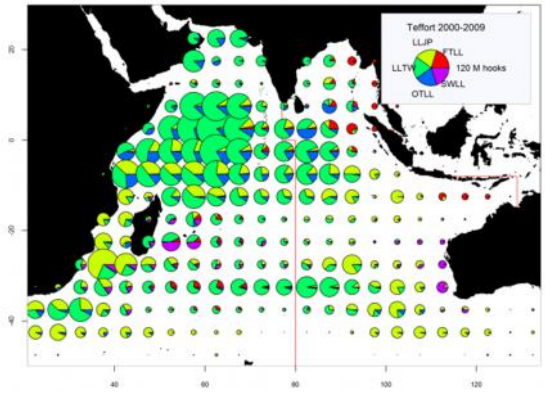












Effort exerted by LONGLINE fleets in the Indian Ocean, in millions (M) of hooks set, for 2003-07 and 2008-12, by year, and main fleet:

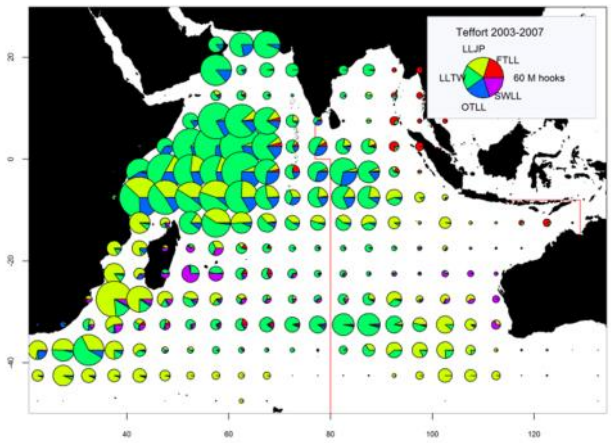
LLJP (light green): deep-freezing longliners from Japan

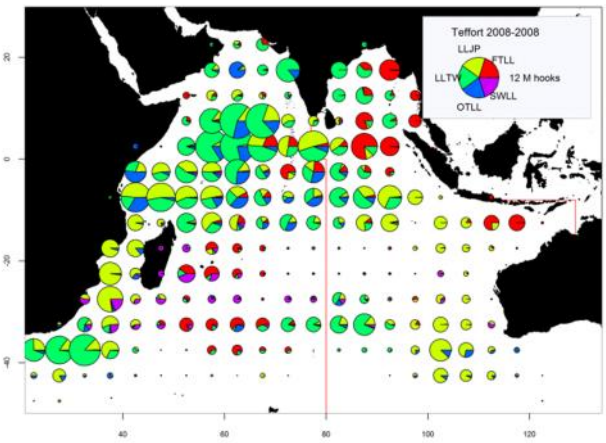
LLTW (dark green): deep-freezing longliners from Taiwan,China

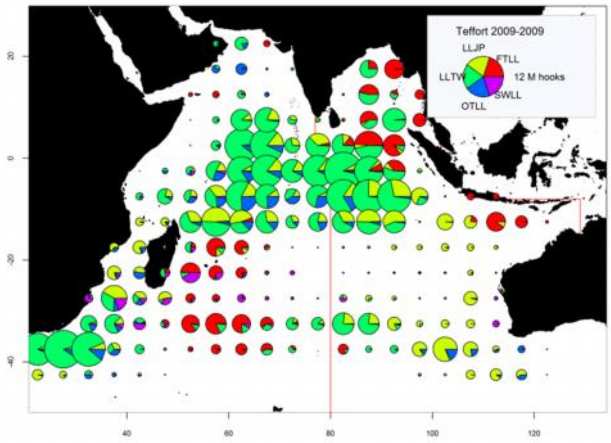
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)

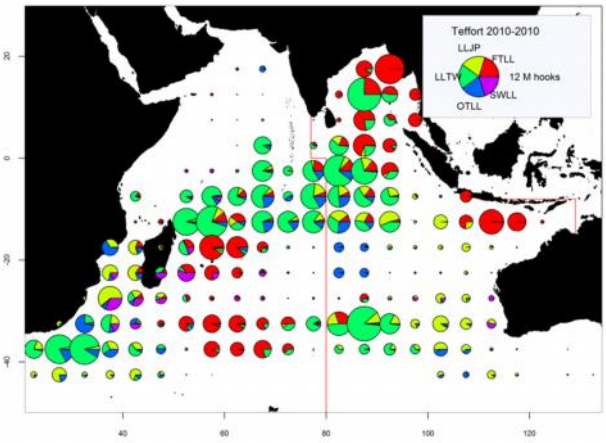
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)

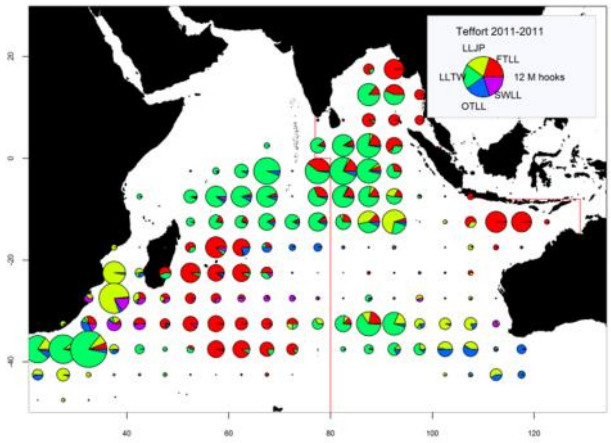
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, South Korea and various other fleets)

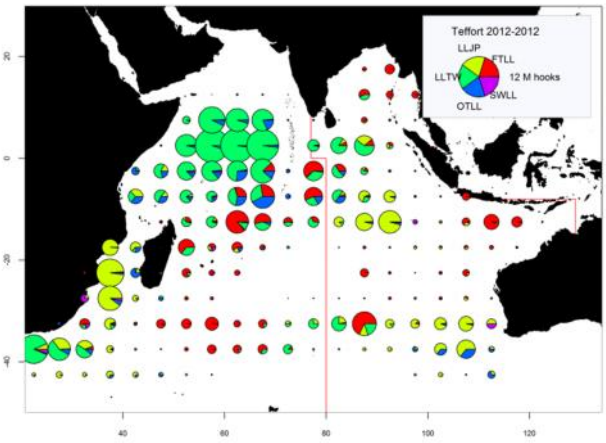












Effort exerted by LONGLINE fleets in the Indian Ocean, in millions (M) of hooks set, for 2003-07 and 2008-12, by year, quarter, and main fleet:

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)

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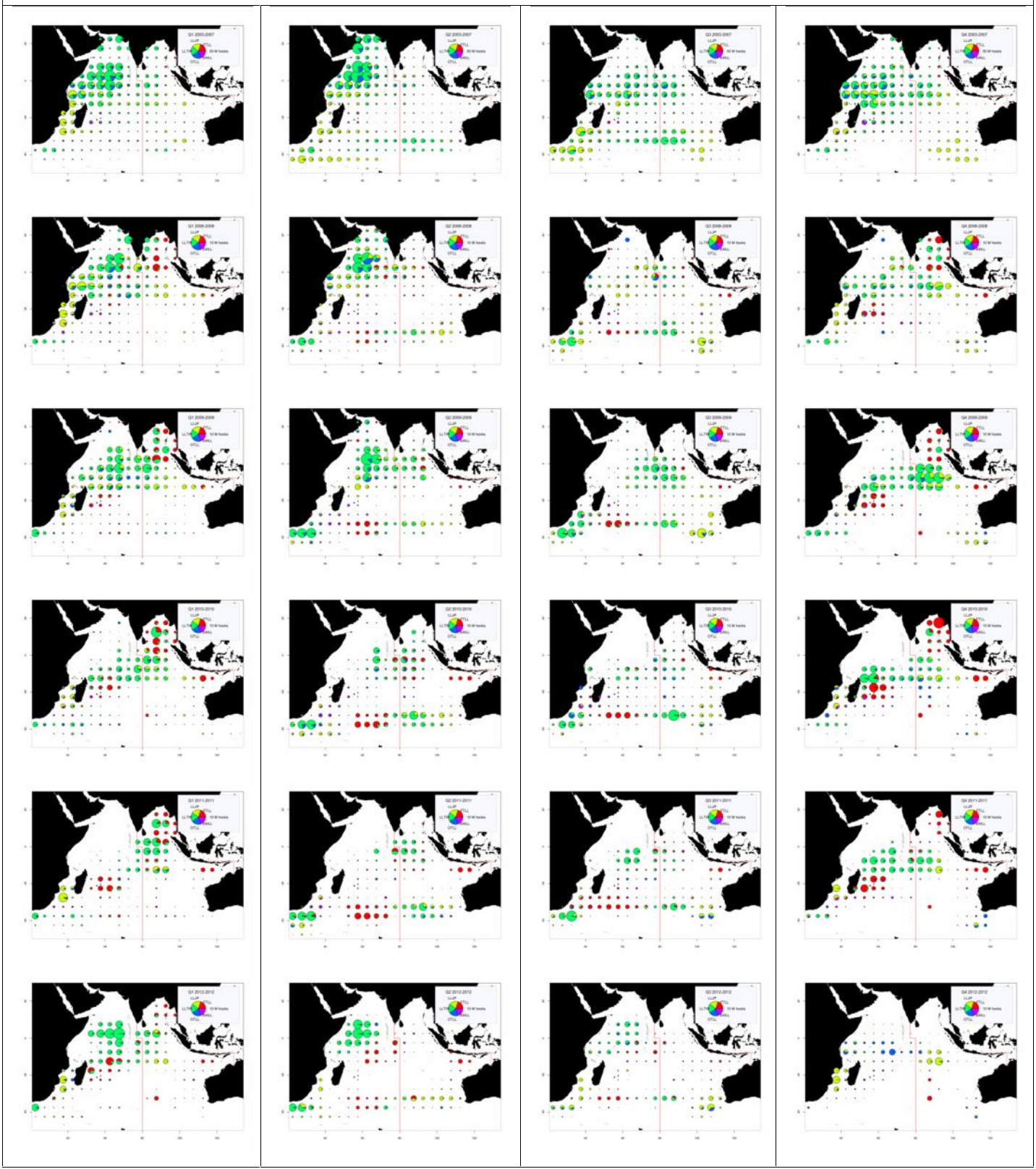


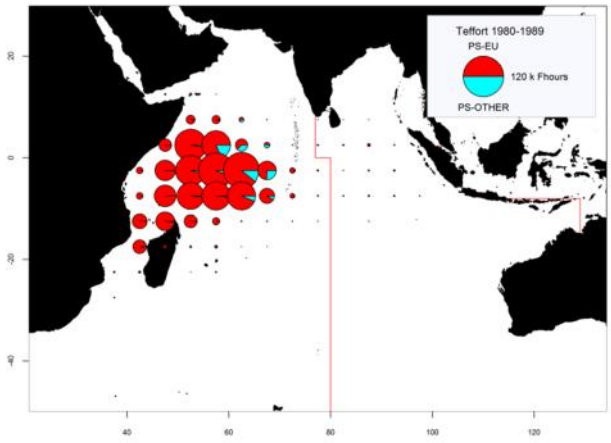
Purse seine

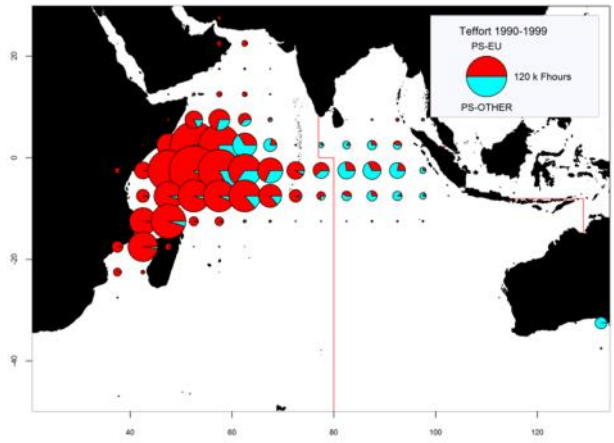
Effort exerted by industrial PURSE SEINE fleets in the Indian Ocean, in thousands (k) of fishing hours (Fhours), by decade (1980-2009) and main fleet:

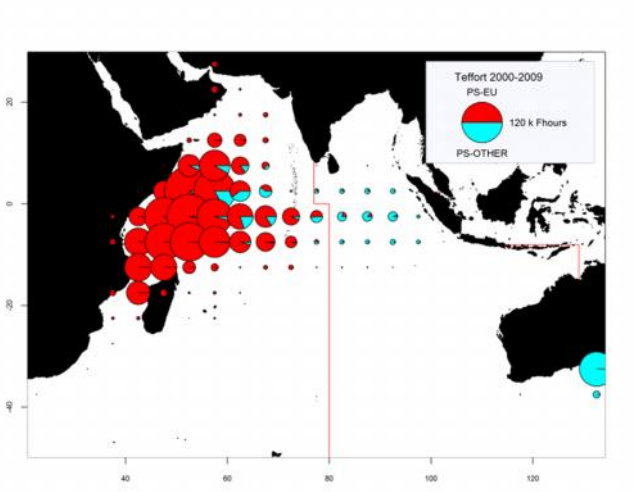
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)

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; data for Australia refers to days-at-sea)







Effort exerted by industrial PURSE SEINE fleets in the Indian Ocean, in thousands (k) of fishing hours (Fhours), for 2003-07 and 2008-12, by year, and main fleet:

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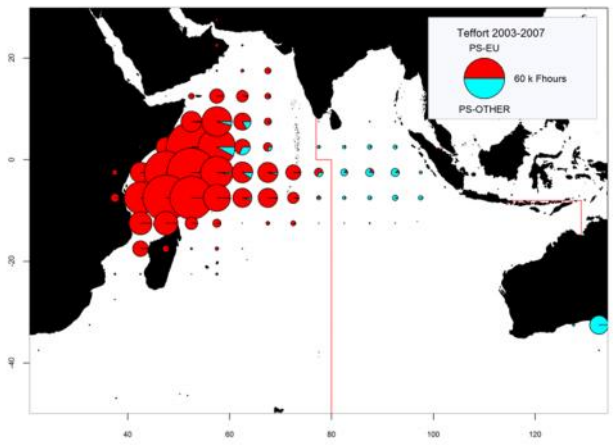
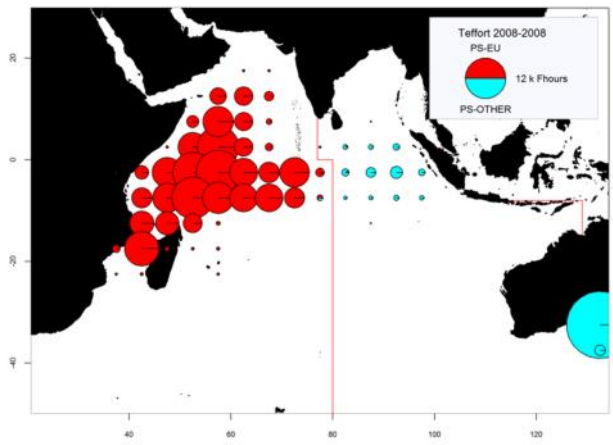
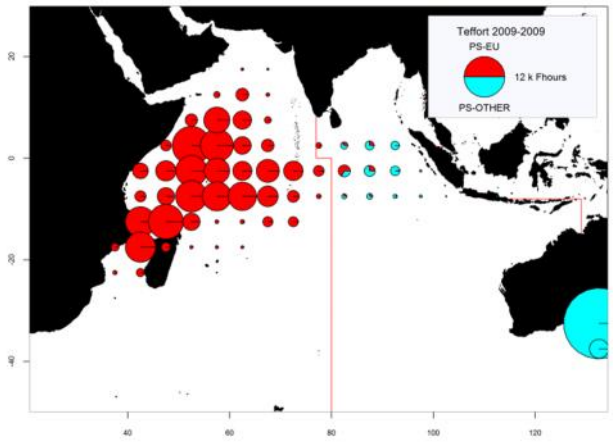
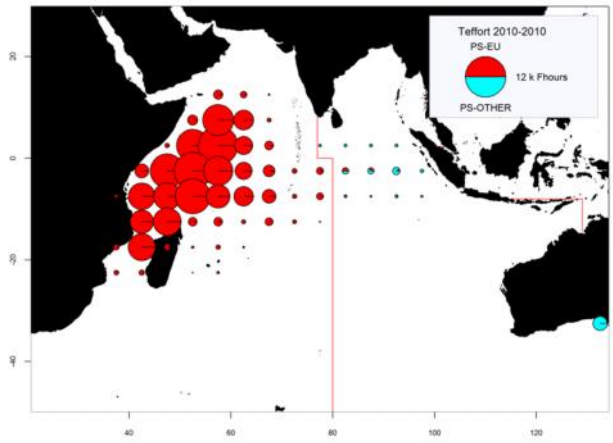
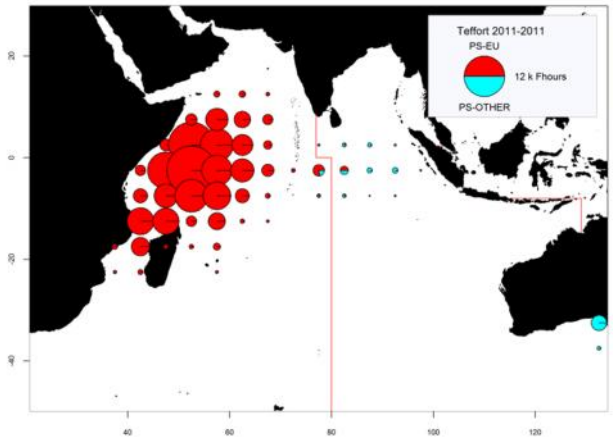
(excludes effort data for purse seiners of Iran and Thailand; data for Australia refers to days-at-sea)

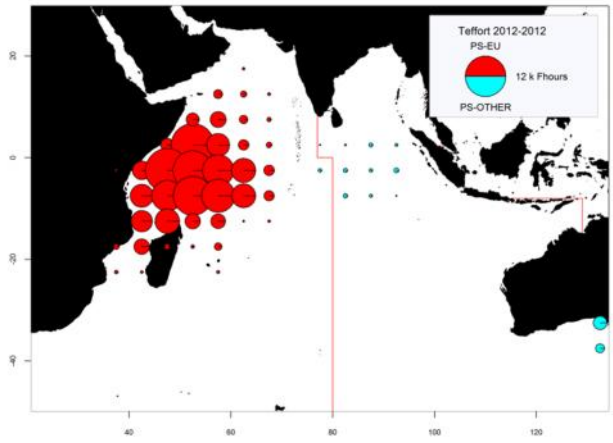












Effort exerted by industrial PURSE SEINE fleets in the Indian Ocean, in thousands (k) of fishing hours (Fhours), for 2003-07 and 2008-12 by year, quarter, and main fleet:

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; data for Australia refers to days-at-sea)

b) *Pole-and-line*

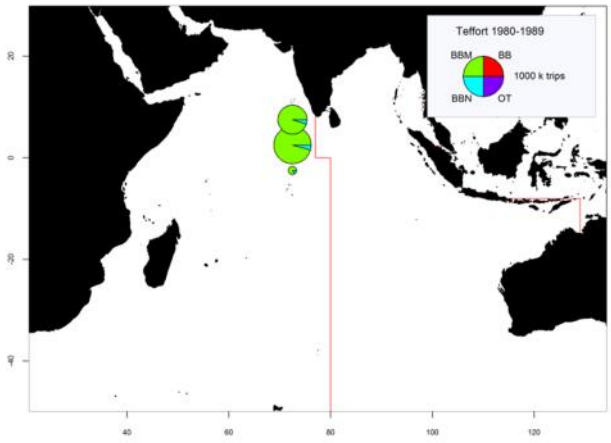
Effort exerted by POLE-AND-LINE fleets in the Indian Ocean, in thousands (k) of trips (equivalent to fishing days), by decade (1980-2009) and type of boat:

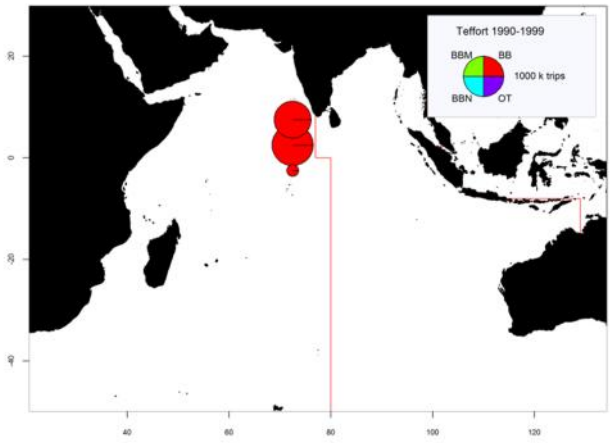
BBM (green): Pole-and-line (mechanized baitboats)

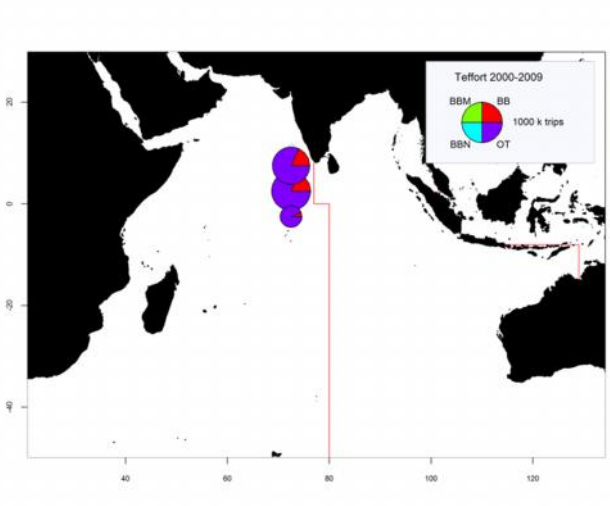
BBN (blue): Pole-and-line (non-mechanized baitboats)

BB (red): Pole-and-line (all types of baitboat, especially mechanized)

OT (purple): Pole-and-line and other gears unidentified (effort not available by gear)







Effort exerted by POLE-AND-LINE fleets in the Indian Ocean, in thousands (k) of trips (equivalent to fishing days), for 2003-07 and 2008-12, by year, and type of boat:

BBM (green): Pole-and-line (mechanized baitboats)

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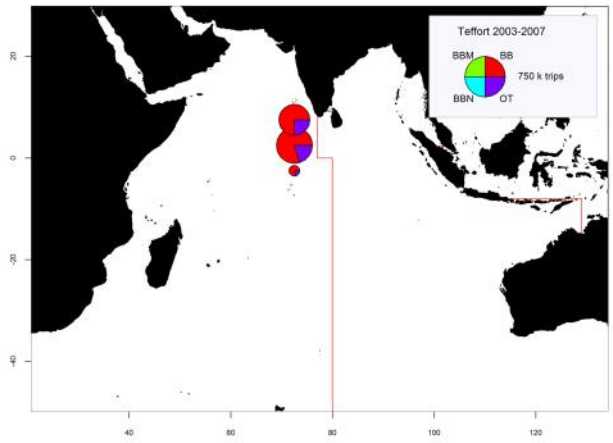
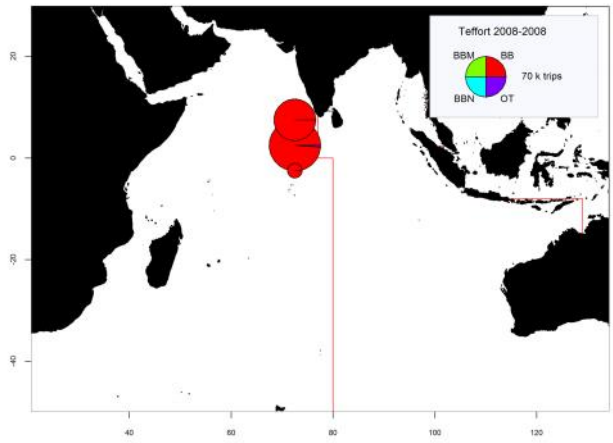
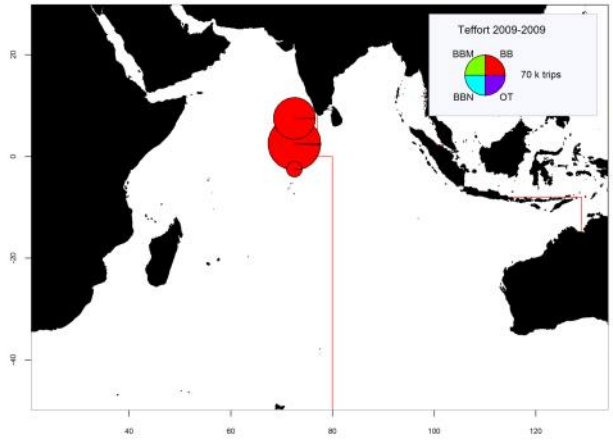
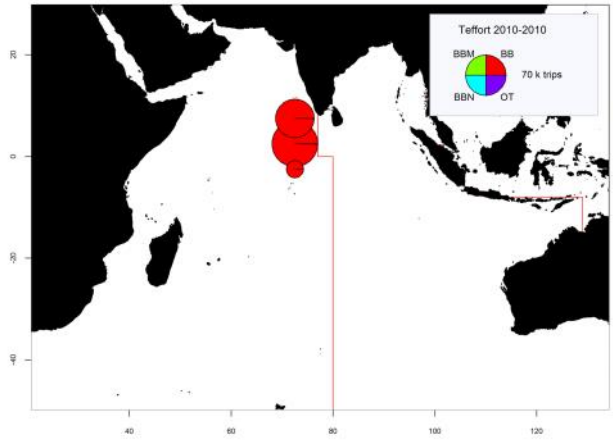
BB (red): Pole-and-line (all types of baitboat, especially mechanized)

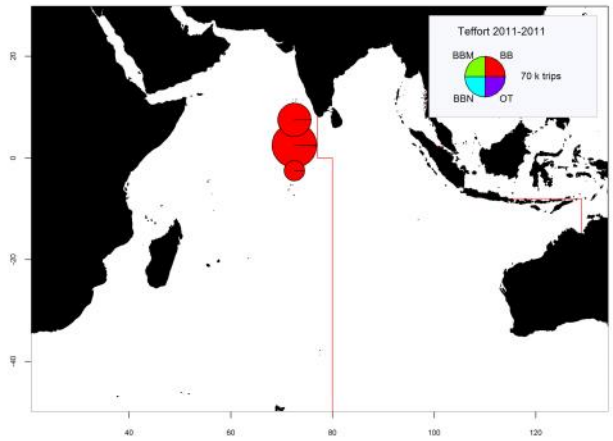
OT (purple): Pole-and-line and other gears unidentified (effort not available by gear)

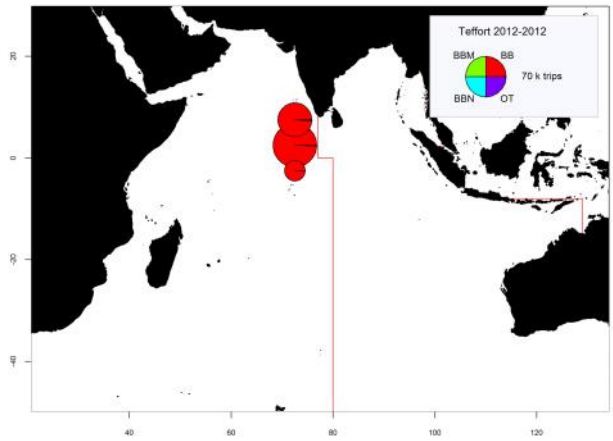












2. TIME-AREA CATCHES

a. Major species: By gear

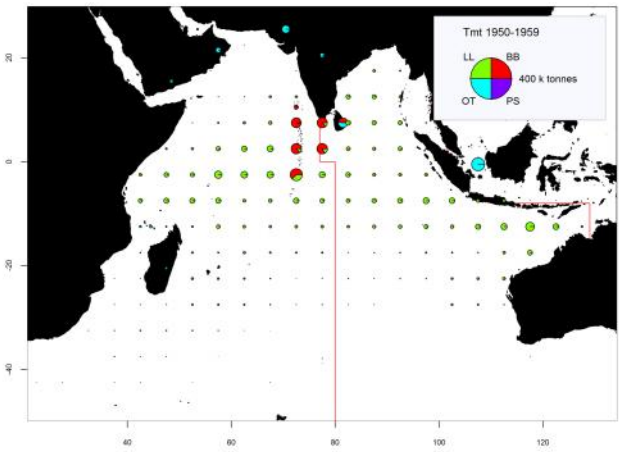
Time-area catches (total combined in tonnes) of major IOTC species (tropical tunas, albacore and swordfish) estimated by gear and decade (1950-2009):

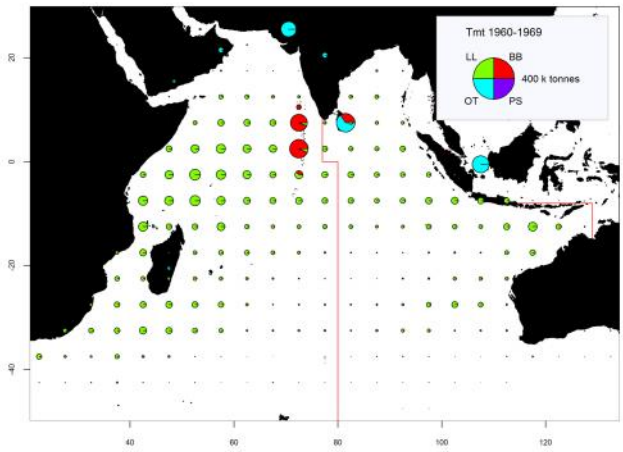
Longline (LL, bright green): freezing longliners from Japan, Taiwan,China, EU, Seychelles, South Korea, and other fleets.

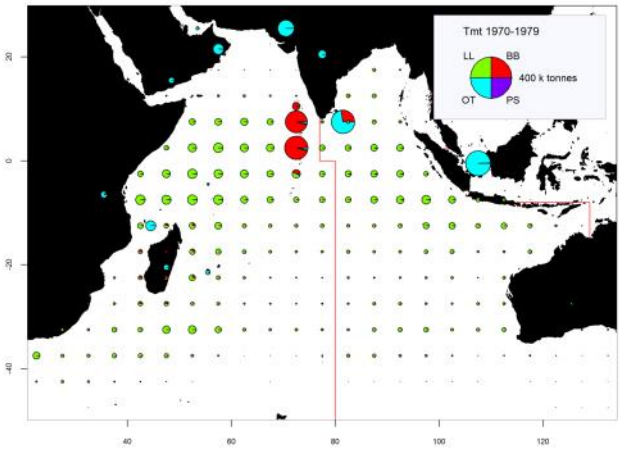
Purse seine (PS, purple) from EU, Iran, I.R., Japan, Seychelles, Thailand and other fleets.

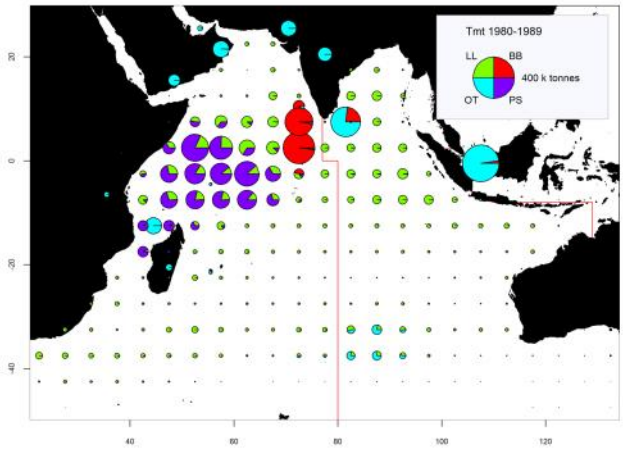
Pole-and-line (BB, red): baitboat fisheries from Maldives, India, and other countries.

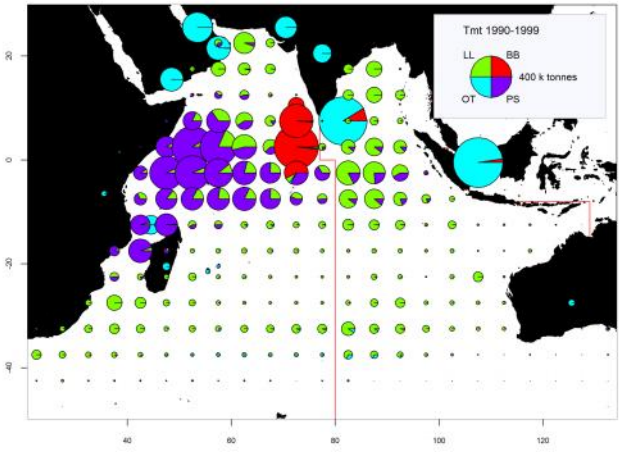
Other fleets (OTHR, blue): other fleets, especially small-scale fisheries operating in coastal waters.

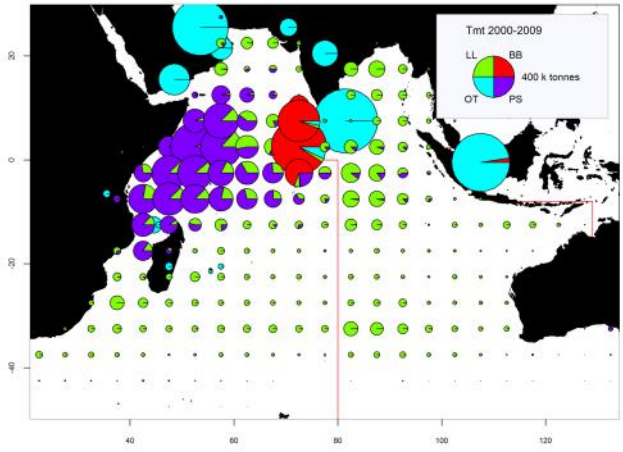












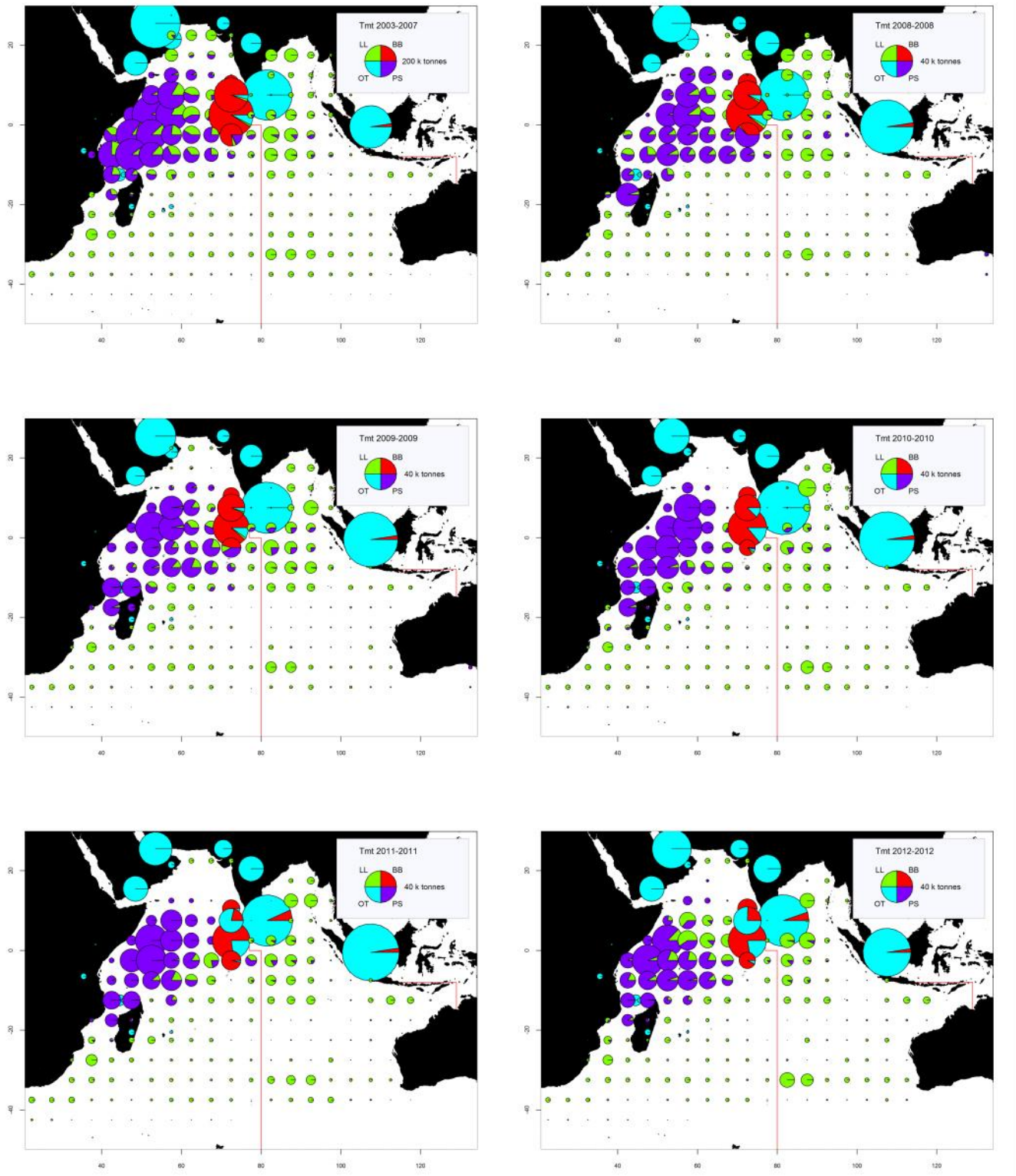
Time-area catches (total combined in tonnes) of major IOTC species (tropical tunas, albacore and swordfish) estimated for 2003-07 and 2008-12, by year and gear:

Longline (LL, bright green): freezing longliners from Japan, Taiwan,China, EU, Seychelles, South Korea, and other fleets.

Purse seine (PS, purple) from EU, Iran, I.R., Japan, Seychelles, Thailand and other fleets.

Pole-and-line (BB, red): baitboat fisheries from Maldives, India, and other countries.

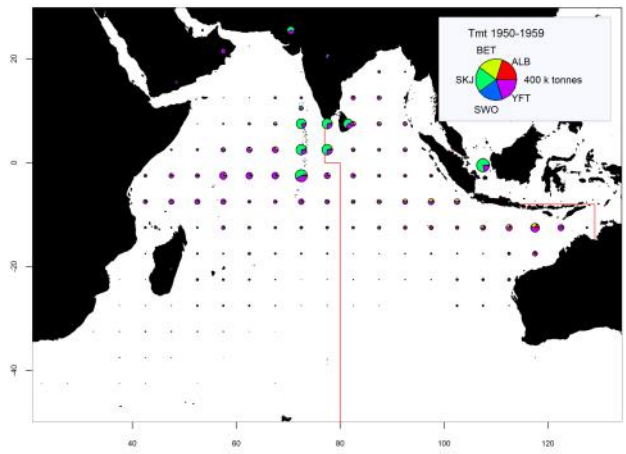
Other fleets (OTHR, blue): other fleets, especially small-scale fisheries operating in coastal waters.

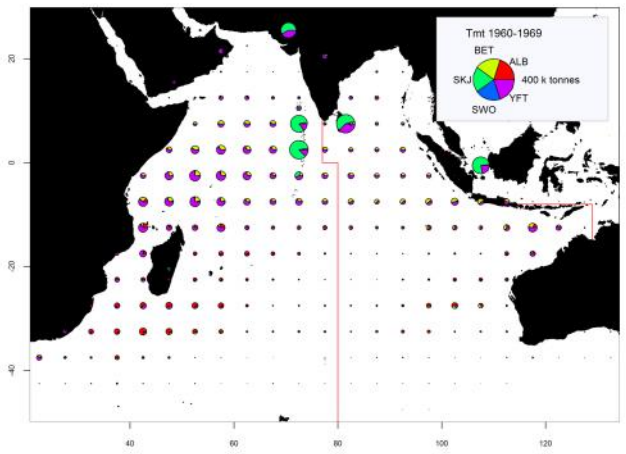


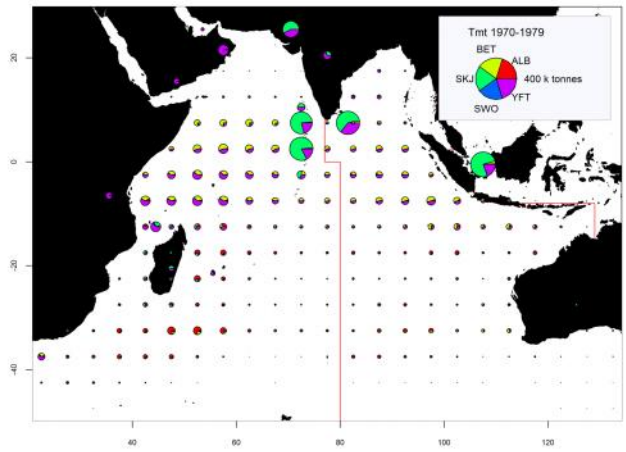
b. Major species: By species

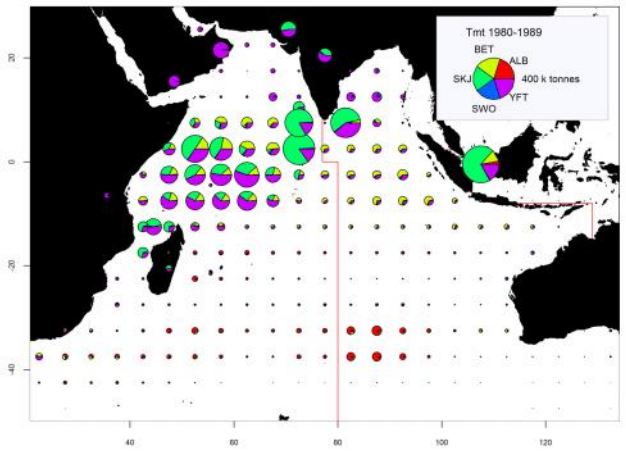
Time-area catches (total combined in tonnes) of major IOTC species (tropical tunas, albacore and swordfish) estimated by species and decade (1950-2009):

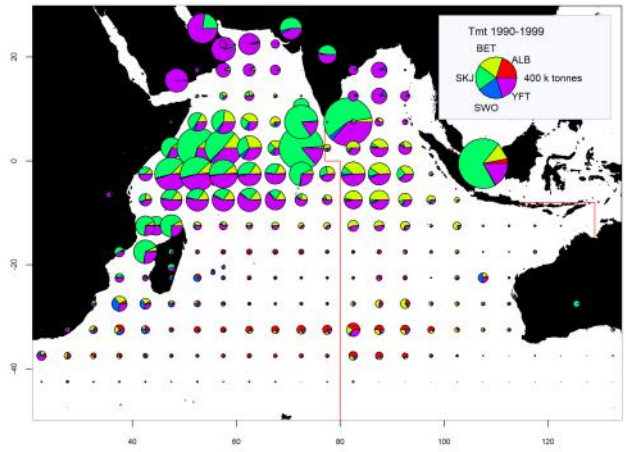
Albacore (ALB, red); **yellowfin tuna** (YFT, purple); **swordfish** (SWO, dark blue); **skipjack tuna** (SKJ, bright green); **bigeye tuna** (BET, light yellow)

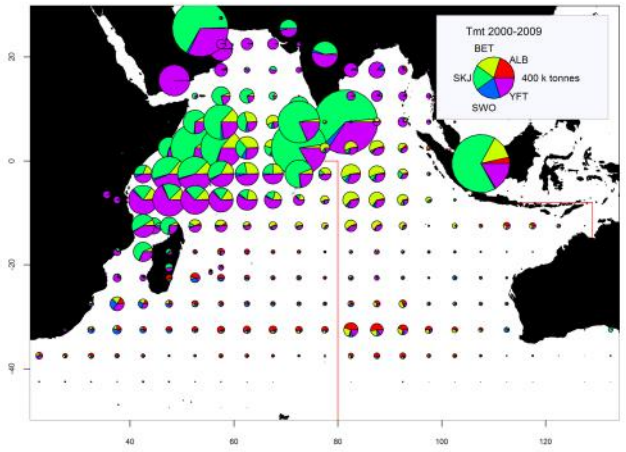






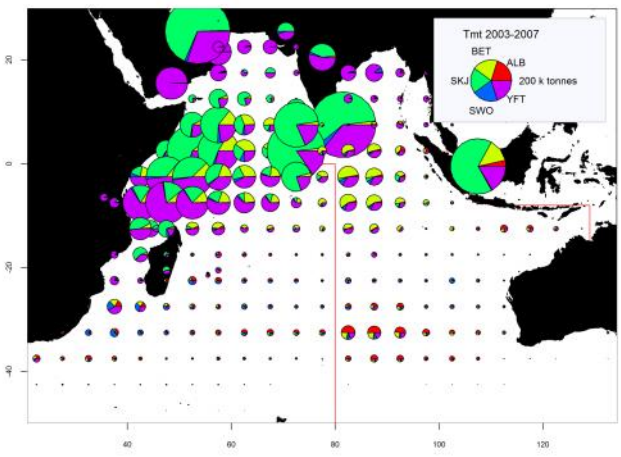


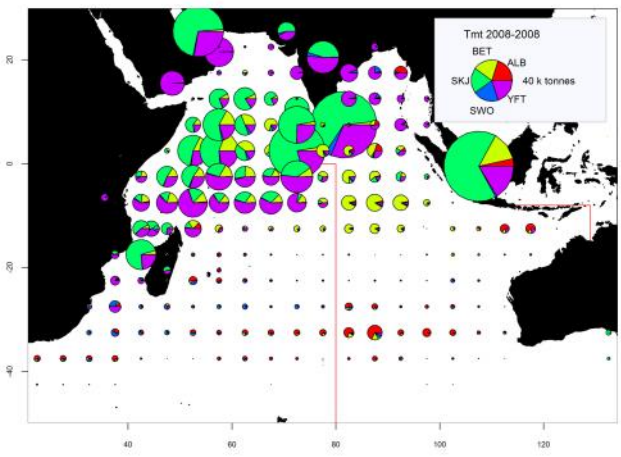


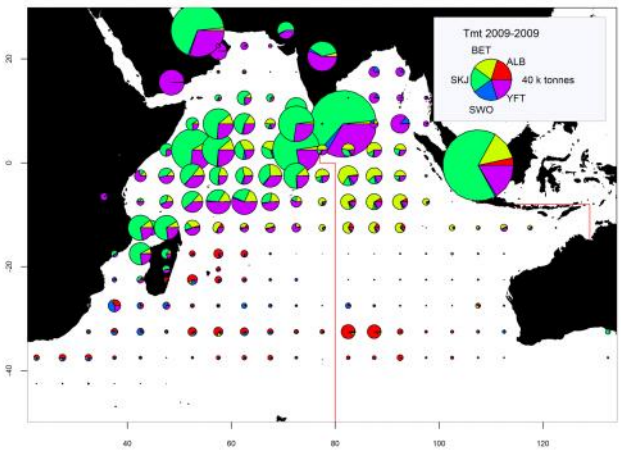


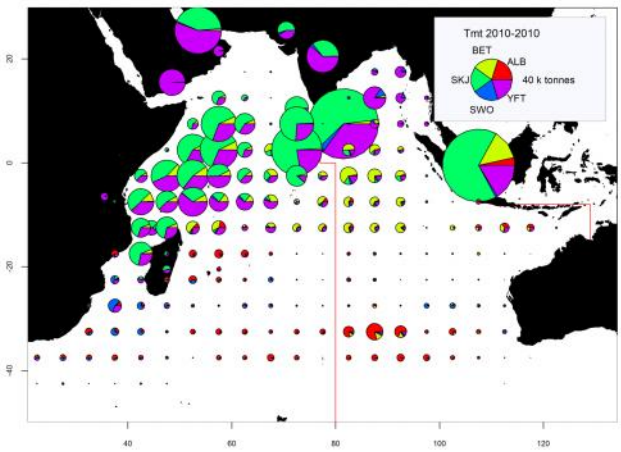
Time-area catches (total combined in tonnes) of major IOTC species (tropical tunas, albacore and swordfish) estimated for 2003-07 and 2008-12, by year and species:

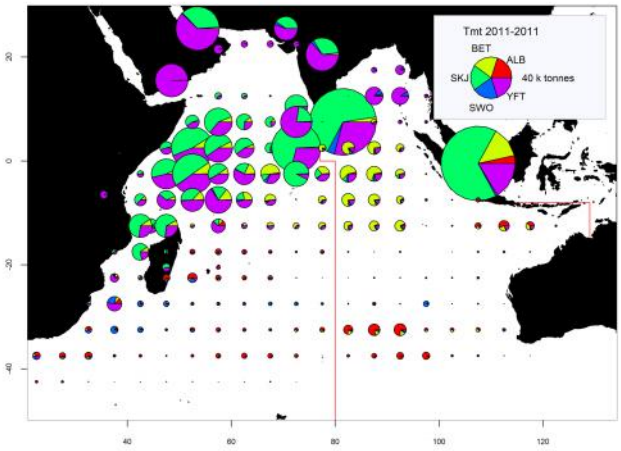
Albacore (ALB, red); **yellowfin tuna** (YFT, purple); **swordfish** (SWO, dark blue); **skipjack tuna** (SKJ, bright green); **bigeye tuna** (BET, light yellow)

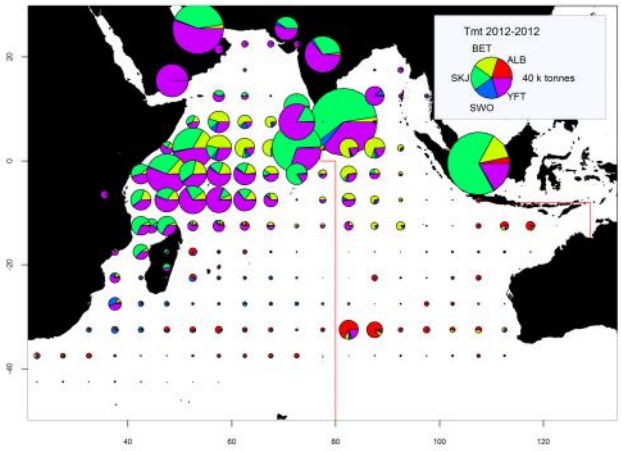












c. Yellowfin tuna (YFT): Recent catches

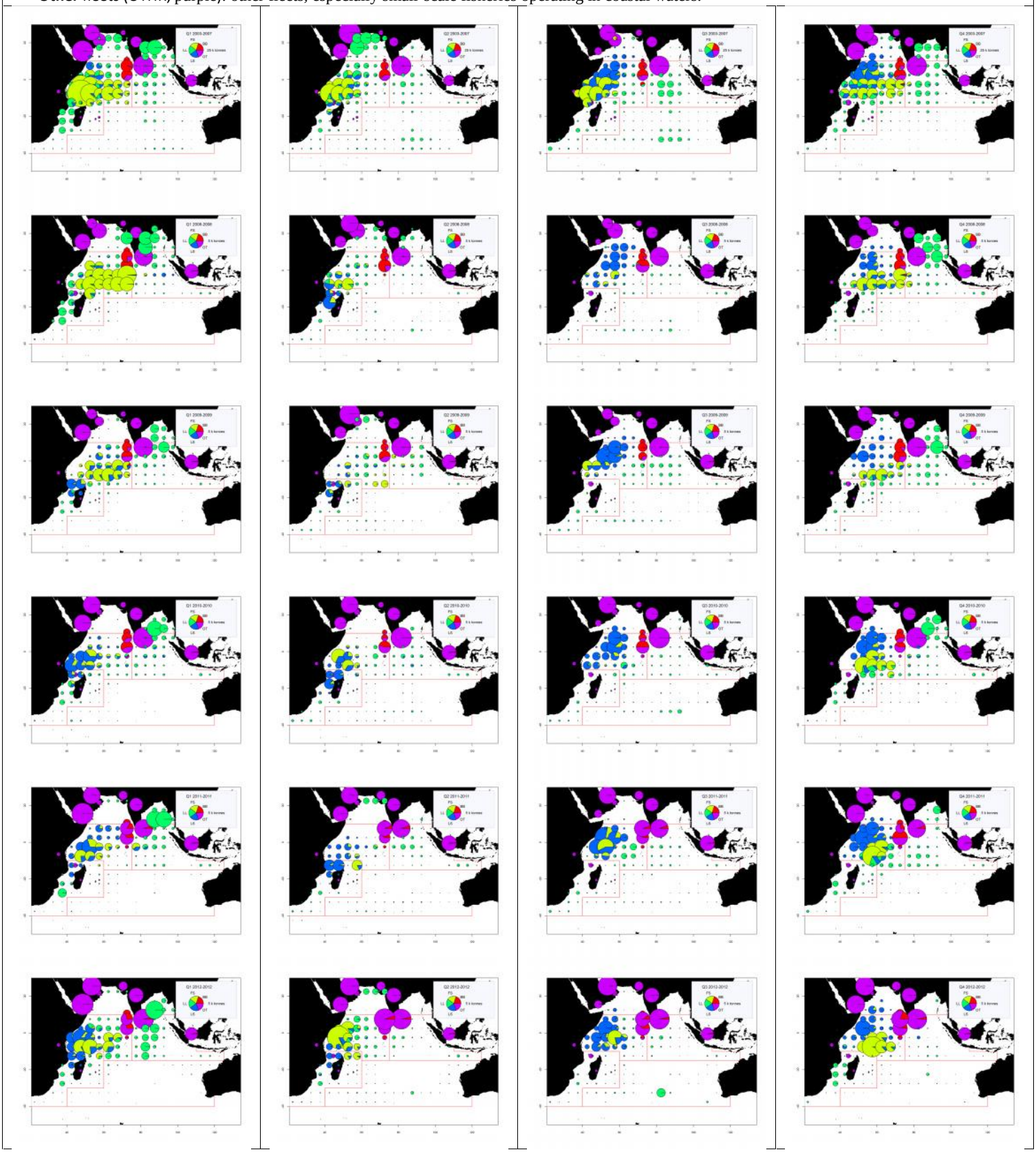
Time-area catches (total combined in tonnes) of YFT estimated for 2003-07 and 2008-12, by year, and quarter:

Longline (LL, bright green): freezing longliners from Japan, Taiwan,China, EU, Seychelles, South Korea, and other fleets.

Purse seiners from EU, Iran, I.R., Japan, Seychelles, Thailand and other fleets, on **free-swimming** (FS, dark yellow) or **associated** (LS, dark blue) schools.

Pole-and-line (BB, red): baitboat fisheries from Maldives, India, and other countries.

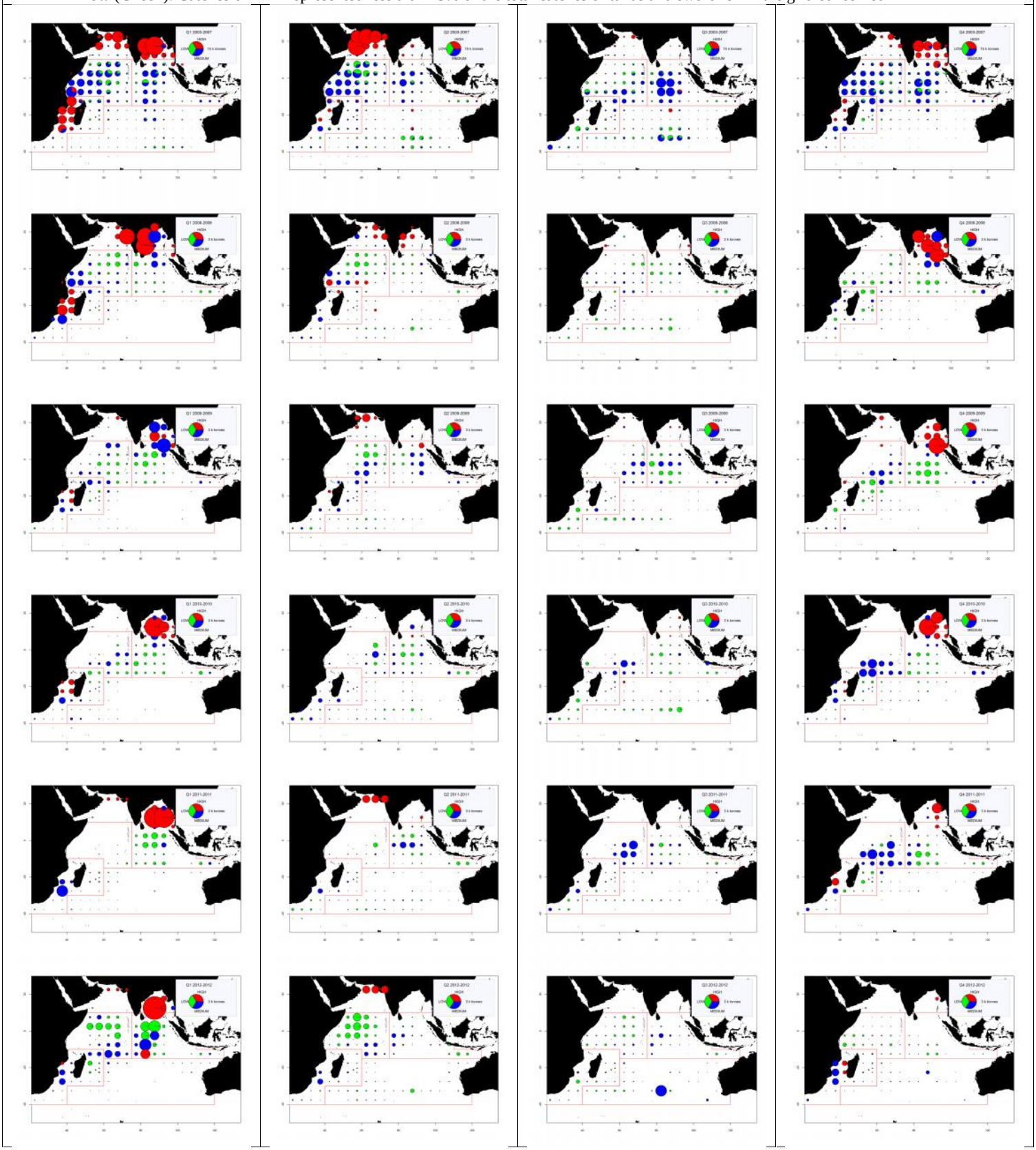
Other fleets (OTHR, purple): other fleets, especially small-scale fisheries operating in coastal waters.



d. Yellowfin tuna (YFT): Main Fishing Areas

Catches of yellowfin tuna (YFT) taken by longline vessels by year, quarter and 5 degree square grid, for the years 2003-12. The different colors show the proportion that the catches of yellowfin tuna on each quarter and 5 degrees square grid made out of the total catches of tropical tunas, albacore and swordfish over the same area and period:

- **High** (**Red**): Catches of YFT represented 75% or more of the total catches of tunas and swordfish in the grid concerned
- **Medium** (**Blue**): Catches of YFT represented 25-75% of the total catches of tunas and swordfish in the grid concerned
- **Low** (**Green**): Catches of YFT represented less than 25% of the total catches of tunas and swordfish in the grid concerned

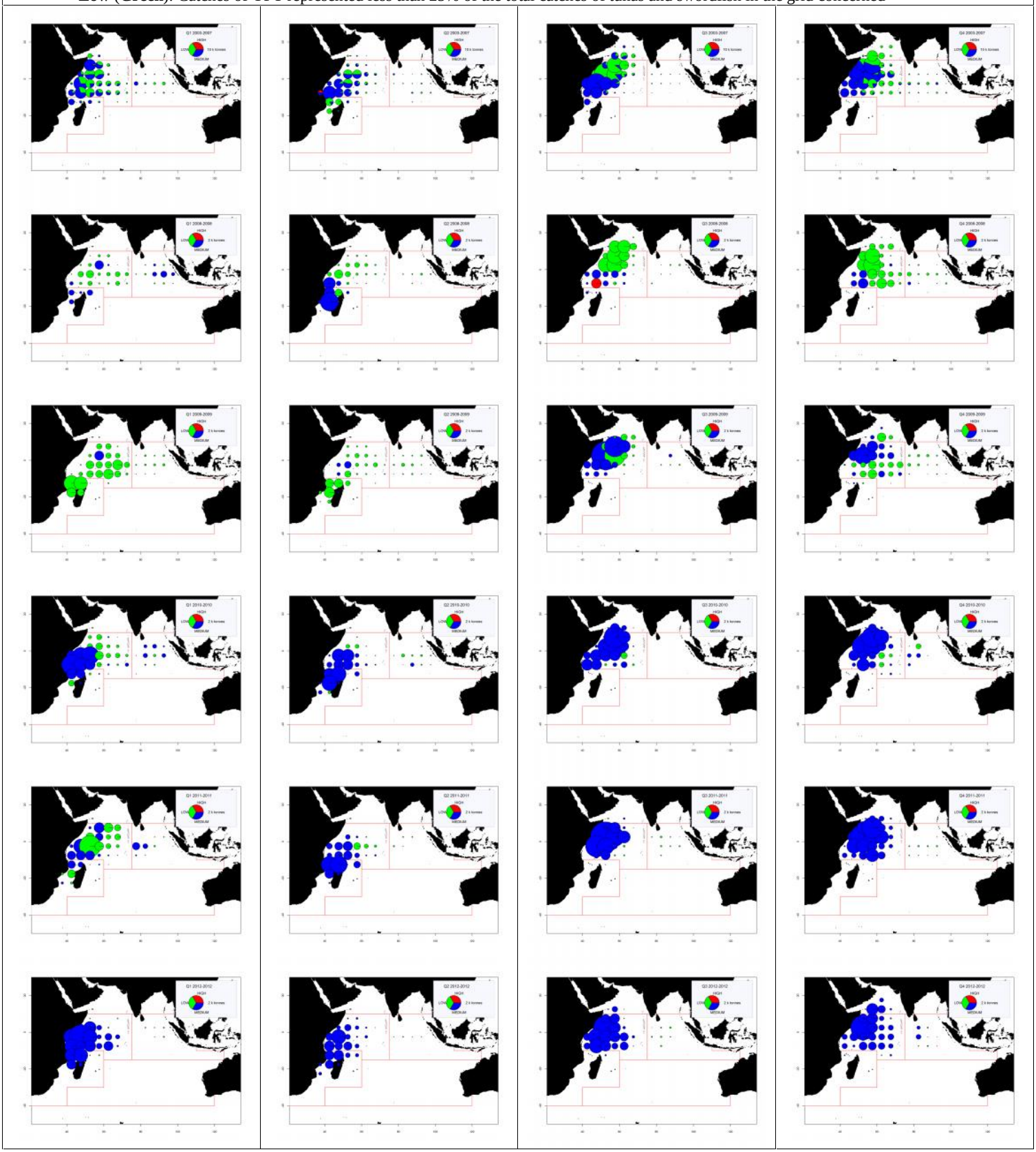


Catches of yellowfin tuna (YFT) taken by purse seine vessels on free swimming schools by year, quarter and 5 degree square grid, for the years 2003-12. The different colors show the proportion that the catches of yellowfin tuna on each quarter and 5 degrees square grid made out of the total catches of tropical tunas, albacore and swordfish over the same area and period:

- **High** (**Red**): Catches of YFT represented 75% or more of the total catches of tunas and swordfish in the grid concerned
- **Medium** (**Blue**): Catches of YFT represented 25-75% of the total catches of tunas and swordfish in the grid concerned
- **Low** (**Green**): Catches of YFT represented less than 25% of the total catches of tunas and swordfish in the grid concerned

Catches of yellowfin tuna (YFT) taken by purse seine vessels on associated schools by year, quarter and 5 degree square grid, for the years 2003-12. The different colors show the proportion that the catches of yellowfin tuna on each quarter and 5 degrees square grid made out of the total catches of tropical tunas, albacore and swordfish over the same area and period:

- **High** (**Red**): Catches of YFT represented 75% or more of the total catches of tunas and swordfish in the grid concerned
- **Medium** (**Blue**): Catches of YFT represented 25-75% of the total catches of tunas and swordfish in the grid concerned
- **Low** (**Green**): Catches of YFT represented less than 25% of the total catches of tunas and swordfish in the grid concerned



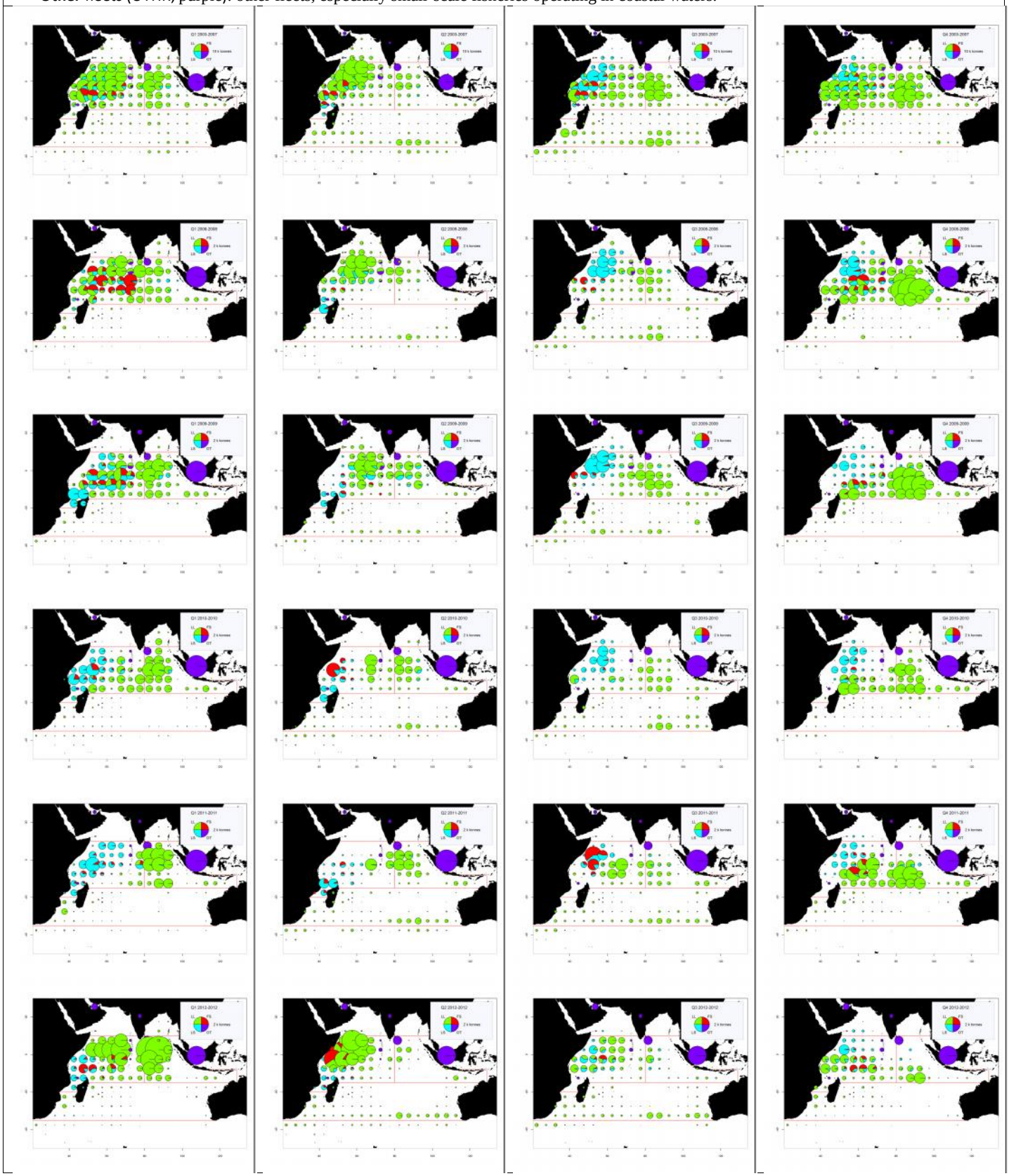
e. Bigeye tuna (BET): Recent catches

Time-area catches (total combined in tonnes) of BET estimated for 2003-07 and 2008-12, by year, and quarter:

Longline (LL, bright green): freezing longliners from Japan, Taiwan,China, EU, Seychelles, South Korea, and other fleets.

Purse seine: industrial tuna purse seiners from EU, Iran, I.R., Japan, Seychelles, Thailand and other fleets, on **free-swimming** (FS, red) or **associated** (LS, light blue) schools.

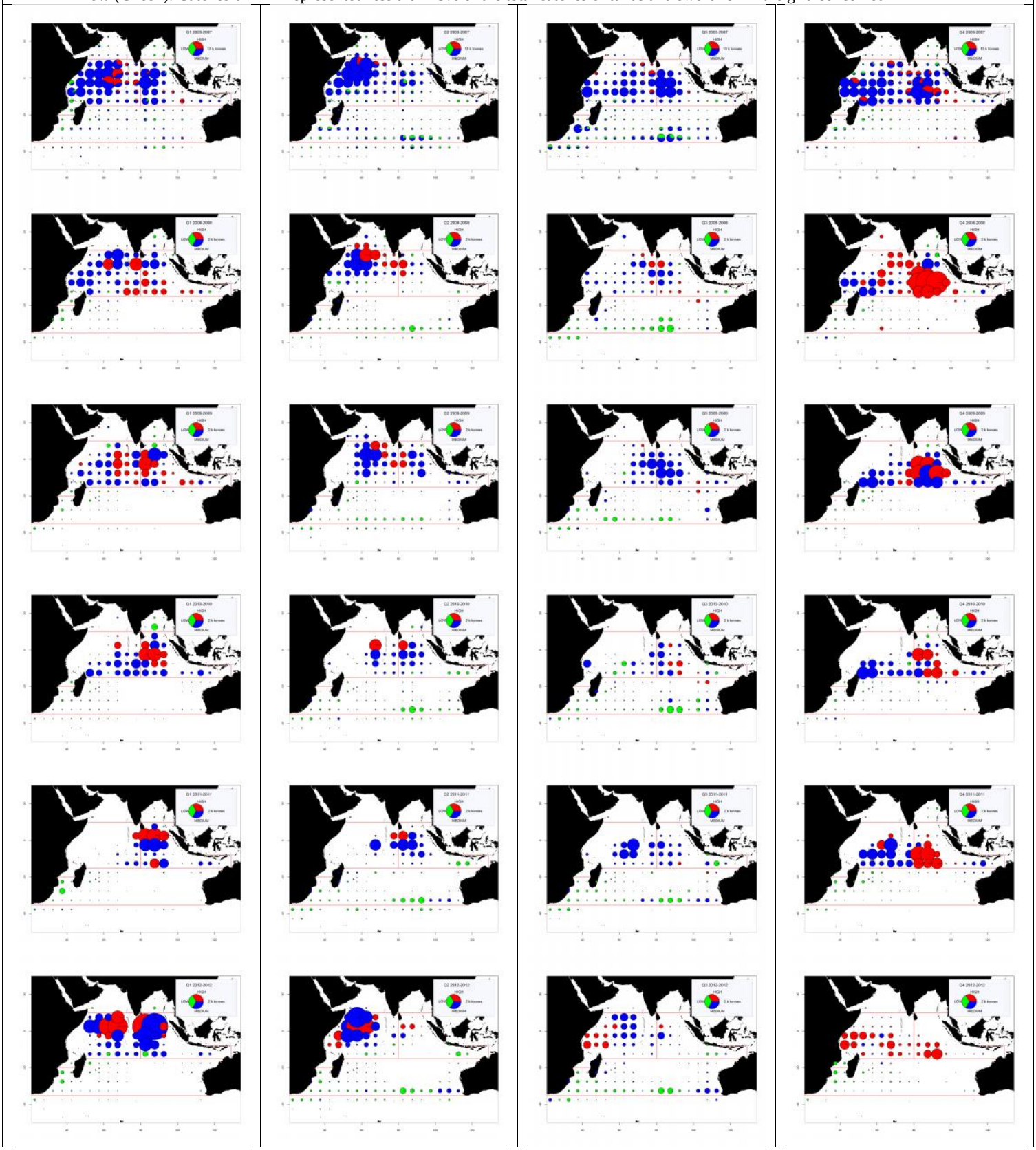
Other fleets (OTHR, purple): other fleets, especially small-scale fisheries operating in coastal waters.



f. Bigeye tuna (BET): Main Fishing Areas

Catches of bigeye tuna (BET) taken by longline vessels by year, quarter and 5 degree square grid, for the years 2003-12. The different colors show the proportion that the catches of yellowfin tuna on each quarter and 5 degrees square grid made out of the total catches of tropical tunas, albacore and swordfish over the same area and period:

- **High** (**Red**): Catches of BET represented 75% or more of the total catches of tunas and swordfish in the grid concerned
- **Medium** (**Blue**): Catches of BET represented 25-75% of the total catches of tunas and swordfish in the grid concerned
- **Low** (**Green**): Catches of BET represented less than 25% of the total catches of tunas and swordfish in the grid concerned



g. Skipjack tuna (SKJ): Recent catches

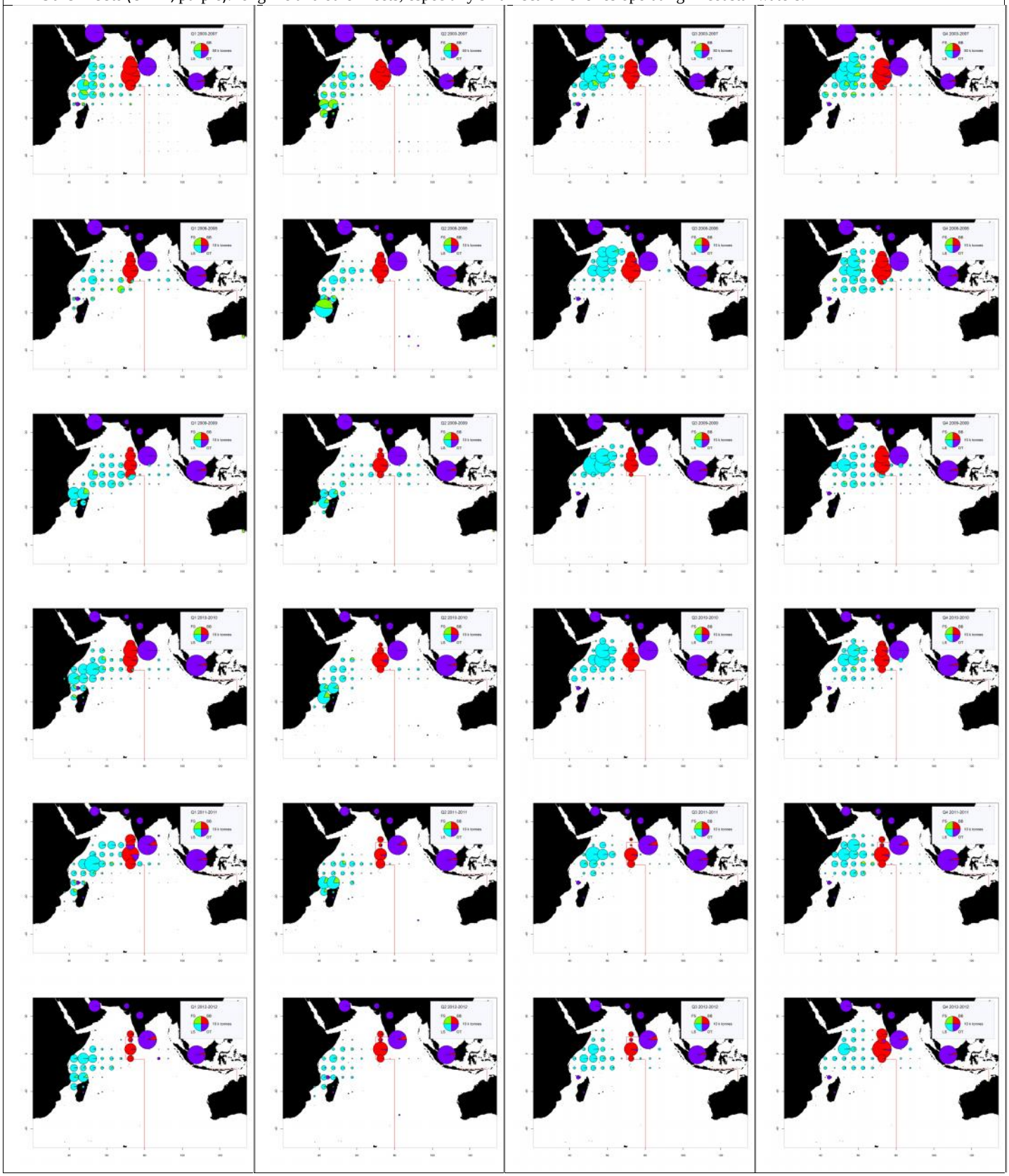
Time-area catches (total combined in tonnes) of SKJ estimated for 2003-07 and 2008-12, by year, and quarter:

Longline (LL, bright green): freezing longliners from Japan, Taiwan,China, EU, Seychelles, South Korea, and other fleets.

Purse seine: industrial tuna purse seiners from EU, Iran, I.R., Japan, Seychelles, Thailand and other fleets, on **free-swimming** (FS, bright green) or **associated** (LS, light blue) schools.

Pole-and-line (BB, red): baitboat fisheries from Maldives, India, and other countries.

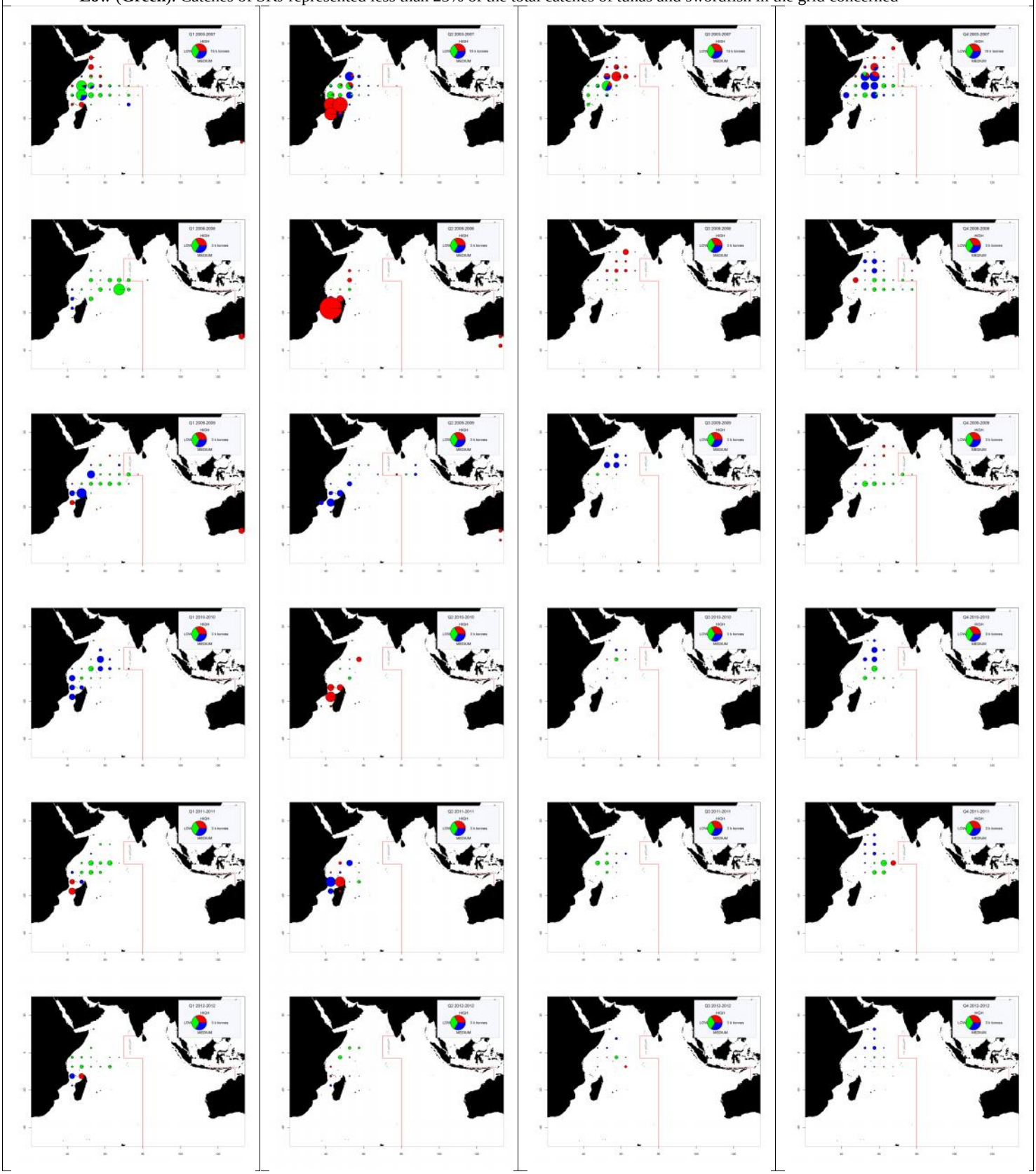
Other fleets (OTHR, purple): longline and other fleets, especially small-scale fisheries operating in coastal waters.



h. Skipjack tuna (SKJ): Main Fishing Areas

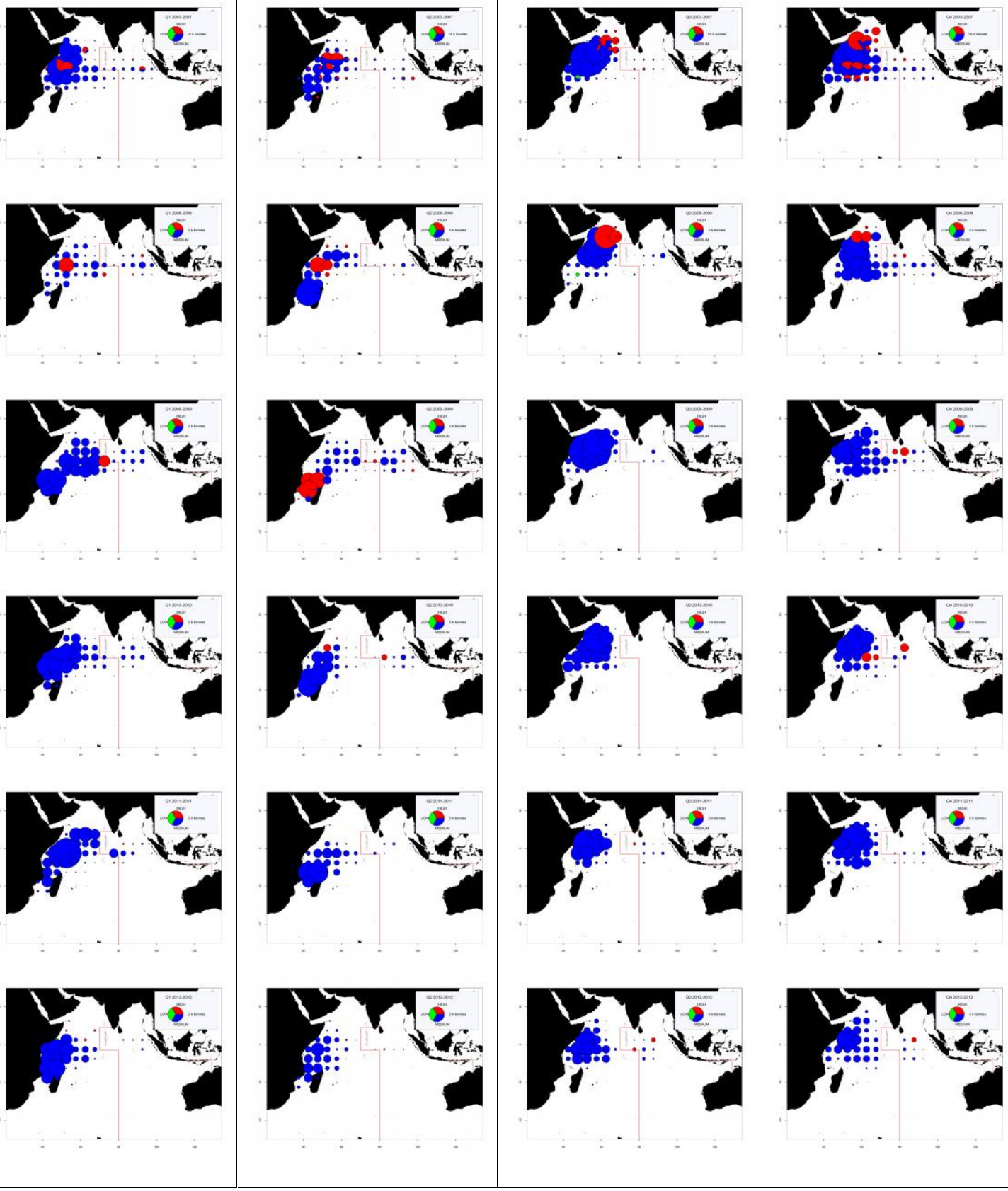
Catches of skipjack tuna (SKJ) taken by purse seine vessels on free swimming schools by year, quarter and 5 degree square grid, for the years 2003-12. The different colors show the proportion that the catches of yellowfin tuna on each quarter and 5 degrees square grid made out of the total catches of tropical tunas, albacore and swordfish over the same area and period:

- **High** (**Red**): Catches of SKJ represented 75% or more of the total catches of tunas and swordfish in the grid concerned
- **Medium** (**Blue**): Catches of SKJ represented 25-75% of the total catches of tunas and swordfish in the grid concerned
- **Low** (**Green**): Catches of SKJ represented less than 25% of the total catches of tunas and swordfish in the grid concerned



Catches of skipjack tuna (SKJ) taken by purse seine vessels on associated schools by year, quarter and 5 degree square grid, for the years 2003-12. The different colors show the proportion that the catches of yellowfin tuna on each quarter and 5 degrees square grid made out of the total catches of tropical tunas, albacore and swordfish over the same area and period:

- **High** (**Red**): Catches of SKJ represented 75% or more of the total catches of tunas and swordfish in the grid concerned
- **Medium** (**Blue**): Catches of SKJ represented 25-75% of the total catches of tunas and swordfish in the grid concerned
- **Low** (**Green**): Catches of SKJ represented less than 25% of the total catches of tunas and swordfish in the grid concerned



3. AVERAGE WEIGHT

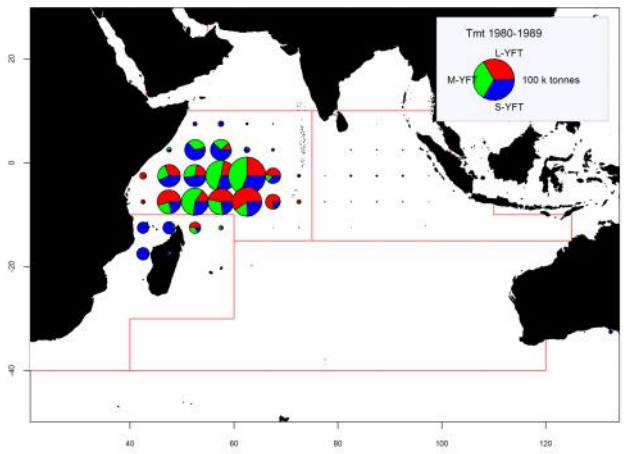
a. Yellowfin tuna (YFT)

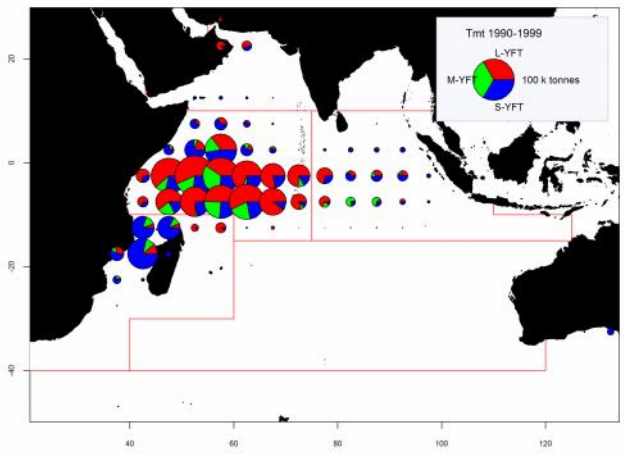
Average weight of yellowfin tuna (YFT) taken by:

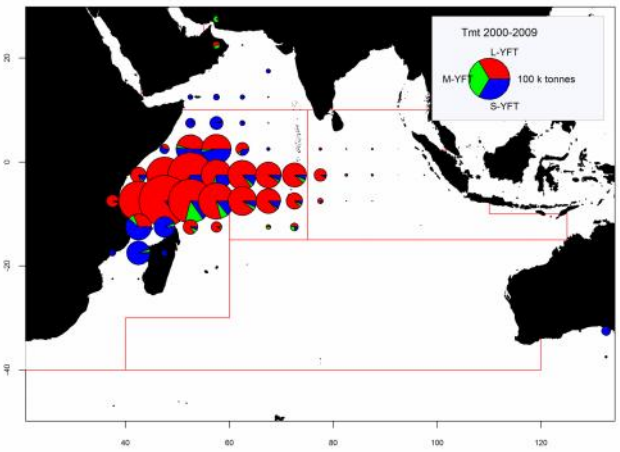
- All fisheries combined (right)
- Purse seine on free (top left) and associated (top right) schools,
- Longlines from Japan (mid left) and Taiwan,China (mid right)
- Pole-and-line from Maldives and India (bottom left)
- Gillnets from Sri Lanka, Iran, and other countries (bottom right)

Catches (in metric tons) of yellowfin tuna (YFT) for the purse seine fishery on free-swimming schools for three different periods and types of weight:

- **S-YFT** (blue): Catches from strata in which the average weight estimated from the CAS is lower than 10kg
- **M-YFT** (green): Catches from strata in which the average weight estimated from the CAS is between 10kg and 30kg
- **L-YFT** (red): Catches from strata in which the average weight estimated from the CAS is 30kg or greater



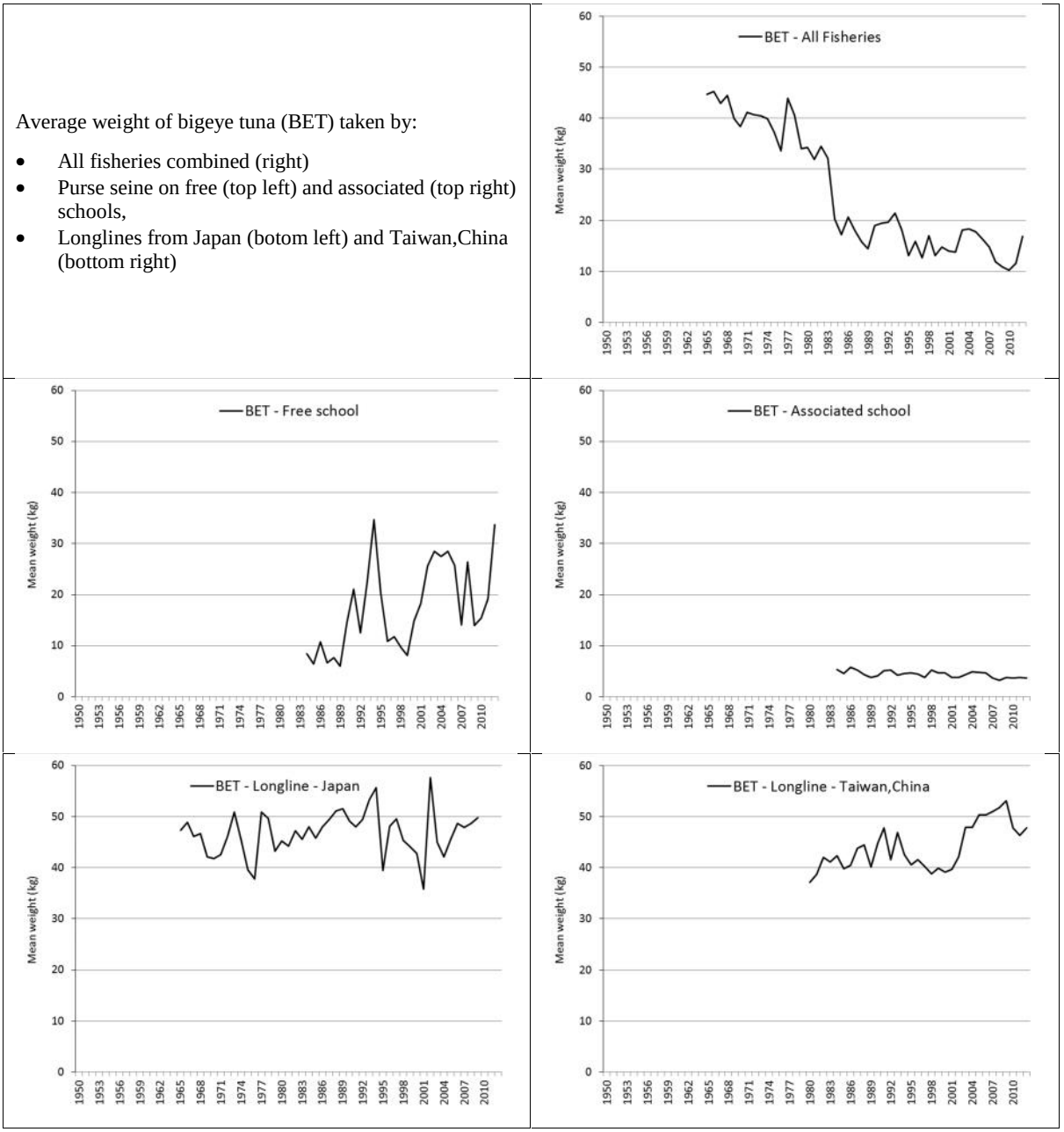




b. Bigeye tuna (BET)

Average weight of bigeye tuna (BET) taken by:

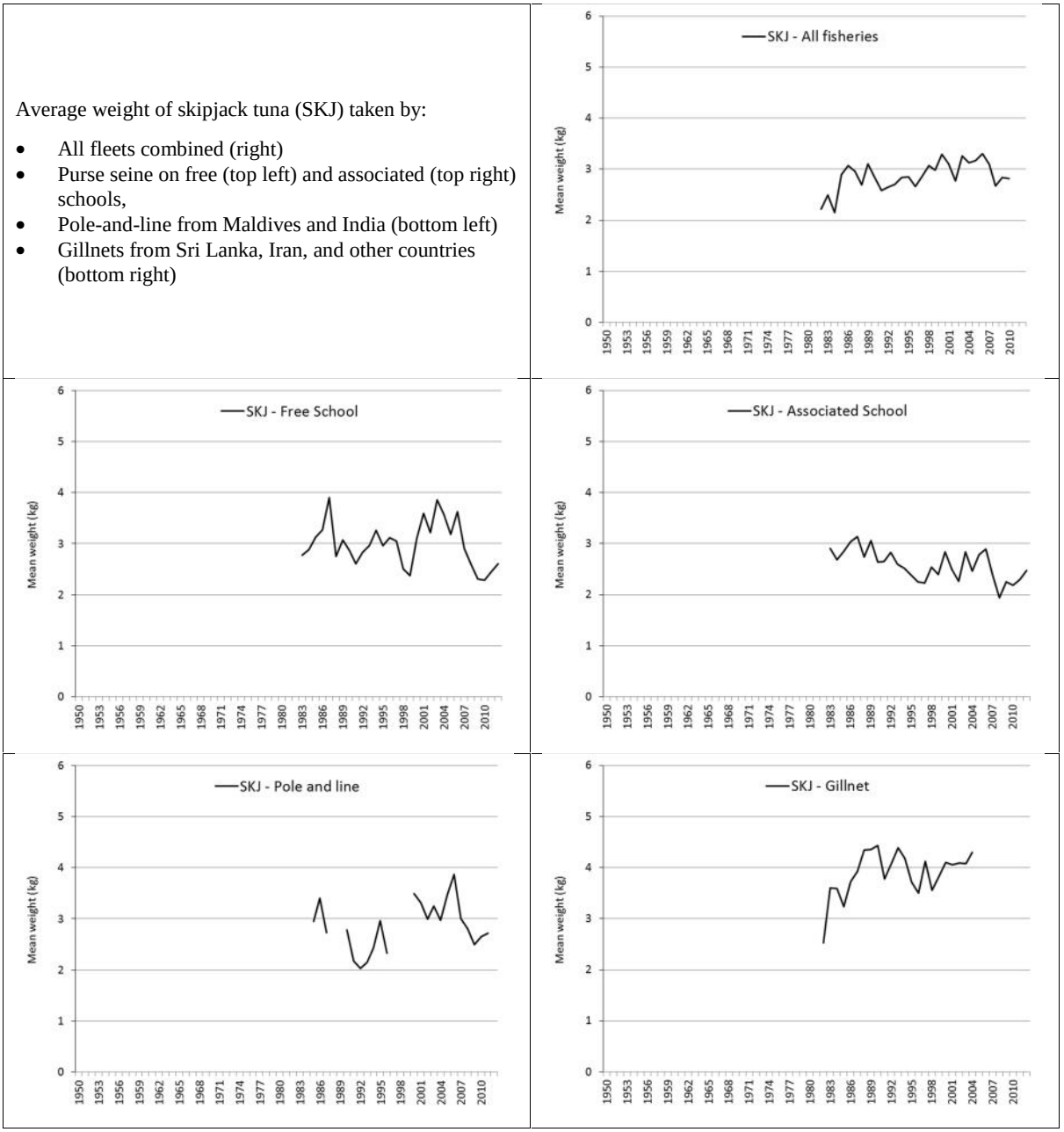
- All fisheries combined (right)
- Purse seine on free (top left) and associated (top right) schools,
- Longlines from Japan (botom left) and Taiwan,China (bottom right)



c. Skipjack tuna (SKJ)

Average weight of skipjack tuna (SKJ) taken by:

- All fleets combined (right)
- Purse seine on free (top left) and associated (top right) schools,
- Pole-and-line from Maldives and India (bottom left)
- Gillnets from Sri Lanka, Iran, and other countries (bottom right)

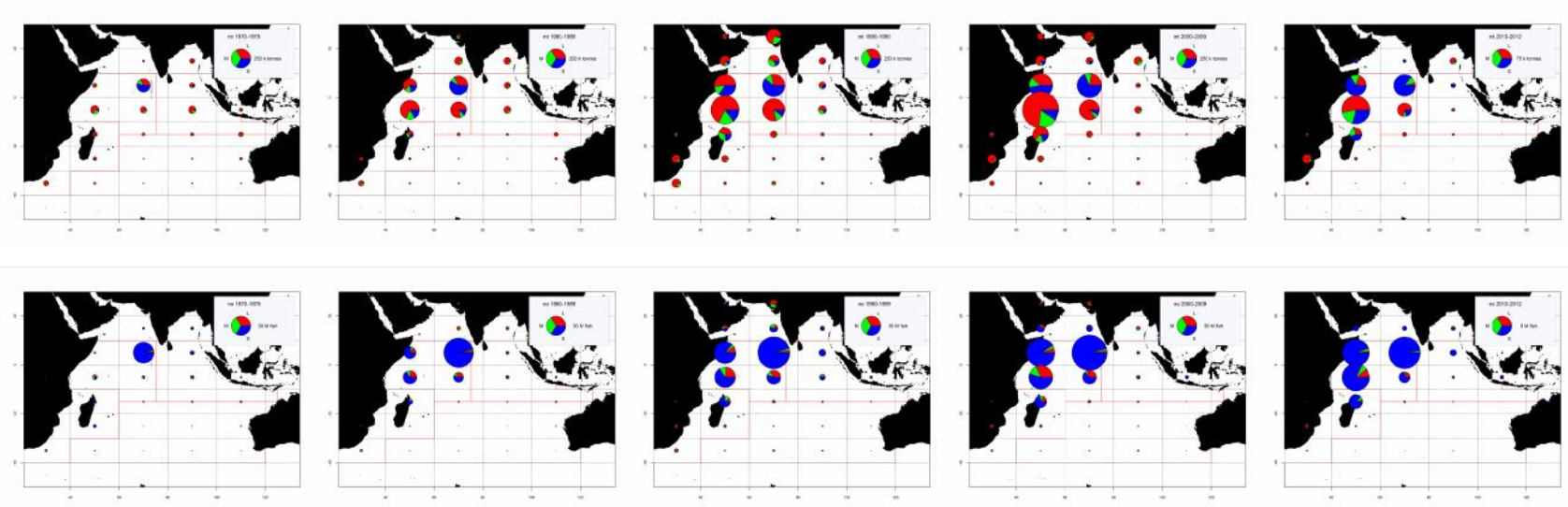


4. CATCH PER SIZE CLASS

a. Yellowfin tuna (YFT)

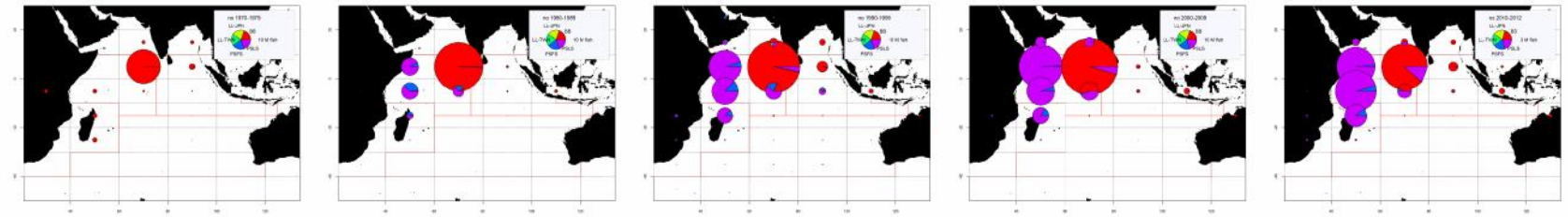
Total catches of YELLOWFIN TUNA (YFT) in weight (top) and number (bottom) derived from the catch-at-size of surface (purse seine and pole-and-line) and longline fisheries for 1970-2009, by decade, and 2010-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

- **Large size** (**Red**): Catches of YFT for which the weight estimated is 30kg or greater
- **Medium size** (**Green**): Catches of YFT for which the weight estimated is between 15kg and 30kg
- **Small size** (**Blue**): Catches of YFT for which the weight estimated is under 15kg



Total catches of yellowfin tuna (YFT) of very small size (under 5kg), in number, derived from the catch-at-size of surface (purse seine and pole-and-line) and longline fisheries for 1970-2009, by decade, and 2010-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

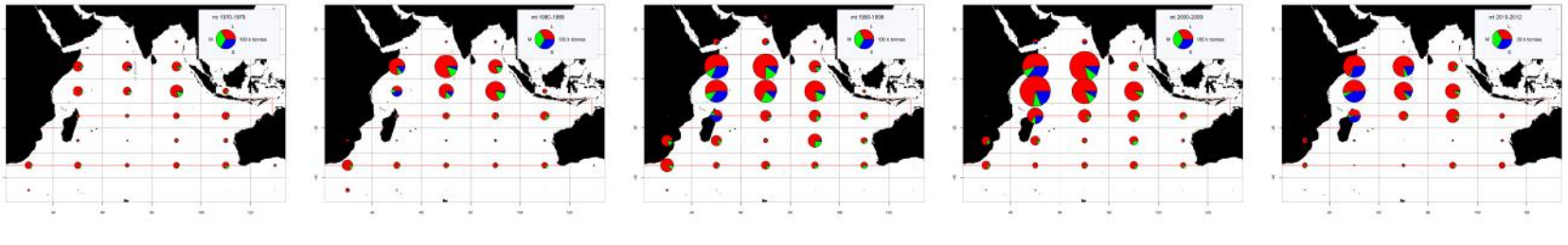
- **BB** (**Red**): Pole-and-line fisheries (Maldives and India)
- **PSLS** (**Purple**): Industrial purse seiners on associated schools (e.g. FAD)
- **PSFS** (**Light blue**): Industrial purse seiners on free-swimming schools
- **LL** (**Green**): Industrial longline fisheries

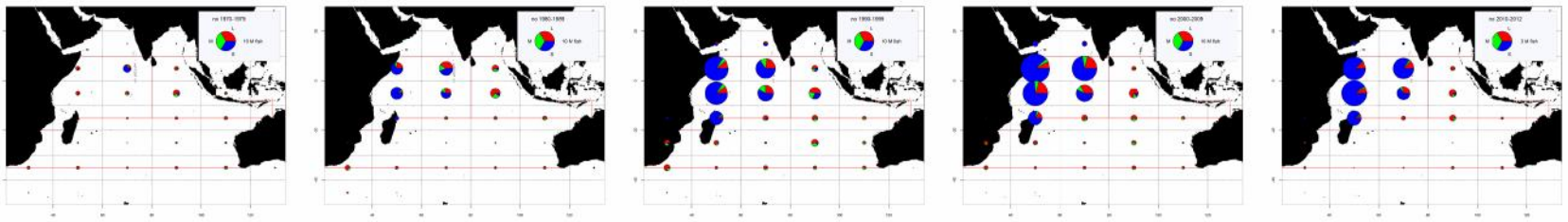


b. Bigeye tuna (BET)

Total catches of BIGEYE TUNA (BET) in weight (top) and number (bottom) derived from the catch-at-size of surface (purse seine and pole-and-line) and longline fisheries for 1970-2009, by decade, and 2010-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

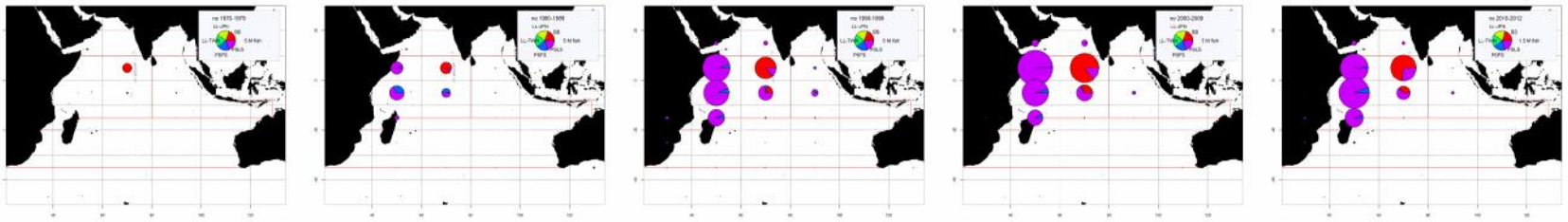
- **Large size** (**Red**): Catches of BET for which the weight estimated is 30kg or greater
- **Medium size** (**Green**): Catches of BET for which the weight estimated is between 15kg and 30kg
- **Small size** (**Blue**): Catches of BET for which the weight estimated is under 15kg





Total catches of bigeye tuna (BET) of very small size (under 5kg), in number, derived from the catch-at-size of surface (purse seine and pole-and-line) and longline fisheries for 1970-2009, by decade, and 2010-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

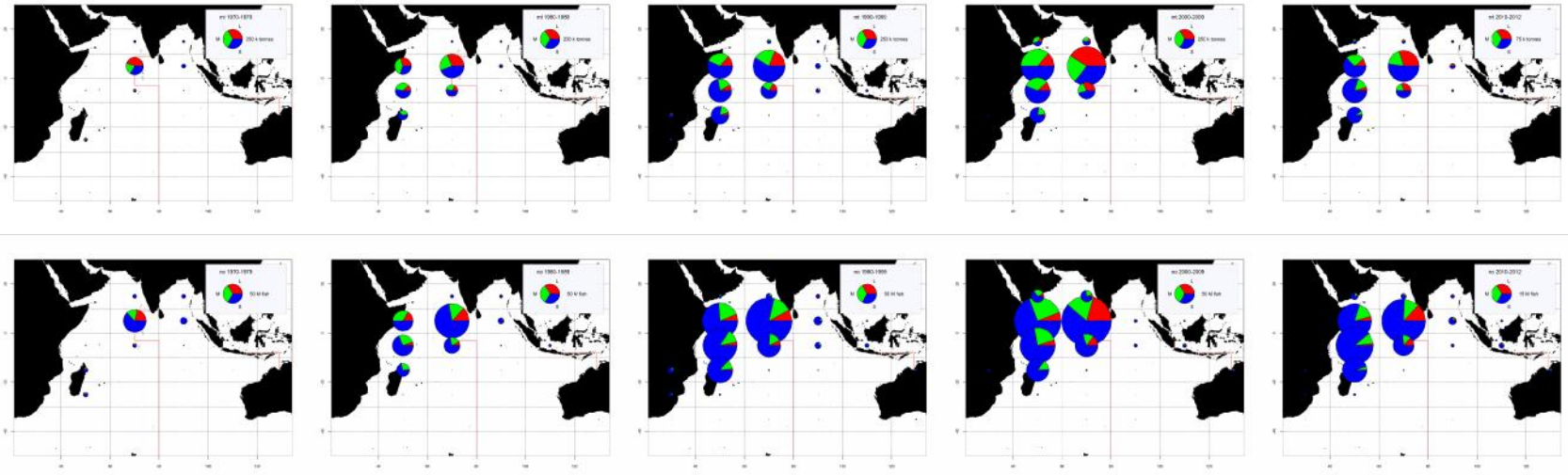
- **LL-TWN** (**Green**): Industrial longline fisheries
- **LL-JPN** (**Red**): Pole-and-line fisheries (Maldives and India)
- **PSLS** (**Purple**): Industrial purse seiners on associated schools (e.g. FAD)
- **PSFS** (**Light blue**): Industrial purse seiners on free-swimming schools



c. Skipjack tuna (SKJ)

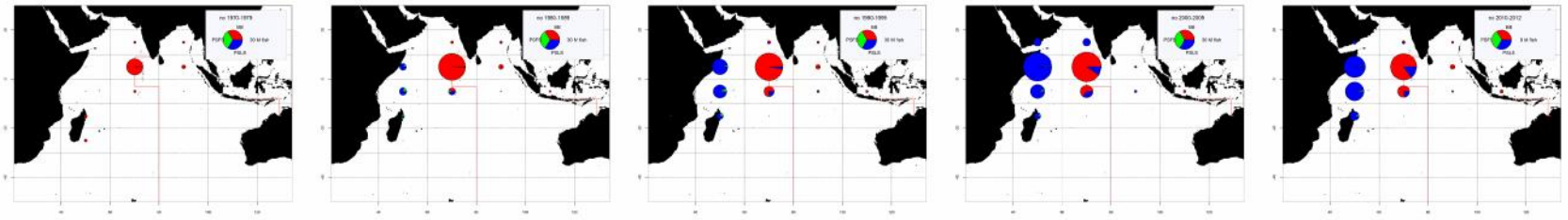
Total catches of SKIPJACK TUNA (SKJ) in weight (top) and number (bottom) derived from the catch-at-size of surface (purse seine and pole-and-line) and longline fisheries for 1970-2009, by decade, and 2010-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

- **Large size** (**Red**): Catches of SKJ for which the weight estimated is 5kg or greater
- **Medium size** (**Green**): Catches of SKJ for which the weight estimated is between 3kg and 5kg
- **Small size** (**Blue**): Catches of SKJ for which the weight estimated is under 3kg



Total catches of skipjack tuna (SKJ) of very small size (under 1.5kg), in number, derived from the catch-at-size of surface (purse seine and pole-and-line) and longline fisheries for 1970-2009, by decade, and 2010-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

- **BB** (**Red**): Pole-and-line fisheries (Maldives and India)
- **PSLS** (**Blue**): Industrial purse seiners on associated schools (e.g. FAD)
- **PSFS** (**Green**): Industrial purse seiners on free-swimming schools

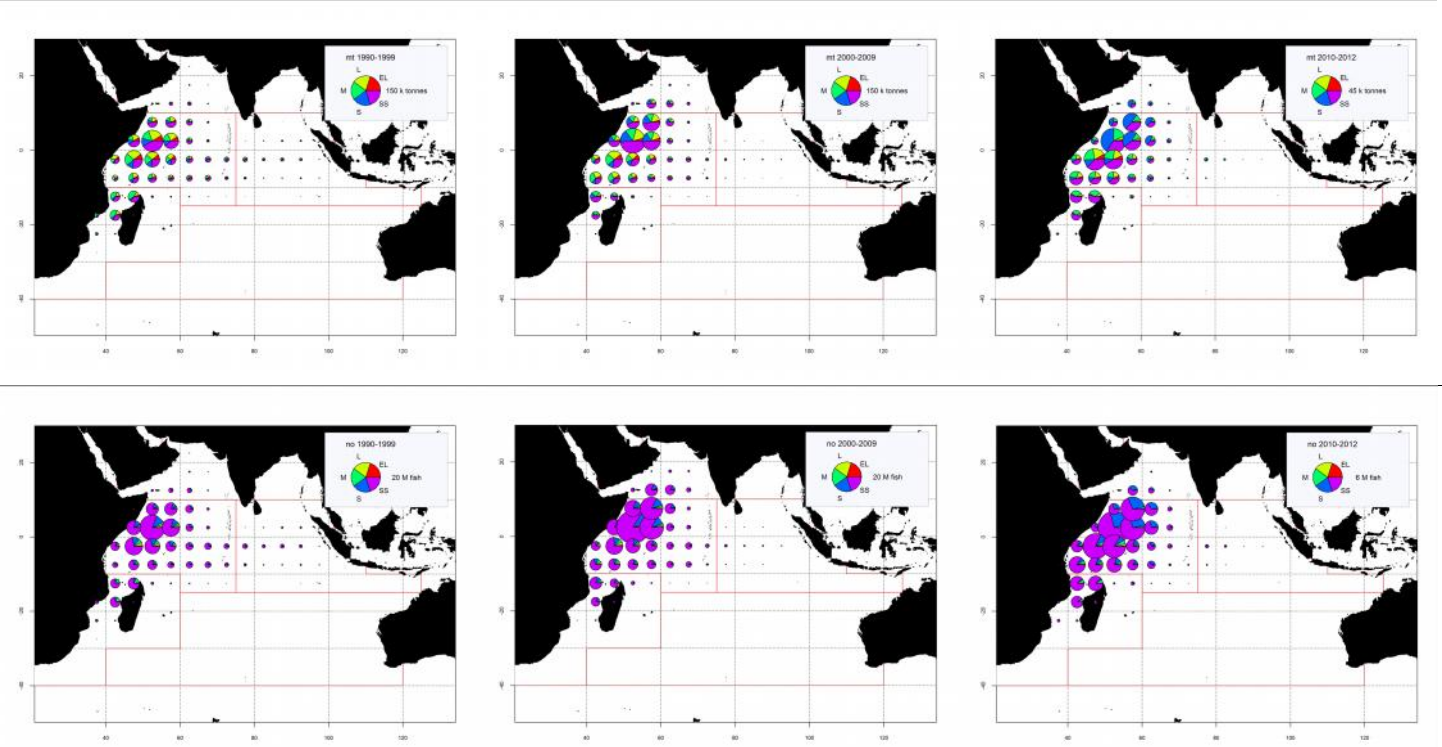


d. By fishery: Yellowfin tuna (YFT)

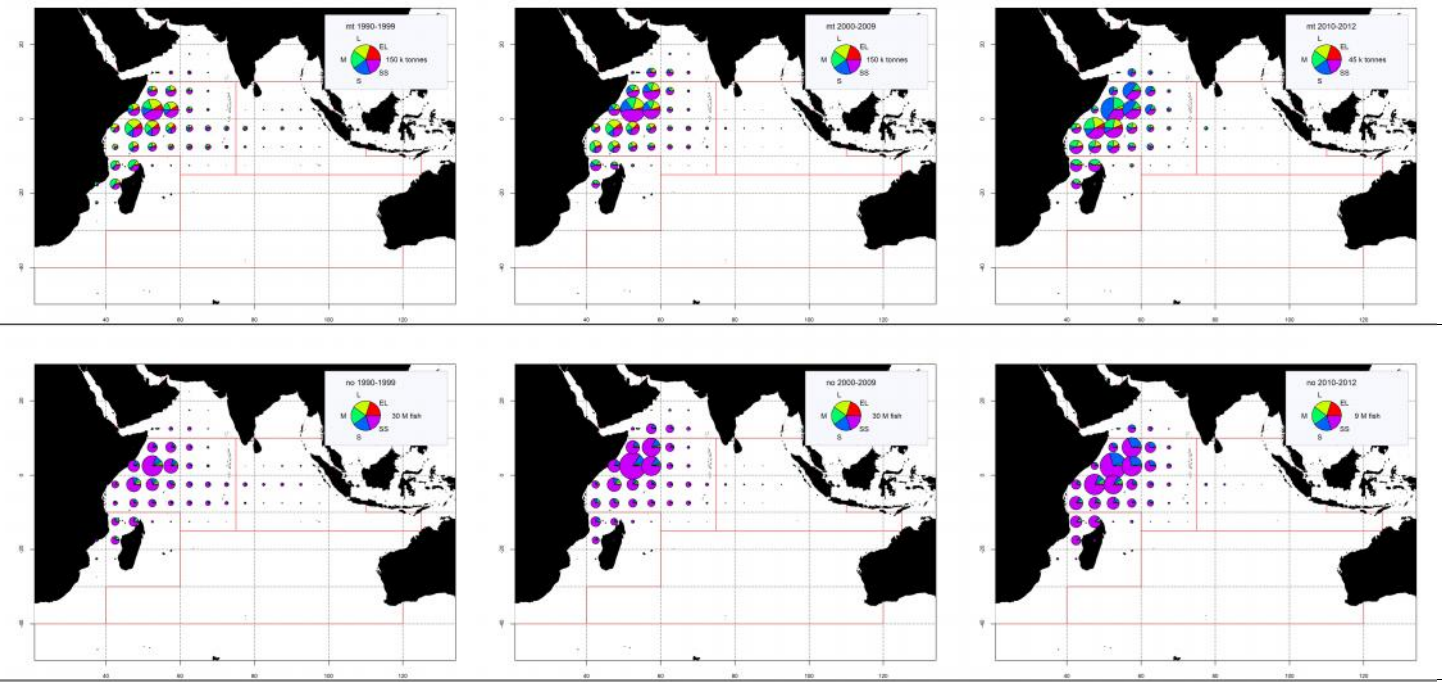
Total catches of YELLOWFIN TUNA (YFT) in weight (top) and number (bottom) derived from the catch-at-size of industrial purse seiners on free-swimming schools (top two rows; PSFS) and associated schools (bottom two rows; PSLS) for 1990-2009, by decade, and 2012-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

- **Very small size** (**SS; purple**): Catches of YFT for which the weight estimated is under 5kg
- **Small size** (**S**; **blue**): Catches of YFT for which the weight estimated is between 5 and 15kg
- **Medium size** (**M**; **green**): Catches of YFT for which the weight estimated is between 15kg and 30kg
- **Large size** (**L**; **yellow**): Catches of YFT for which the weight estimated is between 30kg and 45kg
- **Very large size** (**EL**; **red**): Catches of YFT for which the weight estimated is 45kg or greater

Free-swimming schools



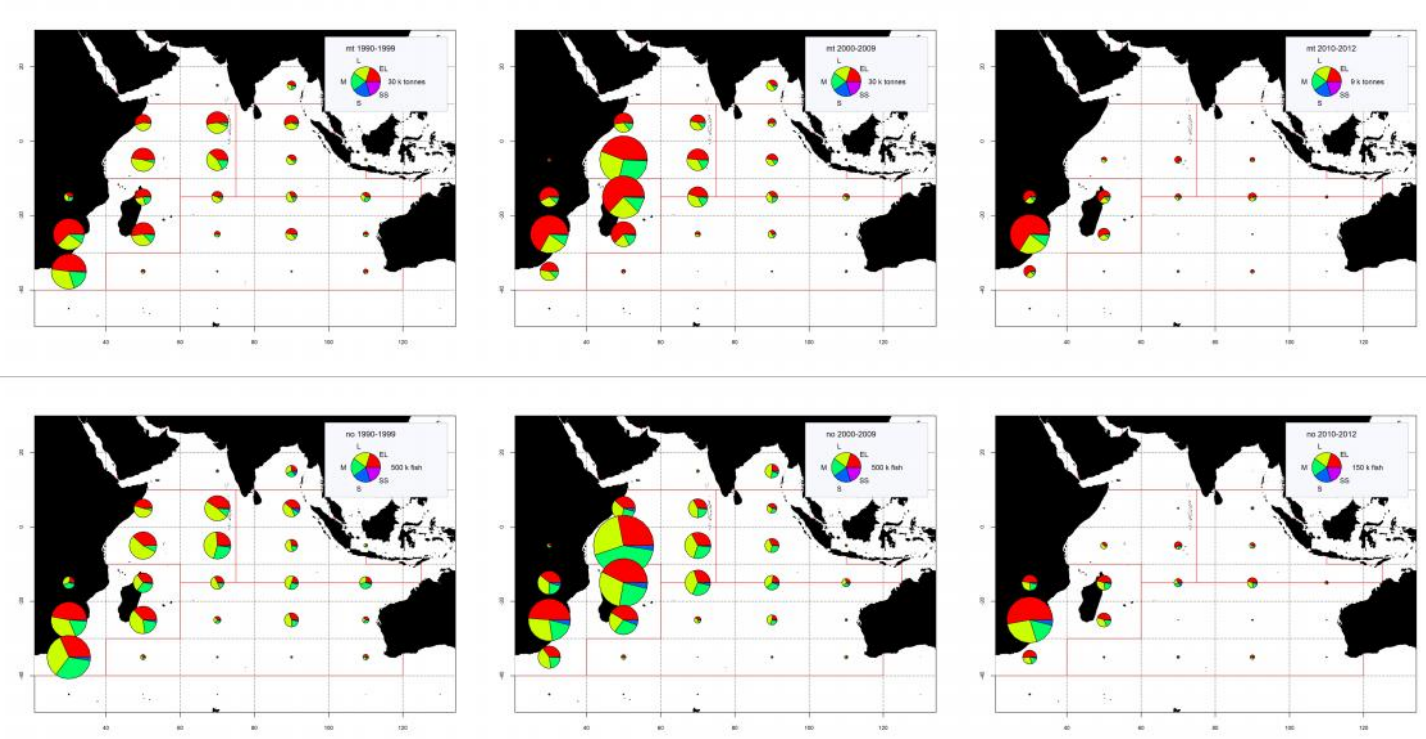
Associated schools



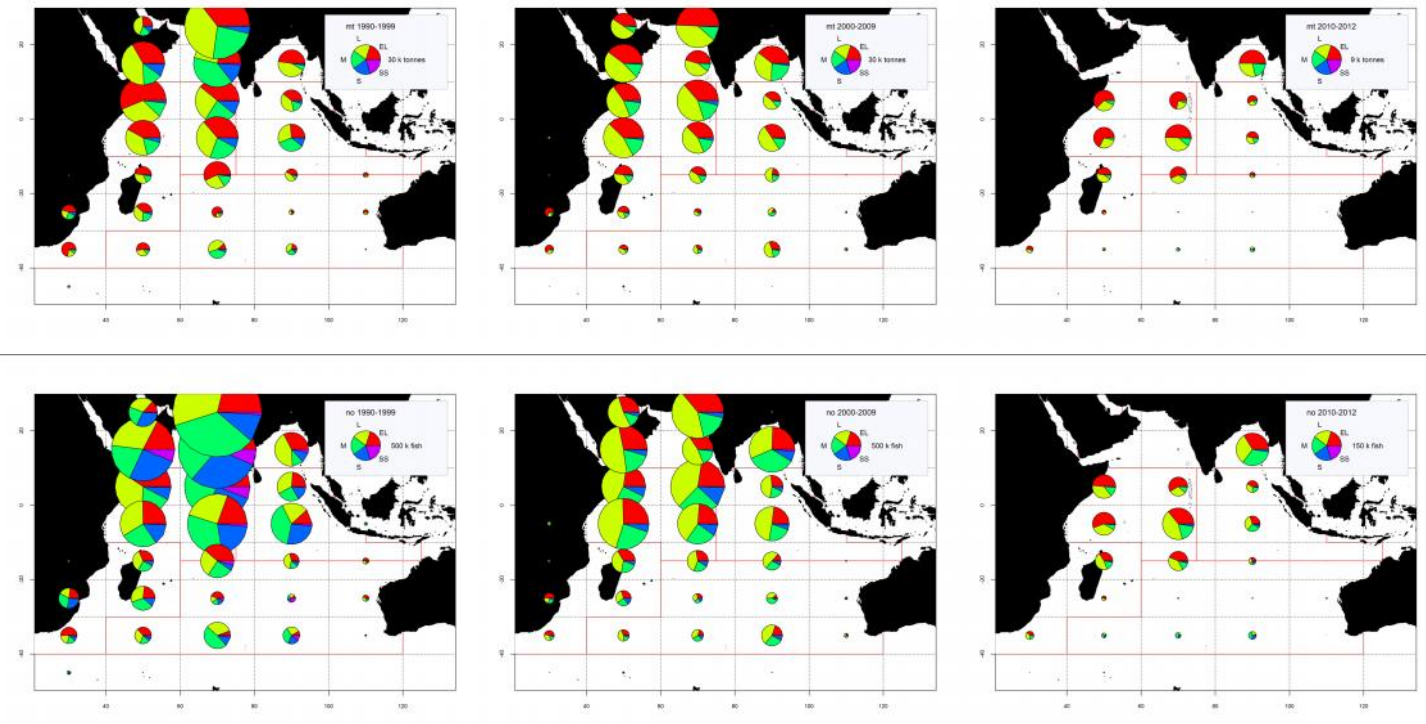
Total catches of YELLOWFIN TUNA (YFT) in weight (top) and number (bottom) derived from the catch-at-size of industrial longliners of Japan (top two rows) and Taiwan,China (bottom two rows) for 1990-2009, by decade, and 2012-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

- **Very small size** (**SS; purple**): Catches of YFT for which the weight estimated is under 5kg
- **Small size** (**S**; **blue**): Catches of YFT for which the weight estimated is between 5 and 15kg
- **Medium size** (**M**; **green**): Catches of YFT for which the weight estimated is between 15kg and 30kg
- **Large size** (**L**; **yellow**): Catches of YFT for which the weight estimated is between 30kg and 45kg
- **Very large size** (**EL**; **red**): Catches of YFT for which the weight estimated is 45kg or greater

Longline Japan



Longline Taiwan,China

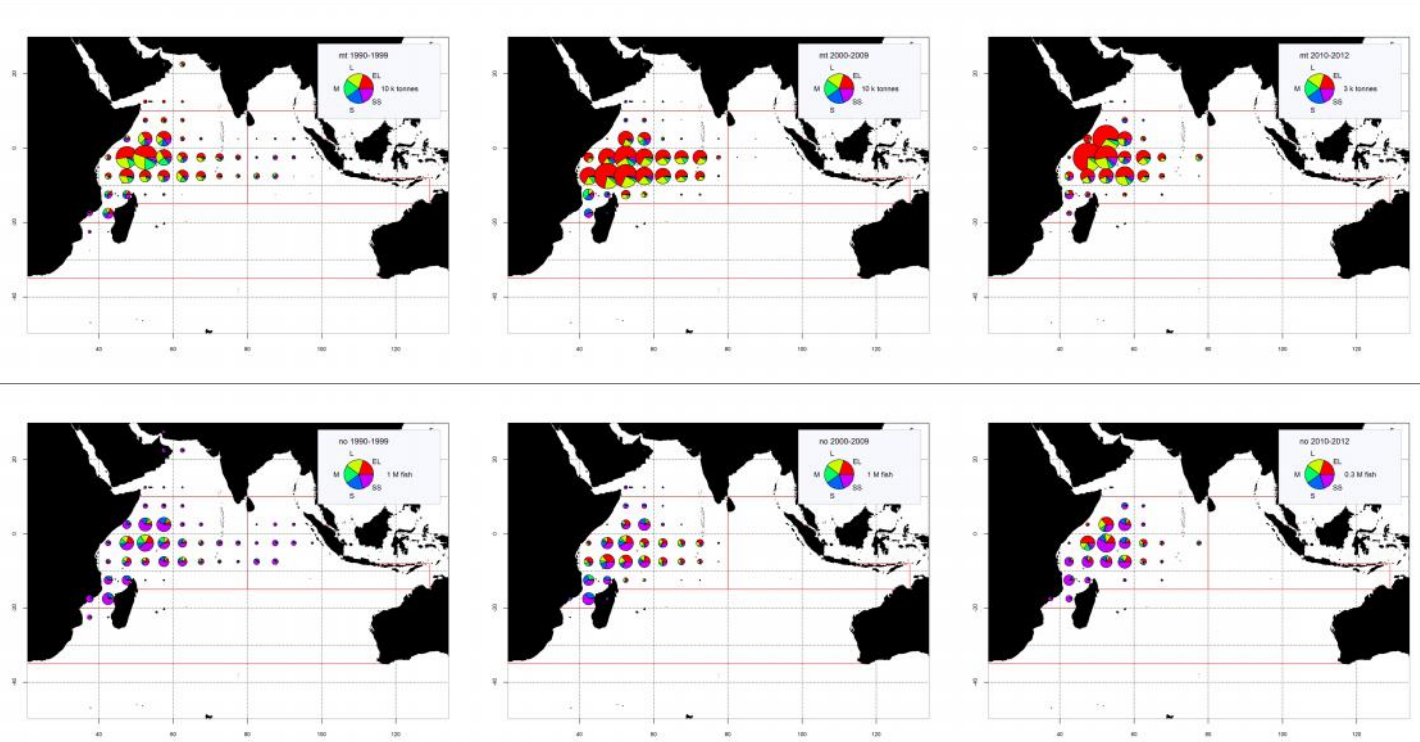


e. By fishery: Bigeye tuna (BET)

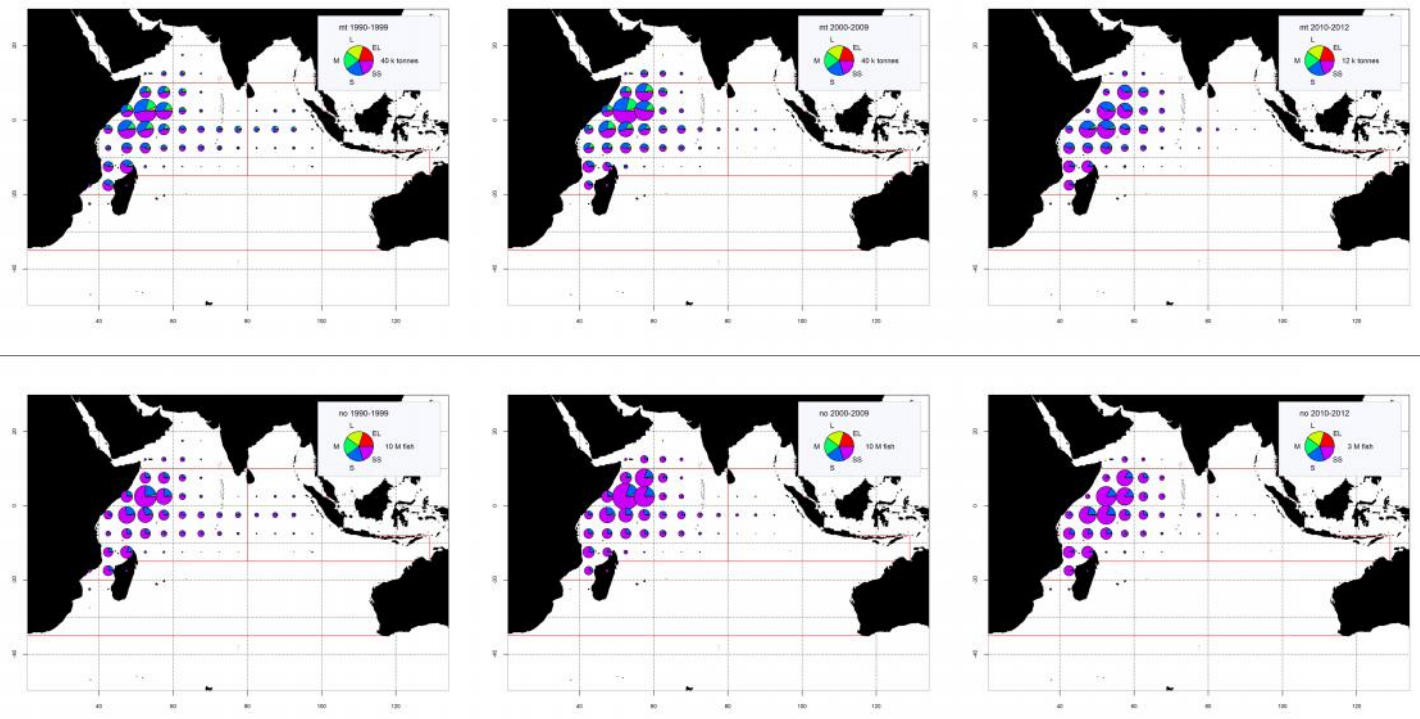
Total catches of BIGEYE TUNA (BET) in weight (top) and number (bottom) derived from the catch-at-size of industrial purse seiners on free-swimming schools (top two rows; PSFS) and associated schools (bottom two rows; PSLS) for 1990-2009, by decade, and 2012-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

- **Very small size** (**SS; purple**): Catches of BET for which the weight estimated is under 5kg
- **Small size** (**S**; **blue**): Catches of BET for which the weight estimated is between 5 and 15kg
- **Medium size** (**M**; **green**): Catches of BET for which the weight estimated is between 15kg and 30kg
- **Large size** (**L**; **yellow**): Catches of BET for which the weight estimated is between 30kg and 45kg
- **Very large size** (**EL**; **red**): Catches of BET for which the weight estimated is 45kg or greater

Free-swimming schools



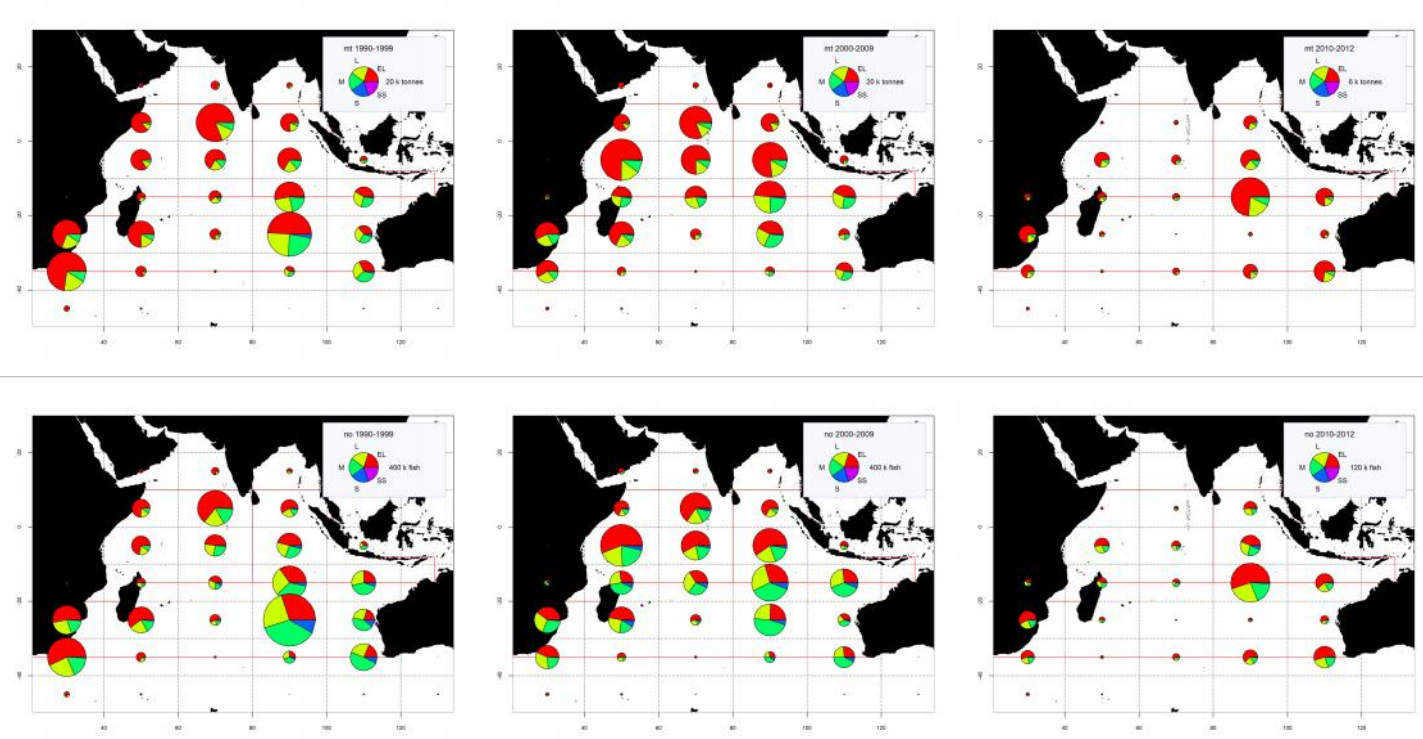
Associated schools



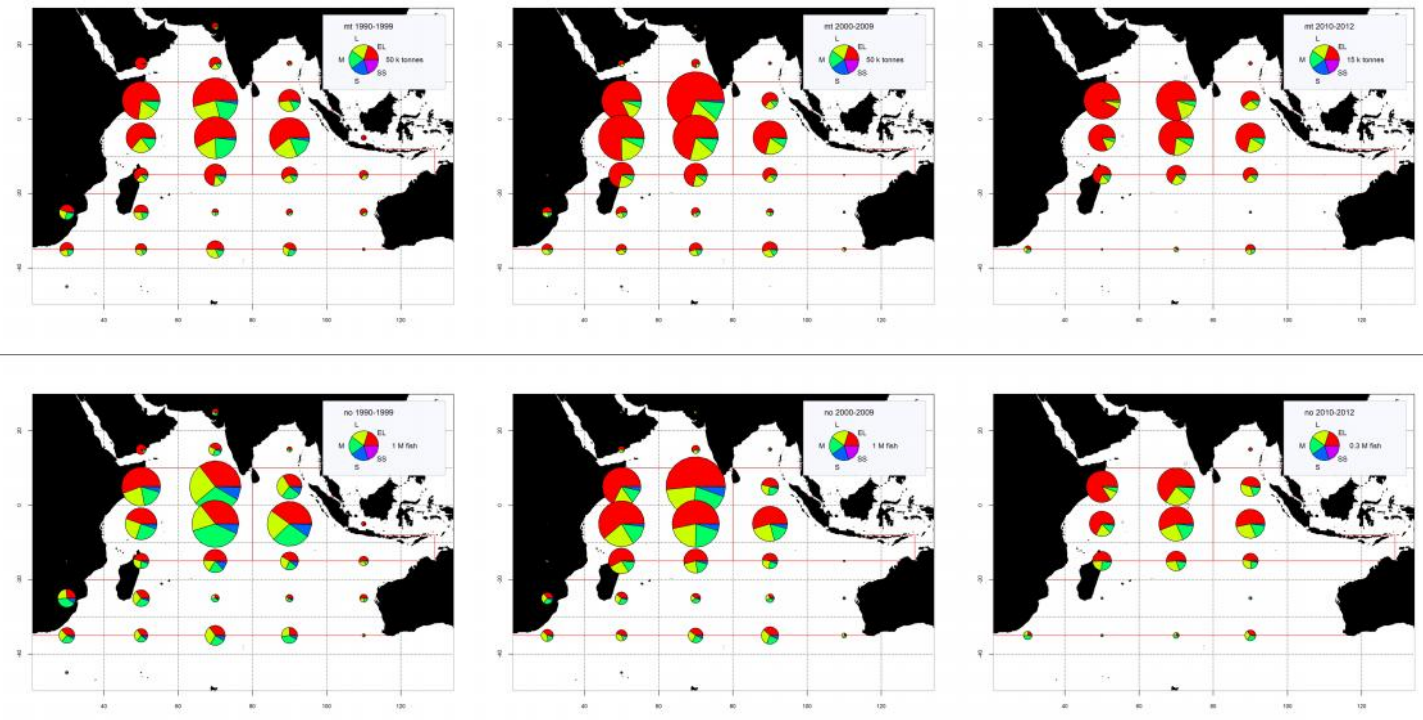
Total catches of BIGEYE TUNA (BET) in weight (top) and number (bottom) derived from the catch-at-size of industrial longliners of Japan (top two rows) and Taiwan,China (bottom two rows) for 1990-2009, by decade, and 2012-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

- **Very small size** (**SS; purple**): Catches of BET for which the weight estimated is under 5kg
- **Small size** (**S**; **blue**): Catches of BET for which the weight estimated is between 5 and 15kg
- **Medium size** (**M**; **green**): Catches of BET for which the weight estimated is between 15kg and 30kg
- **Large size** (**L**; **yellow**): Catches of BET for which the weight estimated is between 30kg and 45kg
- **Very large size** (**EL**; **red**): Catches of BET for which the weight estimated is 45kg or greater

Longline Japan



Longline Taiwan,China

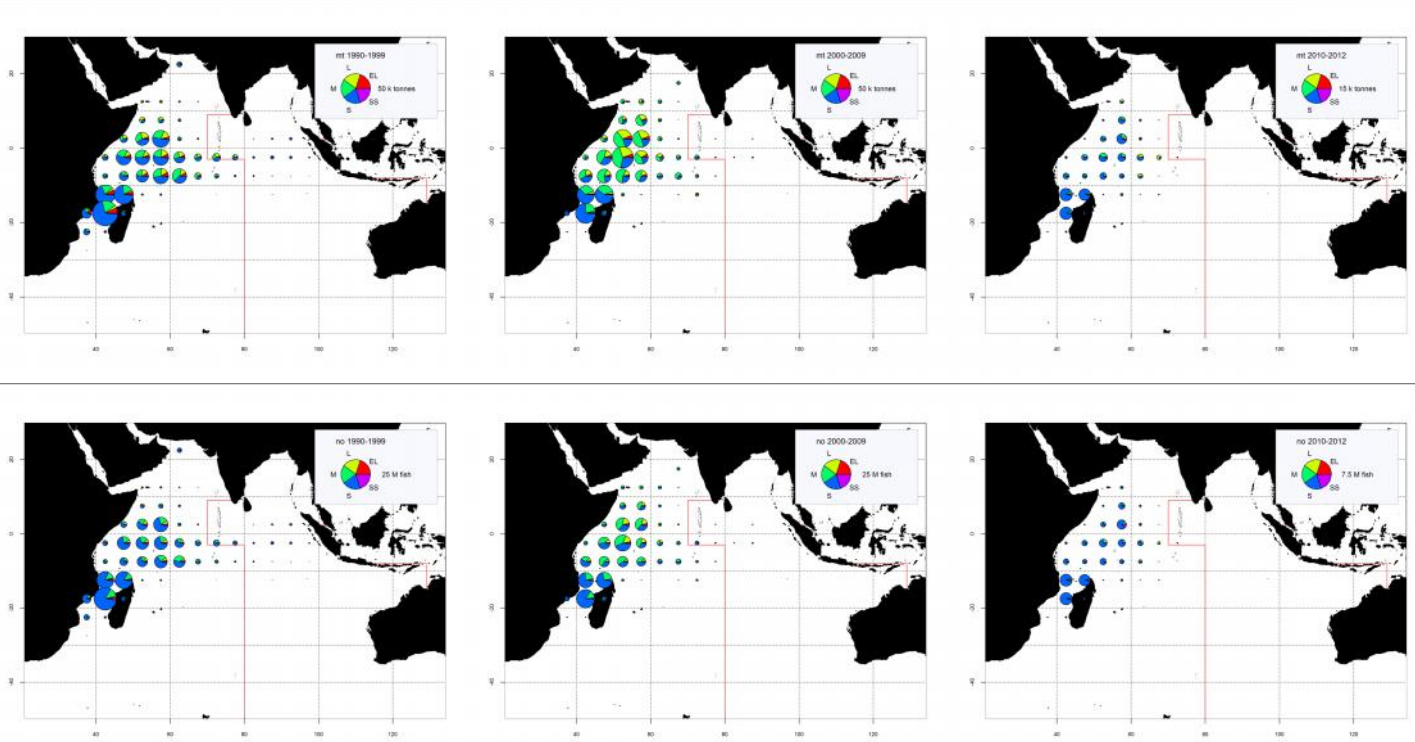


f. By fishery: Skipjack tuna (SKJ)

Total catches of SKIPJACK TUNA (SKJ) in weight (top) and number (bottom) derived from the catch-at-size of industrial purse seiners on free-swimming schools (top two rows; PSFS) and associated schools (bottom two rows; PSLS) for 1990-2009, by decade, and 2012-12. Catches are presented by 10 latitude by 20 longitude area and size class, including:

- **Very small size** (**SS; purple**): Catches of SKJ for which the weight estimated is under 1.5kg
- **Small size** (**S**; **blue**): Catches of SKJ for which the weight estimated is between 1.5 and 3kg
- **Medium size** (**M**; **green**): Catches of SKJ for which the weight estimated is between 3kg and 5kg
- **Large size** (**L**; **yellow**): Catches of SKJ for which the weight estimated is between 5kg and 7kg
- **Very large size** (**EL**; **red**): Catches of SKJ for which the weight estimated is 7kg or greater

Free-swimming schools



Associated schools