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# REVIEW OF THE STATISTICAL DATA AVAILABLE FOR THE TROPICAL TUNA SPECIES

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## Abstract

*This document reviews the status of the information available on tropical tunas in the databases at the IOTC Secretariat as of September 2011. It covers data on nominal catches, catch-and-effort, and size-frequency data.*

## 1. OVERVIEW

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)*[4].

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 other parties on the activity of vessels (IOTC Resolution 07/04; 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[5].

**Catch and effort data** which refer to the fine-scale data – usually from logbooks, and reported per fleet, year, gear, type of school, month, grid and species. Information on the use of fish aggregating devices (FADs) and supply vessels is also collected.

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[4] This Resolution superseded IOTC Resolutions 98/01, 05/01 and 08/01
[5] 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, quarter 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.

## 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** fisheries of **Iran** and **Pakistan**: To date, Iran and Pakistan have not reported catches of bigeye tuna for their gillnet fisheries. Although both countries have reported catches of yellowfin tuna and skipjack tuna, they have not reported catch-and-effort data as per the IOTC standards, in particular for those vessels that operate outside their EEZ.
- **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. This is probably due to the mislabelling of catches of bigeye tuna as yellowfin tuna. 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**: Maldives has not reported catch-and-effort data by gear type and geographic area since 2002[6].
- **Coastal** fisheries of **Comoros**[7], **Indonesia, Madagascar, Sri Lanka** (other than gillnet/longline) and **Yemen**: The catches of tropical tunas for these fisheries have been estimated by the Secretariat in recent years. 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.

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

- **Longline** fishery of **India**: India has reported very incomplete catches and catch-and-effort data for its longline fishery.
- **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**: To date, Iran has not reported catch-and-effort data as per IOTC standards for its purse seine fleet.
- **Longline** fishery of **Philippines:** Philippines has reported very low catches of tropical tunas for its longline fishery, in particular catches of bigeye tuna. The amounts of frozen bigeye tuna products exported from Philippines vessels to other countries (IOTC Bigeye tuna Statistical Document Programme) have been consistently higher than the amounts reported by Philippines as total catch for this species.
- **Discard levels for all fisheries**: The total amount of tropical tunas discarded at sea remains unknown for most fisheries and time periods.

[6] 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, to be presented at the WPTT in 2011.

[7] The "Direction national des resources haléutiques" of the Comoros conducted a fisheries census in 2011, with the assistance of the IOTC-OFCF Project. In addition, the IOTC Secretariat provided support for the implementation of a sampling system. These activities will make it possible for Comoros to estimate catches of tropical tunas and other species for 2011 and following years.

**3. Size data from All Fisheries:**

- **Longline** fisheries of **Japan** and **Taiwan,China:** During the WPTT meeting in 2010, the IOTC Secretariat 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 low.
- **Gillnet** fisheries of **Iran** and **Pakistan:** To date, Pakistan has not reported size frequency data for its gillnet fishery. Even though Iran has reported size frequency data for its gillnet fishery, data are not reported by month or geographic area; in addition, the proportion of fish sampled over the total numbers of fish caught has been decreasing in recent years, for all species.
- **Longline** fisheries of **India, Malaysia, Oman** and **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 thought to be too low and lengths are not available by gear type or fishing area.
- **Longline** fishery of **Indonesia**: Indonesia has reported 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 Indonesia.
- **Coastal** fisheries of **Comoros**[8], **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 Secretariat had to use length-age keys, length-weight keys, and processed weight-live weight keys for tropical tuna species from other oceans due to the general paucity of biological data available from the Indian Ocean.

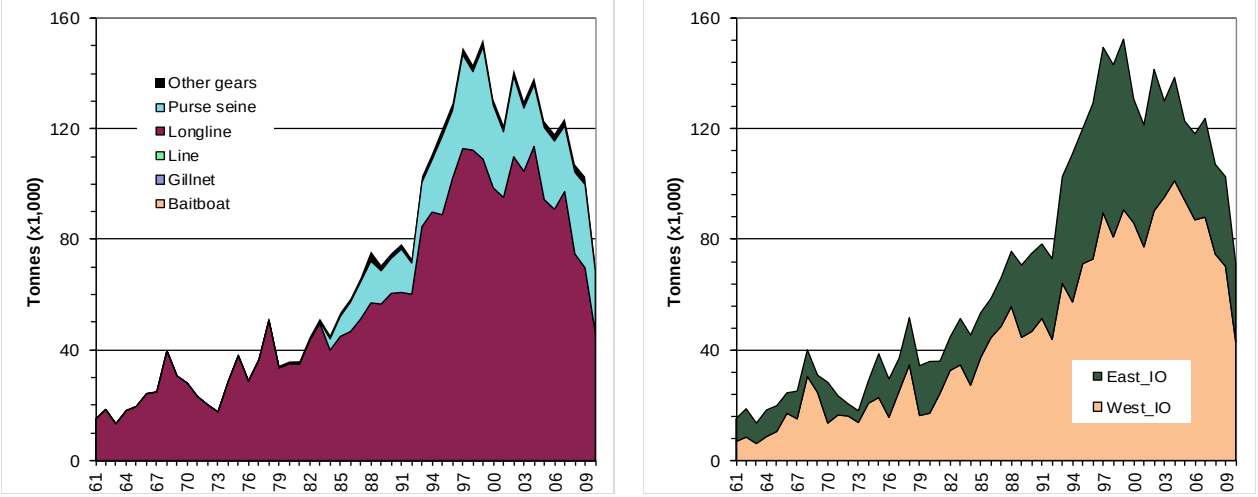
[8] *Ibid.* 7

## 2. STATUS OF FISHERIES STATISTICS FOR TROPICAL TUNAS

### *Bigeye tuna (BET)*

- **Fisheries and catch trends**

Bigeye tuna is mainly caught by industrial purse seine and longline fisheries and appears only occasionally in the catches of other fisheries. However, in recent years the amounts of bigeye tuna caught by gillnet fisheries are likely to be considerably higher due to the major changes experienced in some of these fleets, notably changes in boat size, fishing techniques and fishing grounds.




**Figures 1-2:** Catches of bigeye tuna by gear (left) and IOTC area (right) by year estimated for the WPTT (1961-2010)

Total annual catches have increased steadily since the start of the fishery, reaching the 100,000 t level in 1993 and peaking at 150,000 t in 1999 (**Figure 1**). Total annual catches averaged 131,000 t over the period 2001–2005 and 105,000 t over the period 2006–2010. In 2010, preliminary catches of bigeye tuna have been estimated to be at around 70,000 t. This represents a large drop in catches with respect to those estimated for 2009 and previous years. The Secretariat believes that the recent drop in catches could be related, at least in part, with the expansion of piracy in the northwest Indian Ocean, which has led to a marked drop in the levels of longline effort in the core fishing area of the species (**Maps 7-12**).

Bigeye tunas 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 the access to the bigeye resource and the emergence of a sashimi market made bigeye tuna a target species for the main industrial longline fleets. Total catch of bigeye by longliners in the Indian Ocean increased steadily from the 1970's to reaching 100,000 t in 1993 and around 140,000–150,000 t for a short period from 1997–1999 (**Figure 1**). While the average annual catch by longliners for the period from 2003 to 2007 was 100,000 t (105,000 t in 1998–2002), the value for 2008–10 is 64,000 t, with marked drops in catches recorded during the three years. The catches estimated for 2010 are at around 46,000 t, 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 in the Indian Ocean, taking as much as 40% of the total longline catch in the Indian Ocean (**Figure 3**). However, the catches of Taiwanese longliners have decreased markedly in recent years, with current catches of bigeye tuna (17,000 t) representing less than one third of the catches recorded 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, on free swimming schools of yellowfin tuna or skipjack tuna (**Figure 1**). The total catch of bigeye tuna by purse seiners in the Indian Ocean reached 40,700 t in 1999, but the average annual catch for the period from 2006 to 2010 was 26,000 t (25,000 t in 2001–2005). Purse seiners under flags of the EU and Seychelles take the majority of bigeye tuna for this fishery (**Figure 3**). Purse seiners mainly take small juvenile bigeye (averaging around 5 kg) whereas longliners catch much larger and heavier fish; and while purse seiners take much lower tonnages of bigeye compared to longliners,

they take larger numbers of individual fish. Even though the activities of purse seiners have been also affected by piracy in the Indian Ocean, the effects have not been as marked as with longliners. 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 operate in the northwest Indian Ocean, with levels of activity near those in the past (Maps 7–12).

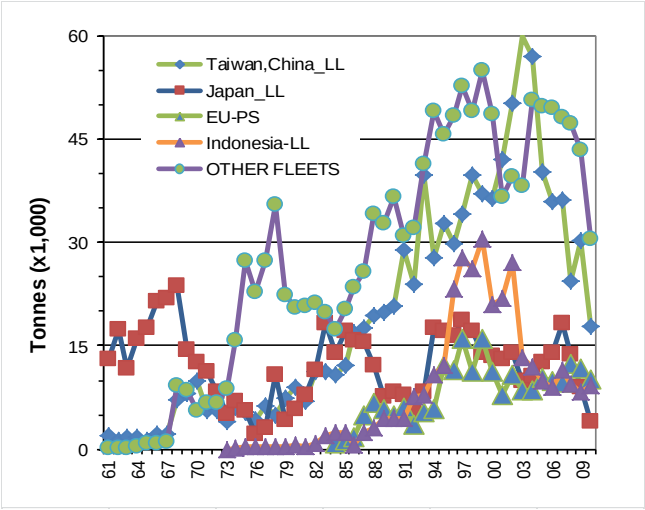
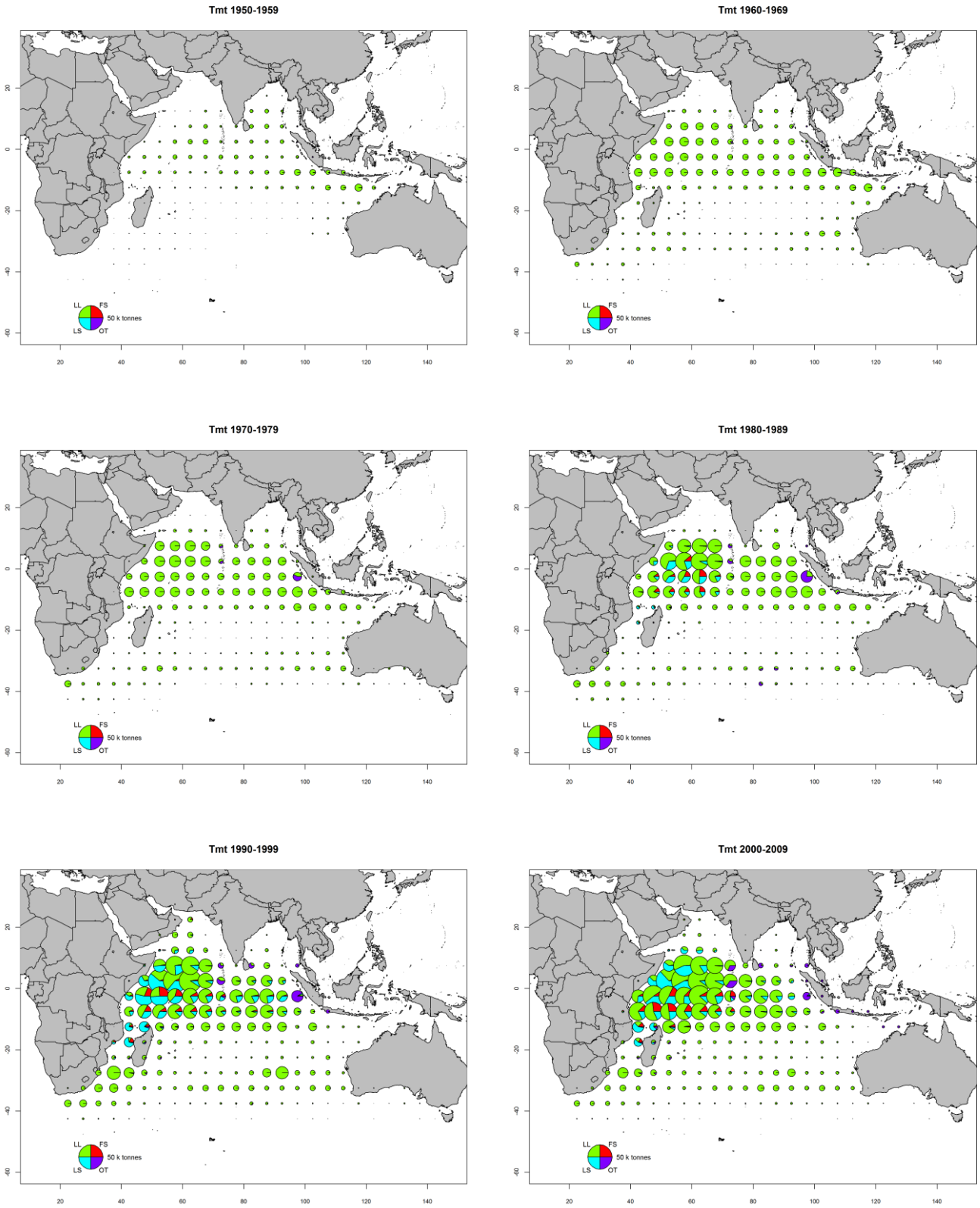



**Figure 3**: Catches of bigeye tuna by fleet by year estimated for the WPTT (1961-2010)

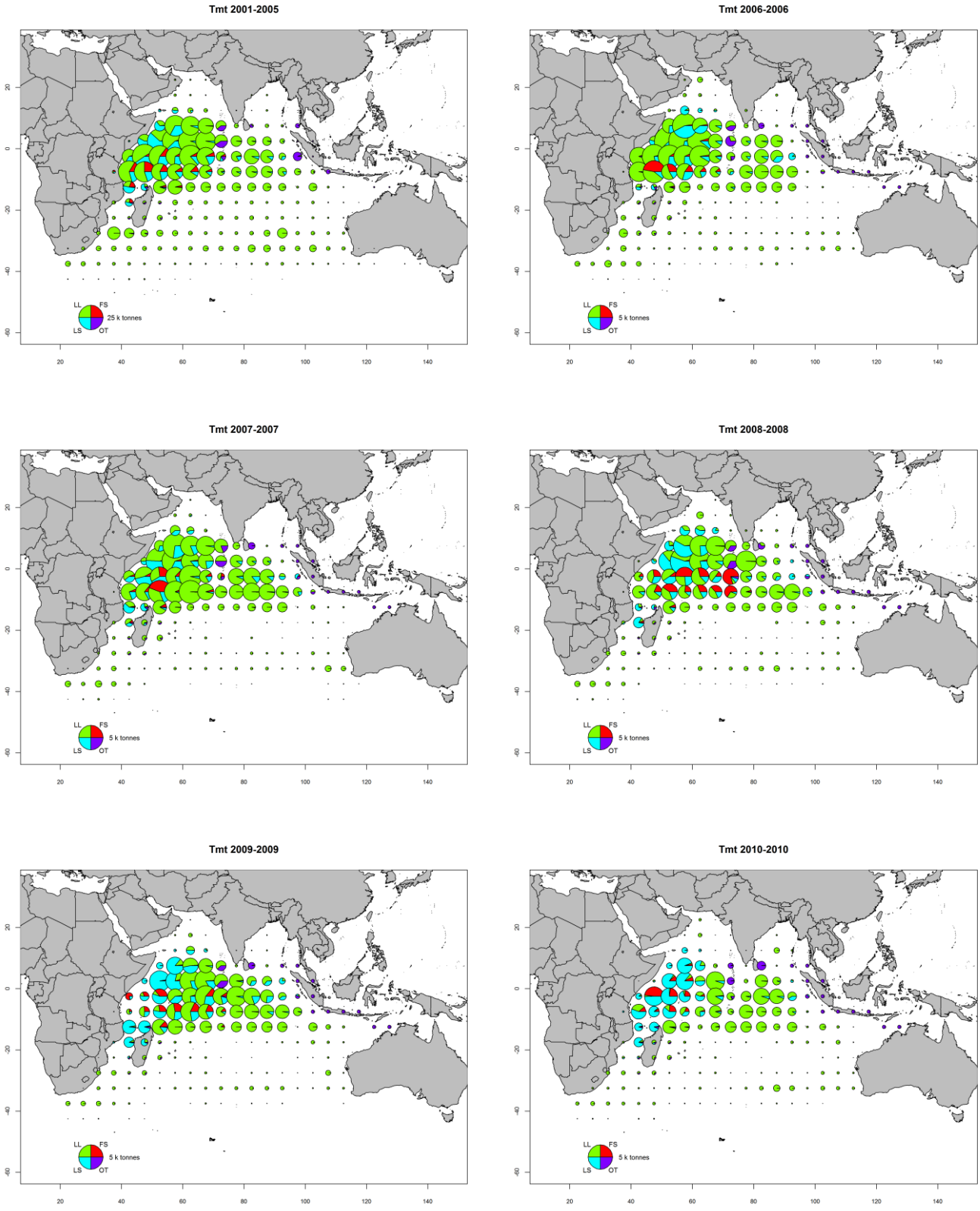
By contrast with yellowfin and skipjack tunas, for which the major catches take place in the western Indian Ocean, bigeye tuna is also exploited in the eastern Indian Ocean (**Figure 2, Maps 1–6**). The relative increase in catches in the eastern Indian Ocean in the late 1990's was mostly due to increased activity of small longliners fishing for fresh tuna. This fleet started its operation in the mid 1980's. However, the catches of bigeye tuna in the eastern Indian Ocean have shown a decreasing trend in recent years.

In recent years (**Maps 7–12**) the catches of bigeye tuna in the western Indian Ocean have dropped considerably, especially in areas off Somalia, Kenya and Tanzania and in particular since 2008. The drop in catches is due to the effect of piracy in the western Indian Ocean region, as explained above.




**Maps 1-6:** 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




**Maps 7-12:** Time-area catches (total combined in tonnes) of bigeye tuna estimated for the period 2001–2005 by type of gear and for 2006–10, 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

- **BET: Status of Fisheries Statistics at the IOTC**

**Retained catches** are thought to be well known for the major fleets (**Figure 4**); but are less certain for non-reporting industrial purse seiners and longliners (NEI) and for other industrial fisheries (longliners of India and Philippines). Catches are also uncertain for some artisanal fisheries including the pole-and-line fishery in the Maldives, the gillnet fisheries of Iran and Pakistan, the gillnet/longline fishery in Sri Lanka and the artisanal fisheries in Indonesia, Comoros and Madagascar.

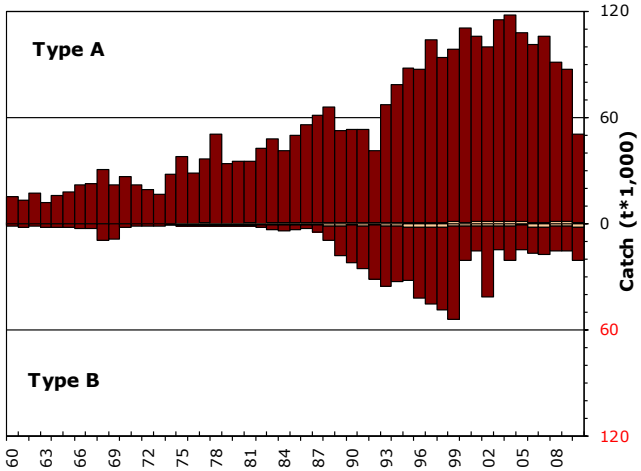



**Figure 4.** Uncertainty of annual catch estimates for bigeye tuna (Data as of September 2011)

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

**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:** There have not been significant changes to the catches of bigeye tuna since the WPTT in 2010 (**Figure 5**).

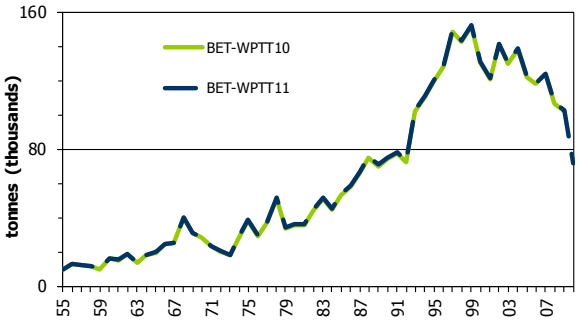



**Figure 5**: Bigeye tuna: Catches used by the WPTT in 2010 *versus* those estimated for the WPTT11 (1955-2010)

**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 (**Figure 6**), 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 very little data available for the fresh-tuna longline fishery of Taiwan,China
- uncertain data from significant fleets of industrial purse seiners from Iran and longliners from India, Indonesia, Malaysia, Oman, Philippines, and Taiwan,China (fresh tuna up to 2006).
- No data available for the gillnet fisheries of Iran and Pakistan and the gillnet/longline fishery of Sri Lanka, especially in recent years.

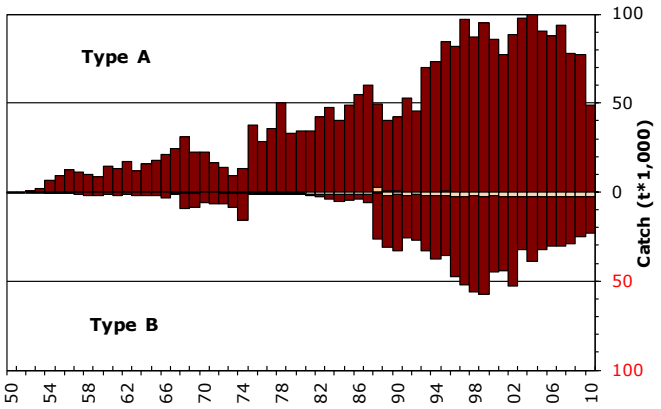



**Figure 6.** Uncertainty of time-area catches for bigeye tuna (Data as of September 2011)

*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.*

**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 longline).

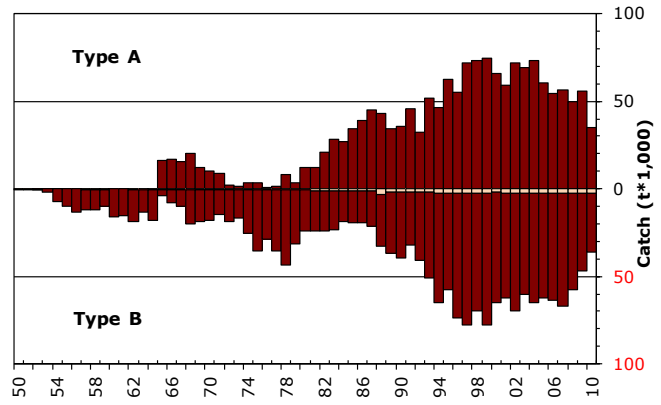



**Figure 7**. Uncertainty of catch-at-size data for bigeye tuna (Data as of September 2011)

*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 but the estimates are more uncertain for some years and some fisheries due to (**Figure 7**):

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

- **BET Tagging data:**

35,971 bigeye (17.8%) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them, 96.1% were tagged during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and were mostly released off the coast of Tanzania in the western Indian Ocean, between May 2005 and September 2007. The remaining was tagged during small-scale tagging projects, and by other institutions with the support of IOTC, in Maldives, Indian, and in the south west and the eastern Indian Ocean. To date, 5,563, i.e. 15.7%, were recovered and reported to the IOTC headquarters.

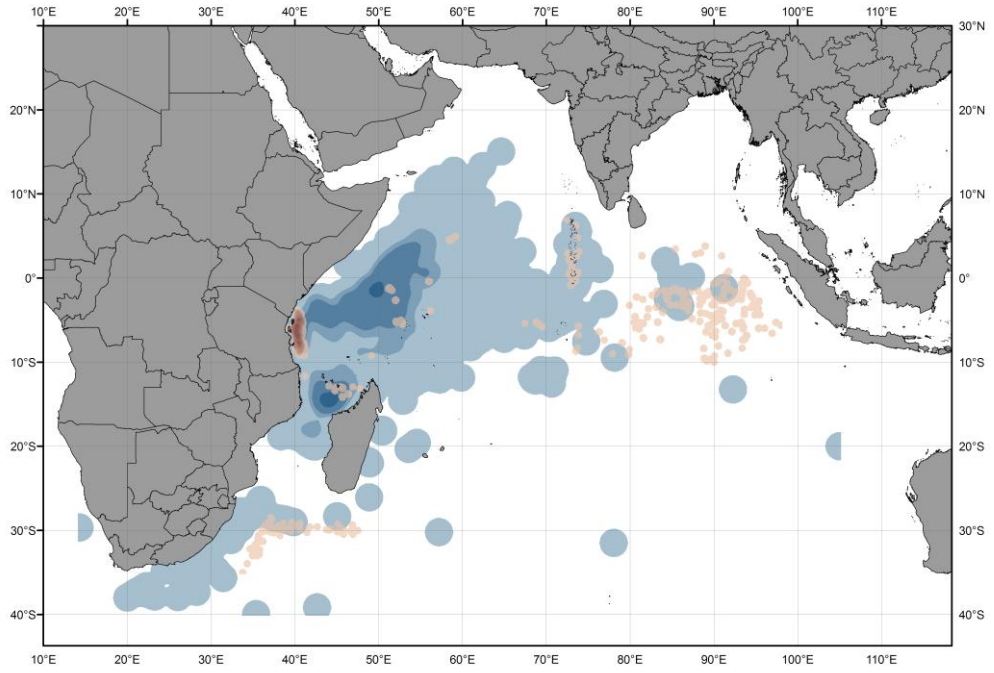



**Figure 8**. Densities of releases (in red) and recoveries (in blue) of BET. Data as of September 2011.

***Skipjack tuna (SKJ)***

- **Fisheries and catch trends**

Catches of skipjack (**Figure 9**) increased slowly from the 1950s, reaching around 50,000 t during the mid-1970s, mainly due to the activities of pole-and-lines and gillnets. The catches increased rapidly with the arrival of the purse seiners in the early 1980s, and skipjack became one of the most important tuna species in the Indian Ocean. Annual total catches exceeded 400,000 t in the late 1990's and the average annual catch for the period from 2006 to 2010 was 490,000 t (505,000 t over the period 2001-05). Catches in 2006 are the highest recorded in the history of the fishery (625,000 t). Skipjack tuna catches dropped markedly in 2007 (477,000 t), with further drops recorded ever since. The catch levels estimated for 2010, though preliminary, represent the lowest catches recorded since 1998, at around 430,000 t.

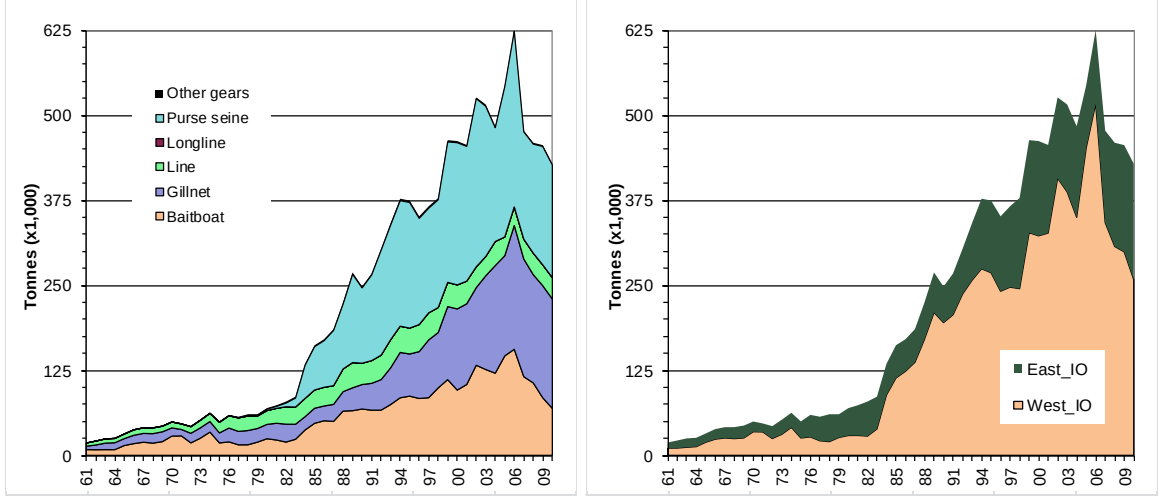



**Figure 9-10:** Catches of skipjack tuna by gear (left) and IOTC area (right) by year estimated for the WPTT (1961–2010)

The increase of skipjack catches by **purse seiners** (**Figure 11**) is due to the development of a fishery in association with Fish Aggregating Devices (FADs) (**Maps 16-24**). In recent years, 85 % of the skipjack tuna caught by purse-seine is taken under FADs. Catches by purse seiners increased steadily since 1984 with the highest catches recorded in 2002 (240,000 t) and 2006 (247,000 t). The Catches dropped markedly during 2003 and 2004, probably as a consequence of exceptional purse seine catch rates on free schools of yellowfin tuna during those years. In 2007 purse seine catches dropped by around 100,000 t (145,000 t.), with similar catches recorded in 2008. In 2009 and 2010 the catches remained low (150,000–160,000 t). The constant increase in catches and catch rates of purse seiners until 2006 are believed to be associated to 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 shown since 2007coincided with a similar decline in the catches of Maldivian baitboats.

The Maldivian fishery (**Figure 11**) has effectively increased its fishing effort with the mechanisation of its **pole-and-line** fishery since 1974, including an increase in boat size and power and the use of anchored FADs since 1981. Skipjack represents some 75% 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 (137,000 t). The catches of skipjack tuna have declined dramatically ever since, with catches in 2009 and 2010 estimated to be at around 65,000 t and 56,000 t, respectively, representing less than half the catches in 2006.

Several fisheries using **gillnets** have reported large catches of skipjack tuna in the Indian Ocean (**Figure 9**), 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 (**Figure 11**) 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.

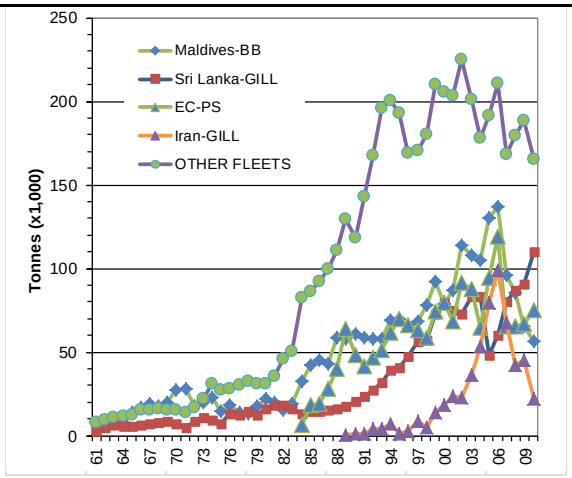
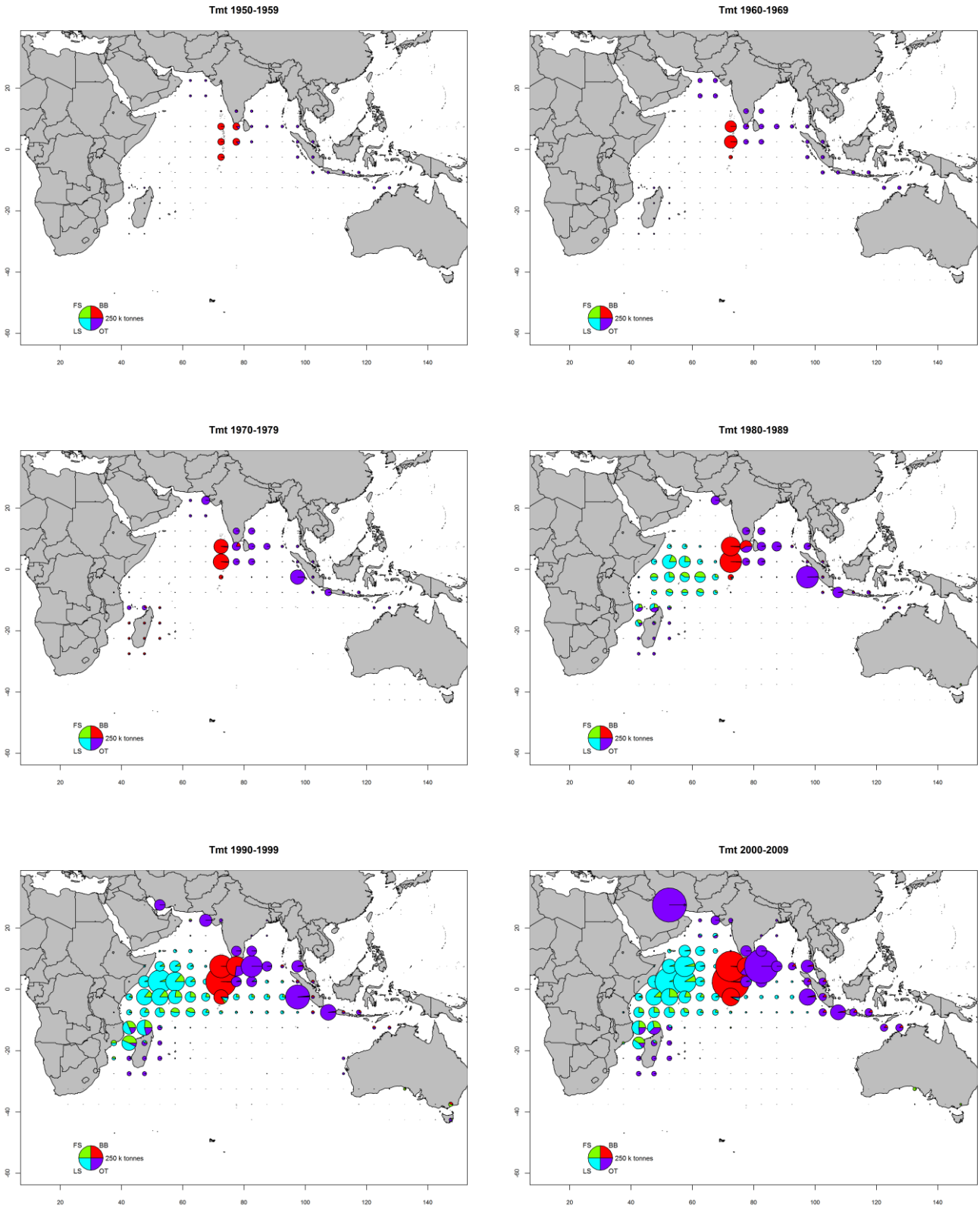


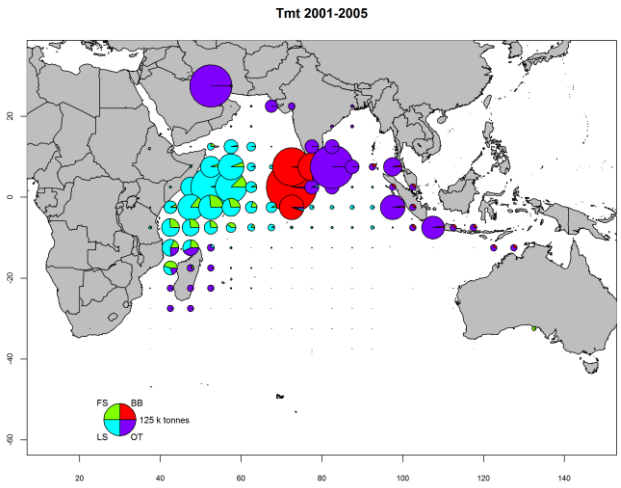

**Figure 11:** Catches of skipjack tuna by fleet by year estimated for the WPTT (1961–2010)

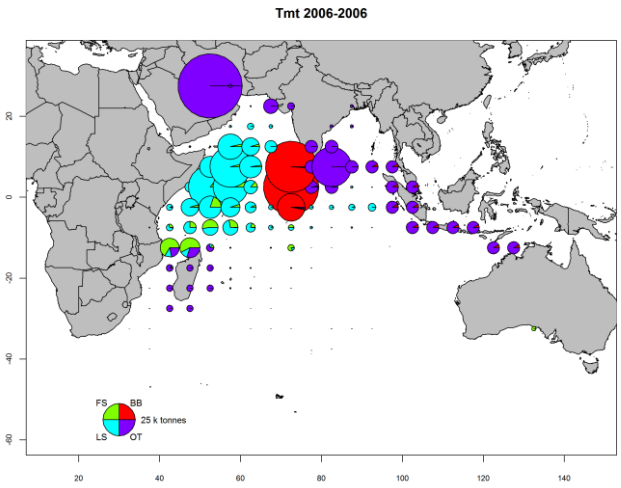
The majority of the catches of skipjack tuna originate from the western Indian Ocean (**Figure 10; Maps 13-24**). Since 2007 (**Maps 19-24**) the catches of skipjack tuna in the western Indian Ocean have dropped considerably, especially in areas off Somalia, Kenya, Tanzania and around the Maldives. Although the drop in catches could be partially explained by a drop in catch rates and fishing effort by the purse seine fishery, due to the effects of piracy in the western Indian Ocean region, drops in the catches of other fisheries (Iran and Maldives) are not fully understood.

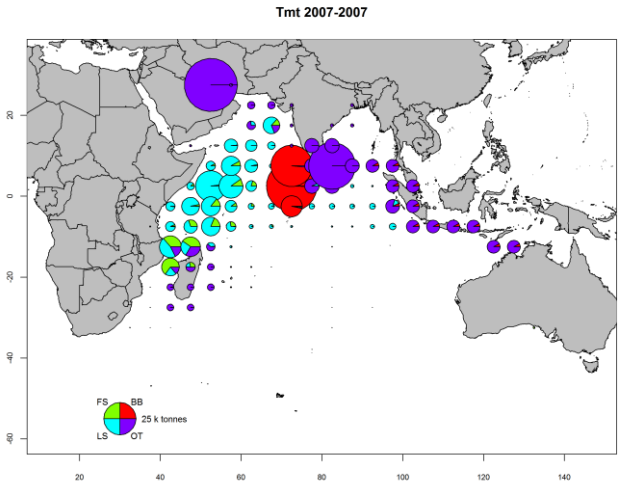


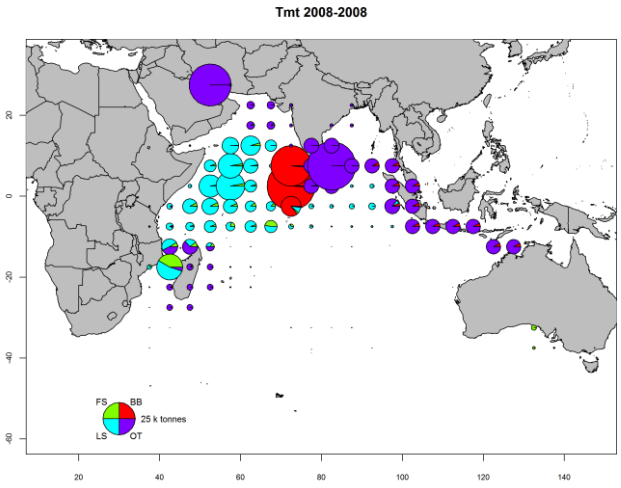

**Maps 13-18:** Time-area catches (total combined in tonnes) of skipjack tuna estimated for the period 1950–2009, by decade and type of gear:

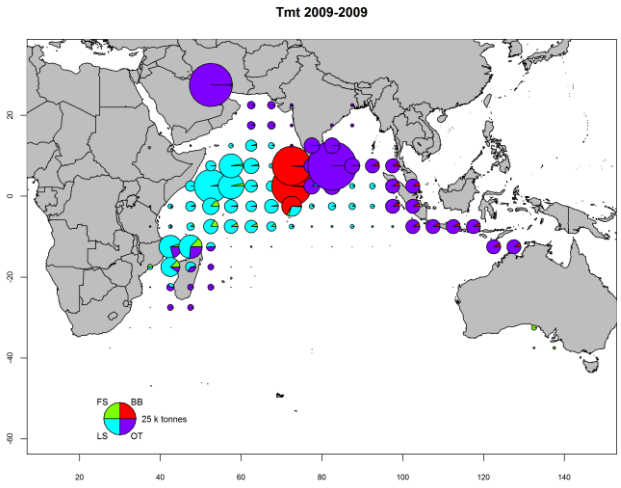
Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (BB), and other fleets (**OT**), including longline, drifting gillnets, and various coastal fisheries

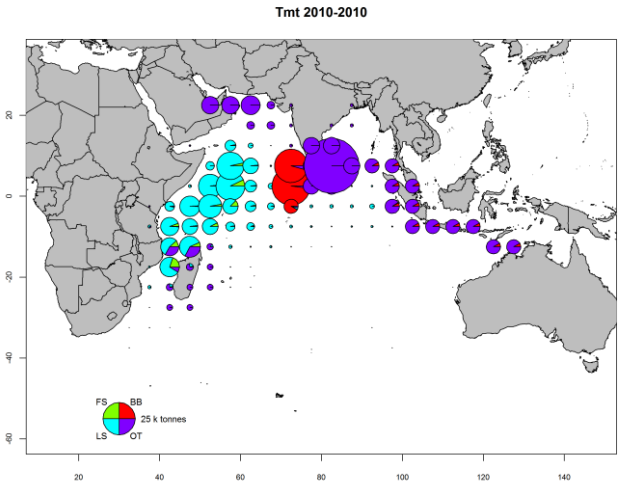



**Maps 19-24:** Time-area catches (total combined in tonnes) of skipjack tuna estimated for the period 2001–2005 by type of gear and for 2006–10, by year and type of gear:

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

- **SKJ: 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 (**Figure 12**), 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.

**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.

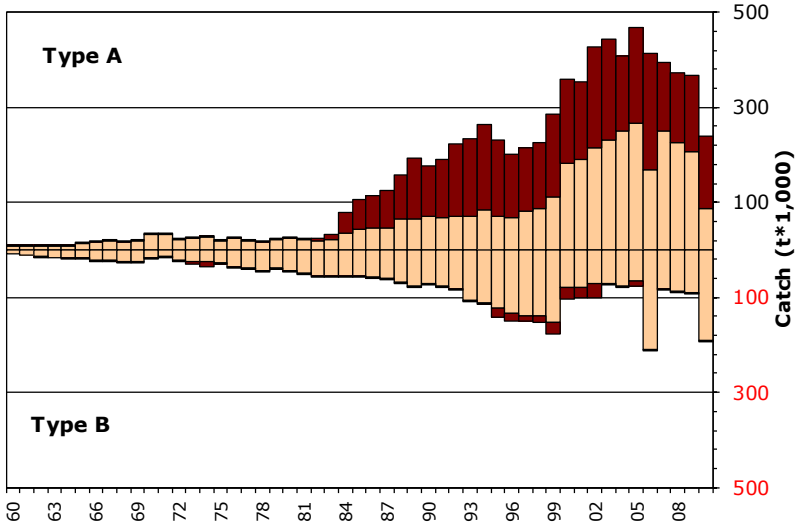



**Figure 12.** Uncertainty of annual catch estimates for skipjack tuna (Data as of September 2011)

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

**Changes to the catch series:** There have been no major changes to the catches of skipjack tuna since the WPTT in 2010 (**Figure 13**).

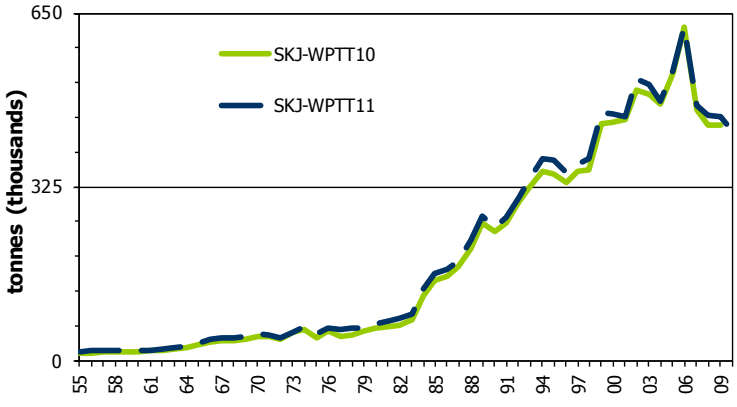



**Figure 13:** Skipjack tuna: Catches used by the WPTT in 2010 versus those estimated for the WPTT11 (1955–2010)

**CPUE Series**: Catch and effort data are available from various industrial and artisanal fisheries (**Figure 14**). However, these data are not available from the important fisheries or they are considered to be of poor quality for the following reasons:

- no data are available 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 Indonesia, Madagascar and Comoros

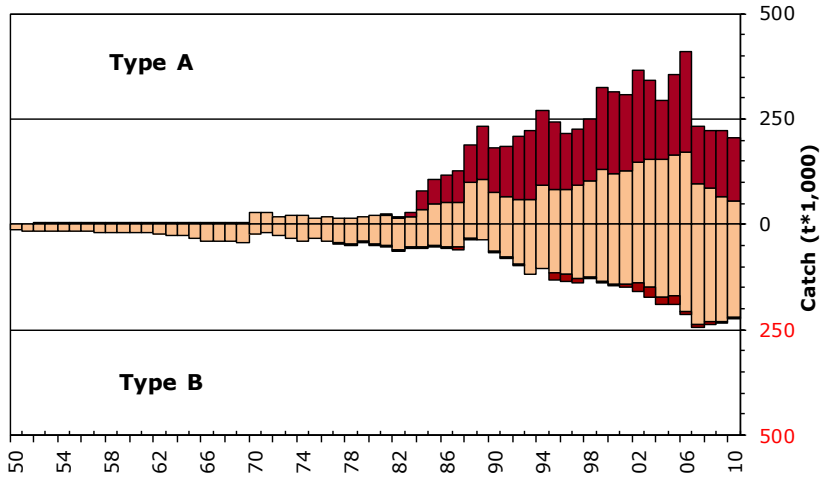



**Figure 14.** Uncertainty of time-area catches for skipjack tuna (Data as of September 2011)

*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.*

**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).

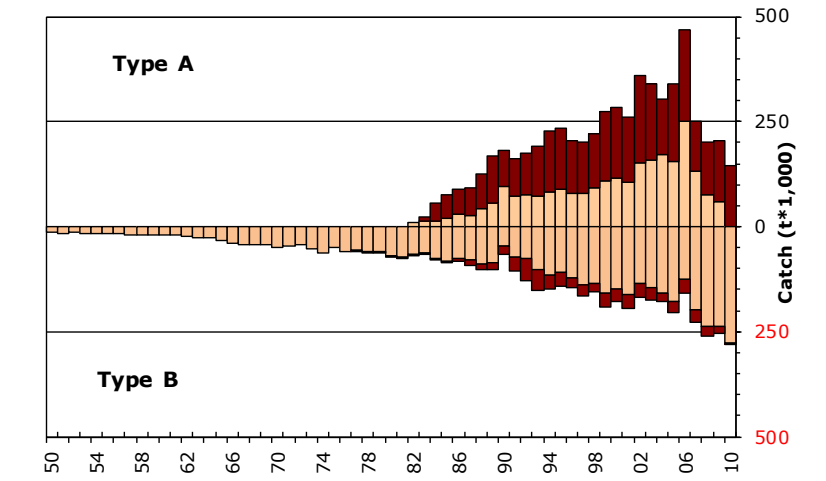



**Figure 15**. Uncertainty of catch-at-size data for skipjack tuna (Data as of September 2011)

*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**: CAS are available but the estimates are uncertain for some years and fisheries due to (**Figure 15**):

- 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)

- **SKJ Tagging data:**

100,620 skipjack (49.8%) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP) Most of them, 77.8%, 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. The remaining was tagged during small-scale tagging projects, and by other institutions with the support of IOTC, in Maldives, Indian, and in the south west and the eastern Indian Ocean. To date, 15 270, i.e. 15.2%, were recovered and reported to the IOTC headquarters.

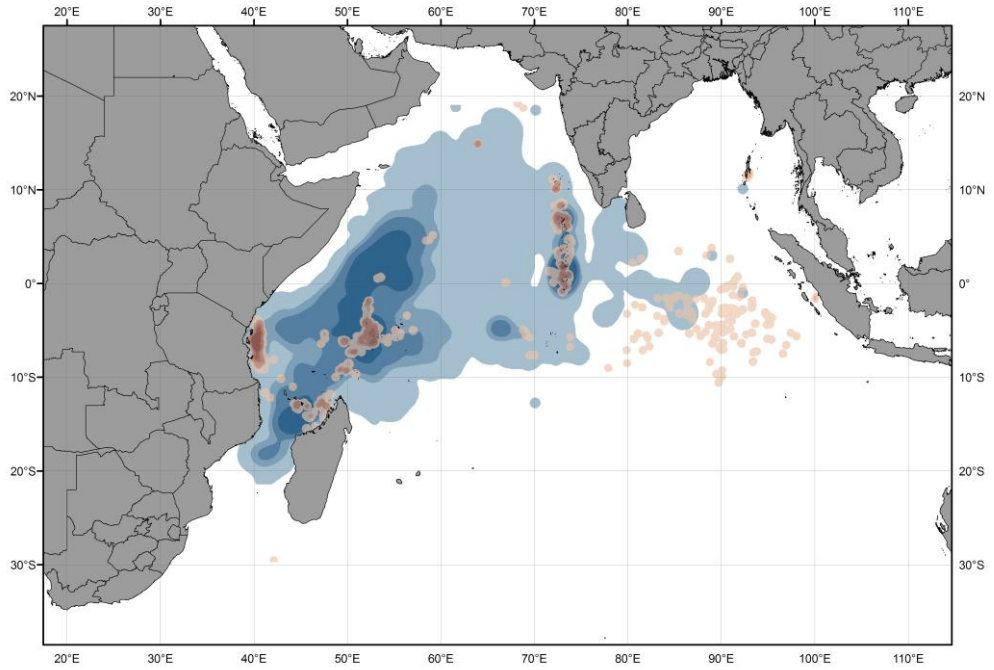



**Figure 16**. Densities of releases (in red) and recoveries (in blue) of SKJ. Data as of September 2011.

***Yellowfin tuna (YFT)***

- **Fisheries and catch trends**

Catches by gear, area, country and year from 1961 to 2010 are shown in **Figure 17**, **18** and **19**. Contrary to the situation in other oceans, the artisanal fishery component in the Indian Ocean is substantial, taking approximately 20-25 % of the total catch. Catches of yellowfin tuna (**Figure 17**) 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, ranging between 330,000 and 380,000 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 (530,000 t) and average annual catch for the period at 477,000 t (358,000 t over the period 1999–2002). Yellowfin tuna catches dropped markedly after 2006, with the lowest catches recorded in 2009, at around 275,000 t. Catch levels in 2010 are estimated to be at around 300,000 t, although they represent preliminary figures.

Although some Japanese purse seiners have fished in the Indian Ocean since 1977, the **purse seine (Figure 17)** 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 seiners typically take fish ranging from 40 to 140 cm fork length and smaller fish are more common in the catches taken north of the equator. Catches of yellowfin increased rapidly to around 127,000 t in 1993. Subsequently, they fluctuated around that level, until 2003-2005 when they were substantially higher (over or close to 200,000 t). Catch levels of yellowfin tuna decreased since 2006, ranging between 88,000 and 116,000 t, with the lowest value recorded in 2009. The amount of effort exerted by the EU purse seine vessels (fishing for yellowfin and other tunas) varies seasonally and from year to year.

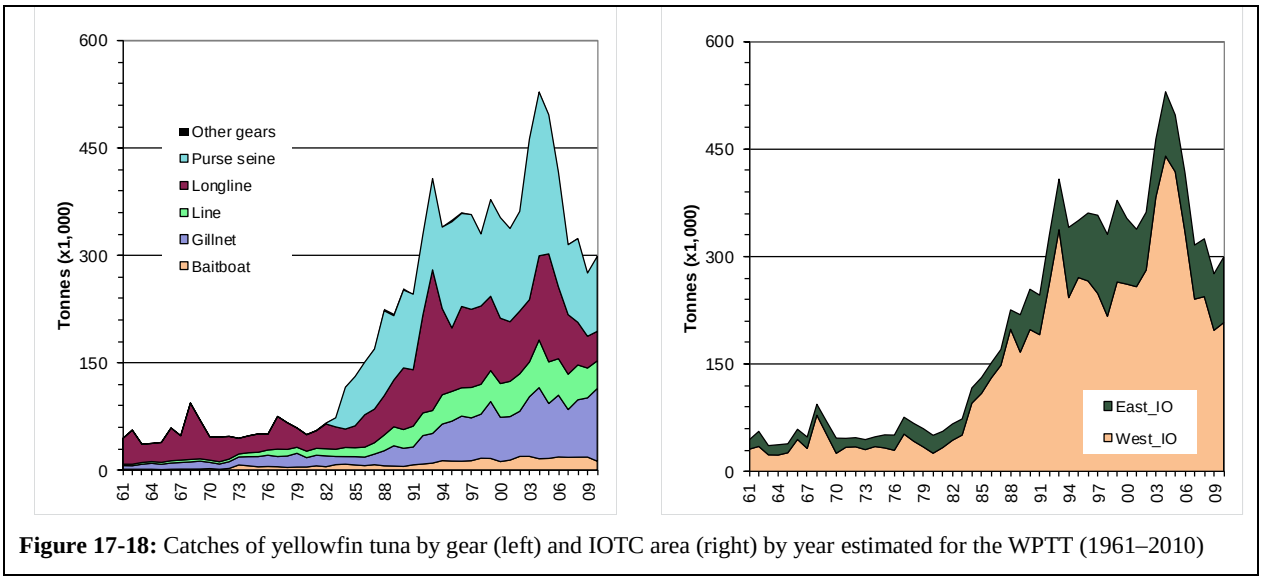



**Figure 17-18:** Catches of yellowfin tuna by gear (left) and IOTC area (right) by year estimated for the WPTT (1961–2010)

The purse seine fishery is characterized by the use of two different fishing modes (**Maps 25-36**): the fishery on floating objects (FADs), which catches large numbers of small yellowfin in association with skipjack and juvenile bigeye, and a fishery on free swimming schools, which catches larger yellowfin 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 took 36–63 % of the yellowfin 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 (49% for 1999–2002) or following years (55% for 2007–2009).

The **longline** fishery (**Figure 17**) started in the beginning of the 1950's and expanded rapidly over the whole Indian Ocean. It catches mainly large fish, from 80 to 160 cm fork length, although smaller fish in the size range 60 cm – 100 cm 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 (197,000 t). Catches between 1994 and 2004 fluctuated between 80,000 t and 118,000 t. The second highest catches of yellowfin tuna by longliners were recorded in 2005 (151,000 t). As it was the case with purse seine fisheries, since 2005 longline catches have ever felled with current catches estimated to be at around 41,000 t, representing a more than three-fold decrease over the catches in 2005. The Secretariat 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 has led to a marked drop in the levels of longline effort in one of the core fishing areas of the species (**Maps-31-36**).

Catches by **other gears**, namely pole-and-line, gillnet, troll, hand line and other minor gears, have increased steadily since the 1980s (**Figure 17**). 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 80,000 t. During the year 2004 the catches by artisanal gears attained its maximum over the time series, peaking at 183,000 t.

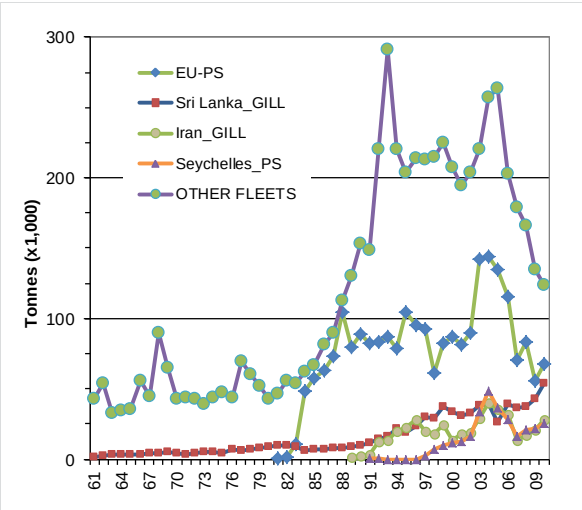
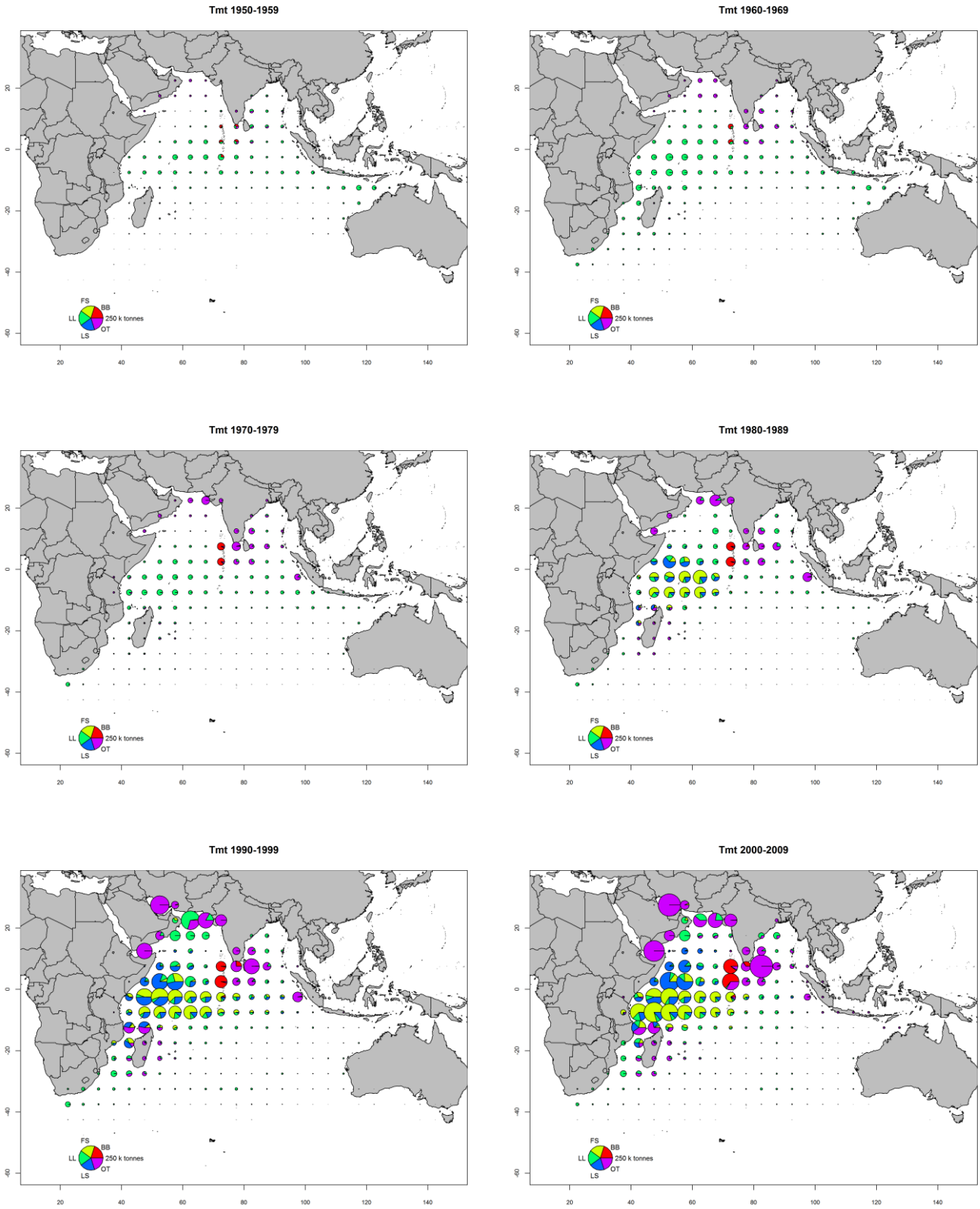



**Figure 19**: Catches of yellowfin tuna by fleet by year estimated for the WPTT (1961–2010)

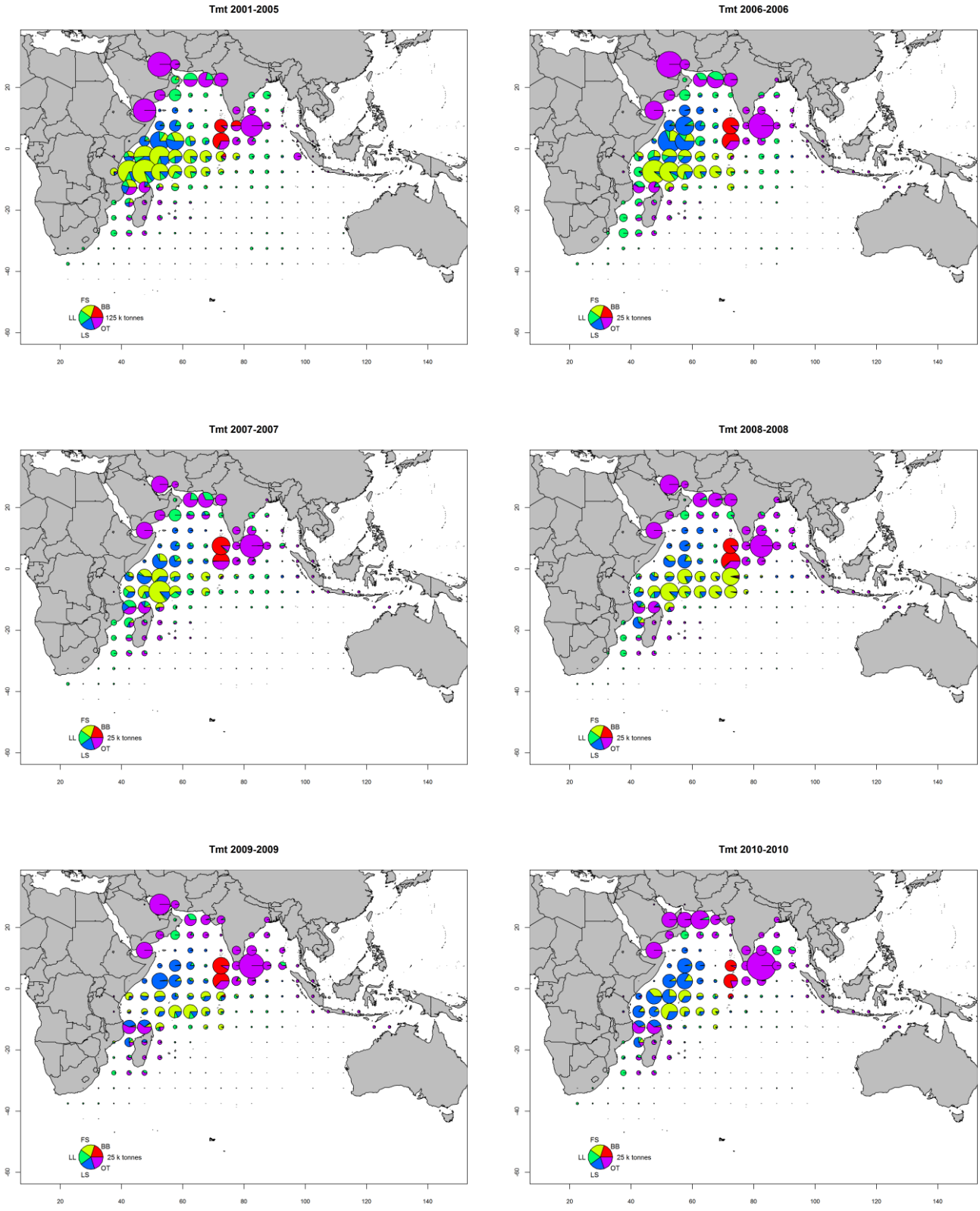
Yellowfin tuna catches in the Indian Ocean during 2003, 2004, 2005 and 2006 were much higher than in previous years, while bigeye catches remained at their average levels. Purse seiners currently take the bulk of the yellowfin tuna catch, mostly from the western Indian Ocean (**Figure 17**), around Seychelles (**Maps 25-36**). In 2003 and 2004, purse seine total catches made 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 catches have been near their highest levels and longliners have reported higher than normal catches in the tropical western Indian Ocean during this period.

Most yellowfin tuna are caught in Indian Ocean, north of 12°S, and in the Mozambique Channel, north of 25°S (**Maps 25-36**). In recent years (**Maps 31-36**) 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 2008 and 2010. 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 (Maps 31–36). 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 operate in the northwest Indian Ocean, with levels of activity near to those in the past (Maps 31–36).




**Maps 25-30:** 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




**Maps 31-36:** Time-area catches (total combined in tonnes) of yellowfin tuna estimated for the period 2001–2005 by type of gear and for 2006–2010, 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

- **YFT: Status of Fisheries Statistics at the IOTC**

**Retained catches** are generally well known (**Figure 20**); however, catches are less certain for:

- many coastal fisheries, notably those from Indonesia, Sri Lanka, Yemen, Madagascar and Comoros
- 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.

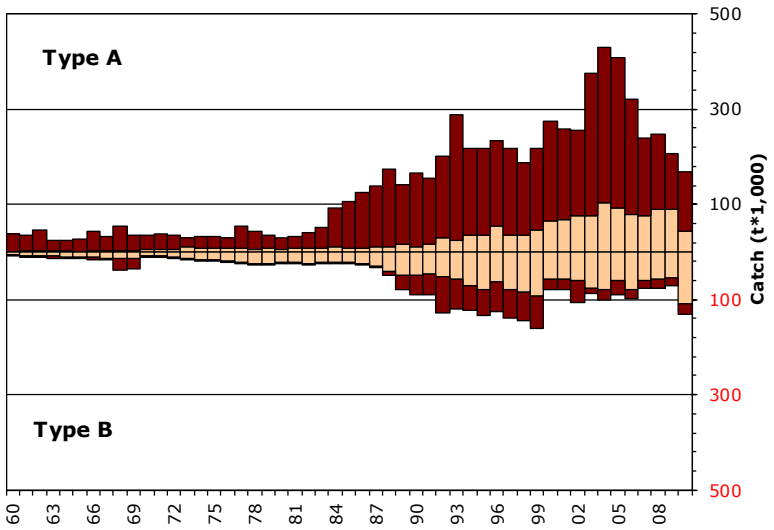



**Figure 20.** Uncertainty of annual catch estimates for yellowfin tuna (Data as of September 2011)

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

**Changes to the catch series:** There have not been significant changes to the catches of yellowfin tuna since the WPTT in 2010 (**Figure 21**).

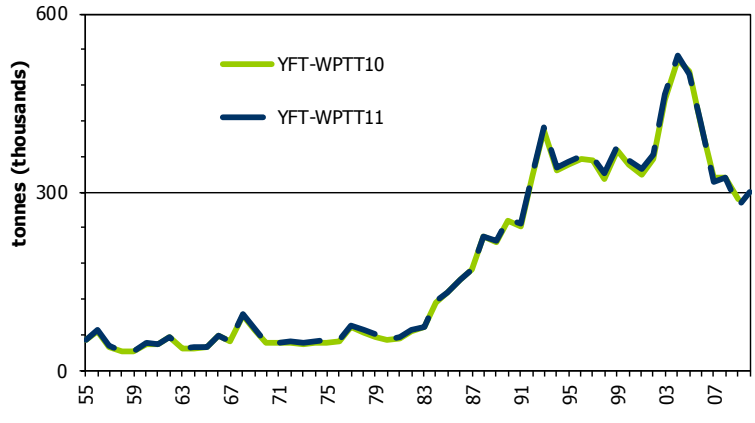



**Figure 21:** Yellowfin tuna: Catches used by the WPTT in 2010 versus those estimated for the WPTT11 (1955–2010)

**CPUE Series**: Catch-and-effort data are available from the major industrial and artisanal fisheries (**Figure 22**). However, these data are not available for some important artisanal 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 very little data available for the fresh-tuna longline fishery of Taiwan,China

- no data are available 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, Madagascar and Comoros

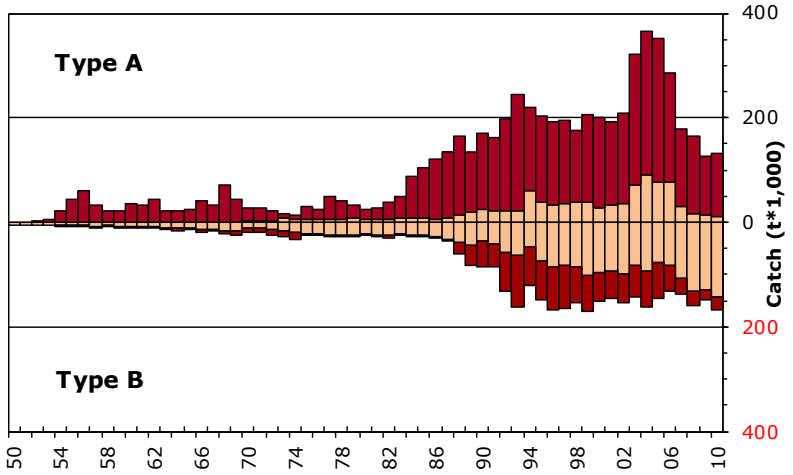



**Figure 22.** Uncertainty of time-area catches for yellowfin tuna (Data as of September 2011)

*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.*

**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.

**Catch-at-Size table**: This is available (**Figure 23**) 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
- the paucity of catch by area data available for some industrial fleets (NEI, Iran, India, Indonesia, Malaysia).

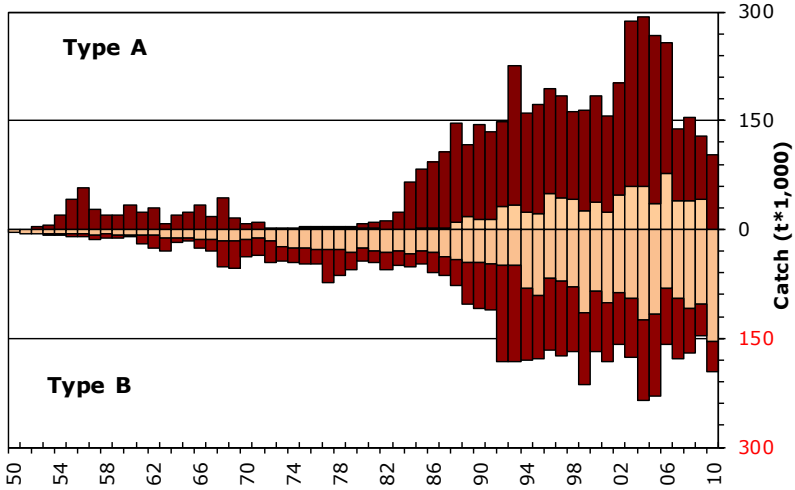



**Figure 23**. Uncertainty of catch-at-size data for yellowfin tuna (Data as of September 2011)

*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.*

- **YFT Tagging data:**

63,310 yellowfin (31.4%) 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. The remaining was tagged during small-scale tagging projects, and by other institutions with the support of IOTC, in Maldives, Indian, and in the south west and the eastern Indian Ocean. To date, 10,560, i.e. 16.7%, were recovered and reported to the IOTC headquarters.

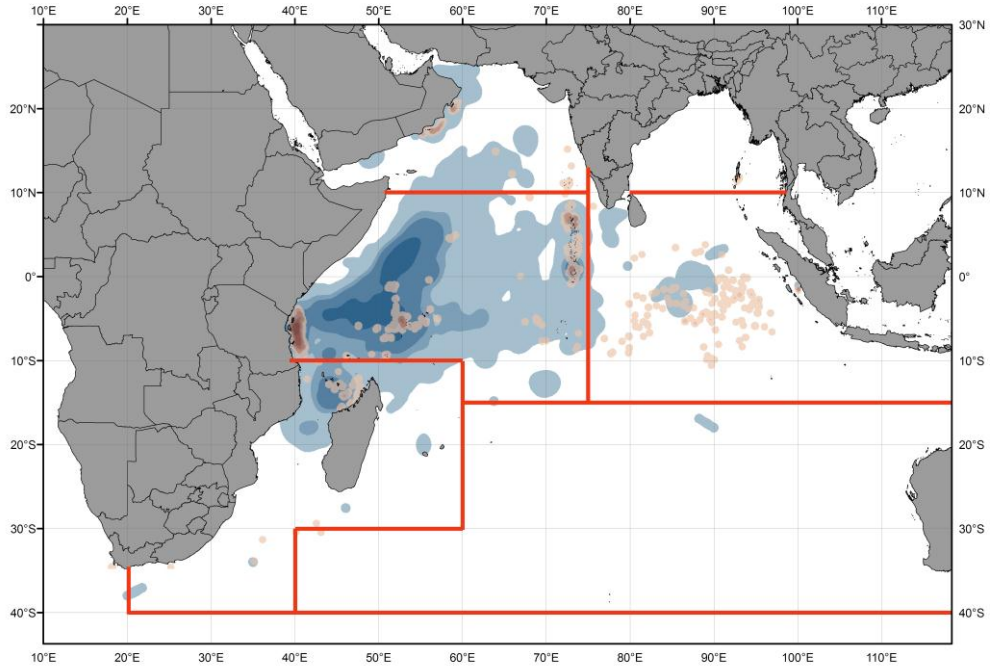



**Figure 24**. Densities of releases (in red) and recoveries (in blue) of YFT. The red line represents the stock assessment areas. Data as of September 2011.

## APPENDIX I

## ESTIMATION OF CATCHES OF NON-REPORTING FLEETS

The estimates of catches of non reporting fleets were updated in 2011:

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 need to be estimated during those years. This reduced confidence in the catch estimates for yellowfin tuna and bigeye tuna, and to a lesser extent, skipjack tuna during that period. 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** (**Figure 22**): 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.

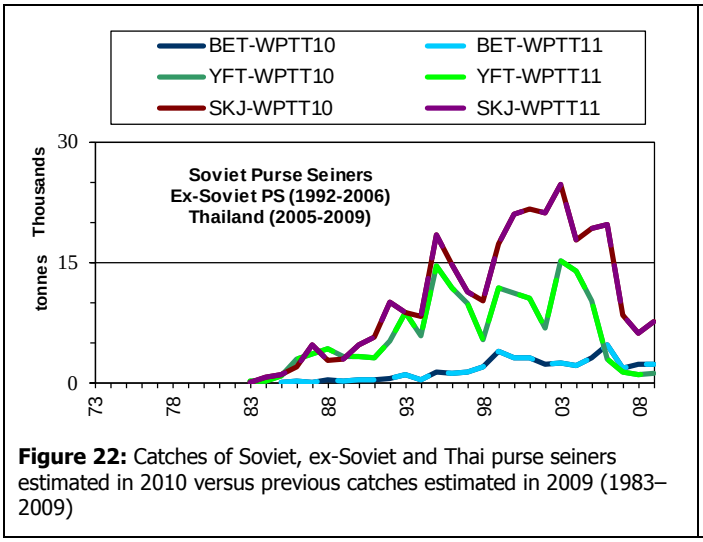



**Figure 22:** Catches of Soviet, ex-Soviet and Thai purse seiners estimated in 2010 versus previous catches estimated in 2009 (1983–2009)

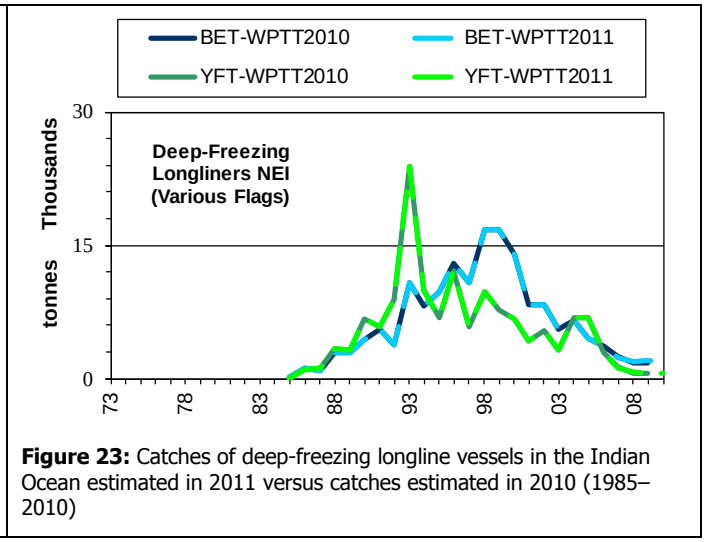



**Figure 23:** Catches of deep-freezing longline vessels in the Indian Ocean estimated in 2011 versus catches estimated in 2010 (1985–2010)

- **Deep-freezing longline** (**Figure 23**): 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 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** (**Figures 24-25**): 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 [9] and/or institutions in the countries where the fleets are based and/or foreign institutions. This applies to Indonesia (2002–2006), Thailand (1998–2006), Sri Lanka (2002–03), Malaysia (2000–2006), Oman (2004–2005) and Seychelles (2000–2002). Since 2007 Indonesia and Malaysia have reported catches for their longline fleets. However, 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 (2005-10), Indonesia (1973–2001), Thailand (1994–2097), Sri Lanka (1990–2001; 2004–05), Malaysia (1989–2099), 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 2006-10 have also been provided, including time area catches and effort for 2007-10. 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 1973–2010 and for Taiwan,China in years prior to 2001 were estimated as explained in the three bullet points above.

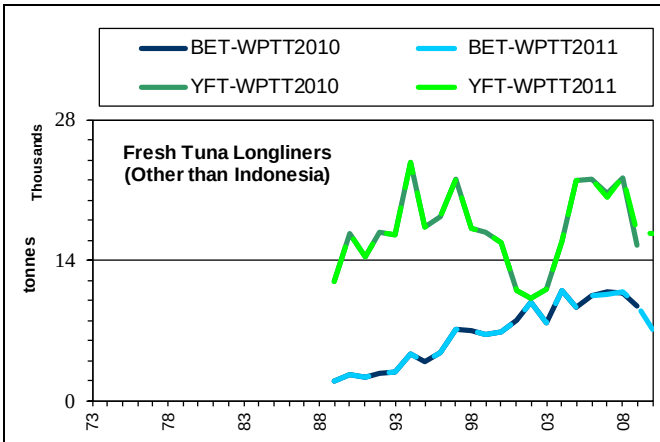



**Figure 24:** Catches of fresh-tuna longline vessels based in India, Malaysia, Maldives, Mauritius, Oman, Seychelles, Singapore, Sri Lanka, Thailand and Yemen (mainly registered in China, Taiwan,China and Indonesia) estimated in 2010 versus catches estimated in 2011 (1989–2010)

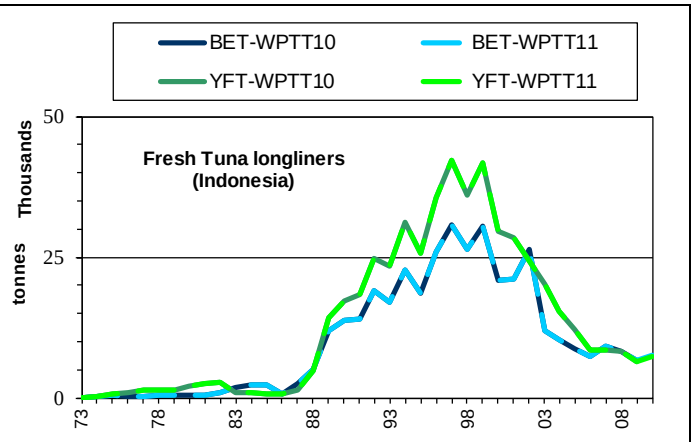



**Figure 25:** Catches of fresh-tuna longline vessels based in Indonesia (domestic and foreign) estimated in 2010 versus catches estimated in 2011 (1973–2010)

[9] Overseas Fishery Cooperation Foundation of Japan