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REVIEW OF THE STATISTICAL DATA AND FISHERY TRENDS FOR BILLFISH

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PURPOSE

To provide the Working Party on Billfish (WPB) with a review of the status of the information available on billfish species in the databases at the IOTC Secretariat as of **September 2014**, as well as a range of fishery indicators, including catch and effort trends, for fisheries catching billfish in the IOTC area of competence. It covers data on nominal catches, catch-and-effort, and size-frequency.

BACKGROUND

Prior to each WPB 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 WPB 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 by the secretariat for billfish, in accordance with IOTC Resolution 10/02 *Mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*[2], for the period 1950–2013.

The document describes the progress achieved in relation to the collection and verification of data and identifies problem areas as assessed from the information available.

The document also provides: summaries of important reviews to series of historical catches for billfish species (**Appendix I**); a range of fishery indicators, including catch and effort trends, for fisheries catching billfish in the IOTC area of competence (**Appendix II**); and the range of equations used by the IOTC Secretariat to convert billfish measurements between non-standard and the standard measurement used for each species (**Appendix III**).

The report covers the following areas:

- Overview
- Main issues relating to the data available on billfish
- Overview of billfish fisheries in the Indian Ocean:
    - Catch trends
    - Status of fisheries statistics for billfish.

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 10/08; IOTC Resolution 05/03; IOTC Resolution 11/03; IOTC Resolution 12/05; IOTC Resolution 13/07)).

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

Length frequency data: individual body lengths of IOTC species per fleet, year, gear, fishing mode, quarter and 5 degree square areas.

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[2] This Resolution superseded IOTC Resolutions 98/01, 05/01 and 08/01

Billfish species and main fisheries in the Indian Ocean

Table 1 below shows the five species of billfish under IOTC management.

Table 1. Billfish tuna species under the IOTC mandate

IOTC code	English name	Scientific name
BLM	Black marlin	*Makaira indica*
BUM	Blue marlin	*Makaira nigricans*
MLS	Striped marlin	*Tetrapturus audax*
SFA	Indo-Pacific sailfish	*Istiophorus platypterus*
SWO	Swordfish	*Xiphias gladius*

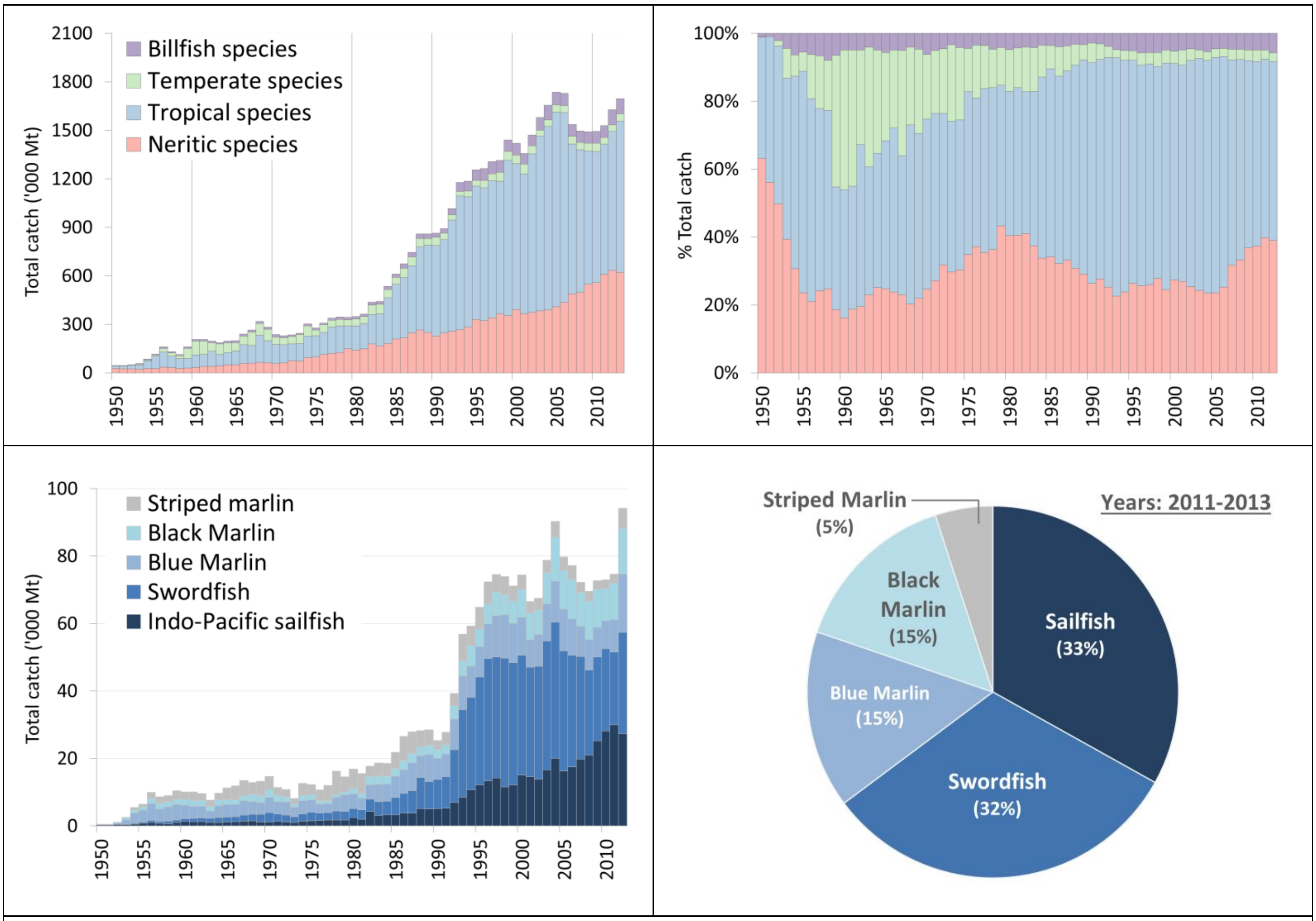
DISCUSSION

The contribution of billfish to the total catches of IOTC species in the Indian Ocean has remained relatively constant over the years (Fig. 1a, b), accounting for around 5% of the total catch of IOTC species. Total catches of billfish species have generally increased in line with other species groups under the mandate of IOTC, increasing from around 25,000 t in the early 1990s to nearly 75,000 t in the mid-1990s. Since then, average catches per annum have remained relatively stable at between 70,000 t and 75,000 t, with the exception of 2004 and 2012–2013 when catches over 90,000 t were reported (mostly attributed to increases in catches of Blue marlin, and Striped marlin) (Fig. 1c).

Of the five billfish species, Sailfish and Swordfish account for 65% of the catch in recent years (2011–13; Fig. 1d), followed by Blue Marlin and Black Marlin with 15% of the total catch each, and the remaining 5% accounted for by Striped Marlin. The importance of each species, in terms of share of total catch of billfish, has changed over time – mostly as a result of changes to the number of longline vessels. Catches of Swordfish in particular increased during the 1990s as a result of changes in targeting by Taiwan,China, and the arrival of European longline fleets operating in the area, increasing the share of total billfish catch from 20–30% in the early 1990s to as much as 50% by 2002. Catches of Swordfish over the last 10 years have since declined back to around a third of the total billfish catch, largely as a result of declining catches from Taiwan,China. Very large catches of marlins were also recorded in 2012 and, to a lesser extent, 2013. This increase in the catches is likely to come from increased activities by longliners in waters of the western central and northwest Indian Ocean. The return of the fleet is the consequence of increased security in the area off Somalia.

The majority of catches of billfish are caught by longline vessels. Up to the early 1980s longline vessels accounted for over 90% of the total billfish (largely as bycatch); in the last 20 years the proportion has fallen to between 50% to 70% as catches from gillnet fisheries have become increasingly important for a number of fleets such as Iran and Sri Lanka. In addition the number of longline vessels has also declined in recent years in response to the threat of Somali piracy in the western tropical Indian Ocean. Nevertheless, catches are still dominated by a number of longline fleets – namely Taiwan,China and European fleets, fleets that seem to be resuming fishing activities in their main fishing grounds.

While a number countries in the IOTC region have important fisheries for billfish (Fig. 2), in recent years six countries (Sri Lanka, Indonesia, Taiwan,China, I.R. Iran, Pakistan and India), have reported as much as 75% (from 2011–13) of the of the total catches of billfish species from all countries and species combined.



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

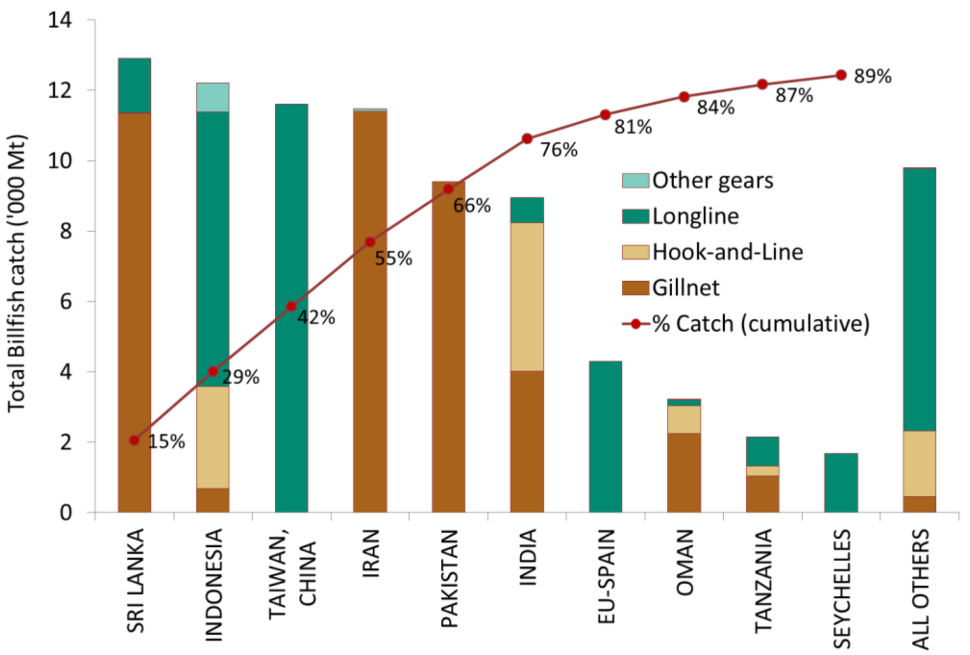


Fig. 2: Billfish (all species): average catches in the Indian Ocean over the period 2010–13, by country. Countries are ordered from left to right, according to the importance of catches reported. The red line indicates the (cumulative) proportion of catches of all billfish species for the countries concerned, over the total combined catches reported from all countries and fisheries.

MAIN ISSUES IDENTIFIED RELATING TO THE STATISTICS OF BILLFISH

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

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

- **Drifting gillnet** fisheries of **I.R. Iran** and **Pakistan**: In recent years I.R. Iran has reported catches of marlins and swordfish for its gillnet fishery, including catches for the years 2012 and 2013. The IOTC Secretariat used the new catches reported by I.R. Iran to re-build the historical series of catches of billfish for its offshore gillnet fishery. In addition, the catches reported by Pakistan for recent years, including swordfish and black marlin, differ markedly from alternative estimates received by the IOTC Secretariat. In recent years both fisheries have reported catches of billfish at around 20,000 t (20% of the total catches). Catches for this component remain very uncertain.
- **Gillnet/longline** fishery of **Sri Lanka**: In recent years Sri Lanka has caught over 10% of the catches of marlins in the Indian Ocean. Although Sri Lanka has reported catches of marlins by species for its gillnet/longline fishery, the catch ratio of blue marlin to black marlin has changed dramatically over time. This is thought to be a sign of frequent misidentification rather than the effect of changes in catch rates for this fishery. Although the IOTC Secretariat adjusted the catches of marlins using proportions derived from years with good monitoring of catches by species, the catches estimated remain uncertain.
- **Artisanal** fisheries of **Indonesia**: The catches of billfish reported by Indonesia for its artisanal fisheries in recent years are considerably higher than those reported in the past, and represent around 5% of the total catches of billfish in the Indian Ocean. In 2011 the Secretariat revised the complete nominal catch dataset for Indonesia, using information from various sources, including official reports. However, the quality of the dataset for the artisanal fisheries of Indonesia is thought to be poor, with a likely underestimation of catches of billfish in recent years.
- **Artisanal** fisheries of **India**: In early 2012 the Secretariat revised the complete nominal catch dataset for India, using new information available. The catches of billfish estimated in recent years represent around 8% of the total catches in the Indian Ocean, and refer mainly to Indo-Pacific sailfish and black marlin. To date, India has not reported catch-and-effort data for its artisanal fisheries.

2. Catch-and-Effort data from Sport Fisheries:

- **Sport** fisheries of **Australia, France(Reunion)**, **India**, **Indonesia**, **Madagascar**, **Mauritius**, **Oman, Seychelles**, **Sri Lanka**, **Tanzania**, **Thailand** and **UAE**: To date, no data have been received from any of the referred sport fisheries. Sport fisheries are known to catch billfish species, in particular blue marlin, black marlin and Indo-Pacific sailfish. Although data are available from other sport fisheries in the region (Kenya, Mauritius, Mozambique, South Africa), this information cannot be used to estimate levels of catch for other fisheries.

3. Catch-and-Effort data from Industrial Fisheries:

- **Longline** fishery of **Indonesia**: The catches of swordfish and marlins for the fresh tuna longline fishery of Indonesia may have been underestimated in the past due to them not being sampled sufficiently in port and to the lack of logbook data from which to derive estimates. The catches of billfish estimated in recent years (all species combined) represent around 10% of the total catches in the Indian Ocean, especially swordfish and blue marlin. Catches for this component are highly uncertain.
- **Longline** fishery of **India**: In recent years, India has reported very incomplete catches and catch-and-effort data for its commercial longline fishery. The IOTC Secretariat has estimated total catches for this period using alternative sources, the final catches estimated considerably higher than those reported (representing 2% of the total catches of billfish in recent years).
- **Longline** fishery of the Republic of **Korea**: The nominal catches and catch-and-effort data series for billfish for the longline fishery of Korea are conflicting, with nominal catches of swordfish and marlins lower than the catches reported as catch-and-effort for some years. Although in 2010 the IOTC Secretariat revised the nominal catch dataset to account for catches reported as catch-and-effort, the quality of the estimates remains unknown. However, the catches of longliners of the Rep. of Korea in recent years are very small.
- **Longline** fishery of **EU-Spain:** To date, the Secretariat has not received catch-and-effort data for marlins and sailfish for the longline fishery of EU-Spain.

- **Purse seine** fisheries of **Seychelles**, **Thailand**, **I.R. Iran** and **Japan**: To date, the referred countries have not reported catches of billfish from purse seiners, although they are thought to be very low.

4. Size data from All Fisheries:

- Size data for all billfish species is generally considered unreliable and insufficient to be of use for stock assessment purpose, as sampling numbers for all species are below the minimum sampling coverage one fish per tonne of catch recommended by IOTC; and the quality of the samples collected by fishermen on commercial boats cannot be verified.
- **Longline** fishery of **Taiwan,China**: Size data have been available for the longline fishery of Taiwan,China since 1980; however, the IOTC Secretariat has identified some issues in the length frequency distributions, in particular fish recorded under various types of size class bins (e.g. 1cm, 2cm, 10cm, etc.) all reported under a unique class bin (e.g. 2cm, with all fish between 10-20 cm reported as 10-12cm). For this reason, the average weights estimated for this fishery are considered unreliable.
- **Gillnet** fisheries of **Iran** and **Pakistan:** To date, Iran and Pakistan have not reported size frequency data for their gillnet fisheries.
- **Gillnet/longline** fishery of **Sri Lanka:** Although Sri Lanka has reported length frequency data for swordfish and marlins in recent years, the lengths reported are considered highly uncertain, due to misidentification of marlins and likely sampling bias (large specimens of swordfish and marlins are highly processed and not sampled for length, while small specimens are sampled).
- **Longline** fisheries of **India** and **Oman:** To date, India and Oman have not reported size frequency data for their commercial longline fisheries.
- **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 disaggregated by month and fishing area (5x5 grid) and refer mostly to the component of the catch that is unloaded fresh. The quality of the samples in the IOTC database is for this reason uncertain.
- **Fresh-tuna longline** fishery of **Taiwan,China[3]:** Data are only available for striped marlin and swordfish for the year 2010, with no size data available for other species or years.
- **Longline** fishery of **Japan:** The number of samples reported and total number of fish sampled for the longline fishery of Japan since 2000 has been very low.
- **Artisanal** fisheries of **India** and **Indonesia**: To date, India and Indonesia have not reported size frequency data for their artisanal fisheries.

5. Biological data for all billfish species:

- Industrial **longline** fisheries, in particular **Taiwan,China**, **Indonesia**, **EU**, **China** and the **Republic** of **Korea**: The Secretariat had to use length-age keys, length-weight keys, and processed weight-live weight keys for billfish species from other oceans due to the general paucity of biological data available from the fisheries indicated.
- Industrial **longline** fisheries, in particular **Taiwan,China**, **Indonesia**, **EU**, and **China**: There has not been regular reporting of length frequency data by sex from any of the referred fisheries.

[3] Refers to Taiwan Province of China.

2. STATUS OF FISHERIES STATISTICS FOR BILLFISH SPECIES

Swordfish (SWO)

- **Catch trends**

Over 90% of Swordfish are caught mainly using drifting longlines (>85%), on longline fisheries directed to tunas (**Table 1,** LL) or swordfish (**Table 1,** ELL), while the remaining the catches are taken by other fisheries, in particular drifting gillnets. Between 1950 and 1980, catches of swordfish in the Indian Ocean slowly increased in tandem with the level of coastal state and distant water fishing nation longline effort targeting tunas (**Fig. 3**). Swordfish were mainly a bycatch of industrial longline fisheries before the early 1990's with catches slightly increasing from 1950 to 1990 proportionally to the increase in the catches of target species (tropical and temperate tunas).

The catches of swordfish markedly increased after 1990, from around 8,000 t in 1991 to a peak of 36,000 t in 1998 and 37,000 t in 2004. The change in target species from tunas to swordfish by part of the fleet of Taiwan,China along with the development of longline fisheries in Australia, Reunion island, Seychelles and Mauritius and the arrival of longline fleets from the Atlantic Ocean (EU,Portugal, EU,Spain the EU,UK and other fleets operating under various flags[4]), all targeting swordfish, are the main reasons for this significant increase.

Since 2004, annual catches have declined steadily, largely due to the continued decline in the number of active Taiwan,China longliners in the Indian Ocean (**Fig. 3**). Annual catches since 2004 have been dominated by the Taiwan,China and EU fleets (Spain, UK, France and Portugal), with the fishery extending eastward due to the effects of piracy actions (**Fig. 6**).

TABLE 1. Best scientific estimates of the catches of swordfish by type of fishery for the period 1950–2013 (in metric tons). Data as of September 2014.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
ELL	-	-	-	9	1,841	9,993	12,740	14,965	13,009	11,543	8,173	8,106	9,510	7,686	8,337	8,785
LL	282	1,425	2,136	4,372	22,689	20,048	24,204	17,390	17,129	16,080	13,497	13,726	11,740	10,332	17,484	17,575
OT	37	39	186	807	1,998	2,846	3,324	3,337	2,936	2,810	3,482	3,019	3,020	3,545	4,237	5,445
Total	**320**	**1,465**	**2,322**	**5,189**	**26,527**	**32,886**	**40,267**	**35,693**	**33,074**	**30,433**	**25,153**	**24,852**	**24,270**	**21,564**	**30,058**	**31,804**

Fisheries: Swordfish longline (**ELL**); Longline (**LL**); Other gears (**OT**)

TABLE 2. Best scientific estimates of the catches of swordfish by fishing area for the period 1950–2013 (in metric tons). Data as of September 2014

Area	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
NW	100	547	776	1,888	8,278	10,180	12,868	12,254	10,785	8,430	6,321	4,506	2,668	2,483	8,690	8,683
SW	14	254	406	606	8,624	7,682	6,325	9,791	8,995	7,423	6,437	6,381	8,211	7,005	7,354	7,349
NE	168	453	756	2,168	6,504	9,296	11,400	7,975	9,275	9,359	8,889	10,862	9,896	9,147	11,796	12,489
SE	37	203	307	387	3,034	5,709	9,641	5,656	4,014	5,207	3,502	3,097	3,483	2,923	2,215	3,283
OT	0	8	76	140	88	20	33	16	6	15	5	5	11	6	4	1
Total	**320**	**1,465**	**2,322**	**5,189**	**26,527**	**32,886**	**40,267**	**35,693**	**33,074**	**30,433**	**25,153**	**24,852**	**24,270**	**21,564**	**30,058**	**31,804**

Areas: Northwest Indian Ocean (**NW**); Southwest Indian Ocean (**SW**); Northeast Indian Ocean (**NE**); Southeast Indian Ocean (**SE**); Southern Indian Ocean (**OT**)

Longliners from **Taiwan,China** have been operating in the Indian Ocean since 1954, with catches of swordfish rarely higher than 1,000 t until 1979. Swordfish catches increased gradually from 1,000 in 1979 to 5,500 t in 1988. The catches by the Taiwanese fleet increased dramatically during the 1990's to over 12,000 t per year as the species was increasingly targeted by the fleet. After a peak of 18,000 t recorded in 1995, catches dropped to 12,000 t in 2004, and again in the following years, with catches in 2011 amounting to around 3,500 tons. Catches in recent years increased to values over 5,000 tons (**Fig. 4**).

[4] Senegal, Guinea, etc.

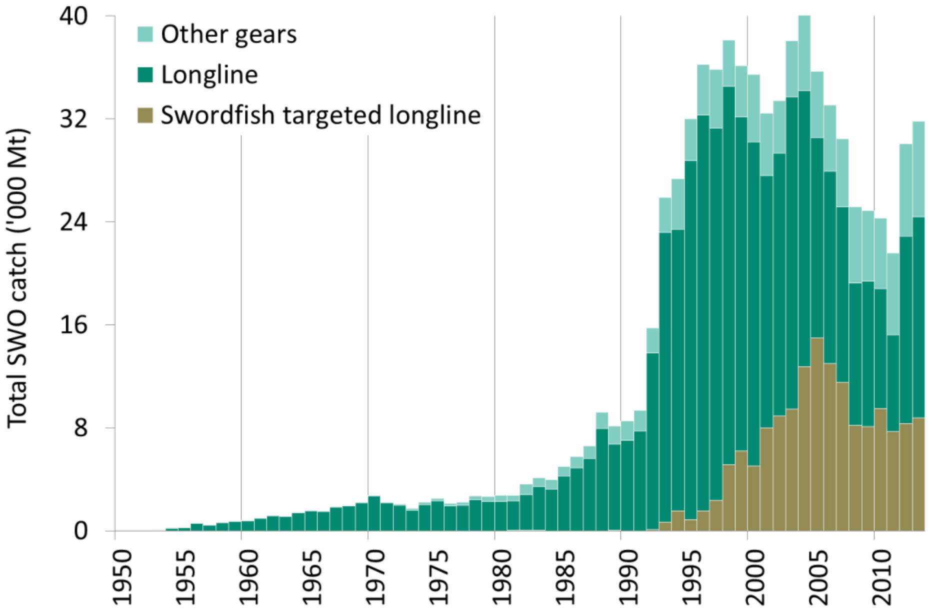


Fig. 3. Catches of swordfish by gear and year recorded in the IOTC Database (1950–2013).

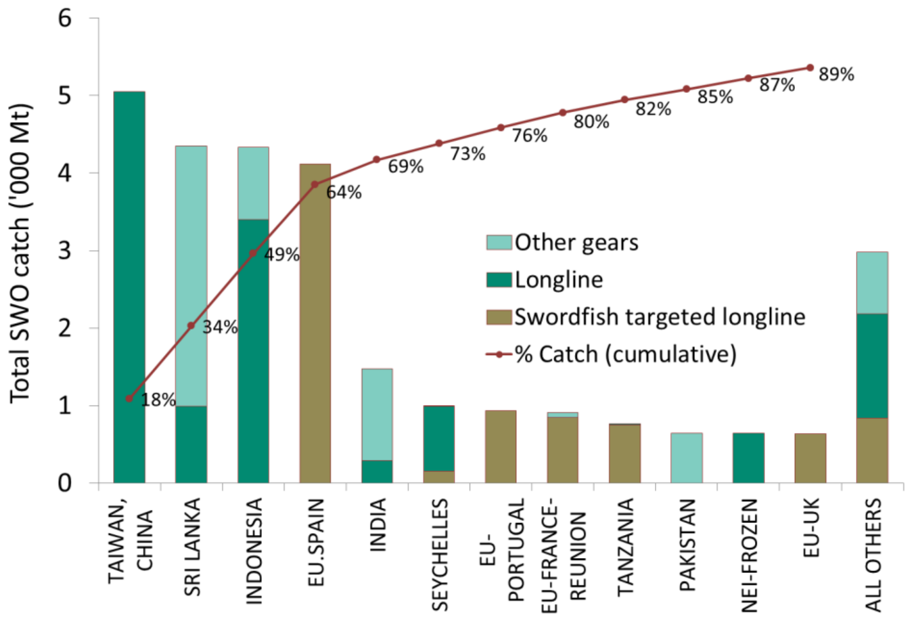


Fig. 4. Swordfish: average catches in the Indian Ocean over the period 2011–13, by country. Countries are ordered from left to right, according to the importance of catches of swordfish reported. The red line indicates the (cumulative) proportion of catches of swordfish for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

Catches of swordfish of up to 6,000 t have been recorded in recent years for a fleet of deep-freezing and fresh tuna longliners operating under flags of non-reporting countries (**NEI**). The catches have been low since 2007, at around 1,000 t (**Fig. 4**).

The catches of Swordfish of industrial longliners from **Japan** have increased proportionally to those of yellowfin tuna, the target species of this fleet during the first years of the fishery, and have remained stable until the early 1990's. The average annual catches over the last two decades have amounted to around 1,600 t, rising to over 2,500 t in 1994 and 1997, although most recently in 2012 and 2013 catches of between 600 t to 700 t have been reported.

In **Sri Lanka**, swordfish catches have ranged between 2,400 and 5,500 t over the last decade, with the highest catches recorded in 2013. These are taken mostly by boats that use a combination of drifting gillnets and longlines. Results from the sampling conducted by NARA[5] during 2005 and 2006 with the support of the IOTC-OFCF[6] Project in different locations in Sri Lanka led to a re-estimation of the historical catch series, in 2012[7].

The catches of **Indonesian** fresh-tuna longliners operating in Indian Ocean waters increased steadily until 2003 (3,400 t), and have decreased since then. It is, however, likely that the catches recorded for the swordfish are incomplete, as the statistics for years before 2003 are thought to be more uncertain (as port sampling was only initiated in 2003), and coverage of the frozen component of catches from port sampling, which is likely to contain significant amounts of swordfish, was not sufficient. Catch estimates for 2012 and 2013 are three-fold those in 2011 and remain uncertain.

During the last two decades, several domestic longline fisheries targeting swordfish started to operate in Reunion (EU-**France**), **Australia**, **Seychelles, South Africa** and, more recently, **Mauritius**, with total accumulated catches estimated to be between 2,000 t and 3,000 t in recent years (see 'All other fleets, **Fig. 4**).

Spanish, Portuguese and UK longliners coming from the Atlantic Ocean have been operating in the Indian Ocean since the early 90s with current accumulated catches around 5,000 t. Around 25% of the catches of swordfish in the Indian Ocean have been taken by vessels operating under EU flags in recent years.

The annual catches of swordfish by longliners from the **Republic of Korea**, recorded since 1965, have rarely exceeded 1,000 t. The highest catch, 1,100 t, was recorded in 1994. In 2010 the Secretariat revised the catches of swordfish for Korea over the time-series using catches reported as nominal catches and catch-and-effort.

Swordfish is mostly exploited in the western Indian Ocean (**Fig. 5a-f**), in waters off Somalia, and in the southwest Indian Ocean. Other important fisheries operate in waters off Sri Lanka, Western Australia and Indonesia. In 2009-11 (**Fig. 6a-f**) the catches of swordfish in the western tropical Indian Ocean have dropped considerably, especially in areas off Somalia, Kenya and Tanzania, from around 13,000 t in 2005 to 6,500 t in 2008, and in particular 2,500 t in 2011. The drop in catches is the consequence of a drop in fishing effort in the area by longline fisheries, due to either piracy or decreased fish abundance, or a combination of both. Catches in 2012 in this area were three-fold those in 2011.

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[5] National Aquatic Resources and Development Agency of Sri Lanka

[6] Overseas Fisheries Cooperation Foundation of Japan

[7] Moreno et al. (2012). Pilot project to improve data collection for tuna, sharks and billfish from artisanal fisheries in the Indian Ocean. Part II: Revision of catch statistics for India, Indonesia and Sri Lanka (1950-2011). Assignment of species and gears to the total catch and issues on data quality. Document presented at the 15th Session of the IOTC Scientific Committee, Seychelles, 10-15 December 2012. IOTC–2012–SC15–38

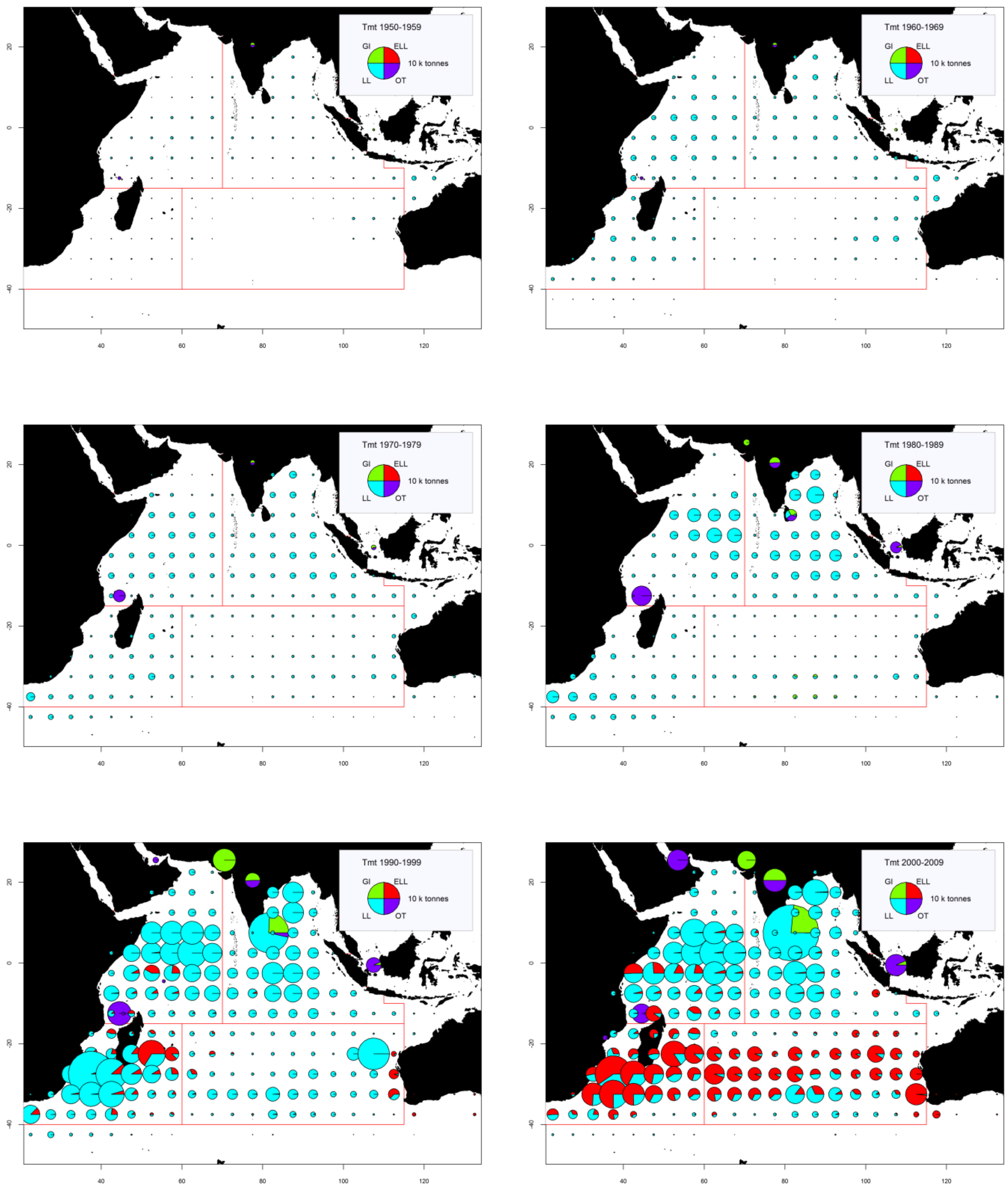


Fig. 5a-f: Time-area catches (total combined in tonnes) of swordfish as reported for longline fisheries targeting swordfish (**ELL**), other longline fisheries (**LL**), gillnet fisheries (**GI**), and for all other fleets combined (**OT**), for the period 1950-2009, by decade and type of gear. Red lines represent the areas used for the assessments of swordfish.

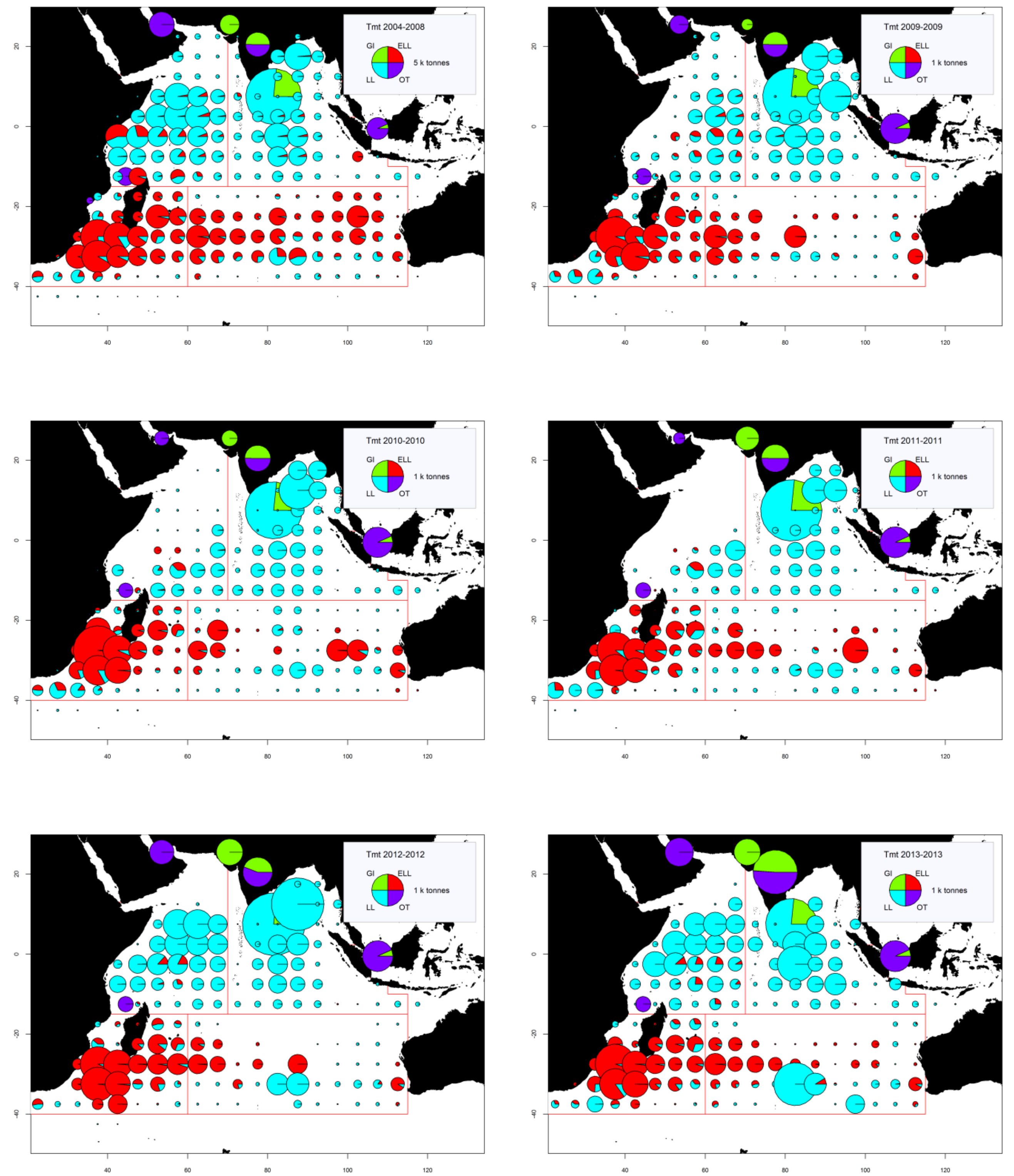


Fig. 6a-f: Time-area catches (total combined in tonnes) of swordfish for longline fisheries targeting swordfish (**ELL**), other longline fisheries (**LL**), gillnet fisheries (**GI**), and for all other fleets combined (**OT**), for the period 2004-2008 by type of gear and for 2009-13, by year and type of gear. Red lines represent the areas used for the assessments of swordfish.

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

Retained catches are fairly well known (**Fig. 8a**); however catches are uncertain for:

- **Drifting gillnet** fisheries of **I.R. Iran** and **Pakistan**: The IOTC Secretariat used the catches of swordfish and marlins reported by I.R. Iran for the years 2012 and 2013 to rebuild historical catches of billfish for this fishery. However, catch rates and species composition for the Iranian and Pakistani gillnet fisheries differ and they are also in contradiction with other estimates, derived from sampling in Pakistan. Estimates of catches of swordfish by drifting gillnet in Pakistan and I.R. Iran have represented over 4% of the total combined catches of swordfish reported, from all fisheries.

- **Longline** fishery of **Indonesia**: The catches of swordfish for the longline fishery of Indonesia may have been underestimated over the time series due to insufficient sampling coverage. Although the new catches estimated by the Secretariat for the period 2003–09 are thought to be more accurate, swordfish catches remain uncertain, especially in recent years (where they represent around 12% of the total catches of swordfish in the Indian Ocean).
- **Longline** fishery of **India: India** has reported very incomplete catches and catch-and-effort data for its commercial longline fishery. Although the new catches estimated by the Secretariat are thought to be more accurate, catches of swordfish remain uncertain (catches of swordfish in recent years represent less than 4% of the total catches of swordfish in the Indian Ocean).
- **Longline** fleets from **non-reporting** countries (NEI): The Secretariat had to estimate catches of swordfish for a fleet of longliners targeting tunas or swordfish and operating under flags of various non-reporting countries. The catches estimated since 2006 are, however, low (they represent around 3% of the total catches of swordfish in the Indian Ocean).

Discards are believed to be low although they are unknown for most industrial fisheries, mainly longliners. Discards of swordfish may also occur in the driftnet fishery of Iran, as this species has no commercial value in this country.

Changes to the catch series: There have been relatively minor revisions to the catches of swordfish since the WPB meeting in 2013 (**Fig. 7**). Any differences in the data series since the last WPB are relatively small changes to the nominal catch as a result of reallocation of catch reported as other billfish species or as aggregated species groups reported by Sri Lanka, and Pakistan to a lesser extent. These changes, however, did not lead to very significant changes in the total catch estimates for swordfish.

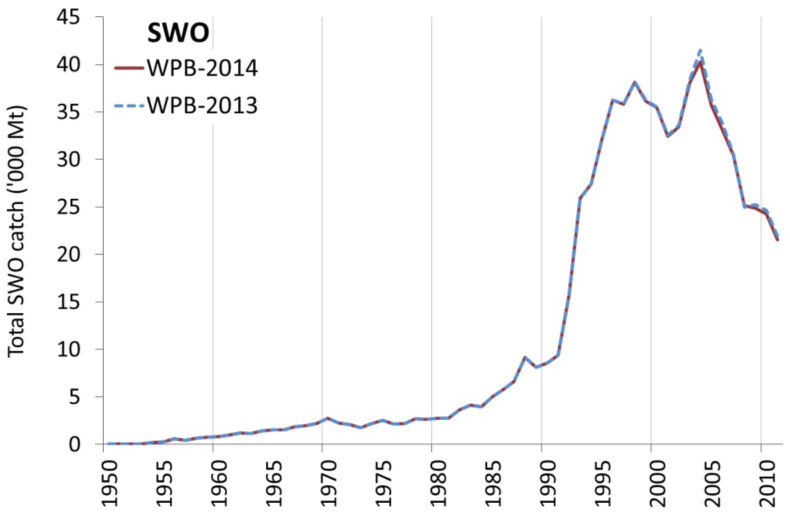


Fig. 7. Swordfish: catches used by the WPB in 2014 *versus* those estimated for the WPB in 2013 (1950–2011).

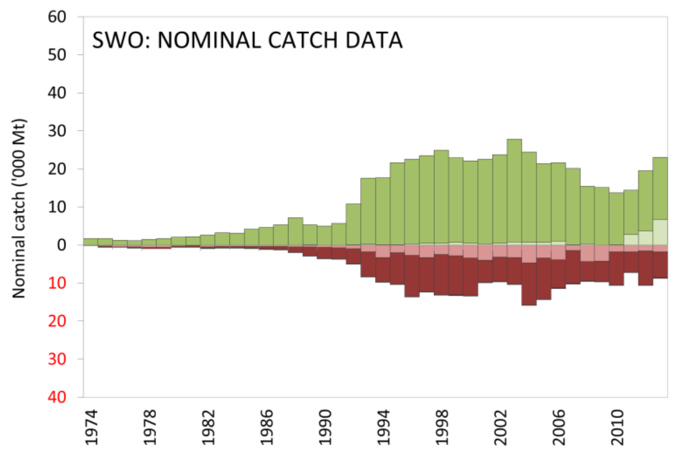
Catch–per–unit–effort (CPUE) Series (Fig. 8b): Catch and effort series are available from some industrial longline fisheries. Nevertheless, catch and effort are not available from some fisheries or they are considered poor quality, especially since the early 90s (**Indonesia**, fresh-tuna longliners from **Taiwan,China**[8], Non-reporting longliners (**NEI**)).

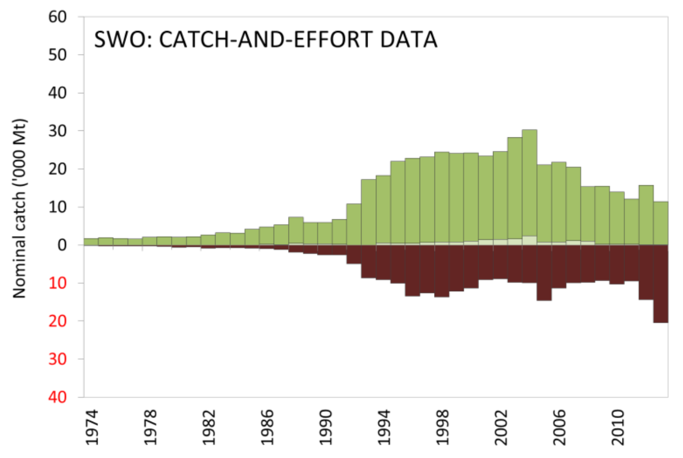
[8] Catch-and-effort statistics for the fresh-tuna longline fishery of Taiwan,China are available since 2007, although logbook coverage levels are still low.

In addition, catch-and-effort data are not available for the gillnet and longline fishery of Sri Lanka and the drifting gillnet fisheries of **Iran** and **Pakistan**.

Fish size or age trends (e.g. by length, weight, sex and/or maturity): In general, the amount of catch for which size data for the species are available before 2005 is still very low and the number of specimens measured per stratum has been decreasing in recent years (**Fig. 8c**).

- **Average fish weight** (**Appendix II**) can be assessed for several industrial fisheries although they are incomplete or poor quality for most fisheries before the early-80s and in recent years (low sampling coverage and time-area coverage of longliners from Japan). The average weights of swordfish are variable but show no clear trend.
- **Catch-at-Size(Age)** data are available but the estimates are thought to have been compromised for some years and fisheries due to:
    - the uncertainty in the length frequency data recorded for longliners of **Japan** and **Taiwan,China**, for which average weights of swordfish derived from length frequency data and catch-and-effort data are very different.
    - the uncertainty in the catches of swordfish for the drifting gillnet fisheries of **Iran** and the longline fishery of **Indonesia**.
    - the total lack of size data before the early-70s and poor coverage before the early-80s and for most artisanal fisheries (**Pakistan**, **India**, **Indonesia**).
    - the paucity of size data available from industrial longliners since the early-1990s (**Japan**, **Philippines**, **India** and **China**).
    - the lack of time-area catches for some industrial fleets (**Indonesia**, **India**, NEI).
    - the paucity of biological data available, notably sex-ratio and sex-length-age keys.





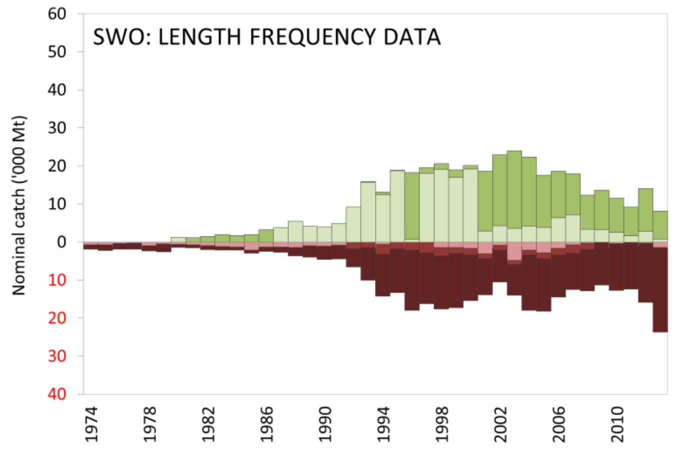


Fig. 8a-c. Swordfish: data reporting coverage (1974–2013).

Each IOTC dataset (nominal catch, catch-and-effort, and length frequency) are assessed against IOTC reporting standards, where: a score of 0 indicates the amount of nominal catch associated with each dataset that is fully reported according to IOTC standards; a score of between 2 – 6 refers to the amount of nominal catch associated with each dataset that is partially reported by gear and/or species (i.e., adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; a score of 8 refers to the amount of nominal catch associated with catch-and-effort data that is not available.

Data as of September 2014.

Key to IOTC Scoring system

Nominal Catch	By species	By gear
Fully available	0	0
Partially available (part of the catch not reported by species/gear)*	2	2
Fully estimated (by the IOTC Secretariat)	4	4

*Catch assigned by species/gear by the IOTC Secretariat; or 15% or more of the catches remain under aggregates of species

Catch-and-Effort	Time-period	Area
Available according to standards	0	0
Not available according to standards	2	2
Low coverage (less than 30% of total catch covered through logbooks)	2	
Not available at all	8	

Size frequency data	Time-period	Area
Available according to standards	0	0
Not available according to standards	2	2
Low coverage (less than 1 fish measured by metric ton of catch)	2	
Not available at all	8	

Key to colour coding

- Total score is 0 (or average score is 0-1)
- Total score is 2 (or average score is 1-3)
- Total score is 4 (or average score is 3-5)
- Total score is 6 (or average score is 5-7)
- Total score is 8 (or average score is 7-8)

Blue Marlin (BUM)

- **Catch trends**

The catch series for the blue marlin was substantially revised in 2014, following new reports of catch for drifting gillnet fleets. Blue marlin are caught mainly under drifting longlines (70%) and gillnets (25%) with remaining catches recorded under troll and hand lines (**Table 3**, **Fig. 9**). Blue marlins are considered to be a bycatch of industrial and artisanal fisheries. Longline catches of Blue marlin are typically higher than those of black marlin and striped marlin combined. In recent years, the fleets of Taiwan,China (longline), Indonesia (longline and handline), Iran and Pakistan (gillnet), and Sri Lanka (longline gillnet) account for around 90% of the total catch of blue marlin (**Fig. 12**). The distribution of blue marlin catches has changed since the 1980's with most of the catch now taken in the western areas of the Indian Ocean (**Figs. 11 & 12**).

Catch trends for blue marlin are variable; however, this may reflect the level of reporting. The catches of blue marlin under drifting longlines were more or less stable until the late-70's, at around 3,000 t to 4,000 t, and have steadily increased since then to reach values between 8,000 t and 13,000 t since the early 1990's. The largest catches reported by longlines were recorded in 2012 (~12,000 t) and 1998 (~11,000 t). The high catches in 2012 are likely to be the consequence of higher catch rates by some longine fleets, which resumed operation in the Western Tropical Indian Ocean. Catches under drifting longlines have been recorded under **Taiwan,China** and **Japan** fleets and, recently, **Indonesia**, **India**, **Sri Lanka** and several **NEI** fleets (**Fig. 10**). In recent years, the deep-freezing longliners from **Taiwan,China** and **Japan** have reported most of the catches of blue marlin in waters of the western and central tropical Indian Ocean and, to a lesser extent, the Mozambique Channel and the Arabian Sea (**Figs. 11 & 12**).

TABLE 3: Best scientific estimates of the catches of blue marlin by type of fishery for the period 1950–2013 (in metric tons). Data as of September 2014.

Fishery	By decade (average)						By year (last ten years)									
	1950s	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
LL	2,563	3,515	3,493	4,982	7,200	7,384	8,800	7,721	7,734	6,276	6,397	6,463	5,751	6,093	12,101	9,514
GN	1	2	124	761	2,357	2,687	3,172	4,545	2,977	2,559	2,410	2,049	2,198	3,148	4,879	4,032
HL	5	9	17	105	149	133	107	130	139	151	202	265	282	276	257	273
OT	0	0	0	2	4	7	5	7	8	8	11	15	15	16	15	16
Total	**2,570**	**3,527**	**3,634**	**5,850**	**9,711**	**10,211**	**12,085**	**12,404**	**10,857**	**8,994**	**9,019**	**8,791**	**8,246**	**9,532**	**17,252**	**13,834**

Fisheries: Gillnet (**GN**); Longline (**LL**); Hook-and-Line (**HL**), including handline, trolling, baitboat, and sport fisheries; Other gears (**OT**)

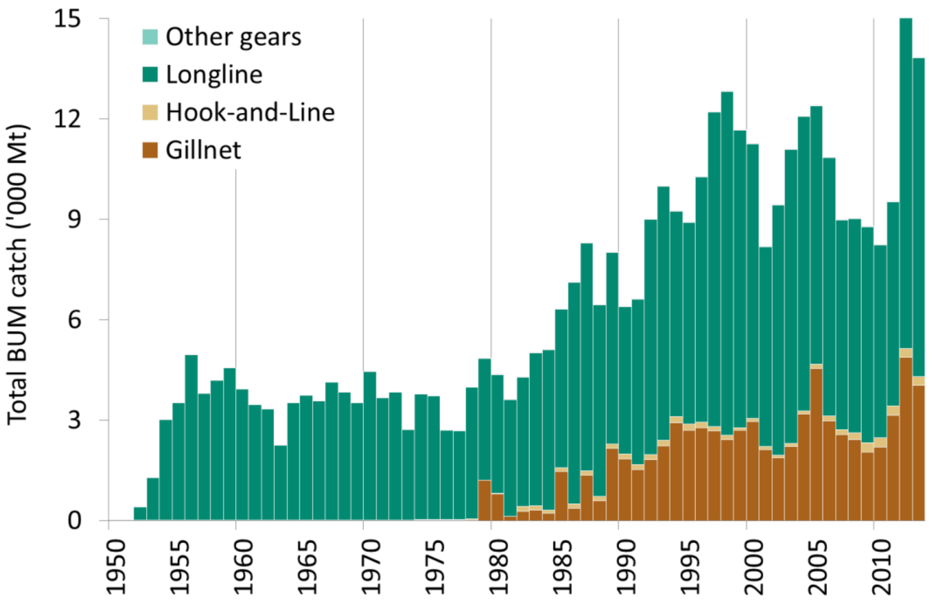


Fig. 9. Catches of blue marlin by gear and year recorded in the IOTC Database (1950–2013).

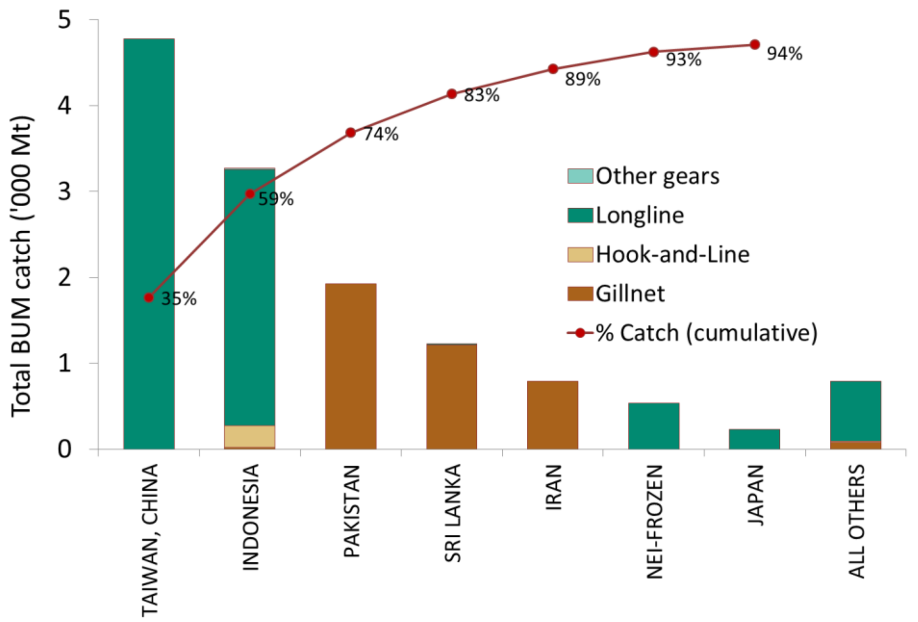


Fig. 10: Blue marlin: average catches in the Indian Ocean over the period 2010–13, by country. Countries are ordered from left to right, according to the importance of catches of blue marlin reported. The red line indicates the (cumulative) proportion of catches of blue marlin for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

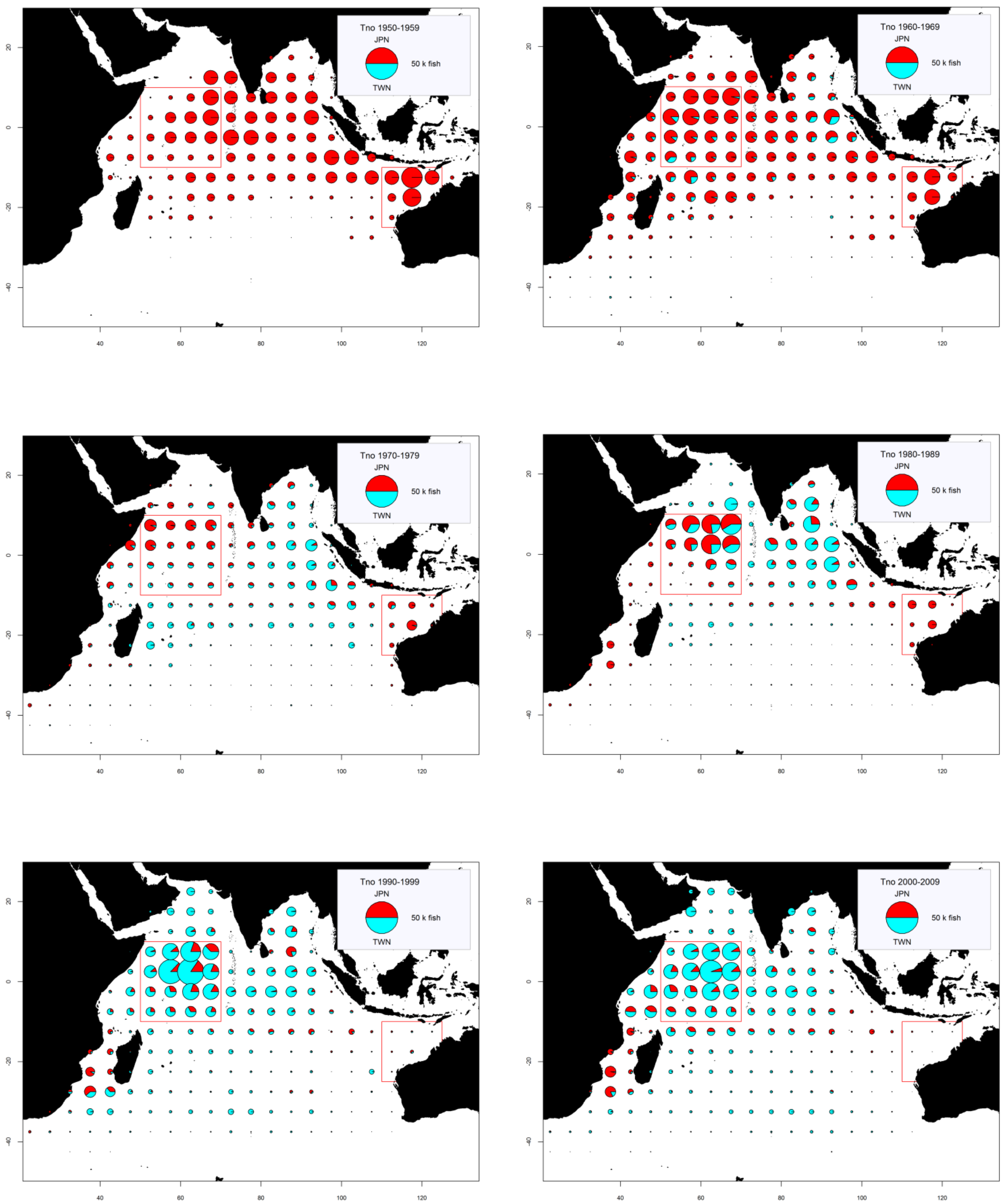


Fig. 11a-f. Time-area catches (in number of fish) of blue marlin as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for the period 1950-2009, by decade and fleet. Red lines represent the marlin hotspots identified by the IOTC WPB.

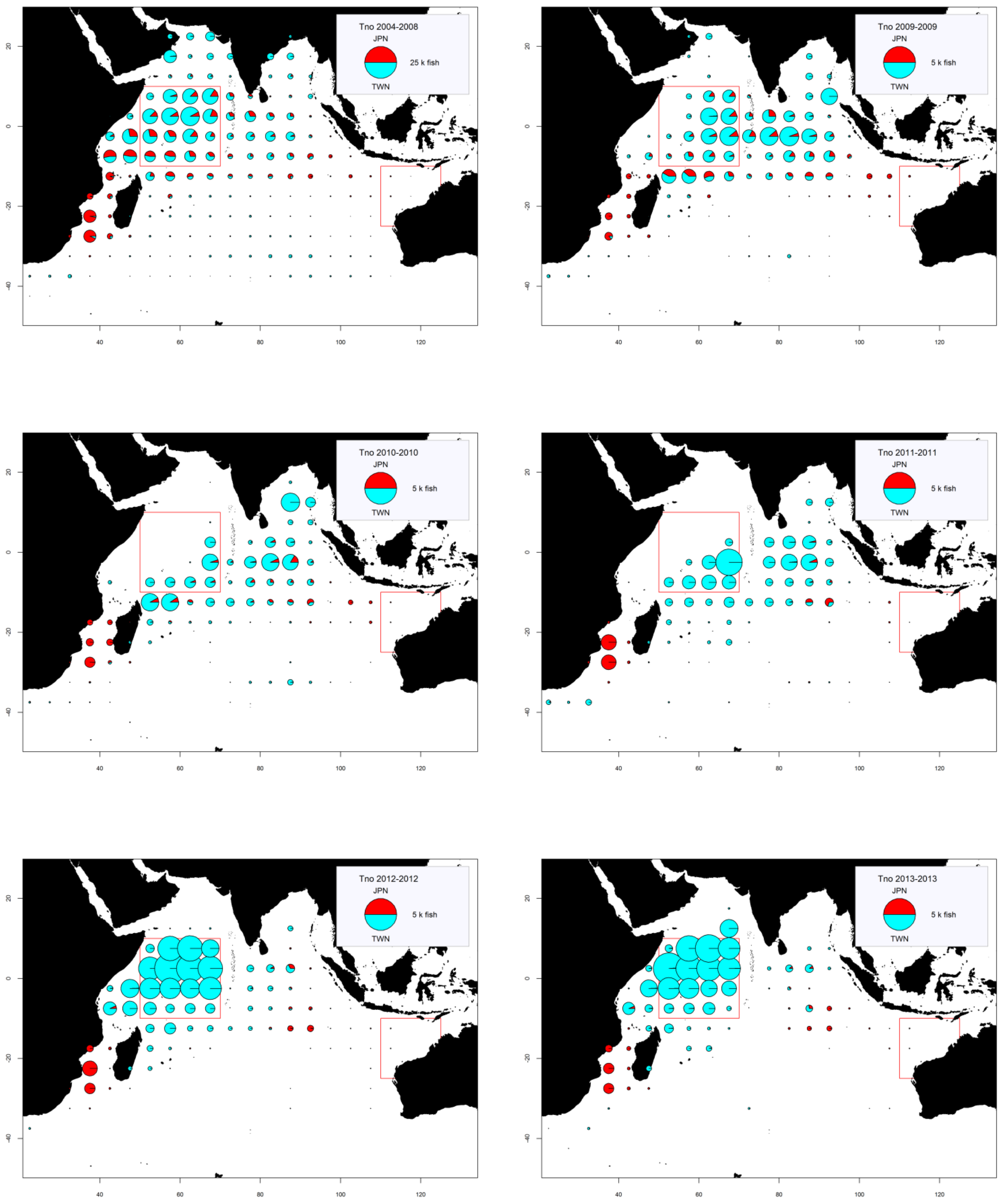


Fig. 12a-f. Time-area catches (in number of fish) of blue marlin as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for the period 2004–08 by fleet and for 2009–13, by year and fleet. Red lines represent the marlin hotspots identified by the IOTC WPB.

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

Minimum catch estimates have been derived from very small amounts of information and are therefore highly uncertain. Difficulties in the identification of marlins also contribute to the uncertainties of the information available to the Secretariat.

Retained catches are poorly known for most fisheries (**Fig. 14a**) due to:

- catch reports often refer to total catches of all three marlin species combined or as an aggregate of all billfish species; catches by species are estimated by the Secretariat for some years and artisanal (gillnet/longline fishery of **Sri Lanka** and artisanal fisheries of **India**, **Iran** and **Pakistan**) and industrial (longliners of **Indonesia** and **Philippines**) fisheries.
- catches of non-reporting industrial longliners (**India**, **NEI**) and the gillnet fishery of **Indonesia** are estimated by the Secretariat using alternative information
- catches are likely to be incomplete for industrial fisheries for which the blue marlin is not a target species
- conflicting catch reports: Longline catches from the **Republic of Korea** are reported as nominal catches, and catch and effort reports are conflicting, with higher catches recorded in the catch and effort table. For this reason, the Secretariat revised the catches of blue marlin for the Republic of Korea over the time-series using both datasets. Although the new catches estimated by the Secretariat are thought to be more accurate, catches of blue marlin remain uncertain for this fleet.
- a lack of catch data for most sport fisheries.

Discards are unknown for most industrial fisheries, mainly longliners. Discards of blue marlin may also occur in some gillnet fisheries.

Changes to the catch series: There have been relatively large revisions to the catch estimates of blue marlin since the WPB meeting in 2013 (**Fig. 13a**), mostly the result of changes to catch-by-species for Iran, and to a lesser extent Indonesia (**Fig. 13b**).

In previous years Iran has reported aggregated catches for all billfish species, which were then estimated by species and gear by the IOTC Secretariat. In 2014 Iran provided catches by billfish species, for 2012 and 2013, which significantly revises the catch-by-species previously estimated by the Secretariat.

The main change is the significantly higher proportions of black marlin rather than blue marlin reported by Iran, assigned to the offshore gillnet fishery. As a result of changes in the catch series for Iran – and revision of the catch-by-species for the offshore fishery for earlier years based on the 2012 and 2013 data – total catches of blue marlin have been revised down by as much as 20% for a number of years around the mid-2000’s (see Appendix I for more details).

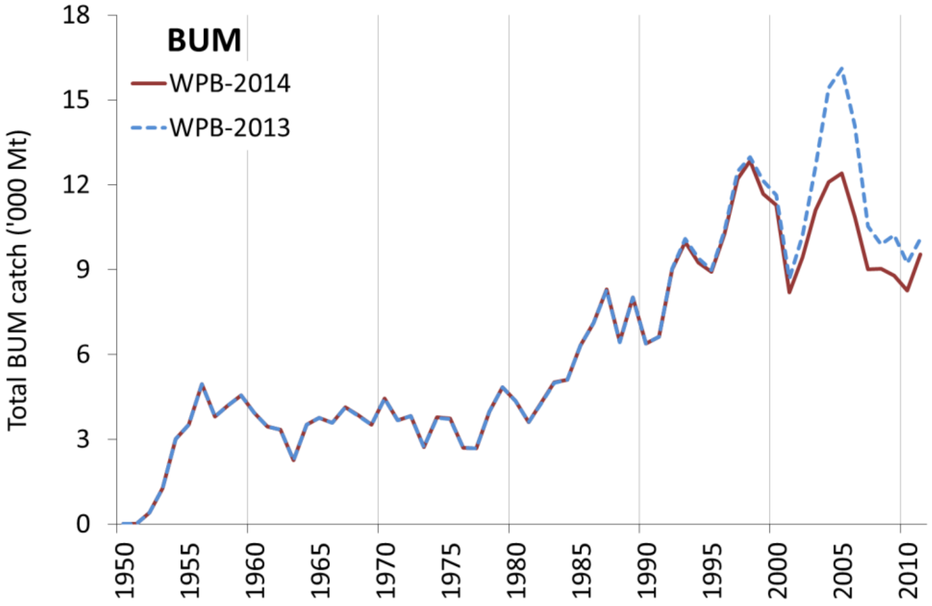


Fig. 13a. Blue marlin: catches used by the WPB in 2014 *versus* those estimated for the WPB in 2013 (1950–2011).

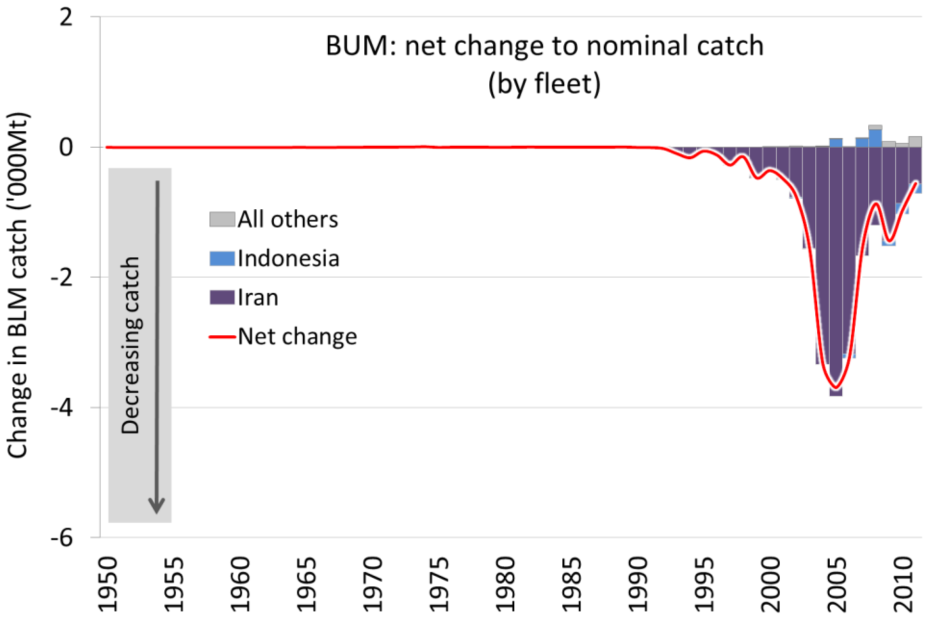


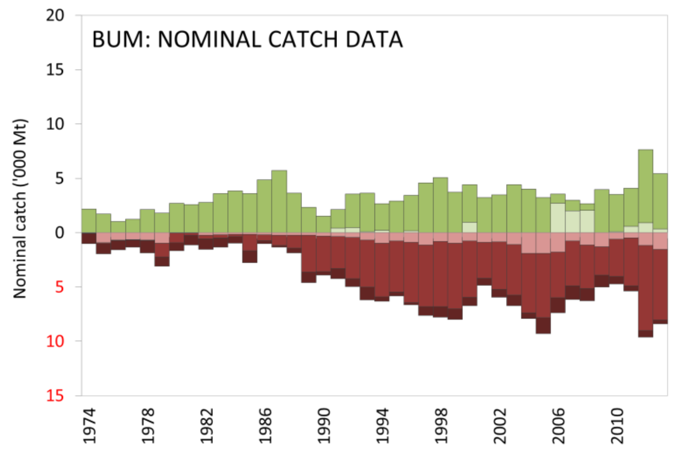
Fig. 13b. Blue marlin: revisions to catch estimates (WPB2014 –WPB2013) by fleet, (1950–2011).

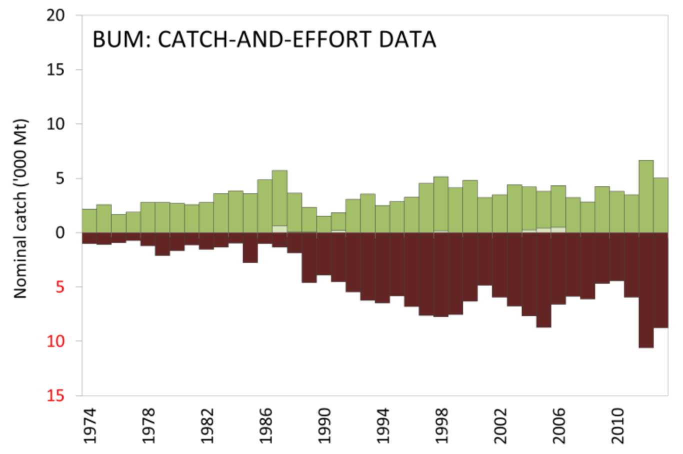
Catch–per–unit–effort (CPUE) Series (**Fig. 14b**): Nominal CPUE series are available from some industrial longline fisheries (primarily the Japanese longline fleet; **Appendix II**) although catches are likely to be incomplete (catches of non-target species are not always recorded in logbooks). No catch and effort data are available from sports fisheries, other than for partial data from the sports fisheries of Kenya; or other artisanal (gillnet fisheries of Iran and Pakistan, gillnet/longlines of Sri Lanka, gillnets of Indonesia) or industrial fisheries (NEI longliners and all purse seiners).

Fish size or age trends (e.g. by length, weight, sex and/or maturity; Fig. 14c): Average fish weight can only be assessed for the longline fishery of **Japan** since 1970 and **Taiwan,China** since 1980. However, the number of specimens measured on Japanese longliners in recent years is very low and miss-identification of striped and blue marlin may occur in some longline fisheries; the length frequency distributions derived from samples collected by fishermen on Taiwanese longliners are likely to be biased for the reasons explained on page 5 (**Appendix II**).

Catch-at-Size(Age) tables have not been built for blue marlin due to a lack of information reported by CPCs and the issues identified in some datasets. Fish size is derived from various length and weight information, however the reliability of the size data is reduced for some fleets and when relatively few fish out of the total catch are measured.

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





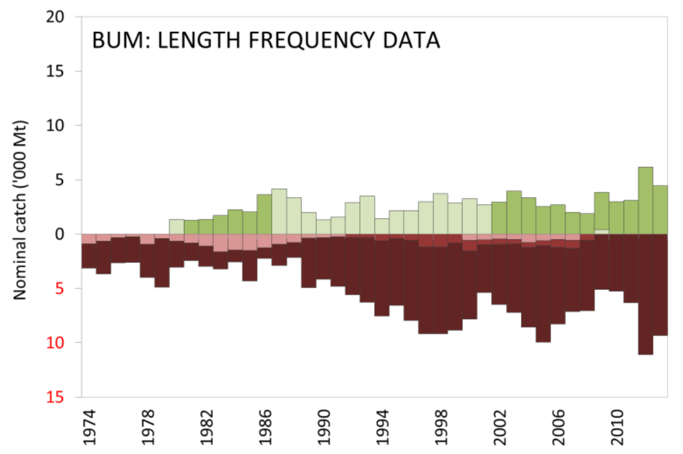


Fig. 14. Blue marlin: data reporting coverage (1974–2013).

Each IOTC dataset (nominal catch, catch-and-effort, and length frequency) are assessed against IOTC reporting standards, where: a score of 0 indicates the amount of nominal catch associated with each dataset that is fully reported according to IOTC standards; a score of between 2 – 6 refers to the amount of nominal catch associated with each dataset that is partially reported by gear and/or species (i.e., adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; a score of 8 refers to the amount of nominal catch associated with catch-and-effort data that is not available.

Data as of September 2014.

Key to IOTC Scoring system

Nominal Catch	By species	By gear
Fully available	0	0
Partially available (part of the catch not reported by species/gear)*	2	2
Fully estimated (by the IOTC Secretariat)	4	4

*Catch assigned by species/gear by the IOTC Secretariat; or 15% or more of the catches remain under aggregates of species

Catch-and-Effort	Time-period	Area
Available according to standards	0	0
Not available according to standards	2	2
Low coverage (less than 30% of total catch covered through logbooks)	2	
Not available at all	8	

Size frequency data	Time-period	Area
Available according to standards	0	0
Not available according to standards	2	2
Low coverage (less than 1 fish measured by metric ton of catch)	2	
Not available at all	8	

Key to colour coding

- Total score is 0 (or average score is 0-1)
- Total score is 2 (or average score is 1-3)
- Total score is 4 (or average score is 3-5)
- Total score is 6 (or average score is 5-7)
- Total score is 8 (or average score is 7-8)

Black Marlin (BLM)

- **Catch trends –**

The catch series for the black marlin was substantially revised in 2014, following new reports of catch for drifting gillnet fleets. Black marlin are caught mainly under drifting longlines (30%) and gillnets (50%) with remaining catches recorded under troll and hand lines (**Table 4, Fig. 15**). Black marlin are the bycatch of industrial and artisanal fisheries. In recent years, the fleets of **Sri Lanka** (longline and gillnet), Iran (gillnet), India (gillnet and troll), **Indonesia** (troll and hand lines) and **Pakistan** (gillnet) account for around 90% of the catch of black marlin (**Fig. 16**). Catches of black marlin have increased steadily since the 1990s, from 2,700 t in 1991 to over 10,000 t in 2011. The highest catches over the time series of black marlin were recorded in 2014, at over 14,000 t (**Table 4**).

TABLE 4. Best scientific estimates of the catches of black marlin by type of fishery for the period 1950–2013 (in metric tons). Data as of September 2014.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LL	846	1,633	1,288	1,370	1,485	1,911	2,071	2,053	2,120	1,872	2,684	1,788	1,484	1,501	2,226	2,374
GN	26	31	44	439	2761	6,916	9,870	8,390	8,458	6,738	6,222	6,931	6,065	7,113	8,516	8,551
HL	24	27	42	446	727	1,032	996	812	954	1,078	1,351	2,164	1,634	1,836	2,267	2,837
OT	0	0	4	65	112	226	170	227	237	257	329	460	465	482	479	637
Total	**896**	**1,692**	**1,377**	**2,320**	**5,085**	**896**	**13,107**	**11,483**	**11,769**	**9,944**	**10,585**	**11,343**	**9,649**	**10,932**	**13,487**	**14,400**

Fisheries: Gillnet (**GN**); Longline (**LL**); Hook-and-Line (**HL**), including handline, trolling, baitboat, and sport fisheries; Other gears (**OT**)

Between the early-1950s and the late-1980s part of the Japanese fleet was licensed to operate within the EEZ of Australia, and reported very high catches of black marlin in that area, in particular in waters off northwest Australia (**Fig. 17**). In recent years, deep-freezing longliners from **Japan** and **Taiwan,China** have reported lower catches of black marlin, mostly in waters off the western coast of India and, to a lesser extent, the Mozambique Channel (**Fig. 18**).

In 2013 and 2014 Iran reported catches of swordfish and marlins for its drifting gillnet fisheries for the first time. The catches of black marlin reported, 3,000 t in 2013 and 4,000 t in 2014, were used to re-build historical catches for Iran. Pakistan has also reported catches of marlins for its fishery in recent years, with catches of black marlin at around 1,000 t in 2013-14. The new catches estimated for the drifting gillnet fishery represent over 30% of the total catches of black marlin in the Indian Ocean.

The catches of black marlin in **Sri Lanka** have risen steadily since the mid-1990’s as a result of the development of the fishery using a combination of drifting gillnets and longlines, from around 1,000 t in the early 1990s to over 4,500 t in 2011. In 2012 and 2013 catches dropped to 3,000 and 2,500 t, respectively.

In recent years (2011–13) **India** has reported higher catches of black marlin for its fisheries, amounting to around 1,500 t to 3,500 t, largely from increases in catches from gillnet and troll).

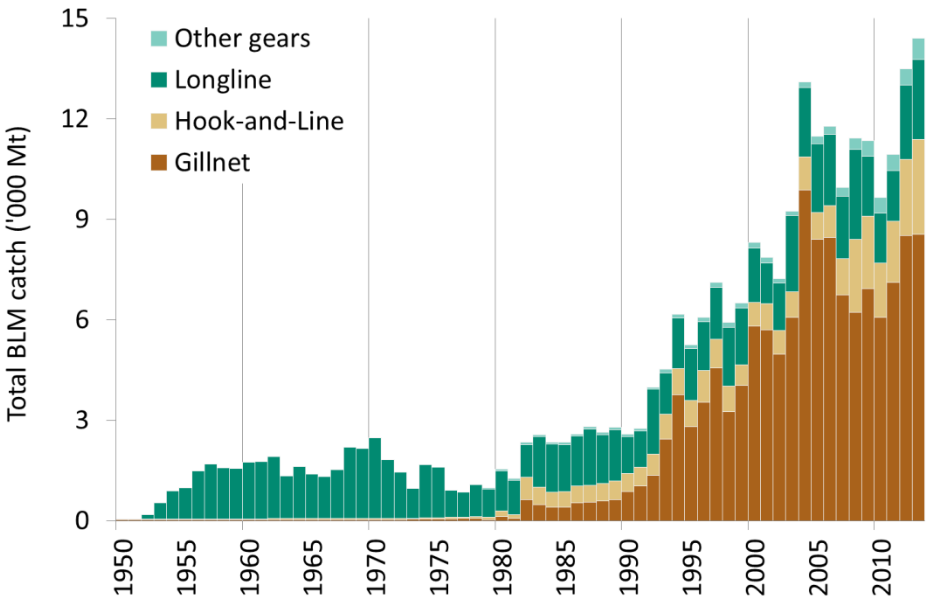


Fig. 15. Catches of black marlin by gear and year recorded in the IOTC Database (1950–2013).

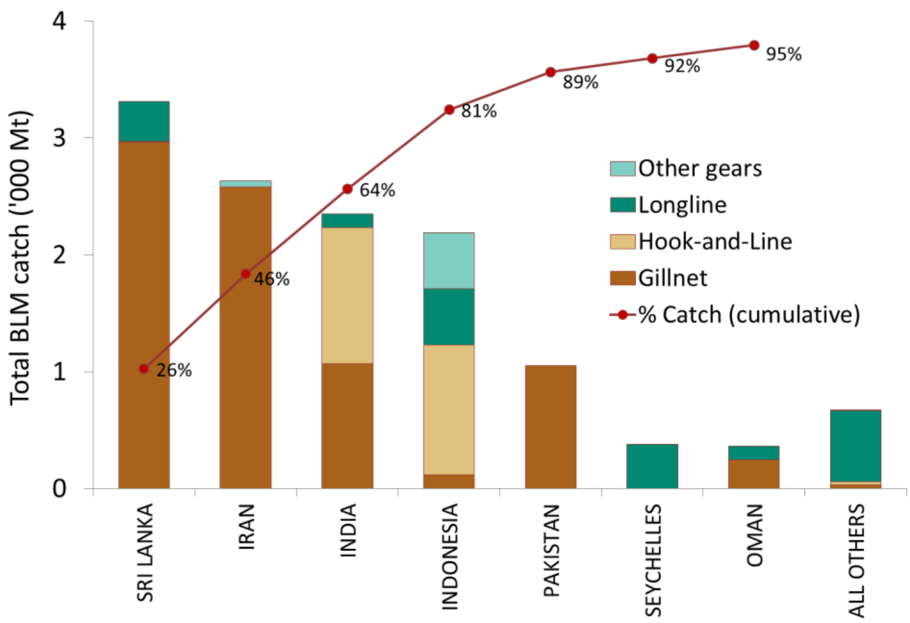


Fig. 16: Black marlin: Average catches in the Indian Ocean over the period 2010–13, by country. Countries are ordered from left to right, according to the importance of catches of black marlin reported. The red line indicates the (cumulative) proportion of catches of blue marlin for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

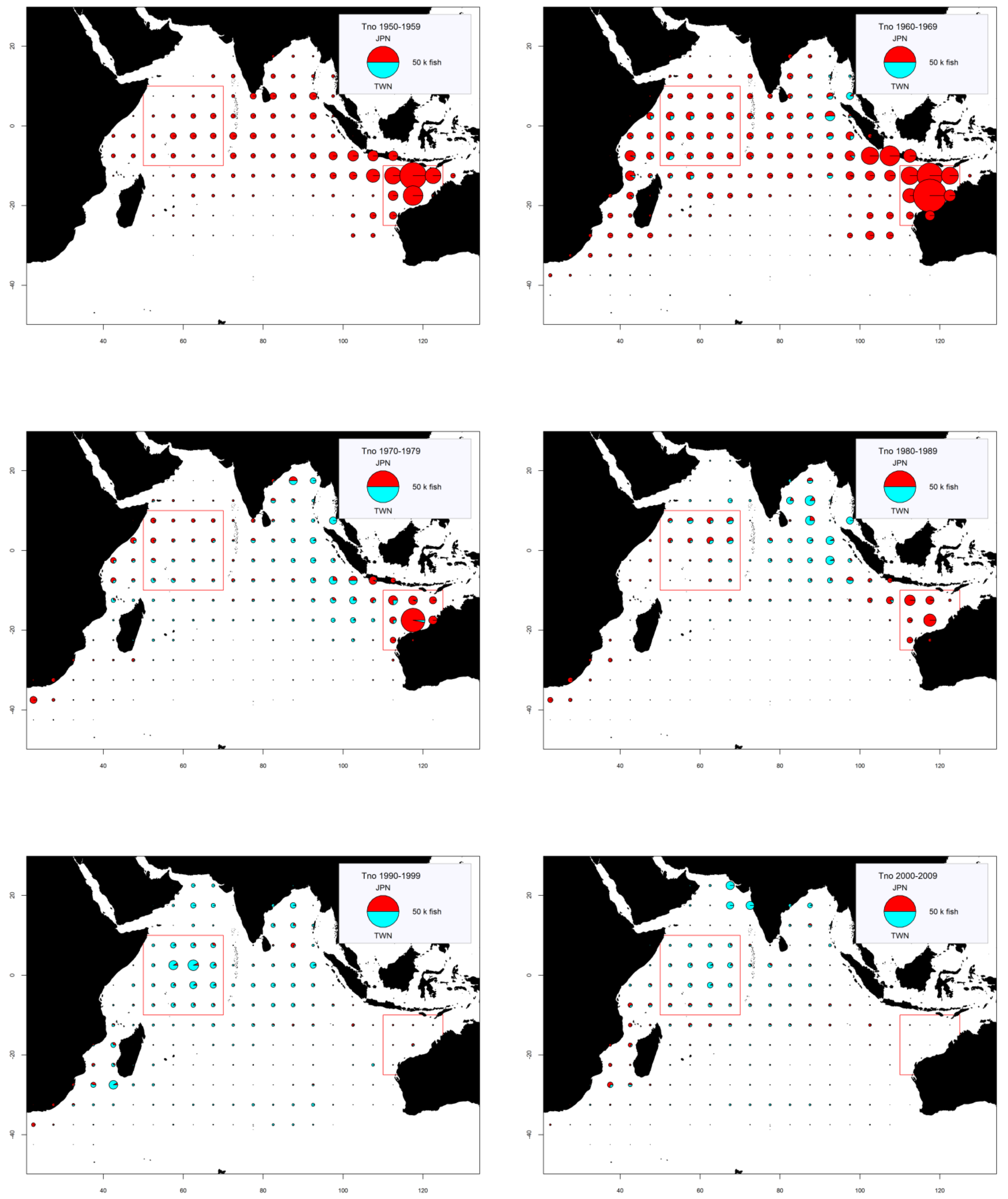


Fig. 17a-f. Time-area catches (in number of fish) of black marlin as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for the period 1950–2009, by decade and fleet. Red lines represent the marlin hotspots identified by the IOTC WPB.

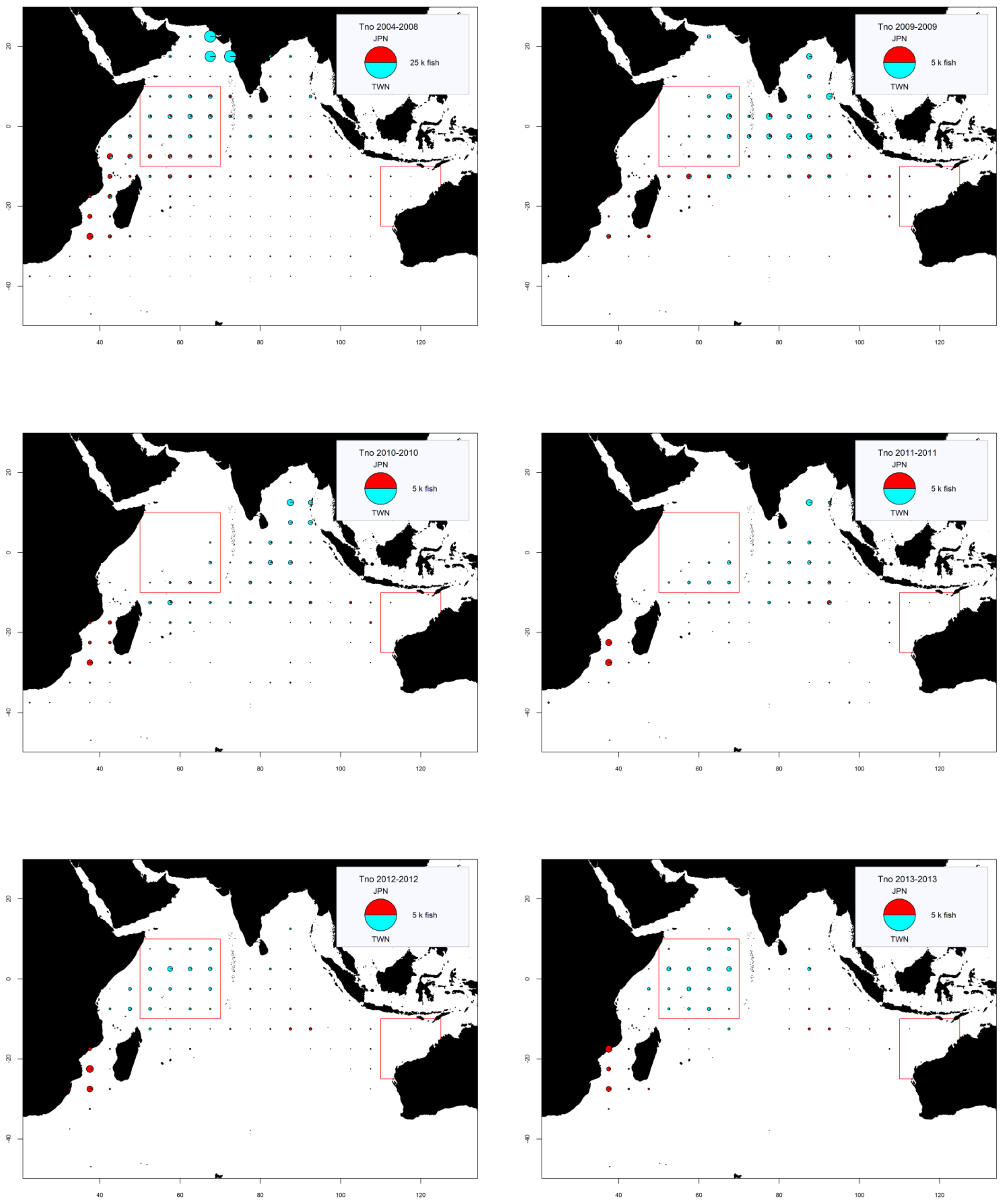


Fig. 18a-f. Time-area catches (in number of fish) of black marlin as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for the period 2004–08 by fleet and for 2009–13, by year and fleet. Red lines represent the marlin hotspots identified by the IOTC WPB.

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

Minimum catch estimates have been derived from very small amounts of information and are therefore highly uncertain. Difficulties in the identification of marlins also contribute to the uncertainties of the information available to the Secretariat.

Retained catches are uncertain for some fisheries (**Fig. 20a**), due to the fact that:

- catch reports often refer to total catches of all three marlin species combined; catches by species are estimated by the Secretariat for some years and artisanal (gillnet/longline fishery of **Sri Lanka** and artisanal fisheries of **India**, **Iran** and **Pakistan**) and industrial (longliners of **Indonesia** and **Philippines**) fisheries.
- catches of non-reporting industrial longliners (**India**, **NEI**) and the gillnet fishery of **Indonesia** are estimated by the Secretariat using alternative information.
- catches are likely to be incomplete for industrial fisheries for which the black marlin is not a target species.
- conflicting catch reports: Longline catches from the **Republic of Korea** are reported as nominal catches, and catch and effort reports are conflicting, with higher catches recorded in the catch and effort table. For this reason, the Secretariat revised the catches of black marlin for the Republic of Korea over the time-series using both datasets. Although the new catches estimated by the Secretariat are thought to be more accurate, catches of black marlin remain uncertain for this fleet.
- a lack of catch data for most sport fisheries.

Discards are unknown for most industrial fisheries, mainly longliners. Discards of black marlin may also occur in some driftnet fisheries.

Changes to the catch series: There have been relatively large revisions to catches of black marlin since the WPB meeting in 2013 (**Fig. 19a**), mostly the result of changes to catch-by-species for Iran, and to a lesser extent Indonesia (**Fig. 19b**).

As previously noted, in 2014 Iran provided detailed catches for billfish species that significantly revised the catch-by-species previously estimated by the IOTC Secretariat; the main change being the proportion of catches assigned as black marlin rather than blue marlin for Iran's offshore gillnet fishery.

As a result of changes in the catch series for Iran in 2012 and 2013 – and revision of the catch-by-species for the offshore fishery for earlier years – total catches of black marlin have been revised upwards by as much as 30% to 50% for a number of years around the mid-2000's (e.g., in 2005 catches have been revised from around 7,400 t to nearly 11,500 t) (see Appendix I for more details).

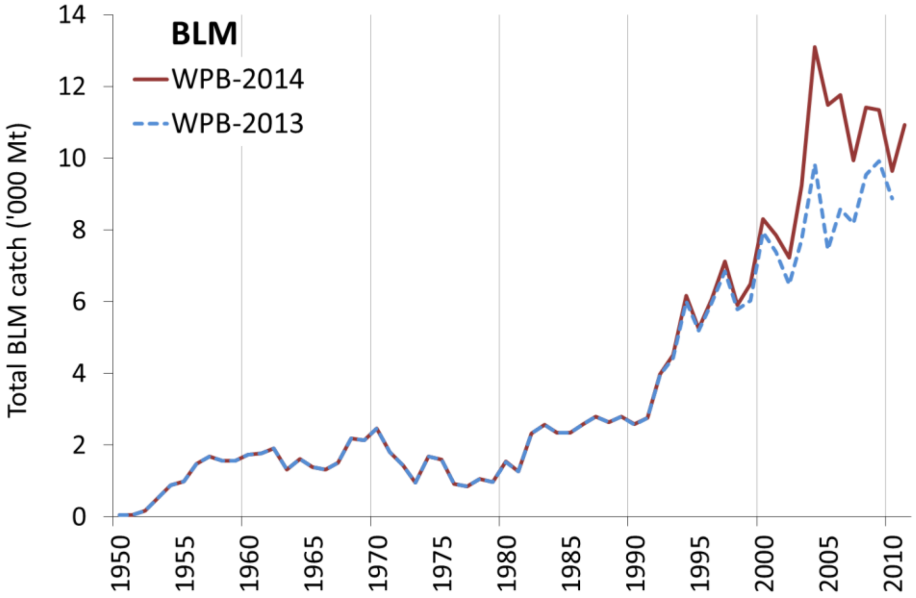


Fig. 19a. Black marlin: catches used by the WPB in 2014 *versus* those estimated for the WPB in 2013 (1950–2011).

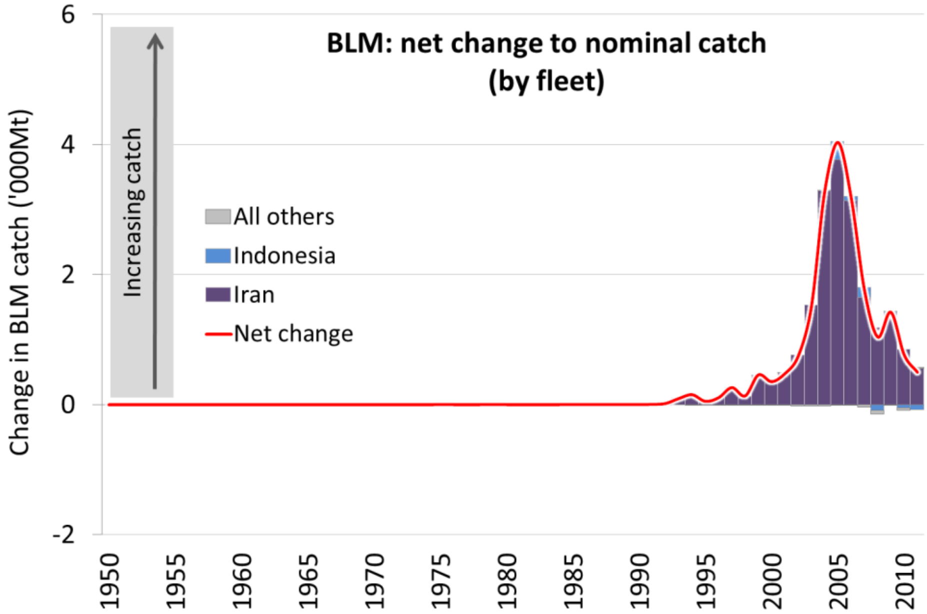


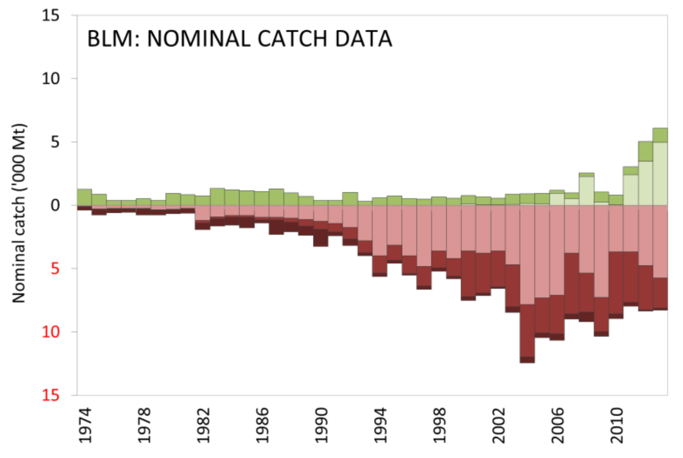
Fig. 19b. Black marlin: revisions to catch estimates (WPB2014 – WPB2013) by fleet, (1950–2011).

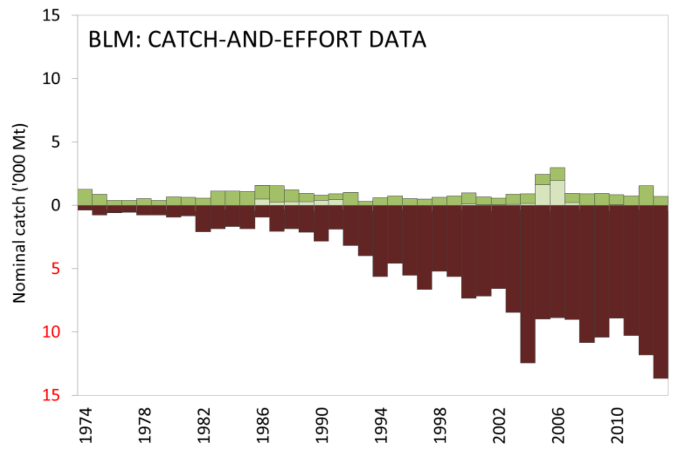
Catch–per–unit–effort (CPUE) Series (Fig. 20b): Standardised CPUE series have not yet been developed. Nominal CPUE series are however available from some industrial longline fisheries (primarily the Japanese longline fleet; **Appendix II**) although catches are thought to be incomplete (catches of non-target species are not always recorded in logbooks). No catch and effort data are available from sports fisheries, other than for partial data from the sports fisheries of Kenya; or other artisanal (gillnet fisheries of Iran and Pakistan, gillnet/longlines of Sri Lanka, gillnets of Indonesia) or industrial fisheries (NEI longliners and all purse seiners).

Fish size or age trends (e.g. by length, weight, sex and/or maturity; Fig. 20c): Average fish weight can only be assessed for the longline fishery of Japan since 1970 and Taiwan,China since 1980. The number of specimens measured on Japanese longliners in recent years is, however, very low (**Appendix II**). The length frequency distributions derived from samples collected by fishermen on Taiwanese longliners are likely to be biased for the reasons explained on page 5.

Catch-at-Size(Age) tables have not been built for black marlin due to a lack of information reported by CPCs and the issues identified with some datasets. Fish size is derived from various length and weight information, however the reliability of the size data is reduced for some fleets or when relatively few fish out of the total catch are measured.

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





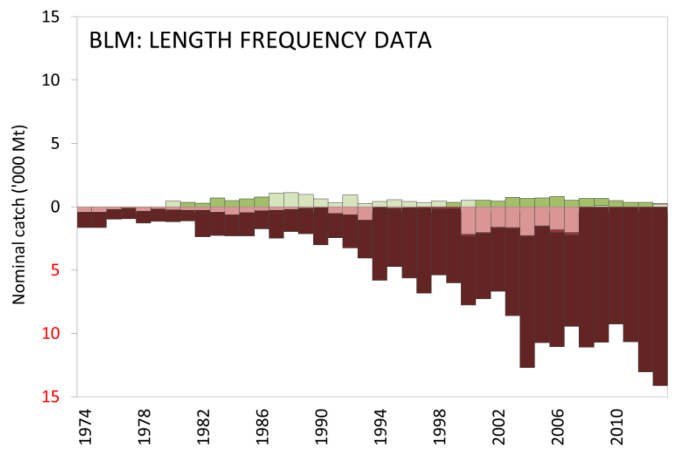


Fig. 20. Black marlin: data reporting coverage (1974–2013).

Each IOTC dataset (nominal catch, catch-and-effort, and length frequency) are assessed against IOTC reporting standards, where: a score of 0 indicates the amount of nominal catch associated with each dataset that is fully reported according to IOTC standards; a score of between 2 – 6 refers to the amount of nominal catch associated with each dataset that is partially reported by gear and/or species (i.e., adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; a score of 8 refers to the amount of nominal catch associated with catch-and-effort data that is not available.

Data as of September 2014.

Key to IOTC Scoring system

Nominal Catch	By species	By gear
Fully available	0	0
Partially available (part of the catch not reported by species/gear)*	2	2
Fully estimated (by the IOTC Secretariat)	4	4

*Catch assigned by species/gear by the IOTC Secretariat; or 15% or more of the catches remain under aggregates of species

Catch-and-Effort	Time-period	Area
Available according to standards	0	0
Not available according to standards	2	2
Low coverage (less than 30% of total catch covered through logbooks)	2	
Not available at all	8	

Size frequency data	Time-period	Area
Available according to standards	0	0
Not available according to standards	2	2
Low coverage (less than 1 fish measured by metric ton of catch)	2	
Not available at all	8	

Key to colour coding

- Total score is 0 (or average score is 0-1)
- Total score is 2 (or average score is 1-3)
- Total score is 4 (or average score is 3-5)
- Total score is 6 (or average score is 5-7)
- Total score is 8 (or average score is 7-8)

Striped Marlin (MLS)

- **Catch trends**

The catch series for the blue marlin was revised in 2014, following new reports of catch for drifting gillnets and the fisheries of Indonesia. Striped marlin are caught mainly under drifting longlines (72% of the total catch). The remaining catches are recorded under gillnets and troll lines (**Table 5, Fig. 21**). Striped marlin are generally considered to be a bycatch of industrial fisheries. Catch trends for striped marlin are variable, ranging from 2000 t to 8000 t per year; however, this may reflect the level of reporting. Similarly, catches reported under drifting longlines are highly variable, with lower catch levels between 2009 and 2011 largely due to declining catches reported by Taiwan,China, deep-freezing and fresh-tuna longliners. The catches of striped marlin increased in 2012 and 2013, as longline vessels resumed their activities in the Western tropical Indian Ocean.

TABLE 5: Best scientific estimates of the catches of striped marlin by type of fishery for the period 1950–2013 (in metric tons). Data as of September 2014.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LL	1,024	3,076	3,605	5,029	4,990	2,951	3,713	2,974	3,086	2,433	2,313	1,846	1,935	1,801	4,778	2,937
GN	5	8	16	22	161	541	880	876	807	479	389	407	330	540	983	1,160
HL	3	5	10	32	69	135	102	135	142	153	195	273	277	286	284	289
OT	0	0	0	6	10	20	15	20	21	23	29	41	41	43	43	43
Total	**1,031**	**3,089**	**3,631**	**5,089**	**5,229**	**3,647**	**4,710**	**4,005**	**4,055**	**3,087**	**2,927**	**2,567**	**2,583**	**2,670**	**6,088**	**4,429**

Fisheries: Gillnet (**GN**); Longline (**LL**); Hook-and-Line (**HL**), including handline, trolling, baitboat, and sport fisheries; Other gears (**OT**)

Catches under drifting longlines have been recorded under **Taiwan,China**, **Japan**, **Republic of Korea** fleets and, recently, **Seychelles**, **Indonesia** and several **NEI** fleets. Taiwan,China and Japan have reported large drops in the catches of striped marlin for its longline fleets since the mid-1980's and mid-1990's, respectively. The reason for such decreases in catches is not fully understood. Between the early-50s and the late-80s part of the Japanese fleet was licensed to operate within the EEZ of Australia, reporting relatively high catches of striped marlin in the area, in particular in waters off northwest Australia. High catches of the species were also reported in the Bay of Bengal during this period, by both Taiwan,China and Japanese longliners. The distribution of striped marlin catches has changed since the 1980's with most of the catch now taken in the western areas of the Indian Ocean (**Fig. 23**). These changes of fishing area and catches over the years are thought to be related to changes in the type of access agreements to EEZs of coastal countries in the Indian Ocean, rather than changes in the distribution of the species over time. However, between 2007 and 2011, catches in the northwest Indian Ocean have dropped markedly, in tandem with a reduction of longline effort in the area as a consequence of maritime piracy off Somalia (**Fig. 24**). Catch levels increased substantially in 2012 and, to a lesser extent, 2013.

The catches of striped marlin reported by fleets using gillnets have been low over the entire time-series, amounting to between 500 and 1,000 t in recent years. However, recent information received by the IOTC Secretariat tends to indicate that the catches of striped marlin by the gillnet fishery of Pakistan may be much higher than those officially reported, and a thorough review of the catch series may be required in the future for this species.

Discards are believed to be low although they are unknown for most industrial fisheries, mainly longliners. Discards of striped marlin may also occur in the driftnet fishery of the I.R of Iran, as this species has no commercial value in this country.

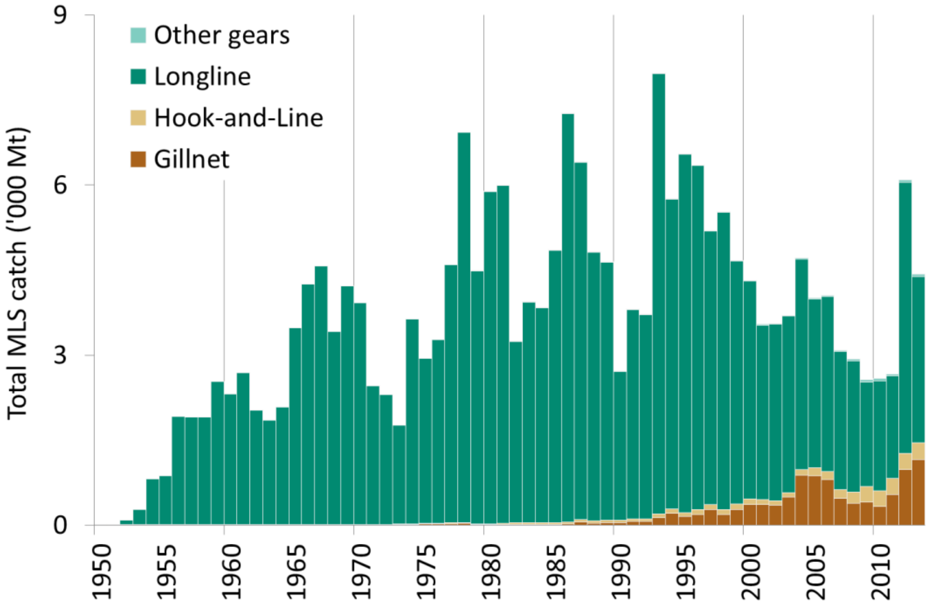


Fig. 21. Catches of Striped marlin by gear and year recorded in the IOTC Database (1950–2013).

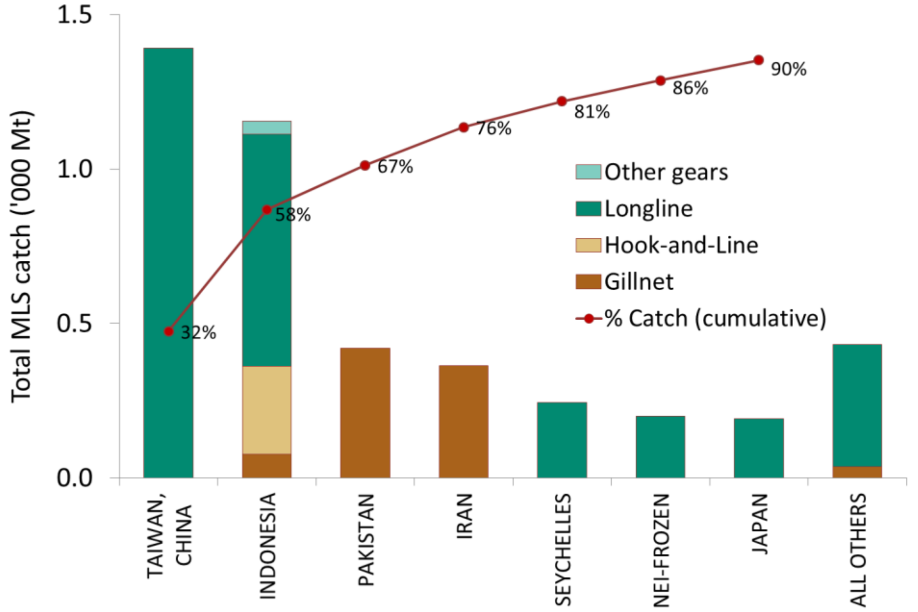


Fig. 22: Striped marlin: Average catches in the Indian Ocean over the period 2010–13, by country. Countries are ordered from left to right, according to the importance of catches of black marlin reported. The red line indicates the (cumulative) proportion of catches of Striped marlin for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

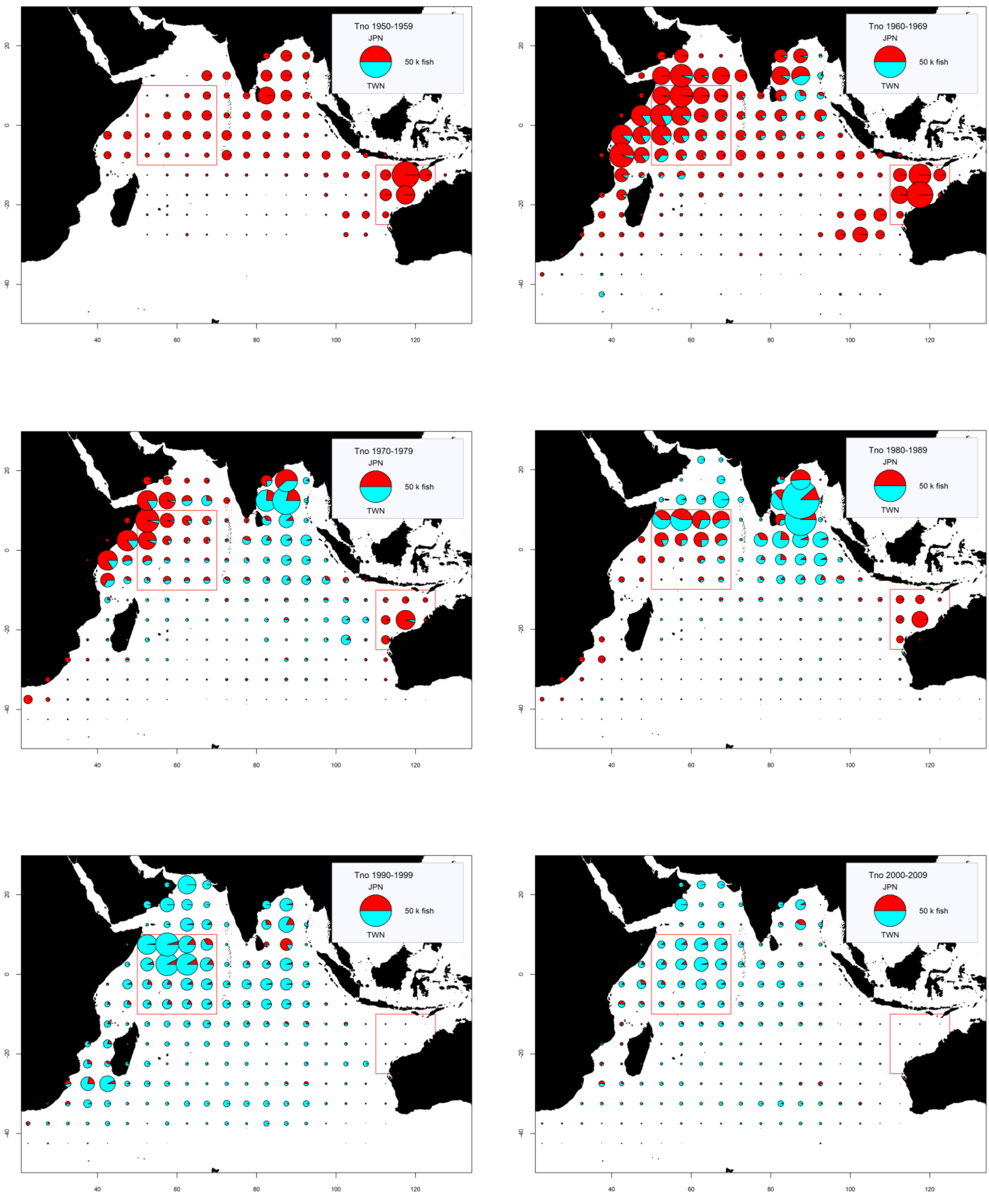


Fig. 23a-f. Time-area catches (in number of fish) of striped marlin as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for the period 1950–2009, by decade and fleet. Red lines represent the marlin hotspots identified by the IOTC WPB.

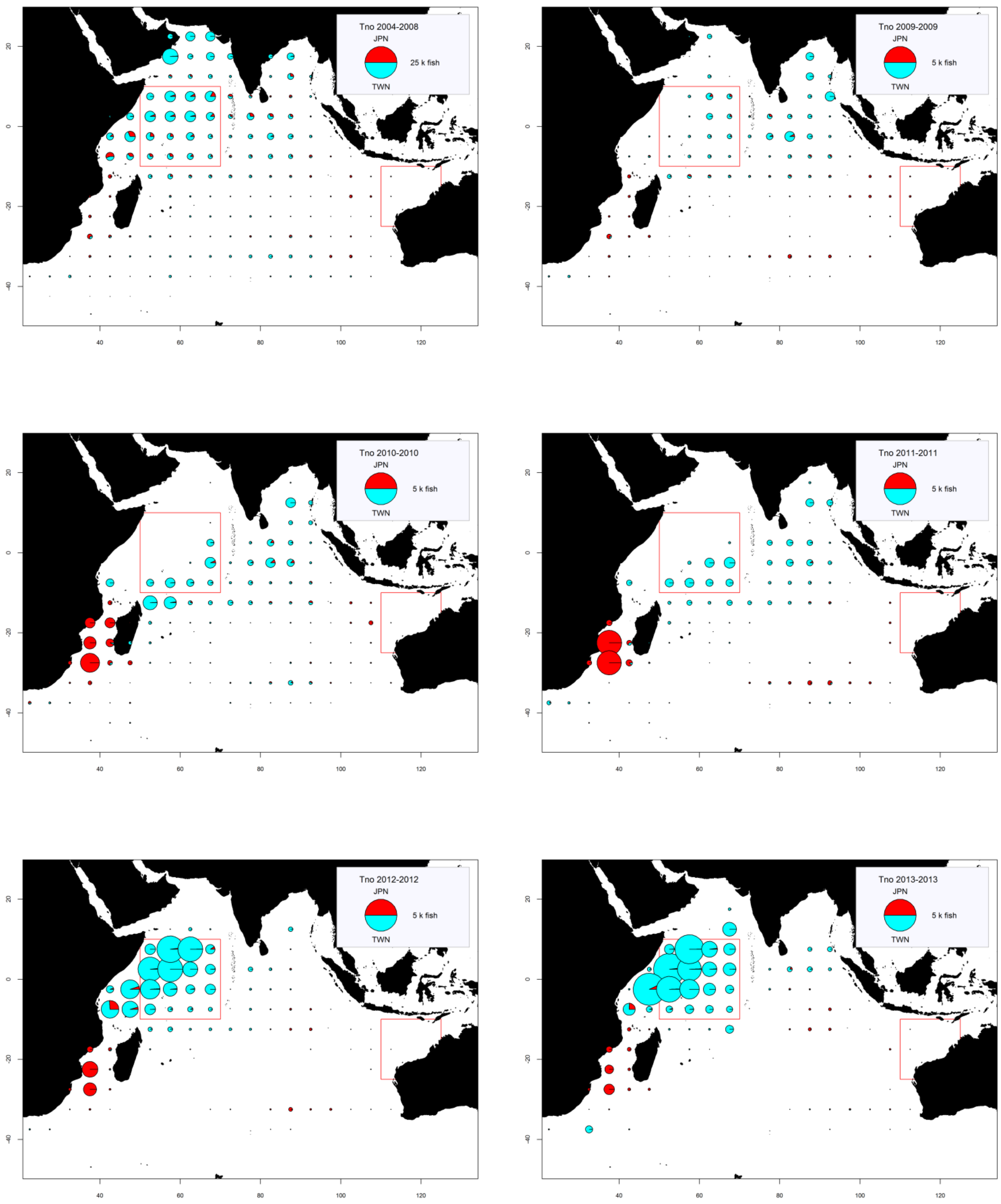


Fig. 24a-f. Time-area catches (in number of fish) of striped marlin as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for the period 2004–08 by fleet and for 2009–13, by year and fleet. Red lines represent the marlin hotspots identified by the IOTC WPB.

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

Retained catches are reasonably well known (**Fig. 26a**) although they remain uncertain for some fleets:

- Catch reports refer to total catches of all three marlin species; catches by species have to be estimated by the IOTC Secretariat for some industrial fisheries (longliners of **Indonesia** and **Philippines**).
- Catches of non-reporting industrial longliners (**India**, **NEI**) estimated by the IOTC Secretariat using alternative information. As they are not reported by the countries concerned, catches are likely to be incomplete for some industrial fisheries for which the striped marlin is seldom the target species.
- Conflicting catch reports for the drifting gillnet fishery of Pakistan, with very high catches of striped marlins reported by alternative sources, as derived from sampling in different locations in Pakistan.
- Conflicting catch reports: The catches for longliners flagged to the **Republic of Korea**, reported as nominal catches and catches and effort, are conflicting with higher catches recorded in the catch and effort table. For this reason, the IOTC Secretariat revised the catches of striped marlin over the time-series using both datasets. Although the new catches estimated by the IOTC Secretariat are thought to be more accurate, catches of striped marlin remain uncertain for this fleet.

Discards are thought to be low although they are unknown for most industrial fisheries, mainly longliners. Discards of striped marlin may also occur in some driftnet fisheries.

Changes to the catch series: There have been minor changes to the catches of striped marlins since the WPB meeting in 2013 (**Fig. 25a**). The main revisions occur around the mid-2000s as a result of improvements to the estimate of total catch and catch-by-species for Iran and Indonesia (**Fig. 25b**). These changes, however, did not lead to significant changes in the catch estimates for striped marlins.

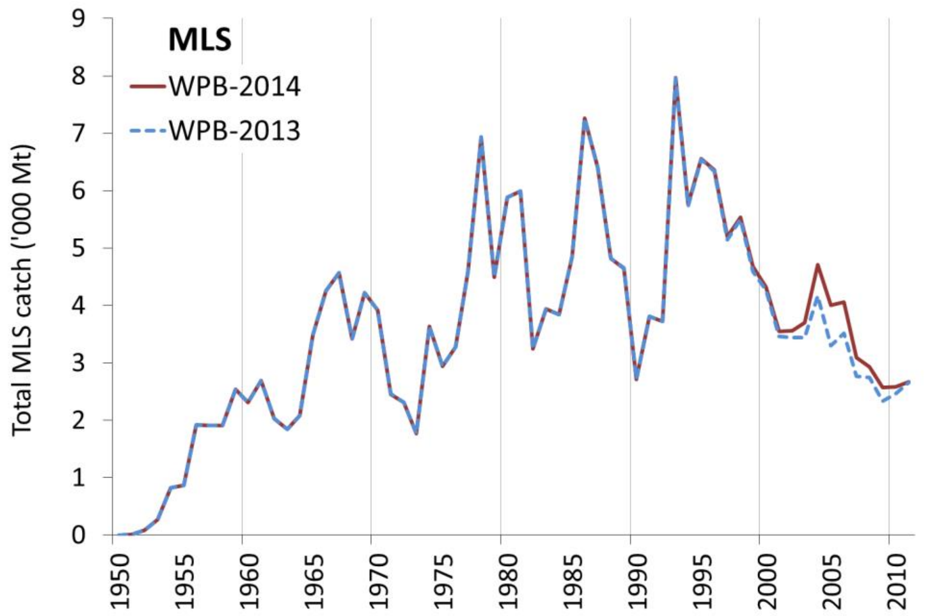


Fig. 25a. Striped Marlin: catches used by the WPB in 2014 *versus* those estimated for the WPB in 2013 (1950–2011).

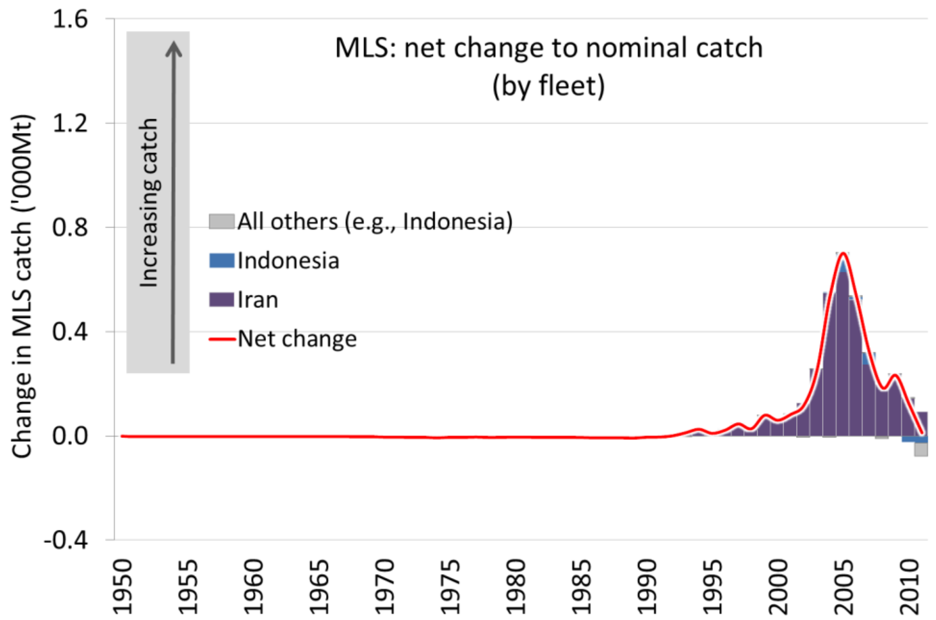


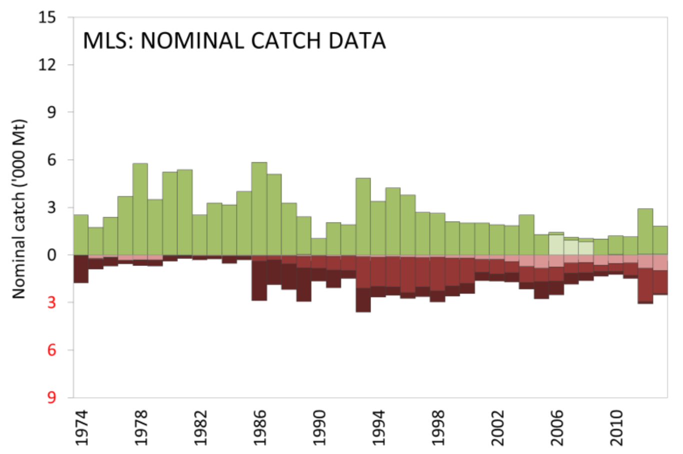
Fig. 26b. Striped marlin: revisions to catch estimates (WPB2014 – WPB2013) by fleet, (1950-2011).

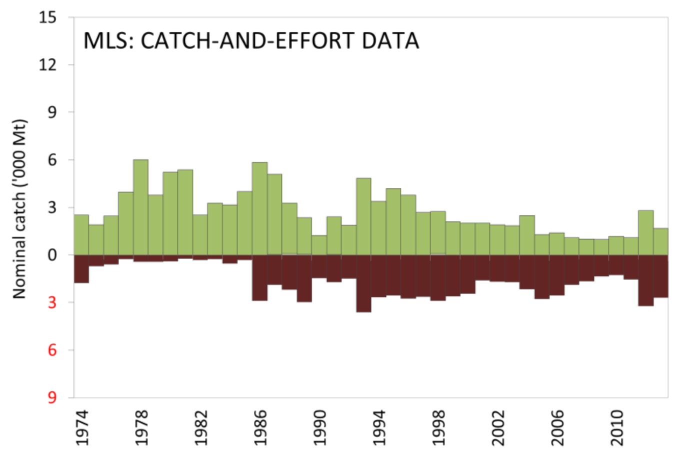
Catch–per–unit–effort (CPUE) series (Fig. 26b): Standardised CPUE series have not yet been developed. Nominal CPUE series are however available from some industrial longline fisheries (primarily the Japanese longline fleet; **Appendix II**) although catches are thought to be incomplete (catches of non-target species are not always recorded in logbooks). No catch and effort data are available from sports fisheries, other than for partial data from the sports fisheries of Kenya; or other artisanal (gillnet fisheries of I.R. Iran and Pakistan, gillnet/longlines of Sri Lanka, gillnets of Indonesia) or industrial fisheries (NEI longliners and all purse seiners).

Fish size or age trends (e.g. by length, weight, sex and/or maturity, Fig. 26c): Average fish weight can only be assessed for the longline fishery of Japan since 1970 and Taiwan,China since 1980. However, the number of specimens measured on Japanese longliners in recent years is very low and miss-identification of striped and blue marlin may be occurring in the Taiwanese longline fishery; the length frequency distributions derived from samples collected on Taiwanese longliners differ greatly from those collected on longliners flagged in Japan (**Appendix II**).

Catch-at-Size(Age) tables have not been built for this species due to a lack of information reported by CPCs. Fish size is derived from various length and weight information, however the reliability of the size data is reduced when relatively few fish out of the total catch are measured or the samples collected are unreliable.

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





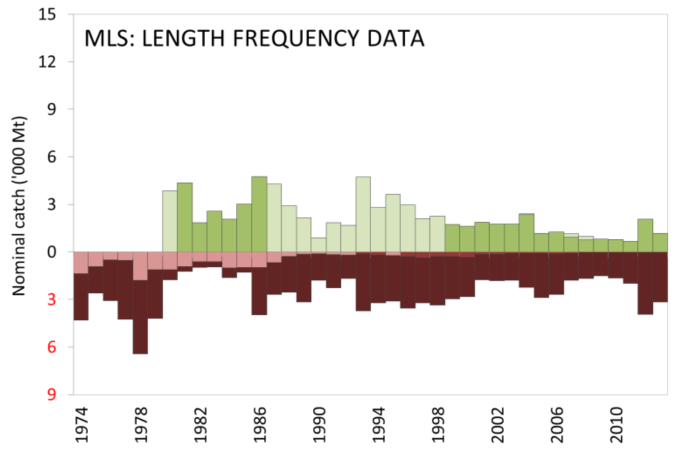


Fig. 27. Striped marlin: data reporting coverage (1974–2013).

Each IOTC dataset (nominal catch, catch-and-effort, and length frequency) are assessed against IOTC reporting standards, where: a score of 0 indicates the amount of nominal catch associated with each dataset that is fully reported according to IOTC standards; a score of between 2 – 6 refers to the amount of nominal catch associated with each dataset that is partially reported by gear and/or species (i.e., adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; a score of 8 refers to the amount of nominal catch associated with catch-and-effort data that is not available.

Data as of September 2014.

Indo-Pacific Sailfish (SFA)

Indo-Pacific sailfish is caught mainly under gillnets (75%) with remaining catches recorded under troll and hand lines (20%), longlines (5%) or other gears (**Table 6, Fig. 28**). The average annual catch over recent years is estimated at around 29,000 t. In recent years, the countries attributed with the highest catches of Indo-Pacific sailfish are situated in the Arabian Sea (India, Iran, Sri Lanka and Pakistan). Smaller catches are reported for line fishers in Comoros and Mauritius and by Indonesia and other longline fleets. This species is also a popular catch for sport fisheries (e.g. Kenya, Mauritius, Seychelles).

TABLE 6: Best scientific estimates of the catches of indo-pacific sailfish by type of fishery for the period 1950–2013 (in metric tons). Data as of September 2014.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LL	299	818	444	335	1,411	1,466	958	1,438	1,403	2,223	2,526	1,299	991	928	664	975
GN	165	181	507	1,809	6,056	12,470	14,798	11,047	11,712	13,415	13,862	17,994	21,028	23,385	21,413	22,699
HL	171	213	456	1,430	2,498	3,980	4,269	3,645	4,240	4,024	4,513	5,720	5,992	5,472	5,096	5,821
OT	-	-	3	44	42	85	63	84	88	95	134	171	172	181	178	255
Total	**634**	**1,212**	**1,410**	**3,618**	**10,007**	**18,000**	**20,088**	**16,215**	**17,443**	**19,758**	**21,034**	**25,183**	**28,184**	**29,965**	**27,351**	**29,750**

Fisheries: Gillnet (**GN**); Longline (**LL**); Hook-and-Line (**HL**), including handline, trolling, baitboat, and sport fisheries; Other gears (**OT**)

Catches of Indo-Pacific sailfish greatly increased since the mid-1990's (from around 5,000 t in the early 1990s to almost 30,000 t in 2011 and similar catch levels in the following years. The increases are largely due to the development of a gillnet/longline fishery in Sri Lanka (**Fig. 29**) and, especially, the extension in the area of operation of Iranian gillnet vessels to areas beyond the EEZ of I.R. Iran. In the case of Iranian gillnets (**Fig. 29**), catches have increased from less than 1,000 t in the early 1990's to over 7,700 t in 2011 and similar values in subsequent years.

Catches of Indo-Pacific sailfish under drifting longlines (**Table 6**) and other gears have also increased – to a lesser extent than catches from gillnet – from around 2,500 t to over 8,000 t in recent years. However, it is likely that longline fleets under report catches of this species due to its little commercial value. In recent years, deep-freezing longliners from Japan have reported catches of Indo-Pacific sailfish in the central western Indian Ocean, between Sri Lanka and the Maldives and the Mozambique Channel (**Fig. 30**).

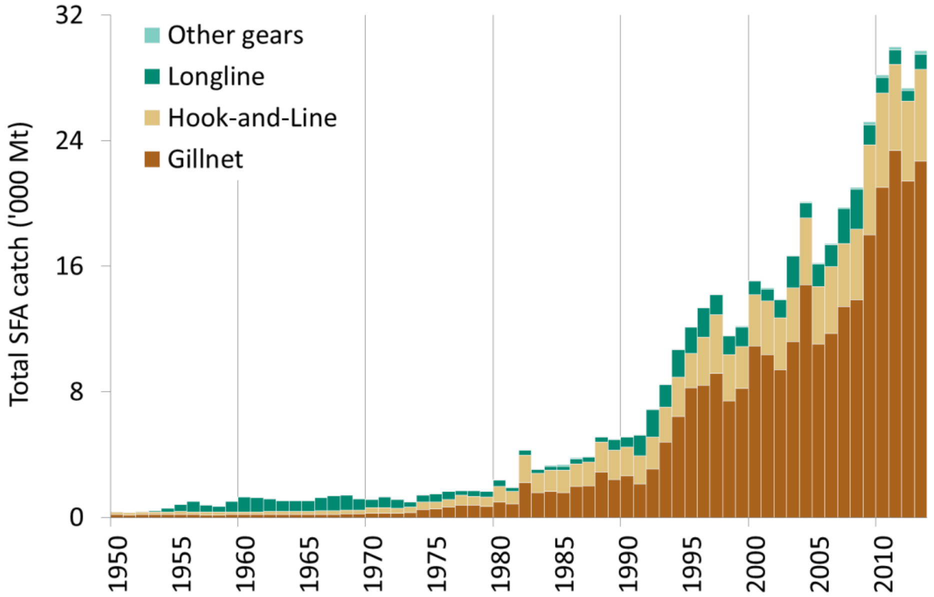


Fig. 28. Catches of Indo-pacific sailfish by gear and year recorded in the IOTC Database (1950–2013).

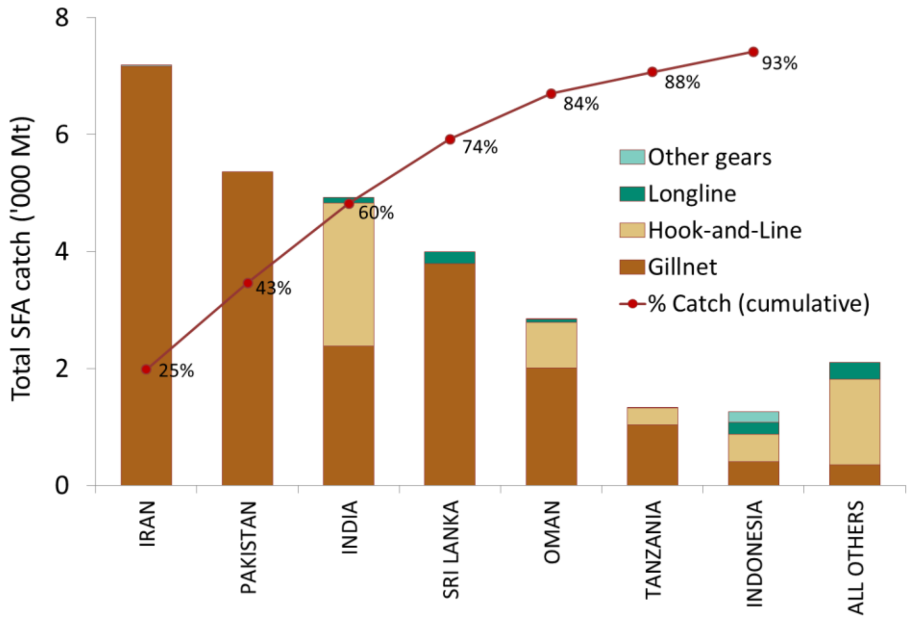


Fig. 29: Indo-Pacific sailfish: Average catches in the Indian Ocean over the period 2010–13, by country. Countries are ordered from left to right, according to the importance of catches of black marlin reported. The red line indicates the (cumulative) proportion of catches of Indo-Pacific sailfish for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

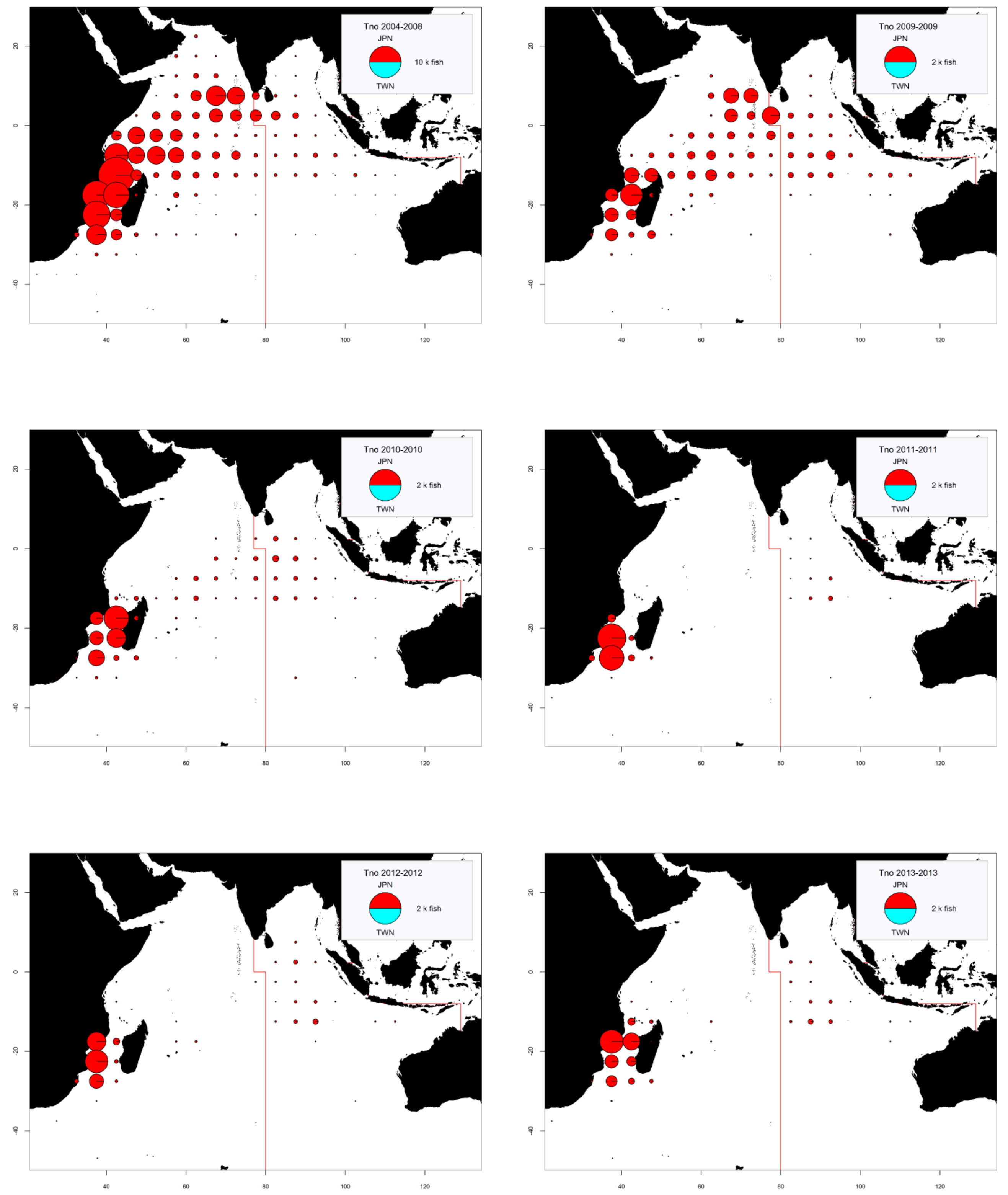


Fig. 30a-f. Time-area catches (in number of fish) of Indo-Pacific sailfish as reported for the longline fisheries of Japan (JPN) for the period 2004–08, by fleet and for 2009–13, by year and fleet. Red lines represent the IOTC Areas.

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

Minimum catch estimates have been derived from very small amounts of information and are therefore highly uncertain. Unlike the other billfish, Indo-Pacific sailfish are probably more reliably identified because of the large and distinctive first dorsal fin that runs most of the length of the body.

Retained catches are poorly known for most fisheries (**Fig. 32a**) due to:

- Catch reports often refer to total catches of all billfish species combined; catches by species are estimated by the Secretariat for some artisanal (gillnet/longline fishery of **Sri Lanka** and artisanal fisheries of **India** and **Pakistan**) and industrial (longliners of **Indonesia** and **Philippines**) fisheries.
- Catches of IP sailfish reported for some fisheries may refer to the combined catches of more than one species of billfish, in particular marlins and shortbill spearfish (many coastal fisheries).
- Catches likely to be incomplete for some artisanal fisheries (e.g. gillnets of Pakistan, pole and lines of Maldives) due to under-reporting.
- Catches are likely to be incomplete for industrial fisheries for which the Indo-Pacific sailfish is not a target species.
- A lack of catch data for most sport fisheries.

Discards are unknown for most industrial fisheries, mainly longliners (for which they are presumed to be moderate-high).

Changes to the catch series: Catches of sailfish remain largely unchanged since the WPB meeting in 2013 (**Fig. 31**), and have been unaffected by revisions to the catch-by-species for Iranian gillnet offshore fisheries, and also the revisions to the catch series in Indonesia.

Catch–per–unit–effort (CPUE) series (**Fig. 32b**): Standardised and nominal CPUE series have not yet been developed. No catch and effort data are available from sports fisheries, other than for partial data from the sports fisheries of Kenya; or other artisanal (gillnet fisheries of I.R. Iran and Pakistan, gillnet/longlines of Sri Lanka, gillnets of Indonesia) or industrial fisheries (NEI longliners and all purse seiners).

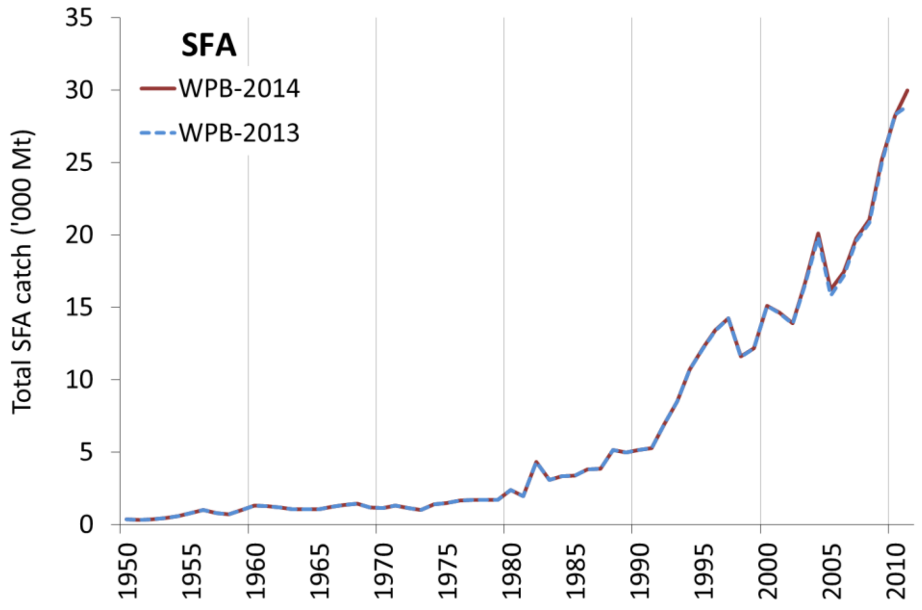
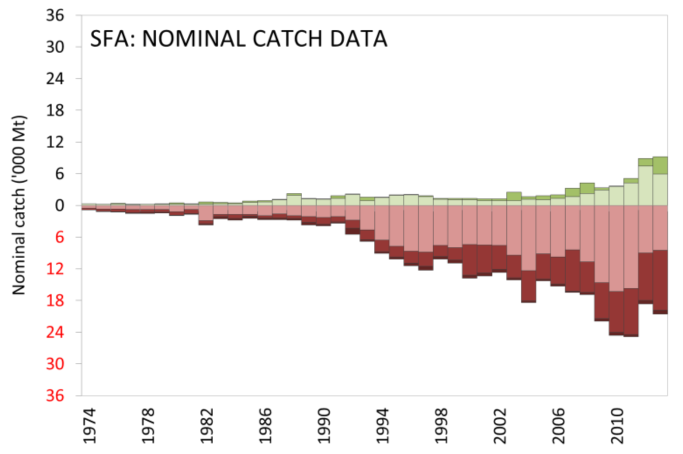


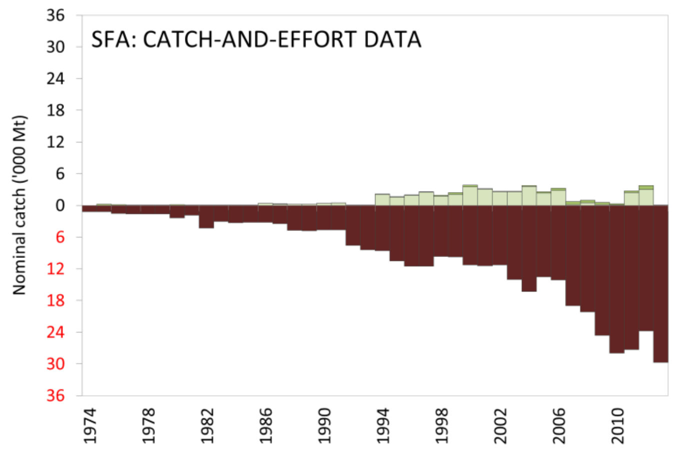
Fig. 31. Indo-Pacific sailfish: catches used by the WPB in 2014 *versus* those estimated for the WPB in 2013 (1950–2011).

Fish size or age trends (e.g. by length, weight, sex and/or maturity; Fig. 32c): Average fish weight can only be assessed for the longline fishery of Japan since 1970 and the gillnet/longline fishery of Sri Lanka since the late 1980s (**Appendix II**). The number of specimens measured on Japanese longliners in recent years is, however, very low. Furthermore, the specimens discarded might be not accounted for in industrial fisheries, where they are presumed to be of lower size (possible bias of existing samples).

Catch-at-Size(Age) tables have not been built for this species due to a lack of information reported by CPCs. Fish size is derived from various length and weight information, however the reliability of the size data is reduced when relatively few fish out of the total catch are measured.

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





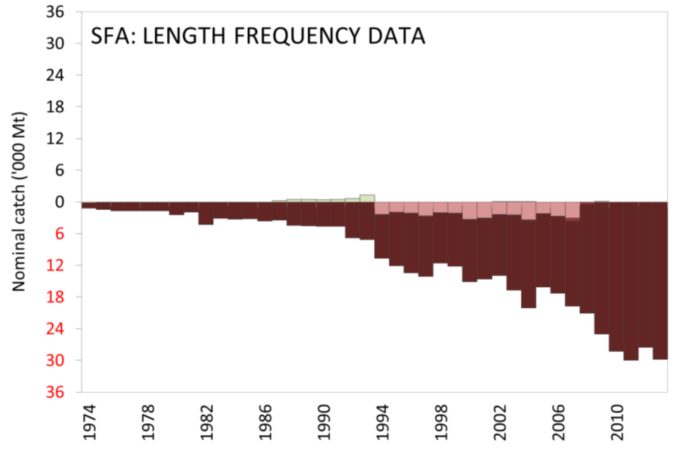


Fig. 32. Indo-Pacific sailfish: data reporting coverage (1974–2013).

Each IOTC dataset (nominal catch, catch-and-effort, and length frequency) are assessed against IOTC reporting standards, where: a score of 0 indicates the amount of nominal catch associated with each dataset that is fully reported according to IOTC standards; a score of between 2 – 6 refers to the amount of nominal catch associated with each dataset that is partially reported by gear and/or species (i.e., adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; a score of 8 refers to the amount of nominal catch associated with catch-and-effort data that is not available.

Data as of September 2014.

Key to IOTC Scoring system

Nominal Catch	By species	By gear
Fully available	0	0
Partially available (part of the catch not reported by species/gear)*	2	2
Fully estimated (by the IOTC Secretariat)	4	4

*Catch assigned by species/gear by the IOTC Secretariat; or 15% or more of the catches remain under aggregates of species

Catch-and-Effort	Time-period	Area
Available according to standards	0	0
Not available according to standards	2	2
Low coverage (less than 30% of total catch covered through logbooks)	2	
Not available at all	8	

Size frequency data	Time-period	Area
Available according to standards	0	0
Not available according to standards	2	2
Low coverage (less than 1 fish measured by metric ton of catch)	2	
Not available at all	8	

Key to colour coding

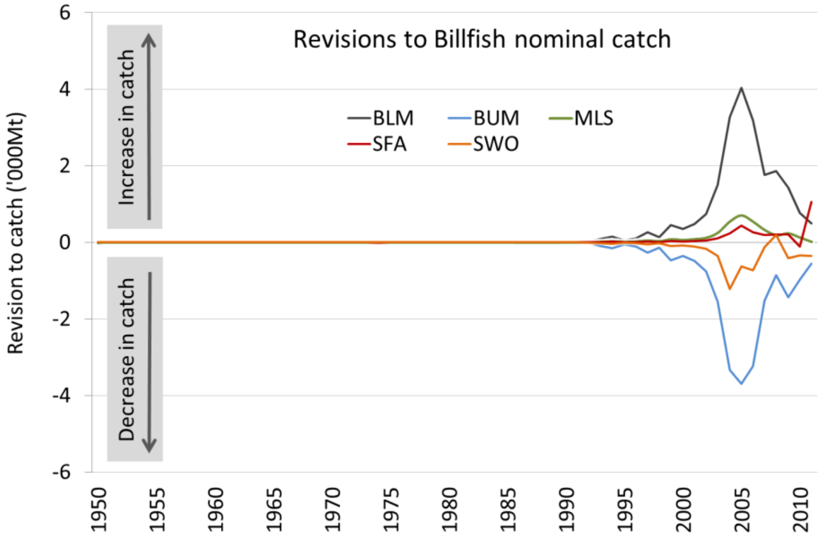
- Total score is 0 (or average score is 0-1)
- Total score is 2 (or average score is 1-3)
- Total score is 4 (or average score is 3-5)
- Total score is 6 (or average score is 5-7)
- Total score is 8 (or average score is 7-8)

APPENDIX I

SUMMARY OF MAIN REVISIONS TO BILLFISH CATCH SERIES

In 2014, revisions were made to the catch series for a small number of countries – namely Iran, and Indonesia – based on new information made available to the IOTC Secretariat, in addition to inconsistencies in the reported data. While estimates of total billfish catch remain largely the same as for WPB-2013, the catches by species have changed – in particular the reassignment of catches of blue marlin to black marlin for Iran's gillnet fishery (**Fig. i.**).

Fig. i. Revisions to Billfish nominal catch (all fleets).

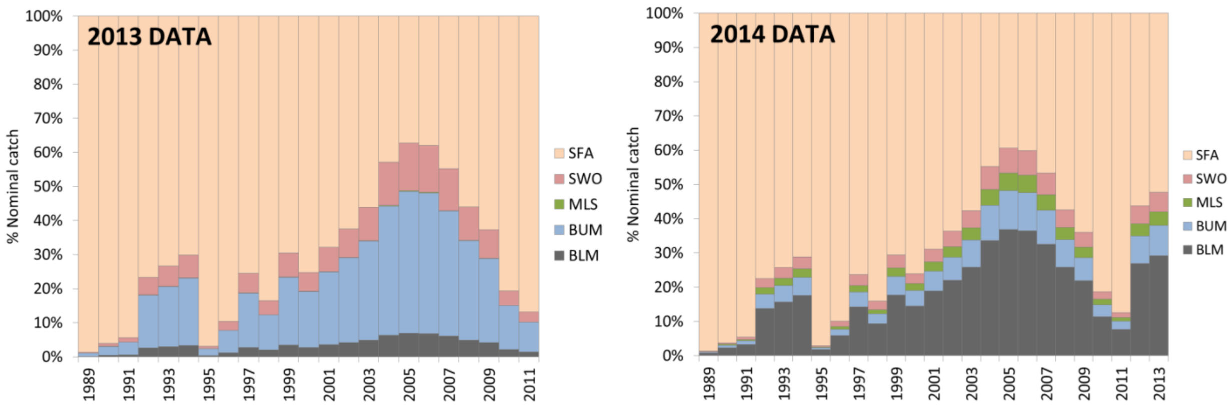


Islamic Republic of Iran – gillnet fisheries

- In previous years I.R. Iran has reported all gillnet catches of billfish as Indo-Pacific Sailfish, which have then been disaggregated by species and gear (coastal and offshore gillnet) by the IOTC Secretariat. In 2014 Iran reported catches separately by billfish species, albeit for 2012 and 2013 only.
- The data for 2012 and 2013 significantly revises the billfish species composition previously estimated by the IOTC Secretariat and assigned to Iran's offshore gillnet fishery[9]. The main change are higher ratios of black marlin to blue marlin, contrary to previous estimates by the Secretariat given blue marlins are more generally associated with offshore fisheries (**Fig. ii**).
- The issue requires further investigation in order to confirm the new species composition, and that the proportion of catch assigned to the coastal and offshore gillnet fisheries estimated by the Secretariat are correct.
- As a result of changes in the catch series for Iran – and revision of the catch-by-species for the historical series based on the 2012 and 2013 data – total catches of blue marlin have been revised down by as much as 20% for a number of years around the mid-2000's.
- Conversely, total catches of black marlin have been revised upwards by as much as 30% to 50% around the mid-2000's (e.g., in 2005 catches of black marlin have been revised from around 7,400 t to nearly 11,500 t).

[9] Species composition previously estimated using Sri Lanka fisheries as a proxy fleet.

Fig. ii. Comparison of billfish species composition for I.R. Iran, WPB-2013 and WPB-2014.



Indonesia – artisanal catches

- In 2014 further improvements were made to the nominal catch of Indonesia, building upon the revised catch series implemented by the Secretariat in 2012/2013[10].
- In recent years the Secretariat has noted large fluctuations in the total nominal catch of Indonesia (**Fig. ii**). In both cases, the issue appears to be inconsistencies in the data reported to the Secretariat – specifically the mixing of catches caught in the Indian Ocean and Pacific Ocean reported at landing sites.
- In 2012 the total catch of IOTC species reported by Indonesia was almost 25% lower than in 2011, most likely the result of assigning catches from the Indian Ocean to areas outside the IOTC area. Likewise, in 2013 total catches reported by Indonesia were around 23% higher compared to 2011 due to catches from the Pacific Ocean also being included in the catch reports to the IOTC Secretariat.
- One reason for the inconsistencies may be confusion over the definition of catches to be reported to the Secretariat. During 2014 it was established that Indonesia publishes two types of catch statistics:

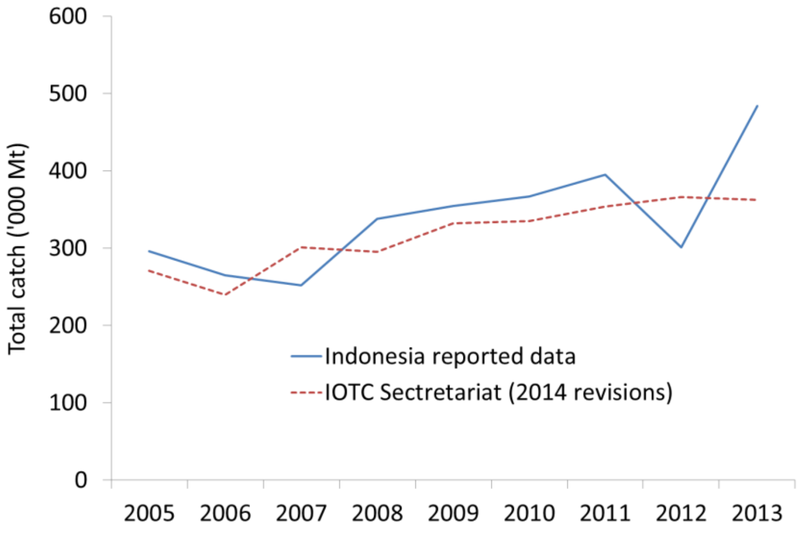
  - Catches by Province – includes total landings by vessels in each province, and can include catches from neighbouring sea areas in which the pattern of fisheries resources, and structure of the fisheries can be quite different from each other). Catches originating from the Indian Ocean, Pacific Ocean, Straits of Malacca, etc. are combined in statistics produced at Province level.
  - Catches by Fisheries Management Areas – capture fisheries statistics for coastal fisheries are compiled by major coastal area, divided into 11 Fisheries Management Areas (FMAs). Catches in coastal areas of the Indian Ocean are recorded exclusively by three FMAs - Malacca Strait and Andaman Sea, Western Sumatera and Sunda Strait, and coastal area covered by Southern Java, Southern Nusa Tenggara, Sawu Sea, and Western of Timor Sea.

- To compensate the possible misreporting of catches, in 2014 the catch series was adjusted to reflect the total catches published by Indonesia for FMAs in the Indian Ocean, from 2005 onwards[11] (**Fig. iii**). The revised catch series is presented in FIGURE xx for comparison. The IOTC Data Section has also requested Indonesia officially provides the Secretariat with corrections to the catch series for 2012 and 2013.

[10] Based on the recommendations from a comprehensive review of the national fisheries data by an IOTC consultant in 2012. For more details, see the research findings and data collated by Moreno, G. (IOTC) in 2012.

[11] Data published by the Directorate General of Capture Fisheries of Indonesia, by Fisheries Management Area is available from 2005 onwards.

Fig. iii. Revision to Indonesia total catch (all IOTC species) based on published data by Fisheries Management Areas.



APPENDIX II

REVIEW OF FISHERIES TRENDS FOR BILLFISH

1. EFFORT

a) Longline

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

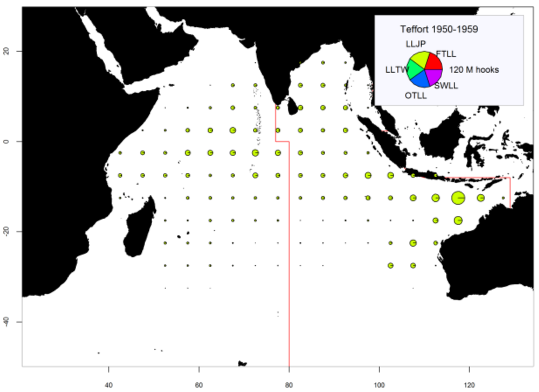
LLJP (light green): deep-freezing longliners from Japan

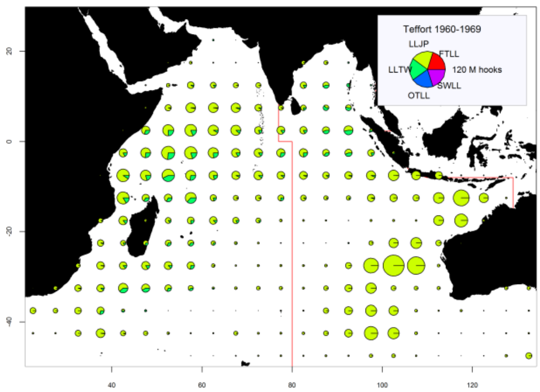
LLTW (dark green): deep-freezing longliners from Taiwan,China

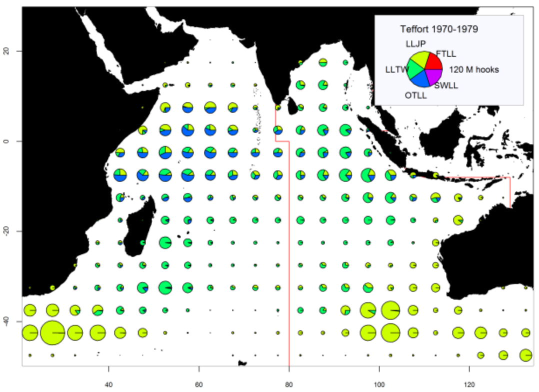
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)

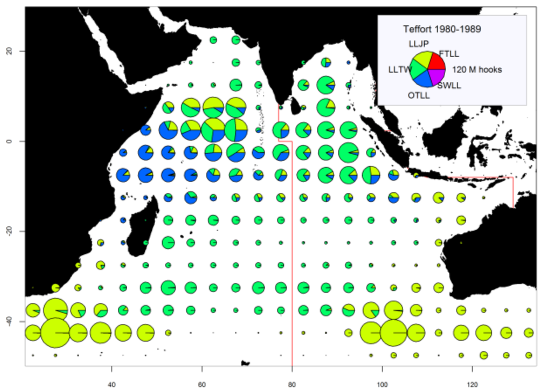
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)

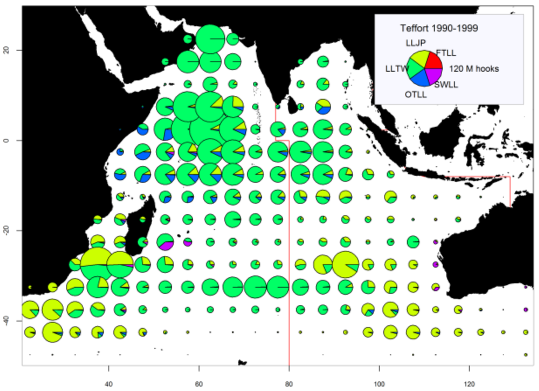
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, South Korea and various other fleets)

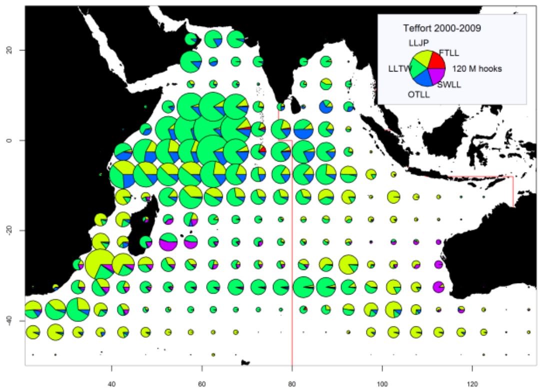












Effort exerted by LONGLINE fleets in the Indian Ocean, in millions (M) of hooks set, for 2004-08 and 2009-13, by year, and main fleet:

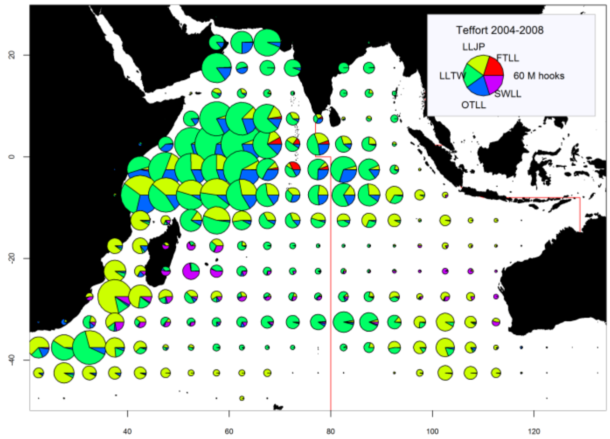
LLJP (light green): deep-freezing longliners from Japan

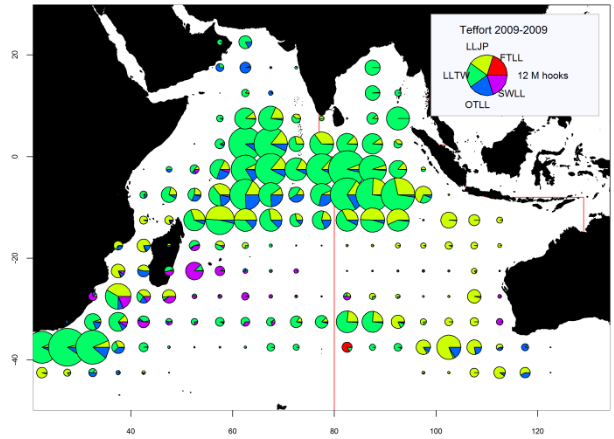
LLTW (dark green): deep-freezing longliners from Taiwan,China

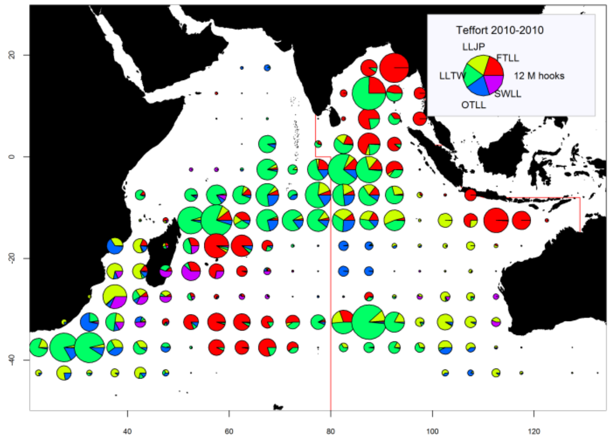
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)

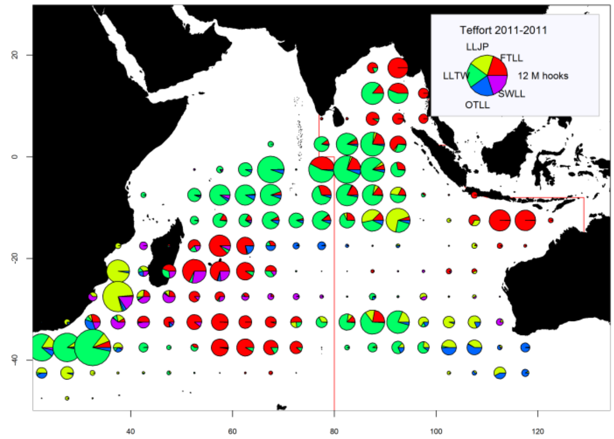
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)

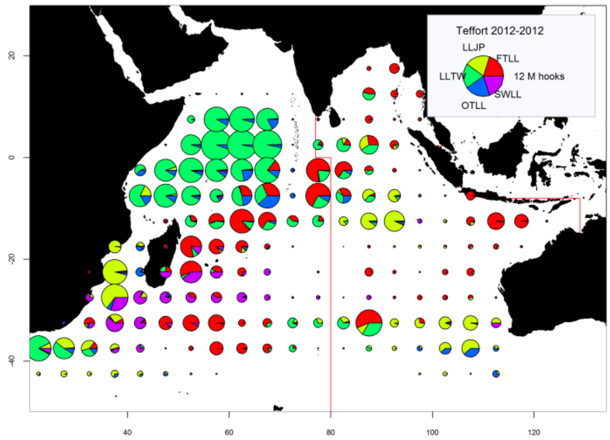
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, South Korea and various other fleets)

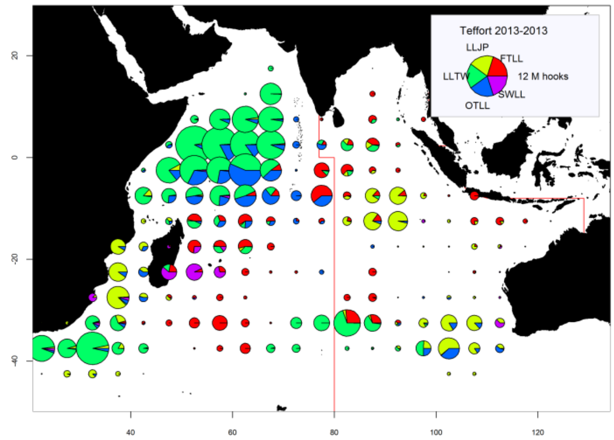












Effort exerted by LONGLINE fleets in the Indian Ocean, in millions (M) of hooks set, for 2004-08 and 2009-13, by year, quarter, and main fleet:

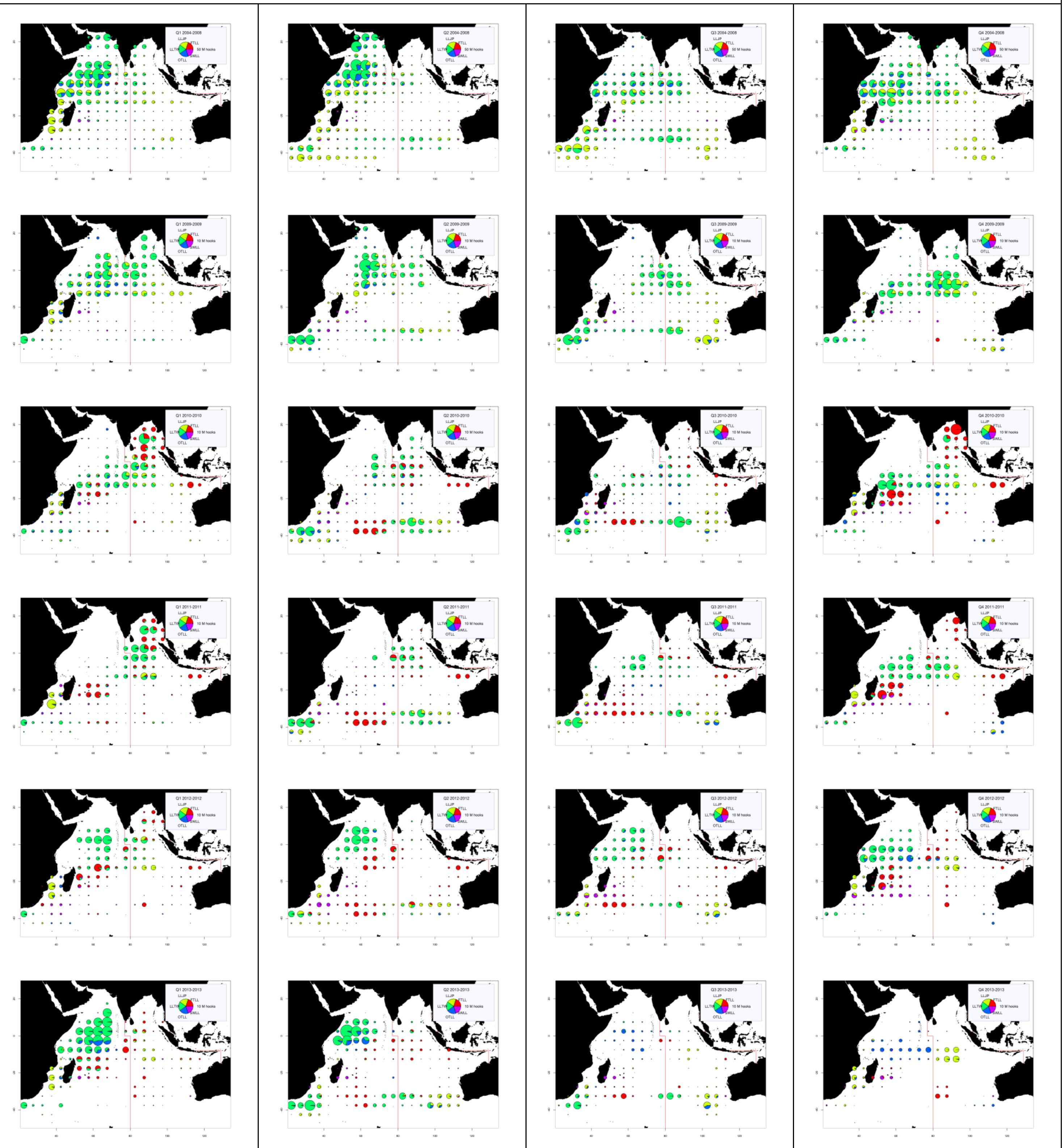
LLJP (light green): deep-freezing longliners from Japan

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)

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



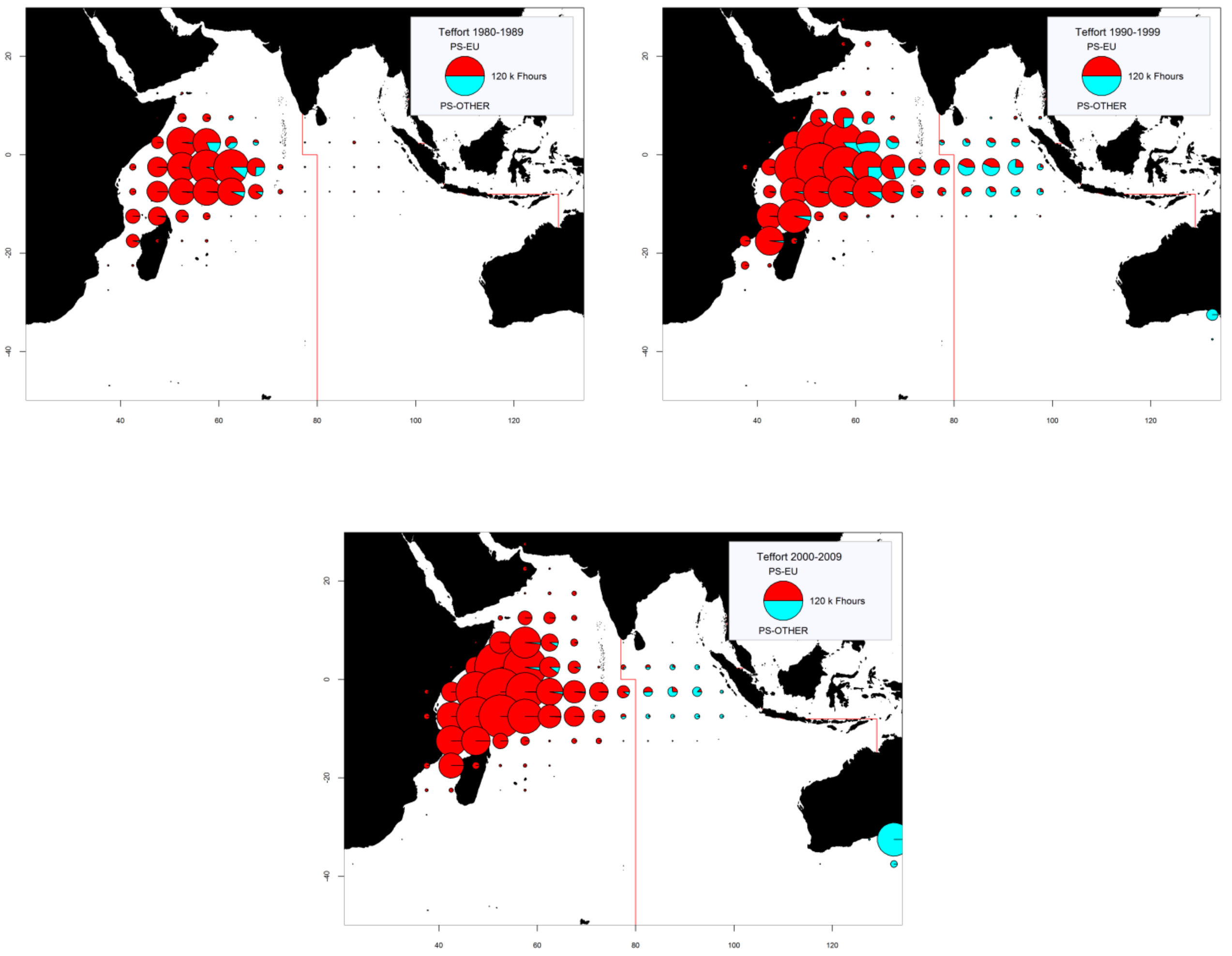
b) *Purse seine*

Effort exerted by industrial PURSE SEINE fleets in the Indian Ocean, in thousands (k) of fishing hours (Fhours), by decade 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)

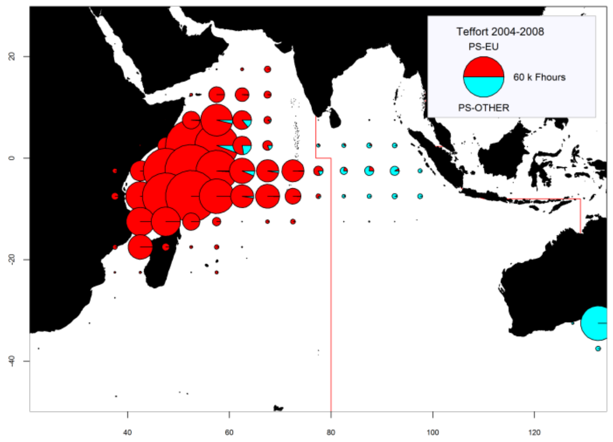


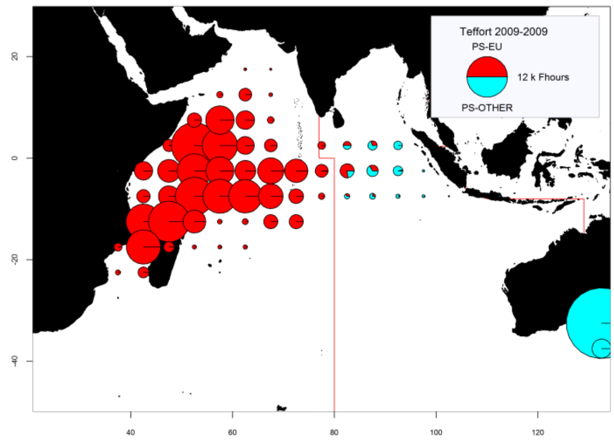
Effort exerted by industrial PURSE SEINE fleets in the Indian Ocean, in thousands (k) of fishing hours (Fhours), for 2004–08 and 2009–13, by year, and main fleet:

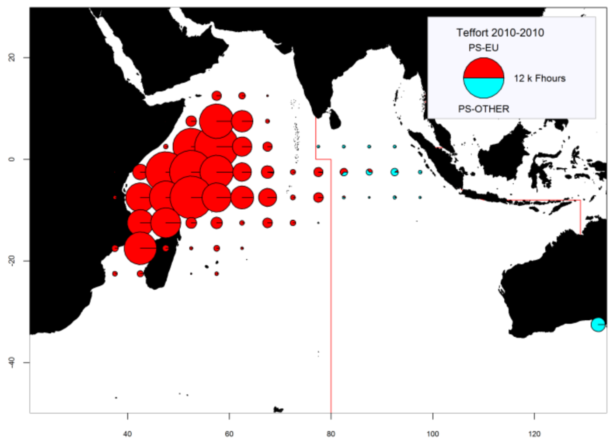
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)

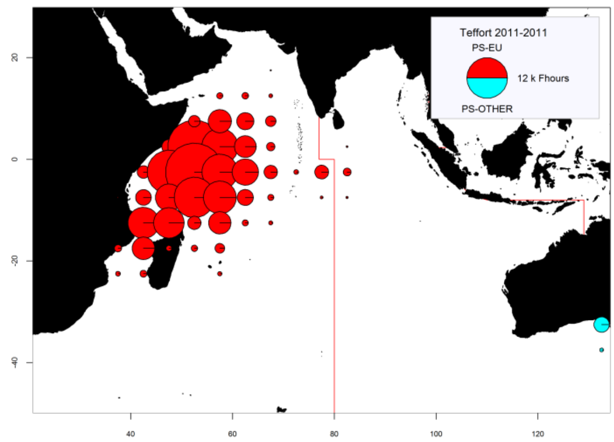
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin)

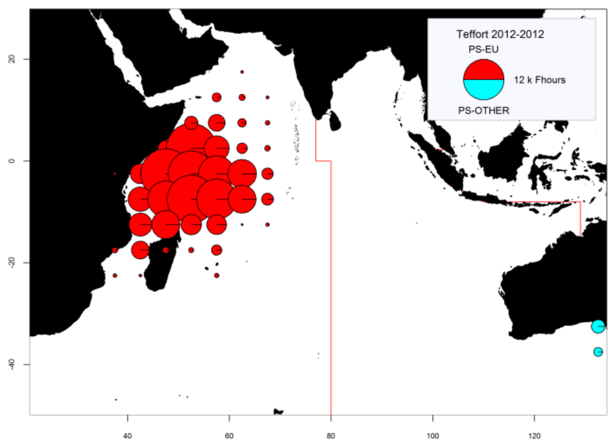
(excludes effort data for purse seiners of Iran and Thailand)

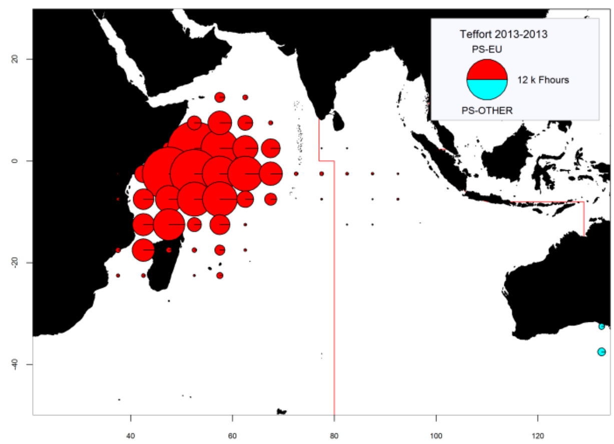










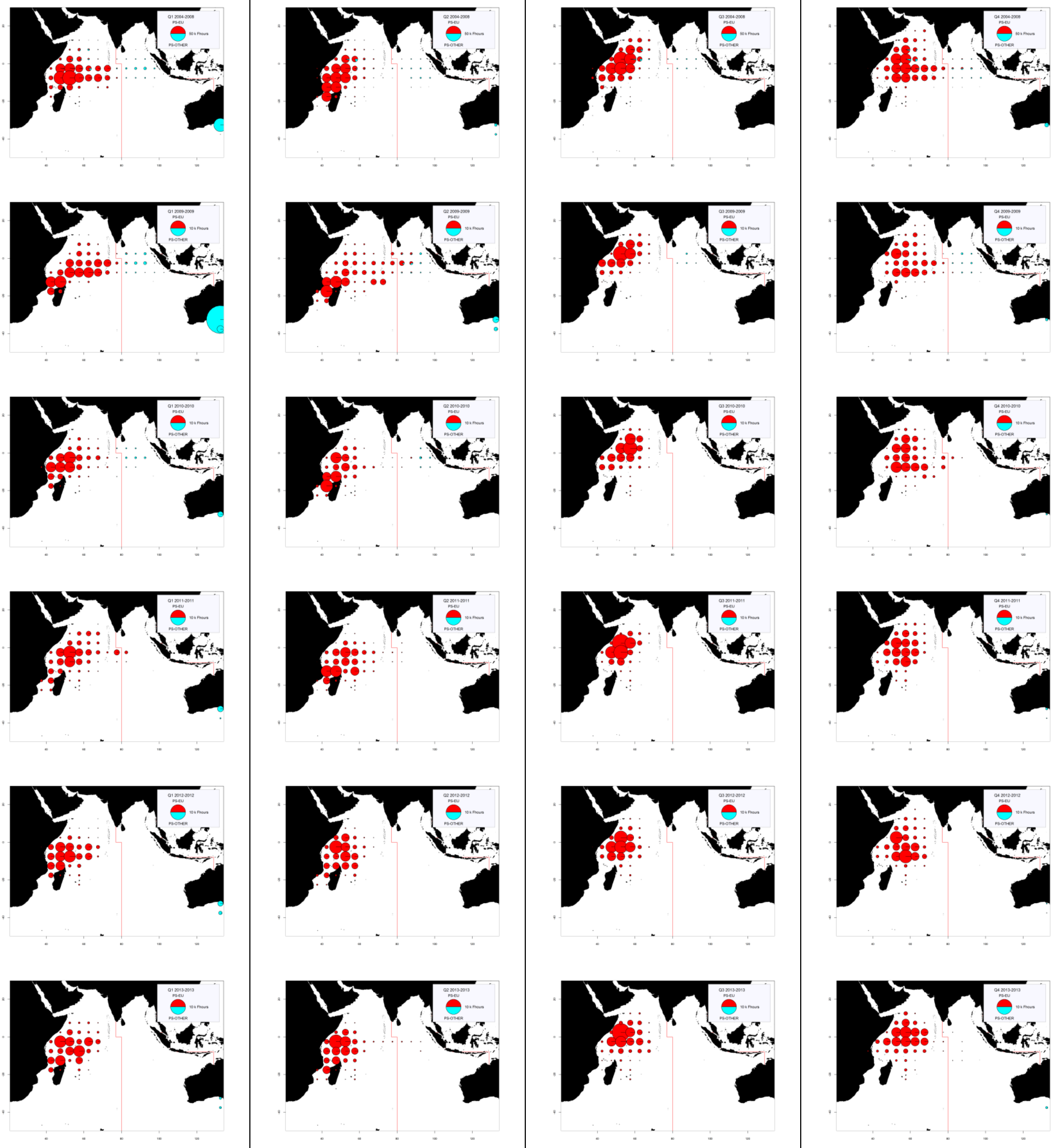


Effort exerted by industrial PURSE SEINE fleets in the Indian Ocean, in thousands (k) of fishing hours (Fhours), for 2004-08 and 2009-13, by year, quarter, and main fleet:

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)

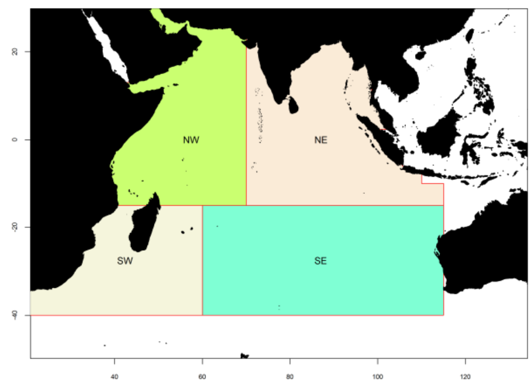
(excludes effort data for purse seiners of Iran)



2. SWORDFISH

a. Catch rates and area fished

Areas used for the assessment of the Indian Ocean swordfish stock

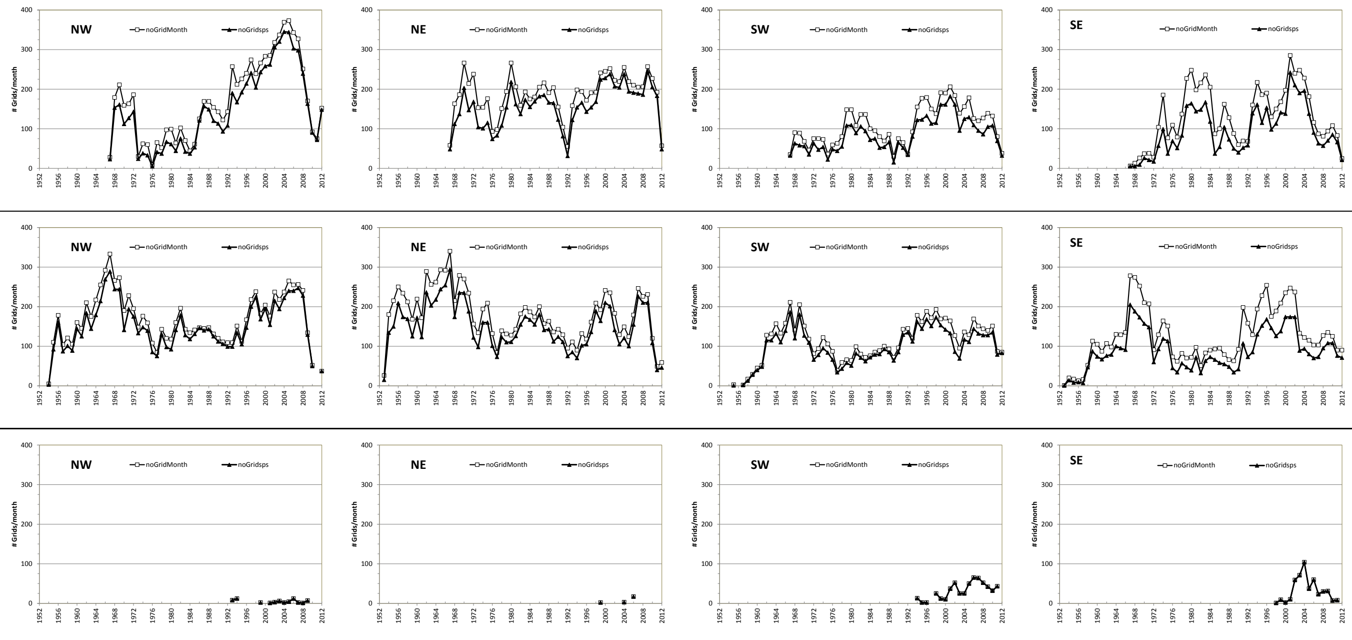


Number of five degree squares/month explored and number of squares/month with catches of swordfish reported by the longline fisheries of EU-Taiwan,China (top), Japan (center), and Spain (bottom), by area and year (1952 to 2012): Indian Ocean NW (left); NE (center right); SW (center left); SE (right). The areas referred to above are shown in the map above

TWN

JPN

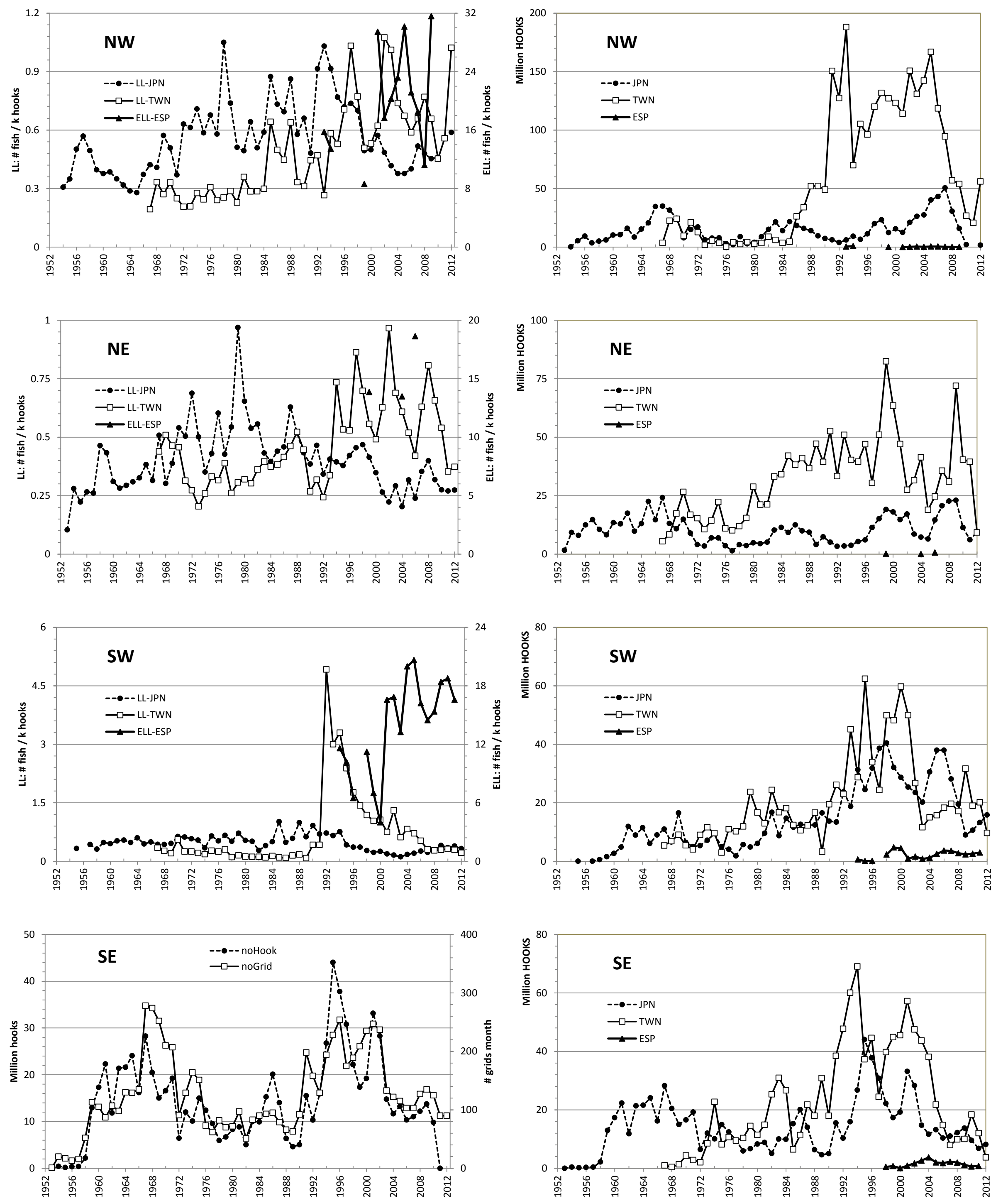
ESP



Total number of five degree squares/month on which catches of swordfish have been ever reported: NW (1,231); NE (665); SW (382); SE (645)

Nominal CPUE (number of fish/1000 hooks; left panel) and total fishing effort (million of hooks set; right panel) for the longline fleets of EU-Spain, Japan, and Taiwan,China fishing in the Indian Ocean, by area and year (1952 to 2012): Indian Ocean from top to bottom: NW; NE; SW; SE. The areas referred to before are shown in the map in the previous page

CPUE number of swordfish per thousand hooks	EFFORT: Number of Hooks (millions)



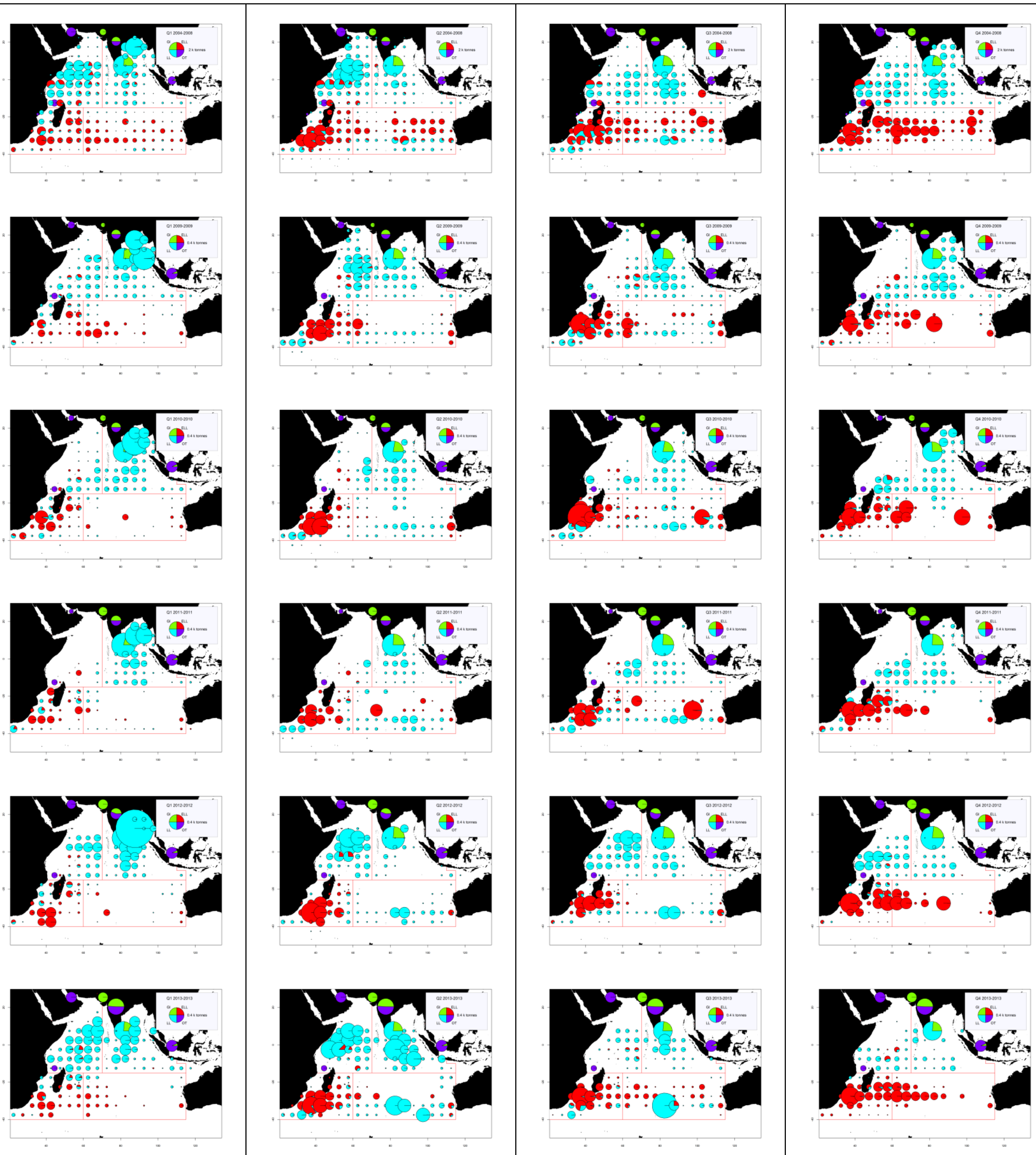
b. Recent catches

Time-area catches (total combined in number of fish for main longline fleets) of SWORDFISH estimated for 2004-08 and 2009-13, by year, and quarter (Time-area catches are not available for all fleets; catches of fresh-tuna longliners are not represented):

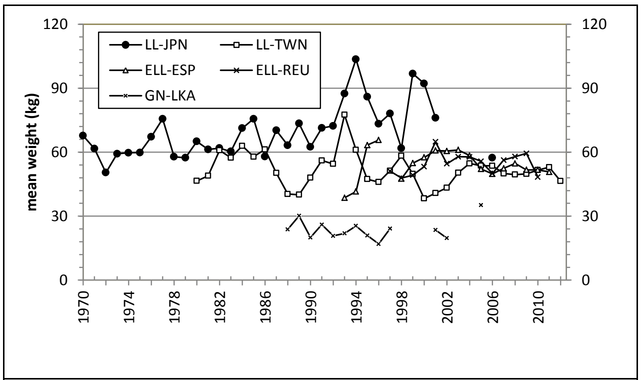
EU-Spain (ESP, red): Longliners from Spain (target swordfish).

Taiwan,China (TWN, blue): Deep-freezing longliners flagged in Taiwan,China (target tunas or swordfish).

Japan (JPN, green): Deep-freezing longliners flagged in Japan (target tunas).

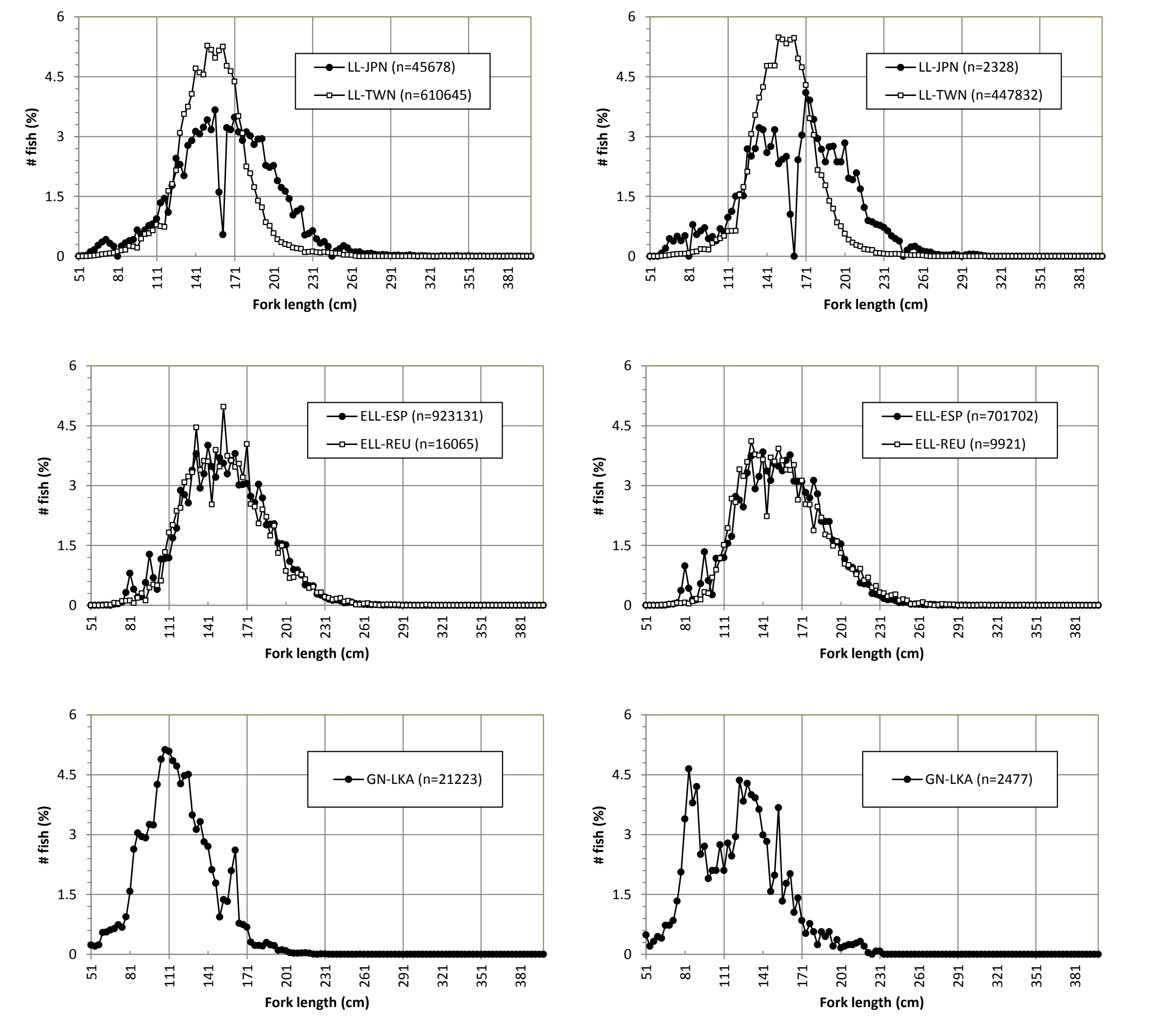


c. Average weight and length frequency samples



Average weight of swordfish (kg) estimated from the size samples available for longliners of Japan (1970-2012), Taiwan,China (1980-2012), EU-Spain (1993-2012), and EU-France-Reunion (1997-2012); and the gillnet fishery of Sri Lanka (1988-2012)

NOTE: Average weights are shown only for years in which 300 or more specimens were sampled for length

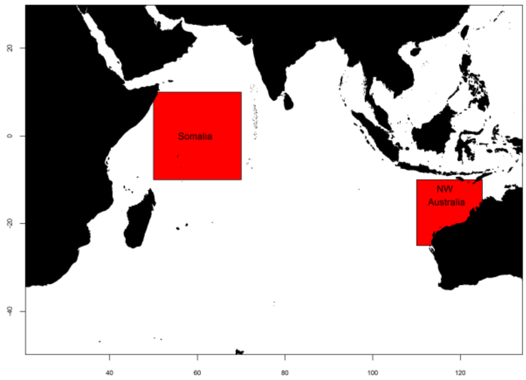


Number of swordfish by length class (fork length; expressed as %) estimated in the Indian Ocean, for 1950-2012 (left) and 2000-09 (right): Longline fisheries of Japan and Taiwan,China (top); swordfish longline fisheries of EU-Spain and EU-France-Reunion (center); gillnet fisheries of Sri Lanka (bottom)

3. BLACK MARLIN

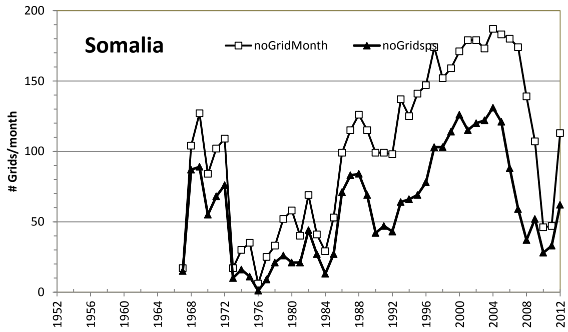
a. Catch rates and area fished

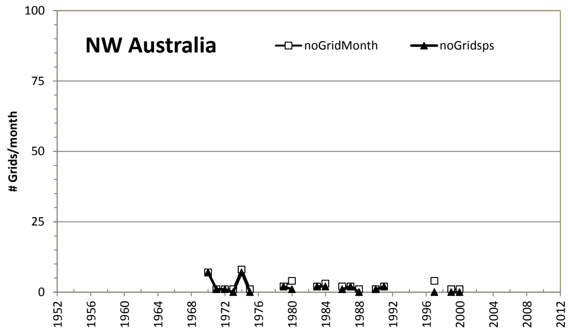
Hot spots of marlins identified by the IOTC WPB



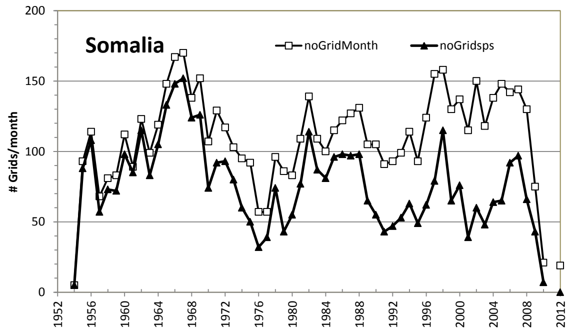
Number of five degree squares/month explored and number of squares/month with catches of black marlin reported by the longline fisheries of Taiwan,China (top), Japan (bottom) by area and year (1952 to 2012): Somalia (left); NW Australia (right). The areas referred to above are shown in the map above

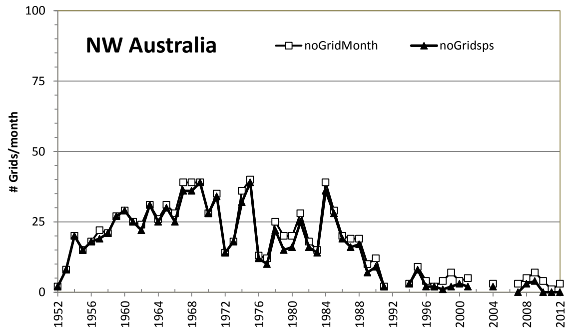
TWN





JPN

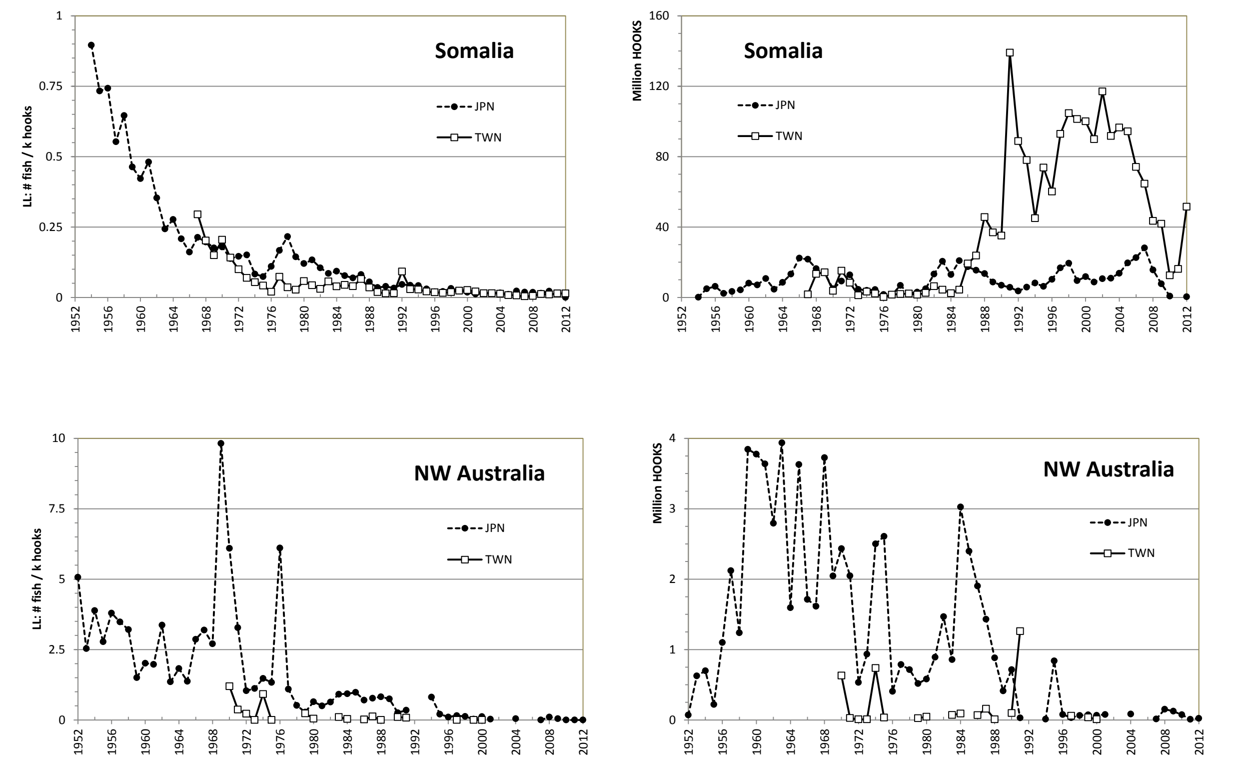




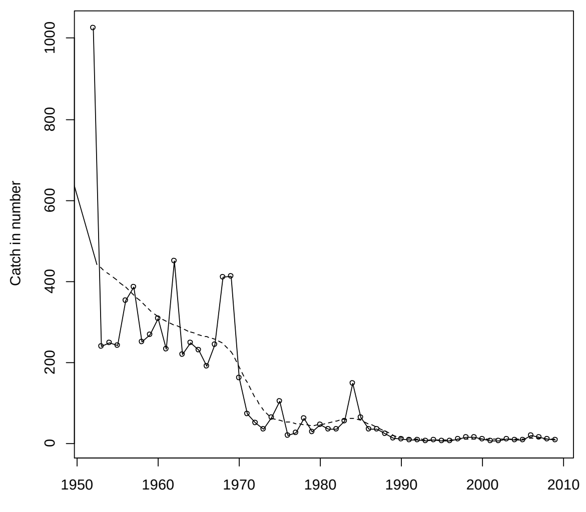
Total number of five degree squares/month on which catches of black marlin have been ever reported: Somalia (192); NW Australia (56)

Nominal CPUE (number of fish/1000 hooks; left panel) and total fishing effort (million of hooks set; right panel) for the longline fleets of Japan, and Taiwan,China fishing in the Indian Ocean, by area and year (1952 to 2012): Somalia (top); NW Australia (bottom). The areas referred to above are shown in the map in the previous page

CPUE number of black marlin per thousand hooks	EFFORT: Number of Hooks (millions)



Average catch (number of fish) in the three 5 degree square grids recording the highest catches of black marlin in the Indian Ocean for the combined Japan and Taiwan,China longline fleets (1952-2010)



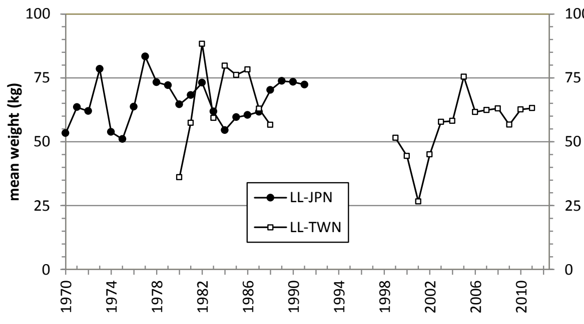
b. Recent catches

Time-area catches (total combined in number of fish for main longline fleets) of BLACK MARLIN estimated for 2004-08 and 2009-13, by year, and quarter:

Taiwan,China (TWN, blue): Deep-freezing longliners flagged in Taiwan,China (target tunas or swordfish).

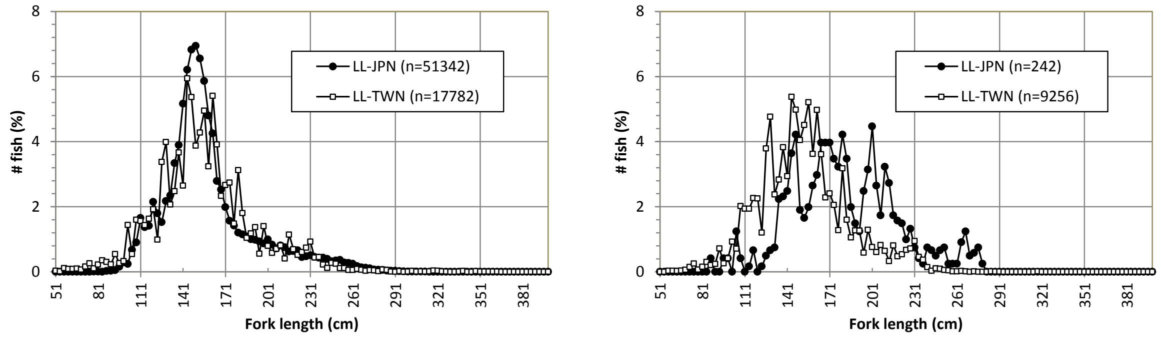
Japan (JPN, red): Deep-freezing longliners flagged in Japan (target tunas).

c. Average weight and length frequency samples



Average weight of black marlin (kg) estimated from the size samples available for longliners of Japan (1970-2012) and Taiwan,China (1980-2012)

NOTE: Average weights are shown only for years in which 300 or more specimens were sampled for length

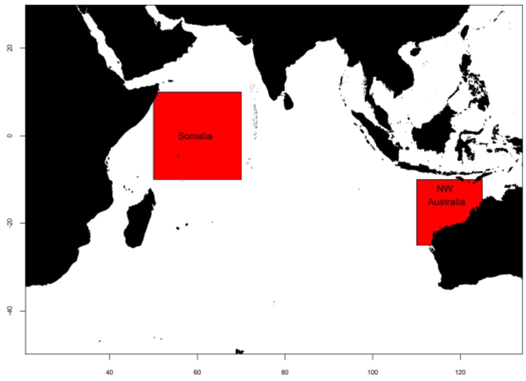


Number of black marlin by length class (eye to fork length; expressed as %) estimated for the longline fisheries of Japan and Taiwan,China in the Indian Ocean, for 1950-2012 (left) and 2000-09 (right)

4. BLUE MARLIN

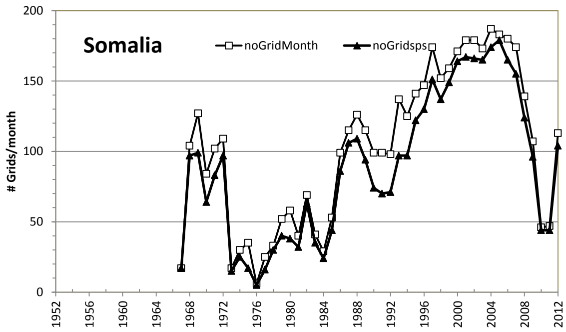
a. Catch rates and area fished

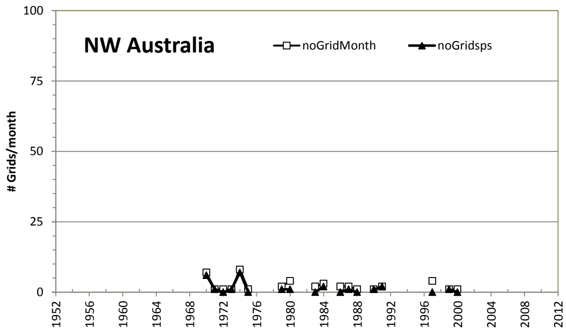
Hot spots of marlins identified by the IOTC WPB



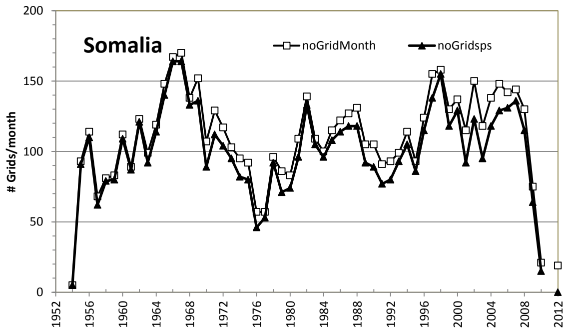
Number of five degree squares/month explored and number of squares/month with catches of blue marlin reported by the longline fisheries of Taiwan,China (top), Japan (bottom) by area and year (1952 to 2012): Somalia (left); NW Australia (right). The areas referred to above are shown in the map above

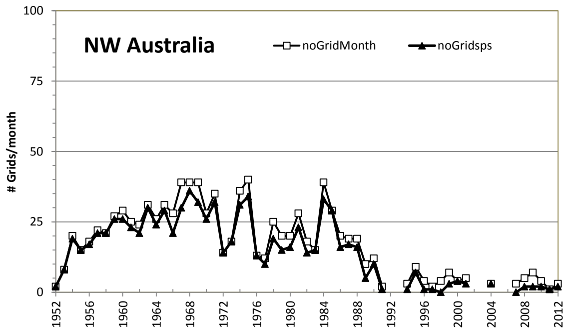
TWN





JPN

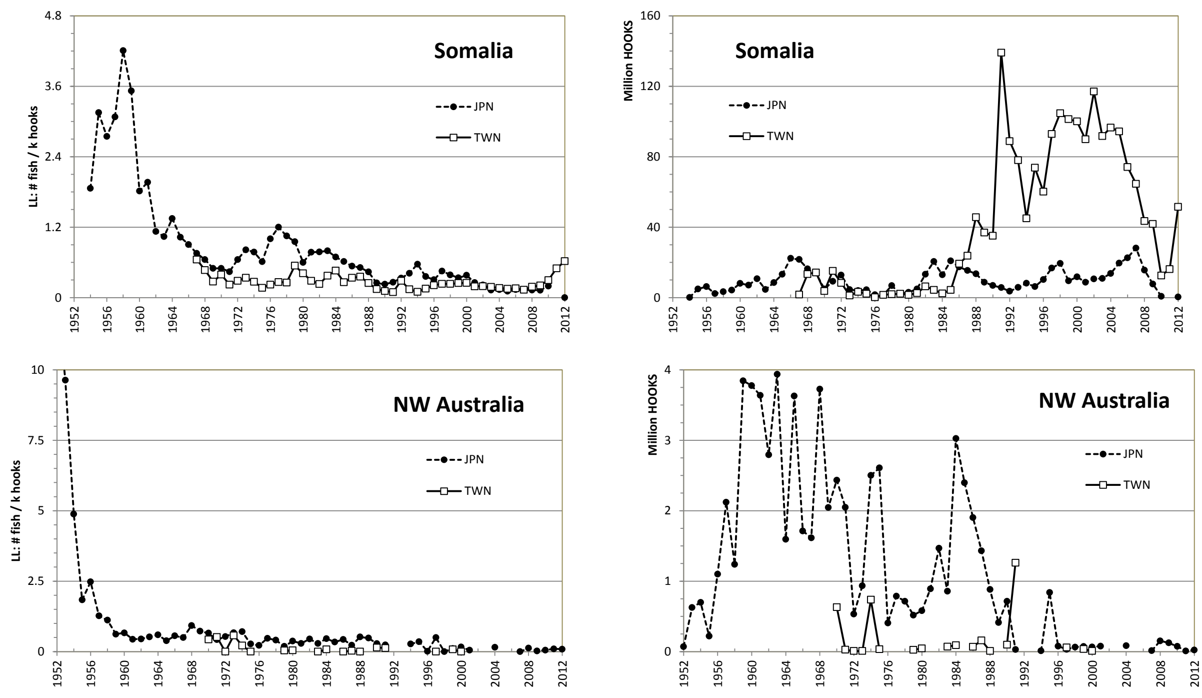




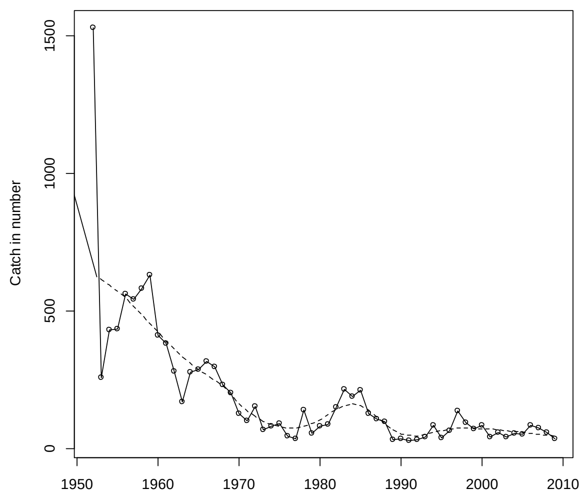
Total number of five degree squares/month on which catches of blue marlin have been ever reported: Somalia (192); NW Australia (56)

Nominal CPUE (number of fish/1000 hooks; left panel) and total fishing effort (million of hooks set; right panel) for the longline fleets of Japan, and Taiwan,China fishing in the Indian Ocean, by area and year (1952 to 2012): Somalia (top); NW Australia (bottom). The areas referred to above are shown in the map in the previous page

CPUE number of blue marlin per thousand hooks	EFFORT: Number of Hooks (millions)



Average catch (number of fish) in the three 5 degree square grids recording the highest catches of blue marlin in the Indian Ocean for the combined Japan and Taiwan,China longline fleets (1952-2010)

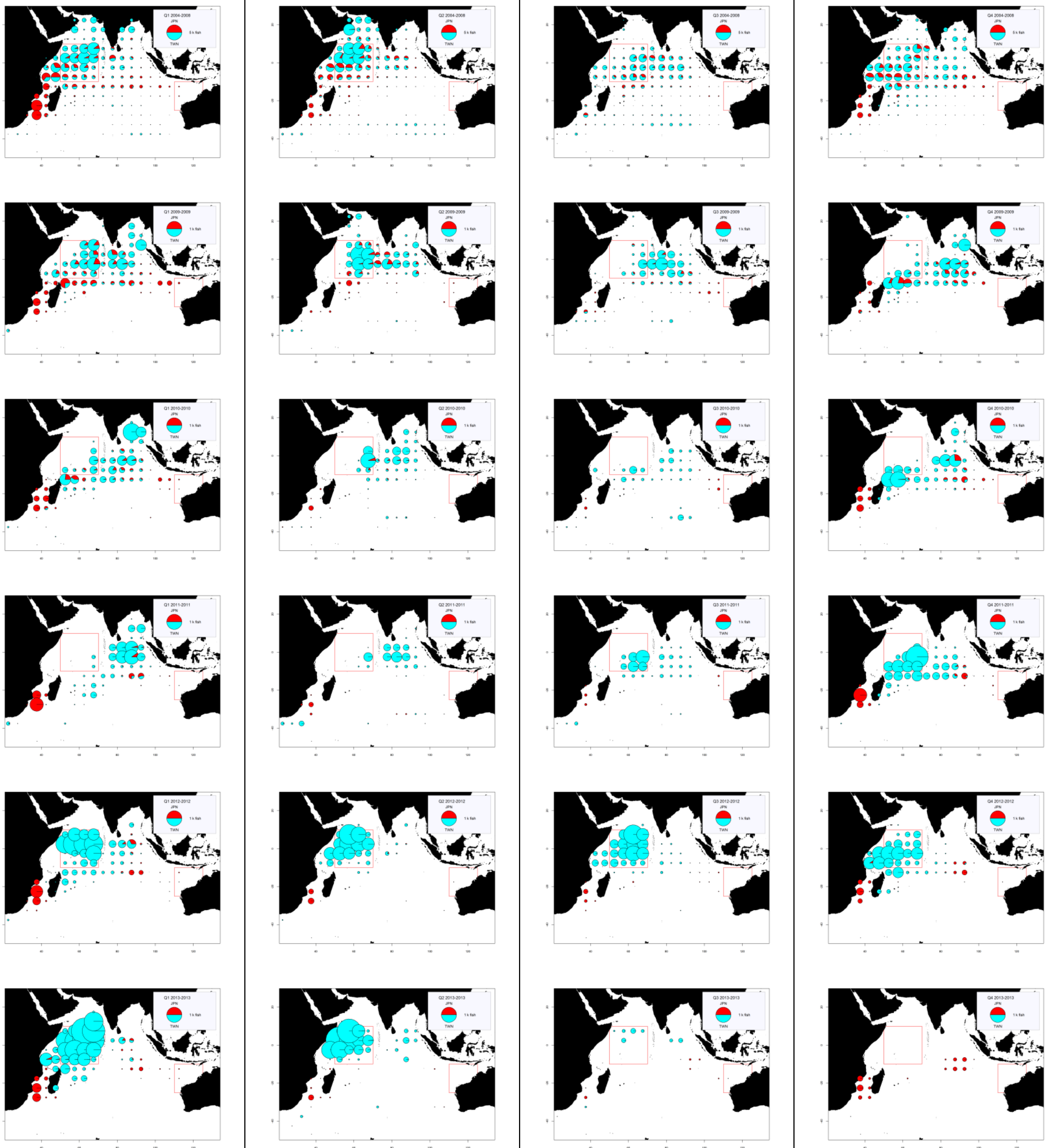


b. Recent catches

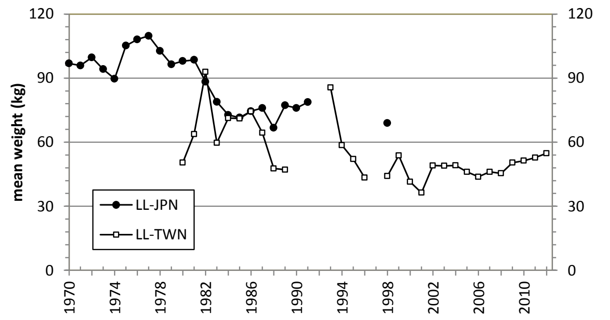
Time-area catches (total combined in number of fish for main longline fleets) of BLUE MARLIN estimated for 2004-08 and 2009-13, by year, and quarter:

Taiwan,China (TWN, blue): Deep-freezing longliners flagged in Taiwan,China (target tunas or swordfish).

Japan (JPN, red): Deep-freezing longliners flagged in Japan (target tunas).

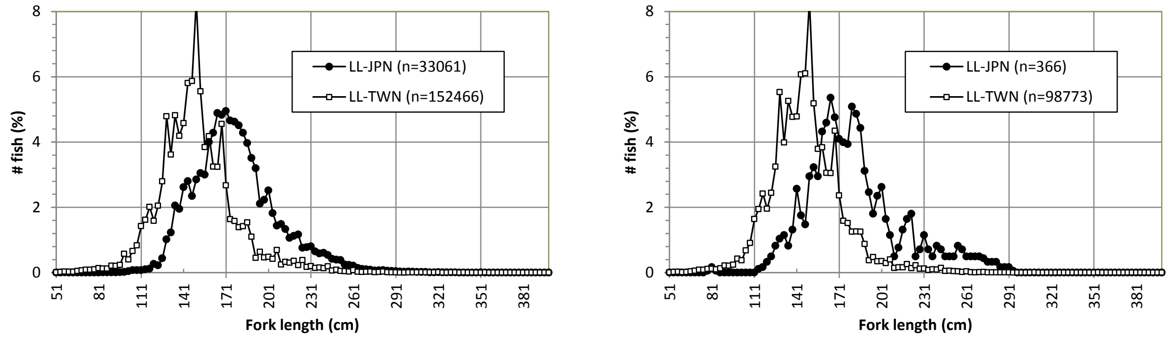


c. Average weight and length frequency samples



Average weight of blue marlin (kg) estimated from the size samples available for longliners of Japan (1970-2012) and Taiwan,China (1980-2012)

NOTE: Average weights are shown only for years in which 300 or more specimens were sampled for length

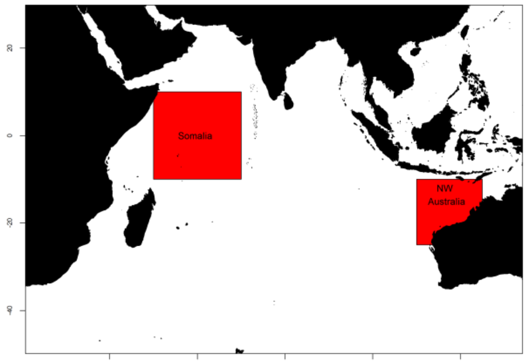


Number of blue marlin by length class (eye to fork length; expressed as %) estimated for the longline fisheries of Japan and Taiwan,China in the Indian Ocean, for 1950-2012 (left) and 2000-09 (right)

5. STRIPED MARLIN

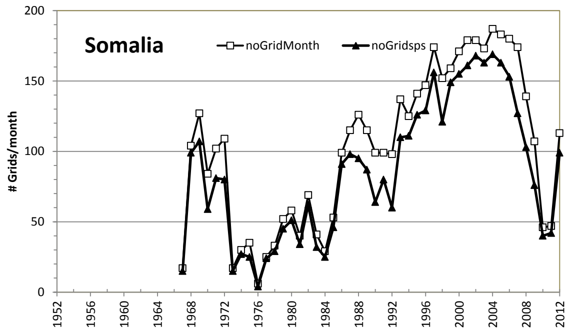
a. Catch rates and area fished

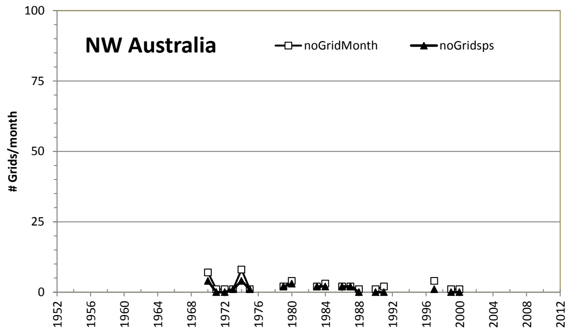
Hot spots of marlins identified by the IOTC WPB



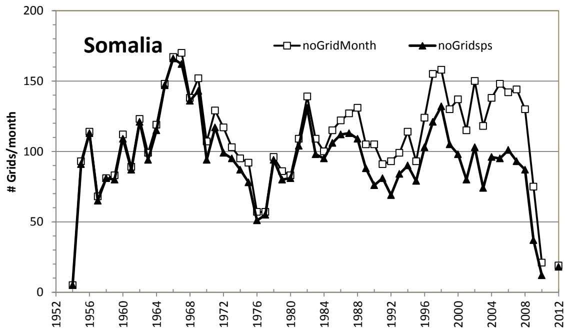
Number of five degree squares/month explored and number of squares/month with catches of striped marlin reported by the longline fisheries of Taiwan,China (top), Japan (bottom) by area and year (1952 to 2012): Somalia (left); NW Australia (right). The areas referred to above are shown in the map above

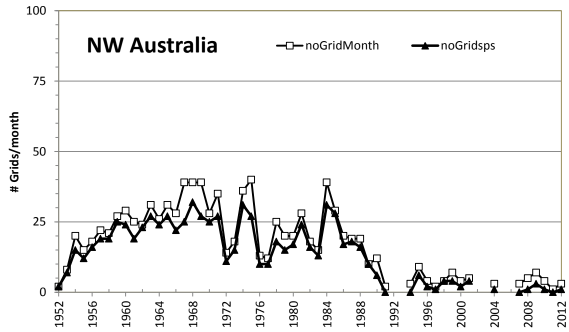
TWN





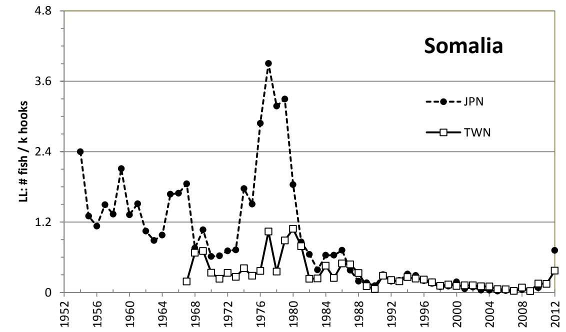
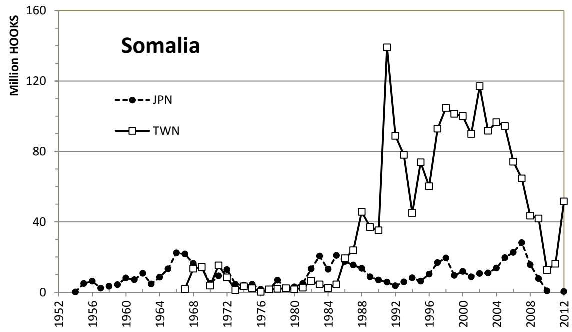
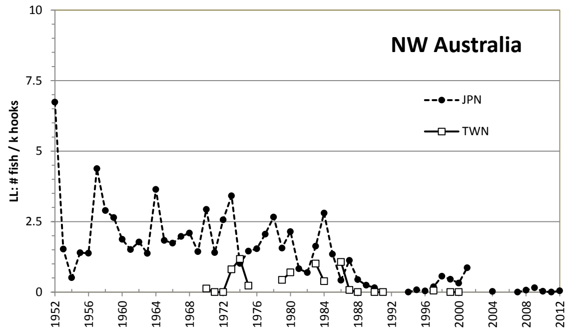
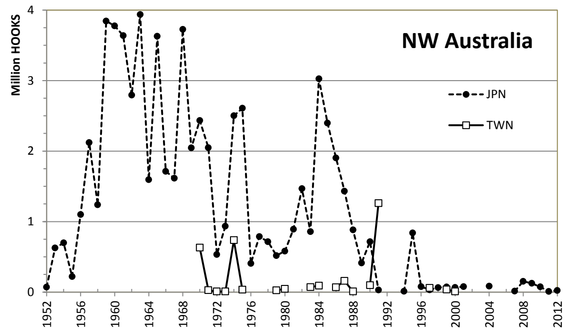
JPN



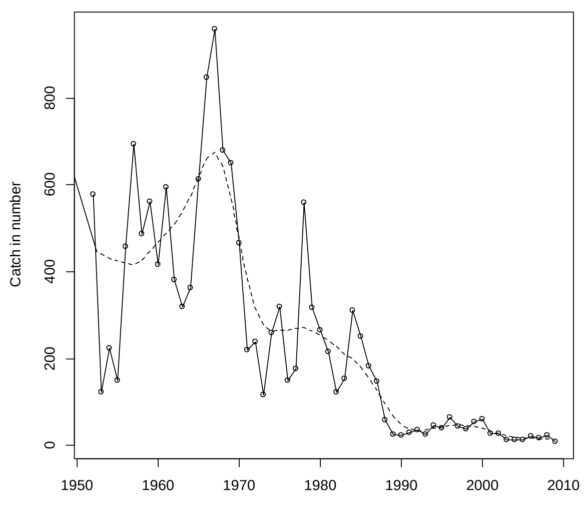


Total number of five degree squares/month on which catches of striped marlin have been ever reported: Somalia (192); NW Australia (54)

Nominal CPUE (number of fish/1000 hooks; left panel) and total fishing effort (million of hooks set; right panel) for the longline fleets of Japan, and Taiwan,China fishing in the Indian Ocean, by area and year (1952 to 2012): Somalia (top); NW Australia (bottom). The areas referred to above are shown in the map in the previous page

CPUE number of striped marlin per thousand hooks	EFFORT: Number of Hooks (millions)
	
	

Average catch (number of fish) in the three 5 degree square grids recording the highest catches of striped marlin in the Indian Ocean for the combined Japan and Taiwan,China longline fleets (1952-2010)

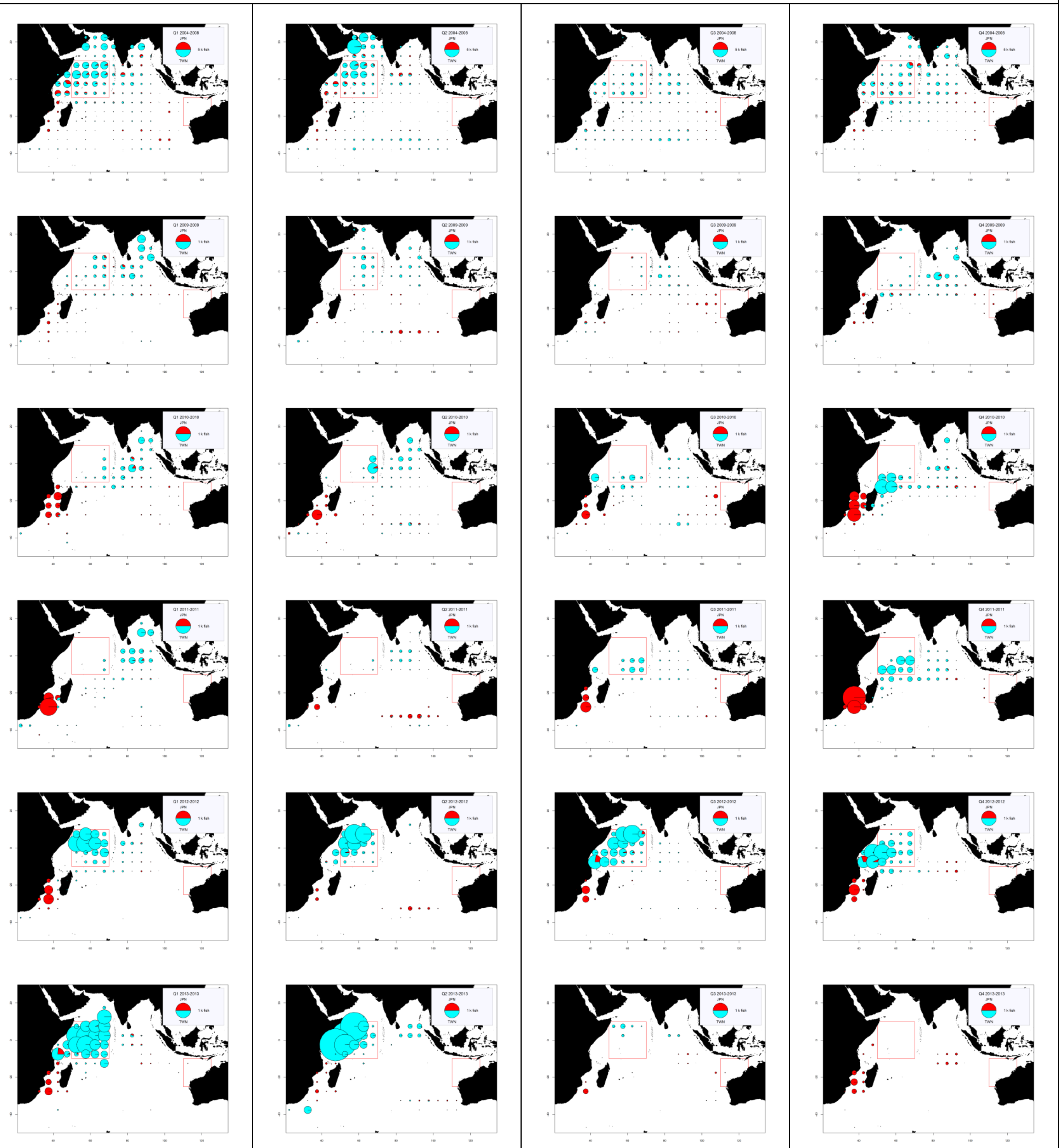


b. Recent catches

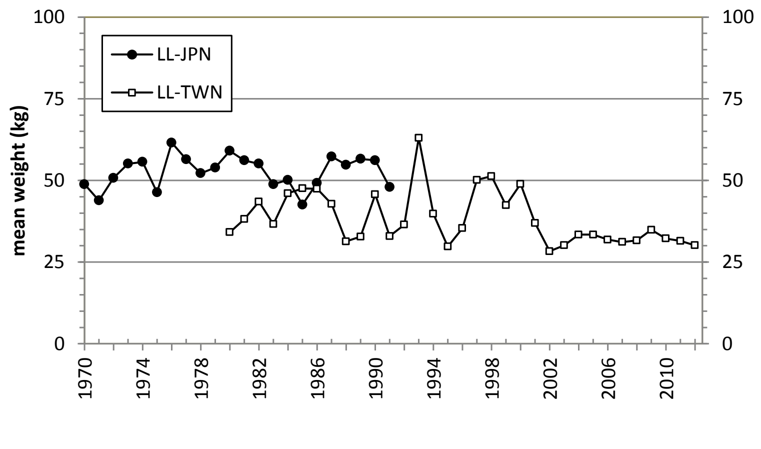
Time-area catches (total combined in number of fish for main longline fleets) of BLUE MARLIN estimated for 2004-08 and 2009-13, by year, and quarter:

Taiwan,China (TWN, blue): Deep-freezing longliners flagged in Taiwan,China (target tunas or swordfish).

Japan (JPN, red): Deep-freezing longliners flagged in Japan (target tunas).

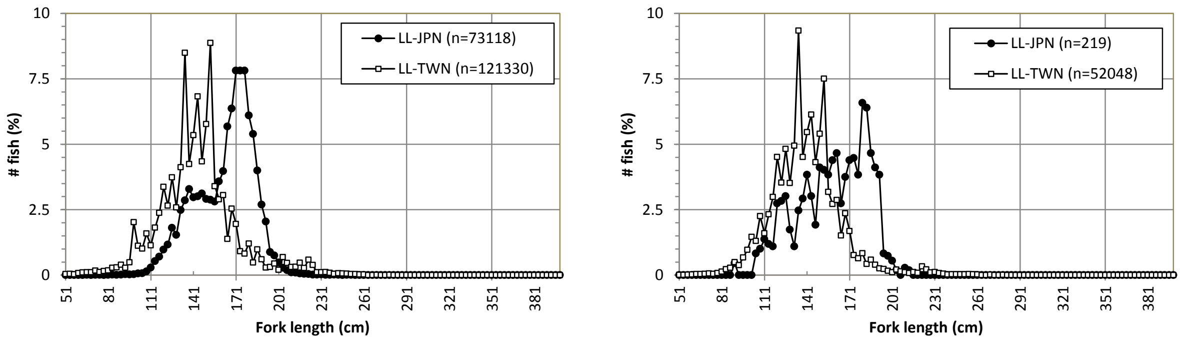


c. Average weight and length frequency samples



Average weight of striped marlin (kg) estimated from the size samples available for longliners of Japan (1970-2012) and Taiwan,China (1980-2012)

NOTE: Average weights are shown only for years in which 300 or more specimens were sampled for length



Number of striped marlin by length class (eye to fork length; expressed as %) estimated for the longline fisheries of Japan and Taiwan,China in the Indian Ocean, for 1950-2012 (left) and 2000-09 (right)

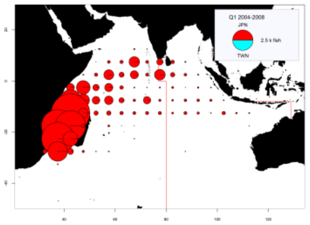
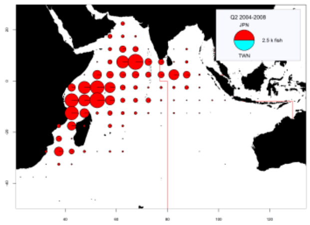
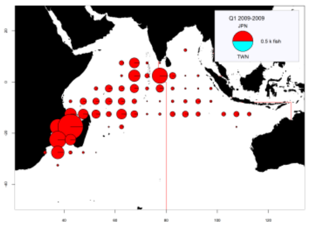
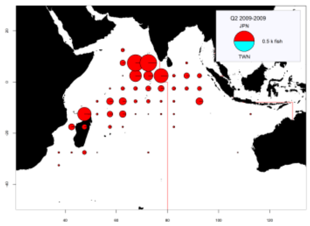
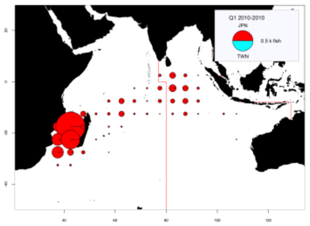
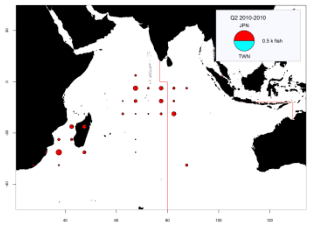
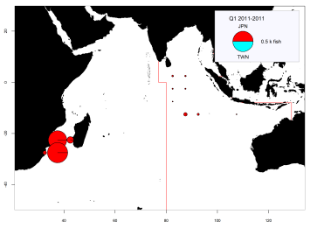
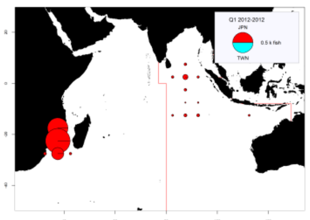
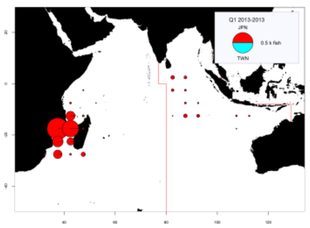
6. INDO-PACIFIC SAILFISH

a. Recent catches

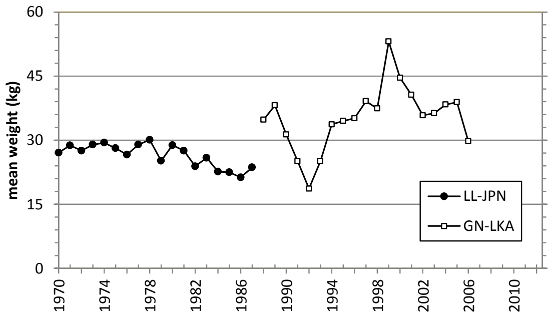
Time-area catches (total combined in number of fish for main longline fleets) of BLUE MARLIN estimated for 2004-08 and 2009-13, by year, and quarter:

Taiwan,China (TWN, blue): Deep-freezing longliners flagged in Taiwan,China (target tunas or swordfish).

Japan (JPN, red): Deep-freezing longliners flagged in Japan (target tunas).

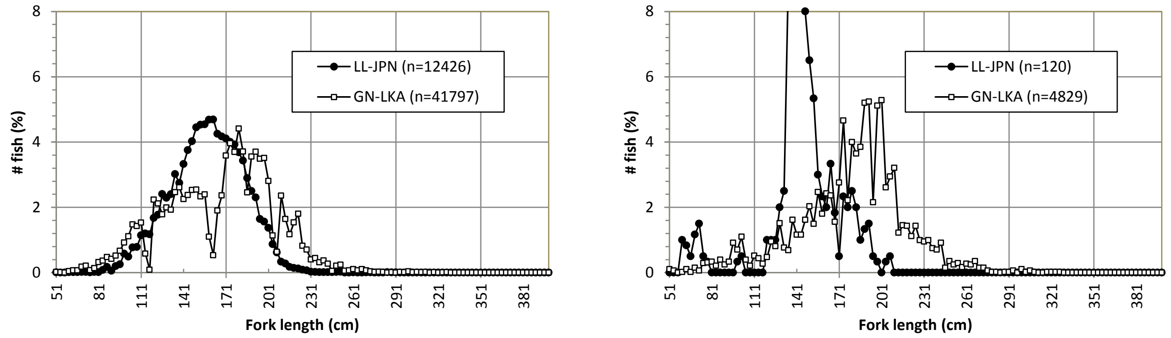
			
			
			
			
			
			

b. Average weight and length frequency samples



Average weight of Indo-Pacific sailfish (kg) estimated from the size samples available for longliners of Japan (1970-2012) and gillnets of Sri Lanka (1980-2012)

NOTE: Average weights are shown only for years in which 300 or more specimens were sampled for length



Number of Indo-Pacific sailfish by length class (eye to fork length; expressed as %) estimated for the longline fishery of Japan and the gillnet fishery of Sri Lanka in the Indian Ocean, for 1950-2012 (left) and 2000-09 (right)

APPENDIX III

ESTIMATION OF CATCHES AT SIZE FOR IOTC BILLFISH SPECIES

Table 7: Current IOTC equations to convert from non-standard measurements into standard lengths, by species

Species: Swordfish — ***Standard length: Lower jaw fork length***

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size (cm)*	*IOTC Secretariat size frequency data*
Cleithrum-caudal fork length[A]	(L+b)/a	a= 0.8087 b= 8.6712	n/a	n/a	No. of samples: 1,241,418 Min: 17 cm Max: 452 cm Lower quartile: 134 cm Average: 155 cm Upper quartile: 176 cm
Cleithrum-keel length[B]	(a*L)+b	a= 1.55108 b= 13.5025	179	Min:88 Max:252	
Eye orbit-fork length[C]	(a*L)+b	a= 1.066 b= 10.449	123	Min:48 Max:255	
Pectoral-anal length[D]	(a*L)+b	a= 2.5407 b= 25.698	1,806	Min:18 Max:105	
Pectoral-caudal fork length[E]	(a*L)+b	a= 1.2398 b= 11.204	55	Min:60 Max:157	
**Weight round[F]	$(W/a)^{\wedge(1/b)}$	a= 0.000004203 b= 3.2134	3,608	Min:89 Max:266	
Weight gilled and gutted[G]	$(W/a)^{\wedge(1/b)}$	a= 0.0000043491 b= 3.188	3,608	Min:89 Max:266	
**Weight headed[H]	$(W/a)^{\wedge(1/b)}$	a= 0.000002032 b= 3.3104	2,569	Min:80 Max:253	

***** Denotes new or updates to existing equations in 2014.***

Sources:

A: Reference not available.

B: Two step conversion as CKL = (0.690253*EFL) -3.541823 in formula LJFL = 8.00884+(1.07064*EFL); NOAA Data (Pacific Ocean).

C, D, E: Data from Reunion Island, Indian Ocean Poisson 2001 (in IOTC-2005-WPTT-05).

F: Converted to GGT (GGT=RND/1.14 (Mejuto et al. 1998)) and inverted length-weight equation (ICCAT Mejuto et al 1998 South-East Atlantic Ocean).

G: Inverted length-weight equation(ICCAT Mejuto et al 1998 South-East Atlantic Ocean).

H: Inverted length-weight equation. Length-weight interrelationships for Swordfish caught in the Central North Pacific, NOAA.

Sources of alternative equations:

Poisson, 2001; BRS (Ward, pers.com); Meneses de Lima et al, 2000.

Table 7(cont): Current IOTC equations to convert from non-standard measurements into standard lengths by species

Species: Black marlin — ***Standard length: Eye orbit to fork of tail***

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size*	*IOTC Secretariat size frequency data*
Cleithrum-Keel length	No equation available				No. of samples: 63,755 Min: 41 cm Max: 395 cm Lower quartile: 146 cm Average: 165 cm Upper quartile: 176 cm
Lower-jaw - fork length[I]	(a*L)+b	a= 0.8972 b= -4.6673	13	Min:119 Max:314	

Species: Blue marlin — ***Standard length: Eye orbit to fork of tail***

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size*	*IOTC Secretariat size frequency data*
Lower-jaw - fork length[J]	(a*L)+b	a= 0.9039 b= -7.248	26	Min:143 Max:295	No. of samples: 212,368 Min: 38 cm Max: 404 cm Lower quartile: 143 cm Average: 161 cm Upper quartile: 179 cm
**Weight gilled and gutted[K]	$(W/a)^{(1/b)}$	a= 0.000010242 b= 2.9749	24	Min:98 Max:234	

Species: Striped marlin — ***Standard length: Lower jaw fork length***

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size*	*IOTC Secretariat size frequency data*
**Eye orbit to fork of tail[M]	(a*L)+b	a= 1.1178 b= 7.7696	263	Min:104 Max:231	No. of samples: 191,294 Min: 50 cm Max: 410 cm Lower quartile: 161 cm Average: 180 cm Upper quartile: 203 cm
**Weight round[N]	$(W/a)^{(1/b)}$	a= 0.000001 b= 3.3	802	Min:150 Max:290	

Species: Indo-Pacific sailfish — ***Standard length: Lower jaw fork length***

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size*	*IOTC Secretariat size frequency data*
Cleithrum-Keel length	No equation available				No. of samples: 54,253 Min: 17 cm Max: 299 cm Lower quartile: 137 Average: 162 cm Upper quartile: 188 cm
**Eye orbit to fork of tail[O]	(a*L)+b	a= 1.076 b= 11.24	n/a	n/a	

Notes

*** Denotes new or amendments to existing equations in 2014.*

Equations to convert Black marlin and Indo-Pacific sailfish from gilled and gutted weights to eye orbit to fork of tail removed due to issues of reliability of the estimated lengths. Standard length for Striped marlin and Indo-Pacific sailfish changed from Eye orbit to fork of tail, to Lower jaw fork length.

Sources:

I, J: BRS (Ward, pers.com.) Eastern and western Australia (cited in IOTC-2005-WPTT-05).

*K: ** Inverted length weight equation, taken from Review of Life History Parameters for Blue Marlin, ISC/13/BILLWG-1/12.*

L: PIFSC Administrative report: (Updated Weight-on-Length Relationships for Pelagic Fishes Caught in the Central North Pacific Ocean and Bottom fishes from the Northwestern Hawaiian Islands) Value of a (52.0203) divided by 1.13 to account for conversion of gilled-and-gutted weight into round weight.

M: Su, N.J., C.L. Sun, S.Z. Yeh, W.C. Chiang, S.P. Wang, and C.H. Liu (2005), LJFL and EFL relationships for the billfishes caught by the Taiwanese offshore and coastal fisheries (ISC/05/MAR&SWO-WGs/_4).

N: Su, N.J., C.L. Sun, S.Z. Yeh, W.C. Chiang, S.P. Wang, and C.H. Liu (2006), An update on landing and sex-specific size composition data of striped marlin and swordfish in the Taiwanese offshore and coastal fisheries, ISC/06/MARWG&SWOWG-2/02.

O: ICCAT Field Manual, Chapter 2.

Sources of alternative equations:

Black marlin: ICCAT Field Manual; Su, et al, 2005.

Blue marlin: ICCAT Field Manual; Lenarz, et al, 1974; Prager et al., 1995; Su, et al, 2005; Thomas, et al, 2013.

Striped marlin: Hinton et al, 2002, Status of striped marlin in the eastern Pacific Ocean in 2001 and outlook for 2002; Su, et al, 2005.

Indo-Pacific Sailfish: Lenarz, et al, 1974; Prager et al., 1995; Su, et al, 2005; Wei-Chuan Chiang et al., 2004.

Table 8: IOTC equations used to convert from standard length into round weight, per species

Species	*Gear Type/s*	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Swordfish	All gears	Tip of lower-jaw to fork of tail(cm) – Round Weight(kg) [P]	RND= a*L^b	a= 0.0000042030 b= 3.21340	2569	Min:80 Max:253
Black marlin	All gears	Eye orbit to fork of tail(cm) – Round Weight(kg) [Q]	RND= a*L^b	a= 0.0000144217 b= 2.98851	24	Min:95 Max:279
Blue marlin	All gears	Eye orbit to fork of tail(cm) – Round Weight(kg) [R]	RND= a*L^b	a= 0.00000272228 b= 3.30967	154	Min:109 Max:269
**Striped marlin	All gears	Lower jaw fork length(cm) – Round Weight(kg) [S]	RND= a*L^b	a= 0.000001 b= 3.3	802	Min:150 Max:290
**Indo-Pac. sailfish	All gears	Lower jaw fork length(cm) – Round Weight(kg) [T]	RND= a*L^b	a= 0.00005 b= 2.583	85	Min: 125 Max:199

***** Denotes new or amendments to existing equations in 2014.***

Sources:

P: Data from the Atlantic Ocean, Spanish longline fishery (Mejuto et al., 1988, ICCAT).

Q, R: PIFSC Administrative report: (Updated Weight-on-Length Relationships for Pelagic Fishes Caught in the Central North Pacific Ocean and Bottom fishes from the Northwestern Hawaiian Islands).

S: Su, N.J., C.L. Sun, S.Z. Yeh, W.C. Chiang, S.P. Wang, and C.H. Liu (2006), An update on landing and sex-specific size composition data of striped marlin and swordfish in the Taiwanese offshore and coastal fisheries, ISC/06/MARWG&SWOWG-2/02.

T: IOTC-2009-WPB-Inf01.

Sources of alternative equations:

Swordfish: SPC (cited in IOTC-2005-WPTT-05); IPTP, 1989 (cited in IOTC-2005-WPTT-05); Romanov, et al, 2012; Setyadji, et al, 2012; Skillman, et al, 1974.

Black marlin: IPTP, 1989 (cited in IOTC-2005-WPTT-05); Prager et al.,1995; SPC (cited in IOTC-2005-WPTT-05); Romanov, et al, 2012; Setyadji, et al, 2012; Skillman, et al, 1974; Uchiyama, et al, 1999.

Blue marlin: IPTP, 1989 (cited in IOTC-2005-WPTT-05); Romanov, et al, 2012; Setyadji, et al, 2012; Skillman, et al, 1974; Thomas, et al, 2013; Uchiyama, et al, 1999.

Striped marlin: Kopf, et al, 2013; Romanov, et al, 2012; Setyadji, et al, 2012; Skillman, et al, 1974; Uchiyama, et al, 1999.

Indo-Pacific Sailfish: IPTP, 1989 (cited in IOTC-2005-WPTT-05); Prager, et al, 1995; Ravi, et al, 2012; Setyadji, et al, 2012; Skillman, et al, 1974; Uchiyama, et al, 1999.

Table 9: Number and proportion of samples reported to the IOTC Secretariat by measurement type and species.

Measurement type	BLM	BUM	MLS	SFA	SWO
Cleithrum to caudal fork length					12,919
Cleithrum-keel length	4			11	2,137
Eye-Fork Length	42,028	24,623	57,351	11,453	39,651
Lower jaw fork length	19,483	169,615	132,954	10,577	1,102,400
Gilled and gutted	9,340	8,486	15,804	1,035	6,346
Headed and gutted weight					17,282
Pectoral-anal length (by using a calliper)					5,010
Pectoral-anal length (by using a tape measure)					1,880
Pectoral-caudal (fork) length					1,431
Round Weight			831		52,362
Total no. of samples	70,855	202,724	206,940	23,076	1,241,418

Measurement type	BLM	BUM	MLS	SFA	SWO
Cleithrum to caudal fork length					1.0%
Cleithrum-keel length	0.0%			0.0%	0.2%
Eye-Fork Length	59.3%	12.1%	27.7%	49.6%	3.2%
Lower jaw fork length	27.5%	83.7%	64.2%	45.8%	88.8%
Gilled and gutted	13.2%	4.2%	7.6%	4.5%	0.5%
Headed and gutted weight					1.4%
Pectoral-anal length (by using a calliper)					0.4%
Pectoral-anal length (by using a tape measure)					0.2%
Pectoral-caudal (fork) length					0.1%
Round Weight			0%		4.2%
Total no. of samples	100%	100%	100%	100%	100%

Figure i: Charts showing conversion equations from non-standard lengths, and weights, to standard length by billfish species.

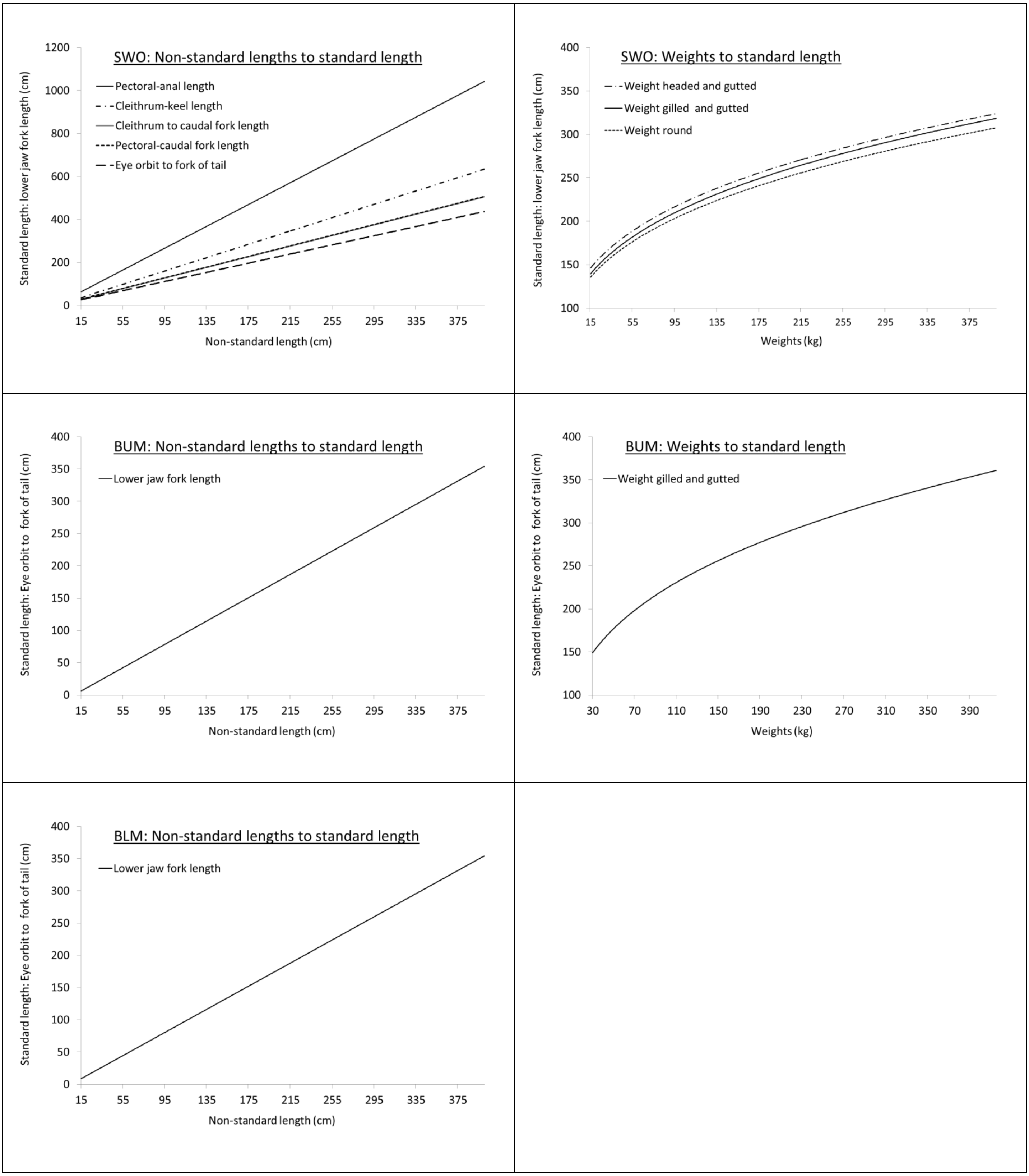
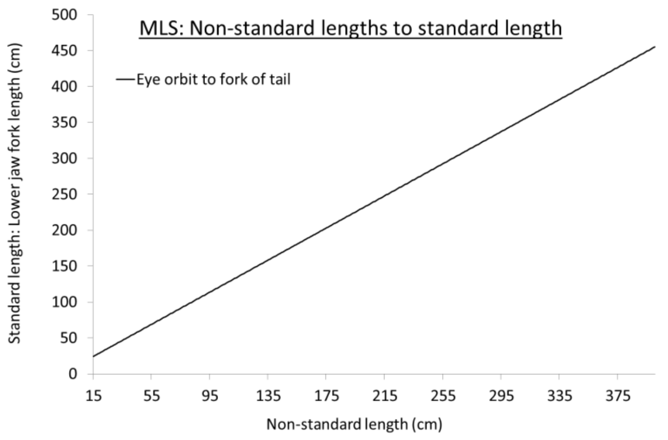
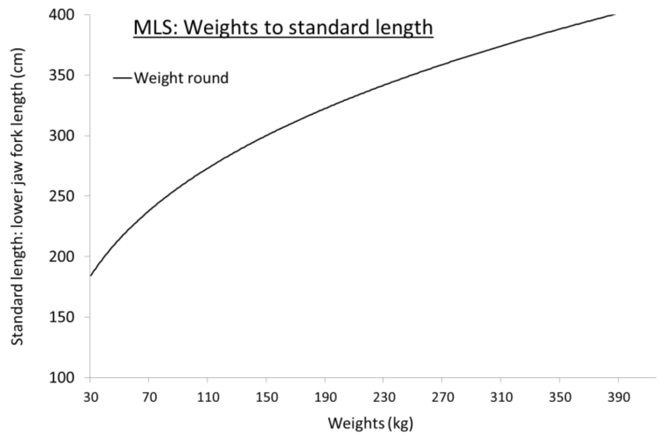


Figure i (continued): Charts showing conversion equations from non-standard lengths and weights, to standard length, by billfish species.





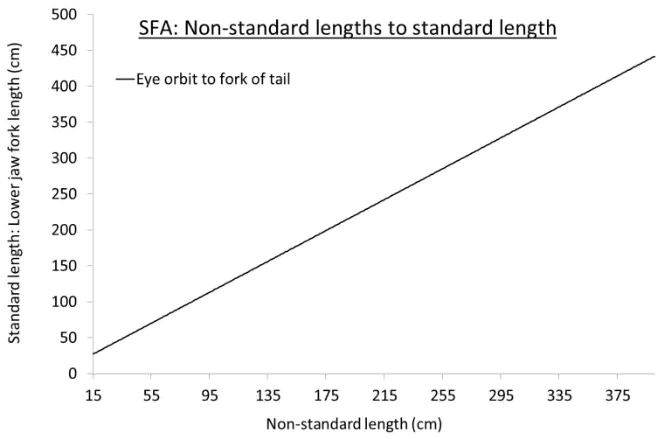
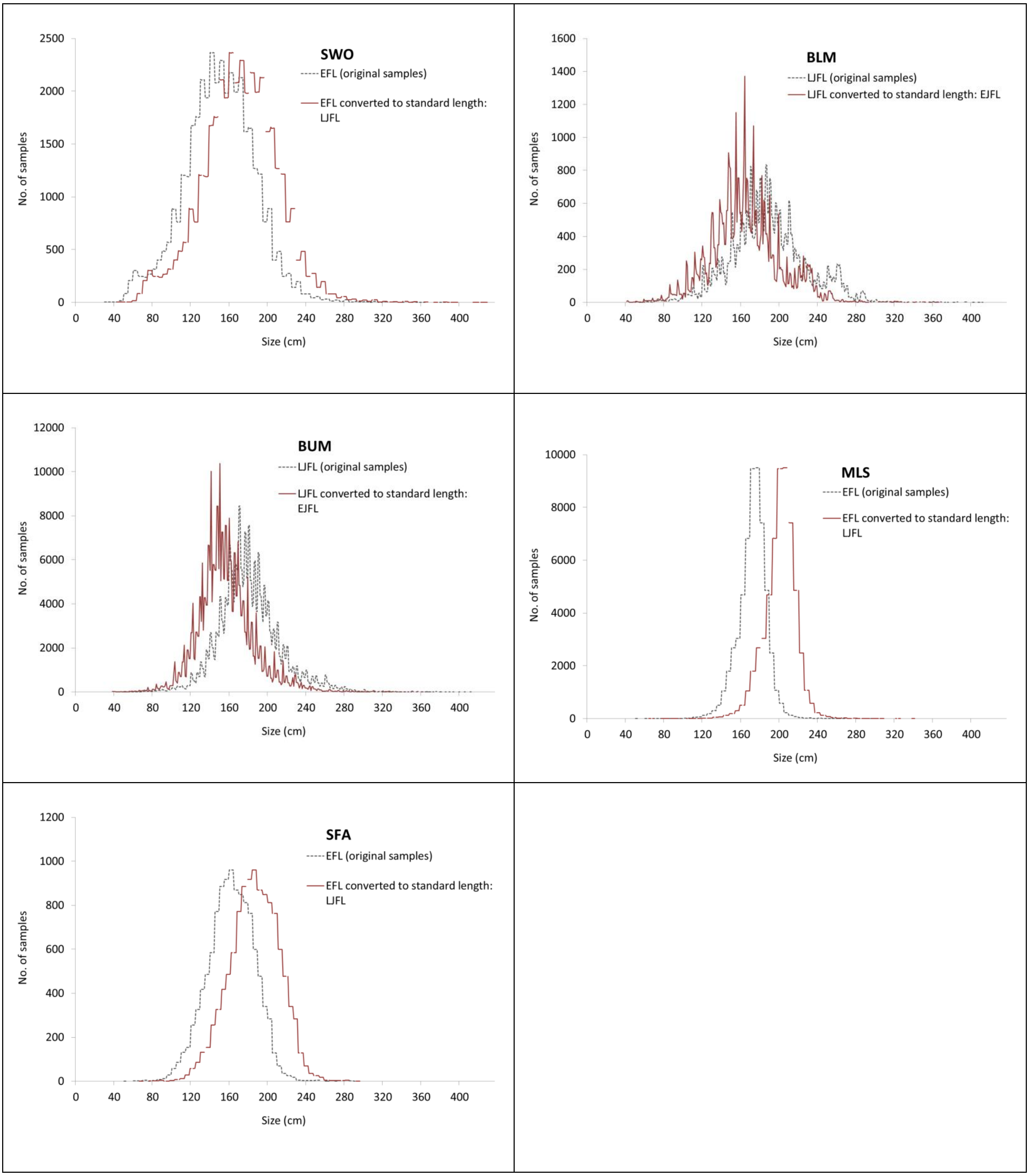


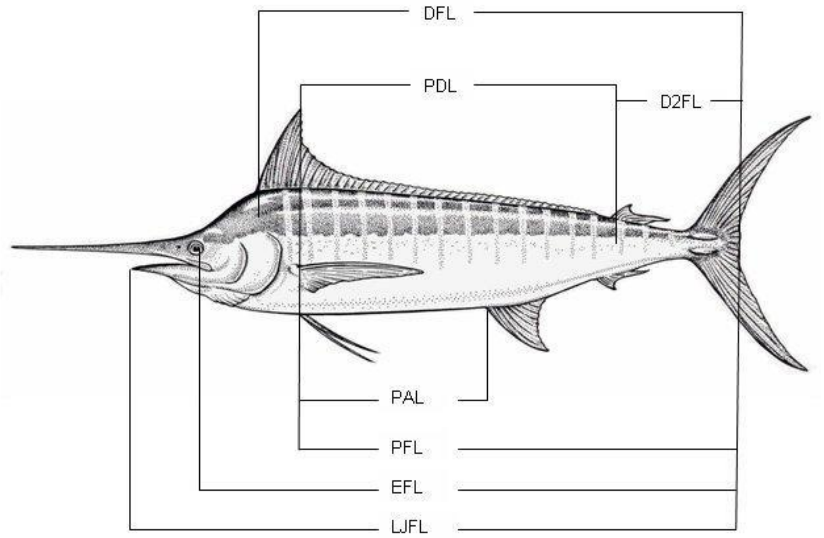
Figure ii. Charts showing the comparison of non-standard lengths and standard lengths, for the main length measurements for each billfish species.

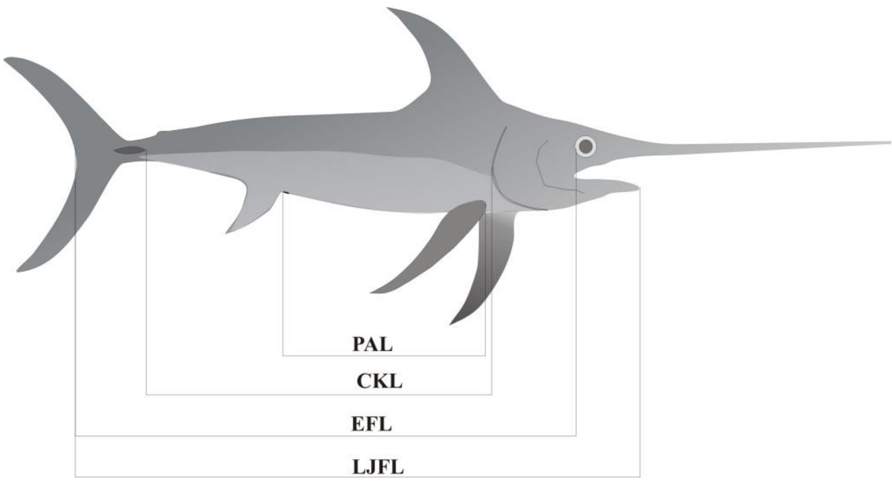


__Notes__: in some cases the conversion between length units – specifically from smaller measurement types to larger measurement types such as Eye orbit to fork of tail (EFL) to Lower jaw fork length (LJFL) – can result in systematic gaps in the length distribution of the converted length frequency.

This is partly related to the precision of the original size data recorded (i.e., 1cm size interval classes, rather than as a continuous distribution). The charts for SWO, MLS and SFA above are examples of converting from smaller to larger measurement units.

Figure iii. Definition of length measurements for billfish species.





Source: Poisson and Taquet, 2001