DRAFT: EXECUTIVE SUMMARY: BIGEYE TUNA

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi

Status of the Indian Ocean bigeye tuna (BET: *Thunnus obesus*) resource

TABLE 1. **Bigeye tuna:** Status of bigeye tuna (*Thunnus obesus*) in the Indian Ocean

Area[1]	**Indicators**		**2013 stock status**[2] **determination**
Indian Ocean	Catch in 2012: Average catch 2008–2012:	115,793 t 107,603 t	
	MSY (1000 t): F_{2012}/F_{MSY}: SB_{2012}/SB_{MSY} : SB_{2012}/SB_0:	132 t (98.5–207 t)[3] 0.42 (0.21–0.80)[3] 1.44 (0.87–2.22)[3] 0.40 (0.27–0.54)[3]	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]The stock status refers to the most recent years' data used in the assessment.
[3]The point estimate is the median of the plausible models investigated in the 2013 SS3 assessment

Colour key	Stock overfished($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY}> 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A new stock assessment was carried out in 2013. The 2013 stock assessment model results did not differ substantively from the previous (2010 and 2011) assessments; however, the final overall estimates of stock status differ somewhat due to the revision of the catch history and updated standardised CPUE indices. All the runs (except 2 extremes) carried out in 2013 indicate the stock is above a biomass level that would produce MSY in the long term (i.e. $SB_{2012}/SB_{MSY} > 1$) and in all runs that current fishing mortality is below the MSY-based reference level (i.e. $F_{2012}/F_{MSY} < 1$) (Table 1 and Fig. 1). The median value of MSY from the model runs investigated was 132,000 t with a range between 98,000 and 207,000 t. Current spawning stock biomass was estimated to be 40% (Table 1) of the unfished levels. Catches in 2012 (≈115,800 t) remain lower than the estimated MSY values from the 2013 stock assessments (Table 1). The average catch over the previous five years (2008–12; ≈107,600 t) also remains below the estimated MSY. In 2012 catch levels of bigeye tuna increased markedly (~24% over values in 2011), especially longline catches. On the weight of stock status evidence available, the bigeye tuna stock is therefore **not overfished**, and is **not subject to overfishing**.

Outlook. Declines in longline effort since 2007, particularly from the Japanese, Taiwan,China and Republic of Korea longline fleets, as well as purse seine effort have lowered the pressure on the Indian Ocean bigeye tuna stock, indicating that current fishing mortality would not reduce the population to an overfished state in the near future.

The Kobe strategy matrix based on all plausible model runs from SS3 in 2013 illustrates the levels of risk associated with varying catch levels over time and could be used to inform future management actions (Table 2).

The SS3 projections from the 2013 assessment show that there is a low risk of exceeding MSY-based reference points by 2015 and 2022 if catches are maintained at the current levels of 115,800 t (0% risk that $B_{2022}<B_{MSY}$ and 0% risk that $F_{2022}>F_{MSY}$) (Table 2). The following key points should be noted:

- The median value of Maximum Sustainable Yield (MSY) from the model runs investigated was 132,000 t with a range between 98,000 and 207,000 t (range expressed as the different runs of SS3 done in 2013 using steepness values of 0.7, 0.8 and 0.9; different natural mortality values; and catchability increase for longline CPUE) (see Table 1 for further description)). Current stock size is above SB_{MSY} and predicted to increase on the short term. Catches at the level of 132,000 t have a low probability of reducing the stock below SB_{MSY} in the short term (3–5

years) and medium term (10 years). Therefore, the annual catches of bigeye tuna should not exceed the median value of MSY. However, for lower productivity model options, catches at the median MSY level will reduce stock biomass over the long-term (10–15 years).

- If catch remains below the estimated MSY levels, then immediate management measures are not required. However, continued monitoring and improvement in data collection, reporting and analysis is required to reduce the uncertainty in assessments.
- provisional reference points: Noting that the Commission in 2012 agreed to Recommendation 12/14 *on interim target and limit reference points*, the following should be noted:
    - **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, and therefore below the provisional limit reference point of $1.4*F_{MSY}$ (Fig. 1).
    - **Biomass**: Current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (Fig. 1).

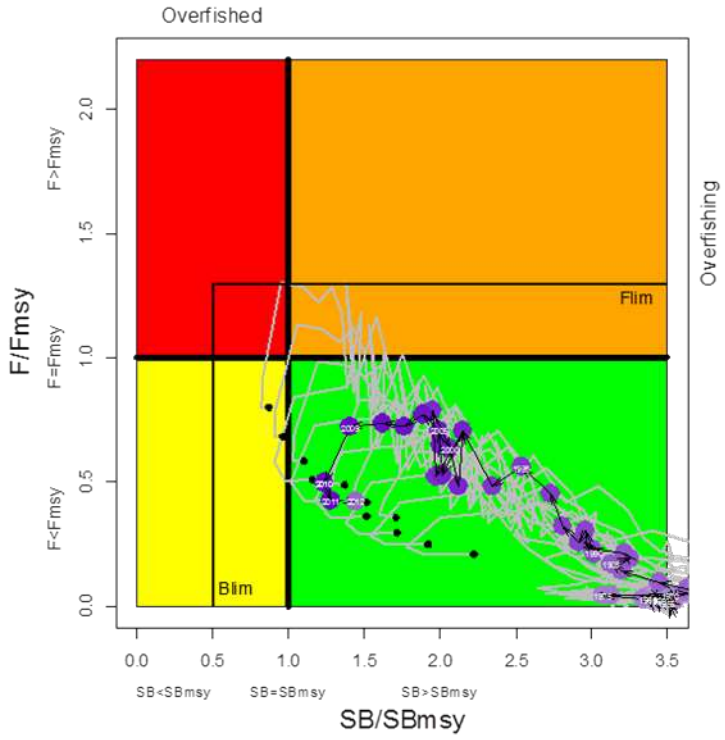


Fig. 1. Bigeye tuna: SS3 Aggregated Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories for the range of 12 plausible model options included in the formulation of the final management advice (grey lines with the black point representing the terminal year of 2012). The trajectory of the median of the 12 plausible model options (purple points) is also presented. The biomass (B_{lim}) and fishing mortality limit (F_{lim}) reference points are also presented.

Table 2. Bigeye tuna: 2013 SS3 Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of weighted distribution of models violating the MSY-based reference points for five constant catch projections (2012 catch level, ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years. Note: from the 2013 stock assessment using catch estimates at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2012) and weighted probability (%) scenarios that violate reference point**				
	100% (115,800 t)	**110%** (127,400 t)	**120%** (139,000 t)	**130%** (150,500 t)	**140%** (162,100 t)
$SB_{2015} < SB_{MSY}$	0	0	0	0	0
$F_{2015} > MSY$	0	0	0	8	17
$SB_{2022} < SB_{MSY}$	0	0	8	17	25
$F_{2022} > MSY$	0	0	8	17	25

SUPPORTING INFORMATION

(Information collated from reports of the Working Party on Tropical Tunas and other sources as cited)

CONSERVATION AND MANAGEMENT MEASURES

Bigeye tuna (*Thunnus obesus*) in the Indian Ocean is currently subject to a number of Conservation and Management Measures adopted by the Commission:

- Resolution 13/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 13/07 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 13/10 *On interim target and limit reference points and a decision framework*
- Resolution 13/11 *On a ban on discards of bigeye tuna, skipjack tuna, yellowfin tuna and a recommendation for non-targeted species caught by purse seine vessels in the IOTC area of competence*
- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*
- Resolution 12/13 *for the conservation and management of tropical tunas stocks in the IOTC area of competence*.
- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area*

FISHERIES INDICATORS

Bigeye tuna – General

Bigeye tuna *(Thunnus obesus)* inhabit the tropical and subtropical waters of the Pacific, Atlantic and Indian Oceans in waters down to around 300 m. Table 3 outlines some of the key life history traits of bigeye tuna relevant for management.

TABLE 3. Bigeye tuna: Biology of Indian Ocean bigeye tuna (*Thunnus obesus*)

Parameter	Description
Range and stock structure	Inhabits the tropical and subtropical waters of the Pacific, Atlantic and Indian Oceans in waters down to around 300 m. Juveniles frequently school at the surface underneath floating objects with yellowfin and skipjack tunas. Association with floating objects appears less common as bigeye grow older. The tag recoveries from the RTTP-IO provide evidence of rapid and large scale movements of juvenile bigeye tuna in the Indian Ocean, thus supporting the current assumption of a single stock for the Indian Ocean. The average minimum distance between juvenile tag-release-recapture positions is estimated at 657 nautical miles. The range of the stock (as indicated by the distribution of catches) includes tropical areas, where reproduction occurs, and temperate waters which are believed to be feeding grounds.
Longevity	15 years
Maturity (50%)	Age: females and males 3 years. Size: females and males 100 cm.
Spawning season	Spawning season from December to January and also in June in the eastern Indian Ocean.
Size (length and weight)	Maximum length: 200 cm FL; Maximum weight: 210 kg. Newly recruited fish are primarily caught by the purse seine fishery on floating objects. The sizes exploited in the Indian Ocean range from 30 cm to 180 cm fork length. Smaller fish (juveniles) form mixed schools with skipjack tuna and juvenile yellowfin tuna and are mainly limited to surface tropical waters, while larger fish are found in sub-surface waters.

Sources: Nootmorn 2004, Froese & Pauly 2009

Bigeye tuna – Fisheries and catch trends

Bigeye tuna is mainly caught by industrial longline (70% in 2012) and purse seine (19% in 2012) fisheries, with the remaining 11% of the catch taken by other fisheries (Table 4). However, in recent years the catches of bigeye tuna by gillnet fisheries are likely to be higher, due to the major changes experienced in some of these fleets, notably changes in boat size, fishing techniques and fishing grounds, with vessels using deeper gillnets on the high seas, in areas where catches of bigeye tuna by other fisheries are important.

Total annual catches have increased steadily since the start of the fishery, reaching the 100,000 t level in 1993 and peaking at over 160,000 t in 1999 (Fig. 2). Catches dropped since then to values between 130,000–150,000 t (2000–07),

further dropping in recent years, to values under 90,000 t in recent years (2010–11), and increasing in 2012 to over 115,000 t. The Scientific Committee believes that the recent drop in catches could be related, at least in part, with the expansion of piracy in the northwest Indian Ocean (Area R1, Table 5), which led to a marked drop in the levels of longline effort in the core fishing area of these species in 2010–11 (Table 5).

TABLE 4. Bigeye tuna: Best scientific estimates of the catches of bigeye tuna (*Thunnus obesus*) by gear and main fleets [or type of fishery] by decade (1950–2009) and year (2003–2012), in tonnes (Data as of September 2013). Catches by decade represent the average annual catch, noting that some gears were not used since the beginning of the fishery (refer to Fig. 2).

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

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

TABLE 5. Bigeye tuna: Best scientific estimates of the catches of bigeye tuna (*Thunnus obesus*) by area [as used for stock assessment in 2013] by decade (1950–2009) and year (2003–2012), in tonnes (Data as of September 2013). Catches by decade represent the average annual catch. The areas are presented in Fig. 4a.

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

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

Bigeye tuna have been caught by industrial longline fleets since the early 1950's, but before 1970 they only represented an incidental catch. After 1970, the introduction of fishing practices that improved catchability of the bigeye tuna resource, combined with the emergence of a sashimi market, resulted in bigeye tuna becoming a primary target species for the main industrial longline fleets. Total catch of bigeye tuna by longliners in the Indian Ocean increased steadily from the 1970's attaining values over 90,000 t between 1996 and 2007, and dropping markedly thereafter (Fig. 2). With the exception of 2012, bigeye tuna catches in recent years have been low, representing less than half the catches of bigeye tuna recorded before the onset of piracy in the Indian Ocean. Since the late 1980's Taiwan,China has been the major longline fleet fishing for bigeye tuna in the Indian Ocean, taking as much as 40% of the total longline catch in the Indian Ocean (Fig. 3). However, the catches of longliners from Taiwan,China between 2007 and 2011 decreased markedly (≈20,000 t), to values three times lower than those in 2003. Catches in 2012 are higher though still far from those in 2003. Large bigeye tuna (averaging just above 40 kg) are primarily caught by longlines, in particular deep longline vessels.

Since the late 1970's, bigeye tuna has been caught by purse seine vessels fishing on tunas aggregated on floating objects and, to a lesser extent, associated to free swimming schools (Fig. 2) of skipjack tuna and yellowfin tuna. The highest catch of bigeye tuna by purse seiners in the Indian Ocean was recorded in 1999 (≈40,000 t). Catches since 2000 have been between 20,000 and 30,000 t. Purse seiners flagged to EU countries and the Seychelles take the majority of purse seine

caught bigeye tuna in the Indian Ocean (Fig. 3). Purse seine vessels mainly take small juvenile bigeye tuna (averaging around 5 kg) whereas longliner vessels catch much larger and heavier fish; and while purse seiner vessels take lower tonnages of bigeye tuna compared to longline vessels, they take larger numbers of individual fish.

By contrast with yellowfin tuna and skipjack tuna, for which the major catches are taken in the western Indian Ocean, bigeye tuna is also exploited in the eastern Indian Ocean (A2 in Fig. 4 and Table 5). The relative increase in catches in the eastern Indian Ocean in the late 1990's was mostly due to increased activity of small longliners fishing tuna to be marketed as fresh product. This fleet started its operation in the mid 1970's. However, the catches of bigeye tuna in the eastern Indian Ocean have shown a decreasing trend in recent years, as some of the vessels moved south to target albacore (Figs. 3, 5).

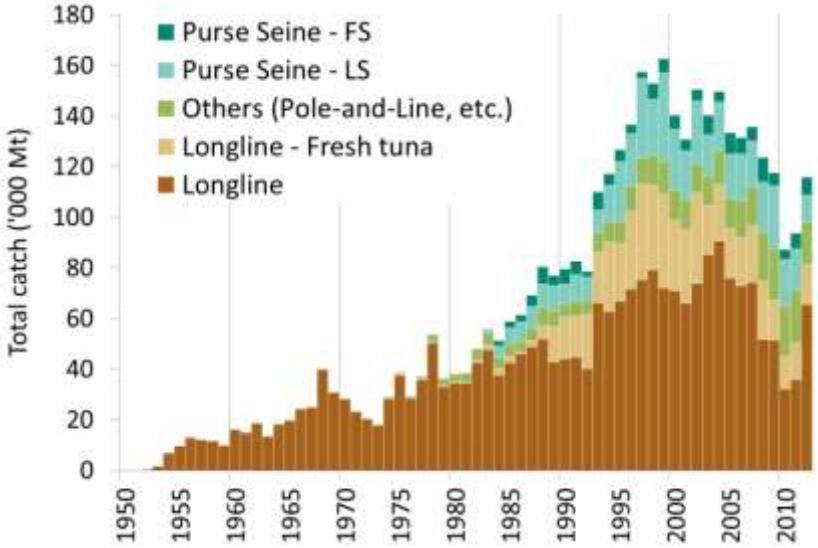


Fig. 2. Bigeye tuna: Annual catches of bigeye tuna by gear (1950–2012) (Data as of September 2013). Gears: Purse seine free-school (FS); Purse seine associated school (LS); Deep-freezing longline (LL); Fresh-tuna longline (FL); Other gears nei (Pole-and-Line, handline, small longlines, gillnet, trolling & other minor artisanal gears) (OT).

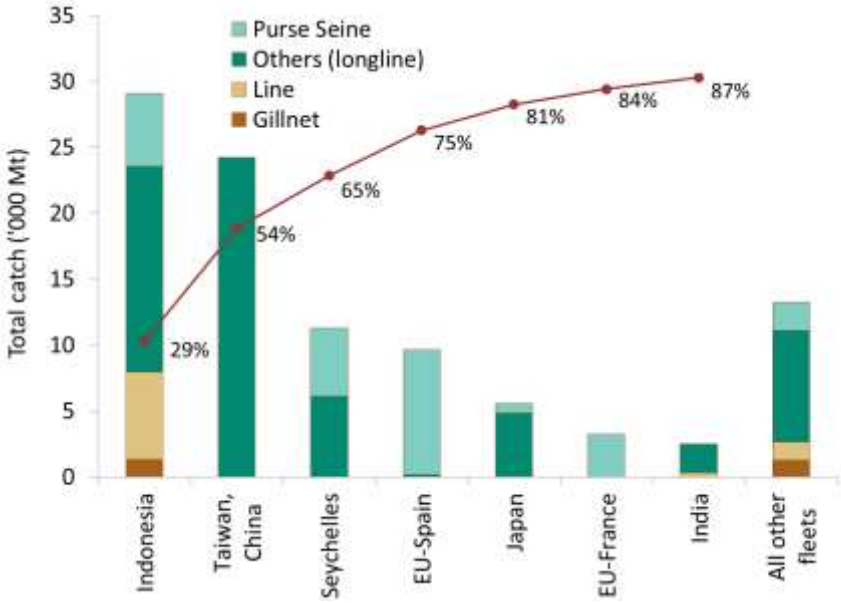


Fig. 3. Bigeye tuna: average catches in the Indian Ocean over the period 2009–12, by country (Data as of September 2013). Countries are ordered from left to right, according to the magnitude of catches of bigeye tuna reported. The red line indicates the (cumulative) proportion of catches of bigeye tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

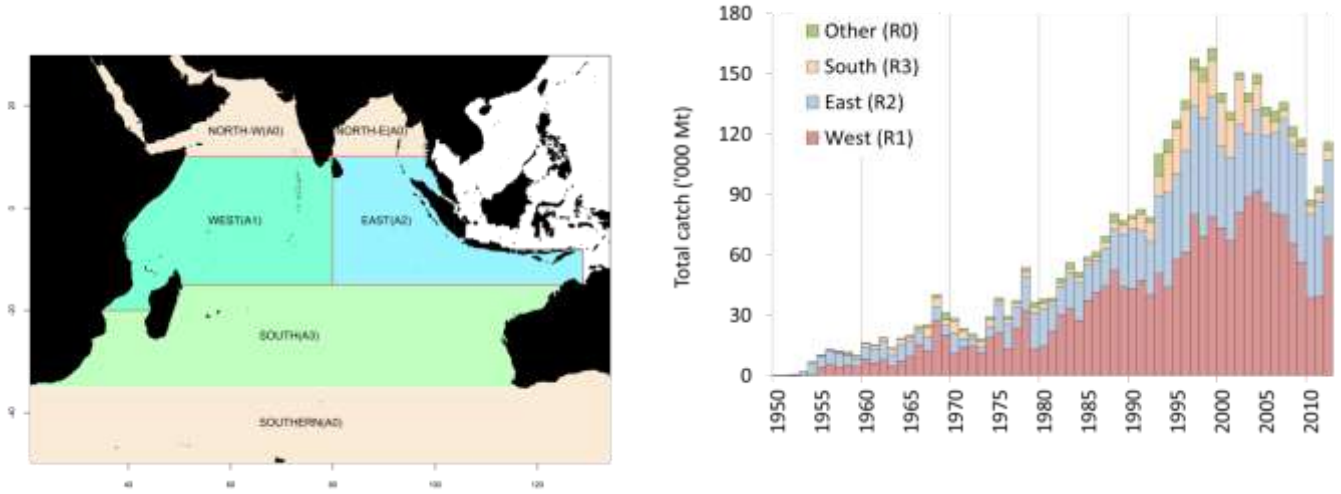


Fig. 4a–b. Bigeye tuna: Catches of bigeye tuna by area by year estimated for the WPTT (1950–2012) (Data as of September 2013). Catches outside the areas presented in the Map were assigned to the closest neighbouring area for the assessment. Areas: West Indian Ocean (A1); East Indian Ocean (A2); Southwest and Southeast Indian Ocean (A3); Other Areas (A0).

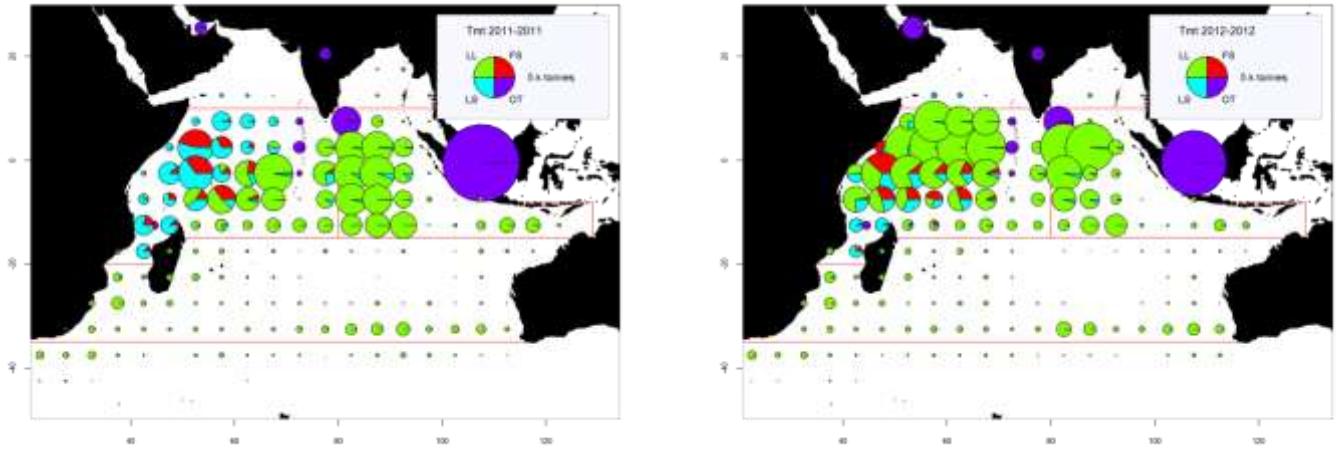


Fig. 5. Bigeye tuna: Time-area catches (total combined in tonnes) of bigeye tuna estimated for 2011 (left) and 2012 (right) by gear. Longline (**LL**), Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), and other fleets (**OT**), including pole-and-line, drifting gillnets, and various coastal fisheries. Data as of September 2013. The catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned, in particular driftnets from Iran, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Indonesia.

Bigeye tuna – uncertainty of catches

Retained catches: Thought to be well known for the major fleets (Fig. 6); but are less certain for non-reporting industrial purse seiners and longliners (NEI) and for other industrial fisheries (e.g. longliners of India). Catches are also uncertain for some artisanal fisheries including the pole-and-line fishery in the Maldives, the gillnet fisheries of Iran (before 2012) and Pakistan, the gillnet and longline combination fishery in Sri Lanka and the artisanal fisheries in Indonesia, Comoros (before 2011) and Madagascar.

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

Changes to the catch series: The catch history for bigeye tuna changed following reviews of the catches of Indonesia, Sri Lanka, and, to a lesser extent, other fisheries (EU,France, India, Pakistan). Overall, the best estimates of catch for the bigeye tuna are higher in 2013 than those used for the WPTT in 2012, with marked increases to the catches since the early 1990s. More details about the reviews are provided in paper IOTC–2013–WPTT15–07 Rev_1.

CPUE Series: Catch-and-effort data are generally available from the major industrial fisheries. However, these data are not available from some fisheries or they are considered to be of poor quality, especially throughout the 1990s and in recent years (Fig. 6), for the following reasons:

- non-reporting by industrial purse seiners and longliners (NEI)
- no data are available for the fresh-tuna longline fishery of Indonesia, over the entire time series, and data for the fresh-tuna longline fishery of Taiwan,China are only available since 2006
- uncertain data from significant fleets of industrial purse seiners from Iran and longliners from India, Indonesia, Malaysia, Oman, and Philippines.
- incomplete data for the driftnet fisheries of Iran and Pakistan and the gillnet/longline fishery of Sri Lanka, especially in recent years.

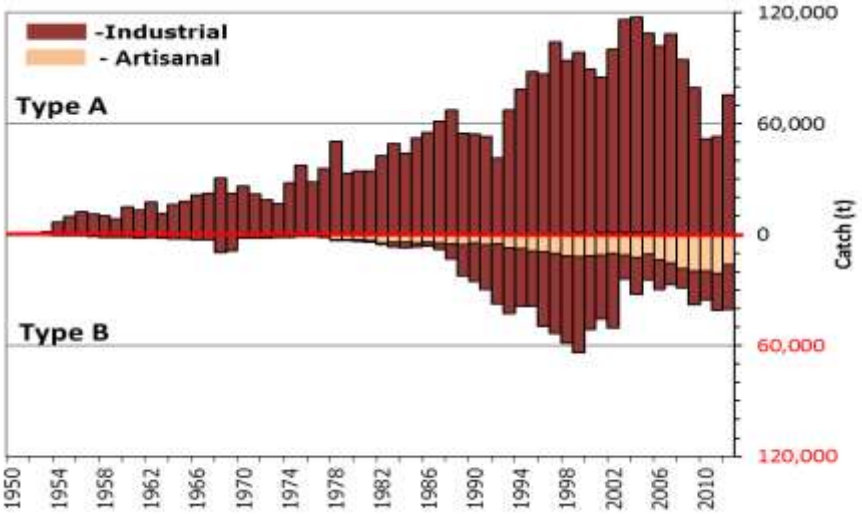


Fig. 6. Bigeye tuna: Uncertainty of annual catch estimates for bigeye tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat). Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Bigeye tuna – Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid in 2011 and 2012 are provided in Fig. 7, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2011 and 2012 are provided in Fig. 8. The total number of fishing trips by vessels flagged to the Maldives by 5 degree square grid, type of boat and gear, for the years 2011 and 2012 are provided in Fig. 9.

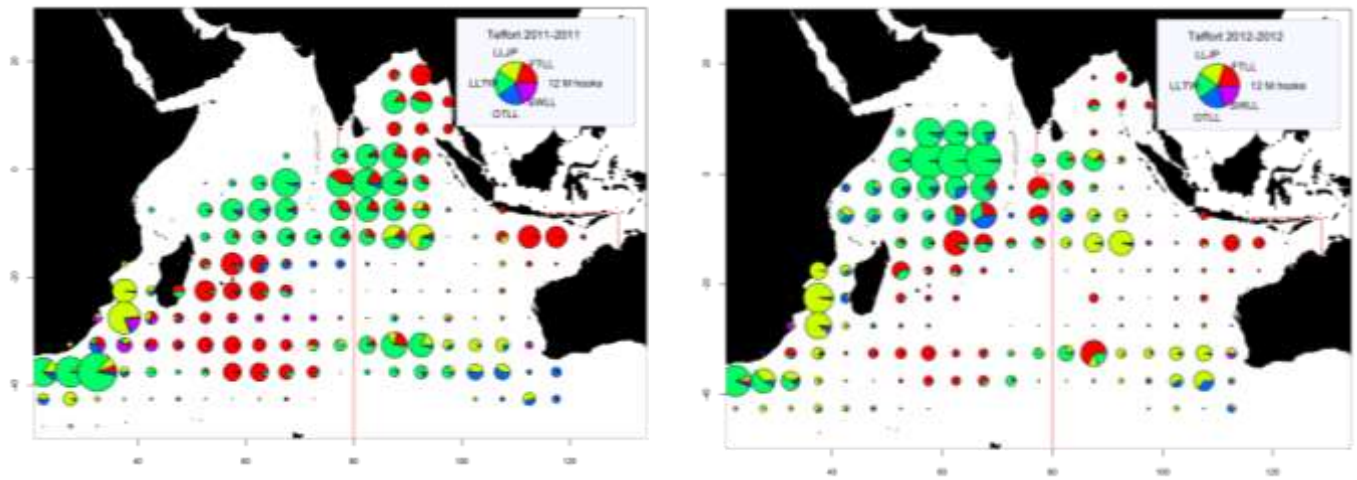


Fig. 7. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2011 (left) and 2012 (right) (Data as of October 2013)
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): 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, Rep. of Korea and various other fleets)

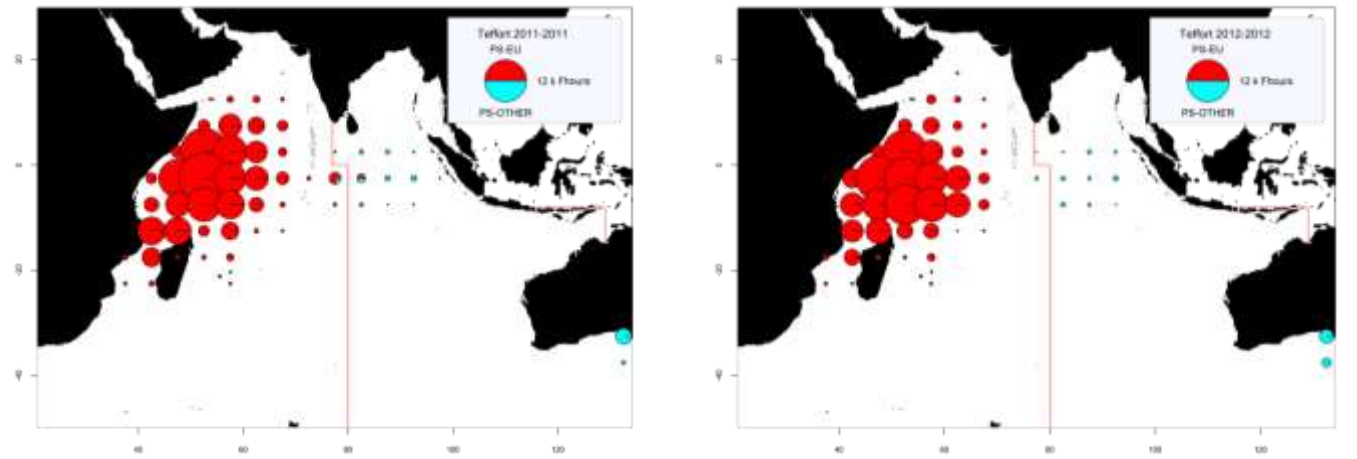


Fig. 8. Number of hours of fishing(Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2011 (left) and 2012 (right) (Data as of October 2013)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles 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)

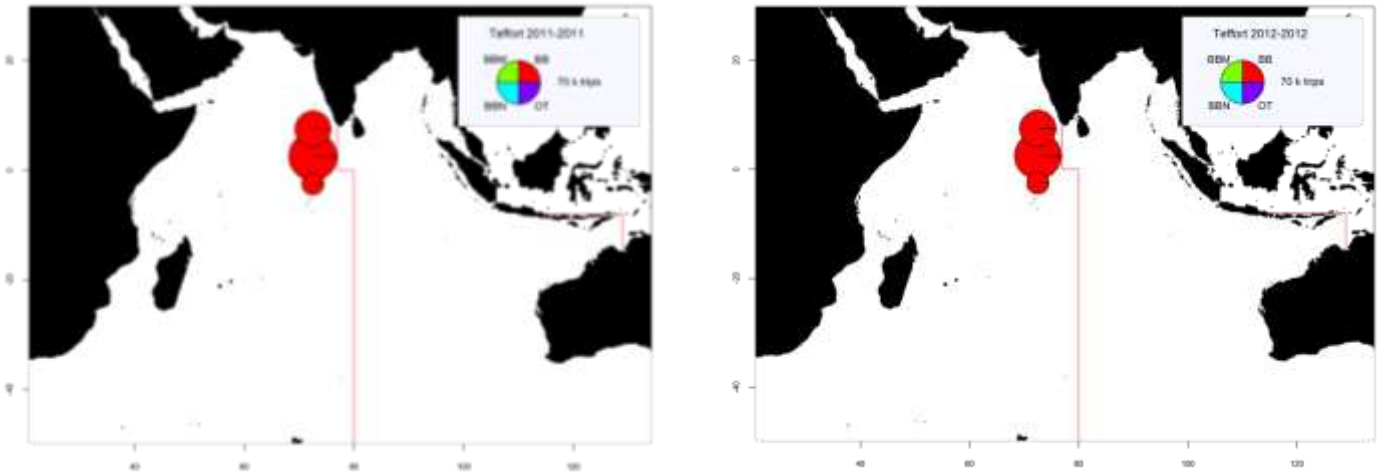


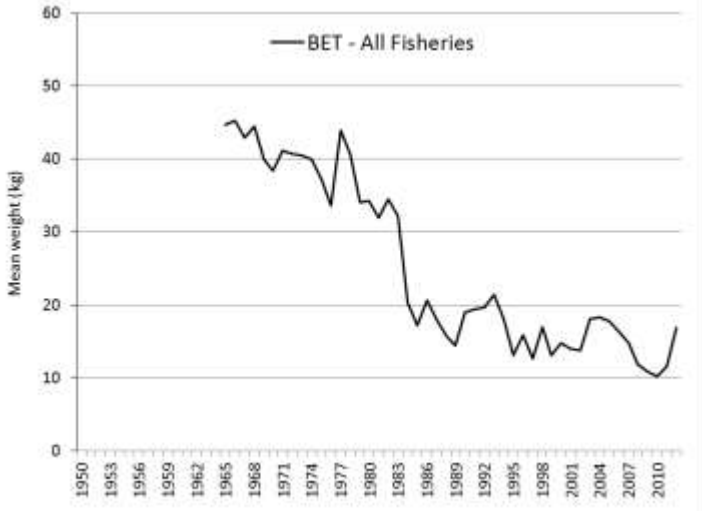
Fig. 9. Number of fishing trips by vessels flagged to the Maldives by 5 degree square grid, type of boat and gear, for the years 2011 (left) and 2012 (right) (Data as of October 2013)
BBN (blue): Baitboat non-mechanized; BBM (Green): Baitboat mechanized; BB (Red): Baitboat unspecified; UN (Purple): Unclassified gears
Note that the above maps were derived using the available catch-and-effort data in the IOTC database, which is limited to the number of baitboat calls (trips) by atoll by month for Maldivian baitboats for the period concerned. Note that some trips may be fully devoted to handlining, trolling, or other activities (data by gear type are not available since 2002). No data are available for the pole-and-line fisheries of India (Lakshadweep) and Indonesia.

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

Trends in average weight: Can be assessed for several industrial fisheries although they are incomplete or of poor quality for most fisheries before the mid-1980s and for some fleets in recent years (e.g. Japan and Taiwan,China longline) (Fig. 10).

Catch-at-Size table: This is available but the estimates are more uncertain for some years and some fisheries due to**):**

- the paucity of size data available from industrial longliners before the mid-60s, from the early-1970s up to the mid-1980s and in recent years (Japan and Taiwan,China)
- the paucity of catch by area data available for some industrial fleets (NEI, India, Indonesia, Iran, Sri Lanka)



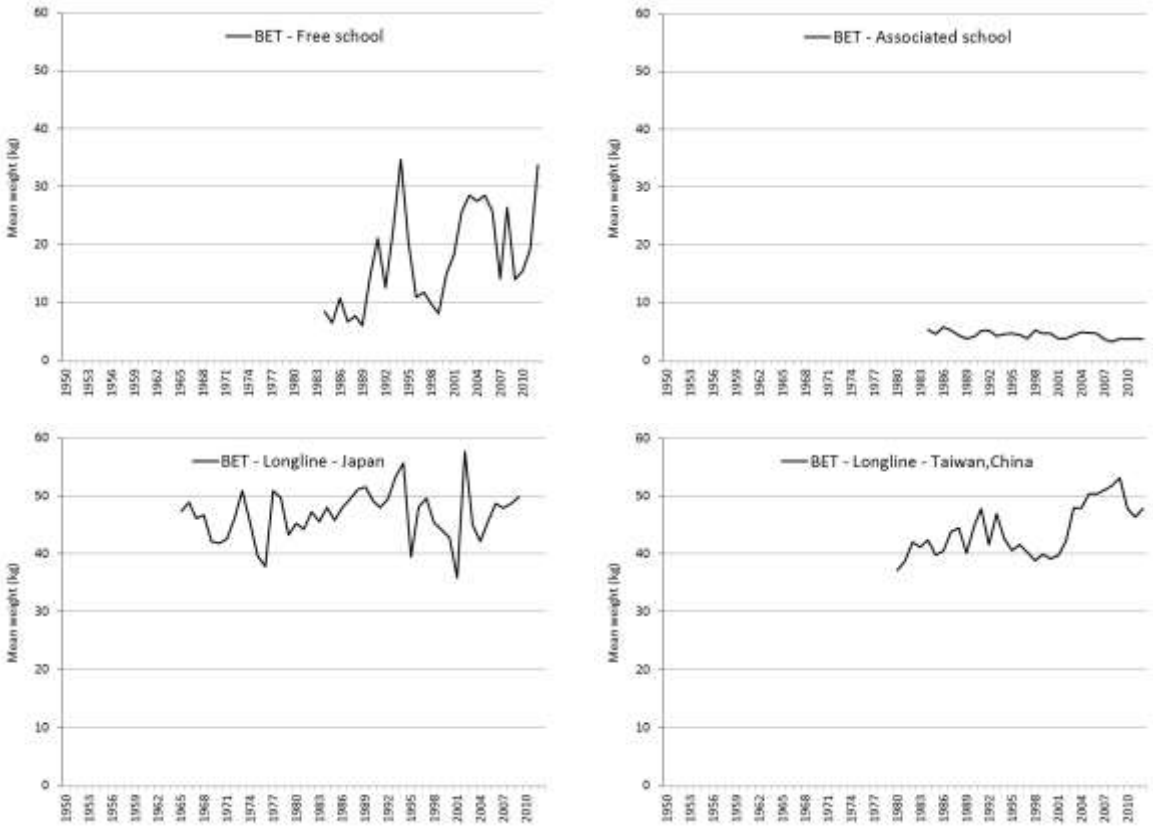


Fig. 10. Bigeye tuna: Changes in average weight (kg) of bigeye tuna from 1950 to 2012 – all fisheries combined (top) and by main fleet (Data as of September 2013).

Bigeye tuna: Standardised catch–per–unit–effort (CPUE) trends

The CPUE series presented at the WPTT15 meeting in 2013 are listed below. However, only the Japanese longline CPUE index (quarterly) for the whole Indian Ocean (1960–2012) (Fig. 11) was utilised for the final stock assessment model runs and in the development of management advice, noting that the Japanese series from the tropical areas and the Indian Ocean as a whole, showed very similar trends.

- Rep. of Korea data (1977–2012): Series (core area and whole Indian Ocean) from document IOTC–2013–WPTT15–24.
- Japan data (1960–2012): Series (whole Indian Ocean, tropical area, temperate area) from document IOTC–2013–WPTT15–25.
- Taiwan,China data (1980–2012): Series (whole Indian Ocean, tropical area, temperate area) from document IOTC–2013–WPTT15–26.

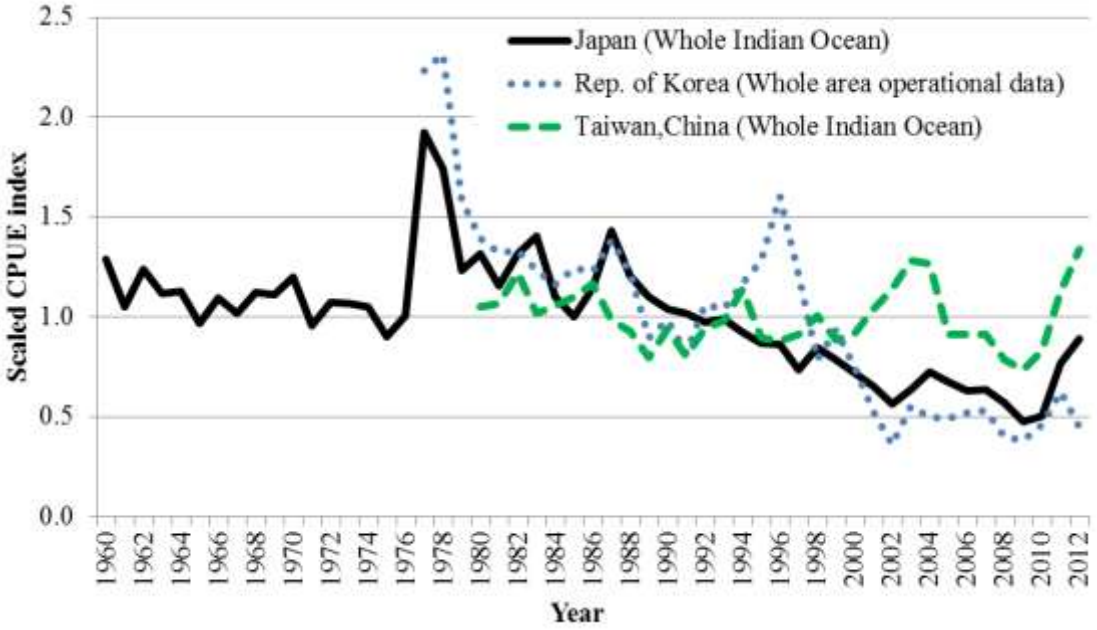


Fig. 11. Bigeye tuna: Standardised CPUE series for the longline fleets of Japan, Rep. of Korea and Taiwan,China for the whole Indian Ocean (1960–2012). The quarterly series for the Japanese longline fleet was used in the final 2013 stock assessment runs used for management advice.

The CPUE series for the Taiwan,China longline fleet conflicts with the declining trends of the Japanese and Rep. of Korea series, except for the most recent years. The recent decline in the Taiwan,China CPUE series and the divergence between nominal and standardised series was thought to be due to changes in targeting and in the spatial distribution of effort, likely related to piracy activities in the northwest Indian Ocean.

Bigeye tuna – tagging data

A total of 35,997 bigeye tuna (17.9%) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them (96.0%) were tagged during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and released off the coast of Tanzania in the western Indian Ocean, between May 2005 and September 2007 (Fig. 12). The remaining were tagged during small-scale projects, and by other institutions with the support of the IOTC Secretariat, in the Maldives, India, and in the south west and the eastern Indian Ocean. To date, 5,789 specimens (16.1%) have been recovered and reported to the IOTC Secretariat. These tags were mainly reported from the purse seine fleets operating in the Indian Ocean (90.9%), while 5.2% were recovered from longline vessels.

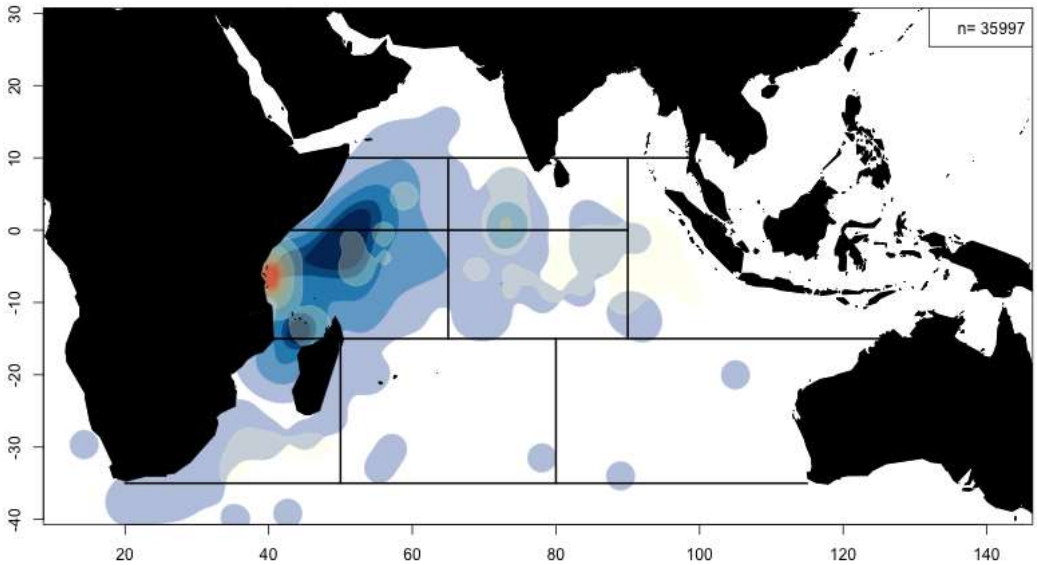
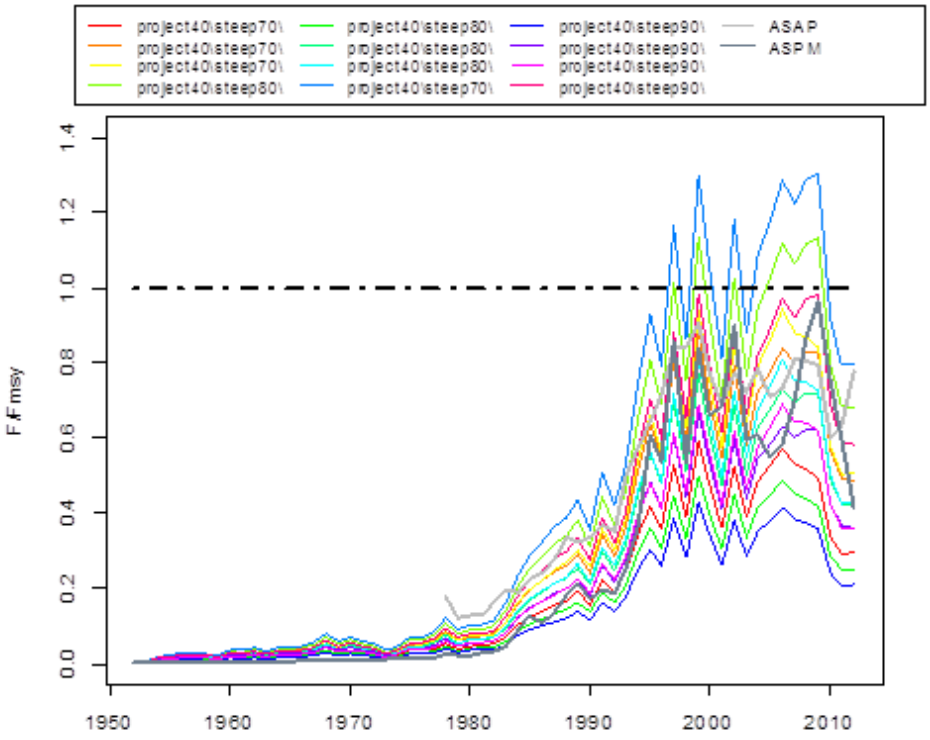


Fig. 12. Bigeye tuna: Densities of releases (in red) and recoveries (in blue) (Data as of September 2012).

STOCK ASSESSMENT

A range of quantitative modelling methods (ASAP, ASPM and SS3) were applied to bigeye tuna in 2013. Management advice for bigeye tuna is based on the range of results from the SS3 models. The SS3 results were preferred to the other assessment platforms (ASPM and ASAP) because a more comprehensive range of model options were investigated and a range of diagnostics indicated that the models represented a reasonable fit to the main datasets. The range of plausible SS3 model options was considered to adequately represent the range of uncertainty in the assessment. Integrating across all outcomes, the 2013 stock assessment model results did not differ substantively from the previous (2010 and 2011) assessments or amongst the models applied, although, the final overall estimates of stock status differ somewhat due to the revision of the catch history, new information, and updated standardised CPUE indices.

All the runs (except 2 extremes) carried out in 2013 indicate that the stock is above a biomass level that would produce MSY in the long term (i.e. $SB_{2012}/SB_{MSY} > 1$) and in all runs that current fishing mortality is below the MSY-based reference level (i.e. $F_{2012}/F_{MSY} < 1$). This is illustrated in Fig. 13, which shows the time trajectories in F/F_{MSY} and B/B_{MSY} across the range of model results applied to characterise uncertainty in stock status.



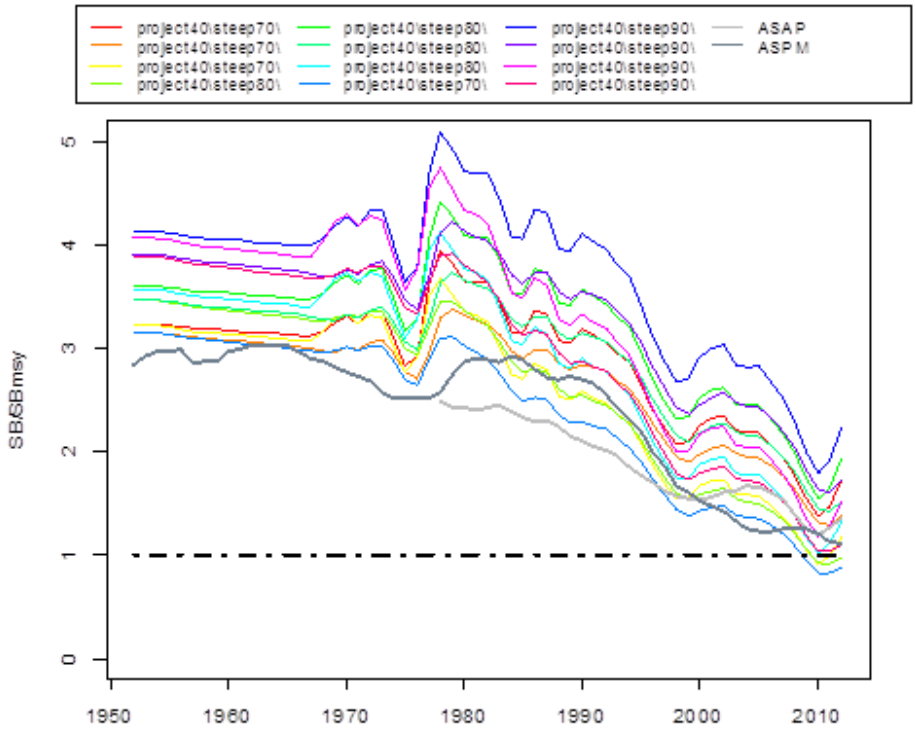


Fig. 13. Bigeye tuna: Ranges of F/F_{MSY} (top) and B/B_{MSY} (bottom) over time, indicating the range of uncertainty in stock assessment outcomes from the stock assessment models used in 2013 (SS3). ASAP and ASPM base cases are presented for comparative purposes.

Key assessment results for the 2013 SS3 stock assessment are shown in Tables 1, 2 and 6; Fig. 1.

Table 6. Bigeye tuna: Key management quantities from the SS3 assessment, for the aggregate Indian Ocean.

Management Quantity	**Aggregate Indian Ocean**
2012 catch estimate	115,793 t
Mean catch from 2008–2012	107,603 t
MSY [plausible range]	132,000 [98,000–207,000]
Data period used in assessment	1952–2012
F_{2012}/F_{MSY} [plausible range]	0.42 [0.21–0.80]
B_{2012}/B_{MSY}	n.a.
SB_{2012}/SB_{MSY} [plausible range]	1.44 [0.87–2.22]
B_{2012}/B_{1952}	n.a.
SB_{2012}/SB_{1952} [plausible range]	0.40 [0.27–0.54]
$B_{2012}/B_{2012,\ F=0}$	n.a.
$SB_{2012}/SB_{2012,\ F=0}$	0.40 [0.27–0.54]

LITERATURE CITED

Froese R, Pauly DE (2009) *FishBase*, version 02/2009, FishBase Consortium, <www.fishbase.org>
Nootmorn, P (2004) Reproductive biology of bigeye tuna in the eastern Indian Ocean. IOTC–2004–WPTT04–05