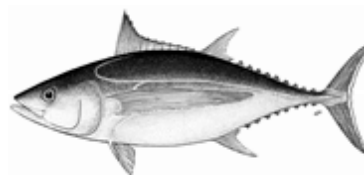## DRAFT: EXECUTIVE SUMMARY: ALBACORE

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

Status of the Indian Ocean albacore (ALB: *Thunnus alalunga*) resource

TABLE 1. Status of albacore (*Thunnus alalunga*) in the Indian Ocean.

Area[1]	Indicators – 2014 assessment			2014 stock status determination 2012[2]
		SS3	ASPIC*	
Indian Ocean	Catch 2013:	38,297 t	38,297 t	
	Average catch 2008–2013:	37,525 t	37,525 t	
	MSY (1000 t) (80% CI):	47.6 (26.7–78.8)	34.7 (28.8–37.4)	
	F_{MSY} (80% CI):	0.31 (0.21–0.42)	0.50 (n.a.)	
	SB_{MSY} (1000 t) (80% CI):	39.2 (25.4–50.7)	68.6 (n.a.)	
	F_{2012}/F_{MSY} (80% CI):	0.69 (0.23–1.39)	0.94 (0.68–1.61)	
	SB_{2012}/SB_{MSY} (80% CI):	1.09 (0.34–2.20)	1.05 (0.73–1.35)	
	SB_{2012}/SB_{1950} (80% CI):	0.21 (0.11–0.33)	0.43 (n.a.)	

[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 for the assessment.
*Total Biomass (B)

| 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 ($F_{year}/F_{MSY} \leq 1$)		
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Trends in the Taiwan,China CPUE series suggest that the longline vulnerable biomass has declined to about 47% of the level observed in 1980–82. There were 20 years of moderate fishing before 1980, and the catch has more than doubled since 1980. Catches have increased substantially since 2007, attributed to the Indonesian and Taiwan,China longline fisheries although there is substantial uncertainty remaining on the catch estimates. It is considered that recent catches have been above the MSY level for one of the models (ASPIC) examined and approaching MSY levels for the other model (SS3). Fishing mortality represented as F_{2012}/F_{MSY} is between 0.70 (Median: SS3) and 0.94 (Point estimate: ASPIC). Biomass is considered to be at or very near to the SB_{MSY} level ($SB_{2012}/SB_{MSY} = 1.09$) from the SS3 model, and also for the B_{MSY} level ($B_{2012}/B_{MSY} = 1.05$) from the ASPIC model (Table 1, Fig. 1). Thus, stock status in relation to the Commission's B_{MSY} and F_{MSY} target reference points indicates that the stock is **not overfished** and **not subject to overfishing** (Table 1), although considerable uncertainty remains in the SS3 and ASPIC assessments, indicating that a precautionary approach to the management of albacore should be applied by reducing fishing mortality or capping total catch levels to those taken in 2012 (34,000 t; Table 2).

Outlook. Maintaining or increasing effort in the core albacore fishing grounds is likely to result in further declines in albacore biomass, productivity and CPUE. The impacts of piracy in the western Indian Ocean has resulted in the displacement of a substantial portion of longline fishing effort into the traditional albacore fishing areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on albacore will decline in the near future unless management action is taken. There is a high risk of exceeding MSY-based reference points by 2015 if catches increase further (above 2012 levels) (50% risk that $SB_{2015} < SB_{MSY}$, and 39% risk that $F_{2015} > F_{MSY}$) (Table 2).

The following should be noted:

- **Maximum Sustainable Yield (MSY)**: Current catches (38,297 t in 2013) are below the current estimated MSY levels from both models (Table 1). However, maintaining or increasing effort will likely result in further declines in biomass, productivity and CPUE.

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- The use of aggregated data versus fine-scale operational data in the CPUE standardisations by the main fleet (Taiwan,China) introduces substantial uncertainty.
- The preliminary catch estimates for 2013, as of 2014 WPTmT05 meeting (~43,000 t) are one of the highest catches on record, and may be a cause for concern for the long-term sustainability of the stock if it remains at these levels. Note, a preliminary ASPIC analysis accounting for the larger catches in 2013 indicated no change in stock status from 2012.
- A Kobe 2 Strategy matrix was calculated to quantify the risk of different future catch scenarios, using the projections from the SS3 model (Table 2). The projections indicated that there is a 50% chance of violating the biomass based reference point by 2015 if catches are maintain or increased up to 20% (i.e. below SB_{MSY}) (Table 2).
- **Provisional reference points:** Noting that the Commission in 2013 adopted Resolution 13/10 to *On interim target and limit reference points and a decision framework*, the following should be noted:
  o **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, and the provisional limit reference point of $1.4*F_{MSY}$ (Fig. 1).
  o **Biomass**: Current spawning biomass is considered to be near the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (Fig. 1).
- **Main fishing gear** (2009–13): Longline ≈93% (fresh ≈56.4%, Frozen ≈36.6%).
- **Main fleets**: Taiwan,China ≈36%; Indonesia ≈32%; Japan ≈9%; China ≈7%.
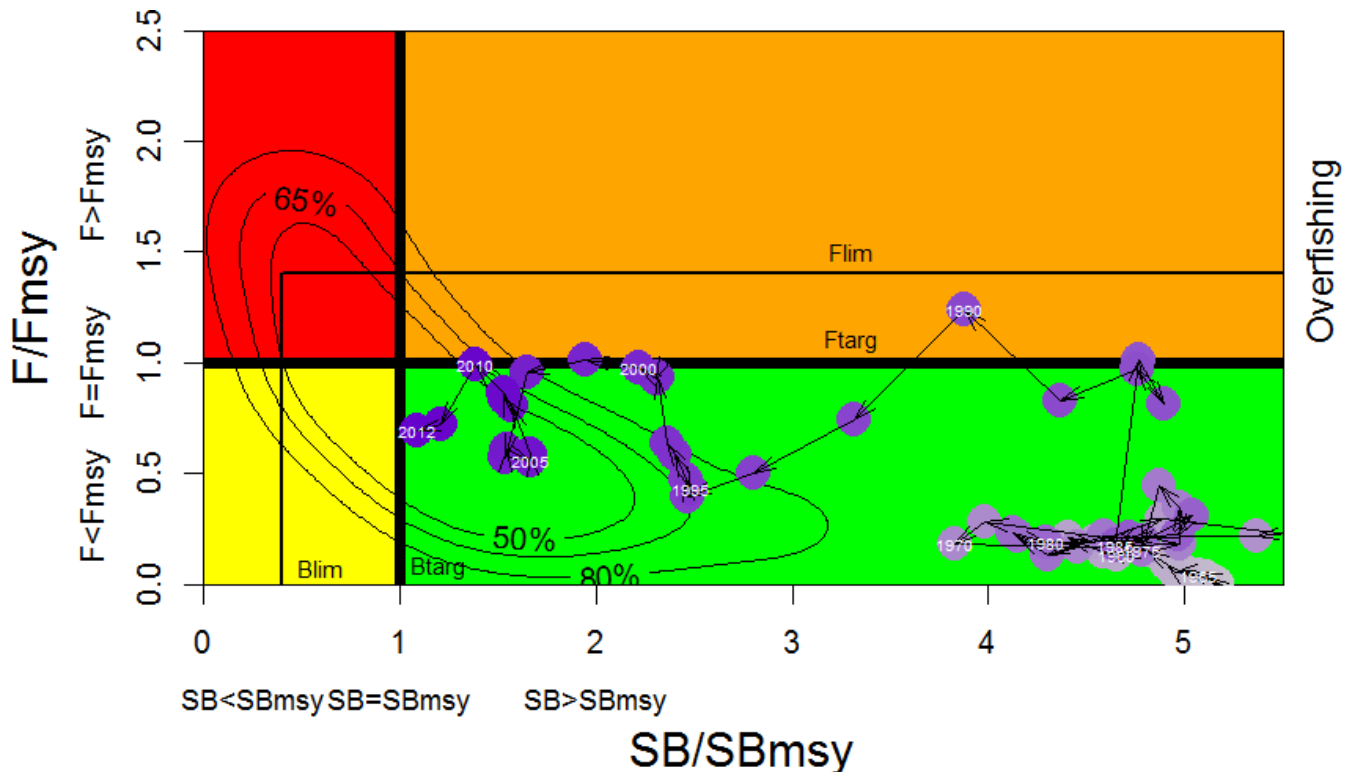
Fig. 1. Albacore: SS3 Aggregated Indian Ocean assessment Kobe plot (contours are the 50, 65 and 80 percentiles of the 2012 grid runs). Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2012. Target (Ftarg and SBtarg) and limit (Flim and SBlim) reference points are shown.

TABLE 2. Albacore: SS3 aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based target (top) and limit (bottom) reference points for nine constant catch projections (average catch level from 2011–013, ± 10%, ± 20%, ± 30% ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	Alternative catch projections (relative to the average catch level from 2011–13) and probability (%) of violating MSY-based target reference points ($SB_{targ} = SB_{MSY}$; $F_{targ} = F_{MSY}$)								
	60%	70%	80%	90%	100% (36,806t)	110%	120%	130%	140%
$SB_{2015} < SB_{MSY}$	31	33	39	42	50	50	50	53	61
$F_{2015} > F_{MSY}$	11	19	22	36	39	44	50	53	56
$SB_{2022} < SB_{MSY}$	11	19	22	33	39	44	47	53	56
$F_{2022} > F_{MSY}$	6	11	22	31	36	44	47	53	56
Reference point and projection timeframe	Alternative catch projections (relative to the average catch level from 2011–13) and probability (%) of violating MSY-based limit reference points ($SB_{lim} = 0.4 B_{MSY}$; $F_{Lim} = 1.4 F_{MSY}$)								
	60%	70%	80%	90%	100% (36,806t)	110%	120%	130%	140%
$SB_{2015} < SB_{Lim}$	0	0	6	8	17	22	28	33	33
$F_{2015} > F_{Lim}$	0	6	14	19	25	31	39	42	44
$SB_{2022} < SB_{Lim}$	0	6	14	19	28	33	36	42	47
$F_{2022} > F_{Lim}$	0	6	14	22	31	36	42	44	50

Note: As detailed in Recommendation 14/07, the colour coding used above, and refers to 25% probability levels (Green: 0–25; Yellow: >25–50; Orange: >50–75; Red: >75–100) associated with the interim target and limit reference points set by the Commission.

APPENDIX I

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

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

- Resolution 14/05 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 13/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 13/09 *on the conservation of albacore caught 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 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

Albacore: General

Overall, the biology of the albacore stock in the Indian Ocean is not well known and there is relatively little new information on albacore stocks. Albacore (*Thunnus alalunga*) life history characteristics, including a relatively late maturity, long life and sexual dimorphism, make the species vulnerable to over exploitation. Table 3 outlines some of the key life history traits of albacore specific to the Indian Ocean.

TABLE 3. Albacore: Biology of Indian Ocean albacore (*Thunnus alalunga*)

Parameter	Description
Range and stock structure	A temperate tuna living mainly in the mid oceanic gyres of the Pacific, Indian and Atlantic oceans. In the Pacific and Atlantic oceans there is a clear separation of southern and northern stocks associated with the oceanic gyres that are typical of these areas. In the Indian Ocean, there is probably only one southern stock, distributed from 5°N to 40°S, because there is no northern gyre.
	Albacore is a highly migratory species and individuals swim large distances during their lifetime. It can do this because it is capable of thermoregulation, has a high metabolic rate, and advanced cardiovascular and blood/gas exchange systems. Pre-adults (2–5 year old albacore) appear to be more migratory than adults. In the Pacific Ocean, the migration, distribution availability, and vulnerability of albacore are strongly influenced by oceanographic conditions, especially oceanic fronts. It has been observed on all albacore stocks that juveniles concentrate in cold temperate areas (for instance in a range of sea-surface temperatures between 15 and 18°C), and this has been confirmed in the Indian Ocean where albacore tuna are more abundant north of the subtropical convergence (an area where these juvenile were heavily fished by driftnet fisheries during the late 1980's). It appears that juvenile albacore show a continuous geographical distribution in the Atlantic and Indian oceans in the north edge of the subtropical convergence. Albacore may move across the jurisdictional boundary between ICCAT and IOTC.
	It is likely that the adult Indian Ocean albacore tunas do yearly circular counter-clockwise migrations following the surface currents of the south tropical gyre between their tropical spawning and southern feeding zones. In the Atlantic Ocean, large numbers of juvenile albacore are caught by the South African pole-and-line fishery (catching about 10,000 t yearly) and it has been hypothesized that these juveniles may be taken from a mixture of fish born in the Atlantic (north east of Brazil) and from the Indian Ocean. For the purposes of stock assessments, one pan-ocean stock has been assumed.
Longevity	10+ years
Maturity (50%)	**Age**: females 5–6 years; males 5–6 **Size**: females n.a.; males n.a.
Spawning season	Little is known about the reproductive biology of albacore in the Indian Ocean but it appears, based on biological studies and on fishery data, that the main spawning grounds are located east of Madagascar between 15° and 25°S during the 4th and 1st quarters of each year. Like other tunas, adult albacore spawn in warm waters (SST>25°C).
Size (length and weight)	Reported to 128 cm FL in the Indonesian longline fishery $W = aL^b$ with $a = 5.691 \times 10^{-5}$, $b = 2.7514$.

n.a. = not available. Sources: Lee & Kuo 1988, Lee & Liu 1992, Lee & Yeh 2007, Froese & Pauly 2009, Xu & Tian 2011, Setyadji et al. 2012

Albacore – Catch trends

Albacore are currently caught almost exclusively using drifting longlines (over 90% of the total catches) (Table 4; Fig. 2), and South of 20°S (Table 5) with remaining catches recorded using purse seines and other gears. The catches increased markedly during the mid-1980's due to the use of drifting gillnets by Taiwan,China (Fig. 3), with total catches in excess of 30,000 t. The drifting gillnet fleet targeted juvenile albacore in the southern Indian Ocean (30°S to 40°S). In 1992 the United Nations worldwide ban on the use of drifting gillnets effectively closed this gillnet fishery. Following the removal of the drifting gillnet fleets, catches dropped to less than 21,000 t by 1993 (Fig. 2). However, catches more than doubled over the period from 1993 (<21,000 t) to 2001 (46,000 t), the year in which the highest catches of albacore were reported. Since 2001, catches have been almost exclusively taken by drifting longlines. Catches for both 2011 and 2012 are estimated to be around 34,000 t (Table 4), 10,000 t lower than the catches recorded in 2010 (44,000 t) – the year in whichthe second highest catches were recorded. In 2013, catches are currently estimated at around 38,000 t. The majority of the catches of albacore are sold to international markets, mostly for canning. A component of the catches of albacore may not go for export, be sold in local markets or retained by the fishermen for direct consumption.

Catches of albacore in recent years have come almost exclusively from vessels flagged to Indonesia and Taiwan,China. The catches of albacore reported for the fresh tuna longline fishery of Indonesia have increased considerably since 2003, ranging between 8,000 t and 15,000 t in recent years, which represents approximately a third of the total catches of albacore in the Indian Ocean.

Longliners from Japan and Taiwan,China have been operating in the Indian Ocean since the early 1950s. Although the Japanese albacore catch ranged from 8,000 t to 18,000 t in the period 1959 to 1969, in 1972, catches rapidly decreased to around 1,000 t due to a change in the target species, mainly to southern bluefin tuna and bigeye tuna. Albacore became a bycatch species for the Japanese fleet with catches between 200 t and 2,500 t. In recent years the Japanese albacore catch has been around 2,000 to 4,000 t.

In contrast to the Japanese longliners, catches by Taiwan,China deep-freezing longliners increased steadily from the 1950's to average around 10,000 t by the mid-1970s. Between 1998 and 2002 catches ranged between 20,000 t to 26,000 t, equating to just over 55% of the total Indian Ocean albacore catch. Between 2005 and 2012 the albacore catches by Taiwan,China deep-freezing longliners have been between 1,500 and 6,000 t, with the lowest catches recorded in 2012 (1,300 t), although catches recovered to around 2,800 t in 2013

Unlike deep-freezing longliners, the catch levels of albacore for the fresh-tuna longline fishery of Taiwan,China have increased in recent years, leading to a shift in the proportion of catches of albacore by deep-freezing and fresh-tuna longliners. In recent years, the catches of fresh-tuna longliners of Taiwan,China have represented 75% of the total catches of Taiwan,China longliners during 2010–12.

While most of the catches of albacore have traditionally come from the southwest Indian Ocean, in recent years a larger proportion of the catch has come from the southern and eastern Indian Ocean (Table 5; Fig. 4). The relative increase in catches in the eastern Indian Ocean since the early 2000's is mostly due to increased activity of fresh-tuna longliners from Taiwan,China and Indonesia. In the western Indian Ocean, the catches of albacore mostly result from the activities of deep-freezing longliners and purse seiners. One consequence of Somali maritime piracy in the western tropical Indian Ocean in recent years has been the movement of part of the deep-freezing longline fleets from this area, for which the target species were tropical tunas or swordfish, to operate in southern waters of the Indian Ocean (Fig. 4) which has led to an increased contribution of albacore to the total catches of some longline fleets.

Fleets of oceanic gillnet vessels from I.R. Iran and Pakistan and gillnet and longline vessels from Sri Lanka have extended their area of operation in recent years, to operate on the high seas closer to the equator. The lack of catch-and-effort data from these fleets makes it impossible to assess whether they are operating in areas where catches of juvenile albacore are likely to occur.
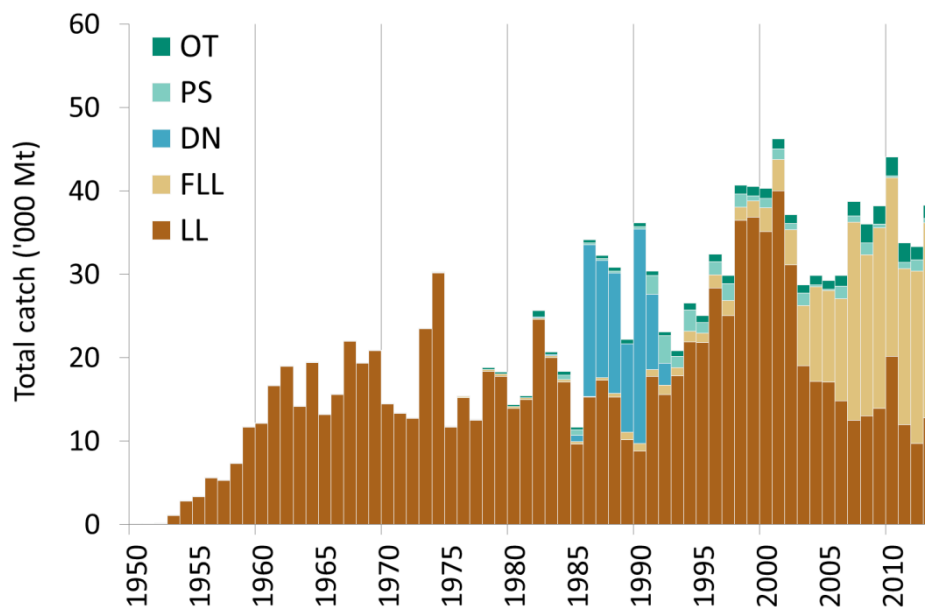
Fig. 2. Albacore: Catches of albacore by gear. Driftnet (DN; Taiwan,China); Freezing-longline (LL); Fresh-tuna longline (FLL); Purse seine (PS); Other gears NEI (OT). (Data as of October 2014)
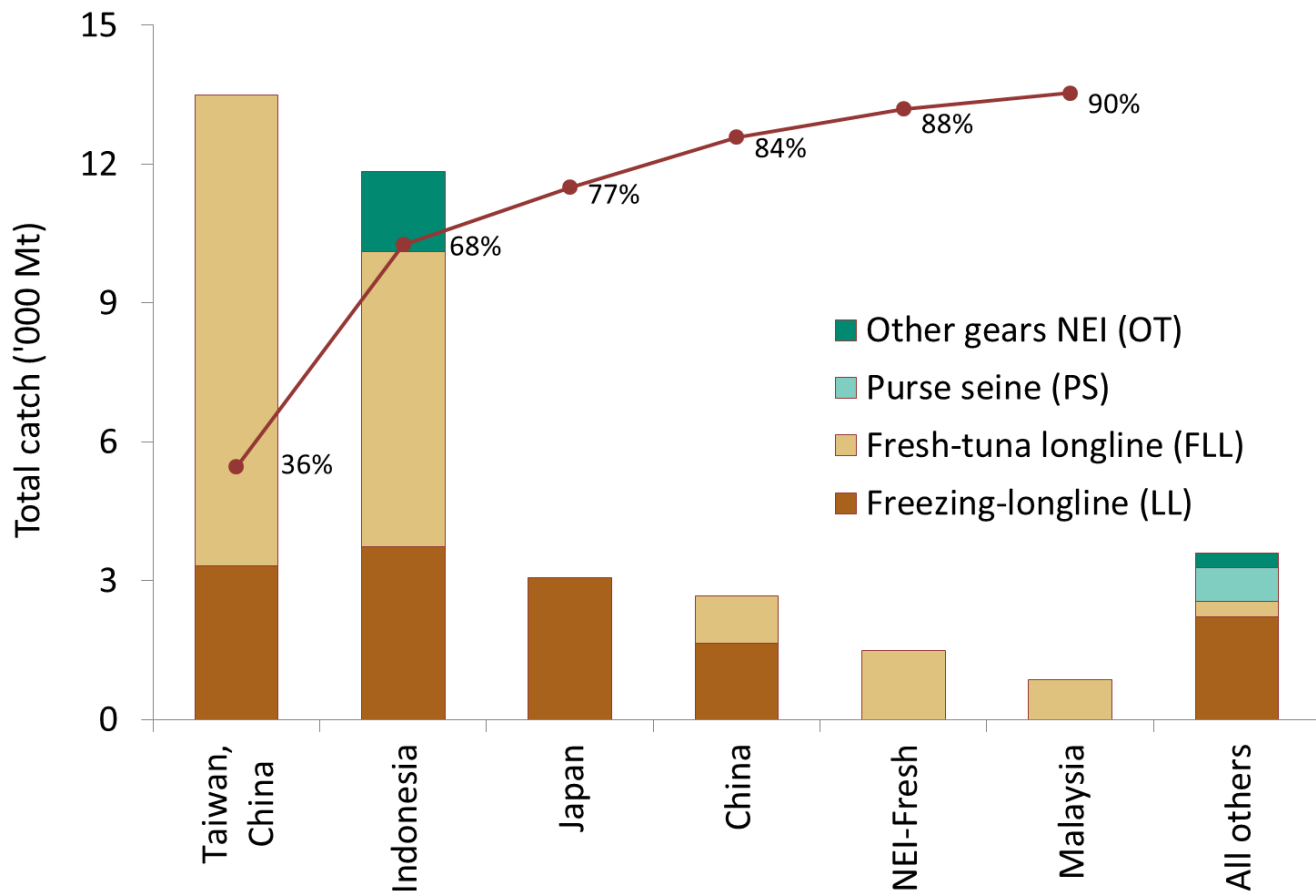
Fig. 3. Albacore: average catches in the Indian Ocean over the period 2010–12, ordered from left to right, according to the importance of catches of albacore reported. The red line indicates the (cumulative) proportion of catches of albacore for the countries concerned, over the total combined catches of albacore reported from all fisheries. (Data as of October 2014)
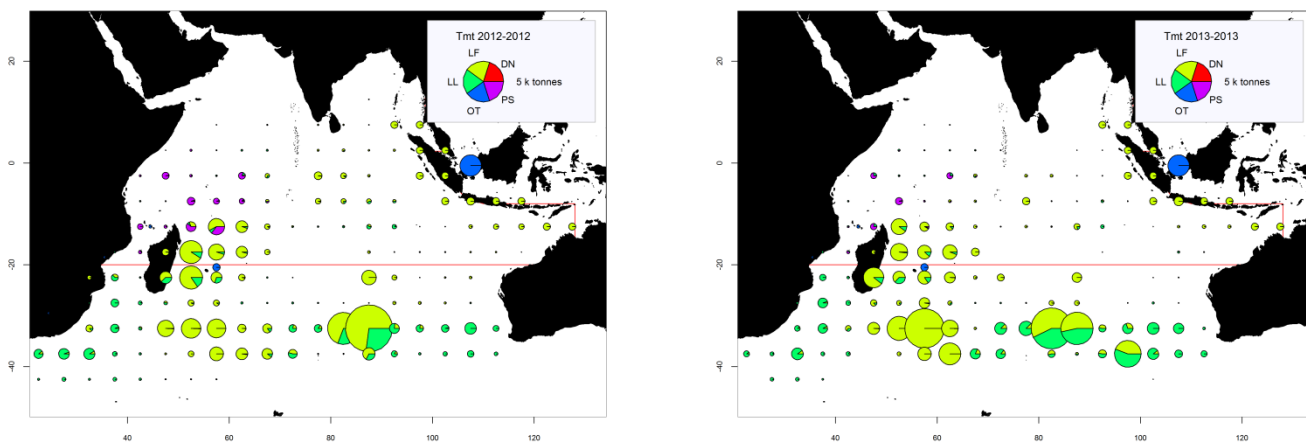
Fig. 4a–b. Albacore: Time-area catches (total combined in tonnes) of albacore estimated for 2012 (left) and 2013 (right) by year and type of gear. Red line depicts the area separation for Table 5. Deep-freezing longline (LL, green), Fresh-tuna longline (LF, light green), Driftnet (DN, red), Purse seine (PS, purple), Other fleets (OT, blue). Time-area catches are not available for all fleets; catches for those were assigned by 5x5 square and month using information from other fleets. (Data as of October 2014)

TABLE 4. Albacore: Best scientific estimates of the catches of albacore (*Thunnus alalunga*) by gear and main fleets [or type of fishery] by decade (1950s–2000s) and year (2004–2013), in tonnes. Catches by decade represent the average annual catch, noting that some gears were not used for all years. (Data as of October 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*
DN				5,823	3,735											
LL	3,715	17,228	16,967	15,827	23,038	21,396	17,187	17,088	14,804	12,510	13,046	13,944	20,195	12,006	9,728	12,800
FLL			80	314	1,324	11,720	11,299	10,971	12,250	23,736	19,332	21,662	21,399	18,696	20,691	23,399
PS				194	1,683	912	232	164	1,548	725	1,424	392	207	725	1,296	501
OT	20	33	94	413	769	1,418	1,174	1,035	1,226	1,765	2,250	2,235	2,235	2,303	1,611	1,597
Total	**3,736**	**17,262**	**17,142**	**22,570**	**30,550**	**35,446**	**29,893**	**29,258**	**29,828**	**38,737**	**36,051**	**38,233**	**44,036**	**33,731**	**33,327**	**38,297**

Fisheries: Driftnet (**DN**; Taiwan,China); Freezing-longline (**LL**); Fresh-tuna longline (**FLL**); Purse seine (**PS**); Other gears nei (**OT**).*Preliminary figures.

TABLE 5. Albacore: Best scientific estimates of the catches of albacore (*Thunnus alalunga*) by fishing area by decade (1950s–2000s) and year (2004–2013), in tonnes. The areas used are shown in Fig. 5. (Data as of October 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*
1-North	771	1,240	1,403	1,727	4,416	6,215	4,767	5,038	6,815	9,344	10,521	6,020	6,870	6,389	5,512	4,463
2-South	2965	16,022	15,738	20,844	26,134	29,231	25,125	24,220	23,013	29,392	25,531	32,213	37,166	27,341	27,814	33,834
Total	**3,736**	**17,262**	**17,142**	**22,570**	**30,550**	**35,446**	**29,893**	**29,258**	**29,828**	**38,737**	**36,051**	**38,233**	**44,036**	**33,731**	**33,327**	**38,297**

Areas: North of 10ºS (**N**); South of 10ºS (**S**). *Preliminary figures.

Albacore – Uncertainty of catches

While retained catches were fairly well known until the early-1990s (Fig. 5), the quality of catch estimates since that time has been compromised due to poor catch reports from some fleets, in particular:

- Longliners of Indonesia: The catches of albacore for the longline fleet of Indonesia were revised in 2013 by the DGCF and the IOTC Secretariat, using previous reports from Indonesia and information obtained from canning factories cooperating with the International Seafood Sustainability Foundation (ISSF). While the new catch estimates are considered more reliable than the previous, the lack of catch-and-effort data and insufficient monitoring of albacore landings in Indonesia makes it difficult to validate such estimates. According to the new estimates Indonesia has been catching 32% (around 11,000 – 13,000 t per year) of the total catches of albacore in the Indian Ocean over the period 2010-12. However, the catches of albacore reported by Indonesia for 2013, at over 16,000 t, are in contradiction with data from the canning factories, which shows a marked drop in imports.
- Longliners of Malaysia: To date, Malaysia has reported incomplete catches of albacore for its longline fleet, as monitoring by Malaysia does not cover the large component of the longline fleet that is based in ports outside Malaysia (in particular in Mauritius). In recent years Malaysia has reported between 5 and 59 active longliners in the Indian Ocean, with catches of albacore ranging between nil and 1,000 t for the same period. An additional 500–2,000 t of albacore were estimated for Malaysian longliners not based in Malaysia.
- Fleets using gillnets on the high seas, in particular I.R. Iran, Pakistan and Sri Lanka: Catches are likely to be less than 1,000 t.
- Non-reporting industrial longliners (NEI): Refers to catches from longliners operating under flags of non-reporting countries. While the catches were moderately high during the 1990s, they have not exceeded 3,000 t in recent years.
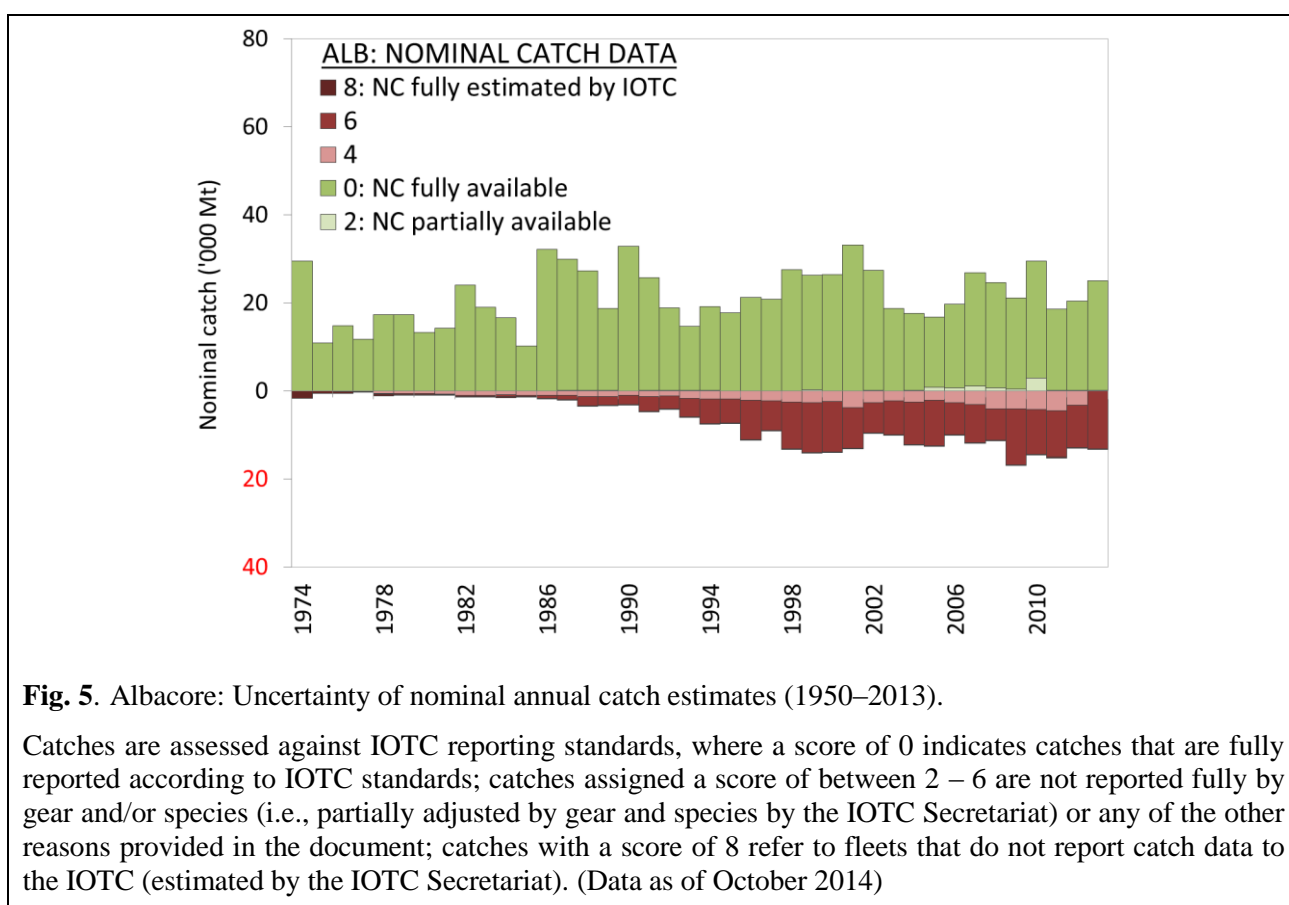
Fig. 5. Albacore: Uncertainty of nominal annual catch estimates (1950–2013).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 are not reported fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat). (Data as of October 2014)

- Levels of discards are believed to be low although they are unknown for industrial fisheries other than European (EU) purse seiners (2003–07).

- Changes to the catch series: The catches of albacore have changed for some years since the WPTmT in 2012, including:
  - Minor to moderate increase in estimates of catches of albacore recorded for the period 1950–2003, following a review of the catches of albacore by coastal longliners in Indonesia.

o Moderate decrease in estimates of catches of albacore in 2007 (11%) and marked decrease in 2008 (24%), following the review of catches of albacore by all fleets conducted for this period.
o Minor changes in estimates of catches of albacore for other years.
- CPUE Series: Catch-and-effort series are available from various industrial fisheries. Nevertheless, catch-and-effort are not available from some fisheries or they are considered to be of poor quality, especially during the last decade, for the following reasons:
  o Uncertain data from significant fleets of longliners, including India, Indonesia, Malaysia, Oman, and Philippines;
  o No data for fresh-tuna longliners flagged in Taiwan,China during 1990–2006;
  o Non-reporting by industrial purse seiners and longliners (NEI).

Albacore – Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid for 2012 and 2013 are provided in Fig. 6, 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 2012 and 2013 are provided in Fig. 7.
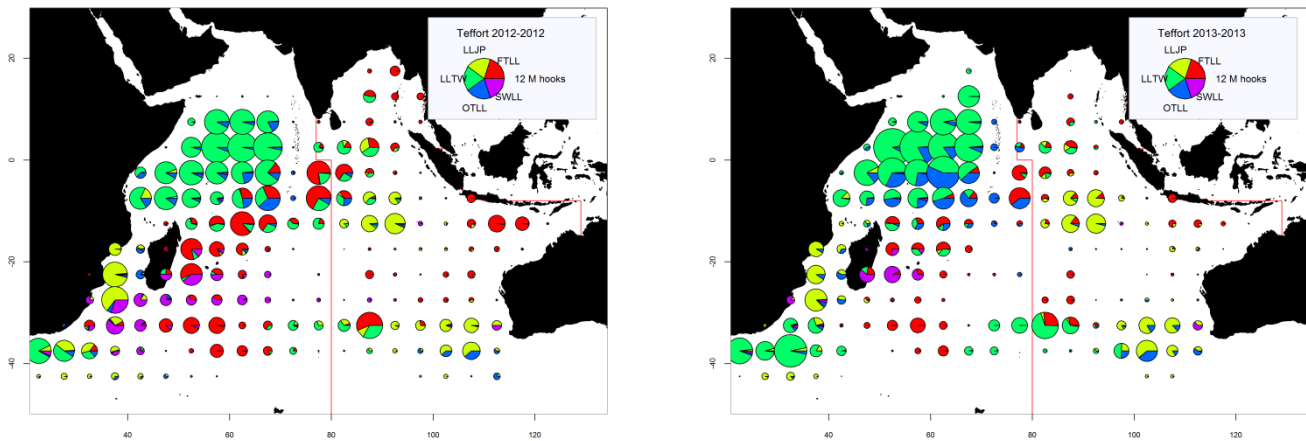
Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2012 (left) and 2013 (right). Red line depicts the IOTC West and East areas. (Data as of October 2014)
**LLJP** (light green): deep-freezing longliners from Japan
LLTW (dark green): 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)
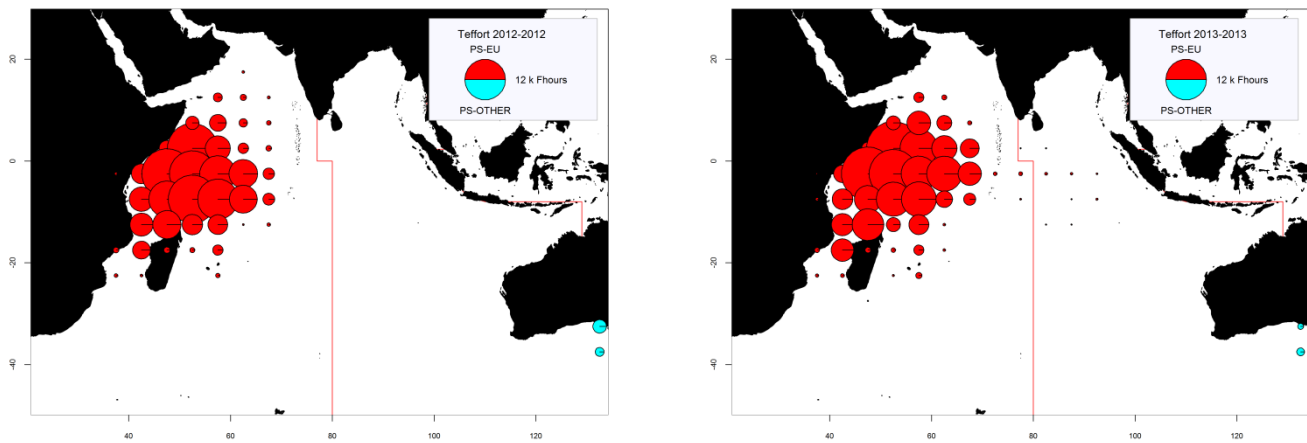
Fig. 7. Number of hours of fishing(Fhours in thousands: k) from purse seine vessels by 5 degree square grid and main fleets, for the years 2012 (left) and 2013 (right). Red line depicts the IOTC West and East areas. (Data as of October 2014)
PS-EU (red): Industrial purse seiners monitored by the EU and 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)

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

The size frequency data for the Taiwan,China deep-freezing longline fishery for the period 1980–2013 is available. However, the lengths of albacore available for Taiwan,China since 2003 are very different from those available for earlier years. The length data and catch-and-effort data for the same time-periods and areas are also conflicting over most of the time series. In general, the amount of catch for which size data for the species are available before 1980 is still very low. The data for the Japanese longline fleet is available; however, the number of specimens measured per stratum has been decreasing in recent years. Size data are also available for industrial purse seiners flagged in EU countries and the Seychelles. Few data are available for the other fleets.

- **Trends in average weight:** Can be assessed for several industrial fisheries although they are incomplete or of poor quality for some fisheries due to the issues identified above.

- **Catch-at-Size(Age):** Tables are available but the estimates are highly uncertain for some periods and fisheries (Fig. 8) including:
   o all industrial longline fleets before the mid-60s, from the early-1970s up to the early-1980s and most fleets in recent years, in particular fresh-tuna longliners;
   o the complete lack of size samples from the driftnet fishery of Taiwan,China over the entire fishing period (1982–92)
   o the paucity of catch by area data available for some industrial fleets (Taiwan,China, NEI, India and Indonesia).

ALB (Longline samples): size (in cm)

ALB (Longline): no. of samples ('000)
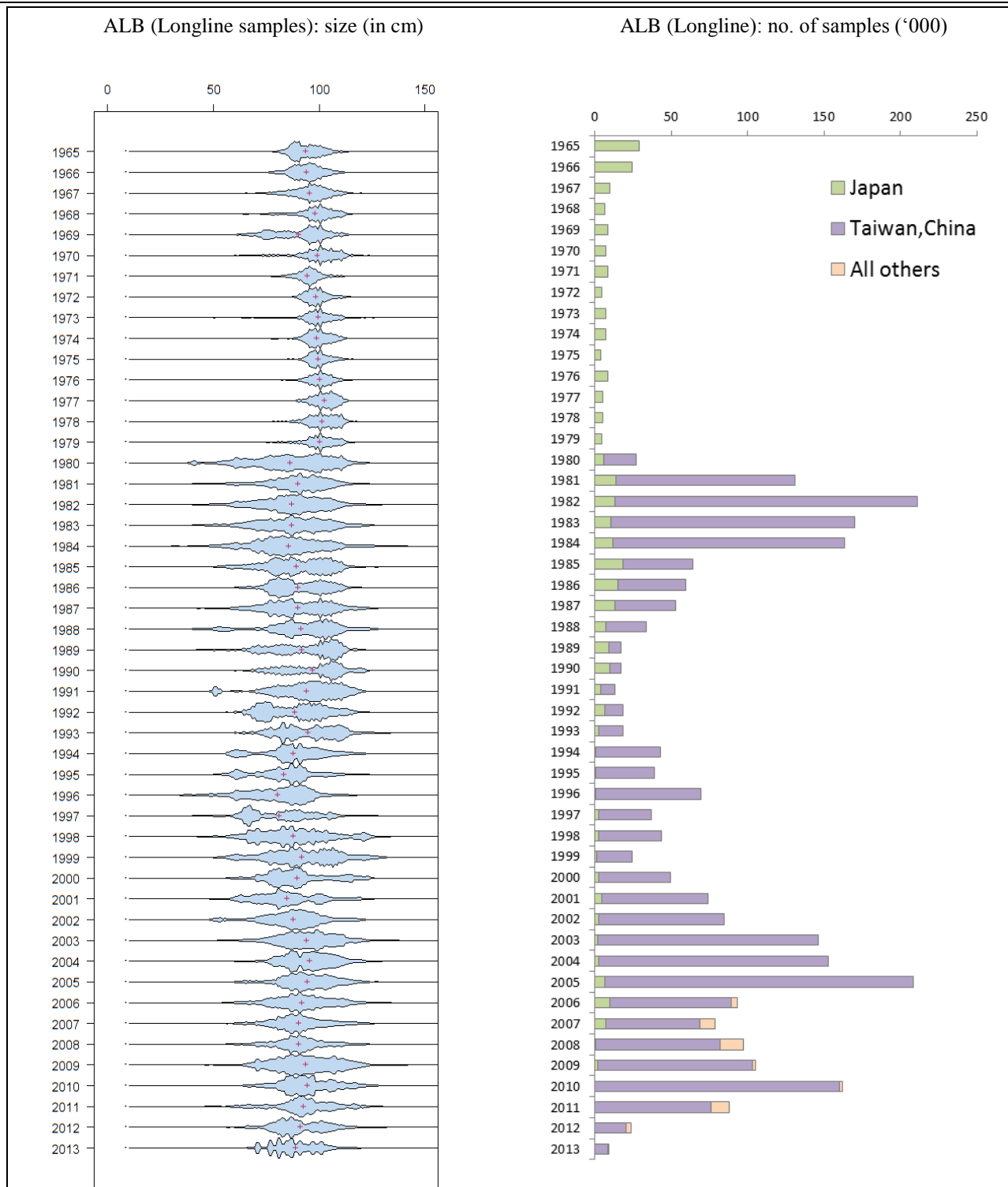
Fig. 8: Left - Albacore: Length frequency distributions (total amount of fish measured by 1 cm length class) derived from the data available at the IOTC Secretariat for freezing longline fisheries, by year. Right - Number of specimens sampled for lengths by main longline fleet.

*Standardised catch–per–unit–effort (CPUE) trends*

The CPUE series available for assessment purposes are listed below and shown in Fig. 9, although the Taiwan,China series (Southern area 1 and Southern area 2a; Fig. 9c) were used in the final stock assessment models for management advice purposes for the reasons discussed in IOTC–2012–WPTmT05–R.

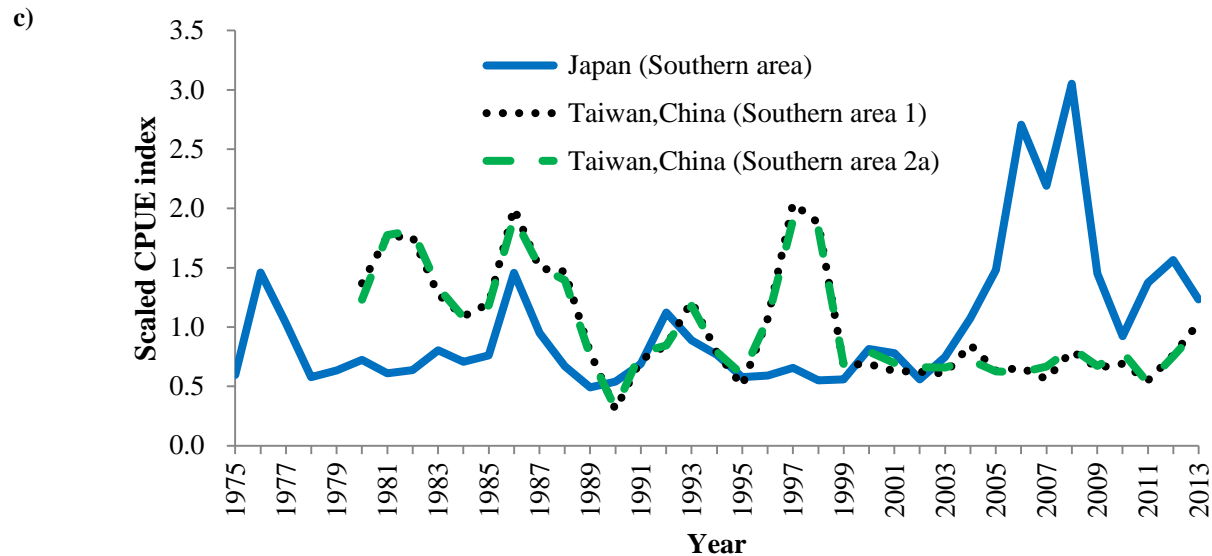- Japan data (1975–2012): 2 series from document IOTC–2014–WPTmT05–18 Rev_1
- Taiwan,China data (1980–2013): 4 series from document IOTC–2014–WPTmT05–19
- Rep. of Korea data (1977–2013): 2 series from document IOTC–2014–WPTmT05–20 Rev_1

c)
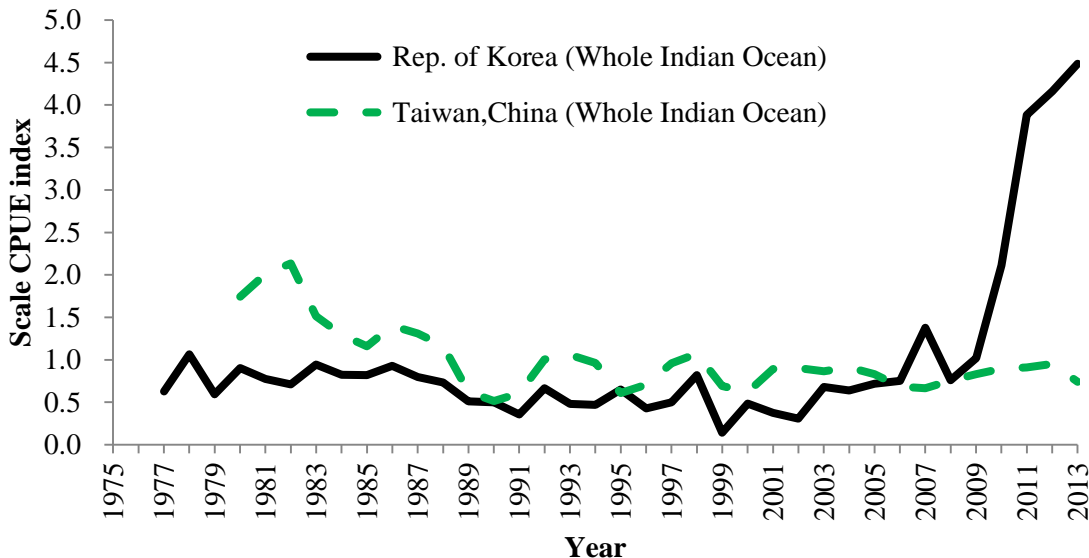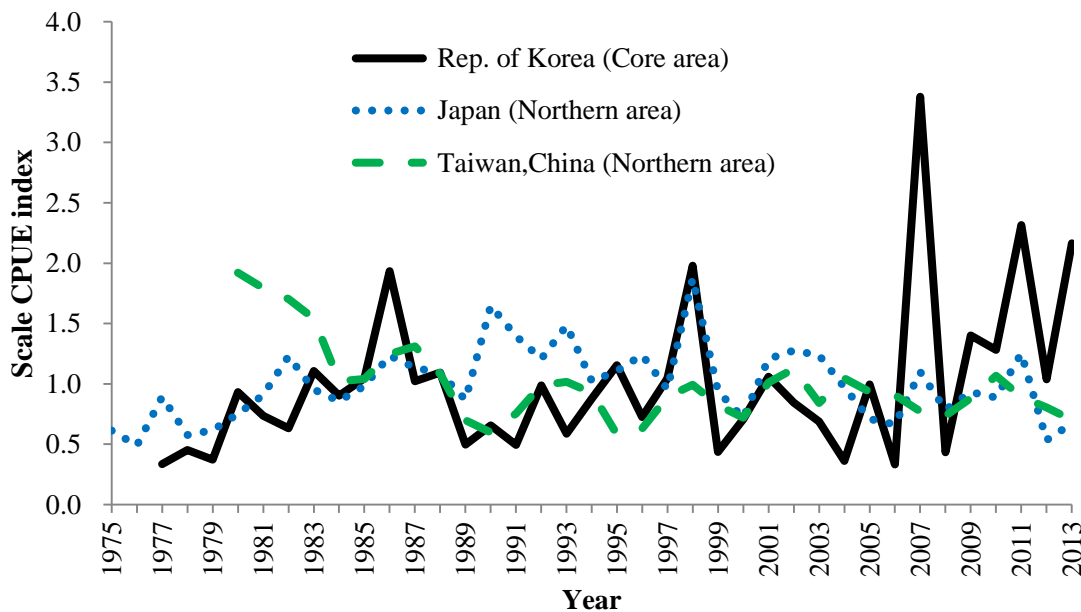
Fig. 9. Comparison of the CPUE series for longline fleets fishing for albacore in the IOTC area of competence. a) Whole Indian Ocean b) Northern area and c) Southern area. Series have been rescaled relative to their respective means from 1975–2013.

STOCK ASSESSMENT

A range of quantitative modelling methods as detailed below (BBDM, ASAP, ASPIC, ASPM and SS3) were applied to the assessment of albacore in 2014, ranging from the highly aggregated ASPIC surplus production model to the age-, sex- and spatially-structured SS3 analysis.

The following is worth noting with respect to the various modelling approaches used in 2014:

- There was more confidence in the abundance indices this year due to the additional CPUE analyses from Japan and Taiwan,China, and the exploration of the Rep. of Korea catch and effort data. This has led to improved confidence in the overall assessments.
- The Taiwan,China CPUE is more likely to closely represent albacore abundance at this time, because a substantial part of the Taiwan,China fleet has always targeted albacore in the southern area (2a) as identified by Taiwan,China.
- Conversely, the Japanese CPUE seems to demonstrate very strong targeting shifts away from albacore (1960s) and back towards albacore in recent years (as a consequence of piracy in the western Indian Ocean, reduced or increased TAC for southern bluefin tuna, and increased commercial value for albacore). Similar trends are seen in the Rep. of Korea CPUE series.
- CPUE series should not be averaged across series with different trends as this is likely to result in spurious trends. Thus, only series which are considered to be most representative of abundance, in this case the Taiwan,China series, should be used in stock assessments while further work is carried out on the Japanese and Rep. of Korea longline series.
- It was recognised that the deterministic production models were only able to explore a limited number of modelling options. The structural rigidity of these simple models causes numerical problems when fit to long time series for some cases. This was also apparent in the ASPM Model approach pursued in WPTmT 2014.

The stock structure of the Indian Ocean albacore resource is under investigation, but currently uncertain. The south-west region was identified as an area of interest, as it is likely that there is stock connectivity with the southern Atlantic albacore population. The albacore stock status should be determined by qualitatively integrating the results of the ASPIC and SS3 stock assessments undertaken in 2014 (Table 6). The two analyses were considered as equally informative.

The output of the ASPIC and SS3 models were considered to most likely be numerically and graphically representative of the current status of albacore in the Indian Ocean. This does not represent an endorsement of the SS3 or ASPIC over the other models used in 2014, as there are still substantial problems with the ASPIC and SS3 on some of the model runs pursued, and all of the models are considered to be informative of stock status.

TABLE 6. Albacore (*Thunnus alalunga*) stock status summary.

Management Quantity	SS3	ASPIC*
2013 catch estimate	38,297 t	38,297 t
Mean catch from 2009–2013	37,525 t	37,525 t
MSY (1000 t) (80% CI)	47.6 (26.7–78.8)	34.7 (28.8–37.4)
Data period used in assessment	1950–2012	1950–2012
F_{MSY} (80% CI)	0.31 (0.21–0.42)	0.50 (n.a.)
SB_{MSY} (80% CI)	39.2 (25.4–50.7)	68.6 (n.a.)
F_{2012}/F_{MSY} (80% CI)	0.69 (0.23–1.39)	0.94 (0.68–1.61)
B_{2012}/B_{MSY} (80% CI)	–	1.05 (0.73–1.35)
SB_{2012}/SB_{MSY} (80% CI)	1.09 (0.34–2.20)	–
B_{2012}/B_{1950} (80% CI)	–	–
SB_{2012}/SB_{1950}	0.21 (0.11–0.33)	0.43 (n.a.)
$B_{2012}/B_{1950, F=0}$	–	–
$SB_{2012}/SB_{1950, F=0}$	–	–

*Total Biomass (B)

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