IOTC–2012–WPTmT04–08

STATUS OF THE INDIAN OCEAN ALBACORE RESOURCE (*Thunnus alalunga*)

PREPARED BY: IOTC SECRETARIAT, 16 JULY 2012

PURPOSE

To encourage the Working Party on Temperate Tunas (WPTmT) to develop a clear and concise draft resource Executive Summary for the consideration of the Scientific Committee.

BACKGROUND

Each year the IOTC Scientific Committee (SC) provides stock status advice and recommendations to the Commission in two primary formats based on stock assessments or other stock status indicators determined by the relevant Working Party, for each of the tuna and tuna-like species under the IOTC mandate. Firstly, advice is tabulated at the front of the SC report and includes recent annual catches, maximum sustainable yield estimates and the ratio of average catch to the MSY levels, in conjunction with stock status advice to the Commission. Secondly, a more detailed stock status description is provided in the report text outlining the current stock status, recommendations to the Commission and in some cases an outlook section. These two forms of advice are generally combined into an Executive Summary for each stock during the SC meeting however, due to time limitations the SC places little emphasis on how the information is presented in the Executive Summaries.

The advice provided by the working parties and the SC has at times, been unclear with some stocks being classified within one of the status categories based on fully quantitative stock assessments, while others are given a status based on little more than qualitative evidence such as unstandardised catch-per-unit-effort series. As such, there is a clear need for the working parties to provide the SC with a clear set of recommendations and advice concerning stock status, and this process was revised in 2011, with a new Executive Summary format agreed to by all of the IOTC working parties.

DISCUSSION

The advice and recommendations provided to the Commission has varied greatly among the reports of the various working parties depending on the indicators used to determine stock status and the level of information available to the working parties and SC. Where possible, in 2011 indicators were standardised and a minimum level of information incorporated in the resource Executive Summaries, the first two pages of which are provided at Appendix A.

In addition, to aid in the development of the Executive Summary for albacore, a draft '*Supporting information – Status of the Indian Ocean albacore resource*" has been developed (Appendix B), for the consideration and modification by participants at WPTmT04, so that the WPTmT may more readily communicate its opinion of stock status to the SC. Note that text in red represents agreed text from 2011, which will need to be updated at the WPTmT04 meeting.

RECOMMENDATION

That the WPTmT **AGREE** to a draft *Status of the Indian Ocean albacore resource*, for the consideration of the Scientific Committee as the basis for an Executive summary and that the draft shall be based on the most appropriate information available.

The WPTmT **RECOMMENDS** that the Scientific Committee **NOTE** the draft *Status of the Indian Ocean albacore resource*.

The WPTmT **AGREED** that the IOTC Secretariat should update the draft *Status of the Indian Ocean albacore resource* document with the latest 2011 catch data prior to the next SC meeting.

APPENDICIES

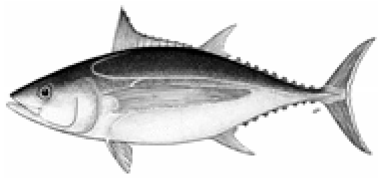
Appendix A: 2011 *Status of the Indian Ocean albacore resource*

Appendix B: Draft: Supporting information – *Status of the Indian Ocean albacore resource*

APPENDIX A

(*EXTRACT OF THE SCIENTIFIC COMMITTEE REPORT – 2011*)

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



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

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

Area[1]	Indicators – 2011 assessment		2011 stock status determination 2010[2]
Indian Ocean	Catch 2010:	43,711 t	
	Average catch 2006–2010:	41,074 t	
	MSY (1 model):	29,900 t (21,500–33,100 t)	
	F_{2010}/F_{MSY} (1 model):	1.61 (1.19–2.22)*	
	B_{2010}/B_{MSY} (1 model):	0.89 (0.65–1.12)*	
	B_{2010}/B_{1980} (1 model):	0.39 (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.
*(Note: at this time the WPTmT had limited confidence in the assessment results (refer to paragraphs 71–77 in the report of the WPTmT03 (IOTC–2011–WPTmT03–R) for further clarification).

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

The SC **RECOMMENDED** the following management advice for albacore in the Indian Ocean noting that there remains considerable uncertainty about the relationship between abundance and the standardized CPUE series, and about the total catches over the past decade.

Stock status. Trends in the Taiwan,China CPUE series suggest that the longline vulnerable biomass has declined to about 39% of the level observed in 1980. There were 20 years of moderate fishing before 1980, and the catch has more than doubled since 1980. Catches have increased substantially since the previous albacore assessment when there was considered to be a risk that $SB<SB_{MSY}$, so the risk will have increased further. It is considered likely that recent catches have been above MSY, recent fishing mortality exceeds F_{MSY} ($F_{2010}/F_{MSY} > 1$). There is a moderate risk that total biomass is below B_{MSY} ($B_{2010}/B_{MSY} \approx 1$) (Table 1, Fig. 1).

Outlook. Maintaining or increasing effort will probably result in further declines in 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.

The SC **RECOMMENDED** the following:

- 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.
- Current catches (average ~41,000 t over the last five years, ~44,000 t in 2010) likely exceed MSY (29,900 t, range: 21,500–33,100 t). Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.
- A Kobe 2 Strategy matrix was calculated to quantify the risk of different future catch scenarios. However, a number of inconsistencies between the model and data were noted for future investigation (matrix not presented here as a result).

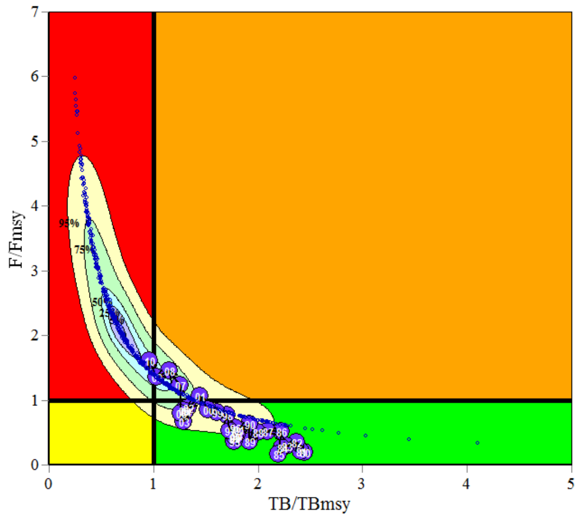


Fig. 1. ASPIC Aggregated Indian Ocean assessment Kobe plot (95% Confidence surfaces shown around 2010 estimate). Fixed B/K=0.9. Blue circles indicate the trajectory of the point estimates for the TB ratio and F ratio for each year 1980–2010 (Note: at this time the WPTmT had limited confidence in the assessment results (refer to paragraphs 71–77 in the report of the WPTmT03 (IOTC–2011–WPTmT03–R) for further clarification).

APPENDIX B

SUPPORTING INFORMATION

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

Note that text in red represents agreed text from 2011, which will need to be updated at the WPTmT04 meeting

CONSERVATION AND MANAGEMENT MEASURES

Albacore (*Thunnus alalunga*) in the Indian Ocean are currently subject to a number of conservation and management measures adopted by the Commission, although none are species specific:

- 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*
- Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 12/07 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*

FISHERIES INDICATORS

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 2 outlines some of the key life history traits of albacore specific to the Indian Ocean.

Catch trends

Albacore are currently caught almost exclusively using drifting longlines (98%) (Fig. 2; Table 3), and South of 10°S (Table 4), with remaining catches recorded using purse seines and other gears (Fig. 2). Catches of albacore were relatively stable until the mid-1980s, except for high catches recorded in 1973 and 1974 (Fig. 1). 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 fleet, catches dropped to less than 20,000 t by 1993 (Figs. 2, 3). However, catches more than doubled over the period from 1993 (less than 20,000 t) to 2001 (44,000 t). Since 2001, catches have been almost exclusively taken by drifting longlines (Figs. 2, 3, 4). Record catches of albacore were reported in 2007, at around 43,000 t, and again in 2008, at 44,000 t. Catches for 2009 are estimated to be approximately 39,000 t, while preliminary catches for 2010 amount to 42,968 t (Table 3).

TABLE 2. 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	8 years (reported to 10 years in the Pacific)
Maturity (50%)	**Age**: females 5–6 years; males n.a. **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)	n.a.

n.a. = not available. SOURCES: Froese & Pauly (2009); Xu & Tian (2011)

Catches of albacore in recent years have come almost exclusively from vessels flagged in Indonesia and Taiwan,China, although the catches of albacore reported for the fresh tuna longline fishery of Indonesia have increased considerably since 2003 to around 17,000 t (Fig. 3), which represents approximately 32% 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 (Fig. 3). 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 6,000 t (Fig. 3).

In contrast to the Japanese longliners, catches by Taiwan,China longliners increased steadily from the 1950's to average around 10,000 t by the mid-1970s. Between 1998 and 2002 catches ranged between 21,500 t to 26,900 t, equating to just over 60% of the total Indian Ocean albacore catch. Between 2003 and 2010 the albacore catches by Taiwan,China longliners have been between 10,000 and 18,000 t, with catches appearing to be on the increase in recent years. There has been a shift in the proportion of catches of albacore by deep-freezing and fresh-tuna longliners in recent years, with increasing catches of fresh-tuna (72% of the total catches for 2008–10) as opposed to deep-freezing longliners (Fig. 2; Table 3).

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 (Fig. 4; Table 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. 6) which has led to increased catches of albacore by some longline fleets, in particular vessels from China, Taiwan,China and Japan (Fig. 4).

Fleets of oceanic gillnet vessels from 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.

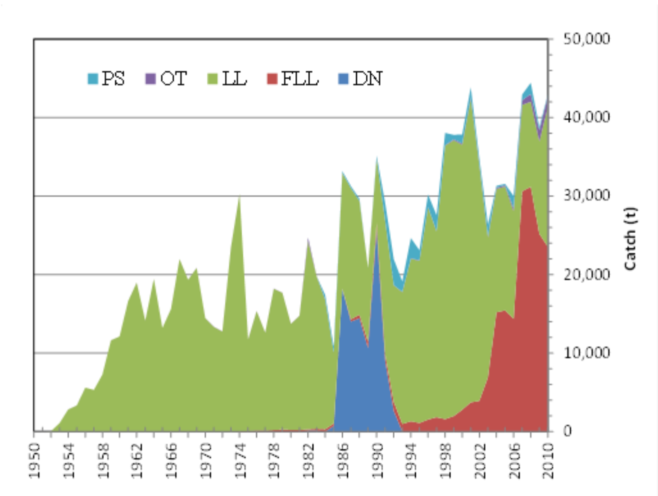


Fig. 2. Annual catches of albacore by gear recorded in the IOTC Database (1950–2010) (Data as of June 2012). Freezing-longline (LL); Fresh-tuna longline (FLL); Purse seine (PS); Other gears NEI (OT).

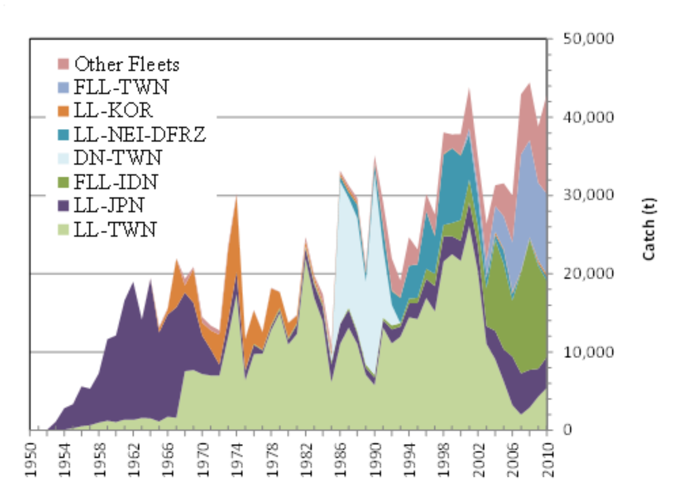


Fig. 3. Annual catches of albacore by fleet recorded in the IOTC Database (1950–2010) (Data as of June 2012). Freezing Longlines of Taiwan,China (LL-TWN), Japan (LL-JPN), Rep. of Korea (LL-KOR), and other nei fleets (LL-NEI-DFRZ); Fresh-tuna longlines of Indonesia (FLL-IDN), and Taiwan,China (FLL-TWN); Driftnets of Taiwan,China (DN-TWN); all other fleets combined (Other Fleets).

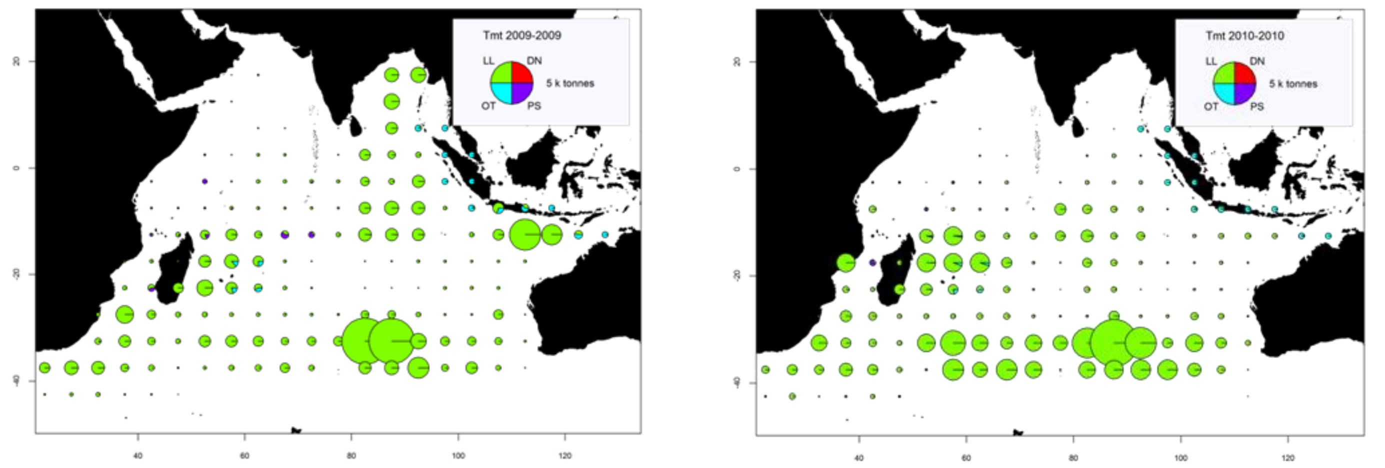


Fig. 4a–b. Time-area catches (total combined in tonnes) of albacore estimated for 2009 (left) and 2010 (right) by type of gear: Longline (LL, green), Driftnet (DFRT, red), Purse seine (PS, purple), Other fleets (OT, blue). Time-area catches are not available for all fleets; catches for those were assigned by 5x5 square and month using information from other fleets. Catches of fresh-tuna longliners are not represented (Data as of June 2012).

TABLE 3. Best scientific estimates of the catches of albacore (*Thunnus alalunga*) by gear and main fleets [or type of fishery] by decade (1950–2000) and year (2001–2010), in tonnes. Data as of June 2012. Catches by decade represent the average annual catch, noting that some gears were not used for all years (refer to Fig. 2).

	By decade (average)						By year (last ten years)									
Fishery	**1950s**	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
DN				5,823	3,735											
LL	3,715	17,233	16,903	15,214	21,876	19,901	38,664	29,999	17,819	15,721	15,774	13,696	11,001	10,837	11,749	17,834
FLL			80	314	1,328	14,940	3,724	3,918	6,908	15,201	15,454	14,383	30,616	31,194	25,206	23,538
PS				203	1,683	920	1,281	772	1,496	232	164	1,548	725	1,424	392	207
OT	6	9	26	68	63	441	186	152	144	163	176	381	599	989	1457	1389
Total	**3,721**	**17,242**	**17,009**	**21,622**	**28,685**	**36,202**	**43,855**	**34,841**	**26,367**	**31,317**	**31,568**	**30,008**	**42,941**	**44,444**	**38,804**	**42,968**

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

TABLE 4. Best scientific estimates of the catches of albacore (*Thunnus alalunga*) by fishing area for the period 1950–2010 (in metric tons). Data as of June 2012.

	By decade (average)						By year (last ten years)									
Area	**1950s**	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
N	69	135	207	55	549	2,229	700	821	742	1,151	1,589	2,452	6,870	4,636	3,237	471
S	3,652	17,107	16,803	21,567	28,135	33,972	43,155	34,021	25,625	30,167	29,979	27,556	36,071	39,809	35,567	42,496
Total	**3,721**	**17,242**	**17,010**	**21,622**	**28,684**	**36,201**	**43,855**	**34,842**	**26,367**	**31,318**	**31,568**	**30,008**	**42,941**	**44,445**	**38,804**	**42,967**

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

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 and Malaysia: To date, Indonesia and Malaysia have reported incomplete catches of albacore for their longline fleets, as they do not monitor activities of longliners under their flags based outside of their territories (e.g. Mauritius, Sri Lanka, and Thailand). In addition, in recent years Indonesia has reported catches of albacore for fresh-tuna longliners under its flag that are in contradiction with the amounts of albacore recorded from alternative sources, including data on exports of albacore from Bali, and data from canning factories under the ISSF scheme. The new catches of albacore estimated by the IOTC Secretariat using the above sources are around 14,000 t (average 2006–10), well above those reported by the flag countries (8,000 t).
- Fleets using gillnets on the high seas, in particular Iran, Pakistan and Sri Lanka: Catches are likely to be less than 1000 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 2000 t in recent years.

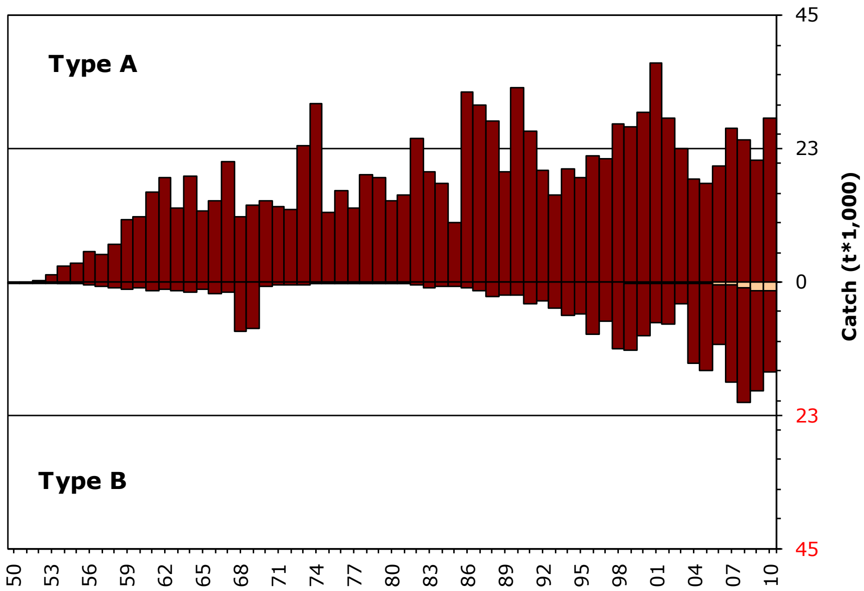


Fig. 5. Albacore: Uncertainty of annual catch estimates for albacore (1950–2010) (Data as of June 2012).

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

- The catch series for albacore has not changed substantially since the WPTmT in 2011.
- Levels of discards are believed to be low although they are unknown for industrial fisheries other than European (EU) purse seiners (2003–07).
- 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:
  - uncertain data from significant fleets of longliners, including India, Indonesia, Malaysia, Oman, and Philippines;
  - no data for fresh-tuna longliners flagged in Taiwan,China during 1990–2006 and poor coverage the following years (2007–10);
  - non-reporting by industrial purse seiners and longliners (NEI).

Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid from 2007 to 2010 are provided in Fig. 6, and total effort from purse seine vessles 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 2007 to 2010 are provided in Fig. 7.

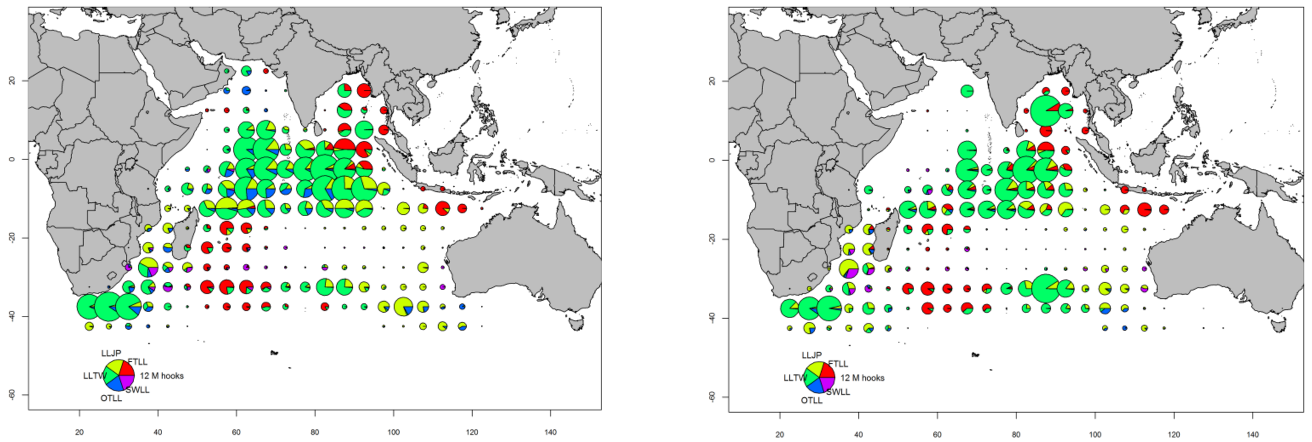


Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): 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)

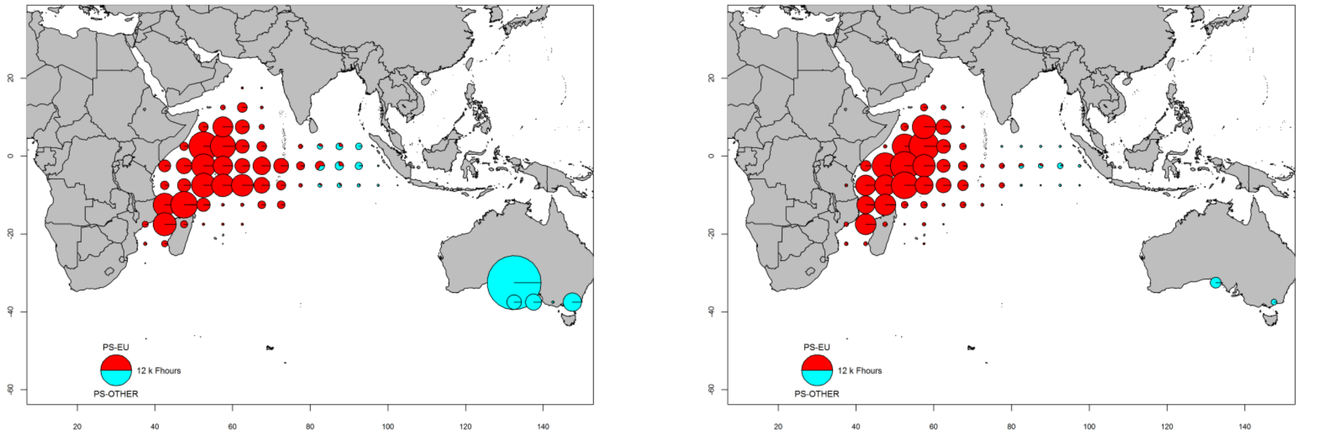


Fig. 7. Number of hours of fishing(Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles 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)

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

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:

- uncertain data from significant fleets of longliners, including India, Indonesia, Malaysia, Oman, and Philippines
- no data for fresh-tuna longliners flagged in Taiwan,China during 1990–2006 and poor coverage the following years (2007–10)
- non-reporting by industrial purse seiners and longliners (NEI)

The CPUE series available for assessment purposes are shown in Fig. 8, although only the Taiwan,China series was used in the stock assessment model for 2011 for the reasons discussed in IOTC–2011–WPTmT03–R.

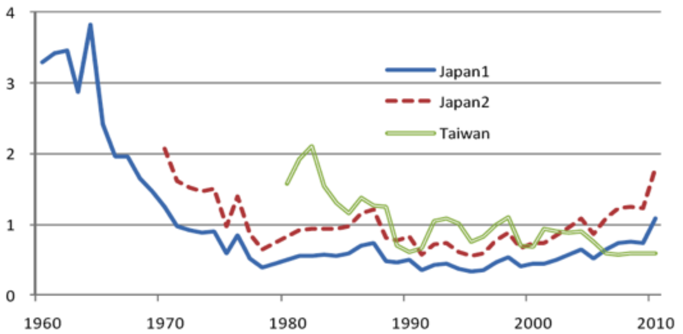


Fig. 8. Comparison of the three CPUE series for Indian Ocean albacore. Series have been rescaled relative to their respective means from 1960–2010.

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

The size frequency data for the Taiwanese deep-freezing longline fishery for the period 1980–2009 is available. 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 fleets is available; however, the number of specimens measured per stratum has been decreasing in recent years. 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 most fisheries before 1980, between 1986 and 1991, and in recent years, due to the lack of length samples for the fleets referred to above (Fig. 9).
- Catch-at-Size(Age) tables are available but the estimates are highly uncertain for some periods and fisheries including:
  - 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
  - the complete lack of size samples from the driftnet fishery of Taiwan,China over the entire fishing period (1982–92)
  - the paucity of catch by area data available for some industrial fleets (Taiwan,China, NEI, India and Indonesia)

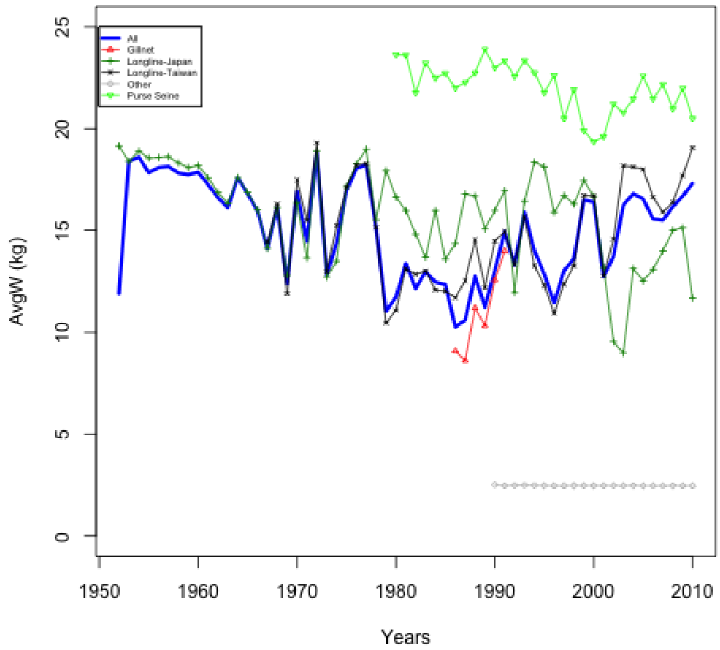


Fig. 9. Average weight in kg of the catches of all fleets (blue), gillnet (red), LL-JPN (dark green), LL-TWN (black), Purse seine (green) and other gears (grey) from 1950 to 2010.

STOCK ASSESSMENT

A single quantitative modelling method, a highly aggregated "A Stock Production Model Including Covariate" (ASPIC) surplus production model, was applied to the albacore assessment in 2011.

The following is worth noting with respect to the modelling approach used:

- The Taiwan,China CPUE standardisation should be used over the Japanese CPUE series because the Japanese CPUE demonstrates strong targeting shifts away from albacore (1960s) and toward albacore in recent years (as a consequence of piracy in the western Indian Ocean), that was not accounted for in the standardization analysis.
- The Fox model had problems converging to a sensible solution when catch data prior to 1980 were included, when the Japanese CPUE were given substantial weight, and/or when the initial biomass was constrained to be less than or equal to the carrying capacity. The Working paper IOTC–2011–WPTmT03–19: *A note on the ASPIC Fox model and Indian Ocean albacore assessment*, examined this issue and found that the long catch time series tends to result in MSY estimates that approach 0. This causes a numerical failure. However, it appears that a range of MSY values may be reasonably consistent with the data.

The Fox model should be given a realistic biological constraint of B(1980) < carrying capacity (B(1980)/K=0.9), otherwise the model estimates B(1980) >> K. There was some incompatibility among the CPUE series, catch data and the Fox model. The structural rigidity of the Fox model limits the number of ways in which the error processes can be examined, and it was felt that this limited the scope of the analysis. Attempts to resolve the limitations are encouraged, as is the use of alternative models.

The general population trends and MSY parameters estimated by the Fox model appeared to be plausibly consistent with the general perception of the fishery and the data. However, these results are considered to be highly uncertain because of i) uncertainty in the recent catches, ii) uncertainty in recent catches, and iii) limited ability to explore alternative interpretations of the data due to software constraints. The WPTmT had limited confidence in the assessment results.

TABLE 5. Albacore (*Thunnus alalunga*) stock status summary.

Management Quantity	Aggregate Indian Ocean
2010 catch estimate	43,700 t
Mean catch from 2006–2010	41,100 t
MSY (80% CI)	29,900 t (21,500–33,100)
Data period used in assessment	1980–2010
F_{2010}/F_{MSY} (80% CI)	1.61 (1.19–2.22)
B_{2010}/B_{MSY} (80% CI)	0.89 (0.65–1.12)
SB_{2010}/SB_{MSY}	–
B_{2010}/B_{1980} (80% CI)	0.39 (n.a.)
SB_{2010}/SB_{1980}	–
$B_{2010}/B_{1980, F=0}$	–
$SB_{2010}/SB_{1980, F=0}$	–

LITERATURE CITED

Froese R & Pauly DE 2009. *FishBase,* version 02/2009, FishBase Consortium, <www.fishbase.org>.

Xu L & Tian SQ 2011. A study of fisheries biology for albacore based on Chinese observer data, IOTC–2011–WPTmT03–11.