OUTCOMES OF THE FOURTEENTH SESSION OF THE SCIENTIFIC COMMITTEE

PREPARED BY: IOTC SECRETARIAT, 2 NOVEMBER, 2012

PURPOSE

To inform the Working Party on Neritic Tunas (WPNT) of the recommendations arising from the Fourteenth Session of the IOTC Scientific Committee (SC) held from 12–17 December 2011, specifically relating to the work of the WPNT.

BACKGROUND

At the 14th Session of the SC, the recommendations relevant to the work of the WPNT contained in Appendix A were adopted by the SC and provided to the Commission for its consideration.

In addition, the SC noted and endorsed the recommendations made by the WPNT in 2011, which included requests to address the deficiencies in data collection, monitoring and reporting by CPCs. The SC requested that the IOTC Secretariat communicate these recommendations to relevant parties so that they may address these matters in 2012 and provide progress updates to the WPNT at its next meeting.

The recommendations on the deficiencies in data collection, monitoring and reporting by CPCs in relation to neritic tunas will be discussed under agenda items 5, 6, 7, 8 and 9 and in paper IOTC–2012–WPNT02–07 and are therefore not presented in this paper.

DISCUSSION

In addition to the recommendations outlined in Appendix A, the SC made several other comments relevant to the WPNT, which participants are asked to consider:

The SC **NOTED** the report of the First Session of the Working Party on Neritic Tunas (IOTC–2011–WPNT01–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 28 participants, including 9 recipients of the Meeting Participation Fund. The SC **AGREED** that the outcomes of the meeting will form the basis of a productive and dynamic group of national scientists focused on neritic tuna and tuna-like stocks which are known to be critically important to many of the Indian Ocean coastal states. The SC expressed its satisfaction that the first meeting of this working party had finally been held after several failed attempts, and thanked all of those responsible for the organisation and successful delivery of the meeting outcomes. (para 95 of the SC14 Report)

The SC **NOTED** that at present very little is known about the population structure and migratory range of most neritic tunas in the Indian Ocean, and **AGREED** that research needs to be undertaken along two separate lines; i) genetic research to determine the connectivity of neritic tunas throughout their distributions, and ii) tagging research to better understand the movement dynamics, possible spawning locations, and post-release mortality of neritic tunas from various fisheries in the Indian Ocean. (para. 96 of the SC14 Report)

The SC also adopted revised Executive Summaries for each of the neritic tuna species which are provided at Appendix B to G.

RECOMMENDATION

That the Working Party on Neritic Tunas **NOTE** the recommendations of the Fourteenth Session of the SC on data and research, and consider how to progress these issues at the present meeting.

APPENDICES

APPENDIX A

CONSOLIDATED SET OF RECOMMENDATIONS OF THE FOURTEENTH SESSION OF THE SCIENTIFIC COMMITTEE (12–17 DECEMBER, 2011) TO THE COMMISSION RELEVANT TO THE WORKING PARTY ON NERITIC TUNAS

Extract of the Report of the Fourteenth Session of the Scientific Committee

(IOTC–2011–SC14–R; Appendix XXXVIII, PAGES 248–259)

Tuna and mackerel – Neritic species

SC14.02 (para. 132) The SC **RECOMMENDED** that the Commission note the management advice developed for each neritic tuna species as provided in the Executive Summary for each species:

- Longtail tuna (*Thunnus tonggol*) – Appendix XIV
- Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix XV
- Bullet tuna (*Auxis rochei*) – Appendix XVI
- Frigate tuna (*Auxis thazard*) – Appendix XVII
- Kawakawa (*Euthynnus affinis*) – Appendix XVIII
- Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XIX

GENERAL RECOMMENDATIONS TO THE COMMISSION

Report of the First Session of the Working Party on Neritic Tunas

SC14.34 (para. 97) The SC **AGREED** that there was an urgent need to carry out stock assessments for neritic tunas in the Indian Ocean, however at present the data held at the IOTC Secretariat would be insufficient to undertake this task. As such, the SC **RECOMMENDED** that the Commission consider allocating appropriate funds to further increase the capacity of coastal states to collect, report and analyse catch data on neritic tuna and tuna-like species in the Indian Ocean.

Increased workload and staffing at the IOTC Secretariat

SC14.45 (para. 114) The SC **RECOMMENDED** that an additional Fishery Officer (P3 or P4) be hired, or consultants contracted, to handle a range of issues related to bycatch, including those from the Commission relating to ecosystems and bycatch issues (see para. 113).

Implementation of the Regional Observer Scheme

SC14.47 (para. 139) The SC **RECOMMENDED** that all IOTC CPCs urgently implement the requirements of Resolution 11/04 on a Regional Observer Scheme, which states that: "The observer shall, within 30 days of completion of each trip, provide a report to the CPCs of the vessel. The CPCs shall send within 150 days at the latest each report, as far as continuous flow of report from observer placed on the longline fleet is ensured, which is recommended to be provided with 1°x1° format to the Executive Secretary, who shall make the report available to the Scientific Committee upon request. In a case where the vessel is fishing in the EEZ of a coastal state, the report shall equally be submitted to that Coastal State." (para. 11), **NOTING** that the timely submission of observer trip reports to the Secretariat is necessary to ensure that the Scientific Committee is able to carry out the tasks assigned to it by the Commission, including the analysis of accurate and high resolution data, in particular for bycatch, which would allow the scientists to better assess the impacts of fisheries for tuna and tuna-like species on bycatch species.

SC14.48 (para. 143) The SC **AGREED** that such a low level of implementation and reporting is detrimental to its work, in particular regarding the estimation of incidental catches of non-targeted species, as requested by the Commission and **RECOMMENDED** the Commission to consider how to address the lack of implementation of observer programmes by CPCs for their fleets and reporting to the IOTC Secretariat as per the provision of Resolution 11/04 *on a Regional Observer Scheme*, noting the update provided in Appendix XXXIV.

Implementation of the Precautionary approach and Management strategy Evaluation

SC14.49 (para. 146) Noting that the development of an MSE process will require management objectives to be specified, the SC **RECOMMENDED** that the Commission provide clear guidance in this regard, noting that the adoption of the Precautionary Approach, as defined in the Fish Stocks Agreement, may be the first step.

SC14.51 (para. 157) The SC **ENDORSED** the roadmap presented for the implementation of MSE in the Indian Ocean in IOTC–2011–SC14–36 and **RECOMMENDED** the Commission agree to initiate a consultative process among managers, stakeholders and scientists to begin discussions about the implementation of MSE in IOTC.

Alternative Management Measures; Impacts of the Purse-Seine Fishery; Juvenile Tuna Catches

SC14.60 (para. 190) The SC **NOTED** however, that the fishery statistics available for many fleets, in particular for coastal fisheries, are not accurate enough for a comprehensive analysis as has been repeatedly noted in previous WPTT and SC reports. In particular, the SC **RECOMMENDED** that all CPCs catching yellowfin tuna should undertake scientific sampling of their yellowfin tuna catches to better identify the proportion of bigeye tuna catches. Therefore, the SC **RECOMMENDED** the countries engaged in those fisheries to take immediate actions to reverse the situation of fishery statistics reporting to the IOTC Secretariat.

SC14.61 (para. 192) The SC **ADVISED** the Commission that the Western and Central Pacific Fisheries Commission has implemented since 2009 a FAD closure for the conservation of yellowfin tuna and bigeye tuna juveniles which has been very effective. The SC **RECOMMENDED** further investigation of the feasibility and impacts of such a measure, as well as other measures, in the context of Indian Ocean fisheries and stocks.

RESEARCH RECOMMENDATIONS AND PRIORITIES

Working Party on Neritic Tunas (WPNT)

Stock structure

SC14.79 (para. 216) Noting that at present very little is known about the population structure and migratory range of most neritic tunas in the Indian Ocean, the SC **RECOMMENDED** a research plan that includes two separate research lines; i) genetic research to determine the connectivity of neritic tunas throughout their distributions, and ii) tagging research to better understand the movement dynamics, possible spawning locations, and post-release mortality of neritic tunas from various fisheries in the Indian Ocean. These should be considered high priority research projects for 2012 and 2013.

Biological information

SC14.80 (para. 217) The SC **RECOMMENDED** that quantitative biological studies are required to determine maturity-at-age and fecundity-at-age relationships, and age and growth for all neritic tunas throughout their range.

CPUE standardisation

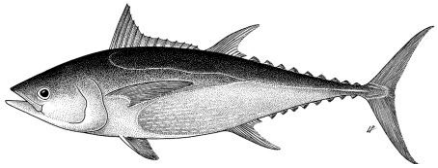
SC14.81 (para. 219) The SC **RECOMMENDED** that where feasible, support should be provided by the IOTC Secretariat and other CPCs, to aid in the development of standardised CPUE series for each neritic tuna species.

Stock assessment

SC14.82 (para. 221) The SC **AGREED** that there was an urgent need to carry out stock assessments for neritic tunas in the Indian Ocean, however at present the data held at the IOTC Secretariat would be insufficient to undertake this task. As such, the SC **RECOMMENDED** that the Commission consider allocating appropriate funds to further increase the capacity of coastal states to collect, report and analyse catch data on neritic tunas.

APPENDIX B
EXECUTIVE SUMMARY: LONGTAIL TUNA

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



Status of the Indian Ocean longtail tuna resource (*Thunnus tonggol*)

TABLE 1. Status of longtail tuna (*Thunnus tonggol*) in the Indian Ocean.

Area[1]	Indicators – 2011 assessment		2011 stock status determination 2010[2]
Indian Ocean	Catch[3] 2010:	141,937 t	UNCERTAIN
	Average catch[3] 2006–2010:	115,973 t	
	MSY:	unknown	
	F_{2010}/F_{MSY}:	unknown	
	SB_{2010}/SB_{MSY}:	unknown	
	SB_{2010}/SB_0:	unknown	

[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.
[3]Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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 longtail tuna in the Indian Ocean, noting that there remains considerable uncertainty about stock structure and about the total catches.

Stock status. No quantitative stock assessment is currently available for longtail tuna in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore stock status remains *uncertain* (Table 1). However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern.

Outlook. The continued increase of annual catches for longtail tuna in recent years has further increased the pressure on the Indian Ocean stock as a whole, however there is not sufficient information to evaluate the effect this will have on the resource. The apparent fidelity of longtail tuna to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis on improving indicators and exploration of stock structure and stock assessment approaches for data poor fisheries are warranted.

The SC **RECOMMENDED** the following:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches urgently need to be reviewed.
- improvement in data collection and reporting is required to assess the stock.

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

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

- Resolution 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area*.
- Resolution 09/02 *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 10/03 *concerning the recording of catch by fishing vessels in the IOTC area*.
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence*.

FISHERIES INDICATORS

General

Longtail tuna (*Thunnus tonggol*) is an oceanic species that forms schools of varying sizes. It is most abundant over areas of broad continental shelf. Table 2 outlines some key life history parameters relevant for management.

TABLE 2. Biology of Indian Ocean longtail tuna (*Thunnus tonggol*).

Parameter	Description
Range and stock structure	An oceanic species that forms schools of varying sizes. It is most abundant over areas of broad continental shelf. Feeds on a variety of fish, cephalopods, and crustaceans, particularly stomatopod larvae and prawns. No information is available on the stock structure of longtail tuna in the Indian Ocean.
Longevity	~20 years
Maturity (50%)	**Age**: n.a.; females n.a. males n.a. **Size:** females and males ~40 cm FL (Pacific Ocean).
Spawning season	The spawning season varies according to location. Off the west coast of Thailand there are two distinct spawning seasons: January-April and August-September.
Size (length and weight)	Maximum: Females and males 145 cm FL; weight 35.9 kgs. Most common size in Indian Ocean ranges 40–70 cm. Grows rapidly to reach 40–46 cm in FL by age 1.

n.a. = not available. SOURCES: Froese & Pauly (2009); Griffiths et al. (2010a, b); Kaymaran et al. (2011)

Longtail tuna – Catch trends

Longtail tuna is caught mainly using gillnets and, to a lesser extent, purse seine and trolling (Fig. 1). The catch estimates for longtail tuna were derived from small amounts of information and are therefore uncertain. Estimated catches of longtail tuna increased steadily from the mid 1950's, reaching around 20,000 t in the mid-1970's and over 50,000 t by the mid-1980's. Catches reached record levels in 2010, at 141,937 t (preliminary estimate). The average annual catch estimated for the period 2006–2010 is 115,973 t (Table 3).

In recent years, the countries attributed with the highest catches of longtail tuna are the I.R. Iran (34%) and Indonesia (31%) and, to a lesser extent, Oman, Pakistan, Malaysia and India (22%) (Fig. 2). In particular, I.R. Iran has reported large increases in the catch of longtail tuna in 2009 and 2010. This may be the consequence of increased drifting gillnet effort in coastal waters due to the threat of Somali piracy in the western tropical Indian Ocean.

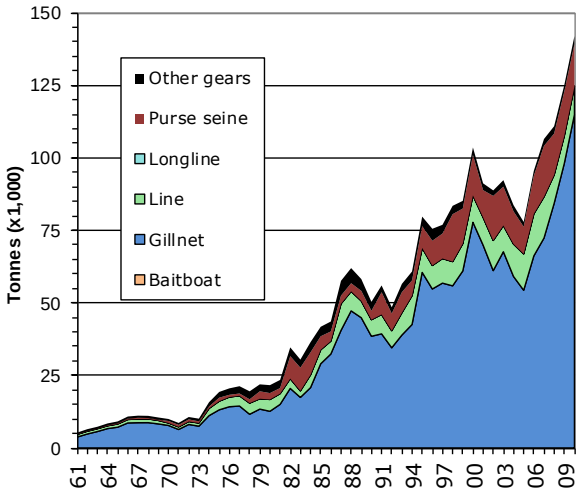


Fig. 1. Longtail tuna: Catches by gear recorded in the IOTC Database (1961–2010).

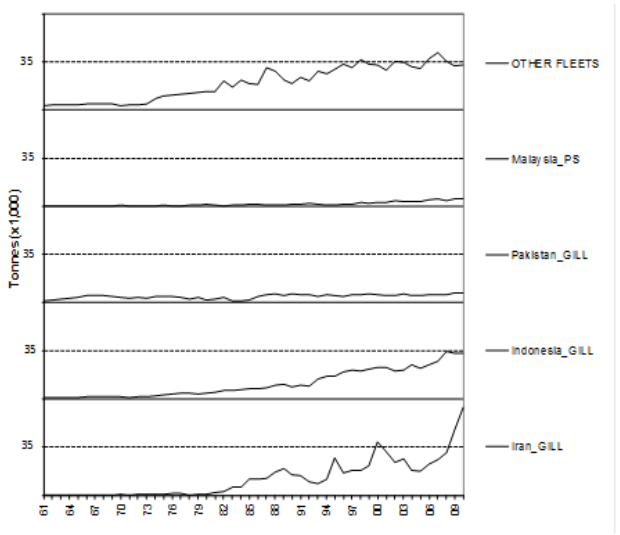


Fig. 2. Longtail tuna: Catches recorded in the IOTC Database for main fishing fleets (1961–2010).

TABLE 3. Best scientific estimates of the catches of longtail tuna by type of fishery for the period 1950–2010 (in metric tonnes). Data as of October 2011.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Purse seine	44	204	980	4,448	8,191	13,912	9,317	15,347	13,367	11,222	9,332	13,105	17,550	14,232	15,197	14,551
Gillnet	2,963	6,761	11,355	29,466	48,717	77,932	70,082	61,269	68,265	59,575	54,711	66,547	72,788	84,711	98,522	115,319
Line	846	1,089	2,379	4,898	7,887	9,278	9,599	10,425	9,053	11,209	12,552	14,527	14,243	9,849	9,530	9,758
Other	290	489	1,054	2,164	2,500	2,428	2,196	1,710	1,603	1,665	1,290	1,338	1,890	2,092	1,807	2,309
Total	**4,143**	**8,544**	**15,767**	**40,976**	**67,294**	**103,550**	**91,193**	**88,751**	**92,288**	**83,671**	**77,884**	**95,518**	**106,472**	**110,883**	**125,056**	**141,937**

Longtail tuna – Uncertainty of catches

Retained catches are uncertain (Fig. 3), notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of longtail tuna by species or by gear for 1950–2004; catches of longtail tuna, kawakawa and other species were reported aggregated for this period. The IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004 by gear and species. The Indonesian catches estimated for longtail tuna represent more than 30% of the total catches of this species in the Indian Ocean in recent years.
- Artisanal fisheries of India and Oman: Although these countries report catches of longtail tuna, until recently the catches have not been reported by gear. The IOTC Secretariat used alternative information to assigning the catches reported by species. The catches of longtail tuna that had to be allocated by gear represented 12% of the total catches of this species in recent years.
- Artisanal fisheries of Mozambique, Myanmar, and Somalia: None of these countries have reported catches to the IOTC Secretariat. Catch levels are unknown but are not considered large.
- Other artisanal fisheries: The IOTC Secretariat estimated catches of longtail tuna for the artisanal fisheries of Yemen (no data reported to the IOTC Secretariat) and Malaysia (catches not reported by species). The catches estimated for longtail tuna represent 9% of the total catches of this species in recent years.
- Discard levels are believed to be very low although they are unknown for most fisheries.
- Changes to the catch series: There have been significant changes to the catches of longtail tuna since December 2010, following two reviews of catches for the coastal fisheries of India and, to a lesser extent, Indonesia, involving marked changes in catches by species. The new catches estimated are markedly lower than those previously recorded representing overall 65% and 75% of the catches recorded in the past for India and Indonesia, respectively.

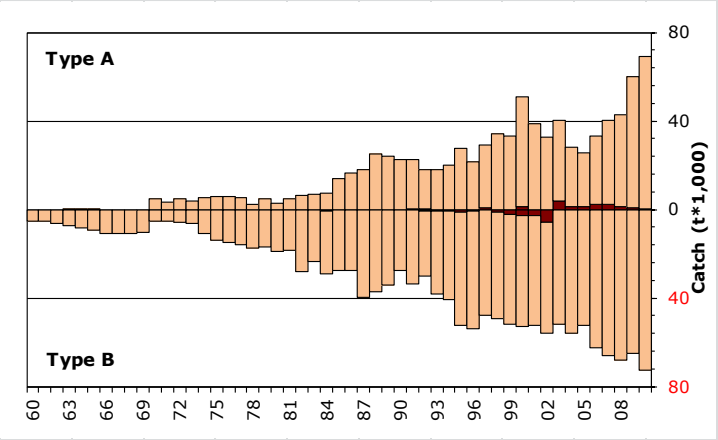


Fig. 3. Longtail tuna: Uncertainty of annual catch estimates (1961–2010) (Data as of October 2011).
*Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.*

Longtail tuna – Effort trends

Effort trends are unknown for longtail tuna in the Indian Ocean.

Longtail tuna – Catch–per–unit–effort (CPUE) trends

Standardised CPUE series have not yet been developed. Nominal CPUE series are however available from some fisheries but they are considered highly incomplete. In most cases catch-and-effort data are only available for short periods of time. Reasonably long catch and effort series (extending for more than 10 years) are only available for Thailand small purse seines and gillnets (Fig. 4). No catch and effort data are available from sports fisheries, other than for partial data from the sports fisheries of Kenya.

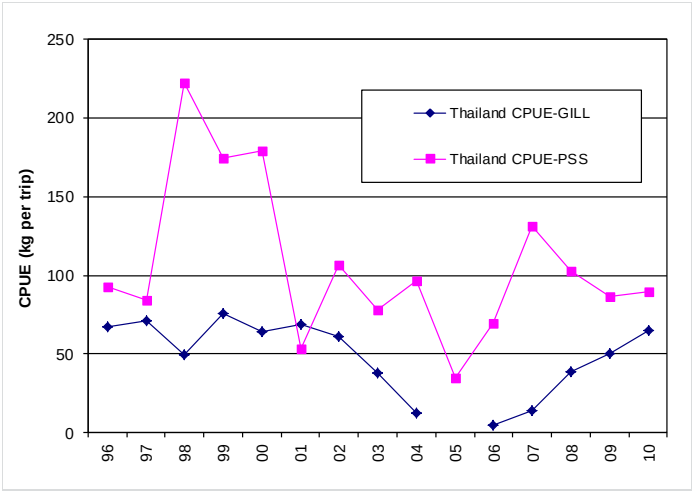


Fig. 4. Longtail tuna: Nominal CPUE series for the gillnet (GILL) and coastal purse seine (PSS) fisheries of Thailand derived from the available catches and effort data (1996–2010).

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

- The size of longtail tuna taken by the Indian Ocean fisheries typically ranges between 15–120 cm depending on the type of gear used, season and location. The fisheries operating in the Andaman Sea (coastal purse seines and troll lines) tend to catch longtail tuna of small size (15–55cm) while the drifting gillnet fisheries operating in the Arabian Sea catch larger specimens (40–100cm).
- Trends in average weight can only be assessed for I.R. Iran drifting gillnets but the amount of specimens measured has been very low in recent years. The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme). Unfortunately, data collection did not continue after the end of the IPTP activities.
- Catch-at-Size(Age) tables are not available for the longtail tuna due to the paucity of size data available from most fleets and the uncertain status of the catches for this species.

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

STOCK ASSESSMENT

No quantitative stock assessment for longtail tuna in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Neritic Tunas. However, a preliminary estimation of stock indicators was attempted on the catch and effort datasets from the Thailand gillnet and purse seine fisheries (described above). However, there is considerable uncertainty about the degree to which this and other indicators represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends. Further work must be undertaken to derive additional stock indicators for this species, because in the absence of a quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing.

TABLE 4. Longtail tuna (*Thunnus tonggol*) stock status summary.

Management Quantity	Aggregate Indian Ocean
2010 catch estimate	114,900 t
Mean catch from 2006–2010	116,000 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2010}/F_{MSY} (80% CI)	–
B_{2010}/B_{MSY} (80% CI)	–
SB_{2010}/SB_{MSY}	–
B_{2010}/B_0 (80% CI)	–
SB_{2010}/SB_0	–
$B_{2010}/B_{0,\ F=0}$	–
$SB_{2010}/SB_{0,\ F=0}$	–

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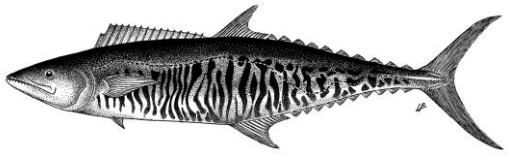
APPENDIX C
EXECUTIVE SUMMARY: NARROW-BARRED SPANISH MACKEREL

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



Status of the Indian Ocean narrow-barred Spanish mackerel resource (*Scomberomorus commerson*)

TABLE 1. Status of narrow-barred Spanish mackerel (*Scomberomorus commerson*) in the Indian Ocean.

Area[1]	**Indicators – 2011 assessment**		**2011 stock status determination**
			2010[2]
Indian Ocean	Catch[3] 2010:	124,107 t	**UNCERTAIN**
	Average catch[3] 2006–2010:	116,444 t	
	MSY:	unknown	
	F_{2010}/F_{MSY}:	unknown	
	SB_{2010}/SB_{MSY}:	unknown	
	SB_{2010}/SB_0:	unknown	

[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.
[3]Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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 narrow-barred Spanish mackerel in the Indian Ocean noting that there remains considerable uncertainty about stock structure and about the total catches.

Stock status. No quantitative stock assessment is currently available for narrow-barred Spanish mackerel in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore stock status remains *uncertain* (Table 1). However, aspects of the fisheries for this species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern. Although indicators from the Gulf and Oman Sea suggest that overfishing is occurring in this area, the degree of connectivity with other regions remains unknown.

Outlook. The continued increase of annual catches for narrow-barred Spanish mackerel in recent years has further increased the pressure on the Indian Ocean stock as a whole, however there is not sufficient information to evaluate the effect this will have on the resource. The apparent fidelity of narrow-barred Spanish mackerel to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis on improving indicators and exploration of stock structure and stock assessment approaches for data poor fisheries are warranted.

The SC **RECOMMENDED** the following:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches urgently need to be reviewed.
- improvement in data collection and reporting is required to assess the stock.

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Narrow-barred Spanish mackerel (*Scomberomorus commerson*) in the Indian Ocean is currently subject to a number of conservation and management measures adopted by the Commission, although none are species specific:

- Resolution 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area*.
- Resolution 09/02 *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 10/03 *concerning the recording of catch by fishing vessels in the IOTC area*.
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence*.

FISHERIES INDICATORS

General

The narrow-barred Spanish mackerel (*Scomberomorus commerson*) is a pelagic, top level predator found throughout tropical marine waters of the Indo-West Pacific. Table 2 outlines some key life history parameters relevant for management.

TABLE 2. Biology of Indian Ocean narrow-barred Spanish mackerel (*Scomberomorus commerson*).

Parameter	Description
Range and stock structure	A pelagic, top level predator found throughout tropical marine waters of the Indo-West Pacific. Juveniles inhabit shallow inshore areas whereas adults are found in coastal waters out to the continental shelf. Adults are usually found in small schools but often aggregate at particular locations on reefs and shoals to feed and spawn. Appear to undertake lengthy migrations. Feed primarily on small fishes such as anchovies, clupeids, carangids, also squids and shrimps. Genetic studies carried out on *S. commerson* from Djibouti, Oman and U.A.E. showed there were small genetic differences among stocks in these three places.
Longevity	~16 years
Maturity (50%)	**Age**: n.a.; females n.a. males n.a. **Size:** females ~81 cm FL and males ~52 cm FL.
Spawning season	Females are multiple spawners. Year-round spawning has been observed in east African waters, with peaks during late spring to summer (April-July) and autumn (September-November) coinciding with the two seasonal monsoons which generate high abundances of plankton and small pelagic fish.
Size (length and weight)	Maximum: Females and males 240 cm FL; weight 70 kgs.

n.a. = not available. SOURCES: Grandcourt et al. (2005); Froese & Pauly (2009); Darvishi et al. (2011)

Narrow-barred Spanish mackerel – Catch trends

Narrow-barred Spanish mackerel is targeted throughout the Indian Ocean by artisanal and recreational fishers. The main method of capture is gillnet, but significant numbers of are also caught trolling (Fig. 1).

The catch estimates for narrow-barred Spanish mackerel were derived from very small amounts of information and are therefore highly uncertain. The catches of narrow-barred Spanish mackerel increased from around 50,000 t the mid-1970's to over 100,000 t by the mid-1990's. The highest catches of Spanish mackerel were recorded in 2010, amounting to 124,107 t. In recent years, catches have been increasing, with average annual catches for 2006–2010 estimated to be at around 116,444 t (Table 3). Narrow-barred Spanish mackerel is caught in both Indian Ocean basins, with higher catches recorded in the West.

In recent years, the countries attributed with the highest catches of Spanish mackerel are India (29%) and Indonesia (23%) and, to a lesser extent, Iran, Pakistan, and Madagascar (20%) (Fig. 2).

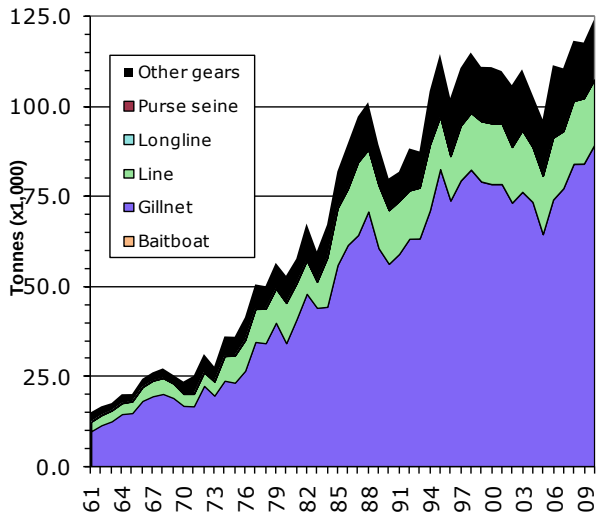


Fig. 1. Narrow-barred Spanish mackerel: Catches by gear recorded in the IOTC Database (1961–2010).

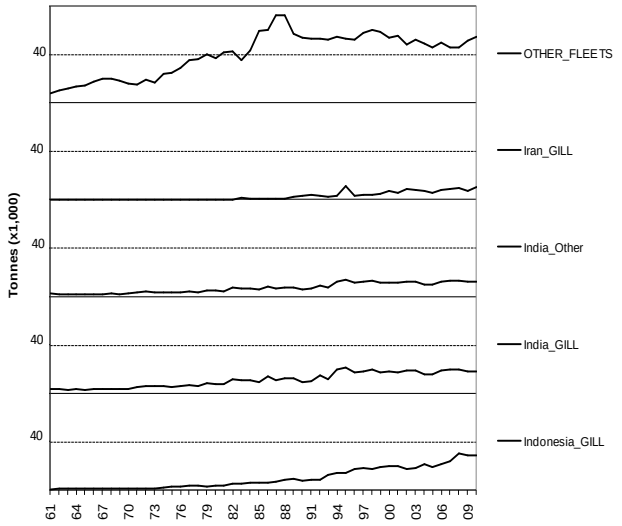


Fig. 2. Narrow-barred Spanish mackerel: Catches recorded in the IOTC Database for main fishing fleets (1961–2010).

TABLE 3. Best scientific estimates of the catches of narrow-barred Spanish mackerel by type of fishery for the period 1950–2010 (in metric tonnes). Data as of October 2011.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Purse seine	0	0	237	1,141	2,571	1,782	1,404	1,928	2,325	1,590	2,116	3,926	1,877	1,951	1,920	2,874
Gillnet	7,164	15,184	26,883	54,952	71,418	78,404	78,408	73,231	76,410	73,571	64,618	74,173	77,371	84,124	84,225	89,352
Line	2,330	3,350	6,529	13,733	14,964	16,823	16,773	15,420	17,023	15,214	16,145	17,137	15,811	17,394	18,099	18,045
Other	1,368	2,012	4,255	6,635	10,616	13,932	13,264	15,354	14,566	12,996	13,537	16,239	15,547	14,793	13,527	13,836
Total	**10,862**	**20,546**	**37,904**	**76,462**	**99,570**	**110,941**	**109,849**	**105,933**	**110,324**	**103,370**	**96,416**	**111,475**	**110,605**	**118,262**	**117,770**	**124,107**

Narrow-barred Spanish mackerel – uncertainty of catches

Retained catches are uncertain (Fig. 3), notably for the following fisheries:

- Artisanal fisheries of India and Indonesia: India and Indonesia have only recently reported catches of narrow-barred Spanish mackerel by gear, including catches by gear for the years 2005–2008 and 2007–2008, respectively. In both cases, the IOTC Secretariat used the catches reported by gear to break previous catches of this species by gear. The catches of narrow-barred Spanish mackerel estimated for this component represent more than 52% of the total catches of this species in recent years.
- Artisanal fisheries of Madagascar: Madagascar has never reported catches of narrow-barred Spanish mackerel to the IOTC Secretariat. During 2010 the IOTC Secretariat conducted a review aiming to break the catches recorded in the FAO database as narrow-barred Spanish mackerel by species, on the assumption that all catches of nertitic tunas had been combined under this name. The new catches estimated are thought to be very uncertain.
- Artisanal fisheries of Mozambique, Myanmar and Somalia: None of these countries have ever reported catches to the IOTC Secretariat. Catch levels are unknown.
- Other artisanal fisheries: Oman and the United Arab Emirates do not report catches of narrow-barred Spanish mackerel by gear. Although most of the catches are believed to be taken by gillnets, some fish may be also caught by using small surrounding nets, lines or other artisanal gears. Thailand and Malaysia report catches of narrow-barred Spanish mackerel and Indo-Pacific king mackerel aggregated.
- All fisheries: In some cases the catches of seerfish species are mislabelled, the catches of Indo-Pacific king mackerel and, to a lesser extent, other seerfish species, labelled as narrow-barred Spanish mackerel. Similarly, the catches of wahoo in some longline fisheries are thought to be mislabelled as narrow-barred Spanish mackerel. This mislabelling is thought to have little impact in the case of the narrow-barred Spanish mackerel but may be important for other seerfish species.
- Discard levels are believed to be low although they are unknown for most fisheries.
- Changes to the catch series: The catch series of narrow-barred Spanish mackerel has changed since those estimated in 2010, following reviews of catches for the coastal fisheries in Indonesia and India, involving marked changes in catches by species. Overall, the new catches estimated represent the 98% of those recorded in the past.

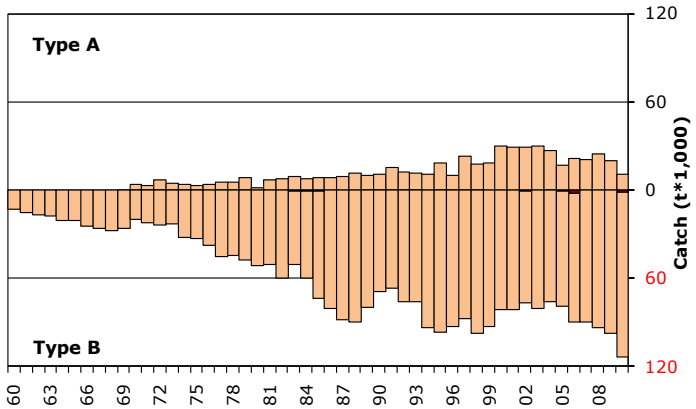


Fig. 3. Narrow-barred Spanish mackerel: Uncertainty of annual catch estimates (1960–2010) (Data as of November 2011).
Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (Type A) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Narrow-barred Spanish mackerel – Effort trends

Effort trends are unknown for narrow-barred Spanish mackerel in the Indian Ocean.

Narrow-barred Spanish mackerel – Catch–per–unit–effort (CPUE) trends

Standardised CPUE series have not yet been developed. Nominal CPUE series are however available from some fisheries but they are considered highly incomplete. In most cases catch-and-effort data are only available for short periods. Reasonably long catch-and-effort data series (extending for more than 10 years) are only available for Sri Lanka gillnets (Fig. 4). The catches and effort recorded are, however, thought to be unrealistic due to the dramatic changes in CPUE recorded in 2003 and 2004.

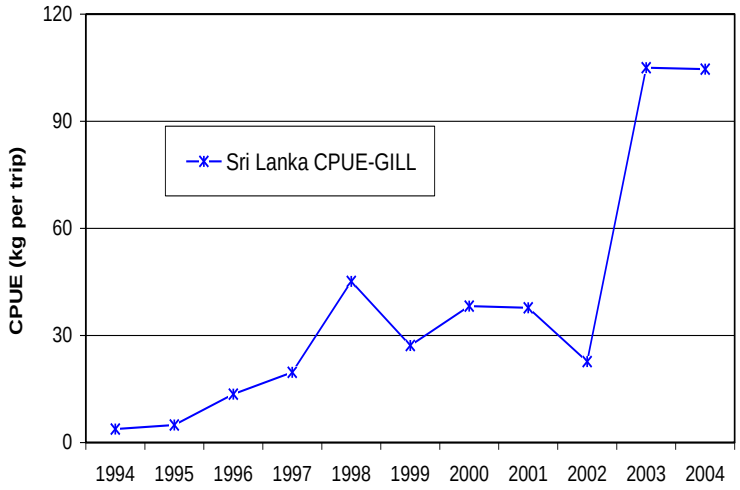


Fig. 4. Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004).

Narrow-barred Spanish mackerel – Fish size or age trends (e.g. by length, weight, sex and/or maturity)

- The size of narrow-barred Spanish mackerel taken by the Indian Ocean fisheries typically ranges between 30–140 cm depending on the type of gear used, season and location. The size of narrow-barred Spanish mackerel taken varies by location with 32–119 cm fish taken in the Eastern Peninsular Malaysia area, 17–39 cm fish taken in the East Malaysia area and 50–90 cm fish taken in the Gulf of Thailand. Similarly, Spanish mackerel caught in the Oman Sea are typically larger than those caught in the Persian Gulf.
- Trends in average weight can only be assessed for Sri Lankan gillnets but the amount of specimens measured has been very low in recent years. The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme). Unfortunately, data collection did not continue after the IPTP activities came to an end.

- Catch-at-Size(Age) tables are not available for narrow-barred Spanish mackerel due to the paucity of size data available from most fleets and the uncertain status of the catches for this species.
- Sex ratio data have not been provided to the Secretariat by CPCs.

STOCK ASSESSMENT

No quantitative stock assessment for narrow-barred Spanish mackerel in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Neritic Tunas. However, a preliminary estimation of stock indicators was attempted on the catch and effort datasets from the Sri Lankan gillnet fishery (described above). However, there is considerable uncertainty about the degree to which this and other indicators represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends. Further work must be undertaken to derive additional stock indicators for this species, because in the absence of a quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing.

TABLE 4. Narrow-barred Spanish mackerel (*Scomberomorus commerson*) stock status summary.

Management Quantity	Aggregate Indian Ocean
2010 catch estimate	124,100 t
Mean catch from 2006–2010	116,400 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2010}/F_{MSY} (80% CI)	–
B_{2010}/B_{MSY} (80% CI)	–
SB_{2010}/SB_{MSY}	–
B_{2010}/B_0 (80% CI)	–
SB_{2010}/SB_0	–
$B_{2010}/B_{0,\ F=0}$	–
$SB_{2010}/SB_{0,\ F=0}$	–

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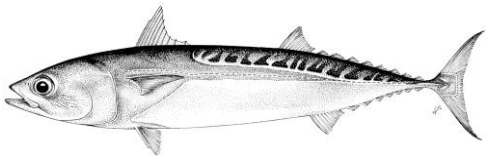
APPENDIX D
EXECUTIVE SUMMARY: BULLET TUNA

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



Status of the Indian Ocean Bullet tuna Resource (*Auxis rochei*)

TABLE 1. Status of bullet tuna (*Auxis rochei*) in the Indian Ocean.

Area[1]	**Indicators – 2011 assessment**		**2011 stock status determination**
			2010[2]
Indian Ocean	Catch[3] 2010:	4,188 t	**UNCERTAIN**
	Average catch[3] 2006–2010:	2,884 t	
	MSY:	unknown	
	F_{2010}/F_{MSY}:	unknown	
	SB_{2010}/SB_{MSY}:	unknown	
	SB_{2010}/SB_0:	unknown	

[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.
[3]Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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 bullet tuna in the Indian Ocean noting that there remains considerable uncertainty about stock structure and about the total catches.

Stock status. No quantitative stock assessment is currently available for bullet tuna in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore stock status remains *uncertain* (Table 1). However, aspects of the fisheries for this species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern.

Outlook. The continued increase of annual catches for bullet tuna is likely to have further increased the pressure on the Indian Ocean stock as a whole, however there is not sufficient information to evaluate the effect this will have on the resource. Research emphasis on improving indicators and exploration of stock structure and stock assessment approaches for data poor fisheries are warranted.

The SC **RECOMMENDED** the following:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches urgently need to be reviewed.
- improvement in data collection and reporting is required to assess the stock.

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Bullet tuna (*Auxis rochei*) in the Indian Ocean is currently subject to a number of conservation and management measures adopted by the Commission, although none are species specific:

- Resolution 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area*.

- Resolution 09/02 *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 10/03 *concerning the recording of catch by fishing vessels in the IOTC area*.
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence*.

FISHERIES INDICATORS

General

Bullet tuna (*Auxis rochei*) is an oceanic species found in the equatorial areas of the major oceans. It is a highly migratory species with a strong schooling behaviour. Table 2 outlines some key life history parameters relevant for management.

TABLE 2. Biology of Indian Ocean bullet tuna (*Auxis rochei*).

Parameter	Description
Range and stock structure	Little is known on the biology of bullet tuna in the Indian Ocean. An oceanic species found in the equatorial areas of the major oceans. It is a highly migratory species with a strong schooling behaviour. Adults are principally caught in coastal waters and around islands that have oceanic salinities. No information is available on the stock structure in Indian Ocean. Bullet tuna feed on small fishes, particularly anchovies, crustaceans (commonly crab and stomatopod larvae) and squids. Cannibalism is common. Because of their high abundance, bullet tunas are considered to be an important prey for a range of species, especially the commercial tunas.
Longevity	Females n.a; Males n.a.
Maturity (50%)	**Age**: 2 years; females n.a. males n.a. **Size:** females and males ~35 cm FL.
Spawning season	It is a multiple spawner with fecundity ranging between 31,000 and 103,000 eggs per spawning (according to the size of the fish). Larval studies indicate that bullet tuna spawn throughout its range.
Size (length and weight)	Maximum: Females and males 50 cm FL; weight n.a.

n.a. = not available. SOURCES: Froese & Pauly (2009)

Bullet tuna – Catch trends

Bullet tuna is caught mainly using gillnet, handline, and trolling gears across the broader Indian Ocean area (Fig. 1). This species is also an important catch for artisanal purse seiners. The catch estimates for bullet tuna were derived from very small amounts of information and are therefore highly uncertain.

Estimated catches of bullet tuna reached around 1,000 t in the early 1990's, increasing markedly in the following years to reach a peak in 1998, at around 2,800 t. The catches decreased sharply in the following years and remained at values of around 2,000 t until the mid-2000's, to increase again sharply up to the 4,188 t recorded in 2010, the highest catches ever recorded for this species (Table 3). The average annual catch estimated for the period 2006 to 2010 is 2,884 t (Table 3). However, the high catches of bullet tuna recorded since 2006, compared to previous years, are thought to be unrealistic. The difference in catches may come from improved identification of specimens of frigate tuna and bullet tuna in recent years, leading to higher catches of bullet tuna reported to the IOTC. Bullet tuna and frigate tuna are very similar and mislabelling is thought to be overspread. In recent years, the countries attributed with the highest catches of bullet tuna are Sri Lanka and India (Fig. 2).

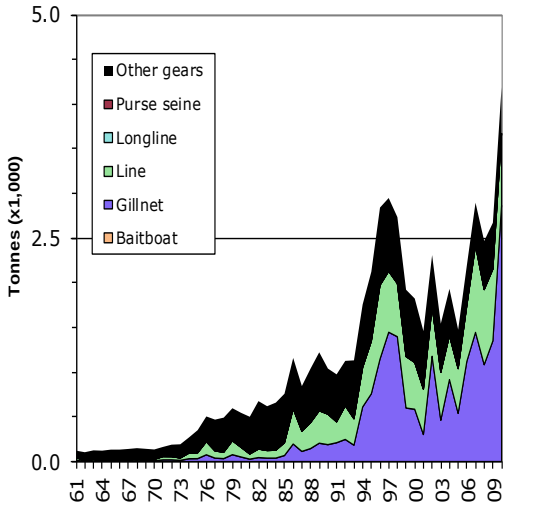


Fig. 1. Bullet tuna: Catches of by gear recorded in the IOTC Database (1961–2010).

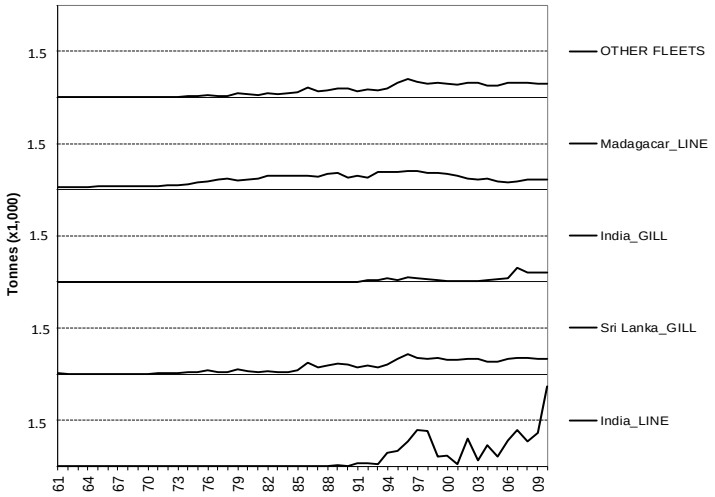


Fig. 2. Bullet tuna: Catches recorded in the IOTC Database for main fishing fleets (1960–2010).

TABLE 3. Best scientific estimates of the catches of bullet tuna by type of fishery for the period 1950–2010 (in metric tonnes). Data as of October 2011.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Purse seine	0	3	10	81	151	194	184	205	204	165	165	204	208	209	194	194
Gillnet	5	8	36	94	680	586	303	1179	463	918	540	1,121	1,447	1,084	1,351	2,866
Line	11	16	71	186	497	525	509	560	537	495	501	626	974	841	804	804
Other	61	103	221	443	533	520	464	367	339	355	270	242	268	335	323	323
Total	**78**	**129**	**337**	**803**	**1,861**	**1,825**	**1,460**	**2,311**	**1,543**	**1,933**	**1,476**	**2,193**	**2,897**	**2,469**	**2,673**	**4,188**

Bullet tuna – Uncertainty of catches

Retained catches are highly uncertain (Fig. 3), for all fisheries:

- Aggregation: Bullet tunas are usually not reported by species, being aggregated with frigate tunas or, less frequently, other small tuna species.
- Mislabelling: Bullet tunas are usually mislabelled as frigate tuna, their catches reported under the latter species.
- Under reporting: the catches of bullet tuna by industrial purse seiners are rarely, if ever, reported.

It is for the above reasons that the catches of bullet tuna in the IOTC database are thought to represent only a small fraction of the total catches of this species in the Indian Ocean. In particular, catches reported by India in recent years are unreliable and need to be verified.

- Discard levels are moderate for industrial purse seine fisheries. The EU recently reported discard levels of bullet tuna for its purse seine fleet, for 2003–2008, estimated using observer data.
- Changes to the catch series: The catch series of bullet tuna has changed substantially since estimates made in 2010, following reviews of catches for the coastal fisheries in Indonesia and, to a lesser extent India, involving marked changes in catches by species.

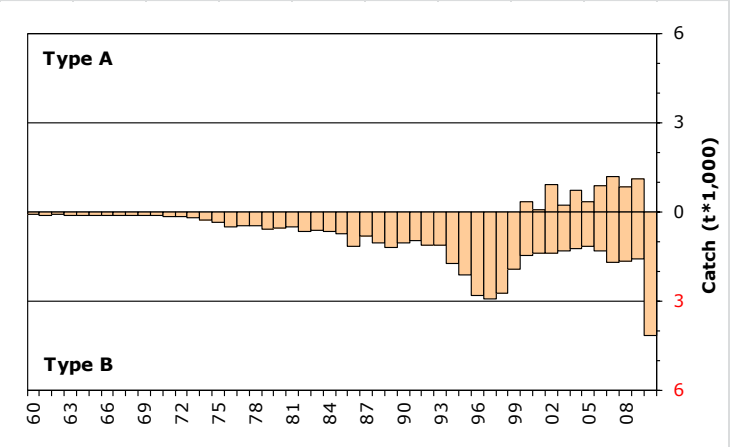


Fig. 3. Bullet tuna: Uncertainty of annual catch estimates (1960–2010) (Data as of October 2011).
Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (Type A) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Bullet tuna – Effort trends

Effort trends are unknown for bullet tuna in the Indian Ocean.

Bullet tuna – Catch–per–unit–effort (CPUE) trends

Standardised CPUE series have not yet been developed. Nominal CPUE series are however available from some fisheries but they are considered highly incomplete and are usually considered to be of poor quality for the fisheries having reasonably long catch-and-effort data series, as it is the case with the gillnet fisheries of Sri Lanka (Fig. 4).

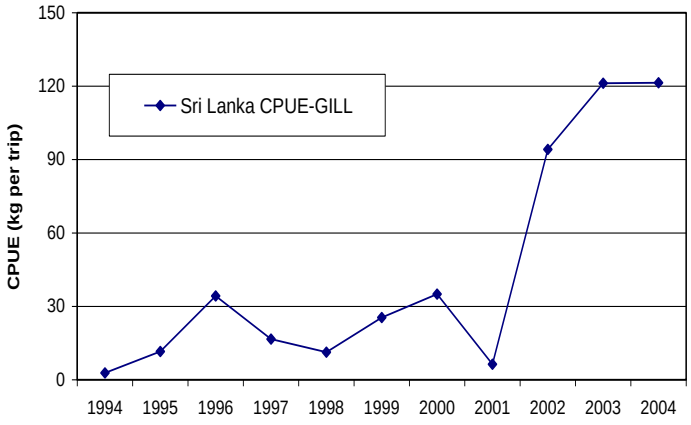


Fig. 4. Bullet tuna: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004).

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

- The size of bullet tuna taken by the Indian Ocean fisheries typically ranges between 13–48 cm depending on the type of gear used, season and location.
- Trends in average weight cannot be assessed for most fisheries. Reasonable long series of length frequency data are only available for Sri Lankan gillnets and lines but the amount of specimens measured has been very low in recent years.
- Catch-at-Size(Age) tables are not available for bullet tuna due to the paucity of size data available from most fleets and the uncertain status of the catches for this species.
- Sex ratio data have not been provided to the Secretariat by CPCs.

STOCK ASSESSMENT

No quantitative stock assessment for bullet tuna in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Neritic Tunas. However, a preliminary estimation of stock indicators was attempted on the catch and effort datasets from the Sri Lankan gillnet fleet (described above). However, there is considerable uncertainty about the degree to which this and other indicators represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends. Further work must be undertaken to derive additional stock indicators for this species, because in the absence of a quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing.

TABLE 4. Bullet tuna (*Auxis rochei*) stock status summary.

Management Quantity	Aggregate Indian Ocean
2010 catch estimate	4,200 t
Mean catch from 2006–2010	2,900 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2010}/F_{MSY} (80% CI)	–
B_{2010}/B_{MSY} (80% CI)	–
SB_{2010}/SB_{MSY}	–
B_{2010}/B_0 (80% CI)	–
SB_{2010}/SB_0	–
$B_{2010}/B_{0,\ F=0}$	–
$SB_{2010}/SB_{0,\ F=0}$	–

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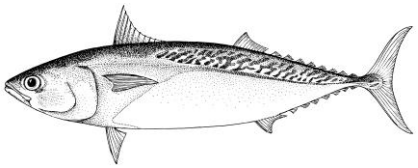
APPENDIX E
EXECUTIVE SUMMARY: FRIGATE TUNA

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



Status of the Indian Ocean Frigate tuna resource (*Auxis thazard*)

TABLE 1. Status of frigate tuna (*Auxis thazard*) in the Indian Ocean.

Area[1]	**Indicators – 2011 assessment**		**2011 stock status determination**
			2010[2]
Indian Ocean	Catch[3] 2010:	71,023 t	**UNCERTAIN**
	Average catch[3] 2006–2010:	64,245 t	
	MSY:	unknown	
	F_{2010}/F_{MSY}:	unknown	
	SB_{2010}/SB_{MSY}:	unknown	
	SB_{2010}/SB_0:	unknown	

[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.
[3]Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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 frigate tuna in the Indian Ocean noting that there remains considerable uncertainty about stock structure and about the total catches.

Stock status. No quantitative stock assessment is currently available for frigate tuna in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore stock status remains *uncertain* (Table 1). However, aspects of the fisheries for this species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern.

Outlook. The continued increase of annual catches for frigate tuna is likely to have further increased the pressure on the Indian Ocean stock as a whole, however there is not sufficient information to evaluate the effect this will have on the resource. Research emphasis on improving indicators and exploration of stock structure and stock assessment approaches for data poor fisheries are warranted.

The SC **RECOMMENDED** the following:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches urgently need to be reviewed.
- improvement in data collection and reporting is required to assess the stock.

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Frigate tuna (*Auxis thazard*) in the Indian Ocean is currently subject to a number of conservation and management measures adopted by the Commission, although none are species specific:

- Resolution 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area*.
- Resolution 09/02 *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 10/03 *concerning the recording of catch by fishing vessels in the IOTC area*.
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence*.

FISHERIES INDICATORS

General

Frigate tuna (*Auxis thazard*) is a highly migratory species found in both coastal and oceanic waters. It is highly gregarious and often schools with other Scombrids. Table 2 outlines some key life history parameters relevant for management.

TABLE 2. Biology of Indian Ocean frigate tuna (*Auxis thazard*).

Parameter	Description
Range and stock structure	Little is known on the biology of frigate tuna in the Indian Ocean. Highly migratory species found in both coastal and oceanic waters. It is highly gregarious and often schools with other Scombrids. Frigate tuna feeds on small fish, squids and planktonic crustaceans (e.g. decapods and stomatopods). Because of their high abundance, frigate tuna are considered to be an important prey for a range of species, especially the commercial tunas. No information is available on the stock structure of frigate tuna in Indian Ocean.
Longevity	Females n.a; Males n.a.
Maturity (50%)	**Age**: n.a.; females n.a. males n.a. **Size:** females and males ~29–35 cm FL.
Spawning season	In the southern Indian Ocean, the spawning season extends from August to April whereas north of the equator it is from January to April. Fecundity ranges between 200,000 and 1.06 million eggs per spawning (depending on size).
Size (length and weight)	Maximum: Females and males 60 cm FL; weight n.a.

n.a. = not available. SOURCES: Froese & Pauly (2009)

Frigate tuna – Catch trends

Frigate tuna is taken from across the Indian Ocean area using drifting gillnets, pole-and-lines, handlines and trolling (Fig. 1). This species is also an important bycatch for industrial purse seiners and is the target of some ring net fisheries. The catch estimates for frigate tuna were derived from very small amounts of information and are therefore highly uncertain.

Estimated catches have increased steadily since the late 1970's, reaching around 15,000 t in the early 1980's and over 45,000 t by the mid-1990's. Catches increased markedly from 2006 and have been in excess of 65,000 t from 2008 (Fig. 2). The average annual catch estimated for the period 2006 to 2010 is 64,245 t with the highest catches recorded in 2010 of 71,023 t (Table 3).

In recent years, the countries attributed with the highest catches are Indonesia (60%), India (17%), I.R. Iran (8%) and the Maldives (6%).

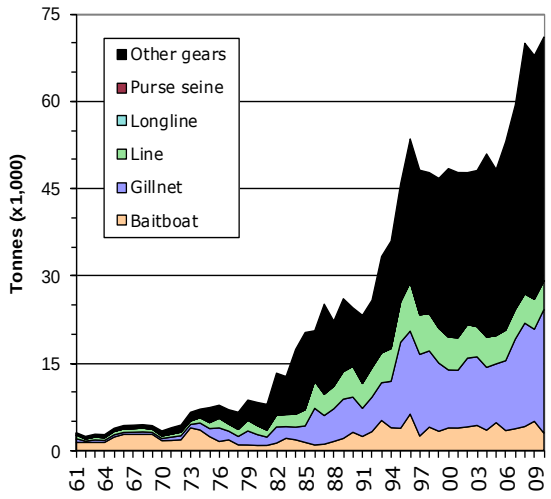


Fig. 1. Frigate tuna: Catches by gear recorded in the IOTC Database (1961–2010).

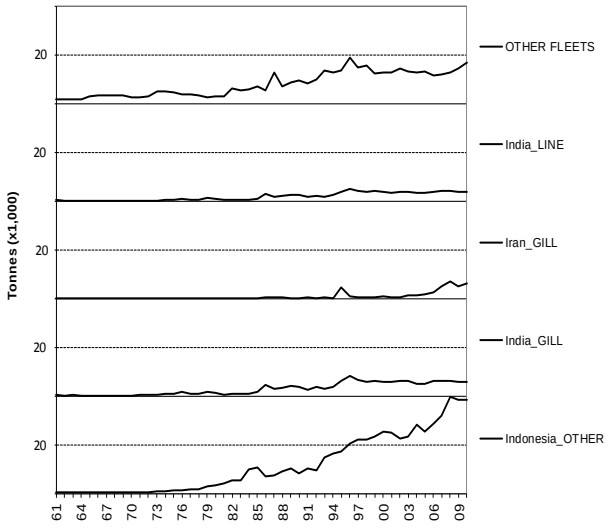


Fig. 2. Frigate tuna: Catches recorded in the IOTC Database for main fishing fleets (1961–2010).

TABLE 3. Best scientific estimates of the catches of frigate tuna by type of fishery for the period 1950–2010 (in metric tonnes). Data as of October 2011.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Purse seine	0	12	895	7,260	16,206	26,427	26,124	24,302	25,149	29,707	27,186	31,173	33,847	41,434	40,262	40,294
Gillnet	265	406	1,268	3,713	9,958	9,978	9,949	11,840	11,816	10,830	10,156	12,051	15,390	17,758	15,864	21,291
Line	372	560	1,015	2,889	5,997	5,653	5,592	5,778	5,197	5,214	4,867	5,257	5,088	5,046	5,169	4,919
Other	1,721	2,477	3,088	3,514	6,319	6,360	6,081	5,808	5,926	5,186	6,074	4,576	5,017	5,715	6,555	4,519
Total	**2,358**	**3,456**	**6,265**	**17,376**	**38,479**	**48,419**	**47,746**	**47,728**	**48,089**	**50,938**	**48,283**	**53,057**	**59,342**	**69,954**	**67,849**	**71,023**

Frigate tuna – Uncertainty of catches

Retained catches are uncertain (Fig. 3), notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of frigate tuna by species or by gear for 1950–2004; catches of frigate tuna, bullet tuna and other species were reported aggregated for this period. The IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004 by gear and species. The Indonesian catches estimated for frigate tuna represent around 60% of the total catches of this species in the Indian Ocean in recent years.
- Artisanal fisheries of India: Although India reports catches of frigate tuna they are not always reported by gear. The IOTC Secretariat has allocated the catches of frigate tuna by gear for years in which this information was not available. In recent years, the catches of frigate tuna in India have represented 17% of the total catches of this species in the Indian Ocean.
- Artisanal fisheries of Mozambique, Myanmar and Somalia: None of these countries have reported catches to the IOTC Secretariat, thus catch levels are unknown.
- Other artisanal fisheries: The catches of frigate tuna and bullet tuna are seldom reported by species and, when reported by species, they usually refer to both species (due to mislabelling, with all catches assigned to the frigate tuna).
- Industrial fisheries: The catches of frigate tuna recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, its catches are seldom recorded in the logbooks, nor can they be monitored in port. The EU recently reported catch levels of frigate tuna for its purse seine fleet, for 2003–2007, estimated using observer data.
- Discard levels are moderate for industrial purse seine fisheries. The EU recently reported discard levels of frigate tuna for its purse seine fleet, for 2003–2007, estimated using observer data.
- Changes to the catch series: The catch series of frigate tuna has changed substantially from those estimated in 2010, following reviews of catches for the coastal fisheries in Indonesia and, to a lesser extent India, involving marked changes in catches by species. Overall, the new catches estimated for Indonesian fisheries are three times higher than those recorded in the past.

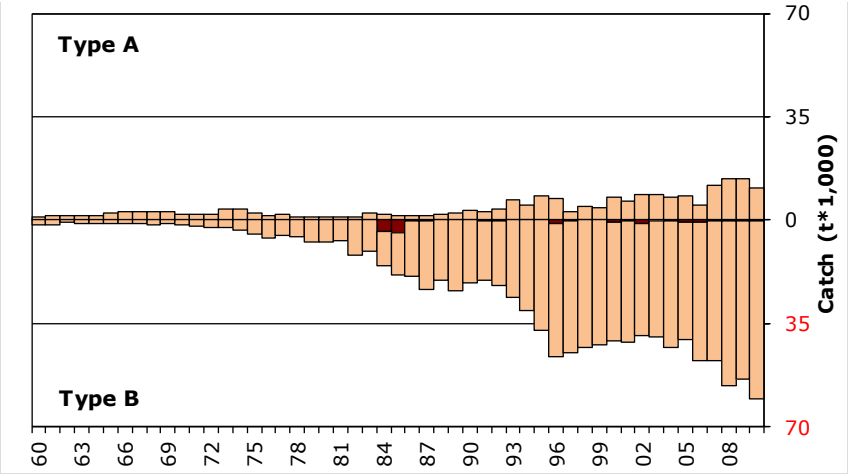


Fig. 3. Frigate tuna: Uncertainty of annual catch estimates (1960–2010) (Data as of October 2011)
Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (Type A) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Frigate tuna – Effort trends

Effort trends are unknown for frigate tuna in the Indian Ocean.

Frigate tuna – Catch–per–unit–effort (CPUE) trends

Standardised CPUE series have not yet been developed. Catch-and-effort series are available from some fisheries but they are considered highly incomplete. In most cases catch-and-effort data are only available for short periods. Reasonably long catch-and-effort series (extending for more than 10 years) are only available for Maldives baitboats and troll lines (Fig. 4) and Sri Lanka gillnets. The catches and effort recorded for Sri Lankan gillnets are, however, thought to be inaccurate due to the dramatic changes in CPUE recorded between consecutive years.

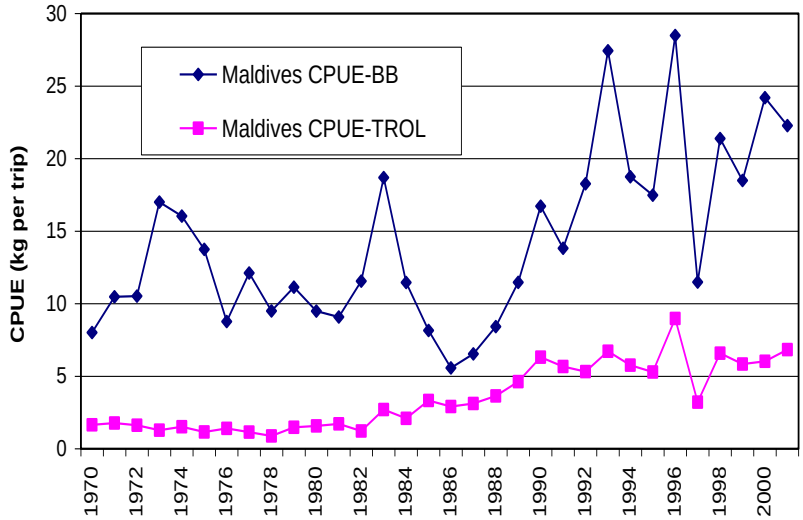


Fig. 4. Frigate tuna: Nominal CPUE series for the baitboat (BB) and line (LINE) fisheries of Maldives derived from the available catches and effort data (1970–2001).

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

- The size of frigate tuna taken by Indian Ocean fisheries typically ranges between 20–50 cm depending on the type of gear used, season and location. The fisheries operating in the Andaman Sea (coastal purse seines and troll lines) tend to catch frigate tuna of small to medium size (15–40cm) while the gillnet, baitboat and other fisheries operating in the Indian Ocean catch usually larger specimens (25–50cm). Length frequency data for the bullet tuna is only available for some Sri Lanka fisheries and periods. These fisheries catch bullet tuna ranging between 15–35 cm.

- Trends in average weight can only be assessed for Sri Lankan gillnets and Maldivian pole-and-lines but the amount of specimens measured has been very low in recent years. The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme). Unfortunately, data collection did not continue in most countries after the end of the IPTP activities.
- Catch-at-Size(Age) tables are not available for the frigate tuna due to the paucity of size data available from most fleets and the uncertain status of the catches for this species.
- Sex ratio data have not been provided to the Secretariat by CPCs.

STOCK ASSESSMENT

No quantitative stock assessment for frigate tuna in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Neritic Tunas. However, a preliminary estimation of stock indicators was attempted on the catch and effort datasets from the Maldives baitboat and line fisheries (described above). However, there is considerable uncertainty about the degree to which this and other indicators represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends. Further work must be undertaken to derive additional stock indicators for this species, because in the absence of a quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing.

TABLE 4. Frigate tuna (*Auxis thazard*) stock status summary.

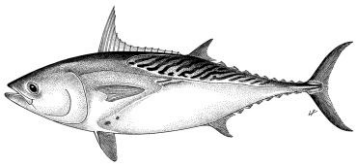
Management Quantity	Aggregate Indian Ocean
2010 catch estimate	71,000 t
Mean catch from 2006–2010	64,200 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2010}/F_{MSY} (80% CI)	–
B_{2010}/B_{MSY} (80% CI)	–
SB_{2010}/SB_{MSY}	–
B_{2010}/B_0 (80% CI)	–
SB_{2010}/SB_0	–
$B_{2010}/B_{0,\ F=0}$	–
$SB_{2010}/SB_{0,\ F=0}$	–

LITERATURE CITED

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

APPENDIX F
EXECUTIVE SUMMARY: KAWAKAWA

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



Status of the Indian Ocean Kawakawa tuna Resource (*Euthynnus affinis*)

TABLE 1. Status of kawakawa (*Euthynnus affinis*) in the Indian Ocean.

Area[1]	**Indicators – 2011 assessment**		**2011 stock status determination**
			2010[2]
Indian Ocean	Catch[3] 2010: Average catch[3] 2006–2010: MSY: F_{2010}/F_{MSY}: SB_{2010}/SB_{MSY}: SB_{2010}/SB_0:	128,871 t 122,895 t unknown unknown unknown unknown	**UNCERTAIN**

[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.
[3]Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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 kawakawa in the Indian Ocean noting that there remains considerable uncertainty about stock structure and about the total catches.

Stock status. No quantitative stock assessment is currently available for kawakawa in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore stock status remains *uncertain* (Table 1). However, aspects of the fisheries for this species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern.

Outlook. The continued increase of annual catches for kawakawa is likely to have further increased the pressure on the Indian Ocean stock as a whole, however there is not sufficient information to evaluate the effect this will have on the resource. Research emphasis on improving indicators and exploration of stock structure and stock assessment approaches for data poor fisheries are warranted.

The SC **RECOMMENDED** the following:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches urgently need to be reviewed.
- improvement in data collection and reporting is required to assess the stock.

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Kawakawa (*Euthynnus affinis*) in the Indian Ocean is currently subject to a number of conservation and management measures adopted by the Commission, although none are species specific:

- Resolution 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area*.
- Resolution 09/02 *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 10/03 *concerning the recording of catch by fishing vessels in the IOTC area*.
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence*.

FISHERIES INDICATORS

General

Kawakawa (*Euthynnus affinis*) lives in open waters close to the shoreline and prefers waters temperatures ranging from 18° to 29°C. Table 2 outlines some key life history parameters relevant for management.

TABLE 2. Biology of Indian Ocean kawakawa (*Euthynnus affinis*).

Parameter	Description
Range and stock structure	Lives in open waters close to the shoreline and prefers waters temperatures ranging from 18° to 29°C. Kawakawa form schools by size with other species sometimes containing over 5,000 individuals. Kawakawa are often found with yellowfin, skipjack and frigate tunas. Kawakawa are typically found in surface waters, however, they may range to depths of over 400 m (they have been reported under a fish-aggregating device employed in 400 m), possibly to feed. Kawakawa larvae are patchy but widely distributed and can generally be found close to land masses. Large changes in apparent abundance are linked to changes in ocean conditions. This species is a highly opportunistic predator feeding on small fishes, especially on clupeoids and atherinids; also squid, crustaceans and zooplankton. No information is available on stock structure of kawakawa in Indian Ocean.
Longevity	n.a.
Maturity (50%)	**Age**: n.a; females n.a. males n.a. **Size:** females and males ~45–50 cm FL.
Spawning season	Spawning occurs mostly during summer. A 1.4 kg female (48 cm FL) may spawn approximately 0.21 million eggs per batch (corresponding to about 0.79 million eggs per season).
Size (length and weight)	Maximum: Females and males 100 cm FL; weight 14 kgs. Juveniles grow rapidly reaching lengths between 50–65 cm by 3 years of age.

n.a. = not available. SOURCES: Froese & Pauly (2009); Taghavi et al. (2010).

Kawakawa – Catch trends

Kawakawa is caught mainly by coastal purse seines, gillnets and, to a lesser extent, handlines and trolling (Fig. 1) and may be also an important by-catch of the industrial purse seiners. The catch estimates for kawakawa were derived from very small amounts of information and are therefore highly uncertain.

Annual estimates of catches for kawakawa increased markedly from around 10,000 t in the mid-1970's to reach the 50,000 t mark in the mid-1980's and 130,634 t in 2009, the highest catches ever recorded for this species. Since 2006, catches have been over 100,000 t. The average annual catch estimated for the period 2006 to 2010 is 122,895 t (Table 3). Catches in 2010 were around 128,871 t. The majority of catches of kawakawa are taken in the East Indian Ocean, representing around 60% of the total catches in recent years. In recent years, the countries attributed with the highest catches are Indonesia (35%), India (19%), Iran (13%), and Malaysia (10%) (Fig. 2).

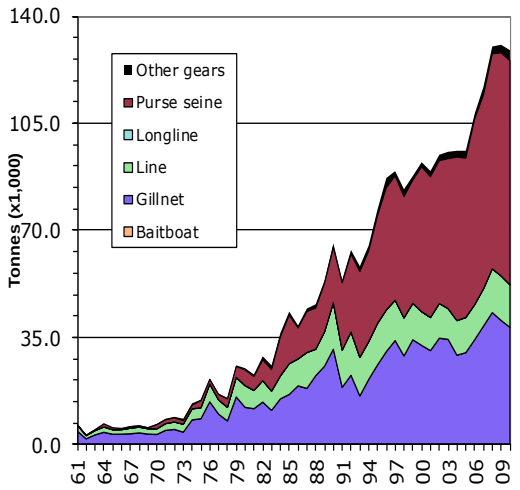


Fig. 1. Kawakawa: Catches by gear recorded in the IOTC Database (1960–2010).

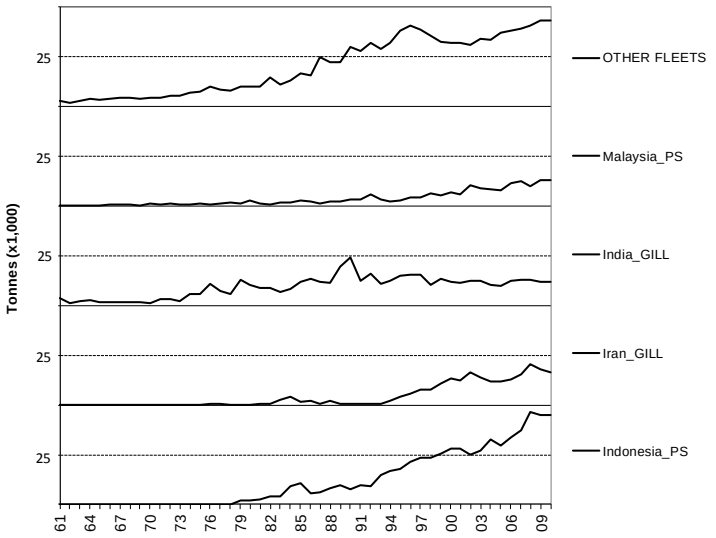


Fig. 2. Kawakawa: Catches recorded in the IOTC Database for main fishing fleets (1960–2010).

TABLE 3. Best scientific estimates of the catches of kawakawa by type of fishery for the period 1950–2010 (in metric tonnes). Data as of October 2011.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Purse seine	100	385	1,824	10,526	31,909	47,382	46,054	46,729	49,018	53,443	52,131	60,627	63,373	70,283	72,941	73,248
Gillnet	1,907	3,408	8,130	16,799	26,457	32,409	30,710	34,775	34,578	29,332	30,175	34,358	38,786	43,225	40,678	38,422
Line	1,154	1,628	3,761	8,441	13,115	11,029	10,825	11,334	10,060	11,318	11,507	11,476	12,188	14,301	14,555	13,914
Other	0	60	279	737	1,581	1,424	1,797	1,851	2,006	1,897	2,188	1,546	2,539	2,271	2,461	3,286
Total	**3,161**	**5,481**	**13,995**	**36,502**	**73,062**	**92,245**	**89,385**	**94,690**	**95,662**	**95,990**	**96,001**	**108,006**	**116,885**	**130,078**	**130,634**	**128,871**

Kawakawa – Uncertainty of catches

Retained catches are uncertain (Fig. 3), notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of kawakawa by species or by gear for 1950–2004; catches of kawakawa, longtail tuna and, to a lesser extent, other species were reported aggregated for this period. The IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004 by gear and species. The catches of kawakawa estimated for this component represent around 35% of the total catches of this species in recent years.
- Artisanal fisheries of India: Although India reports catches of kawakawa they are not always reported by gear. The IOTC Secretariat has allocated the catches of kawakawa by gear for years in which this information was not available. The catches of kawakawa have represented 19% of the total catches of this species in the Indian Ocean in recent years.
- Artisanal fisheries of Mozambique, Myanmar and Somalia: None of these countries have ever reported catches to the IOTC Secretariat. Catch levels are unknown.
- Other artisanal fisheries: The catches of kawakawa are usually not reported by species, being combined with catches of other small tuna species like skipjack tuna and frigate tuna (coastal purse seiners of Malaysia and Thailand).
- Industrial fisheries: The catches of kawakawa recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, its catches are seldom recorded in the logbooks, nor are they monitored in port. The EU recently reported catch levels of frigate tuna for its purse seine fleet, for 2003–2007, estimated using observer data.
- Discard levels are moderate for industrial purse seine fisheries. The EU recently reported discard levels of kawakawa for its purse seine fleet, for 2003–2007, estimated using observer data.
- Changes to the catch series: The catch series of kawakawa has changed substantially since those estimated in 2010, following reviews of catches for the coastal fisheries in Indonesia and, to a lesser extent India, involving marked changes in catches by species. Overall, the new catches estimated for Indonesian fisheries represent the 60% of those recorded in the past.

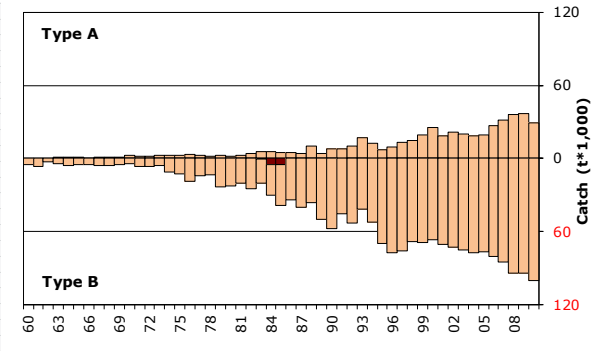


Fig. 3. Kawakawa: Uncertainty of annual catch estimates (1960–2010).
*Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) 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.*

Kawakawa – Effort trends

Effort trends are unknown for kawakawa in the Indian Ocean.

Kawakawa – Catch–per–unit–effort (CPUE) trends

Standardised CPUE series have not yet been developed. Nominal CPUE series are however available from some fisheries but they are considered incomplete. In most cases catch-and-effort data are only available for short periods. Reasonably long catch-and-effort data series (extending for more than 10 years) are only available for Maldives baitboats and troll lines and Sri Lanka gillnets (Fig. 4). The catch-and-effort data recorded for Sri Lankan gillnets are, however, thought to be inaccurate due to the dramatic changes in CPUE recorded between consecutive years.

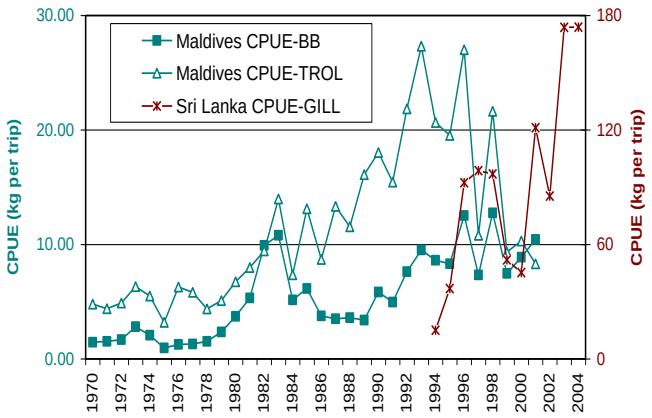


Fig. 4. Kawakawa: Nominal CPUE series for the baitboat (BB) and troll line (TROL) fisheries of Maldives (left axis; 1970–2001) and the gillnet fishery of Sri Lanka (right axis; 1994–2004) derived from the available catches and effort data.

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

- Trends in average weight can only be assessed for Sri Lankan gillnets but the amount of specimens measured has been very low in recent years. The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme). Unfortunately, data collection did not continue after the end of the IPTP activities.
- The size of kawakawa taken by the Indian Ocean fisheries typically ranges between 20–60 cm depending on the type of gear used, season and location. The coastal purse seine fisheries operating in the Andaman Sea tend to catch kawakawa of small size (15–30 cm) while the gillnet, baitboat and other fisheries operating in the Indian Ocean catch usually larger specimens (25–55 cm).
- Catch-at-Size(Age) tables are not available for kawakawa due to the paucity of size data available from most fleets and the uncertain status of the catches for this species.
- Sex ratio data have not been provided to the Secretariat by CPCs.

STOCK ASSESSMENT

No quantitative stock assessment for kawakawa in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Neritic Tunas. However, a preliminary estimation of stock indicators was

attempted on the catch and effort datasets from the Maldives baitboat and troll line fisheries (described above). However, there is considerable uncertainty about the degree to which this and other indicators represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends. Further work must be undertaken to derive additional stock indicators for this species, because in the absence of a quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing.

TABLE 4. Kawakawa (*Euthynnus affinis*) stock status summary.

Management Quantity	**Aggregate Indian Ocean**
2010 catch estimate	128,900 t
Mean catch from 2006–2010	122,900 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2010}/F_{MSY} (80% CI)	–
B_{2010}/B_{MSY} (80% CI)	–
SB_{2010}/SB_{MSY}	–
B_{2010}/B_0 (80% CI)	–
SB_{2010}/SB_0	–
$B_{2010}/B_{0,\ F=0}$	–
$SB_{2010}/SB_{0,\ F=0}$	–

LITERATURE CITED

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

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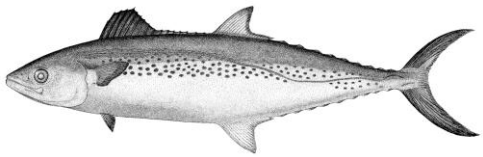
APPENDIX G
EXECUTIVE SUMMARY: INDO-PACIFIC KING MACKEREL

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



Status of the Indian Ocean Indo-Pacific king mackerel Resource (*Scomberomorus guttatus*)

TABLE 1. Status of Indo-Pacific king mackerel (*Scomberomorus guttatus*) in the Indian Ocean.

Area[1]	Indicators – 2011 assessment		2011 stock status determination
			2010[2]
Indian Ocean	Catch[3] 2010:	37,257 t	UNCERTAIN
	Average catch[3] 2006–2010:	37,980 t	
	MSY:	unknown	
	F_{2010}/F_{MSY}:	unknown	
	SB_{2010}/SB_{MSY}:	unknown	
	SB_{2010}/SB_0:	unknown	

[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.
[3]Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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 Indo-Pacific king mackerel in the Indian Ocean noting that there remains considerable uncertainty about stock structure and about the total catches.

Stock status. No quantitative stock assessment is currently available for Indo-Pacific king mackerel in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore stock status remains *uncertain* (Table 1). However, aspects of the fisheries for this species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern.

Outlook. The continued increase of annual catches for Indo-Pacific king mackerel is likely to have further increased the pressure on the Indian Ocean stock as a whole, however there is not sufficient information to evaluate the effect this will have on the resource. Research emphasis on improving indicators and exploration of stock structure and stock assessment approaches for data poor fisheries are warranted.

The SC **RECOMMENDED** the following:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches urgently need to be reviewed.
- improvement in data collection and reporting is required to assess the stock.

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Indo-Pacific king mackerel (*Scomberomorus guttatus*) in the Indian Ocean is currently subject to a number of conservation and management measures adopted by the Commission, although none are species specific:

- Resolution 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area.*
- Resolution 09/02 *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 10/03 *concerning the recording of catch by fishing vessels in the IOTC area*.
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area*.
- Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence*.

FISHERIES INDICATORS

General

The Indo-Pacific king mackerel (*Scomberomorus guttatus*) is a migratory species that forms small schools and inhabits coastal waters, sometimes entering estuarine areas. Table 2 outlines some key life history parameters relevant for management.

TABLE 2. Biology of Indian Ocean Indo-Pacific king mackerel (*Scomberomorus guttatus*).

Parameter	Description
Range and stock structure	A migratory species that forms small schools and inhabits coastal waters, sometimes entering estuarine areas. It is found in waters from the Persian Gulf, India and Sri Lanka, Southeast Asia, as far north as the Sea of Japan. The Indo-Pacific king mackerel feeds mainly on small schooling fishes (e.g. sardines and anchovies), squids and crustaceans. No information is available on the stock structure of Indo-Pacific king mackerel stock structure in Indian Ocean.
Longevity	n.a.
Maturity (50%)	**Age**: 1–2 years; females n.a. males n.a. **Size:** females and males ~40–52 cm FL.
Spawning season	Based on the occurrence of ripe females and the size of maturing eggs, spawning probably occurs from April to July in southern India and in May in Thailand waters. Fecundity increases with age in the Indian waters, ranging from around 400,000 eggs at age 2 years to over one million eggs at age 4 years.
Size (length and weight)	Maximum: Females and males 76 cm FL; weight n.a.

n.a. = not available. SOURCES: Froese & Pauly (2009)

Indo-Pacific king mackerel – Catch trends

Indo-Pacific king mackerel is mostly caught by gillnet fisheries in the Indian Ocean but significant numbers are also caught trolling (Fig. 1). The catch estimates for Indo-Pacific King mackerel were derived from very small amounts of information and are therefore highly uncertain.

Estimated catches have increased steadily since the mid 1960's, reaching around 10,000 t in the early 1970's and over 25,000 t since the mid-1990's. Catches increased steadily since then until 1995, the year in which the highest catches for this species were recorded, at around 43,000 t. The catches of Indo-Pacific king mackerel between 1997 and 2005 were more or less stable, estimated at around 30,000 t. Current catches have been higher, close to 40,000 t. The average annual catch estimated for the period 2006 to 2010 is 37,980 t (Table 3).

In recent years, the countries attributed with the highest catches are India (47%) and Indonesia (28%) and, to a lesser extent, Iran and Thailand (15%) (Fig. 2).

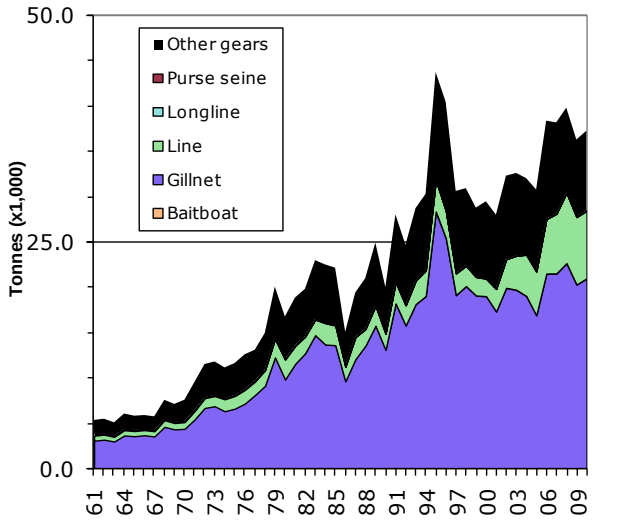


Fig. 1. Indo-Pacific king mackerel: Catches by gear recorded in the IOTC Database (1960–2010).

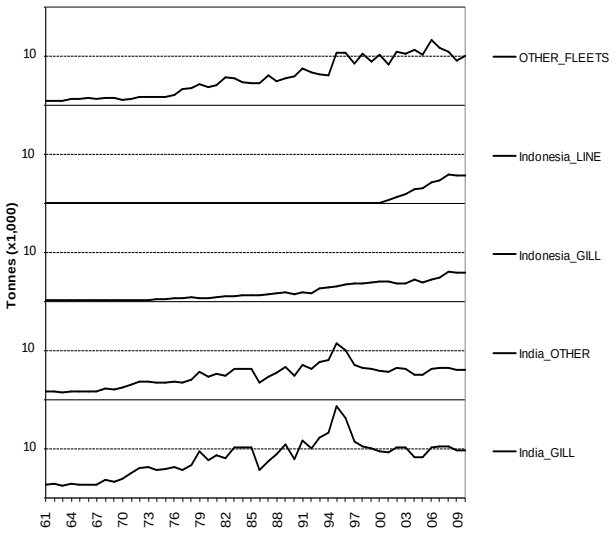


Fig. 2. Indo-Pacific king mackerel: Catches recorded in the IOTC Database for main fishing fleets (1960–2010).

TABLE 3. Best scientific estimates of the catches of Indo-Pacific king mackerel by type of fishery for the period 1950–2010 (in metric tonnes). Data as of October 2011.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Purse seine	0	0	48	240	484	276	189	283	349	220	226	293	260	266	265	262
Gillnet	2,310	3,542	7,325	12,731	19,655	19,035	17,343	19,955	19,747	19,055	16,922	21,524	21,543	22,675	203,19	20,996
Line	453	581	1,326	2,014	2,473	1,915	2,467	3,132	3,726	4,532	4,805	5,995	6,570	7,756	7,423	7,441
Other	1,193	1,657	3,641	5,324	7,994	8,236	7,981	8,915	8,772	8,223	8,807	10,554	9,809	9,108	8,280	8,559
Total	**3,957**	**5,780**	**12,340**	**20,309**	**30,606**	**29,461**	**27,980**	**32,285**	**32,593**	**32,029**	**30,761**	**38,367**	**38,182**	**39,805**	**36,288**	**37,257**

Indo-Pacific king mackerel – Uncertainty of catches

Retained catches are highly uncertain (Fig. 3) for all fisheries due to:

- Aggregation: Indo-Pacific King mackerel is usually not reported by species, being aggregated with narrow-barred Spanish mackerels or, less frequently, other small tuna species.
- Mislabelling: Indo-Pacific King mackerels are usually mislabelled as narrow-barred Spanish mackerel, their catches reported under the latter species.
- Under reporting: the catches of Indo-Pacific King mackerel may be not reported for some fisheries catching them as a bycatch.
- It is for the above reasons that the catches of Indo-Pacific King mackerel in the IOTC database are thought to represent only a small fraction of the total catches of this species in the Indian Ocean.
- Discard levels are believed to be low although they are unknown for most fisheries.
- Changes to the catch series: There have not been significant changes to the estimated catches of Indo-Pacific King mackerel since 2010.

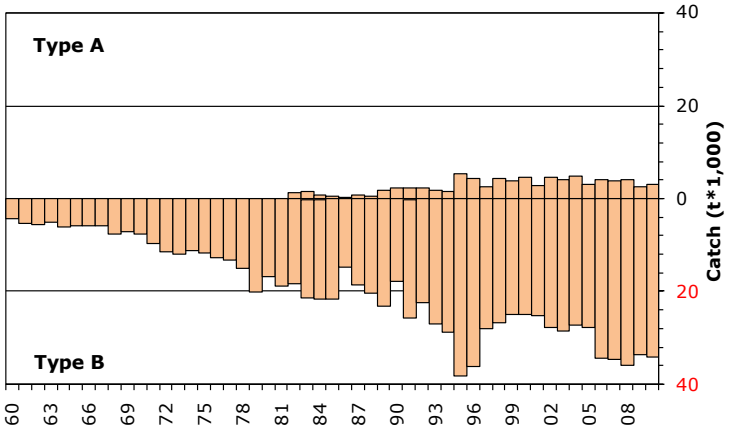


Fig. 3. Indo-Pacific king mackerel: Uncertainty of annual catch estimates (1960–2010) (Data as of October 2011).
*Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.*

Indo-Pacific king mackerel – Effort trends

Effort trends are unknown for Indo-Pacific King mackerel in the Indian Ocean.

Indo-Pacific king mackerel – Catch–per–unit–effort (CPUE) trends

Standardised CPUE series have not yet been developed. Nominal CPUE series are however available from some fisheries but they are considered highly incomplete. In most cases catch-and-effort data are only available for short periods of time. This makes it impossible to derive any meaningful CPUE from the existing data.

Indo-Pacific king mackerel – Fish size or age trends (e.g. by length, weight, sex and/or maturity)

- Trends in average weight cannot be assessed for most fisheries. Samples of king mackerel are only available for the coastal purse seiners of Thailand and gillnets of Sri Lanka but they refer to very short periods and the numbers sampled are very small.
- Catch-at-Size(Age) tables are not available for the Indo-Pacific King mackerel due to the paucity of size data available from most fleets and the uncertain status of the catches for this species.
- Sex ratio data have not been provided to the Secretariat by CPCs.

STOCK ASSESSMENT

No quantitative stock assessment for Indo-Pacific king mackerel in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Neritic Tunas. Further work must be undertaken to derive stock indicators for this species, because in the absence of a quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing.

TABLE 4. Indo-Pacific king mackerel (*Scomberomorus guttatus*) stock status summary.

Management Quantity	Aggregate Indian Ocean
2010 catch estimate	37,300 t
Mean catch from 2006–2010	38,000 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2010}/F_{MSY} (80% CI)	–
B_{2010}/B_{MSY} (80% CI)	–
SB_{2010}/SB_{MSY}	–
B_{2010}/B_0 (80% CI)	–
SB_{2010}/SB_0	–
$B_{2010}/B_{0,\ F=0}$	–
$SB_{2010}/SB_{0,\ F=0}$	–

LITERATURE CITED

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