ANNEX 129

United Kingdom reply of 2 October 2012

United Nations A/67/509

General Assembly

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Agenda item 8
General debate

Letter dated 2 October 2012 from the Permanent Representative of the United Kingdom of Great Britain and Northern Ireland to the United Nations addressed to the President of the General Assembly

I have the honour to enclose herewith the text of the written statement of the delegation of the United Kingdom in exercise of the right of reply to the remarks made by the Minister for Foreign Affairs, Regional Integration and International Trade of Mauritius, Arvin Boolell, on 1 October 2012 in the General Assembly (see annex).

I should be most grateful if you would arrange to have the text of the present letter and its annex circulated as a document of the General Assembly, under agenda item 8.

(*Signed*) Mark **Lyall Grant**
Ambassador
Permanent Representative

Annex to the dated 2 October 2012 from the Permanent Representative of the United Kingdom of Great Britain and Northern Ireland to the United Nations addressed to the President of the General Assembly

The British Government maintains that the British Indian Ocean Territory is British and has been since 1814. It does not recognize the sovereignty claim of the Mauritian Government.

The British Government values its close and constructive cooperation with the Government of Mauritius on a wide range of issues and would like this to include a more constructive dialogue on British Indian Ocean Territory.

ANNEX 130

IOTC, *Mauritius National Report to the Scientific Committee of the Indian Ocean Tuna Commission*, 2012, IOTC–2012–SC15–NR18 Rev 1, December 2012

Received: 29 November & 7 December, 2012

Mauritius National Report to the Scientific Committee of the Indian Ocean Tuna Commission, 2012

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Ministry of Fisheries, Mauritius

INFORMATION ON FISHERIES, RESEARCH AND STATISTICS

In accordance with IOTC Resolution 10/02, final scientific data for the previous year was provided to the Secretariat by 30 June of the current year, **for all fleets other than longline** [e.g. for a National report submitted to the Secretariat in 2012 final data for the 2011 calendar year must be provided to the Secretariat by 30 June 2012)	Not applicable as Mauritius has no fleet other than longline fishing boats
In accordance with IOTC Resolution 10/02, provisional **longline data** for the previous year was provided to the Secretariat by 30 June of the current year [e.g. for a National report submitted to the Secretariat in 2012, preliminary data for the 2011 calendar year was provided to the Secretariat by 30 June 2012). **REMINDER:** Final longline data for the previous year is due to the Secretariat by 30 Dec of the current year [e.g. for a National report submitted to the Secretariat in 2012, final data for the 2011 calendar year must be provided to the Secretariat by 30 December 2012).	YES Final longline data for 2011was submitted on: 27/06/2012
If no, please indicate the reason(s) and intended actions:	

Executive Summary

About 110 000 tonnes of raw tuna are processed annually for export as canned and tuna loins mainly to the EU market. Seafood processing contributes to about 1% to GDP and plays an important role in the socio-economic activity of the country. In 2011, Mauritius issued fishing licences to 98 longliners and 26 purse-seiners of various nationalities to fish in its waters. Moreover, under the fishing agreements between Mauritius and the Seychelles, 7 purse-seiners and 7 longliners were issued with fishing licences. However, under fishing agreement with the Federation of Japan Tuna Fisheries Co-operative Associations no application were received from the Japanese fishing vessels probably due to the piracy threats in the Western Indian Ocean. Tuna fishing longliners regularly call at the Port Louis harbour with an approximate of over 600 calls yearly for unloading and transhipment of tuna. During the year under report, 40 013 tonnes of tuna were transhipped through the Port Louis harbour and albacore tuna constituted more than 40% of the total catch. An increase in the volume of yellowfin, bigeye and skipjack tuna transhipped was also noted due to transhipment effected by European purse-seiners. Four national fishing vessels, less than 24 meters in length, targeting swordfish landed 89 tonnes of chilled fish. The catch composed of 49.2% swordfish and 18.4 % yellowfin, 12.1% bigeye and 9.4 % albacore tuna. The fishing areas were spread between latitudes 12^0S and 23^0S and longitudes 52^0E and 63^0E. About 350 small-scale fishermen operating around the 27 anchored Fish Aggregating Devices set around the island landed 258 tonnes of tuna and the catch was mainly composed of albacore tuna. The sports/recreational fishery supplied the local market with an additional estimated amount of 350 tonnes and the species comprised marlins, sailfish, tuna, dolphinfish and wahoo. Mauritius has been putting all its effort to comply with the IOTC resolutions and is looking forward to further enhance its contribution for the conservation and management of tuna and tuna-like species and address the ecosystem and by-catch issues within the IOTC area of competence.

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1. BACKGROUND/GENERAL FISHERY INFORMATION

The tuna fishery plays an important role in the economy of Mauritius. Two factories produce canned and tuna loins mainly meant for the export market. The production capacity is about 110 000 tonnes yearly and sales amount to around EURO 188 million. The tuna fishery provides direct and indirect employment to some 12 000 persons and contributes 1% to the GDP. Mauritius is one of the two biggest ACP exporters of canned tuna to the EU market and is ranked 3rd in terms of the overall EU canned tuna external supply in terms of volume. It also ranks 3rd in terms of overall EU tuna loins external supply in terms of value.

Mauritius issues fishing licences to foreign vessels to fish in its waters against the payment of a licence fee. Foreign fishing licences were issued to 98 longliners and 26 purse-seiners of various nationalities in 2011. Mauritius has fishing agreements with the Seychelles and the Federation of Japan Tuna Fisheries Co-operative Associations. 7 purse-seiners and 7 longliners were issued with fishing licences under the fishing agreement with the Seychelles, while no application were received from the Japanese fishing vessels probably due to the piracy threats in the Western Indian Ocean.

Due to its ideal geographical position, conducive port infrastructures and dry-docking facilities Mauritius is a regional hub for maritime traffic. Tuna fishing longliners regularly call at the Port Louis harbour with an approximate of over 600 calls yearly for unloading and transhipment of tuna. In 2011, 40 013 tonnes of tuna were transhipped through the Port Louis harbour.

Four national fishing vessels, less than 24 meters in length, targeting swordfish landed 89 tonnes of chilled fish. The catch mainly composed of 49.2% swordfish and 18.4% yellowfin, 12.1% bigeye and 9.4 % albacore tuna. The fishing areas were spread between latitudes 12^{0}S and 23^{0}S and longitudes 52^{0}E and 63^{0}E.

The anchored Fish Aggregating Devices (FADs) fishery was introduced in 1985 for the small-scale fishermen. Twenty-seven FADs were maintained active around the island of Mauritius. About 350 fishermen using motorised boats 6-7 m in length were involved in this fishery and landings amounted to 258 tonnes. The catch was mainly composed of albacore tuna.

The sports/recreational fishing is an important activity for the tourism industry and local recreational fishermen. International big game fishing competitions are held annually. The main fishing gear is trolling and the fishery supplies the local market with an additional estimated amount of about 350 tonnes. The species comprises marlins, sailfish, tuna, dolphinfish and wahoo.

2. FLEET STRUCTURE

The national fleet capacity targeting swordfish was reduced from 11vessels (7 >24m and 4< 24m) in 2007 to only1in 2009 due to a restriction on the export of swordfish. However, in 2010 the fishing activity was re-launched with 3 vessels in operation and 4 vessels (<24m) in 2011. The 4 surface longline vessels carried out 316 days of fishing.

Table 1: Number of vessels operating in the IOTC area of competence, by gear type and size

Year	Gear	Number of Vessels	Number of fishing days	GT	LOA (m)	Preservation Methods
2007	Surface longline	7	446	50.9-99.4	19.90-22.90	Chilled
	Surface longline	4	461	315-597	35.36-48.31	Frozen
2008	Surface longline	6	134	50.9-99.4	19.90-22.90	Chilled
	Surface longline	2	329	577-597	35.36-48.31	Frozen
2009	Surface longline	Nil	Nil	Nil	Nil	Chilled
	Surface longline	1	31	577	48	Frozen
2010	Surface longline	2	87	30.2-38.4	13.50-15.80	Chilled
	Surface longline	1	122	577	48	Frozen
2011	Surface longline	4	316	38.4-99.4	13.50-22.80	Chilled
	Surface longline	Nil	Nil	Nil	Nil	Frozen

3. CATCH and EFFORT (BY SPECIES AND GEAR)

In 2007, about 890 tonnes of fish were landed, both in the frozen and chilled state, by 11 surface longline vessels in operation. The number of vessels was reduced to 1 vessel (>24 m) in 2009 and landed 246 tonnes which mainly composed of swordfish. However, in 2010 fishing for swordfish re-started with 3 vessels in operation and in 2011, 4 vesssels (<24M) landed 89 324 kg comprising mainly swordfish followed by yellowfin, bigeye and albacore tuna. All the fish caught were sold on the domestic market.

Table 2. Annual catch and effort by gear and primary species in the IOTC area of competence. Include a 'not elsewhere indicated – NEI' category for all other catch combined.

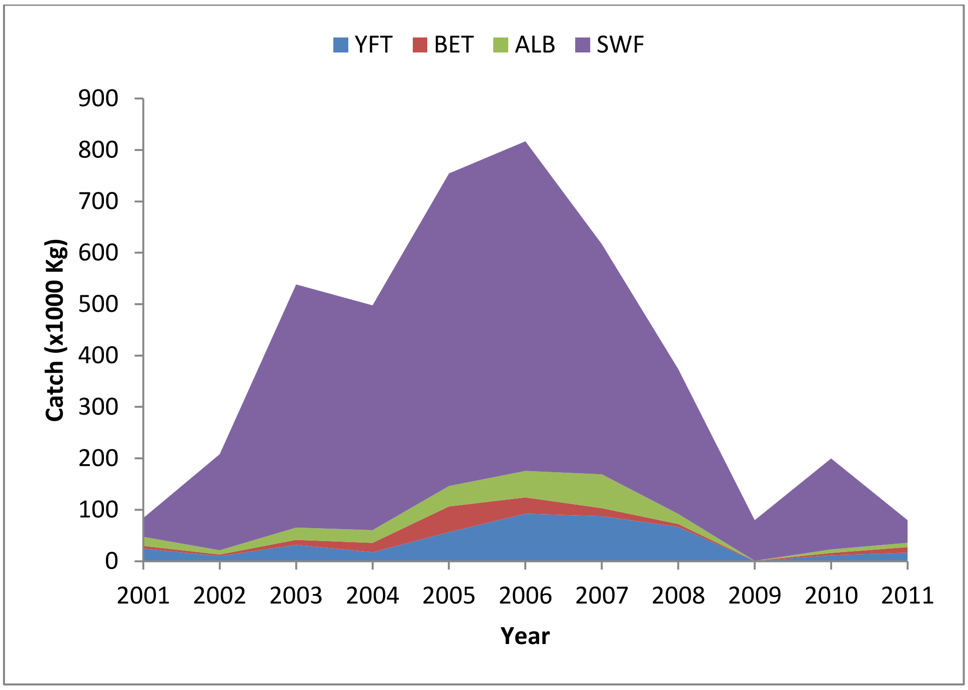
Table 2a: Annual catch (kg) of surface longline chilled fish fishery (vessels <24 m)

Species	2007	2008	2009	2010	2011
Yellowfin	65 924	14 076	0	7 621	16 476
Bigeye	0	0	0	4 60	10 826
Albacore	56 416	14 570	0	4 998	8 415
Swordfish	45 913	8 858	0	17 070	43 999
Other billfish	2 156	1 63	0	260	3 531
Sharks	1 056	6 7	0	Nil	Nil
NEI	6 264	1 462	0	1 925	6 147
Total Catch	**184 326**	**41 379**	0	**32 224**	**89 394**

Table 2b: Annual catch (tonnes) of surface longline frozen fish fishery (vessels >24m)

Species	2007	2008	2009	2010	2011
Yellowfin	21.5	52.5	0.9	3.6	Nil
Bigeye	9.3	5.5	2.1	4.2	
Albacore	15.7	5	0.3	1.8	
Swordfish	402	273	180	161	
Other billfish	11.3	13	3.2	6.0	
Miscellaneous	246	163	39.8	129	
Total Catch	**706**	**512**	**246**	**306**	

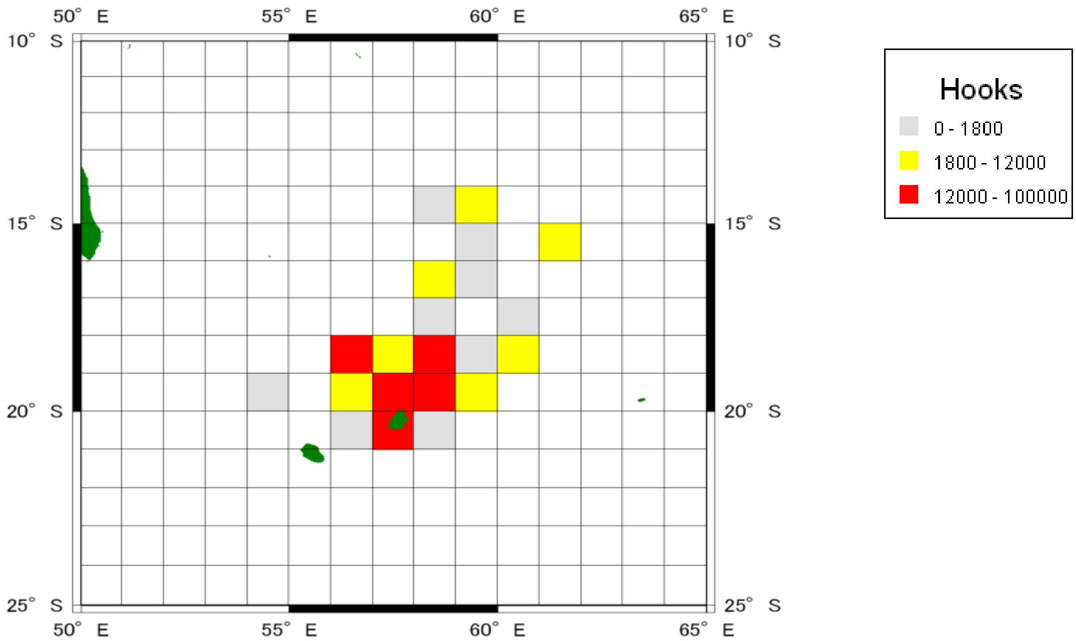
Figure 1. Historical annual catch for the national fleet, by gear and primary species, for the IOTC area of competence for the entire history of the fishery/fleet



Historical annual catch for the national longline fleet and primary species, for the IOTC area of competence for the entire history of the fishery/fleet

Figure 2a. Map of the distribution of fishing effort, by gear type for the national fleet in the IOTC area of competence for 2011

(i) Distribution of hooks of the national surface longline chilled fish fishery for 2011 (<24m)



(ii) Distribution of effort (fishermendays) for the FAD fishery for 2011

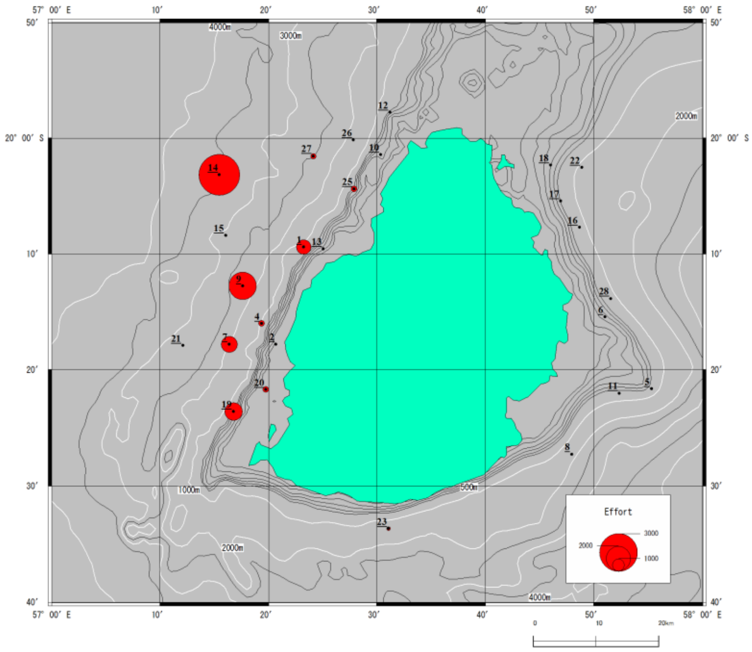
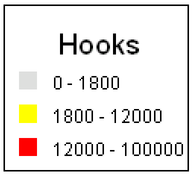
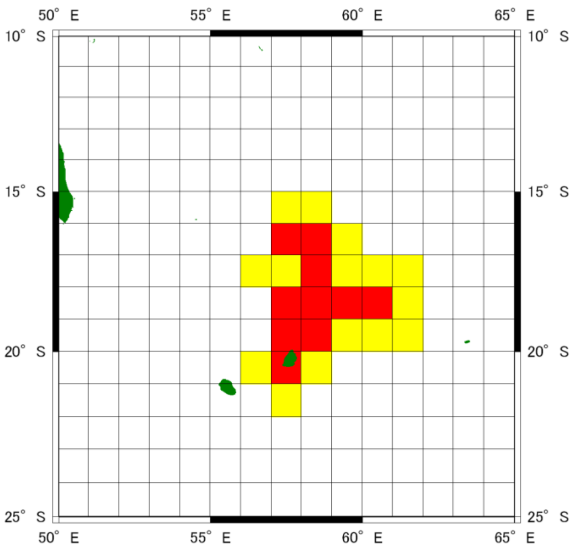


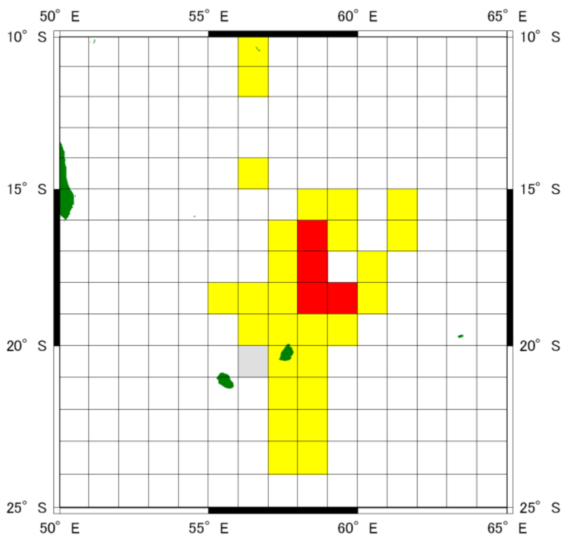
Figure 2b. Map of the distribution of fishing effort, by gear type for the national fleet in the IOTC area of competence for 2007,2008, 2010 and 2011

Distribution of hooks of the national surface longline chilled fish fishery (<24m) in 2007, 2008, 2010 and 2011.



2007 **2008**





2010 **2011**

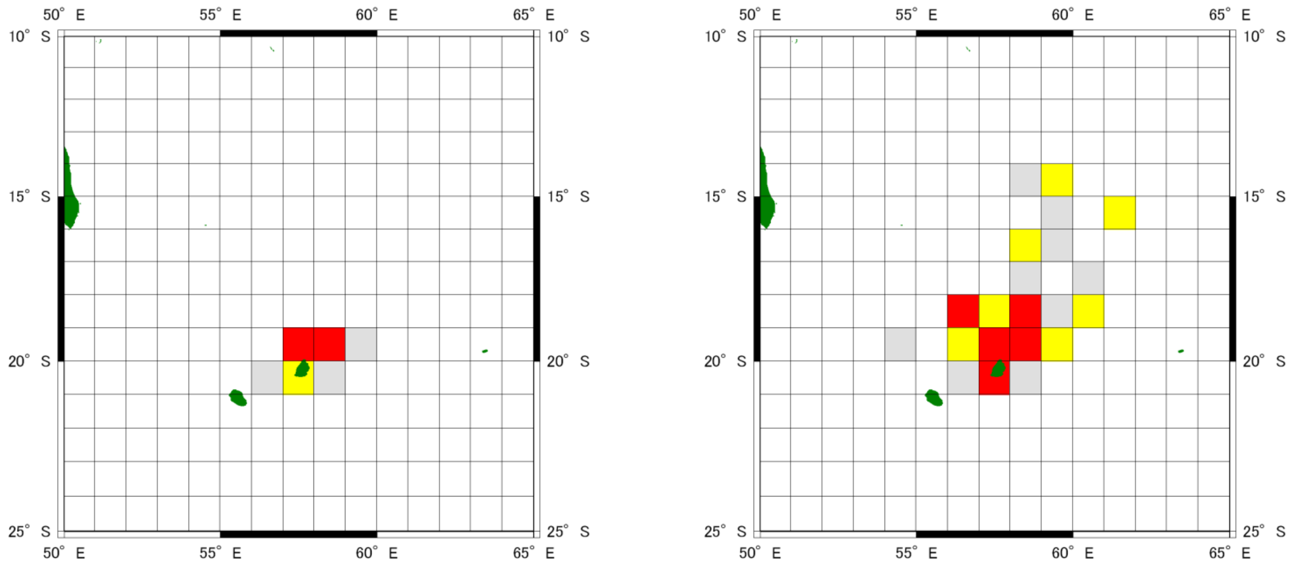
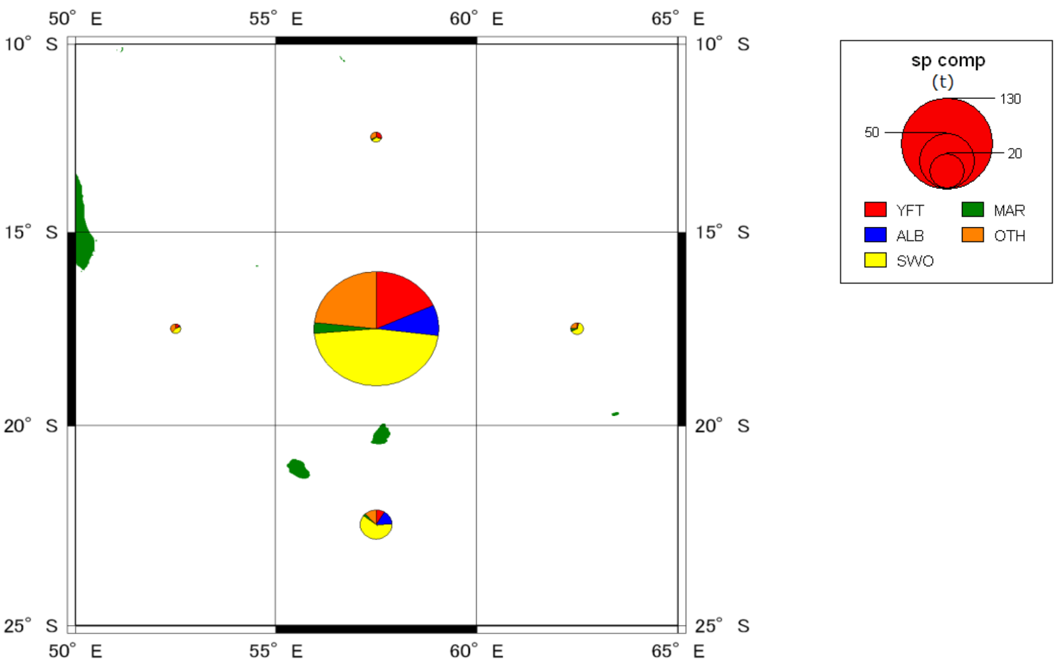


Figure 3a. Map of distribution of fishing catch, by species for the national fleet, in the IOTC area of competence for 2011

(i) Catch distribution of the national surface longline chilled fish fishery for 2011 (<24m)



(ii) Catch distribution (kg) for the FAD fishery for 2011

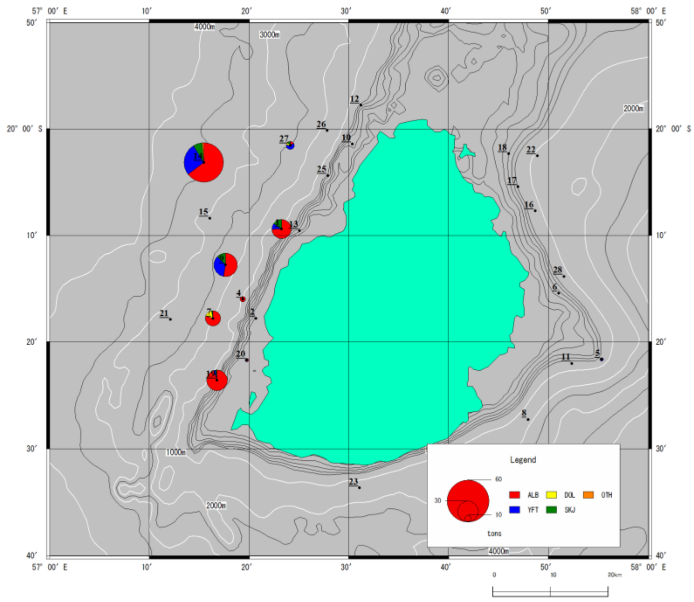
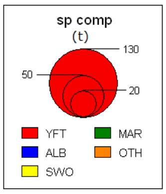
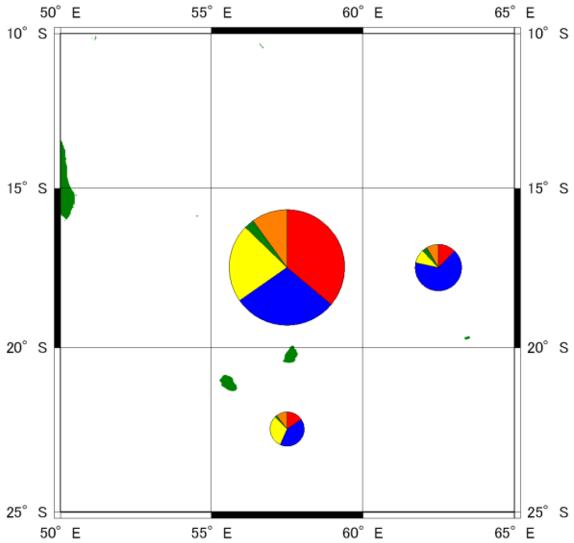


Figure 3b. Map of distribution of fishing catch, by species for the national fleet, in the IOTC area of competence for 2007, 2008, 2010 and 2011

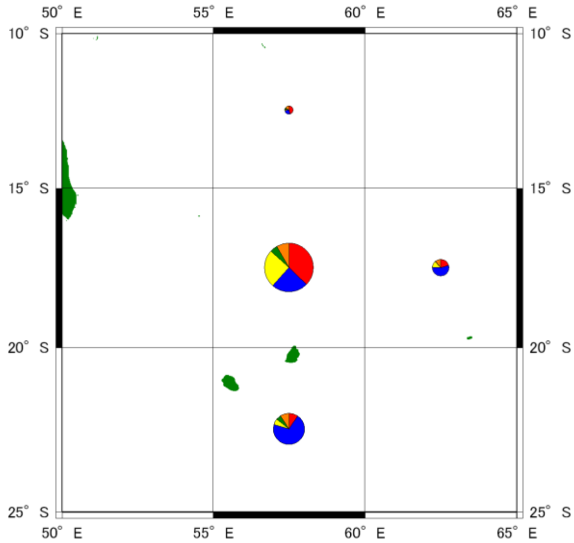
(i) Distribution of species compositions in the catch of local semi-industrial tuna longline fisheries in 2007, 2008, 2010 and 2011



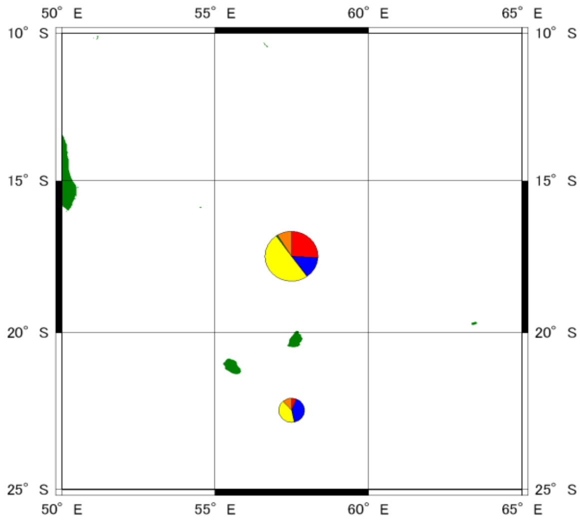
2007



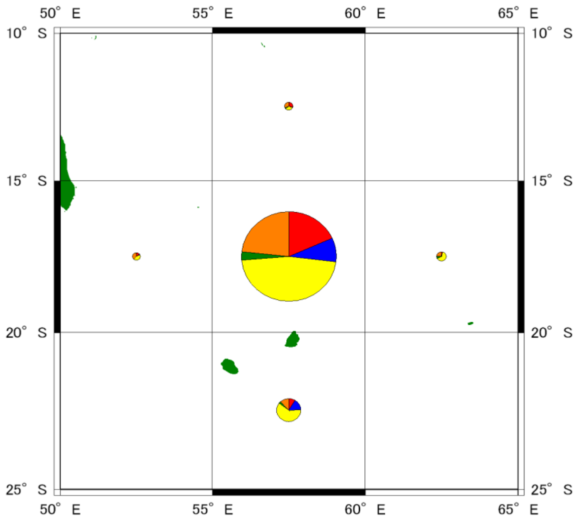
2008



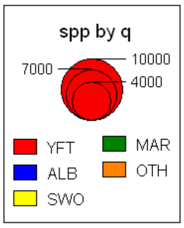
2010



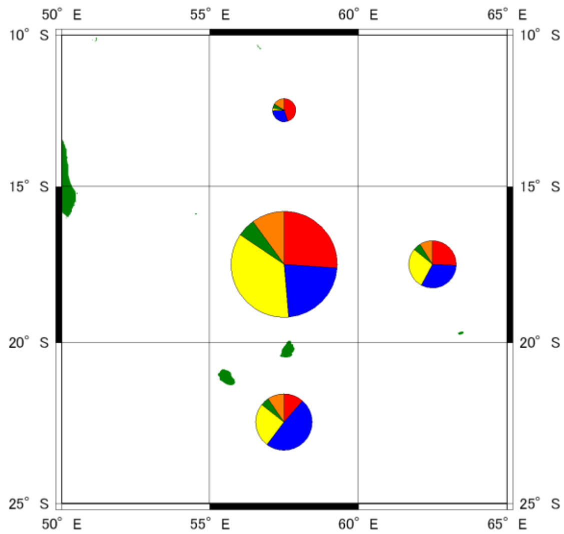
2011



(ii) Quarterly distribution of species compositions of the average catch (kg) in the national surface longline fishery catches (< 24 m) in 4 years (2007, 2008, 2010 and 2011)



Q1



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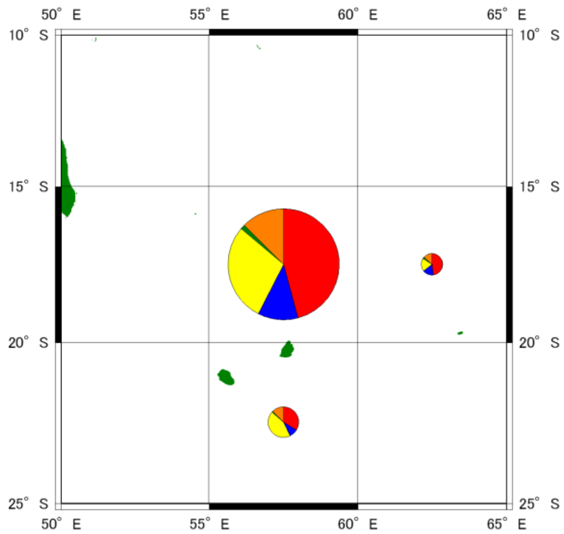

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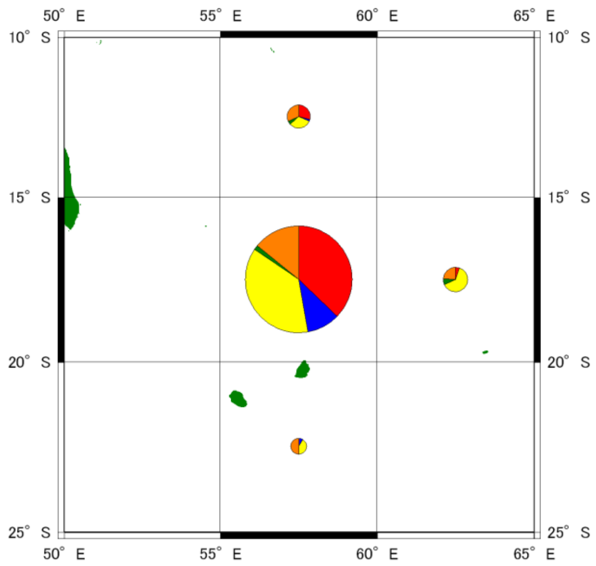

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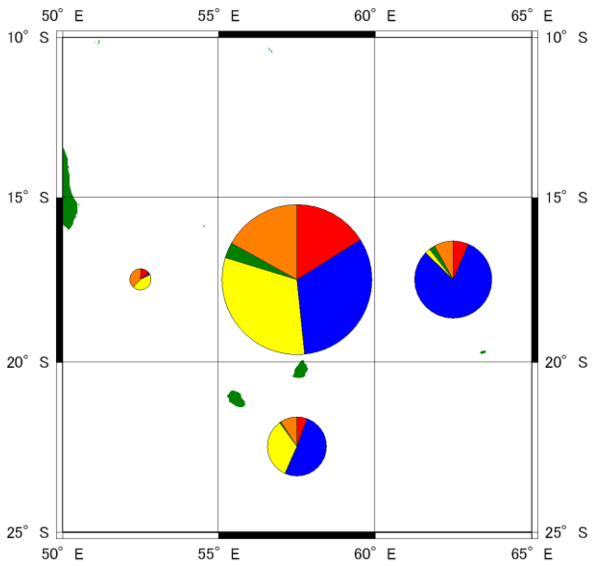

4. RECREATIONAL FISHERY

The sports/recreational fishing is an important activity for the tourism industry and local recreational fishermen. International big game fishing competitions are held annually. Some 60 sports/recreational fishing boats are involved in this fishery. The main fishing gear is trolling and the fishery supplies the local market with an additional estimated amount of about 350 tonnes. The main species comprises marlins, sailfish, tuna, dolphinfish and wahoo. A data collection system is presently being considered with the assistance of two IOTC consultants under the IOTC-OFCF Project.

5. ECOSYSTEM AND BY-CATCH ISSUES

The Fisheries and Marine Resources Act 2007 is presently being reviewed under the Bilateral Cooperation between Norway and Mauritius. The proposed new Act will take on board fisheries international and regional instrument to which Mauritius is a party and will support the Ecosystem Approach to Fisheries Management. It will give the Ministry of Fisheries the flexibility required to address changing needs in a dynamic fisheries environment through regulations.

The Port State Control Unit of the Ministry of Fisheries inspect all calling vessels, verify logbooks and ensure that the vessel has been complying with the conservation and management measures prior to authorising unloading.

5.1 Sharks

Mauritius does not issue national or foreign fishing licence to vessels targeting shark in its EEZ. However, licensed vessels targeting tuna often land shark as by-catch. The licence condition provides that all licensed vessel are required to abide with international and regional fisheries conservation and management measures.

Moreover, it is ensured that shark fins do not exceed 5% of the total body weight onboard by the Port State Control Unit.

Table 3: Total number and weight of sharks, by species, retained by the national fleet in the IOTC area of competence (for the most recent five years at a minimum, e.g. 2007–2011).

In 2011, a total of 3 420 tonnes of sharks was transhipped at Port Louis. The main species of sharks landed from licensed and non-licensed vessels calling at Port Louis consisted of Blue shark and Mako shark.

Table 4: Total number of sharks, by species, released/discarded by the national fleet in the IOTC area of competence (for the most recent five years at a minimum, e.g. 2007–2011). Where available, include life status upon released/discard.

There has been no released or discards of sharks by the national fleet operating in the IOTC area of competence.

5.2 Seabirds

Mauritius had only 4 longline fishing vessels, less than 24 m, targeting swordfish in its EEZ between latitudes 12^0S and 23^0S and longitudes 52^0E and 63^0E and these vessels have no interaction with seabirds.

All foreign licensed vessels have been informed through their local agents to strictly adhere to the mitigation measures provided in Resolution 10/06- Reducing the incidental by-catch of se-birds in longline fisheries.

5.3 Marine Turtles

The Fisheries and Marine Resources Act 2007 provides that: *no person shall land or cause to land, sell or have in his possession in Mauritius or in the maritimes zones any marine turtle whether dead or alive, marine turtle eggs and stuffed marine turtle.* Furthermore in connection with the resolution on the reduction of impacts of the mortality of sea turtles by longline fleets, the local representatives of the fishing companies have been informed that the operators of longline vessels should carry line cutters and de-hookers in order to facilitate the appropriate handling and prompt release of marine turtles caught or entangled.

5.4 Other ecologically related species (e.g. marine mammals, whale sharks)

The Fisheries and Marine Resources Act 2007 provides that: *no person shall land or cause to land, sell or have in his possession in Mauritius or in the maritime zones any marine mammal.*

Table 5. Observed annual catches of species of special interest by species (seabirds, marine turtles and marine mammals) by gear for the national fleet, in the IOTC area of competence (for the most recent five years at a minimum, e.g. 2007–2011 or to the extent available).

No seabirds, marine turtle and marine mammals have been recorded during port inspection by the Port State Control Unit.

6. NATIONAL DATA COLLECTION AND PROCESSING SYSTEMS

6.1. Logsheet data collection and verification (including date commenced and status of implementation)

Mauritius issues licences to authorise foreign and national vessels to fish in its waters. As per the licence condition all fish caught in the EEZ should be landed in its port. However, the Master of the vessel has to submit duly filled logbooks prior to obtaining authorisation to unload. This practise has been in place since 2001 and is still in force.

In 2011, a total of 203 logbooks were collected from calling vessels. The total catch landed by these vessels amounted to 6 024 tonnes out of which 5 121 tonnes were exclusively caught in the EEZ of Mauritius

6.2. Vessel Monitoring System (including date commenced and status of implementation)

Since 2005 a Vessel Monitoring System (VMS) was set up and is operational. A Fisheries Monitoring Centre, housed at the Albion Fisheries Research Centre, was established and provided with logistics to monitor the activities of vessels licensed to fish in the EEZ of Mauritius. A set of regulations was prescribed to provide the legal framework to support the VMS. All licensed fishing vessels should be equipped with the VMS system and have to report to the Fisheries Monitoring Centre (FMC) every two hours on fishing positions, speed and directions. The VMS is linked to the National Coast Guard who also monitors the activities of the vessels. Logbook data received from licensed vessels are verified against the VMS data for consistency.
In 2011, 232 local and foreign fishing vessels reported to the Fisheries Monitoring Centre.

6.3. **Observer programme** (including date commenced and status; number of observer, include percentage coverage by gear type)

Mauritius has not implemented the observer programme as only 4 national vessels, less than 24m, are operating in its EEZ. For practical reasons no observers could be place on those small national vessels as well as the licensed vessels. Six officers were trained as observers, three under the SWIOFP and the other three under the IOC- MCS project. It is expected that in 2013 with developments expected in the fishery sector, Mauritius would be in a better position to implement the observer programme.

Since 1997 a joint surveillance mission plan was set under the Indian Ocean Commission in partnership with the European Union to combat IUU fishing in the EEZ of the member countries of the Indian Ocean Commission. Several vessels were contravened for illegal fishing and one of the vessels was even seized. In September 2012 another vessel was arrested due to illegal fishing in the EEZ of Mauritius and the case is under investigation.

Table 6. Annual observer coverage by operation, e.g. longline hooks, purse seine sets (for the most recent five years at a minimum, e.g. 2007–2011 or to the extent available).

No observer programme was implemented

Figure 4. Map showing the spatial distribution of observer coverage.

Not applicable

6.4. **Port sampling programme** [including date commenced and status of implementation]

6.4.1 Sampling of catch of foreign licensed longliners (2011)

Length frequency data of the albacore tuna were obtained during regular samplings carried out on the catch of licensed longliners. A total of 1 923 albacore tuna was sampled. The length frequency distribution is shown in figure 4. The length varied from 70 to 126 cm. The major part of the catch comprised fish in the range of 98 to 104 cm.

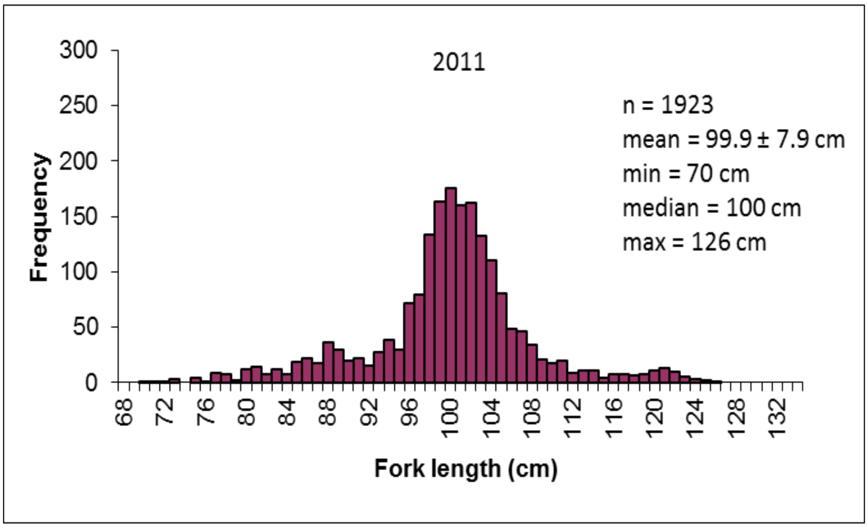

Figure 4. Length frequency distribution of albacore tuna caught by longliners

6.5. Unloading/Transhipment [including date commenced and status of implementation]

6.5.1 Transhipment by foreign tuna fishing vessels

A total of 40 013 tonnes of tuna and tuna-like species was transhipped at Port Louis by tuna fishing vessels and carriers which effected 558 and 55 calls respectively.. The species composition of the fish transhipped is shown in table 5. Albacore tuna constituted more than 40% of the total catch. An increase in the volume of yellowfin, bigeye and skipjack tuna transhipped was observed and this was due to transhipment effected by some European purse-seiners which target mostly these species.

The quantity of fish per species that were transhipped from 2007 to 2011 is shown in table 7.

Table 7: Species composition of fish transhipped (t)

Year	Albacore	Yellowfin	Bigeye	Skipjack	Swordfish	Bluefin	Marlin	Sailfish	Shark	Misc.	Total
2007	12 182	3 281	494	134	2 305	8	67	486	1881	3 110	**23 948**
2008	11 375	1 479	596	133	3 301	34	142	167	1 728	1 972	**20 927**
2009	21 627	2 003	574	2 363	2 111	11	203	147	1 328	4 721	**35 088**
2010	23 908	5 929	2 173	2 839	1 494	410	380	90	2 432	4 068	**43 723**
2011	16 138	7 165	1 979	4 993	525	155	587	1 082	3 420	3969	**40 013**

7. NATIONAL RESEARCH PROGRAMS

No national research programme is in place. However, Mauritius is looking forward to set up a research programme with the assistance of the IOTC and the "Institut de Recherche pour le Developpement" (IRD).

Table 8. Summary table of national research programs, including dates.

Project title	Period	Countries involved	Budget total	Funding source	Objectives	Short description
Nil						

8. IMPLEMENTATION OF SCIENTIFIC COMMITTEE RECOMMENDATIONS AND RESOLUTIONS OF THE IOTC RELEVANT TO THE SC.

Table 9. Respond with progress made to recommendations of the SC and specific Resolutions relevant to the work of the Scientific Committee [to be updated annually to include most recent Conservation and Management Measures adopted by the Commission].

Re s. No.	Resolution	Scientific requirement	CPC progress
05/05	Concerning the conservation of sharks caught in association with fisheries managed by IOTC	Paragraphs 1–12	No licences were issue to vessels targeting sharks. Shark caught as by-catch by foreign licensed vessels are authorised unloading subject to compliance with the 5% ratio of fins to total carcasses onboard.
10/02	Mandatory statistical requirements for IOTC members and cooperating non contracting parties	Paragraphs 1–7	All statistical data for national and foreign longline fishing vessels are regularly submitted to IOTC. The final longline data for 2011 was submitted on 27/06/2012
10/06	On reducing the incidental bycatch of seabirds in longline fisheries.	Paragraphs 3–7	There is no interaction of seabirds by the national longline fishing vessels. Foreign licensed vessels are advised to apply seabird mitigation measures.
11/04	On a regional observer scheme	Paragraph 9	The regional observer programme was not implemented as only 4 vessels (<24m) operated in the EEZ. Measures are being taken for its implementation as from 2013.
12/03	On the recording of catch and effort by fishing vessels in the IOTC area of competence	Paragraphs 1–9	Catch and effort data are compiled from logbooks collected from foreign and national vessels licensed to fish in the EEZ of Mauritius and regularly submitted to IOTC
12/04	On the conservation of marine turtles	Paragraphs 3, 4, 6–10	Marine turtles are protected by Law. Licensed fishing vessels have been apprised of the mitigation measures proposed under this resolution.
12/09	On the conservation of thresher sharks (family alopiidae) caught in association with fisheries in the IOTC area of competence	Paragraphs 4–8	Presence of thresher shark has not been observed onboard calling vessels. Licensed fishing vessels have been requested to strictly abide with this resolution.

9. LITERATURE CITED

- Annual Report 2011- Ministry of Fisheries, Mauritius

- Report on "Catch/effort and length frequency data collected on albacore tuna landed in Mauritius" (WPTmP04-12) by Z. Dhurmeea *et al*

- Report on "Catch of tropical tuna from licensed foreign and national vessels landed in Mauritius from 2008 to 2011" (IOTC-2012-WPTT-15) by T. Sooklall *et al*

10. ACKNOWLEDGEMENT

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ANNEX 131

IOTC, 15th Report of the Scientific Committee, Mahé, Seychelles, 10–15 December 2012

Report of the Fifteenth Session of the IOTC Scientific Committee

Mahé, Seychelles, 10–15 December 2012

DISTRIBUTION:
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ACRONYMS

ACAP	Agreement on the Conservation of Albatrosses and Petrels
aFAD	Anchored fish aggregation device
AIC	Akaike Information Criterion
ASPIC	A Stock-Production Model Incorporating Covariates
B	Biomass (total)
B_{MSY}	Biomass which produces MSY
BRD	Bycatch reduction device
CBD	Convention on Biological Diversity
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CE	Catch and effort
CI	Confidence interval
CMM	Conservation and Management Measure (of the IOTC; Resolutions and Recommendations)
CoC	Compliance Committee
CPCs	Contracting parties and cooperating non-contracting parties
CPUE	catch per unit effort
current	Current period/time, i.e. $F_{current}$ means fishing mortality for the current assessment year
CV	Coefficient of variance
EBSA	Ecologically or biologically significant marine areas
EEZ	Exclusive Economic Zone
ERA	ecological risk assessment
EU	European Union
F	Fishing mortality; F_{2010} is the fishing mortality estimated in the year 2010
FAD	Fish Aggretation device
FAO	Food and Agriculture Organization of the United Nations
FL	Fork length
F_{MSY}	Fishing mortality at MSY
GIS	Geographic information system
GLM	Generalised liner model
GVP	Gross value of production
HCR	Harvest control rule
HBF	Hooks between floats
HS	Harvest strategy
HSF	Harvest strategy framework
HSP	Commonwealth Fisheries Harvest Strategy Policy 2007
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IO	Indian Ocean
IOTC	Indian Ocean Tuna Commission
IOSEA	Indian Ocean - South-East Asian Marine Turtle Memorandum
IOSSS	Indian Ocean Swordfish Stock Structure
IPA	International Plan of Action
ITQ	Individual transferable quota
IUCN	International Union for the Conservation of Nature
IUU	Illegal, unregulated and unreported (fishing)
LJFL	Lower-jaw fork length
LRP	Limit reference point
LL	Longline
LSTLV	Large-scale tuna longline fishing vessel
M	Natural Mortality
MEY	Maximum economic yield
MFCL	Multifan-CL
MOU	Memorandum of understanding
MP	Management procedure
MPA	Marine Protected Area
MPF	Meeting Participation Fund
MSE	Management strategy evaluation
MSY	Maximum sustainable yield
n.a.	Not applicable
NGO	Non-governmental organization
NPOA	National plan of action
OFCF	Overseas Fishery Cooperation Foundation of Japan

OM	Operating model
OT	Oversears Territory
PS	Purse seine
PSA	Productivity Susceptibility Analysis
PSAT	Pop-up satellite tag
q	Catchability
RBC	Recommended biological catch
RFMO	Regional fisheries management organisation
ROP	Regional Observer Programme
ROs	Regional Observer Scheme
RTTP-IO	Regional Tuna Tagging Project of the Indian Ocean
SB	Spawning biomass (sometimes expressed as SSB)
SB_{MSY}	Spawning stock biomass which produces MSY
SC	Scientific committee
SCAF	Standing Committee on Administration and Finance
SE	Standard error
SIOFA	Southern Indian Ocean Fisheries Agreement
SWIOFC	South West Indian Ocean Fisheries Commission
SWIOFP	South West Indian Ocean Fisheries Project
SS3	Stock Synthesis III
SSB	Spawning stock biomass
TAC	Total allowable catch
TAE	Total allowable effort
Taiwan,China	Taiwan, Province of China
TCAC	Technical Committee on Allocation Criteria
TEP	Threatened, endangered or protected (species)
TOR	Terms of reference
tRFMO	tuna Regional Fishery Management Organization
TRP	Target reference point
TrRP	Trigger reference point
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNGA	United Nations General Assembly
VME	Vulnerable marine ecosystems
VMS	Vessel Monitoring System
WP	Working Party of the IOTC
WPB	Working Party on Billfish
WPEB	Working Party on Ecosystems and Bycatch
WPDCS	Working Party on Data Collection and Statistics
WPFC	Working Party on Fishing Capacity
WPM	Working Party on Methods
WPNT	Working Party on Neritic Tunas
WPTmT	Working Party on Temperate Tunas
WPTT	Working Party on Tropical Tunas

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EXECUTIVE SUMMARY

The Fifteenth Session of the Indian Ocean Tuna Commission's (IOTC) Scientific Committee (SC) was held on Mahé, Seychelles, from 10 to 15 December 2012. A total of 54 individuals attended the Session, comprised of 46 delegates from 21 Member countries and 0 delegates from Cooperating Non-Contracting Parties, as well as 9 observers and invited experts.

NOTING that Table 1 in this report provides an overview of the stock status and management advice for each species under the IOTC mandate as well as species directly impacted by fisheries for tuna and tuna-like species, the SC **AGREED** to an Executive Summary for each species or species group as detailed below.

The following are a subset of the complete recommendations from the SC15 to the Commission, which are provided at Appendix XXXVIII.

Tuna – Highly migratory species

The SC **RECOMMENDED** that the Commission note the management advice developed for each tropical and temperate tuna species as provided in the Executive Summary for each species.

- Albacore (*Thunnus alalunga*) – Appendix IX
- Bigeye tuna (*Thunnus obesus*) – Appendix X
- Skipjack tuna (*Katsuwonus pelamis*) – Appendix XI
- Yellowfin tuna (*Thunnus albacares*) – Appendix XII

Billfish

The SC **RECOMMENDED** that the Commission note the management advice developed for each billfish species as provided in the Executive Summary for each species:

- Swordfish (*Xiphias gladius*) – Appendix XIII
- Black marlin (*Makaira indica*) – Appendix XIV
- Blue marlin (*Makaira nigricans*) – Appendix XV
- Striped marlin (*Tetrapturus audax*) – Appendix XVI
- Indo-Pacific sailfish (*Istiophorus platypterus*) – Appendix XVII

Tuna and mackerel – Neritic species

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:

- Bullet tuna (*Auxis rochei*) – Appendix XVIII
- Frigate tuna (*Auxis thazard*) – Appendix XIX
- Kawakawa (*Euthynnus affinis*) – Appendix XX
- Longtail tuna (*Thunnus tonggol*) – Appendix XXI
- Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XXII
- Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix XXIII

Sharks

The SC **RECOMMENDED** that the Commission note the management advice developed for a subset of shark species commonly caught in IOTC fisheries for tuna and tuna-like species:

- Blue sharks (*Prionace glauca*) – Appendix XXIV
- Oceanic whitetip sharks (*Carcharhinus longimanus*) – Appendix XXV
- Scalloped hammerhead sharks (*Sphyrna lewini*) – Appendix XXVI
- Shortfin mako sharks (*Isurus oxyrinchus*) – Appendix XXVII
- Silky sharks (*Carcharhinus falciformis*) – Appendix XXVIII
- Bigeye thresher sharks (*Alopias superciliosus*) – Appendix XXIX
- Pelagic thresher sharks (*Alopias pelagicus*) – Appendix XXX

Marine turtles

The SC **RECOMMENDED** that the Commission note the management advice developed for marine turtles, as provided in the Executive Summary encompassing all six species found in the Indian Ocean:

- Marine turtles – Appendix XXXI

Seabirds

The SC **RECOMMENDED** that the Commission note the management advice developed for seabirds, as provided in the Executive Summary encompassing all species commonly interacting with IOTC fisheries for tuna and tuna-like species:

- Seabirds – Appendix XXXII

Report of the Eighth Session of the Working Party on Ecosystems and Bycatch (WPEB08)

Data reporting requirements

(para.89) **NOTING** that despite the mandatory reporting requirements detailed in Resolutions 05/05, 10/02, 10/06, 12/03 and 12/04, bycatch data remain largely unreported by CPCs and the SC **RECOMMENDED** that the Compliance Committee and the Commission address this non-compliance by taking steps to develop mechanisms which would ensure that CPCs fulfil their bycatch reporting obligations.

Gillnet fisheries of the Indian Ocean

(para.90) The SC **NOTED** that gillnet fisheries are expanding rapidly in the Indian Ocean, with gillnets often being longer than 2.5 km in contravention with UN and IOTC Resolutions, and that their use is considered to have a substantial impact on marine ecosystems. **NOTING** that in 2012 the Commission adopted Resolution 12/01 on the implementation of the precautionary approach, the majority of the SC **RECOMMENDED** that the Commission freeze catch and effort by gillnet fisheries in the Indian Ocean in the near future, until sufficient information has been gathered to determine the impact of gillnet fleets on IOTC stocks and bycatch species caught by gillnet fisheries targeting tuna and tuna-like species, noting that the implementation of any such measure would be difficult.

Sharks – Status of catch statistics and data reporting

(para.99) **NOTING** that Resolution 10/02 *mandatory statistical requirements for IOTC members and Cooperating Non-Contracting Parties (CPC's)*, makes provision for data to be reported to the IOTC on "*the most commonly caught shark species and, where possible, to the less common shark species*", without giving any list defining the most common and less common species, and recognising the general lack of shark data being recorded and reported to the IOTC Secretariat, the SC **RECOMMENDED** that Resolution 10/02 is revised in order to include the list of most commonly caught elasmobranch species (Table 3) for which nominal catch data shall be reported as part of the statistical requirement for IOTC CPCs.

Sharks – Inclusion of two additional shark species to the list of mandatory data requirements for longline gear (Res 12/03)

(para.110) The SC **RECOMMENDED** that, in line with Recommendation 12/15 on the best available science, the list of shark species (or groups of species) for longline gear under Resolution 12/03 should be supplemented by two other shark species which were estimated to be at risk in longline fisheries by the ERA conducted in 2012, the silky shark (*Carcharinus falciformis*) and the oceanic whitetip shark (*Carcharinus longimanus*). The SC **ADVISED** the Commission to define the most appropriate means of collecting this additional information, considering the limitations of both options (logbooks and/or regional observer scheme) presented in paragraphs 108 and 109.

Sharks – Fin to body weight ratio

(para.111) The SC **ADVISED** the Commission to consider, that the best way to encourage full utilisation of sharks, to ensure accurate catch statistics, and to facilitate the collection of biological information, is to revise the IOTC Resolution 05/05 *concerning the conservation of sharks caught in association with fisheries managed by IOTC* such that all sharks must be landed with fins attached (naturally or by other means) to their respective carcass. However, the SC **NOTED** that such an action would have practical implementation and safety issues for some fleets and may degrade the quality of the product in some cases. The SC **RECOMMENDED** all CPCs to obtain and maintain the best possible data for IOTC fisheries impacting upon sharks, including improved species identification.

Sharks – Wire leaders/traces

(para.113) On the basis of information presented to the SC in 2011 and in previous years, the SC **RECOGNISED** that the use of wire leaders/traces in longline fisheries may imply targeting of sharks. The SC therefore **RECOMMENDED** to the Commission that if it wishes to reduce catch rates of sharks by longliners it should prohibit the use of wire leaders/traces.

Marine turtles – Data and reporting requirements

(para.114) The SC **RECOMMENDED** that IOTC Resolution 12/04 *on the conservation of marine turtles* is strengthened to ensure that CPCs report annually on the level of incidental catches of marine turtles by species, as provided at Table 6.

Report of the Fourth Session of the Working Party on Methods (WPM04)

Capacity building

(para.128) The SC **RECOMMENDED** that the IOTC Secretariat coordinate the development and delivery of several training workshops focused on providing assistance to developing CPCs to better understand the MSE process, including how reference points and harvest control rules are likely to function in an IOTC context. The implications of IOTC Resolution 12/01 *on the implementation of the precautionary approach* and IOTC Recommendation 12/14 *on interim target and limit reference points* should be incorporated into the workshop. The SC **REQUESTED** that the Commission's budget incorporate appropriate funds for this purpose.

Report of the Second Session of the Working Party on Neritic Tunas (WPNT02)

(para.165) The SC **RECOMMENDED** that the Commission note that neritic tuna and tuna-like species under the IOTC mandate have become as important or more important as the three tropical tuna species (bigeye tuna, skipjack tuna and yellowfin tuna) to most IOTC coastal states with a total estimated catch of 605,359 t being landed in 2011, and as a result, should be receiving appropriate management resources from the IOTC. In fact, neritic tuna species are in many cases, the major commercial tuna and tuna-like species being exploited by the majority of Indian Ocean coastal states and as such, should be given the same status in terms of time and resource investment.

Matters common to Working Parties

Capacity building activities

(para.177) The SC **RECOMMENDED** that the Commission increase the IOTC Capacity Building budget line so that capacity building workshops/training can be carried out in 2013 and 2014 on the collection, reporting and analyses of catch and effort data for neritic tuna and tuna-like species. Where appropriate this training session shall include information that explains the entire IOTC process from data collection to analysis and how the information collected is used by the Commission to develop Conservation and Management Measures.

Dedicated workshop on CPUE standardisation

(para.189) **NOTING** the combined recommendations from the WPB, WPTmT and WPTT to hold a dedicated workshop on CPUE standardisation, the SC **RECOMMENDED** that a dedicated, informal workshop on CPUE standardisation, including issues of interest for other IOTC species, should be carried out before the next round of stock assessments in 2013. The terms of reference (TORs) for the workshop are provided in Appendix VII. Where possible it should include a range of invited experts, including those working on CPUE standardisation in other ocean/RFMOs, in conjunction with scientists from main tuna fishing countries, and supported by the IOTC Secretariat. The IOTC Secretariat shall include a budget item for this workshop, for the consideration of the Commission.

On Interim Target and Limit Reference Points

(para.194) **NOTING** the completion of the MSE work on tropical tunas is likely to take several years, and that the lack of data or information to improve the work on formal stock assessments should not hinder the application of the Precautionary Approach, the SC **RECOMMENDED** that the Commission consider the adoption of the interim target and limit reference points as a Resolution. Furthermore, interim harvest controls rules should be considered by the Commission for adoption in the Resolution.

Employment of a Fisheries Officer (Science)

(para.195) **NOTING** the rapidly increasing scientific workload at the IOTC Secretariat, including a wide range of additional science related duties assigned to it by the SC and the Commission, and that the current Fishery Officer supporting the IOTC scientific activities will depart at the end of February 2013, the SC strongly **RECOMMENDED** that the Commission approve the hiring of a Fishery Officer (Science) to work on a range of matters in support of the scientific process, including but not limited to science capacity building, bycatch and regional observer schemes.

Review of the Draft, and Adoption of the Report of the Fifteenth Session of the Scientific Committee

(para.251) The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC15, provided at Appendix XXXVIII.

TABLE 1. Status summary for species of tuna and tuna-like species under the IOTC mandate, as well as other species impacted by IOTC fisheries.

Stock	Indicators	Prev[1]	2010	2011	2012	Advice to the Commission
Temperate and tropical tuna stocks: These are the main stocks being exploitation by industrial, and to a lesser extent, artisanal fisheries throughout the Indian Ocean, both on the high seas and in the EEZ of coastal states.						
Albacore *Thunnus alalunga*	Catch 2011: 38,946 t Average catch 2007–2011: 41,609 t MSY (80% CI)): 33,300 t (31,100–35,600 t) F_{2010}/F_{MSY} (80% CI): 1.33 (0.9–1.76) SB_{2010}/SB_{MSY} (80% CI): 1.05 (0.54–1.56) SB_{2010}/SB_{1950} (80% CI): 0.29 (n.a.)					Maintaining or increasing effort in the core albacore fishing grounds is likely to result in further declines in albacore biomass, productivity and CPUE. The impacts of piracy in the western Indian Ocean has resulted in the displacement of a substantial portion of longline fishing effort into the traditional albacore fishing areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on albacore will decline in the near future unless management action is taken. <click here for full stock status summary>
Bigeye tuna *Thunnus obesus*	Catch in 2011: 87,420 t Average catch 2007–2011: 101,639 t SS3[3] / ASPM[4] MSY (1000 t): 114 t (95–183 t) / 103 t (87–119 t) [2]F_{curr}/F_{MSY}: 0.79 (0.50–1.22) / 0.67 (0.48–0.86) [2]SB_{curr}/SB_{MSY}: 1.20 (0.88–1.68) / 1.00 (0.77–1.24) [2]SB_{curr}/SB_0: 0.34 (0.26–0.40) / 0.39					The recent declines in longline effort, particularly from the Japanese, Taiwan,China and Republic of Korea longline fleets, as well as purse seine effort have lowered the pressure on the Indian Ocean bigeye tuna stock, indicating that current fishing mortality would not reduce the population to an overfished state in the near future. <click here for full stock status summary>
Skipjack tuna *Katsuwonus pelamis*	Catch 2011: 398,240 t Average catch 2007–2011: 435,527 t MSY (1000 t): 478 t (359–598 t) F_{2011}/F_{MSY}: 0.80 (0.68–0.92) SB_{2011}/SB_{MSY}: 1.20 (1.01–1.40) SB_{2011}/SB_0: 0.45 (0.25–0.65)					The recent declines in catches are thought to be caused by a recent decrease in purse seine effort as well as due to a decline in CPUE of large skipjack tuna in the surface fisheries. Catches in 2010 (428,000 t) and 2011 (398,240 t) as well as the average level of catches of 2007–2011 (435,527 t) are below MSY targets though may have exceeded them in 2005 and 2006. <click here for full stock status summary>
Yellowfin tuna *Thunnus albacares*	Catch 2011: 302,939 t Average catch 2007–2011: 302,064 t MSY (1000 t): 344 (290–453) F_{2010}/F_{MSY}: 0.69 (0.59–0.90) SB_{2010}/SB_{MSY}: 1.24 (0.91–1.40) SB_{2010}/SB_0: 0.38 (0.28–0.38)					The decrease in longline and purse seine effort in recent years has substantially lowered the pressure on the Indian Ocean stock as a whole, indicating that current fishing mortality has not exceeded the MSY-related levels in recent years. If the security situation in the western Indian Ocean were to improve, a rapid reversal in fleet activity in this region may lead to an increase in effort which the stock might not be able to sustain, as catches would then be likely to exceed MSY levels. <click here for full stock status summary>

Stock	Indicators	Prev[1]	2010	2011	2012	Advice to the Commission
Billfish: These are the billfish stocks being exploitation by industrial and artisanal fisheries throughout the Indian Ocean, both on the high seas and in the EEZ of coastal states. The marlins and sailfish are not usually targeted by most fleets, but are caught and retained as byproduct by the main industrial fisheries. They are important for localised small-scale and artisanal fisheries or as targets in recreational fisheries.						
Swordfish (whole IO) *Xiphias gladius*	Catch 2011: 19,631 t Average catch 2007–2011: 21,870 t MSY: 29,900–34,200 t F_{2009}/F_{MSY}: 0.50–0.63 SB_{2009}/SB_{MSY}: 1.07–1.59 SB_{2009}/SB_0: 0.30–0.53					The decrease in longline catch and effort in recent years has lowered the pressure on the Indian Ocean stock as a whole, indicating that current fishing mortality would not reduce the population to an overfished state. There is a low risk of exceeding MSY-based reference points by 2019 if catches reduce further or are maintained at current levels until 2019 (<11% risk that $B_{2019} < B_{MSY}$, and <9% risk that $F_{2019} > F_{MSY}$). <click here for full stock status summary>
Swordfish (southwest IO) *Xiphias gladius*	Catch 2011: 6,559 t Average catch 2007–2011: 6,939 t MSY: 7,100 t–9,400 t F_{2009}/F_{MSY}: 0.64–1.19 SB_{2009}/SB_{MSY}: 0.73–1.44 SB_{2009}/SB_0: 0.16–0.58					The decrease in catch and effort over the last few years in the southwest region has reduced pressure on this resource. However, in 2010, catches exceeded the maximum recommended by the WPB09 and SC14 in 2011 (6,678 t), with 8,046 t caught in this region. The WPB09 estimated that there is a low risk of exceeding MSY-based reference points by 2019 if catches reduce further or are maintained at 2009 levels (<25% risk that $B_{2019} < B_{MSY}$, and <8% risk that F2019 > F_{MSY}). There is a risk of reversing the rebuilding trend if there is any increase in catch in this region. <click here for full stock status summary>
Black marlin *Makaira indica*	Catch 2011: 6,890 t Average catch 2007–2011: 6,292 t MSY (range): unknown					Longline catch and effort for black marlin in recent years has continued to increase to a total of 7,021 tonnes in 2010. Although a lower catch of 6,890 tonnes was caught in 2011, the pressure on the Indian Ocean stock as a whole remains highly uncertain. Thus, there remains insufficient information to evaluate the effect this will have on the resource. <click here for full stock status summary>
Blue marlin *Makaira nigricans*	Catch 2011: 12,115 t Average catch 2007–2011: 9,443 t MSY (range): unknown					The decrease in longline catch and effort in recent years has lowered the pressure on the Indian Ocean stock as a whole, although 2011 catches increased substantially to 12,115 t. There is insufficient information to evaluate the effect this will have on the resource at this point in time. Given the concerning results obtained from the preliminary stock assessments carried out in 2012 for blue marlin, the data and other inputs for stock assessment urgently needs to be revised so that a new assessment may be carried out in 2013. <click here for full stock status summary>
Striped marlin *Tetrapturus audax*	Catch 2011: 1,885 t Average catch 2007–2011: 2,245 t MSY (range): unknown					The decrease in longline catch and effort in recent years has lowered the pressure on the Indian Ocean stock as a whole, however there is insufficient information to evaluate the effect this will have on the resource. Given the concerning results obtained from the preliminary stock assessments carried out in 2012 for striped marlin, the data and other inputs for stock assessment urgently needs to be revised so that a new assessment may be carried out in 2013. <click here for full stock status summary>
Indo-Pacific Sailfish *Istiophorus platypterus*	Catch 2011: 32,503 t Average catch 2007–2011: 27,103 t MSY (range): unknown					The increase in longline catch and effort in recent years is a substantial cause for concern for the Indian Ocean stock as a whole, however there is not sufficient information to evaluate the effect this will have on the resource. <click here for full stock status summary>

Stock	Indicators	Prev[1]	2010	2011	2012	Advice to the Commission
Neritic tunas and mackerel: These six species have become as important or more important as the three tropical tuna species (bigeye tuna, skipjack tuna and yellowfin tuna) to most IOTC coastal states with a total estimated catch of 605,359 t being landed in 2011. They are caught primarily by coastal fisheries, including small-scale industrial and artisanal fisheries. They are almost always caught within the EEZs of IO coastal states. Historically, catches were often reported as aggregates of various species, making it difficult to obtain appropriate data for stock assessment analyses.						
Bullet tuna *Auxis rochei*	Catch 2011: 4,949 t Average catch 2007–2011: 2,961 t MSY (range): unknown					The continued increase of annual catches for these species are likely to have further increased the pressure on the Indian Ocean stocks as a whole, however there is not sufficient information to evaluate the effect this will have on the resources. Research emphasis on improving indicators and exploration of stock structure and stock assessment approaches for data poor fisheries are warranted. • bullet tuna <click here for full stock status summary> • frigate tuna <click here for full stock status summary> • kawakawa <click here for full stock status summary> • longtail tuna <click here for full stock status summary> • Indo-Pacific king mackerel <click here for full stock status summary> • narrow-barred Spanish mackerel <click here for full stock status summary>
Frigate tuna *Auxis thazard*	Catch 2011: 83,210 t Average catch 2007–2011: 75,777 t MSY (range): unknown					
Kawakawa *Euthynnus affinis*	Catch 2011: 143,393 t Average catch 2007–2011: 134,314 t MSY (range): unknown					
Longtail tuna *Thunnus tonggol*	Catch 2011: 177,795 t Average catch 2007–2011: 134,871 t MSY (range): unknown					
Indo-Pacific king mackerel *Scomberomorus guttatus*	Catch 2011: 49,832 t Average catch 2007–2011: 44,457 t MSY (range): unknown					
Narrow-barred Spanish mackerel *Scomberomorus commerson*	Catch 2011: 146,180 t Average catch 2007–2011: 130,476 t MSY (range): unknown					
Sharks: Although sharks are not part of the 16 species directly under the IOTC mandate, sharks are frequently caught in association with fisheries targeting IOTC species. Some fleets are known to actively target both sharks and IOTC species simultaneously. As such, IOTC Members and Cooperating non-Contracting Parties are required to report information at the same level of detail as for the 16 IOTC species. The following are the main species caught in IOTC fisheries, although the list is not exhaustive.						
Blue shark *Prionace glauca*	Reported catch 2011: 9,540 t Not elsewhere included (nei) sharks: 55,135 t Average reported catch 2007–2011: 9,452 t Not elsewhere included (nei) sharks: 63,783 t MSY (range): unknown					Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on sharks will decline in these areas in the near future, and may result in localised depletion. • blue shark <click here for full stock status summary> • oceanic whitetip shark <click here for full stock status summary> • scalloped hammerhead shark <click here for full stock status summary> • shortfin mako shark <click here for full stock status summary> • silky shark <click here for full stock status summary> • bigeye thresher shark <click here for full stock status summary> • pelagic thresher shark <click here for full stock status
Oceanic whitetip shark *Carcharhinus longimanus*	Reported catch 2011: 388 t Not elsewhere included (nei) sharks: 55,135 t Average reported catch 2007–2011: 347 t Not elsewhere included (nei) sharks: 63,783 t MSY (range): unknown					
Scalloped hammerhead shark *Sphyrna lewini*	Reported catch 2011: 120 t Not elsewhere included (nei) sharks: 55,135 t Average reported catch 2007–2011: 36 t Not elsewhere included (nei) sharks: 63,783 t MSY (range): unknown					
Shortfin mako *Isurus oxyrinchus*	Reported catch 2011: 1,361 t Not elsewhere included (nei) sharks: 55,135 t Average reported catch 2007–2011: 1,207 t					

	Not elsewhere included (nei) sharks:	63,783 t					summary>
	MSY (range):	unknown					
Silky shark *Carcharhinus falciformis*	Reported catch 2011:	3,353 t					
	Not elsewhere included (nei) sharks:	55,135 t					
	Average reported catch 2007–2011:	1,396 t					
	Not elsewhere included (nei) sharks:	63,783 t					
	MSY (range):	unknown					
Bigeye thresher shark *Alopias superciliosus*	Reported catch 2011:	330 t					
	Not elsewhere included (nei) sharks:	55,135 t					
	Average reported catch 2007–2011:	68 t					
	Not elsewhere included (nei) sharks:	63,783 t					
	MSY (range):	unknown					
Pelagic thresher shark *Alopias pelagicus*	Reported catch 2011:	10 t					
	Not elsewhere included (nei) sharks:	55,135 t					
	Average reported catch 2007–2011:	4 t					
	Not elsewhere included (nei) sharks:	63,783 t					
	MSY (range):	unknown					

[1] This indicates the last year taken into account for assessments carried out before 2010
[2]Current period ($_{curr}$) = 2009 for SS3 and 2010 for ASPM.
[3]Central point estimate is adopted from the 2010 SS3 model, percentiles are drawn from a cumulative frequency distribution of MPD values with models weighted as in Table 12 of 2010 WPTT report (IOTC–2010–WPTT12–R); the range represents the 5th and 95th percentiles.
[4]Median point estimate is adopted from the 2011 ASPM model using steepness value of 0.5 which is the most conservative scenario (values of 0.6, 0.7 and 0.8, which are more optimistic, are considered to be as plausible as these values but are not presented for simplification); the range represents the 90 percentile Confidence Interval.

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		
Not assessed/Uncertain		

1. OPENING OF THE SESSION

1. The Fifteenth Session of the Indian Ocean Tuna Commission's (IOTC) Scientific Committee (SC) was held on Mahé, Seychelles, from 10 to 15 December 2012. A total of 54 individuals attended the Session, comprised of 46 delegates from 21 Member countries and 0 delegates from Cooperating Non-Contracting Parties, as well as 9 observers and invited experts. The list of participants is provided at Appendix I.

2. The meeting was opened on 10 December, 2012 by the Chair Dr. Tom Nishida (Japan) who welcomed participants to the Seychelles. The Chair informed participants that the Vice-Chair Mr. Jan Robinson was unable to attend the Session and sent his apologies.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

3. The SC **ADOPTED** the Agenda provided at Appendix II. The documents presented to the SC are listed in Appendix III.

4. **NOTING** that the current FAO rules regarding the time permissible for FAO interpreters to cover sessions of IOTC bodies (FAO interpreters are restricted to a maximum of two, three hour sessions in a single day which would include any short breaks taken by participants), the SC **REQUESTED** that the SC Chair write to the FAO office concerned and indicate that this rule is a serious obstruction to the efficient working of IOTC meetings. The letter should include a request that a short 15 minute break should be allowed in the FAO rules, which would not be counted towards each three hour interpretation block.

3. ADMISSION OF OBSERVERS

5. The SC **NOTED** that at the Sixteenth Session of the Commission, Members decided that its subsidiary bodies should be open to participation by observers from all those who have attended the current and/or previous sessions of the Commission. Applications by new Observers should continue to follow the procedure as outlined in Rule XIII of the IOTC Rules of Procedure.

6. The SC **ADMITTED** the following observers to the Fifteenth Session of the SC:
   - Indian Ocean – South-East Asian Marine Turtle Memorandum of Understanding (IOSEA)
   - International Seafood Sustainability Foundation (ISSF)
   - Overseas Fishery Cooperation Foundation of Japan (OFCF)
   - Marine Stewardship Council (MSC)
   - World Wide Fund for Nature (a.k.a World Wildlife Fund, WWF)

Invited experts

7. The SC **ADMITTED** the invited experts from Taiwan,China, under Rule X.4 and XIII.9 of the IOTC Rules of Procedure, which states that the Commission may invite experts, in their individual capacity, to enhance and broaden the expertise of the SC and of its Working Parties.

4. DECISIONS OF THE COMMISSION RELATED TO THE WORK OF THE SCIENTIFIC COMMITTEE

8. The SC **NOTED** paper IOTC–2012–SC15–03 which outlined the decisions and requests made by the Commission at its Sixteenth Session, held from 22–26 April 2012, specifically relating to the work of the SC, including the 15 Conservation and Management Measures (13 Resolutions and two Recommendations) adopted during the Session. The SC **AGREED** to develop advice in response to each of the requests made by the Commission during the current Session.

9. The SC **NOTED** paper IOTC–2012–SC15–04 which outlined a number of Commission decisions, in the form of previous Resolutions that require a response from the SC in 2012, and **AGREED** to develop advice to the Commission in response to each request during the current session.

5. SCIENCE RELATED ACTIVITIES OF THE IOTC SECRETARIAT IN 2012

10. The SC **NOTED** paper IOTC–2012–SC15–05 which provided an overview of the work undertaken by the IOTC Secretariat in 2012, including the following key activities: 1) Second Working Party on Neritic Tunas; 2) Second stock assessment for skipjack tuna; and 3) the continued increase in participation at IOTC scientific meetings by developing coastal states, including via the submission of working papers.

11. The SC **NOTED** with thanks, the contributions of the staff of the IOTC Secretariat to the science process in 2012, in particular via support to the working party and SC meetings, facilitation of the IOTC Meeting Participation Fund, improvements in the quality of some of the data sets being collected and submitted to the IOTC Secretariat, preparation of the bycatch species identification guides, and through the facilitation of invited experts to raise the standard of IOTC meetings.

Meeting Participation Fund (MPF)

12. The SC **NOTED** that the Commission, at its 16th Session adopted revised rules of procedure for the administration of the IOTC Meeting Participation Fund (MPF). As the main goal of the MPF is to increase the participation of developing CPCs to scientific meetings of IOTC, and in line with paragraph 6 of Resolution 10/05, applications to the MPF are only eligible if the applicant intends to produce and present a working paper relevant to the working party that he/she wishes to attend, or a CPC National Report if the meeting is the SC.

13. The SC **NOTED** that the increased attendance by national scientists from developing CPCs to IOTC Working Parties and the SC in 2012 (46 in 2012; 33 in 2011) was partly due to the IOTC MPF, adopted by the Commission in 2010 (Resolution 10/05 *on the establishment of a Meeting Participation Fund for developing IOTC Members and non-Contracting Cooperating Parties*), and **RECOMMENDED** that the Commission maintain this fund into the future.

14. The SC **NOTED** that the MPF is currently funded through accumulated IOTC budgetary funds and voluntary contributions by CPCs. The Commission may need to develop and implement a procedure for supplying funds to the MPF in the future, as detailed in Resolution 10/05.

15. The SC **RECOMMENDED** that the rules of procedure for the administration of the IOTC meeting participation fund be modified to include funding for Chairs and Vice-Chairs from IOTC developing coastal states, noting that without access to this fund, the ability of developing coastal state scientists to offer their services as Chairs and Vice-Chairs will be very limited. The same rules for document provision shall apply to Chairs and Vice-Chairs funded by the MPF.

16. The SC **NOTED** that for 2011 and 2012, all MPF recipients developed and presented at least one working paper or National Report, relevant to the meeting in which the Commission funded their attendance. The papers presented to IOTC meetings by MPF recipients have continued to improve in quality as a direct result of improved attendance and participation by scientists from developing coastal states.

IOTC-OFCF Project, 2012

17. The SC **NOTED** paper IOTC–2012–SC15–INF01, which outlined the key activities undertaken by the IOTC-OFCF project in 2012. The Memorandum of Understanding between the IOTC and the Overseas Fishery Cooperation Foundation of Japan (OFCF) was initiated in April 2002, with the aim of providing technical guidance to developing countries in the IOTC area of competence, in particular to improve data collection methods and the quality of fisheries statistics being reported to the IOTC Secretariat. Phases I and II of the project ran for eight consecutive years. At the end of Phase II the IOTC and the OFCF considered the implementation of a new Phase with the objective of addressing the concerns of the Commission regarding the quality of the data available for several important artisanal fisheries in the region. Following consideration of the proposal, the OFCF agreed to initiate Phase III of the project, of which, the terms of reference focused on strengthening observer schemes.

18. The SC **THANKED** Japan and the IOTC Secretariat for providing financial and technical support to assist the implementation of the IOTC Observer Scheme in coastal countries of the IOTC area of competence and **RECOMMENDED** that Japan consider an extension of IOTC–OFCF Project activities in the future.

Glossary of scientific terms, acronyms and abbreviations

19. **NOTING** paper IOTC–2012–SC15–INF03 which provided a glossary of scientific terms, acronyms and abbreviations, and report terminology, for the most commonly used scientific terms in IOTC reports and Conservation and Management Measures (CMM), the SC **ENCOURAGED** all authors of papers to be submitted to the IOTC to use the definitions contained in the glossary. The SC indicated that it may wish to modify these incrementally in the future.

Species data catalogues

20. **NOTING** paper IOTC–2012–SC15–INF04 which provided data catalogues for IOTC species and CPCs landing those species, the SC **THANKED** the IOTC Secretariat for preparing the IOTC Data Catalogues, on the quality of nominal catch, catch-and-effort, and size frequency data, and **REQUESTED** that the IOTC Secretariat updates the Catalogues as new information become available.

21. The SC **EXPRESSED** concern that in spite of the efforts by some CPCs and the IOTC Secretariat to improve the quality of data collection, management and reporting in the IOTC area of competence, the quality of the data in the IOTC database appears to be worsening. The decline in data quality observed may be associated with the onset of piracy in the western tropical area in 2007, leading to a drop in the activities and catches of some industrial fleets that have traditionally reported higher quality data.

Pilot project: Improvements to data collections from artisanal fisheries

22. The SC **NOTED** paper IOTC–2012–SC15–38 which provided an overview of the pilot project to improve data collection for tuna, sharks and billfish from artisanal fisheries in the Indian Ocean. Specifically, the project aimed at revising catch statistics for India, Indonesia and Sri Lanka from 1950 to 2011.

23. The SC **ACKNOWLEDGED** the excellent work undertaken by the consultant in collaboration with the IOTC Secretariat in undertaking this thorough, difficult and highly valuable work, including the identification of deficiencies in data collection and reporting by India, Indonesia and Sri Lanka.

24. The SC **NOTED** the comments from various participants which highlighted that data collection and reporting abilities by CPCs are highly variable. CPCs indicated that they are committed to continue to update and improve data collection and reporting systems as resources permit.

25. The SC **NOTED** the difficulties that some CPCs had to provide the information requested by the consultant which usually originate on fragmented data collection and management systems, and the difficulties that some countries have to put together this information. The SC **STRESSED** the need for all CPCs to establish data collection and management systems so as fisheries statistics can be produced for the whole country and as per the mandatory reporting requirements for all CPCs.

IOTC website development

26. The SC **NOTED** the work undertaken by the IOTC Secretariat and a company to complete the new IOTC website. The new website is expected to go live in early March, 2013 once it has been populated with all historical IOTC documents and related material.

6. National Reports from CPCs

27. The SC **NOTED** the 26 National Reports presented by CPCs (Contracting parties and cooperating non-contracting parties) for the meeting, the abstracts of which are provided at Appendix IV. The following matters were raised in regard to the content of specific reports:
    - **Australia**: The SC **NOTED** that catch statistics for sharks in Australian recreational fisheries in the IOTC area of competence are not well estimated at present, although improvements are being made. The SC also noted that no skipjack tuna was caught by Australian vessels in the IOTC area of competence in 2012, as purse seine vessels limited their targeting to southern bluefin tuna.
    - **Belize**: National Report not presented orally as Belize was absent from the SC15 meeting.
    - **China**: Nil comments.
    - **Comoros**: The SC **NOTED** that the current tagging research program funded by the South West Indian Ocean Fisheries Program (SWIOFP) in the Comoros will cease at the end of March 2013, once the current funding arrangement concludes.
    - **Eritrea**: The SC **EXPRESSED** its disappointment that Eritrea did not provide a National Report and **REQUESTED** that the SC Chair remind Eritrea to fulfil its reporting obligations to the IOTC.
    - **European Union** (EU): The SC **NOTED** that the EU report does not include shark discards by some of the EU longline fleets for 2011, as requested by the SC in the National Report template. The EU indicated that the information is provided in historical documents provided to the working parties. In a question regarding the EU observer program which resumed in 2011 for purse seine vessels, the EU indicated that the current coverage rate is approximately 10%, although coverage is limited to areas which are not impacted by piracy activities (most of the western Indian Ocean).
    - **France (territories)**: Nil comments.
    - **Guinea**: The SC **EXPRESSED** its disappointment that Guinea did not provide a National Report and **REQUESTED** that the SC Chair remind the Guinea to fulfil its reporting obligations to the IOTC.

- **India**: The SC **NOTED** the slightly improved situation by India in regard to the mandatory data reporting requirements, as well as the consultations underway with various stakeholders to further improve data collection and reporting. However, substantial improvements remain to be made and higher quality data needs to be provided by India in 2013.
- **Indonesia**: The SC **NOTED** that although the proportion of longline catches of tuna and tuna-like species by Indonesia has continued to increase, catch and effort data as per IOTC requirements is yet to be reported (spatial distribution of catch and effort). Indonesia will provide catch and effort statistics by species, gear and location in accordance with IOTC recording and reporting requirements. The SC **NOTED** that, to date, Indonesia has not reported catch-and-effort data to the IOTC Secretariat, and the provision of size frequency data was discontinued in 2010. The SC **REQUESTED** Indonesia to make the necessary arrangements for this information to be reported in the future.
- **Iran, Islamic Republic of**: The SC **NOTED** that since 2007 the area of operation for I.R. Iran gillnet and purse seine vessels has been substantially reduced as a direct result of piracy activities in the western Indian Ocean. In response to a comment which highlighted the fact that although the I.R. Iran has provided preliminary catch, effort, and size data, by type of vessel, gear, year, month and Province, the data remains incomplete, as it has not been reported by IOTC requirements. I.R. Iran was encouraged to complete this information and report data as per IOTC reporting requirements (Resolution 10/02) in 2013. The I.R. Iran indicated that the lack of bigeye tuna in the reported catch of both purse seine and gillnet vessels was probably due to species identification issues and that it would continue to improve reporting from its purse seine and gillnet fleets.
- **Japan**: The SC **NOTED** the size frequency samples collected on longliners from Japan come from different fishing platforms, including samples collected on training vessels and samples collected from the commercial fishery, by fishers and scientific observers. For this reason, Japan was reminded of the need to provide separate series of size frequency samples, by type of sampler and sampling platform, and assess which dataset(s) are representative of Japan's longline fishery. Japan acknowledged the conflicting estimates of average weight derived from operational catch and size frequency datasets for its longline fisheries and the concerning effect that the problems identified may have on the assessments of tuna and billfish species. Japan indicated that in order to clarify these issues, it will endeavour to identify deficiencies in the size sampling program. Japan also indicated that it would provide a breakdown of its shark catches in the 2013 National Report to the SC, specifically on the numbers of sharks retained and discarded by species.
- **Kenya**: Nil comments.
- **Korea, Republic of**: The SC **NOTED** that the electronic logbooks currently in use by Korean vessels operating in the IOTC area of competence are reporting near real-time data (once logbooks are completed, they are submitted via email to the responsible regulatory authority). In response to a question about the levels of shark discarding by longline vessels from the R.O. Korea, it was indicated that current discard rates are being calculated based on observed rates from 2010, due to a lack of scientific observers being deployed on vessels in recent years.
- **Madagascar**: Nil comments.
- **Malaysia**: Nil comments.

Maldives, Republic of: The SC **CONGRATULATED** the Maldivian pole and line fishing industry on achieving Marine Stewardship Council (MSC) certification of their pole and line fishery, thereby becoming the first Indian Ocean fishery for tuna or tuna-like species to receive certification according to the MSC standards. The Maldives indicated that it would be willing to share its experiences with other IOTC CPCs and thanked all stakeholders, the MSC, the Conformity Assessment Body, and NGOs. The Maldives efforts and leadership role in driving sustainable management of tuna fisheries in the Indian Ocean, and their commitment to improve the management of the Indian Ocean skipjack fishery through their strong participation in the IOTC was acknowledged. Certification of this fishery constitutes an example of the benefits of improved governance focused on sustainability.

- **Mauritius**: The SC **NOTED** that the artisanal fleet of Mauritius around FADs is mainly targeting albacore at depths of around 300 m.
- **Mozambique**: Nil comments.
- **Oman, Sultanate of**: National Report not presented orally as Oman was absent from the SC15 meeting.
- **Pakistan**: The SC **EXPRESSED** its disappointment that Pakistan did not provide a National Report and urged Pakistan to fulfil its reporting obligations to the IOTC.
- **Philippines**: National Report not presented orally as the Philippines was absent from the SC15 meeting.
- **Seychelles, Republic of**: Nil comments.

- **Sierra Leone**: The SC **EXPRESSED** its disappointment that Sierra Leone did not provide a National Report and urged Sierra Leone to fulfil its reporting obligations to the IOTC.
- **Sri Lanka**: The SC **NOTED** that as Sri Lanka produced catch data based on port sampling, almost none of the total catch taken by Sri Lankan vessels can be accurately assigned to either the EEZ of Sri Lanka or the high seas, or at any other spatial scale. The lack of spatial data has a negative impact on stock assessments for IOTC species, for instance when we considered that Sri Lanka is ranked first for skipjack tuna catches in the IOTC area of competence. However, improvements have been made by Sri Lanka to its data collection, monitoring and reporting systems, and Sri Lanka indicated that as the logbook program expands, the improved data will be provided to the IOTC Secretariat.
- **Sudan**: The SC **NOTED** the importance of using correct terminology when discussing IOTC species, in particular when describing catch of tuna and mackerel species under the IOTC mandate.
- **Tanzania, United Republic of**: The SC **EXPRESSED** its disappointment that Tanzania did not provide a National Report and urged Tanzania to fulfil its reporting obligations to the IOTC.
- **Thailand**: Nil comments.
- **United Kingdom (OT)**: The SC **NOTED** the excellent quality of the size frequency data collected by the recreational fishing of the UK(OT) and encouraged other IOTC CPCs to collect similar data from their sport fishery.
    i. The SC **NOTED** the following statement made by the Republic of Mauritius:

    "The Government of the Republic of Mauritius does not recognize the so-called "British Indian Ocean Territory" ("BIOT") which the United Kingdom purported to create by illegally excising the Chagos Archipelago from the territory of Mauritius prior to its accession to independence. This excision was carried out in violation of international law and United Nations General Assembly Resolutions 1514 (XV) of 14 December 1960, 2066 (XX) of 16 December 1965, 2232 (XXI) of 20 December 1966 and 2357 (XXII) of 19 December 1967.

    The Government of the Republic of Mauritius reiterates that the Chagos Archipelago, including Diego Garcia, forms an integral part of the territory of the Republic of Mauritius under both Mauritian law and international law.

    The Government of the Republic of Mauritius does not also recognize the existence of the 'marine protected area' which the United Kingdom has purported to establish around the Chagos Archipelago in breach of international law, including the provisions of the United Nations Convention on the Law of the Sea (UNCLOS). On 20 December 2010, Mauritius initiated proceedings against the United Kingdom under Article 287 of, and Annex VII to, the United Nations Convention on the Law of the Sea to challenge the legality of the 'marine protected area." The dispute is currently before the Arbitral Tribunal constituted under Annex VII to UNCLOS.

    ii. The SC **NOTED** the following statement made by the United Kingdom: "The UK has no doubt about its sovereignty over the British Indian Ocean Territory which was ceded to Britain in 1814 and has been a British dependency ever since. As the UK Government has reiterated on many occasions, we have undertaken to cede the Territory to Mauritius when it is no longer needed for defence purposes."
- **Vanuatu**: The SC **EXPRESSED** its disappointment that Vanuatu did not provide a National Report and urged Vanuatu to fulfil its reporting obligations to the IOTC.
- **Yemen**: The SC **WELCOMED** the Yemen to the IOTC as its newest Member, however the SC **EXPRESSED** its disappointment that Yemen did not provide a National Report or attend the SC meeting in 2012, and urged Yemen to fulfil its reporting obligations to the IOTC.
- **Senegal**: National Report not presented orally as Senegal was absent from the SC15 meeting.
- **South Africa, Republic of**: National Report not presented orally as South Africa was absent from the SC15 meeting.

28. The SC **NOTED** the report provided by the Invited Experts from Taiwan,China which outlined fishing activities in the IOTC area of competence.

Recommendation/s

29. **NOTING** that the Commission, at its 15th Session, expressed concern regarding the limited submission of National Reports to the SC, and stressed the importance of providing the reports by all CPCs, the SC **RECOMMENDED** that the Commission note that in 2012, 26 reports were provided by CPCs, up from 25 in 2011, 15 in 2010 and 14 in 2009 (Table 2).

30. The SC **REMINDED** CPCs that the purpose of the National Reports is to provide relevant information to the SC on fishing activities of Members and Cooperating Non-Contracting Parties operating in the IOTC area of

competence. The report should include all fishing activities for species under the IOTC mandate as well as sharks and other byproduct / bycatch species as required by the IOTC Agreement and decisions by the Commission. The submission of a National Report is mandatory, irrespective if a CPC intends on attending the annual meeting of the SC and shall be submitted no later than 15 days prior to the SC meeting.

31. The SC **REQUESTED** that the CPCs who did not submit a National Report in 2012 (Seven: Eritrea, Guinea, Pakistan, Sierra Leone, Tanzania, Vanuatu and Yemen), do so in 2013. The report is intended to provide a summary of the main features of the tuna and billfish fisheries for Members and Cooperating Non-Contracting Parties. As such, it does not replace the need for submission of data according to the IOTC Mandatory Data Requirements listed in the relevant IOTC Resolution [currently 10/02].

TABLE 2. CPC submission of National Reports to the SC from 2005 to 2012.

CPC	2005	2006	2007	2008	2009	2010	2011	2012
Australia								
Belize	n.a.	n.a.						
China								
Comoros								
Eritrea								
European Union								
France (territories)								
Guinea								
India								
Indonesia	n.a.	n.a.						
Iran, Islamic Republic of								
Japan								
Kenya								
Korea, Republic of								
Madagascar								
Malaysia								
Maldives, Republic of	n.a.	n.a.	n.a.	n.a.				
Mauritius								
Mozambique	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		
Oman, Sultanate of								
Pakistan								
Philippines								
Seychelles, Republic of								
Sierra Leone	n.a.	n.a.	n.a.					
Sri Lanka								
Sudan								
Tanzania, United Republic of	n.a.	n.a.						
Thailand								
United Kingdom (OT)								
Vanuatu								
Yemen	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Senegal*								
South Africa, Republic of*								

*Cooperating non-contracting party in 2012. Green = submitted. Red = not submitted. Green hash = submitted as part of EU report, although needed to be separate. n.a. = not applicable (not a CPC in that year).

Discussions on improving/modifying the National Reporting template

32. The SC **AGREED** that the National Reporting template should be maintained in its current format for 2013 and be reviewed annually for potential improvements.

Status of development and implementation of Nation Plans of Action for seabirds and sharks

33. The SC **NOTED** paper IOTC–2012–SC15–06 which provided the SC with the opportunity to update and comment on the current status of development and implementation of National Plans of Action for seabirds and sharks by each CPC.

34. The SC **NOTED** the adoption of an *Action Plan for reducing incidental catches of seabirds in fishing gears* by the EU in 2012 (IOTC–2012–SC15–INF07). The new Plan focuses on longline and gillnet fisheries where seabird bycatch are known to be highest, although other gears such as trawls and purse seines are also covered by the plan. It entails a wide range of elements under 30 recommended actions that are a combination of binding and non-binding measures. The rules will apply to EU fishing vessels inside and outside EU waters as well as non-EU vessels operating in EU waters. A copy of the Plan may be obtained from the EU or the IOTC Secretariat.

35. The SC **NOTED** that the original purpose of the FAO National Plans of Action for Seabirds (NPOA-Seabirds) in 1998 was to address concerns about longline fishing. However, recent information has shown significant concerns about seabird bycatch in several other capture fisheries, especially gillnet fishing. The 2009 FAO Best Practice Technical Guidelines, developed to assist in the preparation of NPOA-Seabirds, explicitly includes advice on longline, trawl and gillnet fisheries.

36. The SC **NOTED** that species such as cormorants and migratory shearwaters (which are common in coastal waters of many IOTC coastal states), are known to be especially vulnerable to bycatch in gillnet fisheries. CPCs operating gillnet fisheries were strongly **ENCOURAGED** to go through an NPOA-Seabirds assessment exercise. BirdLife International has previously offered assistance to CPCs wishing to assess the impacts of gillnet fishing in their national fisheries.

37. The SC **NOTED** the current status of development and implementation of Nation Plans of Action for sharks and **RECOMMENDED** that all CPCs without an NPOA-Sharks expedite the development and implementation of their NPOA-Sharks, and to report progress to the WPEB in 2013, recalling that NPOA-Sharks are a framework that should facilitate estimation of shark catches, and development and implementation of appropriate management measures, which should also enhance the collection of bycatch data and compliance with IOTC Resolutions.

38. The SC **RECOMMENDED** that the Commission note the updated status of development and implementation of National Plans of Action for sharks and seabirds, by each CPC as provided at Appendix V.

7. Reports of the 2012 IOTC Working Party Meetings

7.1 *Report of the Fourth Session of the Working Party on Temperate Tunas (WPTmT04)*

39. The SC **NOTED** the report of the Fourth Session of the Working Party on Temperate Tunas (IOTC–2012–WPTmT04–R), including the consolidated list of recommendations provided as an appendix to the report.

Data available at the Secretariat for temperate tuna species

40. The SC **NOTED** the main albacore data issues that are considered to negatively affect the quality of the statistics available at the IOTC Secretariat, by type of dataset and fishery, which are provided in Appendix VI of the WPTmT04 report (IOTC–2012–WPTmT04–R), and **RECOMMENDED** that the CPCs listed in the appendix, make efforts to remedy the data issues identified and to report back to the WPTmT at its next meeting.

41. The SC **EXPRESSED** concern that, in recent years, the quality of data on albacore in the IOTC database has worsened. The reason for this was likely to be driven by drops in activity and catches of longliners flagged to Taiwan,China, for which nominal catch and catch-and-effort data are considered to be of good quality; while the uncertainty in the total catches of albacore estimated for longliners flagged to Indonesia has increased, which have accounted for around 40% or more of the total catches of albacore in the Indian Ocean in recent years.

42. **NOTING** that, to date, Indonesia has not provided catch-and-effort data for longliners under its flag, while size data are not available since 2009, the SC **URGED** Indonesia to further strengthen sampling efforts on its coastal and offshore fisheries in early 2013, in particular monitoring of frozen albacore, and continue cooperation with the IOTC Secretariat in order to better determine the catches of albacore by the Indonesian longline fleet.

43. The SC **EXPRESSED** concern on the lack of information regarding the landing ports of the Indonesian longline fleet operating in the high seas and **REQUESTED** Indonesia to provide detailed information, with cooperation from the port countries, to the WPTmT at its next session.

44. The SC **NOTED** that following a request by the Ministry of Fisheries of Mauritius, the IOTC-OFCF Project had provided assistance for an independent evaluation of data collection and reporting systems in Mauritius, in particular evaluation of catch, effort, and size data collection systems for albacore, as recommended by the SC in 2011. The SC **THANKED** Mauritius and the IOTC-OFCF Project for this initiative and **RECOMMENDED** that the Project considers extending support in the future to assist Mauritius to address the recommendations issuing from the evaluation, where possible.

Indonesian longline fishery for albacore

45. **NOTING** the ongoing review of Indonesian catches of albacore being carried out by the IOTC Secretariat in consultation with the Directorate General of Capture Fisheries (DGCF) of Indonesia, and that current catch estimates for Indonesia are derived from reports of albacore imports into canning factories cooperating with the ISSF, the SC **REQUESTED** that the IOTC Secretariat and Indonesia continue cooperation to finalise the review and report final estimates of catches of albacore to the next meeting of the WPTmT.

Chinese longline fishery for albacore

46. The SC **NOTED** that in recent years, the reported catches of albacore from longliners flagged to China fishing in the Indian Ocean have increased markedly and although this may originate from a change in targeting by some vessels, it may also be the consequence of some fishing companies over-reporting catches of albacore in the logbooks during those years. In this regard, the SC **REQUESTED** that China assess the reliability of statistics of albacore available since 2010 for its fleet and report findings to the next meeting of the WPTmT, including new estimates, where required, in particular in the south-west Indian Ocean where the specific composition of the catch appears unrealistic.

Sampling coverage

47. The SC **REQUESTED** that as a matter of priority, India, Indonesia and Japan increase sampling coverage to attain at least the coverage levels recommended by the Commission, including:
    - catches sampled or observed for at least 5% of the vessel activities, including collection of catch, effort and size data for IOTC species and main bycatch species;
    - implementation of logbook systems for offshore fisheries.

    The information collected through the above activities should allow India, Indonesia and Japan to estimate catches by gear and species.

48. The SC **RECOMMENDED** that IOTC CPCs having fleets targeting albacore or ports where albacore landings are high, in particular Mauritius and Indonesia, make every possible effort to collect biological information on albacore in the future. In this regard China informed the SC about the difficulties that Chinese observers are experiencing to collect biological samples of albacore onboard longliners flagged to China. China indicated that it would make every possible effort to maintain data collection at reasonable levels in the future.

Stock assessments

49. The SC **NOTED** the advice from the WPTmT that although the output of the ASPM model was most likely to numerically and graphically represent the current status of albacore in the Indian Ocean, this does not represent an endorsement of the ASPM model over the other models used in 2012, as there are still substantial problems with the ASPM model, and the WPTmT considers all of the models to be equally informative of stock status.

50. **NOTING** that the Taiwan,China indices of abundance used by the WPTmT for the assessment of albacore covered the period from 1984 to 2010, despite the fact that catch-and-effort data for this fleet are available from the late 1960's, the SC **RECOMMENDED** that the WPTmT uses a standardised CPUE series using the complete catch-and-effort data series in the future.

Parameters for future analyses: CPUE standardisation and stock assessments

51. **NOTING** that the areas used in the various CPUE standardisations undertaken in 2012 were very different from one analysis to another, and that there is a need to define core area(s) for the CPUE standardisation of albacore, the SC **REQUESTED** that scientists from CPCs with longline fisheries for albacore, work together to explore their data and defined such core areas, well in advance of the next WPTmT meeting.

52. The SC **AGREED** that there is value in undertaking a number of different modelling approaches to facilitate comparison, and **RECOMMENDED** that spatially structured integrated models, which are capable of more detailed representation of complicated population and fishery dynamics, and integrate several sources of data and biological research that cannot be considered in the simpler production models, be carried out for the next WPTmT, as data and resources permit.

Stock structure of albacore

53. The SC **NOTED** paper IOTC–2012–SC15–INF02 which provided an outline of a project aimed at examining the genetic structure and life history of albacore, in particular spatial and temporal diversity, abundance and migratory range, including possible exchanges with the southern Altantic Ocean.

54. **NOTING** that the results of the Project may be of great assistance to the work of the WPTmT, the SC **REQUESTED** that all applicable CPCs cooperate with the research scientists undertaking the study. It was also considered important to carry out tagging studies on albacore as a complement to any genetic study.

55. The SC **REQUESTED** that the WPTmT assess the feasibility of implementing a tagging Project in the future and present results to the next meeting of the SC, **NOTING** that such a project would require the support of ICCAT as the southern stocks of albacore could be shared across the boundaries of the IOTC and ICCAT.

7.2 Report of the Tenth Session of the Working Party on Billfish (WPB10)

56. The SC **NOTED** the report of the Tenth Session of the Working Party on Billfish (IOTC–2012–WPB10–R), including the consolidated list of recommendations provided as an appendix to the report.

57. The SC **NOTED** the progress made regarding blue marlin and striped marlin stock status determination and reiterated the need for further work on these stocks in 2013.

58. The SC **NOTED** that a range of quantitative modelling methods were applied to blue marlin and striped marlin in 2012: ASPIC surplus production model, Bayesian production model and surplus production model with varying catchability (see report of the WPB10 for descriptions). The results from the blue marlin and striped marlin assessment should be considered preliminary, for future comparison only and not for the development of management advice.

59. The SC **NOTED** the work undertaken by EU,Portugal, which allowed the presentation of a standardised CPUE series for swordfish targeted by EU,Portugal longline fleet was appreciated.

60. The SC **NOTED** that SWIOFP is currently undertaking a research project on swordfish using pop-up archival tags that may shed additional light on the degree of connectivity between swordfish in the southwest and the broader Indian Ocean. **NOTING** the level of fishing activities and catches of swordfish in the southwest Indian Ocean, the SC **AGREED** that a separate executive summary for swordfish in the southwest Indian Ocean be provided to the Commission, noting that work is currently in progress to determine the level of connectivity of swordfish between areas of the Indian Ocean.

61. The SC **NOTED** the outstanding contributions of the invited expert for the meeting, Dr. Humber Andrade, both prior to and during the WPB10 meeting. The SC also **NOTED** the contribution of Dr. Humber Andrade and, due to his specific expertise, it would be highly beneficial to facilitate his participation at the next meeting of the WPB in 2013.

Data available at the Secretariat for billfish species

62. The SC **NOTED** the main billfish data issues that are considered to negatively affect the quality of the statistics available at the IOTC Secretariat, by type of dataset and fishery, which are provided in Appendix VI of the WPB10 report (IOTC–2012–WPB10–R), and **RECOMMENDED** that the CPCs listed in the appendix, make efforts to remedy the data issues identified and to report back to the WPB at its next meeting.

63. The SC **NOTED** that the quality of the data available at the IOTC Secretariat on marlins is likely to be compromised by species misidentification and **REQUESTED** that CPCs review their historical data in order to identify and correct potential identification problems that are detrimental to any analysis of the status of the stocks.

Length-age keys

64. The SC **RECOMMENDED** that as a matter of priority, CPCs that have important fisheries catching billfish (EU, Indonesia, Japan,Sri Lanka and Taiwan,China,) to collect and provide basic or analysed data that would be used to establish length-age keys and non-standard measurements to standard measurements keys for billfish species, by sex and area.

Catch, Catch-and-effort, Size data

65. The SC **REQUESTED** that the EU,Spain improve the status of catch-and-effort data for marlins and sailfish and its provision to the IOTC Secretariat.

66. The SC **REQUESTED** that the EU,Spain longline fleet provide the IOTC Secretariat with catch-and-effort and size data of marlins and sailfish by time and area strata, noting that this is already a mandatory reporting requirement.

67. The SC **REQUESTED** that Japan resume size sampling on its commercial longline fleet, and that Taiwan,China provide size data for its fresh longline fleet to attain the minimum recommended by the Commission (1 fish by metric ton of catch by type of gear and species).

68. The SC **REQUESTED** that Indonesia and India provide catch-and-effort and size frequency data for their longline fleets.

69. The SC **REQUESTED** that CPCs having artisanal and semi-industrial fleets, in particular Iran, Pakistan andSri Lanka, provide catch and effort as well as size data as per IOTC requirements for billfish caught by their fleets.

70. **NOTING** that not all CPCs are collecting size data using standard measurements, the SC **AGREED** that only lower-jaw to fork length, eye to fork length or pectoral to second dorsal length are taken by fishers, samplers and observers for billfish species.

71. The SC **REQUESTED** that the EU record and report information on catches of billfish, by species, for its purse seine fisheries.

Data inconsistencies

72. Noting the progress made to date, the SC **REQUESTED** that the IOTC Secretariat finalise the study aimed at assessing the consistency of average weights derived from the available catch and effort data, as derived from logbooks, and size data provided by EU,Spain, Japan, Seychelles and Taiwan,China and to report final results at the next WPB meeting.

73. The SC **RECOMMENDED** that as a matter of priority, India, Iran and Pakistan provide catch-and-effort data and size data for billfish, in particular for gillnet fisheries, as soon as possible, noting that this is already a mandatory reporting requirement.

Sports fisheries

74. **NOTING** the increasing importance of sports fisheries in the total catch of marlin and sailfish species, the WPB **REQUESTED** that the IOTC Secretariat develop a list of contacts of Institutes, Foundations and NGOs implementing tagging programs of large pelagic fishes in the Indian Ocean and to summarise this information for presentation at the next WPB meeting.

Sri Lankan billfish landings

75. The SC **NOTED** that to date, Sri Lanka has been unable to provide accurate statistics for billfish species to the IOTC Secretariat, due to poor species identification and low levels of sampling coverage for its coastal and offshore fisheries. The SC **ACKNOWLEDGED** that in Sri Lanka billfish are often landed cut into pieces and separated upon arrival at Sri Lankan landing stations which creates difficulties in obtaining accurate length measurements.

76. The SC **AGREED** that as a matter of priority, Sri Lanka increase sampling coverage to attain at least the coverage levels recommended by the Commission (1 fish by metric ton of catch by type of gear and species), including:
    - catches sampled or observed for at least 5% of the vessel activities for coastal fisheries, including collection of catch, effort and size data for IOTC species and main bycatch species;
    - implementation of logbook systems for offshore fisheries that incorporate species level information requirements for billfish, as per IOTC Resolution 12/03.

    The information collected through the above activities should allow Sri Lanka to estimate species level catches by gear for billfish and other important IOTC or bycatch species.

77. The SC **AGREED** that a means to improve the quality of size frequency data from Sri Lanka, would be for billfish size data to be collected from logbooks, as well as measurements collected by observers on vessels fishing on the high seas, rather than sampling at landing sites.

Madagascar's billfish landings

78. **NOTING** that the longline fishery in Madagascar is a new and developing fishery, the SC **RECOMMENDED** that Madagascar ensure that it develops and implements a data collection system, including sampling, logbooks and observers, which would adequately cover the entire fishery.

Maldives billfish landings

79. The SC **NOTED** the attendance of the Maldives at the WPB for the first time and that the aggregated data presented were preliminary and was a useful contribution to the work of the WPB. However, disaggregated finer scale data would need to be provided to the IOTC Secretariat if the data is to be fully utilised by the WPB.

80. The SC **NOTED** that the level of capture of marlins from the Maldivian artisanal fishery appears to be very high compared to the total catches reported for the Indian Ocean and **RECOMMENDED** that the Maldives provide a review of its landings of each marlin species at the next WPB meeting

81. The SC **RECOMMENDED** that the Maldives implement data collection systems, through logbooks and sampling for its fisheries that incorporate species level information requirements for billfish, as per IOTC Resolution 12/03. The information collected should allow the Maldives to estimate species level catches by gear for billfish and other important IOTC or bycatch species.

Mozambique billfish landings

82. **NOTING** that at present no scientific observers are being placed on board foreign flagged vessels licensed to fish in the Mozambique EEZ, the SC **RECOMMENDED** that Mozambique make it a licensing requirement for any foreign vessels fishing in the Mozambique EEZ to take on board scientific observers and to report the data collected as per IOTC requirements. Foreign vessels fishing in the Mozambique EEZ should ensure that scientific observers are brought onboard as per IOTC requirements.

Review of fleet dynamics

83. The SC **RECOMMENDED** that both Japan and Taiwan,China undertake a complete historical review of their longline data and to document the changes in fleet dynamics for presentation at the next WPB meeting. The historical review should include as much explanatory information as possible regarding changes in fishing areas, species targeting, gear changes and other fleet characteristics to assist the WPB understand the current fluctuations observed in the data.

Parameters for future analyses: stock assessments

84. **NOTING** that the current time frames for data exchange do not allow enough time to conduct thorough stock assessment analyses, and this could have a detrimental effect on the quality of advice provided by the WPB, the SC **AGREED** that exchanges of data (CPUE indices and coefficient of variation) should be made as early as possible, but no later than 30 days prior to a working party meeting, so that stock assessment analysis can be provided to the IOTC Secretariat no later than 15 days before a working party meeting, as per the recommendations of the SC, which states: "*The SC also ENCOURAGED data to be used in stock assessments, including CPUE standardisations, be made available not less than three months before each meeting by CPCs and where possible, data summaries no later than two months prior to each meeting, from the IOTC Secretariat; and RECOMMENDED that data to be used in stock assessments, including CPUE standardisations be made available not less than 30 days before each meeting by CPCs.*" (IOTC–2011–SC14–R; p68)

Indian Ocean Swordfish Stock Structure project (IOSSS)

85. The SC **NOTED** that although the results of the IOSSS project did not reveal any structure within the Indian Ocean with the markers used, however the hypothesis of a population structuring at the regional level cannot be discarded and needs to be investigated using different markers or approaches.

Swordfish: European Union longline fisheries CPUE indices

86. The SC **RECOMMENDED** that scientists from the EU undertake a revised CPUE analysis for their longline fleets, and consider combining the analysis prior to the next WPB meeting where swordfish will be dealt with as a priority.

Non-compliance matters

87. **NOTING** that despite the mandatory reporting requirements detailed in Resolutions 10/02 and 12/03 data on billfish fisheries, in particular for the marlins, remain largely unreported by CPCs, the SC **RECOMMENDED** that the Compliance Committee and the Commission note these non-compliance matters, develop mechanisms to ensure that CPCs fulfil their reporting obligations.

7.3 Report of the Eighth Session of the Working Party on Ecosystems and Bycatch (WPEB08)

88. The SC **NOTED** the report of the Eighth Session of the Working Party on Ecosystems and Bycatch (IOTC–2012–WPEB08–R), including the consolidated list of recommendations provided as an appendix to the report. The SC **EXPRESSED** its satisfaction on the large attendance and participation by national scientists working on ecosystem and bycatch topics (48 participants) which resulted in the presentation of 40 working documents.

Data reporting requirements

89. **NOTING** that despite the mandatory reporting requirements detailed in Resolutions 05/05, 10/02, 10/06, 12/03 and 12/04, bycatch data remain largely unreported by CPCs and the SC **RECOMMENDED** that the Compliance Committee and the Commission address this non-compliance by taking steps to develop mechanisms which would ensure that CPCs fulfil their bycatch reporting obligations.

Gillnet fisheries of the Indian Ocean

90. The SC **NOTED** that gillnet fisheries are expanding rapidly in the Indian Ocean, with gillnets often being longer than 2.5 km in contravention with UN and IOTC Resolutions, and that their use is considered to have a substantial impact on marine ecosystems. **NOTING** that in 2012 the Commission adopted Resolution 12/01 on the implementation of the precautionary approach, the majority of the SC **RECOMMENDED** that the Commission freeze catch and effort by gillnet fisheries in the Indian Ocean in the near future, until sufficient information has been gathered to determine the impact of gillnet fleets on IOTC stocks and bycatch species caught by gillnet fisheries targeting tuna and tuna-like species, noting that the implementation of any such measure would be difficult.

91. The SC **RECOMMENDED** that the Commission considers allocating funds to support a regional review of the data available for gillnet fleets operating in the Indian Ocean. The scientists from all CPCs having gillnet fleets in the Indian Ocean should provide at the next session of the WPEB, a report summarising the known information on bycatch in their gillnet fisheries, including sharks, marine turtles and marine mammals, with estimates of their likely order of magnitude where more detailed data are not available.

92. The SC **RECOMMENDED** that the Commission allocate funds to carry out training for CPCs having gillnet fleets on species identification, bycatch mitigation and data collection methods and also to identify other potential sources of assistance to carry out such activities.

93. The SC **EXPRESSED** its support for the two observer projects currently being implemented by WWF in Pakistan, funded by the Australian Government (from 2010–2013 and 2012–2014 respectively), to monitor bycatch levels and interactions with cetaceans in the gillnet fishery. While these projects are aimed at assessing the impacts of gillnet fishing on cetaceans, data is also being collected on all catch, including tuna, finfish, sharks and marine turtles. The projects are province-specific and the aim is for 40% fleet coverage and use both beach and vessel surveys for data collection. The projects have strong community engagement through workshops, awareness campaigns and the establishment community conservation groups. Action plans will also be developed. A third project on tuna catch monitoring in the Pakistan Miani Hor Marine Protected Area, funded by the WWF Smart Fishing Initiative, will also include an element on gillnet bycatch. WWF will keep the WPEB and the SC updated with the results of these projects in 2013.

Sharks

Status of catch statistics and data reporting

94. The SC **NOTED** the status of catch statistics for the main species of sharks, by major fisheries (gears), for the period 1950–2011 (Appendix VI) and **EXPRESSED** strong concern as the information on retained catches and discards of sharks contained in the IOTC database remains very incomplete for most fleets despite their mandatory reporting status, and that catch-and-effort as well as size data are essential to assess the status of shark stocks.

95. The SC **NOTED** the main shark data issues that are considered to negatively affect the quality of the statistics available at the IOTC Secretariat, by type of dataset and fishery, which are provided in Appendix VIII of the WPEB08 report (IOTC–2012–WPEB08–R), and **RECOMMENDED** that the CPCs listed in the Appendix, make efforts to remedy the data issues identified and to report back to the WPEB at its next meeting, noting the status and type of datasets that need to be provided for sharks, and other bycatch species provided at Appendix IX of the WPEB08 report (IOTC–2012–WPEB08–R).

96. **NOTING** that the information on retained catches and discards of sharks contained in the IOTC database remains very incomplete for most fleets despite their mandatory reporting status, and that catch-and-effort as well as size data are essential to assess the status of shark stocks, the SC **RECOMMENDED** that all CPCs collect and report catches of sharks (including historical data), catch-and-effort and biological data on sharks, as per IOTC Resolutions, so that more detailed analysis can be undertaken for the next WPEB meeting.

97. **NOTING** that there is extensive literature available on pelagic shark fisheries and interactions with fisheries targeting tuna and tuna-like species, in countries having fisheries for sharks, and in the databases of governmental or non-governmental organisations, the SC **AGREED** on the need for a major data mining exercise in order to compile data from as many sources as possible and attempt to rebuild historical catch series of the most commonly caught shark species. In this regard, the SC **RECOMMENDED** that the Commission allocates funds for this activity, in the 2013 IOTC budget.

98. The SC **NOTED** the absence of information on shark catches from artisanal fisheries in Mozambique and **RECOMMENDED** that information on shark catches from those fisheries is collected and reported in due course.

99. **NOTING** that Resolution 10/02 *mandatory statistical requirements for IOTC members and Cooperating Non-Contracting Parties (CPC's)*, makes provision for data to be reported to the IOTC on "*the most commonly caught shark species and, where possible, to the less common shark species*", without giving any list defining the most common and less common species, and recognising the general lack of shark data being recorded and reported to the IOTC Secretariat, the SC **RECOMMENDED** that Resolution 10/02 is revised in order to include the list of most commonly caught elasmobranch species (Table 3) for which nominal catch data shall be reported as part of the statistical requirement for IOTC CPCs.

TABLE 3. List of the most commonly caught elasmobranch species

Common name	Species	Code
Manta and devil rays	Mobulidae	MAN
Whale shark	*Rhincodon typus*	RHN
Thresher sharks	*Alopias spp.*	THR
Mako sharks	*Isurus spp.*	MAK
Silky shark	*Carcharhinus falciformis*	FAL
Oceanic whitetip shark	*Carcharhinus longimanus*	OCS
Blue shark	*Prionace glauca*	BSH
Hammerhead shark	Sphyrnidae	SPY
Other Sharks and rays	–	SKH

Mitigation measures

100. The SC **RECOMMENDED** research and development of mitigation measures to minimise bycatch of the oceanic whitetip shark and its unharmed release for all types of fishing gears, and that CPCs with data on oceanic whitetip sharks (i.e. total annual catches, CPUE time series and size data) make these available to the next WPEB meeting.

Shark mortality in relation with the use of drifting FADs

101. The SC **NOTED** the presentation of the information paper IOTC–2012–SC15–INF05 on ghost fishing of silky sharks by drifting FADs.

102. The SC **NOTED** the recommendation from the WPEB on the basic principles for FAD construction that would minimise entanglement of marine turtles (FADs refers to man-made floating objects, drifting or anchored, built for the purpose of fishing pelagic fishes). In addition, new information presented during the SC indicated that entanglement of sharks (primarily silky sharks) occurs frequently when the sub-surface FAD components are made of netting. The estimated shark mortality from these entanglements is likely to be higher than the incidental catch hauled onboard. Furthermore, FAD designs should minimise both marine turtle and shark entanglement. Some CPCs are already using drifting FADs with designs aimed at reducing the entanglements of marine animals. Regardless of the uncertainty in the magnitude of the problem, the SC **AGREED** that the solution is clear and simple and would involve constructing FADs without netting material.

103. The SC **RECOMMENDED** that the Commission note the following in regards to the request to the SC outlined in paragraph 11 of Resolution 12/04, on FAD design:

   c) Develop improved FAD designs to reduce the incidence of entanglement of marine turtles, including the use of biodegradable materials

   Only non-entangling FADs, both drifting and anchored, should be designed and deployed to prevent the entanglement of sharks, marine turtles or any other species, based on the following three basic principles:

   1. The surface structure of the FAD should not be covered, or only covered with non-meshed material.
   2. If a sub-surface component is used, it should not be made from netting but from non-meshed materials such as ropes or canvas sheets.
   3. To reduce the amount of synthetic marine debris, the use of natural or biodegradable materials (such as Hessian canvas, hemp ropes, etc.) for drifting FADs should be promoted.

Ecological risk assessment

104. The SC **NOTED** paper IOTC–2012–SC15–INF10 which provide the results of a preliminary ecological risk assessment (ERA) of shark species caught in the Indian Ocean by longline and purse seine gears, which was a request made by the Commission at its 15^{th} Session in 2011. The SC **RECOGNISED** the highly valuable information provided by this ERA which produced a ranked list of the most vulnerable shark species to longline and purse seine gears as detailed below.

105. The SC **NOTED** the list of the 10 most vulnerable shark species to longline gear (Table 4) and purse seine gear (Table 5), as determined by the productivity susceptibility analysis, compared to the list of shark species/groups required to be recorded for each gear, contained in Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence.*

TABLE. 4. List of the 10 most vulnerable shark species to longline gear compared to the list of shark species/groups required to be recorded in logbooks, as listed in Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence.*

PSA vulnerability ranking	Most susceptible shark species to longline gear	FAO Code	Shark species listed in IOTC Resolution 12/03 for longline gear	FAO Code
1	Shortfin mako (*Isurus oxyrinchus*)	SMA	Blue shark (*Prionace glauca*)	BSH
2	Bigeye thresher (*Alopias superciliosus*)	BTH	Mako sharks (*Isurus* spp.)	MAK
3	Pelagic thresher (*Alopias pelagicus*)	PTH	Porbeagle shark (*Lamna nasus*)	POR
4	Silky shark (*Carcharhinus falciformis*)	FAL	Hammerhead sharks (*Sphyrna* spp.)	SPN
5	Oceanic whitetip shark (*Carcharhinus longimanus*)	OCS		
6	Smooth hammerhead (*Sphyrna zygaena*)	SPZ		
7	Porbeagle (*Lamna nasus*)	POR		
8	Longfin mako (*Isurus paucus*)	LMA		
9	Great hammerhead (*Sphyrna mokarran*)	SPM		
10	Blue shark (*Prionace glauca*)	BSH		

TABLE. 5. List of the 10 most vulnerable shark species to purse seine gear compared to the list of shark species/groups required to be recorded in logbooks, as listed in Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence.*

PSA vulnerability ranking	Most susceptible shark species to purse seine gear	FAO Code	Shark species listed in IOTC Resolution 12/03 for purse seine gear	FAO Code
1	Oceanic whitetip shark (*Carcharhinus longimanus*)	OCS	Whale sharks (*Rhincodon typus*)	RHN
2	Silky shark (*Carcharhinus falciformis*)	FAL		
3	Shortfin mako (*Isurus oxyrinchus*)	SMA		
4	Great hammerhead (*Sphyrna mokarran*)	SPM		
5	Pelagic stingray (*Pteroplatytrygon violacea*)	PLS		
6	Scalloped hammerhead (*Sphyrna lewini*)	SPL		
7	Smooth hammerhead (*Sphyrna zygaena*)	SPZ		
8	Longfin mako (*Isurus paucus*)	LMA		
9	Dusky shark (*Carcharhinus obscurus*)	DUS		
10	Tiger shark (*Galeocerdo cuvier*)	GAC		

106. The SC **NOTED** that although the gillnet fleet is responsible for around 68 % of the total shark catches in the Indian Ocean, there was no data available on gillnet effort distribution nor information from observers on shark size frequencies and post-capture mortality which would allow an ERA to be carried out for sharks caught by gillnet and, hence, to analyse the effect of gillnet fishing on shark. If this information were to become available in the future, then an ERA should be carried out.

Inclusion of two additional shark species to the list of mandatory data requirements for longline gear (Res 12/03)

107. The SC **EXPRESSED** concern that two species, the silky shark (*Carcharinus falciformis*) and the oceanic whitetip shark (*Carcharinus longimanus*) respectively ranked 4th and 5th in terms of vulnerability to longline gear by the ERA, are not contained in the list of shark species (or groups of species) to be recorded in log books under Resolution 12/03.

108. The SC **ACKNOWLEDGED** that catch data for all shark species (or group of species) listed in Resolution 12/03 for longline gear and the two additional shark species mentioned in paragraph 107, should be collected by the most appropriate means and submitted to the IOTC Secretariat. The SC **NOTED** that some CPCs considered that logbooks, supplemented by observer data (field samplers data for artisanal fishing vessels), as the most appropriate way of capturing the information, whereas other CPCs considered that such data collection would preferably be conducted under the IOTC Regional Observer Scheme because of some practical difficulties, and a possible negative effect on data quality by requiring the additional data to be collected through logbooks and frequent changes to the logbook format.

109. The SC **NOTED** that identification cards are now available to assist fishers, observers and field samplers to identify shark species. The SC also **REITERATED** its concern on the paucity of observer (or field sampler) data submitted to the IOTC Secretariat by the CPCs and on the poor spatial coverage of the observed trips compared to the spatial extent of the fishery, which prevent any reliable analysis of bycatch data, including sharks.

110. The SC **RECOMMENDED** that, in line with Recommendation 12/15 on the best available science, the list of shark species (or groups of species) for longline gear under Resolution 12/03 should be supplemented by two other shark species which were estimated to be at risk in longline fisheries by the ERA conducted in 2012, the silky shark (*Carcharinus falciformis*) and the oceanic whitetip shark (*Carcharinus longimanus*). The SC **ADVISED** the Commission to define the most appropriate means of collecting this additional information, considering the limitations of both options (logbooks and/or regional observer scheme) presented in paragraphs 108 and 109.

Fin to body weight ratio

111. The SC **ADVISED** the Commission to consider, that the best way to encourage full utilisation of sharks, to ensure accurate catch statistics, and to facilitate the collection of biological information, is to revise the IOTC Resolution 05/05 *concerning the conservation of sharks caught in association with fisheries managed by IOTC* such that all sharks must be landed with fins attached (naturally or by other means) to their respective carcass. However, the SC **NOTED** that such an action would have practical implementation and safety issues for some fleets and may degrade the quality of the product in some cases. The SC **RECOMMENDED** all CPCs to obtain and maintain the best possible data for IOTC fisheries impacting upon sharks, including improved species identification.

112. The SC **NOTED** that it will soon be mandatory for all EU fleets to land all sharks caught during fishing operations with fins naturally attached.

Wire leaders/traces

113. On the basis of information presented to the SC in 2011 and in previous years, the SC **RECOGNISED** that the use of wire leaders/traces in longline fisheries may imply targeting of sharks. The SC therefore **RECOMMENDED** to the Commission that if it wishes to reduce catch rates of sharks by longliners it should prohibit the use of wire leaders/traces.

Marine turtles

Data and reporting requirements

114. The SC **RECOMMENDED** that IOTC Resolution 12/04 *on the conservation of marine turtles* is strengthened to ensure that CPCs report annually on the level of incidental catches of marine turtles by species, as provided at Table 6.

TABLE 6. Marine turtle species reported as caught in fisheries within the IOTC area of competence.

Common name	Scientific name
Flatback turtle	*Natator depressus*
Green turtle	*Chelonia mydas*
Hawksbill turtle	*Eretmochelys imbricata*
Leatherback turtle	*Dermochelys coriacea*
Loggerhead turtle	*Caretta caretta*
Olive ridley turtle	*Lepidochelys olivacea*

115. The SC **NOTED** paper IOTC–2012–WPEB08–35 which provided results of a study on the EU and France(OT) purse seine fleet interactions with marine turtles in the Indian Ocean. The obsever data showed a low level of interactions with marine turtles and an even lower mortality rate associated with set on FADs.

116. The SC **NOTED** that the lack of data from most CPCs on interactions and mortalities of marine turtles in the Indian Ocean is a substantial concern, resulting in an inability of the WPEB to estimate levels of marine turtle bycatch. There is an urgent need to quantify the effects of fisheries for tuna and tuna-like species in the Indian Ocean on marine turtle species, and it is clear that little progress on obtaining and reporting data on interactions with marine turtles has been made. This data is necessary to allow the IOTC to respond and manage the adverse effects on marine turtles, and other bycatch species.

117. The SC **NOTED** that it is mandatory for marine turtles (in number) to be recorded on logbooks for purse seine and gillnet but not for longline and **RECOMMENDED** that marine turtles, as a group, be added to Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*, in Annex II (Record once per set/shot/operation) paragraph 2.3 (SPECIES) for longline gear.

118. **NOTING** that Resolution 10/02 does not make provisions for data to be reported to the IOTC on marine turtles, the SC **RECOMMENDED** that Resolution 10/02 is revised in order to make the reporting requirements coherent with those stated in Resolution 12/04 on the conservation of marine turtles.

Ecological Risk Assessment Marine Turtles

119. The SC **NOTED** paper IOTC–2012–SC15–INF09 Rev_1 which provide result on a preliminary Ecological Risk Assessment (ERA) and Productivity Susceptibility Analysis (PSA) of marine turtle populations overlapping with IOTC fisheries.

120. The SC **NOTED** that the analyses were based on data provided by Australia, EU,France, France(OT), EU,Portugal and South Africa, supplemented by bibliographic sources. The most threatened species by longline and gillnet are the hawksbill turtle, loggerhead turtle and leatherback turtle, to varying degrees across the sub-populations. The study identified several sources of uncertainties in the data (e.g. species identification, post release survival, gillnet fishing effort and interactions with marine turtles, and size data lacking).

121. The SC **RECOGNISED** the quality of the work undertaken and the highly valuable information provided by this ERA, but **AGREED** that the assessment would benefit greatly from the inclusion of complete data from more IOTC fleets and that mortality rate of marine turtles in gillnet fisheries is likely to be underestimated as it is based on data from an Atlantic gillnet fishery which is not directly comparable. The SC **NOTED** the importance of gillnet fisheries in the Indian Ocean which land an estimated 500,000 t of tuna and tuna-like species each year.

122. **NOTING** that only a few CPCs have made data available to the consultant, the SC **RECOMMENDED** that all IOTC CPCs contact the scientist leading the ERA in order to refine and complete the analysis before the next WPEB meeting.

123. The SC **RECOMMENDED** that the IOTC Secretariat include an additional 20 day consultancy in the 2013 IOTC budget for the Commission's consideration, so that the Ecological Risk Assessment for marine turtles may be continued and that new information received may be incorporated.

Requests contained in IOTC Conservation and Management Measures

124. The SC **RECOMMENDED** that the Commission note the following in regards to the requests to the SC outlined in paragraph 11 of Resolution 12/04:

   a) Develop recommendations on appropriate mitigation measures for gillnet, longline and purse seine fisheries in the IOTC area

   Gillnet: The absence of data for marine turtles on effort, spatial deployment and bycatch in the IOTC area of competence makes any recommendation regarding mitigation measures for this gear premature. Improvements in data collection and reporting of marine turtle interactions with gillnets, and research on the effect of gear types (i.e. net construction and colour, mesh size and soak times) are necessary.

   Longline: Current information suggests inconsistent spatial catches (i.e. high catches in few sets) and by gear/fishery. The most important mitigation measures relevant for longline fisheries are to:

   1. Support further research into the effectiveness of circle hooks as part of a multiple species approach, so as to avoid, as far as possible, promoting a mitigation measure for one bycatch taxon that might exacerbate bycatch problems for other taxa.
   2. Release live animals after careful dehooking/disentangling/line cutting (see handling guidelines in the IOTC marine turtle identification cards).

   Purse seine: see c) below

   b) Develop regional standards covering data collection, data exchange and training

   1. The development of standards using the IOTC guidelines for the implementation of the Regional Observer Scheme should be undertaken, as it is considered the best way to collect reliable data related to marine turtle bycatch in the IOTC area of competence.
   2. The Chair of the WPDCS to work with the IOSEA MoU Secretariat, which has already developed regional standards for data collection, and revise the observer data collection forms and observer reporting template as appropriate, as well are current recording and reporting requirements through IOTC Resolutions, to ensure that the IOTC has the means to collect quantitative and qualitative data on marine turtle bycatch.

3. Encourage CPCs to use IOSEA expertise and facilities to train observers and crew to increase post-release survival rates of marine turtles.

c) *Develop improved FAD designs to reduce the incidence of entanglement of marine turtles, including the use of biodegradable materials*

1. Refer to paragraph 103 above.

Collaboration with IOSEA

125. The SC **NOTED** that the collaboration between the IOTC and the IOSEA could be formalised in 2013, in particular for the revision of the Executive Summary on marine turtles and **AGREED** that both Secretariats' should continue working closely together.

7.4 Report of the Fourth Session of the Working Party on Methods (WPM04)

126. The SC **NOTED** the report of the Fourth Session of the Working Party on Methods (IOTC–2012–WPM04–R), including the consolidated list of recommendations provided as an appendix to the report.

Capacity building

127. The SC **REQUESTED** that the Chair of the Commission includes an agenda item for each Commission meeting, which would provide Commissioner's with annual updates and explanatory material to ensure they are kept abreast of the methods and processes being undertaken as part of the broader IOTC MSE process.

128. The SC **RECOMMENDED** that the IOTC Secretariat coordinate the development and delivery of several training workshops focused on providing assistance to developing CPCs to better understand the MSE process, including how reference points and harvest control rules are likely to function in an IOTC context. The implications of IOTC Resolution 12/01 *on the implementation of the precautionary approach* and IOTC Recommendation 12/14 *on interim target and limit reference points* should be incorporated into the workshop. The SC **REQUESTED** that the Commission's budget incorporate appropriate funds for this purpose.

Implicit and explicit objectives

129. The SC **AGREED** that the role of managers and stakeholders is to identify management objectives, acceptable levels of risk of exceeding limit reference points (LRP), and the criteria against which their performance should be evaluated. The role of IOTC scientists is to identify candidate target reference points (TRP) and LRP (e.g. those contained in Recommendation 12/14 *on interim target and limit reference points*), evaluate candidate TRPs and LRPs, options for harvest control rules (HCR), and the performance of identified candidate HCRs.

130. The SC **AGREED** that management objectives should explicitly state the goals for the fishery, and that some of these objectives may conflict with one another (e.g. maximising total allowable catch (TAC) versus minimising the risk of low population levels). Where possible, the Commission should be made aware of any conflicting management objectives which they agree upon so that Commissioners set priorities among objectives throughout the MSE process.

Work on MSE development

131. The SC **ENDORSED** the workplan for the development of the IOTC MSE process, provided at Appendix IV of the WPM report (IOTC–2012–WPM04–R), and encouraged national scientists to participate in the process.

132. The SC **AGREED** that the interim reference points detailed in IOTC Recommendation 12/14 should act as benchmarks for developing HCRs and theoretical management actions as part of the MSE process, as reference points alone are not sufficient to provide a full implementation of the precautionary approach.

133. The SC **NOTED** that HCRs are the tools used to operationalise management objectives through the use of reference points in an attempt to best meet the Commission's overall objectives, and that Resolution 12/01 *on the implemention on the implementation of the precautionary approach* allows for adoption of provisional HCR by the Commission. Therefore, clearly stated management objectives from the Commission will be critical because they will guide the refinement of the interim reference points and define the success of a future harvest strategy for IOTC stocks.

134. The SC **RECOMMENDED** that the Commission allocate funds in the 2013 and 2014 IOTC budgets, for an external expert on MSE to be hired for 30 days per year, to supplement the skill set available within IOTC CPCs, and for the establishment of a participation fund to cover the planned WPM workshops.

135. The SC **NOTED** that the Maldives indicated their full support to this process of development and evaluation of management plans, and their offer to fund an expert in MSE to join the WPM development team.

Date and place of the Fifth Session of the WPM

136. The SC **NOTED** that while the MSE process was still in its early stages of development, there was no pressing need to hold a WPM meeting in 2013, as the work to be undertaken was of a highly technical nature and would require the involvement of a very limited number of experts in the field of development and implementation of population and fishery models for MSE. Thus, as suggested in the MSE workplan, two workshops composed of experts actively involved in the development work should be held in 2013 to continue the development of the MSE process. The WPM has indicated that it would like to hold the first workshop in April, at the EC JRC, Italy, and the second immediately prior to the meeting of the WPTT at the same venue. A document will then be presented to the next session of SC on the progress of the MSE process.

7.5 Report of the Fourteenth Session of the Working Party on Tropical Tunas (WPTT14)

137. The SC **NOTED** the report of the Fourteenth Session of the Working Party on Tropical Tunas (IOTC–2012–WPTT14–R), including the consolidated list of recommendations provided as an appendix to the report.

Indian Ocean tuna tagging symposium

138. The SC **NOTED** that the Indian Ocean Tuna Tagging Symposium was held in Mauritius with 80 participants (30 October to 2 November 2012), immediately following the IOTC WPTT, in order to present the results of analyses of the tagging data gathered during the Indian Ocean Tuna Tagging Programme (IOTTP). Thirty-five presentations were made during this symposium, providing a wide range of new results on the biology of the three tropical tuna species (bigeye tuna, skipjack tuna and yellowfin tuna), e.g. movements and mixing rates, growth and natural mortality by sex, movement to areas with high incidence of FADs soon after tagging, etc. Most of these results offer a new set of biological data that differ to a certain extent from some of the parameters used by national scientists for current stock assessments. The presentations also dealt with the exploitation rates of the three tropical tuna species. These new results will allow improvements of the stock assessments for the tropical tuna species in the future. Furthermore, the results presented at the symposium will be submitted and published in a special issue of the journal Fisheries Research. All necessary efforts should be undertaken by national scientists in order to ensure the success of the publication as it will increase the visibility of IOTC research activities and of the IOTTP.

Data availability

139. **NOTING** that the main tropical tuna data issues that are considered to negatively affect the quality of the statistics available at the IOTC Secretariat, by type of dataset and fishery, which are provided in Appendix VI of the WPTT report (IOTC–2012–WPTT14–R), the SC **RECOMMENDED** that the CPCs listed in the appendix, make efforts to remedy the data issues identified and to report back to the WPTT at its next meeting.

140. **NOTING** that the Maldivian skipjack tuna catch is not separated by association type, i.e. aFAD or free schools, and therefore the proportion of skipjack tuna caught under aFADs around the Maldives is unknown, the SC **RECOMMENDED** that the Maldivian data collection system is further improved in order to account for the association of the reported catch, as this could improve the standardisation of the pole-and-line CPUE.

141. **NOTING** that there were discrepancies in catch, effort and notably size data (low sampling rate, uneven distribution of sampling in regard to the spatial extent of the fishery) in the Japanese and Taiwan,China tropical tuna data sets, the SC **RECOMMENDED** they review the data to assess reasons for discrepancies identified by the IOTC Secretariat and to report results at the next meeting of the WPTT, including a comparison of length frequency data samples collected from commercial, research and training vessels.

Bigeye tuna

142. The SC **NOTED** that although no new assessment was undertaken for bigeye tuna in 2012, revised stock status indicators (e.g. standardised CPUE series) do not show any substantial differences from those carried out in 2011 that would warrant a change in the overall stock status advice.

143. The SC **NOTED** that additional information (i.e. growth, natural mortality) on bigeye tuna was presented during the tagging symposium held immediately following the WPTT14. The new results are not yet included in the executive summary for this species as they have yet to be considered by the WPTT. New analysis and other information should be considered by the WPTT in 2013, including but not limited to the latitudinal movement of adult bigeye tuna, the possible verification of a two-stanza growth curve, the different maximum size of males and females (larger males) and the low natural mortality now estimated for bigeye tuna. The results arising from the tagging research will likely be of major importance in the future stock assessment analysis of the bigeye tuna stock. Any new information on bigeye tuna biology verified by the WPTT should be incorporated in the next Executive Summary for bigeye tuna in 2013.

144. The SC **NOTED** the issues identified with the stock assessment carried out in 2011, as detailed in the Executive Summary for bigeye tuna (Appendix X).

Skipjack tuna

145. The SC **ACKNOWLEDGED** the excellent work undertaken by the IOTC Secretariat and other collaborators in undertaking the second fully quantitative assessment of skipjack tuna in the Indian Ocean. Further improvements in the assessment will be made by improving the way in which the tagging data and abundance indices are incorporated. Natural mortality and growth also need to be incorporated in an appropriate way.

146. **NOTING** that concerns were expressed on the ability of both the Maldives pole and line CPUE and the EU purse seine CPUE to reflect the dynamics of the stock, and given their major role in driving the current stock assesment results, the SC **RECOMMENDED** that further investigation is carried out for both CPUE series prior to the next WPTT meeting, and during the planned WPM workshop on CPUE standardisation.

147. The SC **RECOMMENDED** further investigation of the existing data to produce an improved standardised CPUE series for the FAD-associated school skipjack tuna fishery in the Indian Ocean, and for information on these matters to be presented to the next meeting of the WPTT.

148. **NOTING** that the areas used in the various CPUE standardisations undertaken in 2012 varied, the SC **AGREED** that there is a need to define core area(s) for each gear (pole-and-line and purse seine) for the CPUE standardisation of skipjack tuna and **RECOMMENDED** that scientists from CPCs with pole-and-line, and purse seine fisheries for skipjack tuna, work together to explore their data in a manner to advance CPUE standardisation work for the next meeting of the WPTT in 2013, and defined such core areas for each gear, well in advance of the next WPTT meeting in 2013.

149. **NOTING** that the tagging data is now more complete and available, including the tagging experiment results from Maldives in the 1990s the SC **RECOMMENDED** effective use of tagging data in the new assessment including any revision on the estimates of mortality and growth rates from the tagging data.

150. **NOTING** the use and application of interim target and limit reference points, the SC **RECOMMENDED** that the Kobe II strategy matrix should include the risk levels associated with those reference points. Furthermore, the SC **AGREED** that the probability of breaching the interim limit reference points for skipjack tuna of $1.5*F_{MSY}$ and $0.4*SB_{MSY}$ is very low and this information should be added to the Executive Summary.

151. The SC **AGREED** that the advice on the status of skipjack tuna in 2012 may be derived from the integrated assessment models used in 2012. Model formulations were explored by the WPTT to ensure that various plausible sources of uncertainty were explored and represented in the final stock status advice.

152. The SC **NOTED** a series of issues identified with the stock assessment carried out in 2012, as detailed in the Executive Summary for skipjack tuna (Appendix XI). Briefly, these include, but are not limited to the following, noting that the reader is referred to the skipjack tuna Executive Summary for a detailed description:
    - In general the indicators obtained for skipjack tuna in the assessment are partially conflicting and highly variable. The average size indicators from the purse seine fleets have dropped for both free and associated schools in recent years. In the long term, however, there does not appear to be an overall major change in mean weight. For the pole-and-line fishery, the average weight indices have also been decreasing over the last three years. However, the gillnet fishery showed an increasing trend during recent years.
    - The catch rates on associated schools are increasing for both the EU,Spain and EU,France fleets. It is difficult to interpret these results, however, it seems that the increase in catch rate is associated with a decrease in effort which could be interpreted as a positive signal. It is possible that the high catch rates for associated schools may be caused by hyperstability (i.e. the aggregating effect of the FADs is masking decreasing population numbers), which is not relevant for free schools of tuna.
    - The advice on the status of skipjack tuna in 2012 was derived from models using an integrated statistical assessment method from 2011 and 2012. Model formulations were explored to ensure that various plausible sources of uncertainty were explored and represented in the final result. In general, the data did not seem to be sufficiently informative to justify the selection of any individual model, and the results of different model runs were presented.

Yellowfin tuna

Japanese – Catch-per-unit-of-effort (CPUE)

153. The SC **NOTED** that changes in gear configuration during the early 1990's appears to have had the effect of increasing the ratio of yellowfin tuna in the Japanese longline catch when compared to bigeye tuna. Other factors

associated with targeting shifts could be explored in more detail (e.g. NHFCL might not always be the best indicator of hook depth or targeting). Understanding the interactions among NHFCL, fine-scale oceanographic condition, and gear shape under the water might bring further improvement of the CPUE standardisation. Further examination of those issues in the future.

Stock Assessment

154. The SC **NOTED** that a range of quantitative modelling methods were applied to the yellowfin tuna assessment in 2012, ranging from the non-spatial, age-structured production model (ASPM) to the age and spatially-structured Multifan-CL and SS3 analysis.

155. The SC **AGREED** that the management advice for yellowfin tuna should be based on the 2012 MFCL stock assessment using the base case analysis with short term recruitment and alternative steepness of the stock-recruitment relationship of 0.7, 0.8 and 0.9 and the ASPM based case using steepness of 0.9. A limitation of the ASPM model is that it is not spatially structured and thus does not allow integration of tagging data within the model, although it does externally by using the improved catch-at-age table and natural mortality estimates based on tagging data.

156. The SC **NOTED** a series of issues identified with the MFCL stock assessment carried out in 2012, as detailed in the Executive Summary for yellowfin tuna (Appendix XII). Briefly, these include, but are not limited to the following, noting that the reader is referred to the yellowfin tuna Executive Summary for a detailed description:
    - A strong temporal decline in recruitment and in biomass within the eastern equatorial region (Region 5).
    - The model estimates limited movement between the two equatorial regions.
    - Similarly, movement rates between the western equatorial region and the Arabian Sea (Region 1) were estimated to be very low.
    - The model estimated that fishing mortality rates within the western equatorial region did not increase during the 2002–2006 period to the extent that would be anticipated given the large increase in catch from the purse seine fishery during that period (on average 470,000 t: well above all estimated MSY values).

157. The SC **NOTED** similarities of yellowfin tuna stocks of the Eastern Pacific Ocean and the Indian Ocean, but results of the assessments in these two areas give wide-ranging differences in the stock behaviour. The SC **AGREED** that a comparative study be done to investigate this issue further.

158. The SC **AGREED** that a comparative analysis on the Multifan-CL / SS3 assessments in both the Indian Ocean and East Pacific Ocean should be performed by a small group of experts (at least the IOTC consultant and the IATTC expert) working jointly. The objective of this comparative work is to understand why the biomass estimated by the models differ by a ratio 1:10 when many parameters driving the assessment are very similar, i.e. spatial extent of the fishery, estimated MSY, size range of fish caught and growth pattern. One of the aims would be to understand why such differences exist in order to revisit some of the basic assumptions of the models. Therefore, the SC **RECOMMENDED** that the Commission consider funding this proposed work which would need to cover one consultant airfare (up to US$6,000), DSA (up to US$350 per day – 7 days), plus an FAO consultancy rate of US$450 per day (7 days). The total amount requested for this comparative study is US$11,600) per consultant.

159. The SC **AGREED** that the review on stock status of yellowfin tuna in 2013 should firstly examine the report of the above-mentioned comparative analysis if available, noting that the 2013 IOTC budget will not be approved until May 2013. It should also include a discussion on major structural changes which could be proposed for the full assessment which will be undertaken in the coming years, for instance covering a number of topics such as: revision of spatial stratification, including the possibility of using smaller areas, input the latest findings in growth patterns and the differential growth between males and females, age-specific natural mortality, input more age classes (12 instead of 7) and spatial dynamics exhibited by tag-recovery data.

Taiwan, China – Catch-per-unit-of-effort (CPUE)

160. The SC **NOTED** that data from Taiwanese vessels flagged to India was not used in the analysis, the SC **RECOMMENDED** that national scientists from Taiwan,China work with the IOTC Secretariat to gain a better estimate of catch in the Bay of Bengal.

Stock assessment consultant

161. The SC **NOTED** the excellent work done by Mr. Adam Langley (consultant) and his contributions and expertise on integrated stock assessment models, and **RECOMMENDED** that his engagement be renewed for the coming year.

Parameters for future analyses: Yellowfin tuna CPUE standardisation and stock assessments

162. **NOTING** that the areas used in the various CPUE standardisations undertaken in 2012 were very different from one analysis to another, the SC **AGREED** that there is a need to define core area(s) for the CPUE standardisation of yellowfin tuna and **RECOMMENDED** that scientists from CPCs with longline and purse seine fisheries for yellowfin tuna, work together to explore their data and define such core areas, well in advance of the next WPTT meeting in 2013.

Development of priorities for an Invited Expert at the next WPTT meeting

163. The SC **RECOMMENDED** the following core areas of expertise and priority areas for contribution that need to be enhanced for the next meeting of the WPTT in 2013, by an Invited Expert:
   - CPUE analysis and standardisation
   - Tuna tagging data analysis
   - Tuna stock assessment models

   Where possible the Invited Expert should attend both the proposed CPUE workshop and the Working Party in 2013, noting that Invited Experts are unpaid.

7.6 Report of the Second Session of the Working Party on Neritic Tunas (WPNT02)

164. The SC **NOTED** the report of the Second Session of the Working Party on Neritic Tunas (IOTC–2012–WPNT02–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 35 participants, up from 28 in 2011, including 10 recipients of the MPF (9 in 2011).

165. The SC **RECOMMENDED** that the Commission note that neritic tuna and tuna-like species under the IOTC mandate have become as important or more important as the three tropical tuna species (bigeye tuna, skipjack tuna and yellowfin tuna) to most IOTC coastal states with a total estimated catch of 605,359 t being landed in 2011, and as a result, should be receiving appropriate management resources from the IOTC. In fact, neritic tuna species are in many cases, the major commercial tuna and tuna-like species being exploited by the majority of Indian Ocean coastal states and as such, should be given the same status in terms of time and resource investment.

166. **NOTING** that monofilament gillnets are recognised to have highly detrimental impacts on fishery ecosystems, as they are non-selective, and that the use of monofilament gillnets have already been banned in a large number of IOTC CPCs, the SC **RECOMMENDED** that the IOTC Secretariat facilitate a review of the use of monofilament gillnets by IOTC CPCs to i) determine the number of CPCs using then, ii) estimate total catch and bycatch, etc., taken by monofilament gillnets in comparison to other net material, and iii) to report the findings at the next WPNT meeting.

IOTC database for neritic tunas

167. The SC **NOTED** the main data issues that are considered to negatively affect the quality of the statistics for neritic tunas available at the IOTC Secretariat, by type of dataset and fishery, which are provided in Appendix VI of the WPNT02 report, and **RECOMMENDED** that the CPCs listed in the appendix, make efforts to remedy the data issues identified and to report back to the WPNT at its next meeting.

168. The SC **NOTED** that some CPCs have data collection systems that do not include provisions for the sampling of neritic tuna species, as required by the Commission, and **RECOMMENDED** that the existing sampling systems are extended to facilitate data collection for neritic tunas, by species, so as to fulfil their mandatory reporting requirements regarding those species. The SC further **NOTED** that some CPCs have fisheries directed at neritic tuna species and may require assistance with the implementation of data collection for those fisheries and **RECOMMENDED** that such CPCs contact the IOTC Secretariat for further guidance.

169. The SC **RECOMMENDED** that the IOTC Secretariat request that any datasets for neritic tuna species held by SWIOFP, or any other parties, be provided to the IOTC Secretariat before the next meeting of the WPNT.

170. **NOTING** that the nominal catch data (NC) for India, Indonesia and Thailand provided at the WPNT02 meeting were found to conflict with the NC data history provided by these countries in recent years, and for catch-and-effort data for most of the history of the gillnet fleet, the SC **RECOMMENDED** that India, Indonesia and Thailand liaise with the IOTC Secretariat to provide a fully justified revised catch history which will replace the data currently held by the IOTC Secretariat before the next WPNT meeting.

Data set availability

171. **NOTING** that some CPCs, in particular from India, Indonesia and Thailand, have collected large data sets on neritic tuna species over long time periods, the SC **RECOMMENDED** that this data, as well as data for other

CPCs, be submitted to the IOTC Secretariat as per the requirements adopted by IOTC Members in Resolution 10/02. This would allow the WPNT to develop stock status indicators or comprehensive stock assessments of neritic tuna species in the future.

Requests for guidance from CPCs

172. The SC **ENDORSED** the request from coastal CPCs having fisheries targeting neritic tunas that the IOTC Secretariat coordinate the different research activities developed and implemented at national and regional levels if appropriate, with the aiming of determining the stock structure and more generally, the status of neritic tuna stocks in the IOTC area of competence.

Stock structure

173. The SC **NOTED** that in the absence of reliable evidence relating to stock structure bullet tuna, frigate tuna, kawakawa, longtail tuna, Indo-Pacific king mackerel and narrow-barred Spanish mackerel are assumed to exist as single stocks throughout the Indian Ocean, until proven otherwise. The need for genetic and tagging studies on neritic tunas in order to further define the stock structure of neritic tunas was identified.

Priorities for an Invited Expert at the next WPNT meeting

174. The SC **RECOMMENDED** the following core areas of expertise and priority areas for contribution that need to be enhanced for the next meeting of the WPNT in 2013, by an Invited Expert:
    - Expertise: stock structure/connectivity; including from regions other than the Indian Ocean; data poor assessment approaches.
    - Priority areas for contribution: kawakawa, longtail tuna and narrow-barred Spanish mackerel biology, ecology and fisheries.

7.7 Summary discussion of matters common to Working Parties

Capacity building activities

175. The SC **NOTED** paper IOTC–2012–SC15–INF08 which provided the SC with an opportunity to consider the science capacity building activities tentatively planned by the IOTC Secretariat for 2013 and 2014 that will revolve around four core topics:
    - Connecting science and management in the IOTC process
    - Basic stock assessment training
    - Advanced stock assessment courses with IOTC Member countries and international experts
    - Experimental design, analysis of ecological data and computational methods in quantitative ecology

    The target audience for these workshops will vary depending on the topic, from national scientists to middle managers who support IOTC Commissioners, from developing coastal states in interpreting scientific advice from the SC.

176. The SC **ENDORSED** the science capacity building activities planned by the IOTC Secretariat in 2013 and 2014.

177. The SC **RECOMMENDED** that the Commission increase the IOTC Capacity Building budget line so that capacity building workshops/training can be carried out in 2013 and 2014 on the collection, reporting and analyses of catch and effort data for neritic tuna and tuna-like species. Where appropriate this training session shall include information that explains the entire IOTC process from data collection to analysis and how the information collected is used by the Commission to develop Conservation and Management Measures.

Funding for Chairs and Vice-Chairs to attend IOTC meetings

178. The SC **RECOMMENDED** that the IOTC Secretariat include a proposed budget line in the IOTC budget for 2013 and all future years, that would cover the travel expenses of Chairs and Vice-Chairs from developing countries (and developed countries when they are not attached to any national institutions) who are otherwise unable to obtain funding to support their attendance at their respective working party meeting, and for a Chair or Vice-Chair to attend the SC meeting each year.

IOTC species identification cards

Billfish identification cards

179. **NOTING** that the IOTC Secretariat has developed identification cards for billfish species at the request of the WPB and SC, but no funds have yet been allocated to print the cards, the SC **RECOMMENDED** that the Commission allocate funds in the 2013 budget to print sets of identification cards for the billfish species, noting that the total estimated printing costs for the first 1000 sets of the identification cards is around a maximum of

US$6,700 (Table 7). The IOTC Secretariat shall seek funds from potential donors to print additional sets of the identification cards at US$5,500 per 1000 sets of cards.

TABLE 7. Estimated production and printing costs for 1000 sets of billfish species identification cards

Description	Unit price	Units required	Total
Printing plates / plate	US$100	12	1,200
Printing /1000 sets	US$5500	1	5,500
Total estimate (US$)			**6,700**

Shark, marine turtle and seabird identification cards

180. The SC **EXPRESSED** its appreciation to the IOTC Secretariat for the finalisation of the identification cards for sharks, marine turtles and seabirds which have been developed, produced and are being circulated to some CPCs. These identification cards should be used by observers, field samplers as well as fishers in order to improve the identification and reporting of bycatch species.

181. The SC **RECOMMENDED** that the Commission allocate additional funds in 2013 to print further sets of the shark, seabird and marine turtle identification cards developed by the IOTC Secretariat, noting that expected costs are in the vicinity of US$6,000 per 1000 sets of cards.

Tunas and mackerels

182. The SC **AGREED** that the development of species identification cards for all tunas under the IOTC mandate (three tropical tuna, two temperate tuna and six neritic tuna and mackerel species), at various life history stages interacting with IOTC fisheries, urgently needs to be developed to improve species identification and data quality being submitted to the IOTC Secretariat.

183. The SC **RECOMMENDED** that the Commission allocate funds in the 2013 budget to develop and print sets of identification cards for the three tropical tuna, two temperate tuna, and six neritic tuna and seerfish species under the IOTC mandate, noting that the total estimated production and printing costs for the first 1000 sets of the identification cards is around a maximum of US$16,200 (Table 8). The IOTC Secretariat shall seek funds from potential donors to print additional sets of the identification cards at US$5,500 per 1000 sets of cards.

TABLE 8. Estimated production and printing costs for 1000 sets of tuna species identification cards (11 species of tropical, temperate and neritic tunas and mackerels)

Description	Unit price	Units required	Total
Purchase images	US$100	22 (2 per species, plus 2 covers)	2,200
Contract days	US$350	20	7,000
Printing plates / plate	US$100	15	1,500
Printing /1000 sets	US$5500	1	5,500
Total estimate (US$)			**16,200**

Fishing hook identification cards

184. Noting the continued confusion in the terminology of various hook types being used in IOTC fisheries, (e.g. tuna hook vs. J-hook; definition of a circle hook), the SC **RECOMMENDED** that the IOTC Secretariat develop an identification guide for hooks and pelagic gears used in IOTC fisheries, as staffing and financial resources permit, and to distribute the guide to all CPCs once completed. The SC also **AGREED** that circle hooks are defined by hooks having their point turned at least 90° from their shank.

Identification cards – general

185. The SC **RECOMMENDED** that IOTC CPCs translate, print and disseminate the identification cards to their observers and field samplers (Resolution 11/04), and as feasible, to their fishing fleets targeting tuna, tuna-like and shark species. This would allow accurate observer, sampling and logbook data on tuna and tuna-like species to be recorded and reported to the IOTC Secretariat as per IOTC requirements.

186. The SC **NOTED** the commitment made by the WWF Smart Fishing Initiative to fund the reproduction of additional bycatch species identification cards. The SC **AGREED** that translation and printing in Persian may best serve the IOTC at this time.

CPUE discussion summary

187. The SC **EXPRESSED** concern that the majority of the important recommendations issued by the SC to the various working parties in previous years in regards to CPUE standardisation have often not been addressed, and that there was no major progress on these issues during the past two years. Therefore, the SC **RECOMMENDED** that the scientists in charge of this work make every possible effort to consider those

guidelines in future CPUE standardisation work in order to improve the quality of CPUE series which are essential to stock assessments.

188. **NOTING** that a set of 'core areas' which are likely to be robust to frequent fluctuations of external factors, may be more informative than using all of the data available, especially when other species were being targeted, the SC **RECOMMENDED** that 'core areas' be identified and agreed to by each working party so as to facilitate and monitor population abundance trends across all fleets. This should be carried out intersessionally and presented at the proposed longline CPUE workshop, to be held in the second quarter of 2013.

Dedicated workshop on CPUE standardisation

189. **NOTING** the combined recommendations from the WPB, WPTmT and WPTT to hold a dedicated workshop on CPUE standardisation, the SC **RECOMMENDED** that a dedicated, informal workshop on CPUE standardisation, including issues of interest for other IOTC species, should be carried out before the next round of stock assessments in 2013. The terms of reference (TORs) for the workshop are provided in Appendix VII. Where possible it should include a range of invited experts, including those working on CPUE standardisation in other ocean/RFMOs, in conjunction with scientists from main tuna fishing countries, and supported by the IOTC Secretariat. The IOTC Secretariat shall include a budget item for this workshop, for the consideration of the Commission.

Risk-based approaches to determining stock status

190. The SC **RECOMMENDED** that the IOTC Secretariat facilitate a process to provide the necessary information to the SC so that it may consider the Weight-of-Evidence approach to determine species stock status, as an addition to the current approach of relying solely on fully quantitative stock assessment techniques.

Working Party Reports

191. **NOTING** that the report of the WPTmT, WPB and WPTT do not include trends of recruitment or biomass, as estimated from the different assessments, the SC **REQUESTED** that the working parties include this information in their future reports.

192. **NOTING** that in 2012 the Commission had adopted Recommendation 12/14 *On interim target and limit reference points*, the SC **AGREED** that as a complement to the information in the KOBEII Strategy Matrix for each species could include estimates on the likelihood of the different scenarios exceeding limit reference points.

Incorporation of the risk levels associated with reference points

193. **NOTING** that Resolution 12/01 *on the implementation of the precautionary approach* was adopted by the Commission in 2012, and that provisional reference points have been adopted in Recommendation 12/14 *on interim target and limit reference points*, the SC **AGREED** that future Kobe II strategy matrices should show the levels of risk of breaching the reference points and that the Executive Summaries for tropical tuna species incorporate explanatory text in this regard.

On Interim Target and Limit Reference Points

194. **NOTING** the completion of the MSE work on tropical tunas is likely to take several years, and that the lack of data or information to improve the work on formal stock assessments should not hinder the application of the Precautionary Approach, the SC **RECOMMENDED** that the Commission consider the adoption of the interim target and limit reference points as a Resolution. Furthermore, interim harvest controls rules should be considered by the Commission for adoption in the Resolution.

Employment of a Fisheries Officer (Science)

195. **NOTING** the rapidly increasing scientific workload at the IOTC Secretariat, including a wide range of additional science related duties assigned to it by the SC and the Commission, and that the current Fishery Officer supporting the IOTC scientific activities will depart at the end of February 2013, the SC strongly **RECOMMENDED** that the Commission approve the hiring of a Fishery Officer (Science) to work on a range of matters in support of the scientific process, including but not limited to science capacity building, bycatch and regional observer schemes.

Chairs and Vice-Chairs of the Working Parties

196. The SC **RECOMMENDED** that the Commission note and endorse the Chairs and Vice-Chairs for each of the IOTC Working Parties, as provided in Appendix VIII.

8. Examination of the Effect of Piracy on Fleet Operations and Subsequent Catch and Effort Trends

197. The SC **NOTED** that the Commission, at its 15th Session '*recognized that piracy activities in the western Indian Ocean, have had substantial negative consequences on the activities of some fleets, as well as the level of observer coverage in these areas. The Commission requests that the Scientific Committee assess the effect of piracy on fleet operations and subsequent catch and effort trends*' (para. 40 of the S15 report).

198. The SC **NOTED** that the Commission, at its 16th Session, further '*recognised the severe impact of piracy acts on humanitarian, commercial and fishing vessels off the coast of Somalia and noted that the range of the attacks extended towards almost all of the western Indian Ocean, notably toward Kenya and Seychelles, with attacks being reported in their respective EEZ.*' (para. 124 of the S16 report).

199. The SC **NOTED** that although no specific analysis of the impacts of piracy on fisheries in the Indian Ocean were presented at IOTC working party meetings in 2012, many papers demonstrated some level of impact on fishing operations in the western Indian Ocean (Somali Basin) and other areas as a result of relocated fishing effort. Specifically, that there has been a substantial displacement of effort into traditional albacore fishing areas, thereby increasing fishing pressure on this species. In recent years, the proportion of fishing effort of the Japanese longline fleet sharply decreased in the north-western Indian Ocean (off the Somalia coastline), while fishing effort increased in the area south of 25°S, especially off western Australia, where catch rates of albacore are higher (Fig. 1). Similarly, as a direct result of piracy activities in the western Indian Ocean, many of the vessels from the I.R. Iran targeting tropical tuna species on the high seas have moved back to the EEZ of I.R. Iran and are now targeting neritic tuna and tuna-like species. This has resulted in substantial increases in the total catch and effort of neritic tuna and tuna-like species under the IOTC mandate.

200. The SC **NOTED** that the number of active vessels in the IOTC area of competence have declined substantially since 2008 (Fig. 2), and that this was likely due to the impact of piracy activities in the western Indian Ocean. The impacts appear to have been greatest on the longline fleets with effort having declined to negligible levels in recent years by most fleets (Figs. 2 and 3). Fishing effort of the purse seine fleet has also shifted east by at least 100 miles compared to the historic distribution of effort and piracy was reported to also be playing a role in determining the behaviour of small-scale fishing vessels which have declined in the region.

201. The SC **NOTED** that there has also been a substantial reduction in total effort due to piracy, evident from the decline in total effort from all major fleets (Fig. 1). In the first half of 2011, 11 vessels from Taiwan,China, moved to the Atlantic Ocean and 2 to the Pacific Ocean. However, in the second half of 2011, 5 vessels returned from the Atlantic Ocean, and 1 vessel returned from the Pacific Ocean. In 2012, the trend has been reversed, with a total of 15 vessels being transferred from the Atlantic Ocean back to the Indian Ocean. Similarly, 6 vessels from Taiwan,China have been transferred from the Pacific Ocean back to the Indian Ocean in 2012. Japan reported a reduction of ~140 vessels since 2006, with 85 remaining in 2011 (preliminary), which corresponds to a decrease of total catch of about 80% (for bigeye tuna and yellowfin tuna combined). In recent years, the proportion of fishing effort of the Japanese longline fleet sharply decreased in the north-western Indian Ocean (off the Somalia coastline), while fishing effort increased in the area south of 25°S, especially off western Australia. The Rep. of Korea reported that one longline vessel was hijacked in 2006 and this had resulted in a large reduction (50%) of the number of Rep. of Korean active vessels, from 26 in 2006 to 7 in 2011; while the remaining vessels moved to the Southern Indian Ocean. The number of EU and associated purse seiners has also decreased from 51 in 2006 to 34 in 2011 (a 33% of reduction).

202. The SC **NOTED** that given the potential impacts of piracy on fisheries in other areas of the Indian Ocean through the relocation of longliners to other fishing grounds, specific analysis should be carried out and presented at the next WPTT and WPTmT meetings by CPCs most affected by these activities, including Japan, Rep. of Korea and Taiwan,China. For example, longline fishing effort has been redistributed to traditional albacore fishing grounds in recent years, thereby further increasing fishing pressure on the albacore stock (see IOTC–2012–WPTmT04–R).

203. The SC **NOTED** that reports from Thailand, China and Taiwan,China that longline vessels from some fleets appear to be moving back towards the central Indian Ocean in 2012, as a direct result of increased CPUE being recorded in these areas. This movement back into the area vacated due to piracy activities should be closely monitored and reported at the SC and the working party meetings in 2013.

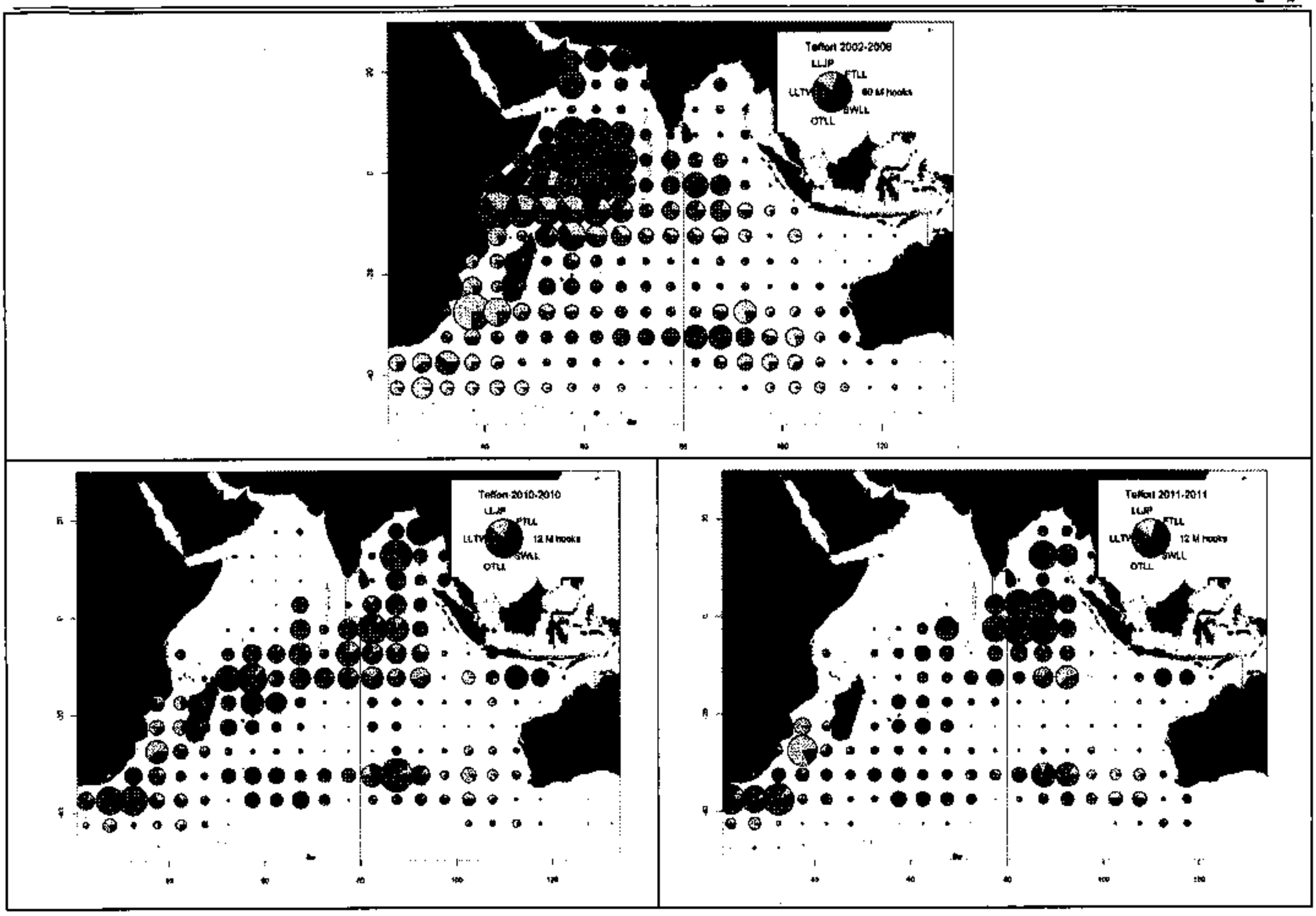
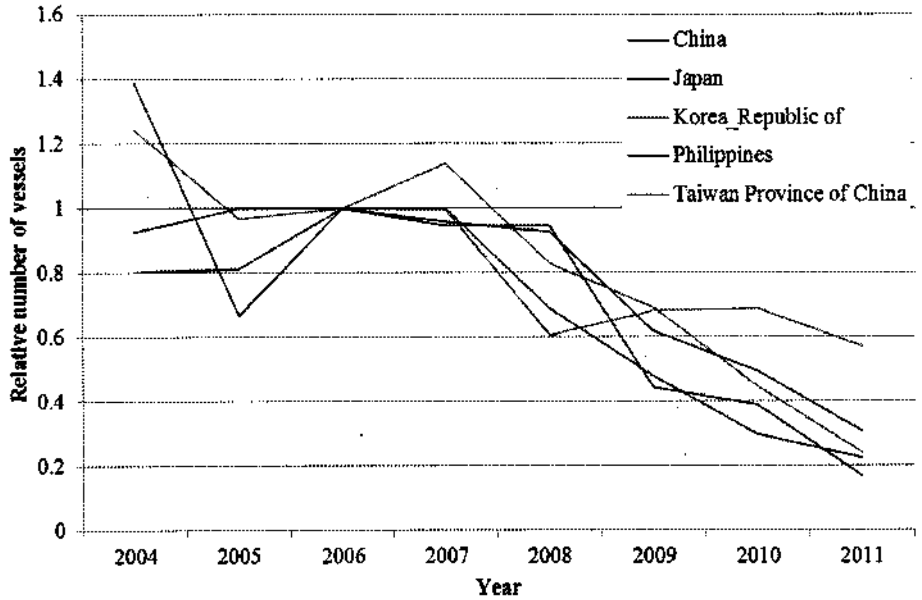


Fig. 1. The geographical distribution of fishing effort (millions of hooks) as reported for the longline fleets of Japan (LLJP), Taiwan,China (LLTW), fresh-tuna longline (FTLL), other longline (OTLL), and longline directed at swordfish (SWLL), in the IOTC area of competence, 2002–06, and 2010–11. The red line represents the boundary between western and eastern Indian Ocean regions. LLJP (light green): deep-freezing longliners from Japan; LLTW (dark green): deep-freezing longliners from Taiwan,China; SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets); FTLL (red): fresh-tuna longliners (China, Taiwan,China and other fleets; OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, South Korea and various other fleets).



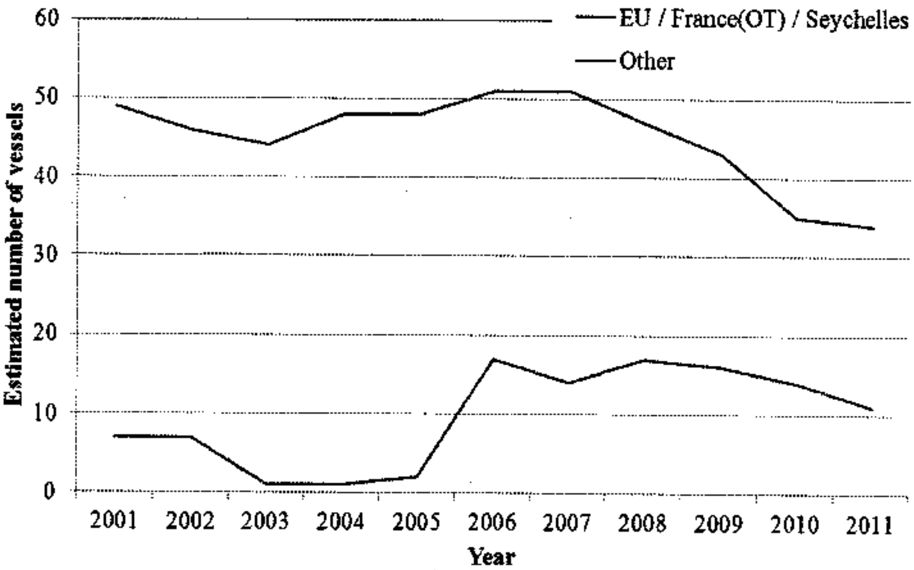


Fig. 2. The change in the relative number of some active longline fleets since 2004 (upper – numbers have been scaled to the number of active vessels in 2006) and estimated numbers of active purse seine vessels from 2001 to 2011 (lower) in the Indian Ocean.

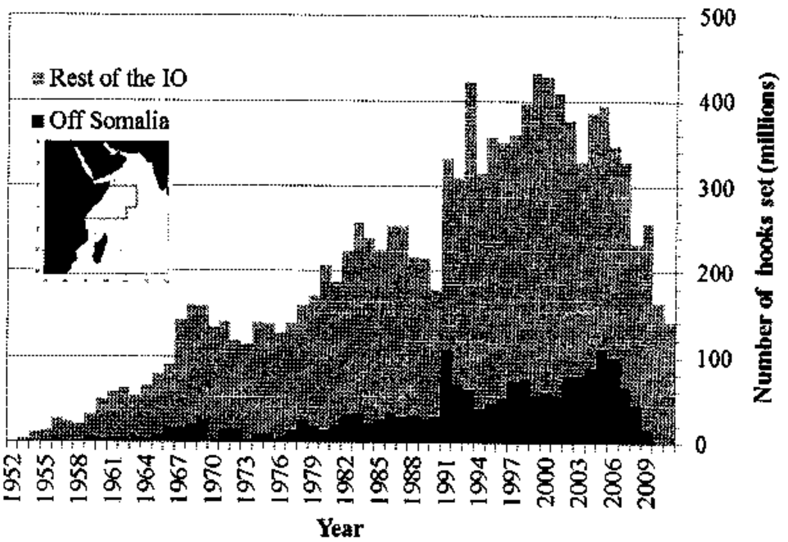


Fig. 3. The total number of hooks set (in millions), by year and geographical area: off the Somalia coastline (area shown in the insert) and for the rest of the Indian Ocean (IO), from 1952 to 2011.

204. The SC **RECOMMENDED** that given the lack of quantitative analysis of the effects of piracy on fleet operations and subsequent catch and effort trends, and the potential impacts of piracy on fisheries in other areas of the Indian Ocean through the relocation of longliners to other fishing grounds, specific analysis should be carried out and presented at the next WPTT meeting by the CPCs most affected by these activities, including Japan, Republic of Korea and Taiwan,China. The Chair of the WPTT shall facilitate the analysis and report back to the SC in 2013.

205. The SC **NOTED** the following statement from the I.R. Iran on combating piracy and developing international guidelines to fishing vessel navigation and compensation:

"The appearance of piracy in recent years in some part of the world, especially in the Indian Ocean, has caused concerns and has had negative impacts on fishing activities. Unfortunately many vessels have been attacked by pirates and have been seriously damaged. From 2008 up to now, unfortunately 50 fishing vessels of Islamic Republic of Iran have been attacked in the Indian Ocean by pirates, who have caused the loss of seven vessels and drowning of nine crewmen. In the meantime the loss of vessels and crew due to a lack of insurance coverage, have not been compensated. Other vessels are not immune from damage or new attacks in the future. The result of this situation is clearly visible in our catch composition and quantity. The Islamic Republic of Iran as a country has experienced lot of pirate attacks and officially requests that the IOTC and its Scientific Committee take anti-piracy steps. I.R. of Iran proposes the

establishment of an ad hoc working group. This working group should prepare an anti-piracy guideline. It is anticipated that through these works and by the developed guidelines and other necessary coordination, the issue of supporting fishermen and fishing vessels against piracy and compensation of their damages will be considered and followed up in the future. Also in this way all responsible international organizations, particularly FAO and the IMO, are expected to support and cooperate with CPCs."

9. Status of Tuna and Tuna-Like Resources in the Indian Ocean

206. **NOTING** that Table 1 in this report provides an overview of the stock status and management advice for each species under the IOTC mandate as well as species directly impacted by fisheries for tuna and tuna-like species, the SC **AGREED** to an Executive Summary for each species or species group as detailed below.

9.1 Tuna – Highly migratory species

207. The SC **RECOMMENDED** that the Commission note the management advice developed for each tropical and temperate tuna species as provided in the Executive Summary for each species.
    - Albacore (*Thunnus alalunga*) – Appendix IX
    - Bigeye tuna (*Thunnus obesus*) – Appendix X
    - Skipjack tuna (*Katsuwonus pelamis*) – Appendix XI
    - Yellowfin tuna (*Thunnus albacares*) – Appendix XII

208. The SC **AGREED** that the Chairs of the IOTC Working Parties should ensure that where possible, all KOBE plots should be presented in a standardised format for the consideration of the SC.

209. The SC **NOTED** paper IOTC–2012–SC15–12 which provided an overview of the biology, stock status and management of southern bluefin tuna (*Thunnus maccoyii*), and thanked CCSBT for providing it.

9.2 Billfish

210. The SC **RECOMMENDED** that the Commission note the management advice developed for each billfish species as provided in the Executive Summary for each species:
    - Swordfish (*Xiphias gladius*) – Appendix XIII
    - Black marlin (*Makaira indica*) – Appendix XIV
    - Blue marlin (*Makaira nigricans*) – Appendix XV
    - Striped marlin (*Tetrapturus audax*) – Appendix XVI
    - Indo-Pacific sailfish (*Istiophorus platypterus*) – Appendix XVII

9.3 Tuna and mackerel – Neritic species

211. 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:
    - Bullet tuna (*Auxis rochei*) – Appendix XVIII
    - Frigate tuna (*Auxis thazard*) – Appendix XIX
    - Kawakawa (*Euthynnus affinis*) – Appendix XX
    - Longtail tuna (*Thunnus tonggol*) – Appendix XXI
    - Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XXII
    - Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix XXIII

10. Status of Marine Turtles, Seabirds and Sharks in the Indian Ocean

10.1 Sharks

212. The SC **RECOMMENDED** that the Commission note the management advice developed for a subset of shark species commonly caught in IOTC fisheries for tuna and tuna-like species:
    - Blue sharks (*Prionace glauca*) – Appendix XXIV
    - Oceanic whitetip sharks (*Carcharhinus longimanus*) – Appendix XXV
    - Scalloped hammerhead sharks (*Sphyrna lewini*) – Appendix XXVI
    - Shortfin mako sharks (*Isurus oxyrinchus*) – Appendix XXVII
    - Silky sharks (*Carcharhinus falciformis*) – Appendix XXVIII
    - Bigeye thresher sharks (*Alopias superciliosus*) – Appendix XXIX
    - Pelagic thresher sharks (*Alopias pelagicus*) – Appendix XXX

10.2 Marine turtles

213. The SC **RECOMMENDED** that the Commission note the management advice developed for marine turtles, as provided in the Executive Summary encompassing all six species found in the Indian Ocean:
    - Marine turtles – Appendix XXXI

10.3 Seabirds

214. The SC **RECOMMENDED** that the Commission note the management advice developed for seabirds, as provided in the Executive Summary encompassing all species commonly interacting with IOTC fisheries for tuna and tuna-like species:
    - Seabirds – Appendix XXXII

11. IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME

215. The SC **NOTED** paper IOTC–2012–SC15–33 Rev_3 which provided an update on the national implementation of the IOTC regional observer scheme (ROS) for each IOTC CPC, noting that the ROS started on 1st July 2010 (Resolution 09/04 superseded by Resolution 10/04 and Resolution 11/04).

216. The SC **NOTED** that 12 CPCs have submitted their list of accredited observers and only seven CPCs have submitted observer trips reports. A total of 38 observer trip reports have been submitted to the IOTC Secretariat: 11 reports for 2010, 23 reports for 2011 and 4 reports for 2012. The SC **NOTED** that these reports are very unevenly distributed among CPCs. In 2011, the only full year of implementation of the ROS to date, it was estimated from the reports and effort data available, that only two CPCs have achieved the minimum 5% observer coverage required in Resolution 11/04.

217. The SC **EXPRESSED** its strong concern regarding the low level of reporting to the IOTC Secretariat of both the observer trip reports and the list of accredited observers since the start of the ROS in July 2010. Such a low level of implementation and reporting is detrimental to the work of the SC, in particular regarding the estimation of incidental catches of non-targeted species, as requested by the Commission. In particular, the SC **NOTED** that the IOTC Regional Observe Programme could be a significant source of potential data for marine turtles (e.g. sex and species composition, etc.) for some longline and gillnet fisheries.

218. The SC **RECOMMENDED** that all IOTC CPCs urgently submit, and keep up-to-date, their list of accredited observers to the IOTC Secretariat and 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)

219. The SC **NOTED** that the timely submission of observer trip reports to the IOTC Secretariat is necessary to ensure that the SC 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 IOTC scientists to better assess the impacts of fisheries for tuna and tuna-like species on bycatch species.

220. The SC **RECOMMENDED** that the Commission 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 XXXIII.

221. The SC **RECOGNISED** that the implementation of national observer programmes is not a simple task, e.g. due to piracy activities, and that the financial and human costs involved in the deployment of observers are important to consider, in particular for CPCs with large fishing fleets. However, the SC **AGREED** that the minimum observer coverage of 5% set out by Resolution 11/04 is already below the minimum necessary coverage estimated by simulations, and that it should not be lowered.

12. OUTLOOK ON TIME-AREA CLOSURES

222. The SC **NOTED** that the Commission, at its 16th Session, adopted Resolution 12/13 *for the conservation and management of tropical tunas stocks in the IOTC area of competence*, which superseded Resolution 10/01. Contained within Resolution 12/13 is a requirement that the SC will provide at its 2012 and 2013 plenary session, the following:

a) *an evaluation of the closure area, specifying in its advice if a modification is necessary, its basic scientific rationale with an assessment of the impact of such a closure on the tropical tuna stocks, notably yellowfin and bigeye tuna*
b) *an evaluation of the closure time periods, specifying in its advice if a modification is necessary, its basic scientific rationale with an assessment of the impact of such a closure on the tropical tuna stocks, notably yellowfin and bigeye tuna*

223. The SC **NOTED** paper IOTC–2011–SC14–39 presented to the SC in 2011, which provided an evaluation of the IOTC time-area closure by estimating what the maximum potential loss of catches would be under different scenarios of time-area closure, as estimated from the catch statistics of the IOTC. The estimation was based on the historical IOTC database as no information was available for the specific closed periods of 2011 (February for longline, November for purse seine) when the measure took effect. The longline effort had already been entirely redistributed to other areas and the purse seine data for November were not yet available when the paper was prepared, nor at the date of the SC.

224. The SC **NOTED** that the results obtained from the study are similar to the analysis carried out for the SC in 2010, which emphasized that catch reduction expected from the current time-area closure were negligible. It was further recalled that the results were also supported by paper IOTC–2011–SC14–40 which provided a preliminary investigation into the effects of the network of Indian Ocean MPAs on yellowfin tuna with particular emphasis on the IOTC time-area closure. The results of the study indicated that the current network including an IOTC closure of only two, one month closures (one month for purse seine and one month for longline), is likely to have little impact on stock status, whether effort is eliminated or redistributed. The study examined scenarios to investigate the impacts of a 12 month closure of the current IOTC time-area closure. Some benefits to the status of yellowfin tuna stocks were predicted if it is assumed that effort (and catch) is eliminated, but where effort is redistributed such a closure had negligible impact on stock status.

225. The SC reiterated its previous **RECOMMENDATION** that the Commission note that the current closure is likely to be ineffective, as fishing effort will be redirected to other fishing grounds in the Indian Ocean. The positive impacts of the moratorium within the closed area would likely be offset by effort reallocation. For example, the WPTmT noted that longline fishing effort has been redistributed to traditional albacore fishing grounds in recent years, thereby further increasing fishing pressure on this stock.

226. **NOTING** that the objective of Resolution 12/13 is to decrease the overall pressure on the main targeted stocks in the Indian Ocean, in particular yellowfin tuna and bigeye tuna, and also to evaluate the impact of the current time/area closure and any alternative scenarios on tropical tuna populations, the SC reiterated its previous **RECOMMENDATION** that the Commission specify the level of reduction or the long term management objectives to be achieved with the current or alternative time area closures and/or alternative measures, as these are not contained within the Resolution 12/13. This will, in turn, guide and facilitate the analysis of the SC, via the WPTT in 2013 and future years.

227. **NOTING** the lack of research examining time-area closures in the Indian Ocean by the WPTT in 2011 and 2012, as well as the slow progress made in addressing the Commission request, the SC reiterated its **RECOMMENDATION** that the SC Chair begins a consultative process with the Commission in order to obtain clear guidance from the Commission about the management objectives intended with the current or any alternative closure. This will allow the SC to address the Commission request more thoroughly.

13. IMPACTS OF CATCHING BIGEYE TUNA AND YELLOWFIN TUNA JUVENILES AND SPAWNERS

228. The SC **NOTED** that the Commission, at its 16th Session, adopted Resolution 12/13 *for the conservation and management of tropical tunas stocks in the IOTC area of competence*, which superseded Resolution 10/01. Contained within Resolution 12/13 is a requirement that the SC will provide at its 2012 and 2013 plenary session, the following:
    c) *an evaluation of the impact on yellowfin and bigeye tuna stocks by catching juveniles and spawners taken by all fisheries. The Scientific Committee shall also recommend measures to mitigate the impacts on juvenile and spawners*

229. The SC **NOTED** that the most direct measure of impact of fishing fleets on juveniles could be obtained by looking at the catches of juvenile yellowfin tuna and bigeye tuna by gear, as presented in Table 9 below. It should be noted that the estimates of catches of juvenile fish are doubtful for some gears, for which catch-at-length information is severely limited or almost non-existent. The SC reiterated its **AGREEMENT** from 2011,

that the WPTT should provide the SC with multi-gear yield-per-recruit estimates for all stocks assessed in 2013, as this is another useful indicator of the impact of each gear on potential yields.

TABLE 9. Catches of juvenile yellowfin tuna and bigeye tuna by gear.

Yellowfin tuna Gear type*	Total catch (mt)	% Juveniles of catch within gear	% Juveniles total juvenile catch
BB	18438	85	13.97
GN	84305	40	30.06
HD	32728	25	7.29
LL	94610	2	1.69
TL	21297	37	7.02
FS	92957	3	2.49
LS	69128	60	36.98
OT	1516	37	0.50
TOTAL	414979	27	100
Bigeye tuna Gear type	**Total catch (mt)**	**% Juveniles of catch within gear**	**% Juveniles total juvenile catch**
BB	1070	70	3.44
GN	445	15	0.31
HD	27	1	0.00
LL	99535	1	4.57
TL	1079	41	2.03
FS	6425	13	3.83
LS	21990	84	84.80
OT	241	92	1.02
TOTAL	130813	17	100

(*) BB : baitboat / GN : Gillnet / HD : Handline / LL : Longline / TL : Troll / FS : Purse seine free schools / LS : Purse seine FAD schools / OT : Others

230. The SC **NOTED** that the existing statistics on catches of juvenile fish by species obtained by the various purse seine fleets fishing on FADs, in both numbers, size (length) and weight, provide a measure of their impact on the stocks, and the corresponding effort statistics (number of boats, GRT and fishing days), give an indication of the capacity of this fleet, which engages, although not exclusively, on the FAD fishery.

231. 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.

232. The SC **NOTED** that a complete analysis of the likely impact of the juveniles caught by any fishery in the Indian Ocean and of any management plan should be carried out within the context of the work on MSE that the SC has agreed to carry out in the future. This could, if necessary, also quantify the impact of such measures not only on the stocks, but also on the fleets, including likely economic impact on activities dependent on the fleets affected.

233. 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. The SC **REQUESTED** 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.

14. Progress on the Implementation of the Recommendations of the Performance Review Panel

234. The SC **NOTED** paper IOTC–2012–SC15–34 which provided an update on progress regarding Resolution 09/01 *on the performance review follow–up.*

235. The SC **RECOMMENDED** that the Commission note the updates on progress regarding Resolution 09/01 *on the performance review follow–up*, as provided at Appendix XXXIV.

15. SCHEDULE AND PRIORITIES OF WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS FOR 2013 AND TENTATIVELY FOR 2014

Research Recommendations and Priorities

236. The SC **NOTED** paper IOTC–2012–SC15–35 which outlined the proposed priorities for IOTC Working Parties and SC meetings for 2013 and tentatively for 2014.

237. The SC **NOTED** the proposed workplans and priorities of each of the Working Parties and **AGREED** to the revised workplans as outlined in Appendix XXXV. The Chairs and Vice-Chairs of each working part shall ensure that the efforts of their working party is focused on the core areas contained within the appendix, taking into account any new research priorities identified by the Commission at its next Session.

238. The SC **ADOPTED** a revised assessment schedule for the tuna and tuna-like species under the IOTC mandate, as well as the current list of key shark species of interest, as outlined in Appendix XXXVI. Following the uncertainty remaining in the bigeye tuna assessment carried out for the previous WPTT meetings in 2010 and 2011, the WPTT **AGREED** that bigeye tuna would be the priority species for stock assessments in 2013. Only stock status indictors (i.e standardised CPUE series) should be updated for skipjack tuna and yellowfin tuna.

Schedule of meetings for 2013 and 2014

239. **NOTING** paper IOTC–2012–SC15–36 which outlined the proposed schedule for IOTC Working Parties and SC meetings for 2013 and tentatively for 2014, the SC **AGREED** that despite the current overfishing status of albacore, there was no urgent need to hold a WPTmT in 2013, but rather that national scientists working on albacore shall produce updated stock status indicators (i.e. standardised CPUE indices) for presentation at the next SC meeting.

240. The SC **NOTED** the options provided to it by the WPEB, highlighting that as quantitative information on sharks becomes available, there should be the possibility for simple stock status analyses based on fisheries and biological indicators. Expertise in stock assessment from other IOTC working parties, e.g. the WPTT or the WPB, would be of value for such analyses. The SC **AGREED** that the WPEB should be retained in its current form, but that the Chair shall ensure that each five day meeting alternatives its core focus among the species covered under its mandate.

241. **NOTING** the difficulty of carrying out stock assessments for three tropical tuna species in a single year, the SC **AGREED** to a revised assessment schedule on a two- or three-year cycle for the three tropical tuna species as outlined in Appendix XXXVI. Following the uncertainty remaining in the bigeye tuna assessment carried out for the previous WPTT meetings in 2010 and 2011, bigeye tuna would be the priority species for stock assessments in 2013, while only stock status indictors (i.e. standardised CPUE series) should be updated for skipjack tuna and yellowfin tuna, including the revision of the executive summaries to incorporate any new work being completed during the WPTT sessions.

242. The SC **AGREED** that while the MSE process was still in its early stages of development, there was no pressing need to hold a WPM meeting in 2013, as the work to be undertaken was of a highly technical nature and would require the involvement of a very limited number of experts in the field of development and implementation of population and fishery models for MSE. Thus, as suggested in the MSE workplan (contained in the WPM04 Report), two workshops composed of experts should be held in 2013 to continue the development of the MSE process. The Chair of the WPM shall present an update on progress made by the small working group at the next SC meeting.

243. The SC **RECOMMENDED** that the Commission endorse the schedule of Working Party and Scientific Committee meetings for 2013, and tentatively for 2014 (Table 10).

TABLE 10. Schedule of Working Party and Scientific Committee meetings for 2013, and tentatively for 2014.

Meeting	2013		2014 (tentative)	
	Date	**Location**	**Date**	**Location**
Working Party on **Neritic Tunas**	2–5 July (4d)	Bali, Indonesia or Tanzania	13–16 July (4d)	Bali, Indonesia or Tanzania
Working Party on **Temperate Tunas**	Nil	Nil	5–8 Aug (4d)	TBD

Working Party on **Ecosystems and Bycatch**	12–16 Sept (5d)	La Réunion	9–13 Sept (5d)	TBD
Working Party on **Billfish**	18–22 Sept (5d)	La Réunion	17–21 Sept (5d)	TBD
Working Party on **Tropical Tunas**	22–27 Oct (6d)	Bilbao or San Sebastián, Spain	21–26 Oct (6d)	TBD
Working Party on **Methods**	Nil	Nil	30 Nov (1d)	Victoria, Seychelles
Working Party on **Data Collection and Statistics**	29–30 Nov (2d)	Victoria, Seychelles	Nil	Nil
Scientific Committee	2–6 Dec (5d)	Victoria, Seychelles	1–5 Dec (5d)	Victoria, Seychelles
Working Party on **Fishing Capacity**	Nil	Nil	Nil	Nil

16. Other Business

16.1 Revised 'Guidelines for the Presentation of Stock assessment Models'

244. The SC **NOTED** paper IOTC–2012–SC15–37 which provided a revision to the previous *Guidelines for the Presentation of Stock Assessment Models* adopted by the SC in 2012, which attempt to ensure greater transparency and facilitate peer-review of models employed in the provision of advice on the status of species managed by the IOTC. Since 2010, the SC and the Commission have agreed to several additional elements to be provided in CPUE and stock assessment papers such as the Kobe management strategy matrix, Kobe plots and interim reference points.

245. The SC **ADOPTED** revised "*Guidelines for the Presentation of Stock Assessment Models*" provided at Appendix XXXVII, and requested that the guidelines be communicated to working party participants well in advance of each meeting to ensure that national scientists/authors of all future CPUE and stock assessment papers presented at IOTC working party meeting comply with the guidelines.

246. The SC **NOTED** the request by the EU that as resources permit, software should be obtained which would allow interested scientists to access and manipulate all stock assessment inputs and detailed outputs from the various assessments carried out by the IOTC working parties each year.

247. **NOTING** the conclusions and recommendation from the KOBE 3 meeting held in 2011,

> "*Kobe III participants* ***agreed*** *that the K2SM is a useful tool for evaluating management strategies or options,* ***provided that the uncertainties in assessments can be adequately quantified****. Participants acknowledged that* ***considerable work remains to be done*** *both to reduce uncertainty in stock assessments, and to develop common standards or guidelines for how uncertainty is reflected. Kobe III participants recommended that the scientific committees and bodies of the tRFMOs jointly develop methods to* ***better quantify the uncertainty*** *and understand how this uncertainty is reflected in the risk assessment inherent in the K2SM.*"

the SC **RECOMMENDED** that in 2013, collaborative efforts be developed among tRFMO on this matter, by targeting the development of how to build K2SM with well estimated levels of uncertainty.

248. The SC **EXPRESSED** its reservations regarding the validity of some of the K2SM that are produced for the consideration of the IOTC working parties when the uncertainties are very large in the stock assessment results (for instance due to the increasing lack of data for major fisheries and due to the unknown cascading errors in the projections), it may be unrealistic to propose reliable K2SM for several of the Indian Ocean stocks.

16.2 GEF-financed global project on tuna fisheries: update and relevance to IOTC

249. The SC **NOTED** paper IOTC–2012–SC15–INF06 which provided an overview of the project: "Sustainable Management of Tuna Fisheries and Biodiversity Conservation in the Areas Beyond National Jurisdiction (ABNJ)" a project funded by the Global Environmental Facility (GEF) and led by the Food and Agriculture Organization (FAO), and scheduled to be operational from 2013 for a period of five years.

250. The SC **NOTED** that the project resources that will be made available under Components 1 (Promotion of sustainable management of tuna fisheries, including development of HCRs and implementation of the precautionary approach); and Component 2 (Reducing Ecosystem Impacts of Tuna Fishing) will accelerate the implementation of relevant recommendations of the SC.

17. Review of the Draft, and Adoption of the Report of the Fifteenth Session of the Scientific Committee

251. The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC15, provided at Appendix XXXVIII.

252. The report of the Fifteenth Session of the Scientific Committee (IOTC–2012–SC15–R) was **ADOPTED** on 15 December 2012.

APPENDIX I
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APPENDIX II
AGENDA FOR THE FIFTEENTH SESSION OF THE SCIENTIFIC COMMITTEE

Date: 10–15 December, 2012
Location: STC Conference Center, Victoria
Mahé, Seychelles
Time: 09:00 – 17:00 daily
Chair: Dr. Tsutomu Nishida; **Vice-Chair:** Mr. Jan Robinson

1. **OPENING OF THE SESSION** (Chair)
2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Chair)
3. **ADMISSION OF OBSERVERS** (Chair)
4. **DECISIONS OF THE COMMISSION RELATED TO THE WORK OF THE SCIENTIFIC COMMITTEE** (Secretariat)
5. **SCIENCE RELATED ACTIVITES OF THE IOTC SECRETARIAT IN 2012** (Secretariat)
6. **NATIONAL REPORTS FROM CPCs** (CPCs)
7. **REPORTS OF THE 2012 IOTC WORKING PARTY MEETINGS**
   - 7.1 IOTC–2012–WPTmT04–R: Report of the Fourth Session of the Working Party on Temperate Tunas
   - 7.2 IOTC–2012–WPB10–R: Report of the Tenth Session of the Working Party on Billfish
   - 7.3 IOTC–2012–WPEB08–R: Report of the Eighth Session of the Working Party on Ecosystems and Bycatch
   - 7.4 IOTC–2012–WPM04–R: Report of the Fourth Session of the Working Party on Methods
   - 7.5 IOTC–2012–WPTT14–R: Report of the Fourteenth Session of the Working Party on Tropical Tunas
   - 7.6 IOTC–2012–WPNT02–R: Report of the Second Session of the Working Party on Neritic Tunas
   - 7.7 Summary discussion of matters common to Working Parties (capacity building activities – stock assessment course; connecting science and management, etc.)
8. **EXAMINATION OF THE EFFECTS OF PIRACY ON FLEET OPERATIONS AND SUBSEQUENT CATCH AND EFFORT TRENDS** (Chair)
9. **STATUS OF TUNA AND TUNA-LIKE RESOURCES IN THE INDIAN OCEAN** (Chair)
   - 9.1 Tuna – Highly migratory species
   - 9.2 Tuna and mackerel – Neritic species
   - 9.3 Billfish
10. **STATUS OF MARINE TURTLES, SEABIRDS AND SHARKS IN THE INDIAN OCEAN** (Chair)
    - 10.1 Marine turtles
    - 10.2 Seabirds
    - 10.3 Sharks
11. **IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME** (Secretariat)
12. **OUTLOOK ON TIME-AREA CLOSURES** (Chair)
13. **IMPACT OF CATCHING BIGEYE TUNA AND YELLOWFIN TUNA JUVENILES AND SPAWNERS** (Chair)
14. **PROGRESS ON THE IMPLEMENTATION OF THE RECOMMENDATIONS OF THE PERFORMANCE REVIEW PANEL** (Secretariat)
15. **SCHEDULE AND PRIORITIES OF WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS FOR 2013 AND TENTATIVELY FOR 2014** (Secretariat)
16. **OTHER BUSINESS** (Chair)
    - 16.1 Revised 'Guidelines for the Presentation of Stock Assessment Models'
    - 16.2 GEF-financed global project on tuna fisheries: update & relevance to IOTC
17. **REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE FIFTEENTH SESSION OF THE SCIENTIFIC COMMITTEE** (Chair)

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC–2012–SC15–01a	Draft agenda of the Fifteenth Session of the Scientific Committee	✓ (5 September 2012)
IOTC–2012–SC15–01b	Draft annotated agenda of the Fifteenth Session of the Scientific Committee	✓ (25 November 2012)
IOTC–2012–SC15–02	Draft list of documents	✓ (11 September 2012)
IOTC–2012–SC15–03	Outcomes of the Sixteenth Session of the Commission (Secretariat)	✓ (14 November 2012)
IOTC–2012–SC15–04	Previous decisions of the Commission (Secretariat)	✓ (14 November 2012)
IOTC–2012–SC15–05	Report of the Secretariat – Activities in support of the IOTC science process in 2012 (Secretariat)	✓ (25 November 2012)
IOTC–2012–SC15–06	Status of development and implementation of National Plans of Action for seabirds and sharks (Secretariat)	✓ (14 November 2012)
IOTC–2012–SC15–07	Examination of the effects of piracy on fleet operations and subsequent catch and effort trends (Chair and Secretariat)	✓ (25 November 2012)
IOTC–2012–SC15–08	Status of the Indian Ocean Albacore Resource (ALB: *Thunnus alalunga*)	✓ (12 November 2012)
IOTC–2012–SC15–09	Status of the Indian Ocean bigeye tuna (BET: *Thunnus obesus*) resource	✓ (14 November 2012)
IOTC–2012–SC15–10	Status of the Indian Ocean skipjack tuna (SKJ: *Katsuwonus pelamis*) resource	✓ (14 November 2012)
IOTC–2012–SC15–11	Status of the Indian Ocean yellowfin tuna (YFT: *Thunnus albacares*) resource	✓ (14 November 2012)
IOTC–2012–SC15–12	Report on biology, stock status and management of southern bluefin tuna: 2012 (from CCSBT)	✓ (9 November 2012)
IOTC–2012–SC15–13	Status of the Indian Ocean bullet tuna (BLT: *Auxis rochei*) resource	✓ (24 November 2012)
IOTC–2012–SC15–14	Status of the Indian Ocean frigate tuna (FRI: *Auxis thazard*) resource	✓ (24 November 2012)
IOTC–2012–SC15–15	Status of the Indian Ocean kawakawa (KAW: *Euthynnus affinis*) resource	✓ (25 November 2012)
IOTC–2012–SC15–16	Status of the Indian Ocean longtail tuna (LOT: *Thunnus tonggol*) resource	✓ (25 November 2012)
IOTC–2012–SC15–17	Status of the Indian Ocean Indo-Pacific king mackerel (GUT: *Scomberomorus guttatus*) resource	✓ (24 November 2012)
IOTC–2012–SC15–18	Status of the Indian Ocean narrow-barred Spanish mackerel (COM: *Scomberomorus commerson*) resource	✓ (25 November 2012)
IOTC–2012–SC15–19	Status of the Indian Ocean Swordfish (SWO: *Xiphias gladius*) resource	✓ (13 November 2012)
IOTC–2012–SC15–20	Status of the Indian Ocean black marlin (BLM: *Makaira indica*) resource	✓ (12 November 2012)
IOTC–2012–SC15–21	Status of the Indian Ocean blue marlin (BUM: *Makaira nigricans*) resource	✓ (12 November 2012)
IOTC–2012–SC15–22	Status of the Indian Ocean striped marlin (MLS: *Tetrapturus audax*) resource	✓ (13 November 2012)
IOTC–2012–SC15–23	Status of the Indian Ocean Indo-Pacific sailfish (SFA: *Istiophorus platypterus*) resource	✓ (12 November 2012)
IOTC–2012–SC15–24	Status of marine turtles in the Indian Ocean	✓ (12 November 2012)
IOTC–2012–SC15–25	Status of seabirds in the Indian Ocean	✓ (12 November 2012)
IOTC–2012–SC15–26	Status of the Indian Ocean blue shark (BSH: *Prionace glauca*)	✓ (9 November 2012)
IOTC–2012–SC15–27	Status of the Indian Ocean oceanic whitetip shark (OCS: *Carcharhinus longimanus*)	✓ (9 November 2012)

Document	Title	Availability
IOTC–2012–SC15–28	Status of the Indian Ocean scalloped hammerhead shark (SPL: *Sphyrna lewini*)	✓ (12 November 2012)
IOTC–2012–SC15–29	Status of the Indian Ocean shortfin mako shark (SMA: *Isurus oxyrinchus*)	✓ (12 November 2012)
IOTC–2012–SC15–30	Status of the Indian Ocean silky shark (FAL: *Carcharhinus falciformis*)	✓ (12 November 2012)
IOTC–2012–SC15–31	Status of the Indian Ocean bigeye thresher shark (BTH: *Alopias superciliosus*)	✓ (12 November 2012)
IOTC–2012–SC15–32	Status of the Indian Ocean pelagic thresher shark (PTH: *Alopias pelagicus*)	✓ (12 November 2012)
IOTC–2012–SC15–33 Rev_2	National Implementation of the regional observer scheme by CPCs (Secretariat)	✓ (14 November 2012) ✓ (29 November 2012) ✓ (6 December 2012)
IOTC–2012–SC15–34	Update on progress regarding Resolution 09/01 – on the performance review follow–up (Secretariat and Chair)	✓ (25 November 2012)
IOTC–2012–SC15–35 Rev_1	Proposed priorities for Working Party's and the Scientific Committee for 2013 and 2014 (Chair & Secretariat)	✓ (25 November 2012) ✓ (6 December 2012)
IOTC–2012–SC15–36	Proposed schedule of Working Party and Scientific Committee meetings for 2013 and 2014 (Secretariat)	✓ (13 November 2012)
IOTC–2012–SC15–37	Revision: 'Guidelines for the Presentation of Stock Assessment Models' (Chair & Secretariat)	✓ (25 November 2012)
IOTC–2012–SC15–38	Pilot project to improve data collection for tuna, sharks and billfish from artisanal fisheries in the Indian Ocean. Part II: Revision of catch statistics for India, Indonesia and Sri Lanka (1950-2011). Assignment of species and gears to the total catch and issues on data quality (G. Moreno, M. Herrera and L. Pierre)	✓ (25 November 2012)
Working Party Reports		
IOTC–2012–WPTmT04–R	Report of the Fourth Session of the Working Party on Temperate Tunas	✓ (7 September 2012)
IOTC–2012–WPB10–R	Report of the Tenth Session of the Working Party on Billfish	✓ (10 October 2012)
IOTC–2012–WPEB08–R	Report of the Eighth Session of the Working Party on Ecosystems and Bycatch	✓ (8 October 2012)
IOTC–2012–WPM04–R	Report of the Fourth Session of the Working Party on Methods	✓ (23 October 2012)
IOTC–2012–WPTT14–R	Report of the Fourteenth Session of the Working Party on Tropical Tunas	✓ (14 November 2012)
IOTC–2012–WPNT02–R	Report of the Second Session of the Working Party on Neritic Tunas	✓ (23 November 2012)
National Reports – Members		
IOTC–2012–SC15–NR01	Australia	✓ (21 November 2012)
IOTC–2012–SC15–NR02	Belize	✓ (30 July 2012)
IOTC–2012–SC15–NR03 Rev_1	China	✓ (19 November 2012) ✓ (12 December 2012)
IOTC–2012–SC15–NR04	Comoros	✓ (29 November 2012)
IOTC–2012–SC15–NR05	Eritrea	NOT RECEIVED
IOTC–2012–SC15–NR06	European Union	✓ (4 December 2012)
IOTC–2012–SC15–NR07	France	✓ (7 December 2012)
IOTC–2012–SC15–NR08	Guinea	NOT RECEIVED
IOTC–2012–SC15–NR09	India	✓ (12 November 2012)
IOTC–2012–SC15–NR10 Rev_1	Indonesia	✓ (2 December 2012) ✓ (9 December 2012)
IOTC–2012–SC15–NR11	Iran, Islamic Republic of	✓ (28 November 2012)
IOTC–2012–SC15–NR12	Japan	✓ (6 December 2012)
IOTC–2012–SC15–NR13	Kenya	✓ (25 November 2012)
IOTC–2012–SC15–NR14 Rev_1	Korea, Republic of	✓ (25 November 2012) ✓ (9 December 2012)
IOTC–2012–SC15–NR15	Madagascar	✓ (5 December 2012)

Document	Title	Availability
IOTC–2012–SC15–NR16	Malaysia	✓ (1 December 2012)
IOTC–2012–SC15–NR17	Maldives, Republic of	✓ (27 November 2012)
IOTC–2012–SC15–NR18 Rev_1	Mauritius	✓ (29 November 2012) ✓ (7 December 2012)
IOTC–2012–SC15–NR19	Mozambique	✓ (25 November 2012)
IOTC–2012–SC15–NR20	Oman, Sultanate of	✓ (5 December 2012)
IOTC–2012–SC15–NR21	Pakistan	NOT RECEIVED
IOTC–2012–SC15–NR22	Philippines	✓ (10 December 2012)
IOTC–2012–SC15–NR23	Seychelles, Republic of	✓ (4 December 2012)
IOTC–2012–SC15–NR24	Sierra Leone	NOT RECIEVED
IOTC–2012–SC15–NR25	Sri Lanka	✓ (23 November 2012)
IOTC–2012–SC15–NR26 Rev_1	Sudan	✓ (18 October 2012) ✓ (5 December 2012)
IOTC–2012–SC15–NR27	Tanzania	NOT RECEIVED
IOTC–2012–SC15–NR28 Rev_2	Thailand	✓ (22 November 2012) ✓ (6 December 2012) ✓ (12 December 2012)
IOTC–2012–SC15–NR29	United Kingdom	✓ (23 November 2012)
IOTC–2012–SC15–NR30	Vanuatu	NOT RECEIVED
IOTC–2012–SC15–NR31	Yemen	NOT RECEIVED
National Reports – Cooperating non-Contracting Parties		
IOTC–2012–SC15–NR32	Senegal	✓ (7 December 2012)
IOTC–2012–SC15–NR33	South Africa, Republic of	✓ (28 November 2012)
Information Papers		
IOTC–2012–SC15–INF01	IOTC-OFCF Project activities in 2012: Progress Report (S. Fujiwara and M. Herrera)	✓ (8 November 2012)
IOTC–2012–SC15–INF02	Analysis of the genetic structure and life history of albacore tuna in terms of diversity, abundance and migratory range at the spatial and time scales: Project GERMON (GEnetic stRucture and Migration Of albacore tuNa) (N. Nikolic and J. Bourjea)	✓ (24 November 2012)
IOTC–2012–SC15–INF03	Glossary of scientific terms, acronyms and abbreviations, and report terminology	✓ (25 November 2012)
IOTC–2012–SC15–INF04	IOTC Species data catalogues (IOTC Secretariat)	✓ (30 November 2012)
IOTC–2012–SC15–INF05	Ghost fishing of silky sharks by drifting FADs: highlighting the extent of the problem (J. Filmalter, L. Dagorn and M. Capelo)	✓ (4 December 2012)
IOTC–2012–SC15–INF06	GEF-financed global project on the "Sustainable Management of Tuna Fisheries & Biodiversity Conservation in the Areas Beyond National Jurisdiction (ABNJ): update & relevance to IOTC	✓ (4 December 2012)
IOTC–2012–SC15–INF07	Action Plan for reducing incidental catches of seabirds in fishing gears (European Union)	✓ (5 December 2012)
IOTC–2012–SC15–INF08	Draft: Building science capacity and understanding among IOTC members	✓ (5 December 2012)
IOTC–2012–SC15–INF09 Rev_1	Ecological Risk Assessment (ERA) and Productivity Susceptibility Analysis (PSA) of sea turtles overlapping with fisheries in the IOTC region (N. Ronel, R. Wanless, A. Angel, B. Mellet and L. Harris)	✓ (25 November 2012) ✓ (5 December 2012)
IOTC–2012–SC15–INF10 Rev_1	Preliminary Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC) (H. Murua, R. Cohelo, M.N. Santos, H. Arrizabalaga, K. Yokawa, E. Romanov, J.F. Zhu, Z.G. Kim, P. Bach, P. Chavance, A. Delgado de Molina and J. Ruiz)	✓ (5 December 2012) ✓ (10 December 2012)
IOTC–2012–SC15–INF11	Comments for IOTC Scientific Committee on CITES draft proposals to amend Appendixes I and II (WPEB)	✓ (12 December 2012)

APPENDIX IV
NATIONAL REPORT ABSTRACTS

Australia

Pelagic longline and purse seine are the two main fishing methods used by Australian vessels to target tuna and billfish in the Indian Ocean Tuna Commission (IOTC) Area of Competence. In 2011, two Australian longliners from the Western Tuna and Billfish Fishery operated in the IOTC Area of Competence. They caught 5.8 t of albacore tuna (*Thunnus alalunga*), 50.0 t of bigeye tuna (*Thunnus obesus*), 14.1 t of yellowfin tuna (*Thunnus albacares*), 189.9 t of swordfish (*Xiphius gladius*) and 0.7 t of striped marlin (*Tetrapturus audax*). These catches represent less than 10 per cent of the peak catches taken by Australian vessels fishing in the IOTC Area of Competence in 2001, for these five species combined. In addition, Australian vessels using minor line methods took a small amount of catch. The number of active longliners and levels of fishing effort have declined substantially in recent years due to reduced profitability, primarily as a result of lower fish prices and higher operating costs. The catch of southern bluefin tuna (*Thunnus maccoyii*) in the purse seine fishery was 4120 t in 2011. There was no purse seine fishing for skipjack tuna (*Katsuwonus pelamis*) in 2011. The peak skipjack catch taken by Australian vessels fishing in the IOTC Area of Competence was 1039 t in 2001. In 2011, approximately 1 t of shark was landed by the Australian longline fleet operating in the IOTC Area of Competence and approximately 13 000 sharks were discarded/released. In the Western Tuna and Billfish Fishery, 1.7 per cent of hooks set in longline operations were observed over two trips in 2011.

Belize

Long line is the main fishing technique used by Belize flagged vessels to target tuna and tuna like species in the Indian Ocean Tuna Commission (IOTC) Convention area. Belize has no national fleet operating outside its jurisdiction. All our fishing vessels are foreign owned vessels licensed to operate on the high seas or in the EEZ of other States under licensing agreements. In 2011 our fleet consisted of 7 long line tuna fishing vessels which operated mainly between 10°- 40°S and 55° - 75°E. Together, our vessels caught 164 m/t of Albacore tuna, 13.9 m/t of yellowfin tuna, 9.634 m/t of bigeye tuna, 2.536 m/t of swordfish, 5.175 m/t of black marlin, 1.04 m/t of blue marlin, 3.388 of striped marlin, 8.85 m/t of wahoo and 1.833 m/t of blue shark. There have been 83% reductions in our overall catches from 1257 m/t in 2007 to 210 m/t in 2011. Albacore has always been the main target species for our vessels from 2007 to 2011 followed by bigeye tuna, yellowfin and swordfish. The number of active long liners and levels of fishing effort have declined significantly in recent years due to reduced profitability, principally resulting from reduced fish prices and increased operating cost. The average size of our vessels from 2007 to 2011 has fluctuated over the years from a low of 88gt to a high of 628 gt. There has also been a reduction in the number of vessels operating in the area from 10 vessels in 2007, 9 in 2008, 6 in 2009 and 7 in 2010 and 2011.

China

Longline is the only fishing method used by Chinese vessels to catch tuna and tuna-like species in the IOTC waters. The number of longliners operating in the Indian Ocean reduced from 20 in 2010 to 15 in 2011 due to piracy, with the main fishing area shifting to the central and southern Indian Ocean (60 °E ~ 90°E , 10°S ~35°S). Chinese fishing fleet caught 1845 MT of main tunas (BET, YFT, ALB) in 2011 (72 % lower than the catch of 6643 MT in 2010). The bigeye tuna and yellowfin tuna catches both from deep freezing longliners and ice fresh longliners have been declined dramatically since 2006. The albacore catch from both deep freezing longliners and ice fresh longliners decreased greatly in 2011, compared with in 2010. The logbook and observer programs are going on for the Chinese longline fleets in the Indian Ocean, from which catch and effort data collection of bycatch species are being improved. No scientific observer was sent out for work due to the piracy issue in 2011.

Comoros

Fishing in Comoros is exclusively artisanal, and operated on 3-9 m motorized or non-motorized wooden or fibreglass non-decked vessels. Comorian fishing exploits mainly pelagic species (*Thunnus albacares, Katsuwonus pelamis, Thunnus alalunga, Istiophorus platypterus, Thunnus obesus, Euthynnus affinis*) and contributes entirely to the population's diet, while providing 55% of total jobs in the agricultural sector, i.e. about 8,000 fishermen. Troll line, drop line and few nets targeting small pelagic species are the main fishing techniques used. A trip lasts between one and seven days. Since February 2011, Comoros have implemented a data collection system at unloading sites, thanks to technical and financial support from the IOTC and the OFCF. Data from this collection are being processed by the IOTC. There is no industrial fishing at national level. This fishing activity is operated by a foreign fleet under a Fishing Agreement. None of the catch of this fleet is unloaded or transhipped within the country.

Eritrea
National Report not provided.

European Union
In accordance with IOTC Resolution 10/02, scientific data for fleets flying the flag of Member States of the European Union have been submitted to the IOTC. The EU fleet, composed of fleets of some Member States of the European Union (Spain, France, Portugal and the United Kingdom) has previously submitted its scientific data. All data required for the work of the Scientific Committee, in accordance with the legislation in force, was transmitted to the IOTC. For reasons related to internal adjustments of several research institutions and/or organizations responsible for the management of scientific data, some information has been submitted with some delay; we are pleased to indicate that some data will be validated and available in the near future. In addition, for security reasons related to the development of piracy in the Western Indian Ocean, observer programmes were strongly affected, as piracy has, on the one hand, reduced the frequency of data collection and, on the other hand, led to a decline in data quality. However, European scientists who participated in the various IOTC Working Parties have also transmitted, during the meetings, some of the data necessary to carry out the work of these Working Parties. In addition, the EU experts attending the Scientific Committee may also provide information that complement already transmitted data. The European Union continues its efforts to harmonize the management, collection and reporting of scientific data.

France (OT)
The French Overseas Territories in the Indian Ocean include Mayotte –a Department since 31 March 2011– and the Scattered, islands that are attached to the administration of the French Southern and Antarctic Lands (TAAF). In January 2010, Mayotte has established a nature marine park (NMP) with a Management Board, which maritime boundaries are those of the Mayotte EEZ. A second marine park was established on 22 February 2012 (Decree No. 2012-245 of 22 February 2012): the NMP of the Glorieuses, which is under the responsibility of the Scattered islands, and extends over the entire Glorieuses EEZ. The total catches in the Indian Ocean of the French purse seiners registered in Mayotte amounted in 2011 to 26,610 metric tonnes, a significant increase of 45% compared to 2010 (18,357 Mt) due to an increase in fishing effort. The observer programme introduced in 2005 and discontinued in 2009 for security reasons, following the increase of Somali piracy, resumed in 2011, especially on the larger purse seine fleet, through a collaboration established with the TAAF. The coastal fishing fleet of Mayotte is composed of a large number of canoes and small boats –practicing mainly handline fishing, trolling and net fishing– and of four small longliners (pelagic drifting longline) targeting mainly tuna and swordfish. Catches by this fleet in the waters of Mayotte are estimated at 110 (2010) and 52 (2011) metric tonnes respectively. The French Tuna Research framework (mostly IRD & Ifremer) includes activities such as an observatory, the study of migration patterns of large pelagic species, genetic studies to define stock boundaries, studies on the reproductive biology, the development of bycatch mitigation measures and the study of the dynamics of the tropical ecosystem. Most projects are financed through national, European or international tenders. The report lists the various projects that continued or started in 2010-2012. Overall, France has actively participated in all the Working Parties organized by IOTC, including by presenting 26 scientific contributions in 2012.

Guinea
National Report not provided.

India
India's tuna fishing fleet includes coastal multipurpose boats operating a number of traditional gears, small pole and line boats, small longliners and industrial longliners. The total production of tunas and tuna-like fishes, including neritic and oceanic tunas, billfishes and seerfishes during the year 2011 was 159,924 tonnes, against a total production of 127,616 tonnes during the year 2010. There was a reduction in production by the oceanic fishery and increase in the tuna landings by coastal sector during the year under report. Survey conducted by the Fishery Survey of India in the EEZ revealed that sharks constitute 19.49% by number and 28.39% by weight to the total catch in the longline fishery. There are no reported instances of sea bird interaction in any of the Indian tuna fishery. Sea turtles, marine mammals and whale sharks are protected in India under various national legislations. Data on tuna production is collected by different agencies in India including Fishery Survey of India (FSI), Central Marine Fisheries Research Institute (CMFRI) and Marine Products Export Development Authority (MPEDA). Policy decisions on fishery management are being formulated by the Department of Animal Husbandry, Dairying and Fisheries (DAHD&F), Ministry of Agriculture, Government of India.

Indonesia
Fisheries management Areas (FMA) 572 (Indian Ocean – west Sumatera) and 573 (South of Java – East Nusa Tenggara), are two fisheries management area among eleven FMAs that located within the IOTC area of competence. Long liners is the main fishing gear type operated in those FMAs, increase from 1118 vessels in 2010 to 1256 vessels in 2011. The national catch of four main tuna species in 2011 was estimated 161,454 t while the total catch for all species by all gears type was estimated 429,751 t.. Through Research institute for Tuna fisheries at Benoa both port sampling and scientific observer programs continuing is conducted. Indonesia since 10 October 2010 already has a National Plan of Action of the Shark (NPOA-Shark) and recently through ministerial decree of MMAF no 12 year 2012 under chapter X formally regulate a management and conservation of bycatch and ecological related species on tuna fisheries. Template of Indonesia fishing logbook was developed and regulated, however it is required more effort to introduce and implement for both to fishers as well as port officers as required by the commission.

Iran, Islamic Republic of
Fishery for tuna and tuna-like species is a major component in large pelagic fisheries in Iran and one of the most important activities in the Persian Gulf & Oman Sea. There are 4 coastal provinces in that areas about 12 thousand vessels consist of fishing boat, dhows and vessel which are engaged in fishing in the coastal and offshore waters. Gillnet and purse seine are two main fishing methods used by Iranian vessels to target large pelagic species (especially tuna and tuna-like) in the IOTC area competency and also some of small boats used trolling in coastal fisheries. Iran has taken various actions to implement the Scientific Committee recommendations and IOTC Resolutions. One of them national actions to improve data collection system for Tuna fishery during 2012 .we have implemented for Iranian industrial purse seiners and artisanal gillnets modification of logbook template to meet mandatory minimum statistic requirement, particularly with regards to data recording of vessel position in IOTC area for target species, Bycatch, and discard.

Japan
This Japanese national report describes following 8 issues in recent five years (2007-2011), i.e., (1) tuna fisheries (longline fishery and purse seine fishery) (2) fleet information, (3) catch and effort by species and gear, (4) ecosystem and bycatch, (5) national data collection and processing systems including "logbook data collection and verification", "vessel monitoring system", "scientific observer programme", "port sampling programme" and "unloading/transhipment", (6) national research programs and (7) Implementation of Scientific Committee recommendations & resolutions of the IOTC relevant to the Scientific Committee and (8) literature cited and working documents.

Kenya
During the year 2011, the active fishing fleet for tuna and tuna-like species in Kenya consisted of 1,011 artisanal fishing crafts and 87 recreational fishing boats. The vessel sizes measure below 10 meters and usegillnets and arisanal longline hooks as the main gear. Recreational fishing boats use baited trolling lines for fishing. Tuna catches increased by 67% from 180 tons to 302 tons. Owing to the vessel capacity constraints, almost all the catch landed is from the territorial waters. About 179 tons of fish were landed from recreational fisheries. The recreational fisheries catches consist of mostly billfishes (129 tons), Yellowfin tuna (21 tons) and the rest consists of a number of pelagic species.

Korea, Republic of
In 2011, 7 vessels of Korean tuna longline fishery were operated in 2011, and they caught 1,985 mt, which was 30.4% decreasing of the catch in 2010. Fishing effort was 5,362 thousand hooks and distributed higher in the western and eastern areas around 20-40°S than before. As results, the catch of bigeye tuna and yellowfin tuna significantly decreased, and albacore tuna and southern bluefin tuna became important in catch. With regard to the improvement of data reporting, the Act of Korean Distant water fisheries development was revised. The Act obliges the fishermen to monthly submit the logbook in electronic format, including the biological measurement, and information on ecologically related species and interaction with fisheries as well. Unfortunately, no observer could be placed on board Korean longline vessels in 2011. It was as a consequence of the 2 safe accidents of Korean observers in previous years. So Korean national observer program has been under improvement since 2011. As a result, three observers were deployed on board for a period of 60-70 days for each observer in 2012.

Madagascar
National tuna fishing is practiced mainly by small longliners. An increase of the number of vessels on this fishery has been observed in these recent years. In 2011, they are among 07 who have license to fishing for tuna and like species. They operate in the East side of Madagascar since 2010. Tuna mainly neritic tunas are also observed in the catches of the fleets that have license to target demersal fishes, they are longliners, trollers and pole and liner operating in the Western side, and Eastern side of Madagascar, but the proportion is relatively low. Statements of the fishing Companies have observed an increase in catches from the year 2010 to the national fleets catches. However, these statements cannot see the details on the locations of fishing. A new version of logbook has been operational since 2012 to fill this lack. An increase in the catches have observed according by the statement of the fishing Companies compared to the last year (2010)

Malaysia
Tuna fisheries contribute only 5% of total marine finfish catch in Malaysia. Compared to neritic tuna, oceanic tuna fishery is quite new to Malaysian fishery and its contribution to the annual marine catch is insignificant compared to other marine fish fishery. Malaysian waters that fall under the IOTC area of competence is part of the narrow Malacca Straits, off the west coast of Peninsular Malaysia. In 2003, the number of Malaysian flag vessels registered under Malaysian flag for fishing in the Indian Ocean increased steadily from 15 vessels to 58 vessels in 2010. In 2011, the number of active vessels dropped to only 7 vessels with 9 berthing compared to 30 berthing in 2010. The catch of tropical tuna also decreased to 114 mt in 2011 from 1138 mt in 2010. In mid 2011, some of Malaysian tuna longline shifted their target species from tropical tuna to albacore. The fleet moved their fishing areas toward the southern part of Madagascar below 250S latitude. The catch of neritic tuna from the Malacca Straits (under IOTC areas of Competence) showed a steady increased in landings from 8,978 mt in 2001 to 21,763 mt in 2011. A large portion of catch of neritic tuna were contributed by purse seines and trawlers. A new revised NPOA-sharks is near completed and is expected to be released by early 2013. Steps have been taken to reduce incidental catch of sharks as commitment to conserve shark population. On sea turtle, apart from mitigation taken to reduce incidental catch by traditional fishermen, the turtle conservation centres in Malaysia also have a turtle hatching program as a way to enhance turtle population

Maldives
Maldives has a traditional tuna fishery dating back hundreds of years. The main fishing method is still livebait pole-and-line but handline fishing is become popular. The main target species are skipjack (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*). Small amounts of juvenile bigeye (*T. obesus*) tuna are caught mixed with yellowfin in the pole-andline catch. Limited amount of trolling and longline fishing is also conducted. The former targets coastal species of kawakawa (*Euthynnus affinis*) and frigate tuna (*Auxis thazard*) and the latter deep-swimming yellowfin and bigeye. Tuna catches increased to an all-time record of 167,000 t in 2006 but have been declining since then. The average tuna catch for the last five years was about 100,000 mt; skipjack representing 72% and yellowfin 22% and remaining 6% kawakawa, frigate and bigeye. The national data collection is based on an enumeration system which is currently being replaced by a modern logbook data collection system. A web-enabled database is also being developed to allow entry of logbook data remotely. The website is being used to enter tuna purchases by the exporters. In addition the database when fully functional will help maintain records of active fishing vessel and fishing licenses. The website is expected to be fully functional in mid-2013. A number of the scientific programmes are in place that helps to increase Maldives' compliance with the IOTC Resolutions. This includes strengthening data collection, compilation and its analyses, expanding coverage of collection of size data, implementation of the VMS and improving information of the ETP species among others. Maldives has limited amount of recreational fishing targeting large-bodied reef fish varieties in the so called 'night fishing'. More recently recreational fishing for pelagics is getting popular in the tourism sector. At present there is no formal method of the recording catches.

Mauritius
About 110 000 tonnes of raw tuna are processed annually for export as canned and tuna loins mainly to the EU market. Seafood processing contributes to about 1% to GDP and plays an important role in the socio-economic activity of the country. In 2011, Mauritius issued fishing licences to 98 longliners and 26 purse-seiners of various nationalities to fish in its waters. Moreover, under the fishing agreements between Mauritius and the Seychelles, 7 purse-seiners and 7 longliners were issued with fishing licences. However, under fishing agreement with the Federation of Japan Tuna Fisheries Co-operative Associations no application were received from the Japanese fishing vessels probably due to the piracy threats in the Western Indian Ocean. Tuna fishing longliners regularly call at the

Port Louis harbour with an approximate of over 600 calls yearly for unloading and transhipment of tuna. During the year under report, 40 013 tonnes of tuna were transhipped through the Port Louis harbour and albacore tuna constituted more than 40% of the total catch. An increase in the volume of yellowfin, bigeye and skipjack tuna transhipped was also noted due to transhipment effected by European purse-seiners. Four national fishing vessels, less than 24 meters in length, targeting swordfish landed 89 tonnes of chilled fish. The catch composed of 49.2% swordfish and 18.4 % yellowfin, 12.1% bigeye and 9.4 % albacore tuna. The fishing areas were spread between latitudes 12^0S and 23^0S and longitudes 52^0E and 63^0E. About 350 small-scale fishermen operating around the 27 anchored Fish Aggregating Devices set around the island landed 258 tonnes of tuna and the catch was mainly composed of albacore tuna. The sports/recreational fishery supplied the local market with an additional estimated amount of 350 tonnes and the species comprised marlins, sailfish, tuna, dolphinfish and wahoo. Mauritius has been putting all its effort to comply with the IOTC resolutions and is looking forward to further enhance its contribution for the conservation and management of tuna and tuna-like species and address the ecosystem and by-catch issues within the IOTC area of competence.

Mozambique
Purse seine and long line are the two main fishing techniques used in Mozambique in the tuna fishery. Those activities are undertaken by distant water fishing fleets, which operate in the EEZ as from 12 nautical miles off shore from January to December. Purse seine fishing occurs mainly between the parallels 10° 32' and 20° south. The purse seine fleet is composed of vessels from France, Spain and Seychelles. Long line fishing occurs between 20° and 26° 52' south, with particular intensity below parallel 25° south. For the purse seine fleet, the peak period of fishing activities occurs between March and June. The longline fleet operates from January to December in Mozambique waters and the peak period is from December to February. During the last 5 years, the longline fleet was composed of vessels from Belize, Panama, Cambodia, Honduras, Japan, China, Korea, Spain and Taiwan. The fishery employs only foreign labour. The catches are conserved on board and transferred to cargo reefer ships or unloaded at foreign ports, mainly Seychelles, Madagascar, Mauritius and South Africa. The tuna fleet never calls to a Mozambican port for landing catches in Mozambique but call for pre-fishing briefing and inspection (Japan fleet). Over the last 10 years, the total catch in Mozambique waters ranged from 948 to 17.470 tonnes per year (Pátria et al., 2011). For the period 2007/2011, a total of 207 fishing licenses for purse seine vessels and 331 fishing licenses for longline vessels were issued, giving an average of 174 tuna fishing licenses issued per year. The number of longline vessels operating in Mozambique EEZ has declined substantially since 2007.

Oman
The total production of the Omani fishery sector amounted to around 159 000 Tons in 2011, with a slight increase of approximately 4.5% compared to 2007. Tuna species, considered as highly valuable products for Omani consumers, have experienced tremendous fluctuations in their total annual production and decreased from 31,420 T in 2007 to 19,550 T in 2011. This fluctuation of coastal tuna activities finds probably its origin, among others, in the modification of environmental factors, predator-prey relationship, spawning problems (Dr. Al Qumi, 2011) and the actual reduction of the industrial pelagic fleet. This segment went from 64 vessels in 2007 to 11 vessels in 2011. This reduction in the industrial fishing capacity was initiated by the national Authorities for the purpose of restructuring the industrial fishing sector to improve its competitiveness and efficiency. Artisanal and coastal fleets have, however, increased massively in the number of vessels and fishermen. For the monitoring aspects of the Tuna fishery, the Omani Government has introduced the logbook data collection scheme, the Vessel Monitoring System (VMS) and Port Sampling Program (PSP), observer programme (underdevelopment) and a scheme to enhance the quality of data gathered in order to manage and sustain efficiently the Omani fisheries. At the same time, the Government started to run and monitor several other projects for other marine species such as sea birds and marine turtles but are still in their starting stages.

Pakistan
National Report not provided.

Philippines
Fisheries are an important component of the agricultural sector in the Philippines and are an important source of protein, livelihood and export earnings. In 2011, total marine catch by the Philippines commercial fleet was estimated at 1,032,820 million tons which accounted for about 20.76% of the total fisheries production. The increased demand for fish from the rapidly growing population and increasing exports has substantially increased fishing pressure on the marine fishery resources over the past two decades. The major key issues facing the fisheries sector are resource depletion and environmental degradation. Declining catch rates and the leveling off of marine landings also supports

these conclusions. The Philippines is still one of the top fish producing countries in the world. Over 1.5 million people depend on the fishing industry for their livelihood. The Philippines is also considered to be a major tuna producer in the Western and Central Pacific Ocean (WCPO). It is also considered a distant water fishing nation as it has fishing vessel operating in other oceans other than the Pacific. The fishing industry's contribution to the country's Gross Domestic Products (GDP) in 2009 was 2% and 2.4% at current and constant prices, respectively. Also in 2010, the foreign trade performance of the fishery industry gave a net surplus of US $ 616 million. With a total export value of US $ 803 million and import value of US $ 187 million. Tuna remained as the top export commodity with a collective volume of 106,449 MT for fresh/chilled/frozen, smoked/dried, and canned tuna products valued at US $337.719 million. Canned tuna, though, constitutes bulk of tuna products being exported. In general, tuna export increased by 2% in terms of volume and 3% in terms of value. Major markets for this commodity include USA, UK and Germany.

Seychelles
The Seychelles national report summarizes activities of the Seychelles registered purse seiners, longliners and semi-industrial vessels for the past 5 years. The total catch for the Seychelles registered Purse Seiners in 2011 was estimated at 63,212 MT, obtained from a fishing effort of 2,347 fishing days. This represents a decrease of 17% over the catches reported for 2010. Skipjack remained the dominant species accounting for 52% of the total catch. For the longline fishery, the total catch for the Seychelles fleet in 2011 was estimated at 7,566 MT obtained from a fishing effort of 16 million hooks, representing an increase of 14% in catch and 7% drop in fishing effort when compared to 2010. The total catch for the local semi industrial vessel targeting tuna and swordfish stands at 238MT representing a decrease of 19% compared to the previous year. The fishing effort decrease by 43% from 506,334 hooks to 289,540 hooks. The Seychelles shark NPOA was developed in April 2007, consisting 11 work programmes and 59 actions. In November 2012, a new steering committee was set to review the shark NPOA. To date, Seychelles does not have an NPOA on seabirds in place. Seychelles has a small semi industrial longline fleet and there have been no reports of interactions with seabirds. The national scientific observer programme is in its final stages of implementation. So far 6 observers have been trained and the programme is expected to start early 2013. Seychelles has taken various actions to implement the Scientific Committee recommendations and IOTC Resolutions. Some of the actions include; modification of logbook format to meet mandatory minimum statistic requirement, particularly with regards to data recording of sharks in longline fishery, steps to implement a National Scientific Observer Programme, collaboration with other institutions on research projects focusing on bycatch mitigation.

Sierra Leone
National Report not provided.

Sri Lanka
Tuna fisheries in Sri Lanka are developing rapidly with the expansion of offshore and deep sea /high seas fishing. Over 4000 boats are being currently engaged in tuna fishing, of which around 700 boats are categorized as single day and being operated in the coastal areas where as about 3300 are operated offshore and high seas adjacent to the EEZ. The multiday boats with modern navigational and communication facilities are being venturing now for high seas fishing. In 2011, the total large pelagic fish production was 112, 507 Mt and skipjack tuna has dominated the catches by contributing 44.7%. Among the different fishing gears used for catching large pelagic fish, large-mesh gillnet (GN) or gillnet cum longline (GN/LL), were the widely used fishing gears in tuna fisheries. Gillnet cum longline combination contributes to more than 75 % of the total tuna fishing effort in the country. Longlines are promoted by the Government of Sri Lanka to ensure quality fish production to cater to the rapidly developing export market. Collection of species wise shark landings was reinitiated in 2011 in accordance with the recommendation made by the 14th Session of the IOTC Scientific Committee. Log book has been introduced and made mandatory for all the multiday vessels (> 32 feet in length) since January 2012 by the Department of Fisheries and Aquatic Resources of Sri Lanka. The existing Fisheries and Aquatic Resources Act No.2 of 1996 has been already amended and going through the process to obtain approval from the Cabinet of Ministers and presenting same in parliament enabling High seas fishing as well as to incorporate the provisions in compliance with the international obligations and conventions.

Sudan
Tuna fishery in Sudanese Red Sea coast sorted to be one type of traditional fishery and industrial fishery. the traditional one usually practicing by local fishermen in whole coast, they used hooks over coral reefs zone and net over depth 50m, while the industrial fishing done by Egyptian trawlers in the southern area, they used trawling and purse seine nets. Seasonally this fishery appears in particular areas of Sudanese red sea, even in winter season (February to April) in huge number in southern area of the sea. Tuna are migratory pelagic fishes and are not very

common on the local market. Usually product as by catch in industrial fishery and artisanal fishery, not targeted, so the real production over the present catch in two types of fishery.

Tanzania, United Republic of
National Report not provided.

Thailand
Neritic tuna and king mackerel species in the Andaman Sea Coast, Thailand comprise 7 species (*Thunnus tonggol, Euthynnus affinis, Auxis thazard, A. rochie, Katsuwonus pelamis* and *Sarda orientalis, Scomberomorus* spp.). These species were caught from purse seine, king mackerel gill net and trawl, while purse seine was the main fishing gear. The trend of neritic tuna catches have been decreasing from 45,083 tons in 1997 to 13,093 tons in 1999. The production was quite stable around 10,711 and increase to 11,861 in 2009. These neritic tuna species are more or less have its production trend similarity. Thai tuna longliners that composed of 3 tuna longliners in 2007 and 2 tuna longliners during 2002-2011. Their main fishing ground was located in the southern part of the Indian Ocean. Data collection from their logbooks displayed important information of catch, fishing operation and effort during 2007-2011, 2276 days fishing operation were recorded. The highest total catch was in 2010 with 607.69 tones followed by 2007, 2011, 2009 and 2008, respectively (461.75, 370.39, 295.23 and 265.57 tones). The highest CPUE was found in 2010 with 13.62 fish 1000 hooks followed by 2007 and 2011, respectively (10.20 and 9.36 fish/1,000 hooks). Albacore tuna was caught with the highest proportion 32.80 % followed by yellowfin tuna, bigeye tuna, swordfish, other fishes and sharks. In 2011 bigeye tuna was caught with the highest proportion 61.4%.

United Kingdom (OT)
On 1 April 2010 the BIOT Commissioner proclaimed a Marine Protected Area (MPA) in the British Indian Ocean Territory [UK (BIOT)]. No fishing licences have been issued since that date and the last foreign fishing licences expired on 31 October 2010. Diego Garcia and its territorial waters are excluded from the MPA and include a recreational fishery. The United Kingdom National Report summarises fishing in its recreational fishery in 2010 and provides details of research activities undertaken. UK (BIOT) does not operate a flag registry and has no commercial tuna fleet or fishing port. The recreational fishery landed 21.29t of tuna and tuna like species on Diego Garcia in 2011. Length frequency data were recorded for a sample of 748 yellowfin tuna from this fishery. The mean length was 76cm. Sharks caught in the recreational fishery are released alive. IUU fishing remains one of the greatest threats to the BIOT ecosystem. Research was undertaken into the impact of the network of Indian Ocean MPAs. A Science Advisory Group has been formed to define a science strategy for BIOT and future research priorities, including those relevant to the pelagic ecosystem and IOTC fisheries. Recommendations of the Scientific Committee and those translated into Resolutions of the Commission have been implemented as appropriate by the BIOT Authorities and are reported.

Vanuatu
National Report not provided.

Yemen
National Report not provided.

Senegal
In Senegal, there are three types of fisheries exploiting tuna and tuna-like species. Industrial fisheries, composed of six pole-and-line vessels, targeting mainly tropical tunas, yellowfin (*Thunnus albacares*), bigeye (*Thunnus obesus*) and skipjack (*Katsuwonus pelamis*) tuna and one longliner targeting swordfish, artisanal fisheries (handline and gillnet) targeting small tunas and the sport fishery targeting billfishes (marlin, swordfish and sailfish) and tunas. In 2011, the total catch of Senegalese pole-and-line was estimated at 6118 tons. Catches increased in comparison to 2010 (4606 tons). The effort in 2011 increased slightly from 1220 fishing days in 2010 to 1366 fishing days in 2011. For the longline fishery, the catches in 2011 were estimated at 533 tons (312 tons in 2010). Catches are essentially made of swordfish (264 tons) and sharks (216 tons). For artisanal fisheries, catches of all species are estimated to 9024 in 2011. The trend is still increasing (8719 tons in 2010). For sport fishery, catches were estimated at 81 tons in 2011 (288 tons in 2010) for an effort of 809 trips. Sampling of the catch unloaded in Dakar port is implemented by samplers from CRODT. This includes collecting statistical fisheries and sampling data for the different species of tropical tunas unloaded by pole-and-line and purse seine vessels. This work is completed by other information from different sources (customs, boat owners, Marine Fisheries Directorate, etc.). Regarding artisanal fisheries, the sampling of the catch,

effort and size frequency of the istiophorids is increased in the main landing sites for artisanal vessels thanks to the funds of the Intensive research Program on Istiophorids (EPBR).

South Africa, Republic of

South Africa has two commercial fishing sectors which either target or catch tuna and tuna-like species as by-catch in the Indian Ocean. These sectors are swordfish/tuna longline (the shark longline fishery has been incorporated into this sector), pole and line/ rod and reel. In addition, there is a boat-based recreational/sport fishery.

APPENDIX V
PROGRESS ON THE DEVELOPMENT AND IMPLEMENTATION OF NPOAS FOR SHARKS AND SEABIRDS

CPC	Sharks	Date of Implementation	Seabirds	Date of implementation	Comments
MEMBERS					
Australia		14-Apr-2004		2006	Sharks: 2nd NPOA-Sharks (Shark-plan 2) was released in July 2012, along with an operational strategy for implementation: http://www.daff.gov.au/fisheries/environment/sharks/sharkplan2 Seabirds: Has implemented a Threat Abatement Plan [TAP] for the Incidental Catch (or Bycatch) of Seabirds During Oceanic Longline Fishing Operations since 1998. The present TAP took effect from 2006 and largely fulfills the role of an NPOA in terms of longline fisheries. The 2006 TAP is currently under review. Also currently undertaking an assessment of seabird bycatch in trawl, gillnet and purse seine fisheries, and will develop an NPOA to bring together fisheries plans and actions to reduce the incidental catch of seabirds in longline, trawl and gillnet fisheries.
Belize					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
China		–		–	Sharks: Development has not begun. Seabirds: Development has not begun.
–Taiwan,China		May 2006		May 2006	Sharks: No revision currently planned. Seabirds: No revision currently planned.
Comoros		–		–	Sharks: Development has not begun. Seabirds: Development has not begun.
Eritrea					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
European Union		5 Feb 2009		16-Nov-2012	Sharks: Approved on 05-Feb-2009 and it is currently being implemented. Seabirds: The EU adopted on Friday 16 November an Action Plan to address the problem of incidental catches of seabirds in fishing gears.
France (territories)					Sharks: Approved on 05-Feb-2009 but not yet implemented. Seabirds: No information received by the Secretariat.
Guinea					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
India					Sharks: Currently being drafted with the assistance of BOBP-IGO Seabirds: India has determined that seabird interactions are not a problem for their fleets.
Indonesia		–		–	Sharks: NPOA guidelines developed and released for public comment among stakeholders in 2010 (funded by ACIAR Australia—DGCF). Training to occur in 2011, including data collection for sharks based on forms of statistical data to national standards (by DGCF (supported by ACIAR Australia). Implementation expected late 2011/early 2012. Seabirds: Development has not begun.
Iran, Islamic Republic of		–		–	Sharks: Have communicated to all fishing cooperatives the IOTC resolutions on sharks.

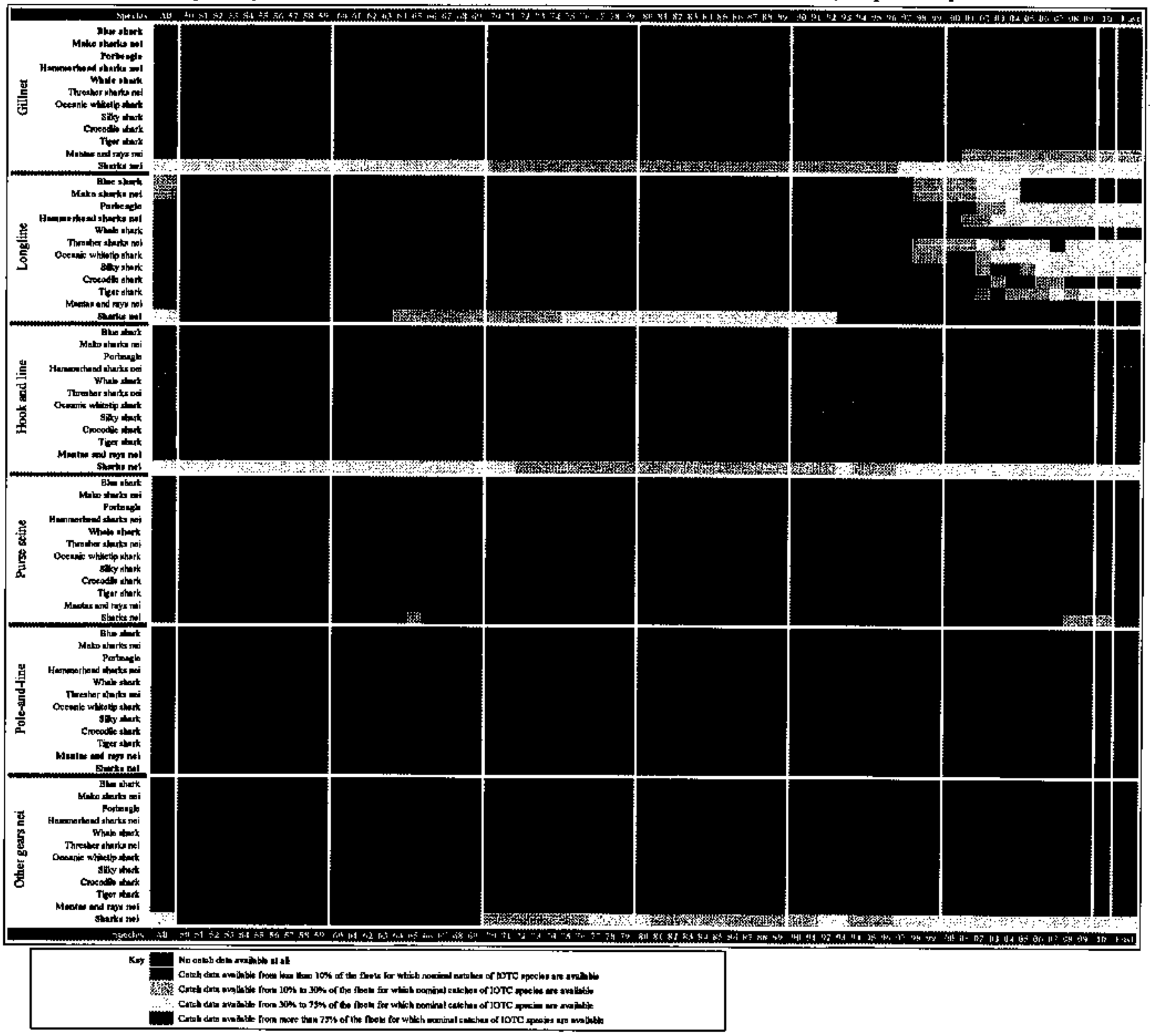
					Have in place a ban on the retention of live sharks. Seabirds: I.R. Iran determined that seabird interactions are not a problem for their fleet as they consist of gillnet vessels only.
Japan		03-Dec-2009		03-Dec-2009	Sharks: NPOA–Shark assessment implementation report submitted to COFI in July 2012 Seabirds: NPOA–Seabird implementation report submitted to COFI in July 2012.
Kenya					Sharks: Development has not begun. Scheduled for development in 2012. Sharks are considered a target species by Kenya. Seabirds: Development has not begun. Scheduled for development in 2012. Kenya has a single longliner targeting swordfish and no seabird interactions have been reported to date.
Korea, Republic of		–		–	Sharks: Approved on 18/08/2011 and is currently being implemented. Seabirds: Early stages of development.
Madagascar		–		–	Sharks: Development has not begun. Seabirds: Development has not begun. Note: A fisheries monitoring system is in place in order to ensure compliance by vessels with the IOTC's shark and seabird conservation and management measures.
Malaysia		2006			Sharks: Revision of second NPOA sharks in progress. Seabirds: No information received by the Secretariat.
Maldives, Republic of		–	n.a.	–	Sharks: An earlier draft of the NOPA is available: Gaps/issues that arose following the total shark ban have been identified through support from the Bay of Bengal Large Marine Ecosystem (BOBLME) Project. Presently Maldives is seeking further support from BOBLME Project to finalize the plan and associated regulation to be published in Government Gazette. Seabirds: Article 12 of IPOA states that if a 'problem exists' CPCs adopt an NPOA. IOTC Resolution 05/09 suggests CPCs to report on seabirds to the IOTC Scientific Committee if the issue is appropriate'. Maldives considers that seabirds are not an issue in Maldives fisheries, both in the pole-and-line fishery and in the longline fishery. The new longline fishing regulations has provision on mitigation measures on seabird bycatch. Maldives will be reporting on seabirds to the appropriate technical Working Party meetings of IOTC.
Mauritius					Sharks: Currently being drafted. Seabirds: Drafting will commence upon completion of NPOA–Sharks. In the meantime fishing companies have been requested to implement all mitigation measures as provided in the IOTC Resolutions.
Mozambique		–		–	Sharks: Development has not begun. Seabirds: Development has not begun.
Oman, Sultinate of					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
Pakistan					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
Philippines		Sept. 2009		–	Sharks: Under periodic review. Shark catches for 2010 provided to the Secretariat. Seabirds: Development has not begun. No seabird interactions recorded.
Seychelles, Republic of		Apr-2007		–	Sharks: NPOA-sharks to be reviewed in 2012. Seabirds: Development has not begun.
Sierra Leone					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.

Sri Lanka					Sharks: An NPOA-sharks is planned for development in 2012 and an update will be provided at the next SC meeting. Seabirds: Sri Lanka has determined that seabird interactions are not a problem for their fleets.
Sudan					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
Tanzania, United Republic of		–		–	Sharks: Initial discussions have commenced. Seabirds: Initial discussions have commenced. Note: Terms and conditions related to protected sharks and seabirds contained within fishing licenses.
Thailand		23-Nov-2005		–	Sharks: Second NPOA-sharks currently being drafted. Seabirds: Development has not begun.
United Kingdom	n.a.	–	n.a.	–	Not applicable: British Indian Ocean Territory (Chagos Archipelago) waters are a Marine Protected Area closed to fishing except recreational fishing around Diego Garcia. For sharks, UK is the 24th signatory to the Convention on Migratory Species 'Memorandum of Understanding on the Conservation of Migratory Sharks' which extends the agreement to UK Overseas Territories including British Indian Ocean Territories; Section 7 (10) (e) of the *Fisheries (Conservation and Management) Ordinance* refers to recreational fishing and requires sharks to be released alive. No seabirds are caught in the recreational fishery.
Vanuatu					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
Yemen					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
COOPERATING NON-CONTRACTING PARTIES					
Senegal		25-Sept-2006		–	Sharks: The Sub-Regional Fisheries Commission supported the development of a NPOA-sharks for Senegal in 2005. Other activities conducted include the organization of consultations with industry, the investigation of shark biology and social -economics of shark fisheries). The NPOA is currently being revised. Consideration is being made to the inclusion of minimum mesh size, minimum shark size, and a ban on shark finning. Seabirds: The need for a NPOA-seabirds has not yet been assessed.
South Africa, Republic of		–		2008	Sharks: The gazetting of the draft NPOA-sharks for public comment has been approved by the Minister of the Department of Agriculture, Forestry and Fisheries (6 July 2012). Seabirds: Published in August 2008 and fully implemented. The NPOA-seabirds has been earmarked for review.

APPENDIX VI
AVAILABILITY OF CATCH DATA FOR SHARKS BY GEAR

Availability of catch data for the main shark species expressed as the amount of fleets (%) for which catch data on sharks are available out of the total number of fleets for which data on IOTC species are available, by fishery, species of shark, and year, for the period 1950–2010

Shark species in bold are those identified by the Commission in 2012, for which data shall be recorded in logbooks and reported to the IOTC Secretariat; reporting of catch data for other species can be done in aggregated form (i.e. all species combined as ***sharks nei*** or ***mantas and rays nei***).
Hook and line refers to fisheries using handline and/or trolling and ***Other gears nei*** to other unidentified fisheries operated in coastal waters
Catch rates of sharks on pole-and-line fisheries are thought to be nil or negligible.
Average levels of reporting for 1950–2010 and 2006–10 are shown column ***All*** and ***Last***, respectively.



APPENDIX VII
TERMS OF REFERENCE FOR THE IOTC CPUE STANDARDISATION WORKSHOP

Workshop on standardisation, interpretation and use of CPUE series as indices of abundance for Indian Ocean tuna stocks

A workshop to deal with issues related to standardisation, interpretation and use of CPUE series as indices of population abundance has been requested by most IOTC working parties, given the importance of those data sources.

This workshop should be based around a team of scientists carrying out intersessional work covering a range of issues, as presented in the ToR below. Each item in the ToR should be covered by one or more documents, with work being carried out before the workshop meeting.

Scientists working with data from any fleet for which a CPUE series could be derived would be welcome to join. Ideally, scientists working on purse seine (PS), longline (LL) and Pole and line (PL) fleets, should be able to take part and carry out the necessary work.

- Coordinator: Dr Rishi Sharma, IOTC Secretariat
- Date: TBA
- Venue: TBA

Terms of Reference

The following ToR covers the most important issues that have been higlighted by different working parties. Work should be carried out, for those factors relevant to them, for the following:

- Fleets: EU PS, JAP LL, TWN LL, KOR LL, MAD PL
- Stocks: YFT, SKJ, ALB, BET

1. Development of common guidelines for CPUE standardisation

Despite very similar methods being applied to standardise CPUE series from various fleets, details of implementation and procedure tend to differ, making sometimes difficult to compare results and analyses.

- To develop a set of guidelines, to be applied on different series. The guidelines should draw on best practices employed elsewhere, and cover model building and selection, and the extraction and output of diagnostics.

2. Fishery changes affecting CPUE series

A number of technical and operational issues have been identified over the years as likely to have an important effect on the relationship between CPUE series and biomass. Improvements in technology, widely recognized in some fleets, are likely to affect many others. Changes in targeting, sometimes driven by external factors such as piracy, are also influential but difficult to quantify.

- To discuss and analyse alternative methods for accounting for targeting changes and their effect of selectivity.
- To explore a range of scenarios of technological change and improvements in efficiency affecting various fleets and their effect on estimated population trends, especially in recent years.

3. Spatial structure and statistical issues

Choices on spatial stratification can have a large influence in CPUE standardsation, especially in settings, such as the Indian Ocean, where changes in spatial coverage and intensity of fleet activity have been observed. The change in information contained in the CPUE series at different spatial scales, and possible differences in the signal observed in various areas, are important factors that could be investigated for series covering large areas.

Some statistical questions could also be addressed, such as the method used to deal with zero catches in strata with recorded effort, could also be discussed and evaluated.

- To explore the need and effect of applying different methods of accounting for zero catch values in strata with positive effort in those series where this is applicable.

4. Sources of data

Data forms the basis for all CPUE series, and different problems have been recognised in every data series employed by IOTC working parties.

- To analyse the effect of missing data on CPUE series and evaluate the possible use of data imputation methods to complete time series.
- To evaluate the advantages (e.g. increase in explanatory power) and disadvantages (e.g. increase in variance) of various environmental variables applied to CPUE series standardisation.
- To investigate the availability and uses of additional data (e.g. VMS data) that could increase the ability of the standardisation procedure to deal with different problems.

5. Combining series of abundance and dealing with conflicts in trends

Various stock assessment methods employed by IOTC working parties can only make use of a single index of abundance for estimating population trends. In such cases, indices from different fleets are unduly combined into an unified index. This procedure can be carried out using different methods, and the relative merits of each could be explored in the specific setting of IOTC series.

- To review and test different methods of combining CPUE series.

6. Impact on advice

The interest of CPUE series in a stock assessment exercise lies in their value as indicators of biomass dynamics, leading to the provision of scientific advice on stock status. The effect of various factors affecting CPUE series on final management advice can be investigated via stochastic simulation.

- To carry out initial simulations on the effect of the most important sources of error and bias in CPUE series on management advice as provided with different stock assessment models.

Appendix VIII

List of Chairs, Vice-Chairs and their Respective Terms for all IOTC Science Bodies

Group	Chair/Vice-Chair	Representative	CPC/Affiliation	Term commencement date	Term expiration date (End date is until replacement is elected)	Comments
SC	Chair	Dr. Tsutomu Nishida	Japan	17–Dec–11	End of SC in 2013	1st term
	Vice-Chair	Mr. Jan Robinson	Seychelles	17–Dec–11	End of SC in 2013	1st term
WPB	Chair	Mr. Jerome Bourjea	EU,France	8–Jul–11	End of WPB in 2013	1st term
	Vice-Chair	Mr. Miguel Santos	EU,Portugal	8–Jul–11	End of WPB in 2013	1st term
WPTmT	Chair	Dr. Zang Geun Kim	Korea, Rep. of	22–Sep–11	End of WPTmT in 2013	1st term
	Vice-Chair	Mr. Takayuki Matsumoto	Japan	6–Sep–12	End of WPTmT in 2014	1st term
WPTT	Chair	Dr. Hilario Murua	EU,Spain	25–Oct–10	End of WPTT in 2012	2nd term
	Vice-Chair	Dr. Shiham Adam	Maldives, Rep. of	23–Oct–11	End of WPTT in 2013	1st term
WPEB	Chair	Dr. Charles Anderson	UK/Independent	14–Oct–10	End of WPEB in 2013	2nd term
	Vice-Chair	Dr. Evgeny Romanov	EU,France	27–Oct–11	End of WPEB in 2013	1st term
WPNT	Chair	Dr. Prathibha Rohit	India	27–Nov–11	End of WPNT in 2013	1st term
	Vice-Chair	Mr. Farhad Kaymaram	I.R. Iran	27–Nov–11	End of WPNT in 2013	1st term
WPDCS	Chair	Mr. Miguel Herrera	Secretariat	4–Dec–10	End of WPDCS 2012	2nd term
	Vice-Chair	Dr. Pierre Chavance	European Union	10–Dec–11	End of WPDCS 2013	1st term
WPM	Chair	Dr. Iago Mosqueira	European Union	18–Dec–11	End of WPM 2013	1st term
	Vice-Chair	Dr. Toshihide Kitakado	Japan	18–Dec–11	End of WPM 2013	1st term
WPFC	Chair	Not active	Not active	Not active	Not active	Not active
	Vice-Chair	Not active	Not active	Not active	Not active	Not active

APPENDIX IX
EXECUTIVE SUMMARY: ALBACORE

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

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

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

Area[1]	Indicators		2012 stock status determination
Indian Ocean	Catch 2011: Average catch 2007–2011:	38,946 t 41,609 t	
	MSY (80% CI)): F_{2010}/F_{MSY} (80% CI): SB_{2010}/SB_{MSY} (80% CI): SB_{2010}/SB_{1950} (80% CI):	33,300 t (31,100–35,600 t) 1.33 (0.9–1.76) 1.05 (0.54–1.56) 0.29 (n.a.)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

There remains considerable uncertainty about the relationship between abundance and the standardised CPUE series, and about the total catches over the past decade.

Stock status. Trends in the Taiwan,China CPUE series suggest that the longline vulnerable biomass has declined to about 29% of the level observed in 1950. There were 20 years of moderate fishing before 1980, and the catch has more than doubled since 1980. Catches have increased substantially since 2007, attributed to the Indonesian fishery although there is substantial uncertainty remaining on the catch estimates. It is considered that recent catches have been well above the MSY level, recent fishing mortality exceeds F_{MSY} (F_{2010}/F_{MSY} = 1.33). Spawning biomass is considered to be at or very near to the SB_{MSY} level (SB_{2010}/SB_{MSY}= 1.05) (Table 1, Fig. 1). Fishing mortality needs to be reduced by at least 20% to ensure that spawning biomass is maintained at MSY levels (Table 2).

Outlook. Maintaining or increasing effort in the core albacore fishing grounds is likely to result in further declines in albacore biomass, productivity and CPUE. The impacts of piracy in the western Indian Ocean has resulted in the displacement of a substantial portion of longline fishing effort into the traditional albacore fishing areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on albacore will decline in the near future unless management action is taken. The following key points should be noted:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- The lack of consistency in the data inputs to the analysis and the impacts of using different areas for each fleet on the CPUE standardisations, makes interpretation of the results difficult.
- The use of fine-scale versus aggregated data in the CPUE standardisations by fleet introduces substantial uncertainty.
- Current catches (average 41,609 t over the last five years, 38,946 t in 2011) exceed the MSY level (33,300 t, range: 31,100–35,600 t). Maintaining or increasing effort will result in further declines in biomass, productivity and CPUE.
- A Kobe 2 Strategy matrix was calculated to quantify the risk of different future catch scenarios, using the projections from the ASPM model (Table 2). The projections indicated that a minimum reduction in fishing

mortality of 20% would be required to ensure that the stock does not move to an overfished state by 2020 (i.e. below SB_{MSY}) (Table 2).

- Provisional reference points: Noting that the Commission in 2012 agreed to Recommendation 12/14 *on interim target and limit reference points*, the following should be noted:
  - **Fishing mortality**: Current fishing mortality is considered to be well above the provisional target reference point of F_{MSY}, but below the provisional limit reference point of $1.4*F_{MSY}$ (Fig. 1; Table 3).
  - **Biomass**: Current spawning biomass is considered to be at or very near the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (Fig. 1; Table 3).

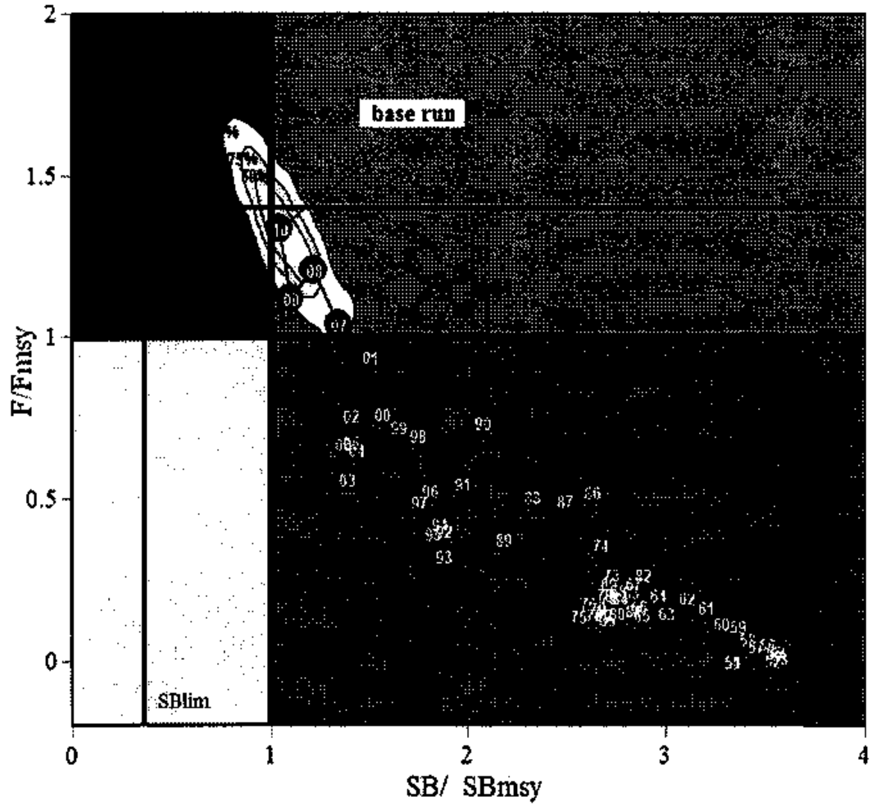


Fig. 1. Albacore: ASPM Aggregated Indian Ocean assessment Kobe plot (95% bootstrap confidence surfaces shown around 2010 estimate). Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2010. Target (Ftarg and SBtarg) and limit (Flim and SBlim) reference points are shown.

TABLE 2. Albacore: ASPM Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based target reference points for nine constant catch projections (2010 catch level, ± 10% ± 20%, ± 30% and ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	Alternative catch projections (relative to 2010) and probability (%) of violating MSY reference points								
	60% (25,749 t)	70% (30,041 t)	80% (33,332 t)	90% (38,624 t)	100% (42,915 t)	110% (47,207 t)	120% (51,498 t)	130% (55,790 t)	140% (60,081 t)
$SB_{2013} < SB_{MSY}$	<1	1	8	15	23	35	46	55	65
$F_{2013} > F_{MSY}$	<1	2	18	47	74	91	98	>99	>99
$SB_{2020} < SB_{MSY}$	<1	<1	12	40	69	90	>99	>99	>99
$F_{2020} > F_{MSY}$	<1	<1	20	67	94	>99	>99	>99	>99

TABLE 3. Albacore: ASPM Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based limit reference points for nine constant catch projections (2010 catch level, ± 10% ± 20%, ± 30% and ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	Alternative catch projections (relative to 2010) and probability (%) of violating MSY limit reference points								
	60% (25,749 t)	70% (30,041 t)	80% (33,332 t)	90% (38,624 t)	100% (42,915 t)	110% (47,207 t)	120% (51,498 t)	130% (55,790 t)	140% (60,081 t)
$SB_{2013} < SB_{LIM}$	<1	<1	<1	<1	<1	<1	<1	<1	<1
$F_{2013} > F_{LIM}$	<1	<1	<1	7	26	53	75	89	97
$SB_{2020} < SB_{LIM}$	<1	<1	<1	<1	5	28	51	70	83
$F_{2020} > F_{LIM}$	<1	<1	<1	30	69	94	>99	>99	>99

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

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

- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area*
- Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 12/07 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*

FISHERIES INDICATORS

General

Overall, the biology of the albacore stock in the Indian Ocean is not well known and there is relatively little new information on albacore stocks. Albacore (*Thunnus alalunga*) life history characteristics, including a relatively late maturity, long life and sexual dimorphism, make the species vulnerable to over exploitation. Table 4 outlines some of the key life history traits of albacore specific to the Indian Ocean.

TABLE 4. Albacore: Biology of Indian Ocean albacore (*Thunnus alalunga*)

Parameter	Description
Range and stock structure	A temperate tuna living mainly in the mid oceanic gyres of the Pacific, Indian and Atlantic oceans. In the Pacific and Atlantic oceans there is a clear separation of southern and northern stocks associated with the oceanic gyres that are typical of these areas. In the Indian Ocean, there is probably only one southern stock, distributed from 5°N to 40°S, because there is no northern gyre. Albacore is a highly migratory species and individuals swim large distances during their lifetime. It can do this because it is capable of thermoregulation, has a high metabolic rate, and advanced cardiovascular and blood/gas exchange systems. Pre-adults (2–5 year old albacore) appear to be more migratory than adults. In the Pacific Ocean, the migration, distribution availability, and vulnerability of albacore are strongly influenced by oceanographic conditions, especially oceanic fronts. It has been observed on all albacore stocks that juveniles concentrate in cold temperate areas (for instance in a range of sea-surface temperatures between 15 and 18°C), and this has been confirmed in the Indian Ocean where albacore tuna are more abundant north of the subtropical convergence (an area where these juvenile were heavily fished by driftnet fisheries during the late 1980's). It appears that juvenile albacore show a continuous geographical distribution in the Atlantic and Indian oceans in the north edge of the subtropical convergence. Albacore may move across the jurisdictional boundary between

	ICCAT and IOTC. It is likely that the adult Indian Ocean albacore tunas do yearly circular counter-clockwise migrations following the surface currents of the south tropical gyre between their tropical spawning and southern feeding zones. In the Atlantic Ocean, large numbers of juvenile albacore are caught by the South African pole-and-line fishery (catching about 10,000 t yearly) and it has been hypothesized that these juveniles may be taken from a mixture of fish born in the Atlantic (north east of Brazil) and from the Indian Ocean. For the purposes of stock assessments, one pan-ocean stock has been assumed.
Longevity	10+ years
Maturity (50%)	**Age**: females 5–6 years; males 5–6 **Size**: females n.a.; males n.a.
Spawning season	Little is known about the reproductive biology of albacore in the Indian Ocean but it appears, based on biological studies and on fishery data, that the main spawning grounds are located east of Madagascar between 15° and 25°S during the 4th and 1st quarters of each year. Like other tunas, adult albacore spawn in warm waters (SST>25°C).
Size (length and weight)	Reported to 128 cm FL in the Indonesian longline fishery $W = aL^b$ with $a = 5.691\times10^{-5}$, $b = 2.7514$.

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

Albacore – Catch trends

Albacore are currently caught almost exclusively using drifting longlines (98%) (Figs. 2, 3, 4; Table 5), South of 10°S (Table 6), with remaining catches recorded using purse seines and other gears (Fig. 2). Catches of albacore were relatively stable until the mid-1980s, except for high catches recorded in 1973 and 1974 (Fig. 2). The catches increased markedly during the mid-1980's due to the use of drifting gillnets by Taiwan,China (Fig. 3), with total catches in excess of 30,000 t. The drifting gillnet fleet targeted juvenile albacore in the southern Indian Ocean (30°S to 40°S). In 1992 the United Nations worldwide ban on the use of drifting gillnets effectively closed this gillnet fishery.

Following the removal of the drifting gillnet fleet, catches dropped to less than 20,000 t by 1993 (Figs. 2, 3). However, catches more than doubled over the period from 1993 (less than 20,000 t) to 2001 (44,000 t). Since 2001 catches have been almost exclusively taken by drifting longlines (Figs. 2, 3, 4). Record catches of albacore were reported in 2008 at approximately 44,500 t. Catches for 2010 were estimated to be 42,915 t, while catches for 2011 amount to 38,946 t (Table 5).

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

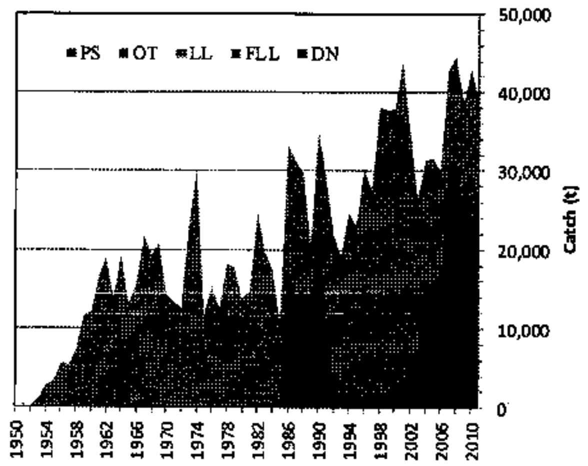


Fig. 2. Albacore: Annual catches of albacore by gear recorded in the IOTC Database (1950–2011) (Data as of October 2012). Freezing-longline (LL); Fresh-tuna longline (FLL); Purse seine (PS); Other gears NEI (OT).

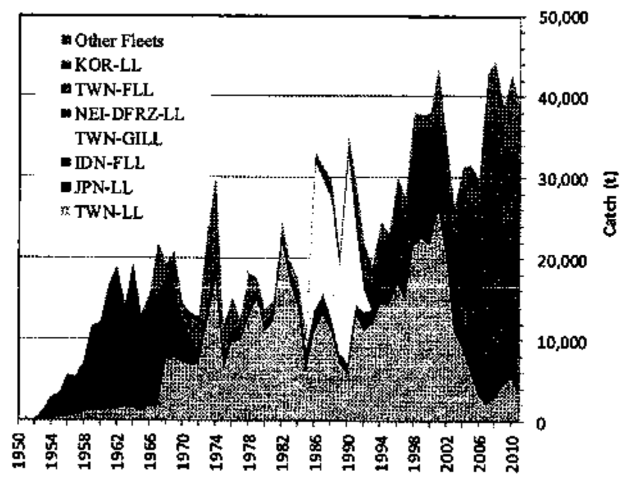


Fig. 3. Albacore: Annual catches of albacore by fleet recorded in the IOTC Database (1950–2011) (Data as of October 2012). Freezing Longlines of Taiwan,China (LL-TWN), Japan (LL-JPN), Rep. of Korea (LL-KOR), and other nei fleets (LL-NEI-DFRZ); Fresh-tuna longlines of Indonesia (FLL-IDN), and Taiwan,China (FLL-TWN); Driftnets of Taiwan,China (DN-TWN); all other fleets combined (Other Fleets).

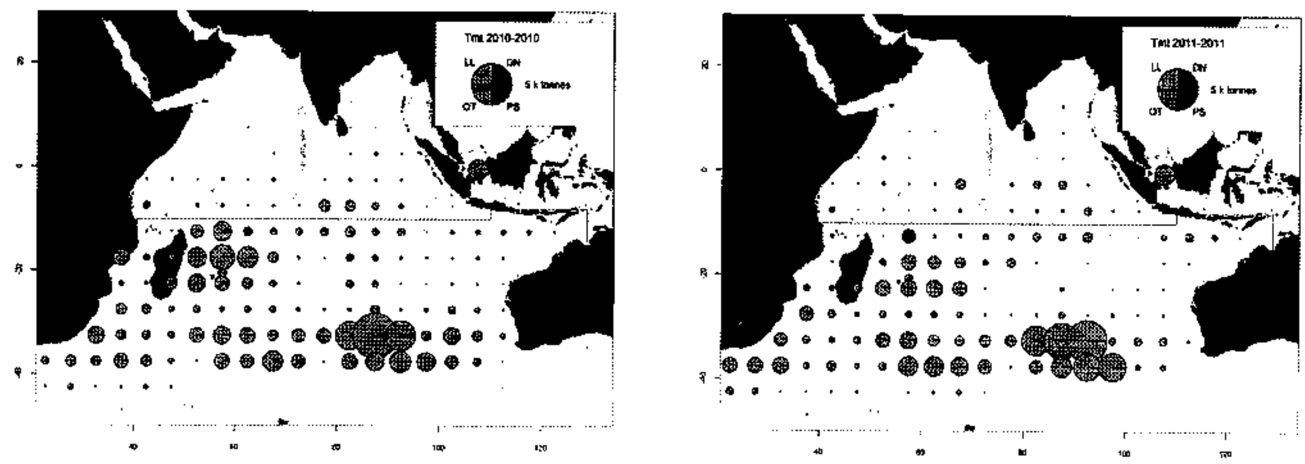


Fig. 4a–b. Albacore: Time-area catches (total combined in tonnes) of albacore estimated for 2010 (left) and 2011 (right) by type of gear: Longline (LL, green), Driftnet (DFRT, red), Purse seine (PS, purple), Other fleets (OT, blue). The catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned, in particular the coastal fisheries of Indonesia (Data as of October 2012).

Longliners from Japan and Taiwan,China have been operating in the Indian Ocean since the early 1950s (Fig. 3). Although the Japanese albacore catch ranged from 8,000 t to 18,000 t in the period 1959 to 1969, in 1972, catches rapidly decreased to around 1,000 t, due to a change in the target species, mainly to southern bluefin tuna and bigeye tuna. Albacore became a bycatch species for the Japanese fleet with catches between 200 t and 2,500 t. In recent years the Japanese albacore catch has been around 2,000 to 6,000 t (Fig. 3).

In contrast to the Japanese longliners, catches by Taiwan,China longliners increased steadily from the 1950's to average around 10,000 t by the mid-1970s. Between 1998 and 2002 catches ranged between 21,500 t to 26,900 t, equating to just over 60% of the total Indian Ocean albacore catch. Between 2003 and 2010 the albacore catches by Taiwan,China longliners have been between 10,000 and 18,000 t, with catches appearing to be increasing in recent years. There has been a shift in the proportion of catches of albacore by deep-freezing and fresh-tuna longliners in recent years, with increasing catches of fresh-tuna (72% of the total catches for 2008–10) as opposed to deep-freezing longliners (Fig. 2; Table 5).

While most of the catches of albacore have traditionally come from the southwest Indian Ocean, in recent years a larger proportion of the catch has come from the southern and eastern Indian Ocean (Fig. 4; Table 6). The relative increase in catches in the eastern Indian Ocean since the early 2000's is mostly due to increased activity of fresh-tuna longliners from Taiwan,China and Indonesia. In the western Indian Ocean, the catches of albacore mostly result from the activities of deep-freezing longliners and purse seiners. One consequence of Somali maritime piracy in the western tropical Indian Ocean in recent years has been the movement of part of the deep-freezing longline fleets out of this area, where the target species were tropical tunas or swordfish, to operate in southern waters of the Indian Ocean. This led to increased catches of albacore by some longline fleets, in particular vessels from China, Taiwan,China and Japan.

Fleets of oceanic gillnet vessels from Iran and Pakistan and gillnet and longline vessels from Sri Lanka have extended their area of operation in recent years, to operate on the high seas closer to the equator. The lack of catch-and-effort data from these fleets makes it impossible to assess whether they are operating in areas where catches of juvenile albacore are likely to occur.

TABLE 5. Albacore: Best scientific estimates of the catches of albacore (*Thunnus alalunga*) by gear and main fleets [or type of fishery] by decade (1950–2000) and year (2002–2011) in tonnes. Data as of October 2012. Catches by decade represent the average annual catch, noting that some gears were not used for all years (refer to Fig. 3).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
DN				5,823	3,735											
LL			80	314	1,328	15,029	3,925	6,912	15,203	15,454	14,741	30,902	31,291	25,318	23,630	26,584
FLL	3,715	17,233	16,904	15,214	21,876	19,806	29,989	17,808	15,721	15,774	13,264	10,714	10,741	11,635	17,689	10,268
PS	6	9	26	70	64	443	156	149	168	180	385	598	989	1,456	1,388	1,369
OT				203	1,683	920	772	1,496	232	164	1,548	725	1,424	392	207	725
Total	**3,721**	**17,242**	**17,010**	**21,624**	**28,686**	**36,198**	**34,842**	**26,364**	**31,324**	**31,572**	**29,938**	**42,940**	**44,444**	**38,801**	**42,915**	**38,946**

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

TABLE 6. Albacore: Best scientific estimates of the catches of albacore (*Thunnus alalunga*) by fishing area for the period 1950–2011 (in metric tons). Data as of October 2012.

Area	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
N	754	1,199	1,171	668	2,238	3,985	2,436	2,671	2,316	3,022	3,826	12,410	6,687	2,993	2,300	2,190
S	2,967	16,043	15,840	20,955	26,448	32,213	32,406	23,693	29,008	28,550	26,112	30,530	37,758	35,808	40,615	36,756
Total	**3,721**	**17,242**	**17,011**	**21,623**	**28,686**	**36,198**	**34,842**	**26,364**	**31,324**	**31,572**	**29,938**	**42,940**	**44,445**	**38,801**	**42,915**	**38,946**

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

Albacore – Uncertainty of catches

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

- Longliners of Indonesia and Malaysia: to date, Indonesia and Malaysia have reported incomplete catches of albacore for their longline fleets, as they do not monitor activities of longliners under their flags based outside of their ports (e.g. Mauritius, Sri Lanka, and Thailand). In addition, in recent years Indonesia has reported catches of albacore for fresh-tuna longliners under its flag that are in contradiction with the amounts of albacore recorded from alternative sources, including data on exports of albacore from Bali, and data from canning factories under the ISSF scheme. The new catches of albacore estimated by the IOTC Secretariat using the above sources are around 14,000 t (average 2006–10), well above those reported by the flag country (8,000 t).
- Fleets using gillnets on the high seas, in particular Iran, Pakistan and Sri Lanka: Catches are likely to be less than 1,000 t.

- Non-reporting industrial longliners (NEI): Refers to catches from longliners operating under flags of non-reporting countries. While the catches were moderately high during the 1990s, they have not exceeded 2,000 t in recent years.

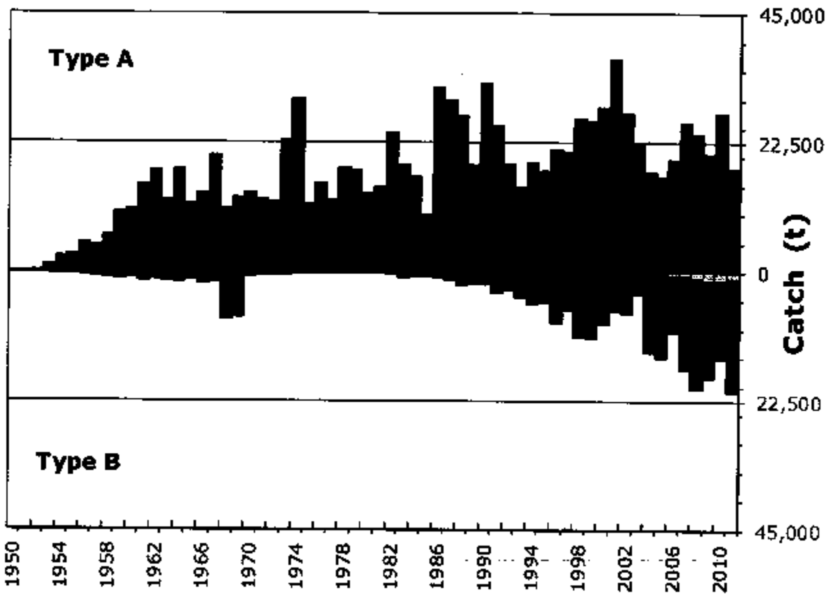


Fig. 5. Albacore: Uncertainty of annual catch estimates for albacore (1950–2011) (Data as of October 2012). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

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

Albacore – Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid in 2010 and 2011 are provided in Fig. 6, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2010 and 2011 are provided in Fig. 7.

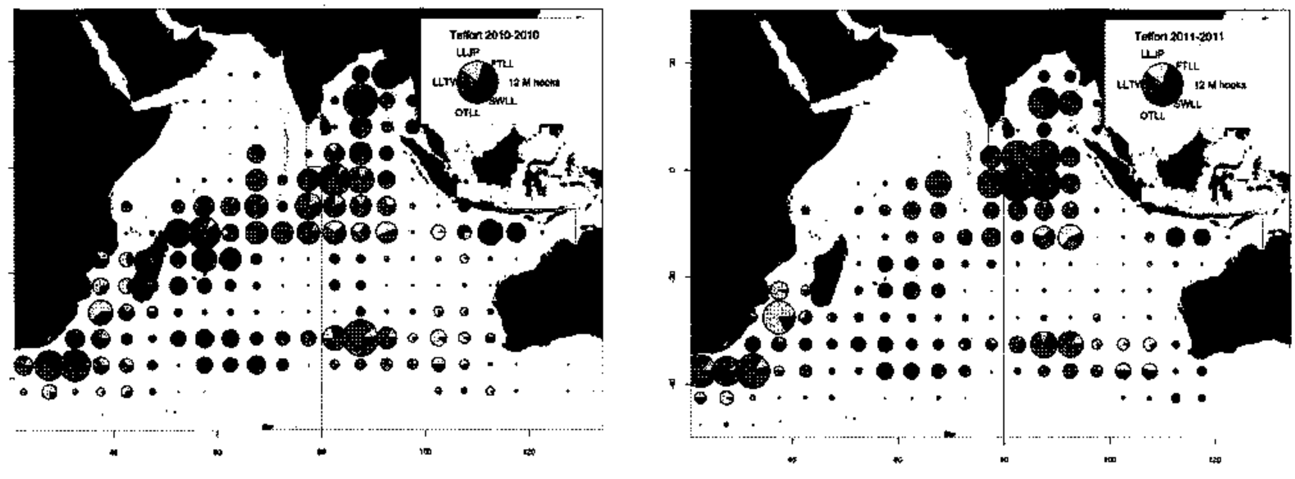


Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

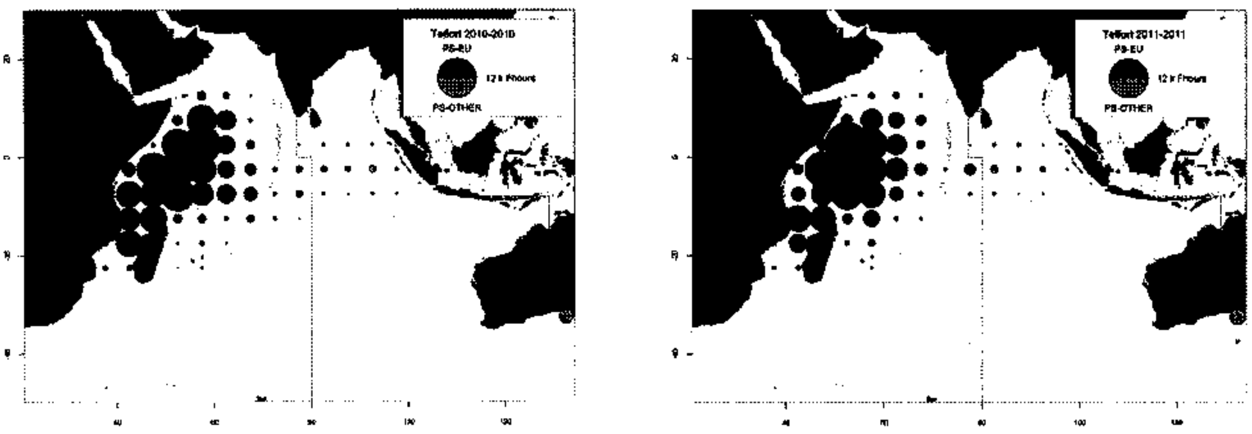


Fig. 7. Number of hours of fishing(Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

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

The size frequency data for the deep-freezing longline fishery from Taiwan,China for the period 1980–2009 is available. In general, the amount of catch for which size data for the species are available before 1980 is still very low. The data for the Japanese longline fleets is available; however, the number of specimens measured per stratum has been decreasing in recent years. Few data are available for the other fleets.

- Trends in average weight can be assessed for several industrial fisheries although they are incomplete or of poor quality for most fisheries before 1980, between 1986 and 1991, and in recent years, due to the lack of length samples for the fleets referred to above (Fig. 8).
- Catch-at-Size/Age tables are available but the estimates are highly uncertain for some periods and fisheries including:
    - o all industrial longline fleets before the mid-60s, from the early-1970s up to the early-1980s and most fleets in recent years, in particular fresh-tuna longliners
    - o the complete lack of size samples from the driftnet fishery of Taiwan,China over the entire fishing period (1982–92)
    - o the paucity of catch by area data available for some industrial fleets (Taiwan,China, NEI, India and Indonesia)

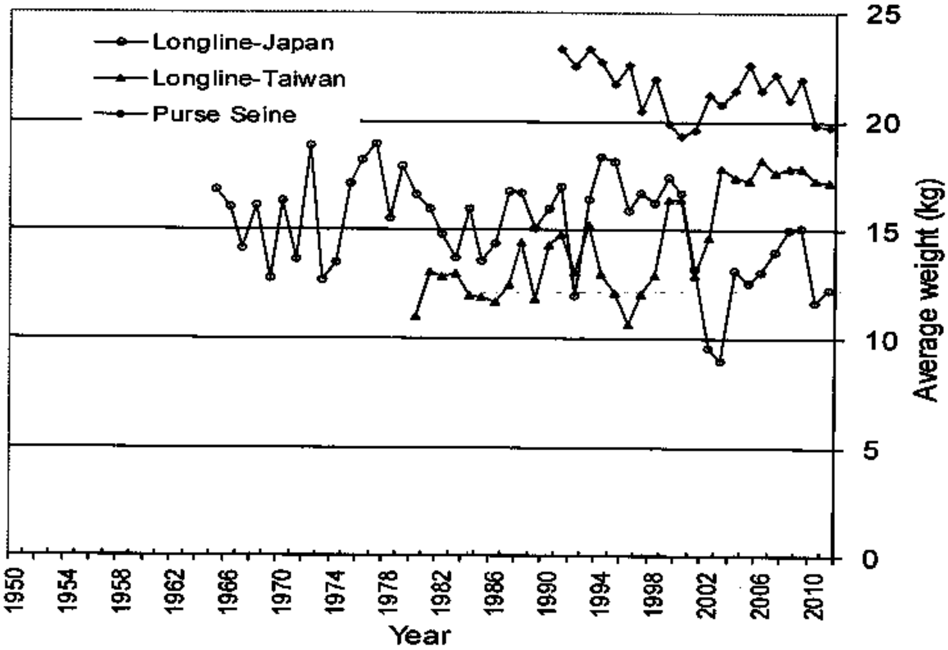


Fig. 8. Albacore: Average weight in kg of the catches of all fleets (blue), gillnet (red), LL-JPN (dark green), LL-TWN (black), Purse seine (green) and other gears (grey) from 1950 to 2011.

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

Catch-and-effort series are available from various industrial fisheries. Nevertheless, catch-and-effort are not available from some fisheries or they are considered to be of poor quality, especially during the last decade, for the following reasons:

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

The CPUE series available for assessment purposes are shown in Fig. 9, although only the Taiwan,China series or a combined CPUE (weighted average of Japan and Taiwan,China) were used in the stock assessment models for 2012 for the reasons discussed in IOTC–2012–WPTmT04–R.

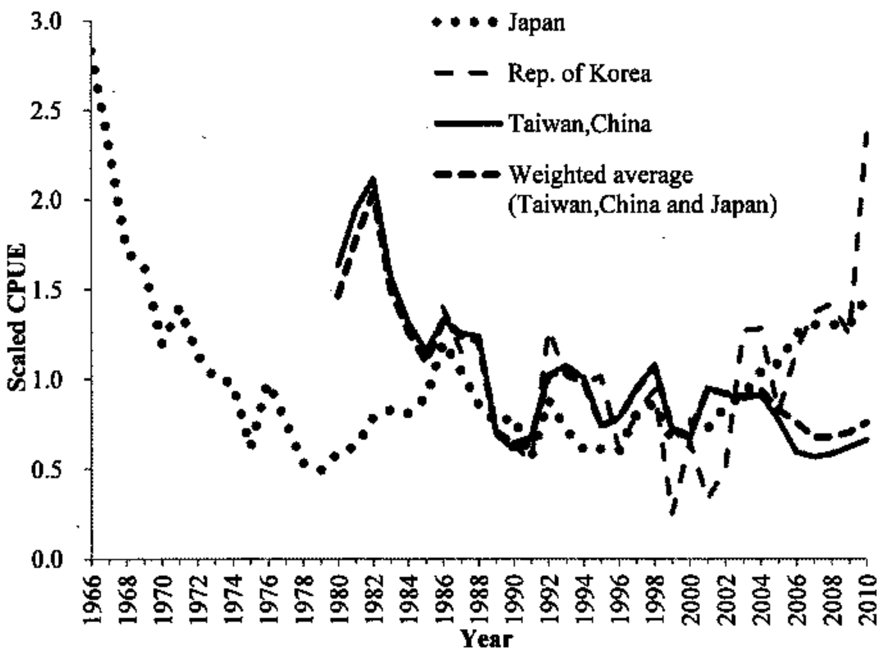


Fig. 9. Albacore: Comparison of the three CPUE series for longline fleets fishing for albacore in the IOTC area of competence, as well as the weight average of the Taiwan,China and Japan series. Series have been rescaled relative to their respective means from 1966–2010.

STOCK ASSESSMENT

A range of quantitative modelling methods (ASPIC, ASPM and SS3) were applied to the albacore assessment in 2012, ranging from the highly aggregated ASPIC surplus production model to the age-, sex- and spatially-structured SS3 analysis.

The following is worth noting with respect to the various modelling approaches used in 2012:

- There was more confidence in the abundance indices this year due to the additional CPUE analyses from Japan and Taiwan,China, and the exploration of the Rep. of Korea catch and effort data. This has led to improved confidence in the overall assessments.
- The Taiwan,China CPUE is more likely to closely represent albacore abundance at this time, because a substantial part of the Taiwanese fleet has always targeted albacore.
- Conversely, the Japanese CPUE seems to demonstrate very strong targeting shifts away from albacore (1960s) and back towards albacore in recent years (as a consequence of piracy in the western Indian Ocean). Similar trends are seen in the Rep. of Korea CPUE series.
- CPUE series should not be average across series with different trends as this is likely to result in spurious trends. Thus, only series which are considered to be most representative of abundance, in this case the Taiwan,China series, should be used in stock assessments while further work is carried out on the Japanese and Korean longline series.
- Albacore stock status should be determined by qualitatively integrating the results of the various stock assessments undertaken in 2012. All analyses were treated as being equally informative, and focus was given to the features common to all of the results.
- It was recognised that the deterministic production models were only able to explore a limited number of modelling options. The structural rigidity of these simple models causes numerical problems when fit to long time series for some cases.

The stock structure of the Indian Ocean albacore resource is under investigation, but currently uncertain. The south-west region was identified as an area of interest, as it is likely that there is stock connectivity with the southern Atlantic albacore population.

In deciding upon the most appropriate way to present the integrated stock assessment results, the output of the ASPM model were considered to most likely numerically and graphically represent the current status of albacore in the Indian

Ocean (Table 7). However, this does not represent an endorsement of the ASPM model over the other models used in 2012, as there are still substantial problems with the ASPM model, and all of the models should be considered to be equally informative of stock status.

TABLE 7. Albacore (*Thunnus alalunga*) stock status summary.

Management Quantity	**Aggregate Indian Ocean (TWN,CHN CPUE only) (base case)**
2011 catch estimate	38,946 t
Mean catch from 2007–2011	41,609 t
MSY (80% CI)	33,300 (31,100–35,600)
Data period used in assessment	1950–2010
F_{2010}/F_{MSY} (80% CI)	1.33 (0.90–1.76)
B_{2010}/B_{MSY} (80% CI)	–
SB_{2010}/SB_{MSY} (80% CI)	1.05 (0.54–1.56)
B_{2010}/B_{1950} (80% CI)	–
SB_{2010}/SB_{1950}	0.29 (n.a.)
$B_{2010}/B_{1950,\ F=0}$	–
$SB_{2010}/SB_{1950,\ F=0}$	–

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APPENDIX X
EXECUTIVE SUMMARY: BIGEYE TUNA

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

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

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

Area[1]	Indicators			2012 stock status determination
Indian Ocean	Catch in 2011: Average catch 2007–2011:	87,420 t 101,639 t		
		SS3[3]	ASPM[4]	
	MSY (1000 t): F_{curr}/F_{MSY}: SB_{curr}/SB_{MSY}: SB_{curr}/SB_0:	114 t (95–183 t) 0.79 (0.50–1.22) 1.20 (0.88–1.68) 0.34 (0.26–0.40)	103 t (87–119 t) 0.67 (0.48–0.86) 1.00 (0.77–1.24) 0.39	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]The stock status refers to the most recent years' data used in the assessment.
[3]Central point estimate is adopted from the 2010 SS3 model, percentiles are drawn from a cumulative frequency distribution of MPD values with models weighted as in Table 12 of 2010 WPTT report (IOTC–2010–WPTT12–R); the range represents the 5th and 95th percentiles.
[4]Median point estimate is adopted from the 2011 ASPM model using steepness value of 0.5 (values of 0.6, 0.7 and 0.8 are considered to be as pausible as these values but are not presented for simplification); the range represents the 90 percentile Confidence Interval.
Current period (curr) = 2009 for SS3 and 2010 for ASPM.

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was carried out in 2012. Revised stock status indicators (e.g. standardised CPUE series) do not show any substantial differences from those carried out in 2011 that would warrant a change in the overall stock status advice. Both of the stock assessments carried out in 2010 and 2011 indicate that the stock is above a biomass level that would produce MSY in the long term and that current fishing mortality is below the MSY-based reference level (i.e. $SB_{current}/SB_{MSY}$ > 1 and $F_{current}/F_{MSY}$ < 1) (Table 1 and Fig. 1). Current spawning stock biomass was estimated to be 34–40 % (Table 1) of the unfished levels. The central tendencies of the stock status results from the WPTT 2011 when using different values of steepness were similar to the central tendencies presented in 2010. Catches in 2011 (87,420 t) remain lower than the estimated MSY values from the 2010 and 2011 stock assessments (Table 1). The average catch over the previous five years (2007–2011; 101,639 t) also remains below the estimated MSY. On the weight of stock status evidence available, the bigeye tuna stock is therefore not overfished, and is not subject to overfishing.

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

The Kobe strategy matrix (Combined SS3 and ASPM) illustrates the levels of risk associated with varying catch levels over time and could be used to inform future management actions (Table 2). Based on the ASPM projections from the 2011 assessment, with steepness 0.5 value for illustration, there is relatively a low risk of exceeding MSY-based reference points by 2020 both when considering current catches of 87,420 t (approximately 11% risk of $SB<SB_{MSY}$) or even if catches increase to around 100,000 t (<41% risk that $B_{2020}<B_{MSY}$ and $F_{2020}>F_{MSY}$).

Moreover, the SS3 projections from the 2010 assessment show that there is a low risk of exceeding MSY-based reference points by 2019 if catches are maintained at the lower range of MSY levels or at the catch level of 102,000 t (< 30% risk that $B_{2019}<B_{MSY}$ and < 25% risk that $F_{2019}>F_{MSY}$) (Table 1). The following key points should be noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean ranges between 102,000 and 114,000 t (range expressed as the median value for 2010 SS3 and steepness value of 0.5 for 2011 ASPM for illustrative purposes (see Table 1 for further description)). Annual catches of bigeye tuna should not exceed the lower range of this estimate which corresponds to the 2009 catches and last year's management advice.
- If the recent declines in effort continue, and catch remains substantially below the estimated MSY of 102,000–114 000 t, then immediate management measures are not required. However, continued monitoring and improvement in data collection, reporting and analysis is required to reduce the uncertainty in assessments.
- provisional reference points: Noting that the Commission in 2012 agreed to Recommendation 12/14 *on interim target and limit reference points*, the following should be noted:
  - **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, and therefore below the provisional limit reference point of $1.4*F_{MSY}$ (Fig. 1).
  - **Biomass**: Current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (Fig. 1).

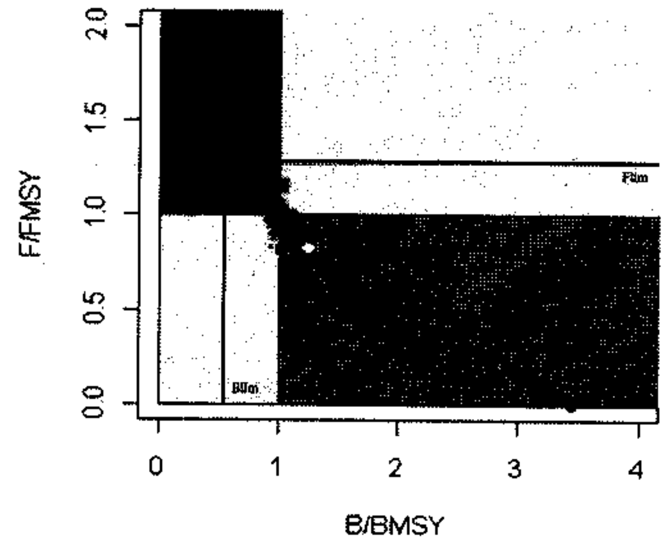


Fig. 1. Bigeye tuna: SS3 Aggregated Indian Ocean assessment Kobe plot. Black circles represent the time series of annual median values from the weighted stock status grid (white circle is 2009). Blue squares indicate the MPD estimates for 2009 corresponding to each individual grid C model, with colour density proportional to the weighting (each model is also indicated by a small black point, as the squares from highly down-weighted models are not otherwise visible)

TABLE 2. Bigeye tuna: Combined 2010 SS3 and 2011 ASPM Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for five constant catch projections (2009 and 2010 catch levels, ± 20% and ± 40%) projected for 3 and 10 years. K2SM adopted from the 2011 ASPM model using steepness value of 0.5 (values of 0.6, 0.7 and 0.8 are considered to be as pausible as these values but are not presented for simplification). Note that the catch levels for 2009 and 2010 have since been revised, but are not reflected in the projections

Reference point and projection timeframe	Alternative catch projections (relative to 2009) and probability (%) of violating reference point				
	2010 SS3				
	60% (61,200 t)	**80%** (81,600 t)	**100%** (102,000 t)	**120%** (122,400 t)	**140%** (142,800 t)
$SB_{2012} < SB_{MSY}$	19	24	28	40	50
$F_{2012} > F_{MSY}$	<1	<6	22	50	68
$SB_{2019} < SB_{MSY}$	19	24	30	55	73
$F_{2019} > F_{MSY}$	<1	<6	24	58	73

Reference point and projection timeframe	Alternative catch projections (relative to 2010) and probability (%) of violating reference point				
	2011 ASPM				
	60% (42,900t)	80% (57,200t)	100% (71,500t)	120% (85,800t)	140% (100,100t)
$SB_{2013} < SB_{MSY}$	4	8	15	24	35
$F_{2013} > F_{MSY}$	<1	<1	1	8	33
$SB_{2020} < SB_{MSY}$	<1	<1	1	11	41
$F_{2020} > F_{MSY}$	<1	<1	<1	5	38

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

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

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

FISHERIES INDICATORS

Bigeye tuna – General

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

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

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

and weight)	Newly recruited fish are primarily caught by the purse seine fishery on floating objects. The sizes exploited in the Indian Ocean range from 30 cm to 180 cm fork length. Smaller fish (juveniles) form mixed schools with skipjack tuna and juvenile yellowfin tuna and are mainly limited to surface tropical waters, while larger fish are found in sub-surface waters.

Sources: Nootmorn 2004, Froese & Pauly 2009

Bigeye tuna – Fisheries and catch trends

Bigeye tuna is mainly caught by industrial longline (59% in 2011) and purse seine (26% in 2011) fisheries, with the remaining 15% of the catch is taken by other fisheries (Table 4; Fig. 2). However, in recent years the catches of bigeye tuna by gillnet fisheries are likely to be higher, due to the major changes experienced in some of these fleets, notably changes in boat size, fishing techniques and fishing grounds, with vessels using deeper gillnets on the high seas, in areas where catches of bigeye tuna are high.

Total annual catches have increased steadily since the start of the fishery, reaching the 100,000 t level in 1993 and peaking at 150,000 t in 1999 (Fig. 2). Catches dropped since then to values between 120,000–140,000 t (2000–07), further dropping in recent years, to values under 90,000 t in recent years (2010–11). The SC believes that the recent drop in catches could be related, at least in part, with the expansion of piracy in the northwest Indian Ocean, which has led to a marked drop in the levels of longline effort in the core fishing area of these species.

Table 4. Bigeye tuna: Best scientific estimates of the catches of bigeye tuna (*Thunnus obesus*) by gear and main fleets [or type of fishery] by decade (1950–2009) and year (2002–2011), in tonnes. Data as of September 2012. Catches by decade represent the average annual catch, noting that some gears were not used for all years (refer to Fig. 2)

Fishery	By decade (average)						By year (last-ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
LL	6,488	21,970	30,462	45,940	88,106	93,721	109,895	104,613	113,940	94,094	90,668	93,493	69,947	66,761	46,371	51,587
FS	0	0	0	2,067	4,808	6,042	4,099	7,172	3,658	8,501	6,406	5,670	9,648	5,317	3,827	6,172
LS	0	0	0	4,234	18,224	20,147	24,944	15,662	18,749	17,568	18,249	18,066	19,831	24,773	18,440	16,636
OT	146	262	567	1,449	2,086	4,560	2,236	2,306	2,257	2,618	5,467	5,912	8,620	11,868	12,228	13,024
Total	6,634	22,231	31,030	53,690	113,225	124,470	141,174	129,753	138,604	122,782	120,791	123,141	108,047	108,719	80,866	87,420

Longline (LL); Purse seine free-school (FS); Purse seine associated school (LS); Other gears nei (OT)

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

Since the late 1970's, bigeye tuna has been caught by purse seine vessels fishing on tunas aggregated on floating objects and, to a lesser extent, associated to free swimming schools (Fig. 2) of yellowfin tuna or skipjack tuna. The highest catch of bigeye tuna by purse seiners in the Indian Ocean was recorded in 1999 (≈40,000 t). Catches since 2000 have been between 20,000 and 30,000 t. Purse seiners under flags of EU countries and Seychelles take the majority of purse seine caught bigeye tuna in the Indian Ocean (Fig. 3). Purse seiners mainly take small juvenile bigeye (averaging around 5 kg) whereas longliners catch much larger and heavier fish; and while purse seiners take lower tonnages of bigeye tuna compared to longliners, they take larger numbers of individual fish. Even though the activities of purse seiners have been affected by piracy in the Indian Ocean, the impacts have not been as marked as for longline fleets. The main reason for this is the presence of security personnel onboard purse seine vessels of the EU and Seychelles, which has made it possible for purse seiners under these flags to continue operating in the northwest Indian Ocean (Fig. 4).

By contrast with yellowfin tuna and skipjack tuna, for which the major catches are taken in the western Indian Ocean, bigeye tuna is also exploited in the eastern Indian Ocean (Fig. 3). The relative increase in catches in the eastern Indian Ocean in the late 1990's was mostly due to increased activity of small longliners fishing tuna to be marketed fresh.

This fleet started its operation in the mid 1970's (Fig. 3, Indonesia). However, the catches of bigeye tuna in the eastern Indian Ocean have shown a decreasing trend in recent years, as some of the vessels moved south to target albacore.

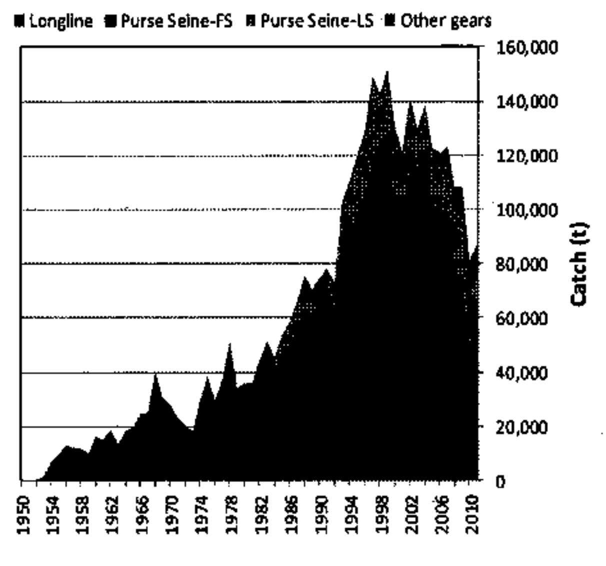


Fig. 2. Bigeye tuna: Annual catches of bigeye tuna by gear (1950–2011) (Data as of September 2012)

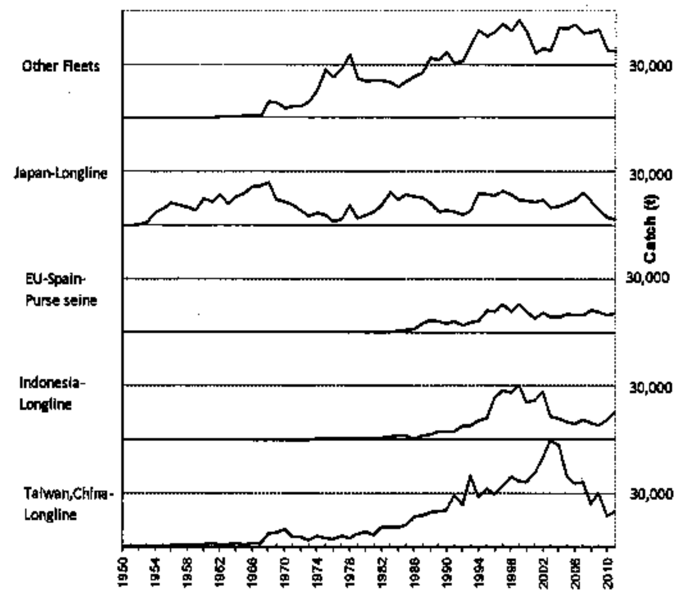


Fig. 3. Bigeye tuna: Annual catches of bigeye tuna by fleet (1950–2011) (Data as of September 2012)

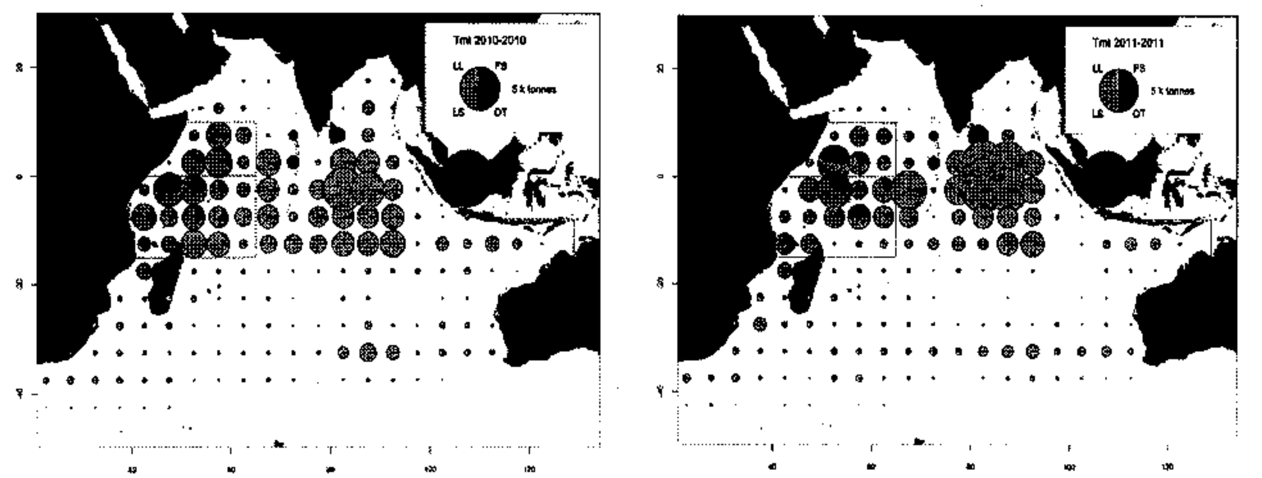


Fig. 4. Bigeye tuna: Time-area catches (total combined in tonnes) of bigeye tuna estimated for 2010 (left) and 2011 (right) by gear. Longline (LL), Purse seine free-schools (FS), Purse seine associated-schools (LS), and other fleets (OT), including pole-and-line, drifting gillnets, and various coastal fisheries (Data as of September 2012). The catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned, in particular driftnets from Iran, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Indonesia

Bigeye tuna – uncertainty of catches

Retained catches: Thought to be well known for the major fleets (Fig. 5) but are less certain for non-reporting industrial purse seiners and longliners (NEI) and for other industrial fisheries (longliners of India and Philippines). Catches are also uncertain for some artisanal fisheries including the pole-and-line fishery in the Maldives, the gillnet fisheries of Iran and Pakistan, the gillnet and longline combination fishery in Sri Lanka and the artisanal fisheries in Indonesia, Comoros and Madagascar.

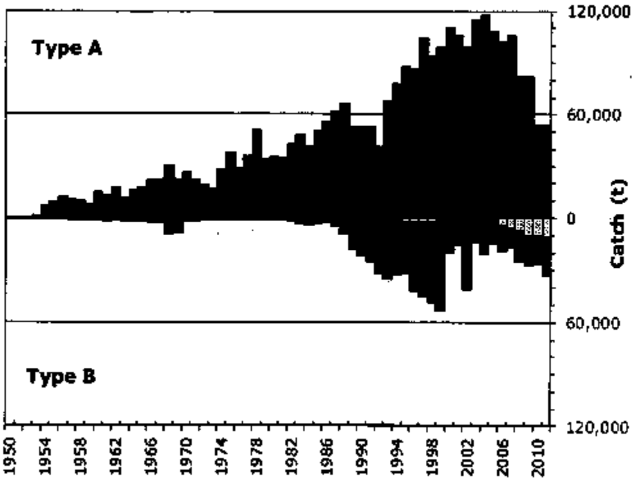


Fig. 5. Bigeye tuna: Uncertainty of annual catch estimates for bigeye tuna (Data as of September 2012). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (Type A) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

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

Changes to the catch series: There have not been significant changes to the catches of bigeye tuna since the WPTT in 2011.

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

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

Bigeye tuna – Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid in 2010 and 2011 are provided in Fig. 6, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2010 and 2011 are provided in Fig. 7. The total number of fishing trips by vessels flagged to the Maldives by 5 degree square grid, type of boat and gear, for the years 2009 and 2010 are provided in Fig. 8.

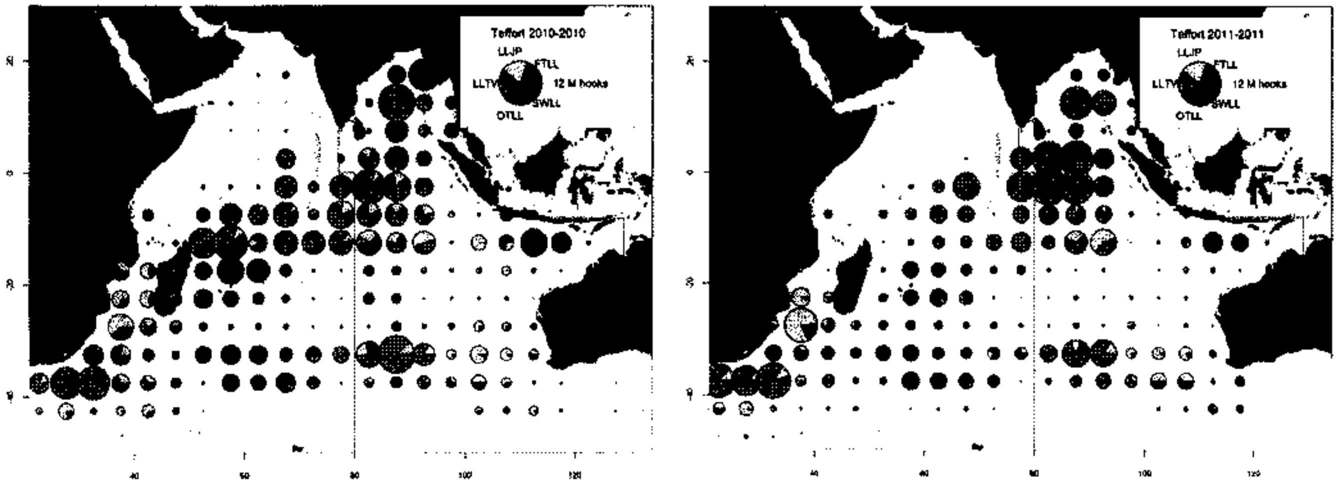


Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

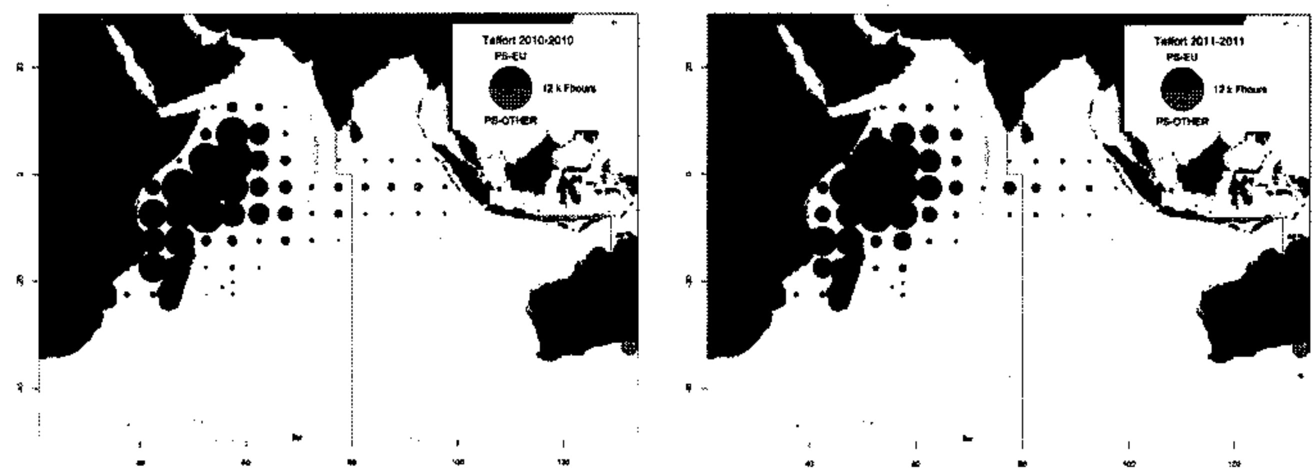


Fig. 7. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

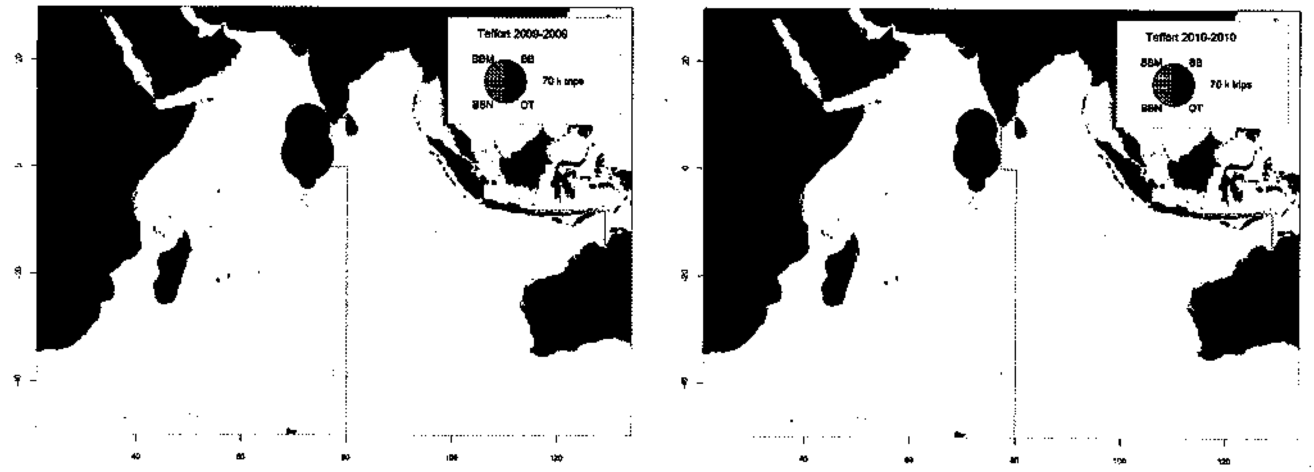


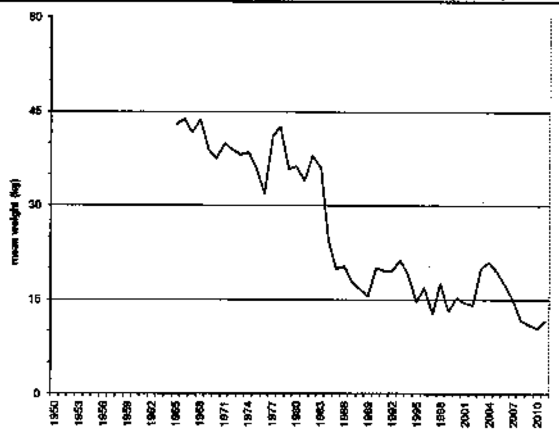
Fig. 8. Number of fishing trips by vessels flagged to the Maldives by 5 degree square grid, type of boat and gear, for the years 2009 (left) and 2010 (right) (Data as of September 2012)
BBN (blue): Baitboat non-mechanized; BBM (Green): Baitboat mechanized; BB (Red): Baitboat unspecified; UN (Purple): Unclassified gears
Note that the above maps were derived using the available catch-and-effort data in the IOTC database, which is limited to the number of baitboat calls (trips) by atoll by month for Maldivian baitboats for the period concerned. Note that some trips may be fully devoted to handlining, trolling, or other activities (data by gear type are not available since 2002). No data are available for the pole-and-line fisheries of India (Lakshadweep) and Indonesia.

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

Trends in average weight: Can be assessed for several industrial fisheries although they are incomplete or of poor quality for most fisheries before the mid-1980s and for some fleets in recent years (e.g. Japan longline) (Fig. 9).

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

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



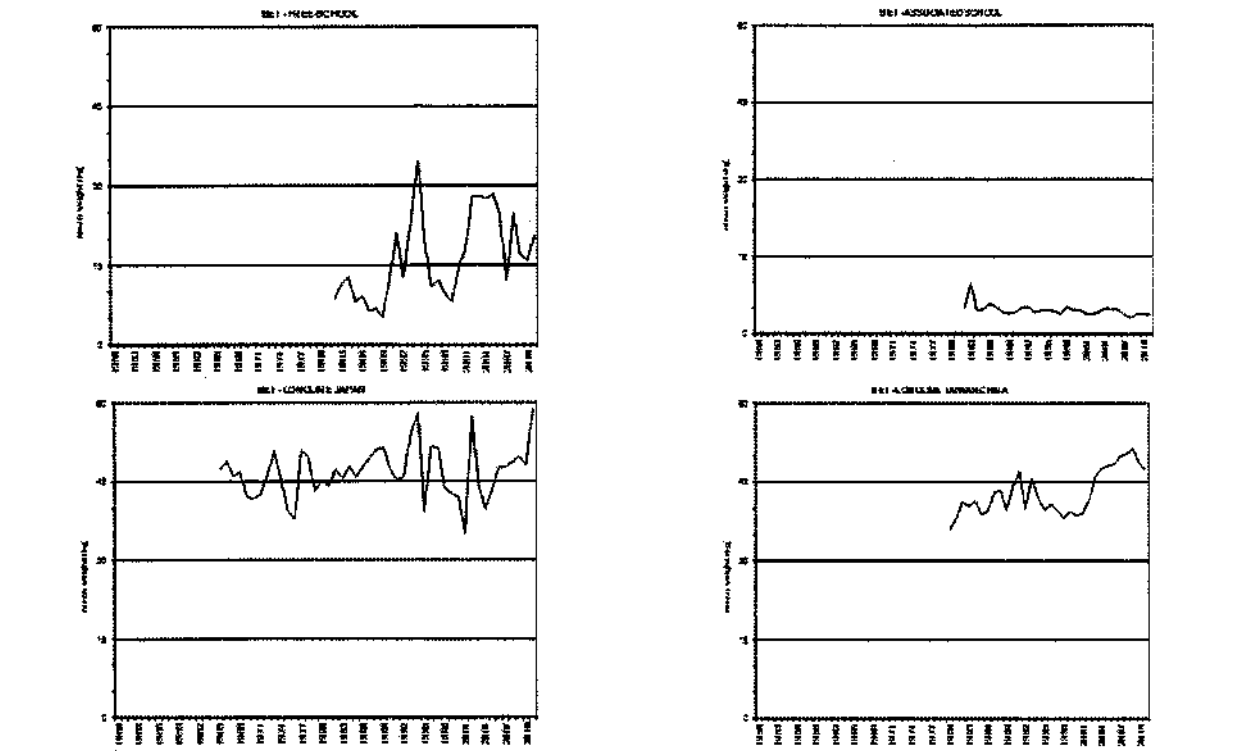


Fig. 9. Bigeye tuna: Changes in average weight (kg) of bigeye tuna from 1950 to 2010 – all fisheries combined (top) and by main fleet (Data as of September 2012)

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

The CPUE series presented at the WPTT14 meeting in 2012 are listed below and shown in Fig. 10, noting that the Japanese series from the tropical areas and the Indian Ocean as a whole, showed very similar trends and are therefore not shown separately:

- Japan data (1960–2011): Series 2 from document IOTC–2012–WPTT14–26. Whole Indian Ocean (Fig. 10).
- Taiwan,China data (1979–2011): Series from document IOTC–2012–WPTT14–27 (Fig. 10).
- Rep. of Korea data (1978–2011): Series from document IOTC–2012–WPTT14–25 (Fig. 10).
- Japan data (1960–2011): Series 1 from document IOTC–2012–WPTT14–26. Tropical area of Indian Ocean.

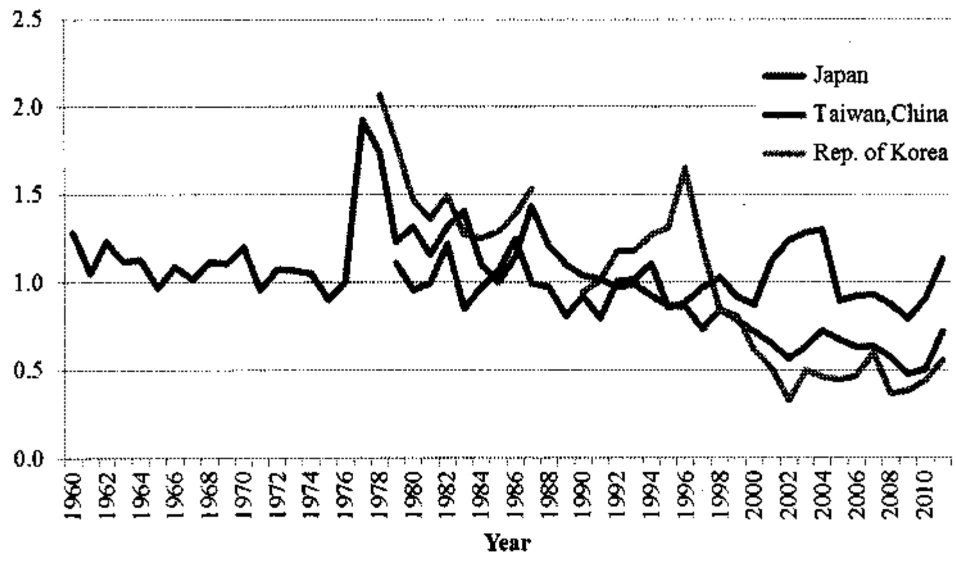


Fig. 10. Comparison of the three standardised CPUE series for Indian Ocean bigeye tuna. Series have been rescaled relative to their respective means from 1960–2011

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

Bigeye tuna – tagging data

A total of 35,997 bigeye tuna (17.9%) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them (96.0%) were tagged during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and released off the coast of Tanzania in the western Indian Ocean, between May 2005 and September 2007 (Fig. 11). The remaining were tagged during small-scale projects, and by other institutions with the support of the IOTC Secretariat, in the Maldives, Indian, and in the south west and the eastern Indian Ocean. To date, 5,740, (15.9%), have been recovered and reported to the IOTC Secretariat. These tags were mainly reported from the purse seine fleets operating in the Indian Ocean (91.5%), while 4.9% were recovered from longline vessels.

Although bigeye tuna was not subject to a stock assessment analysis by the WPTT in 2012, additional analysis of bigeye tuna was presented during the tagging symposium held immediately following the WPTT14. The new results are not yet included in this executive summary as they have yet to be considered by the WPTT. The SC noted that the new analysis and other information should be considered by the WPTT in 2013, including but not limited to the latitudinal movement of adult bigeye tuna, the possible verification of a two-stanza growth curve, the different maximum size of males and females (larger males) and the low natural mortality now estimated for bigeye tuna. The results arising from the tagging research will likely be of major importance in the future stock assessment analysis of the bigeye tuna stock. Any new information on bigeye tuna biology verified by the WPTT should be incorporated in the next executive summaries.

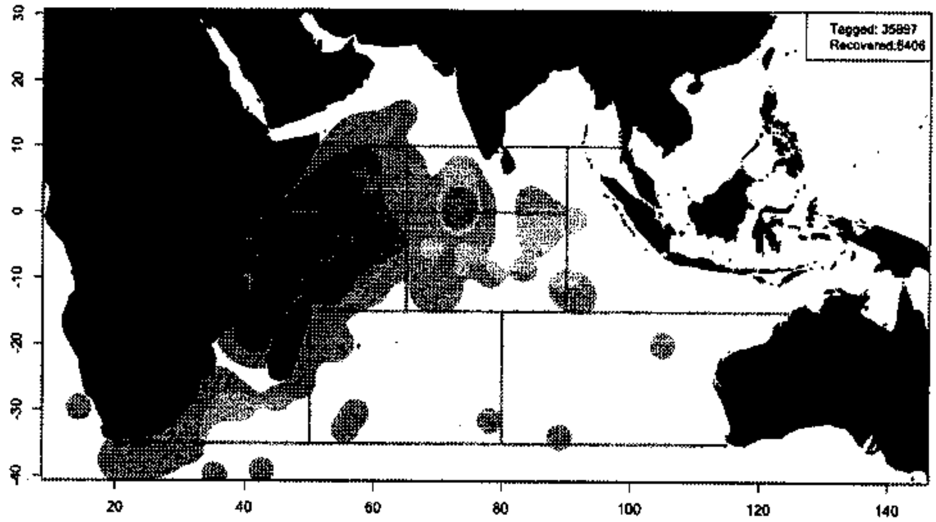


Fig. 11. Bigeye tuna: Densities of releases (in red) and recoveries (in blue). Data as of September 2012

STOCK ASSESSMENT

No stock assessment was carried out in 2012. The most up to date CPUE trends do not give a pessimistic view of the stock which would require a more thorough stock assessment in 2012. Management advice for bigeye tuna is based on the 2010 SS3 stock assessment and various steepness scenarios of the current 2011 ASPM stock assessment results. For last year's SS3 assessment, the data did not seem to be sufficiently informative to justify the selection of any individual model and the results were combined on the basis of a model weighting scheme that was proposed to, and agreed by, the WPTT in 2010.

A single quantitative modelling method (ASPM) was applied to the bigeye tuna assessment in 2011, using data from 1950–2010. The following is worth noting with respect to the modelling approach used:

- The steepness value (h=0.5) was selected on the basis of the likelihood and was near the lower boundary of what would be considered plausible for bigeye tuna. Selection of steepness on the basis of the likelihood was not considered reliable because i) steepness is difficult to estimate in general, and ii) substantial autocorrelation in the recruitment deviates was ignored in the likelihood term.

- Cohort-slicing to estimate ages from lengths introduces substantial errors, for long-living species such as bigeye tuna, except for the youngest ages.
- Uncertainty in natural mortality was not considered.

It is essential to include uncertainty in the steepness parameter as a minimum requirement for the provision of management advice. The general population trends and MSY parameters estimated by the ASPM model appeared to be plausibly consistent with the general perception of the fishery and the data. However, these results are considered to be uncertain because of i) uncertainty in the catch rate standardization, and ii) uncertainty in recent catches.

Management advice for bigeye tuna was based on the 2010 SS3 stock assessment and various steepness scenarios of the current 2011 ASPM stock assessment results (Tables 1, 5). For last year's SS3 assessment, the data did not seem to be sufficiently informative to justify the selection of any individual model and the results were combined on the basis of a model weighting scheme that was proposed to, and agreed by, the WPTT in 2010.

Key assessment results for the 2010 SS3 and 2011 ASPM stock assessments are shown in Tables 1, 2 and 5; Fig. 1.

Table 5. Bigeye tuna: Key management quantities from the 2010 SS3 and 2011 ASPM assessments for bigeye tuna in the Indian Ocean

Management Quantity	**2010 SS3**	**2011 ASPM**
2009 (SS3) and 2010 (ASPM) catch estimate	102,000 t	71,500 t
Mean catch from 2006–2010	104,700 t	104,700 t
MSY	114,000 t (95,000–183,000)	102,900 t (86,600–119,300) (2)
Data period used in assessment	1952–2009	1950–2010
F_{curr}/F_{MSY} (3)	0.79 (1) (0.50 – 1.22) (1)	0.67 (0.48–0.86) (2)
B_{curr}/B_{MSY} (3)	–	–
SB_{curr}/SB_{MSY} (3)	1.20 (1) (0.88 – 1.68)	1.00 (0.77–1.24) (2)
B_{curr}/B_0 (3)	–	0.43 (n.a.)
SB_{curr}/SB_0 (3)	0.34(1) (0.26 – 0.40)	0.39(2)
$B_{curr}/B_{0,F=0}$ (3)	–	–
$SB_{curr}/SB_{0,F=0}$ (3)	–	–

[1] Central point estimate is adopted from the 2010 SS3 model, percentiles are drawn from a cumulative frequency distribution of MPD values with models weighted as in Table 12 of 2010 WPTT report (IOTC–2010–WPTT12–R); the range represents the 5th and 95th percentiles.
[2] Median point estimate is adopted from the 2011 ASPM model using steepness value of 0.5 (values of 0.6, 0.7 and 0.8 are considered to be as pausible as these values but are not presented for simplification); the range represents the 90 percentile Confidence Interval.
[3] Current period ($_{curr}$) = 2009 for SS3 and 2010 for ASPM.

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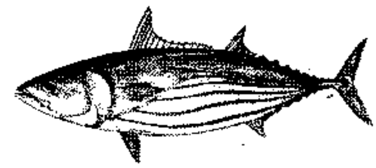
Nootmorn, P (2004) Reproductive biology of bigeye tuna in the eastern Indian Ocean. IOTC–2004–WPTT04–05

APPENDIX XI
EXECUTIVE SUMMARY: SKIPJACK TUNA

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



Status of the Indian Ocean skipjack tuna (SKJ: *Katsuwonus pelamis*) resource

TABLE 1. Status of skipjack tuna (*Katsuwonus pelamis*) in the Indian Ocean

Area[1]	Indicators		2012 stock status determination
Indian Ocean	Catch 2011:	398,240 t	
	Average catch 2007–2011:	435,527 t	
	MSY (1000 t):	478 t (359–598 t)	
	F_{2011}/F_{MSY}:	0.80 (0.68–0.92)	
	SB_{2011}/SB_{MSY}:	1.20 (1.01–1.40)	
	SB_{2011}/SB_0:	0.45 (0.25–0.65)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(C_{year}/MSY> 1)		
Stock not subject to overfishing (C_{year}/MSY≤ 1)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. The results suggest that the stock is not overfished ($B>B_{MSY}$) and that overfishing is not occurring ($C<MSY$ and $F<F_{MSY}$) (Table 1 and Fig. 1). Spawning stock biomass was estimated to have declined by approximately 45 % in 2011 from unfished levels (Table 1).

Outlook. The recent declines in catches are thought to be caused by a recent decrease in purse seine effort as well as due to a decline in CPUE of large skipjack tuna in the surface fisheries. There remains considerable uncertainty in the assessment, and the range of runs analysed illustrate a range of stock status to be between 0.73–4.31 of SB_{2011}/SB_{MSY} based on all runs examined. The WPTT does not fully understand the recent declines of pole-and-line catch and CPUE, which may be due to the combined effects of the fishery and environmental factors affecting recruitment or catchability. Catches in 2010 (428,000 t) and 2011 (398,240 t) as well as the average level of catches of 2007–2011 (435;527 t) are below MSY targets though may have exceeded them in 2005 and 2006.

The Kobe strategy matrix illustrates the levels of risk associated with varying catch levels over time and could be used to inform management actions. Based on the SS3 assessment conducted in 2011, there is a low risk of exceeding MSY-based reference points by 2020 if catches are maintained at the current levels (< 20 % risk that $B_{2019} < B_{MSY}$ and 30 % risk that C_{2019}>MSY as proxy of $F > F_{MSY}$) and even if catches are maintained below the 2005–2010 average (500,000 t) based on the analysis done in 2011 (the 2012 reference point indicates that 500,000 t levels maybe too high for the Indian Ocean skipjack tuna stock). The following key points should be noted:

- The mean estimates of the Maximum Sustainable Yield for the skipjack tuna Indian Ocean stock is 478,190 t (Table 1) and considering the average catch level from 2007–2011 was 435,527 t, the stock appears to be in no immediate threat of breaching target and limit reference points.
- If the recent declines in effort continue, and catch remains substantially below the estimated MSY, then urgent management measures are not required. However, recent trends in some fisheries, such as Maldivian pole-and-line, suggest that the situation of the stock should be closely monitored.
- The Kobe strategy matrix (Table 2: from the 2011 assessment) illustrates the levels of risk associated with varying catch levels over time and could be used to inform management actions.
- provisional reference points: Noting that the Commission in 2012 agreed to Recommendation 12/14 *on interim target and limit reference points*, the following should be noted:
  - **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, and therefore below the provisional limit reference point of $1.5*F_{MSY}$

(Fig. 1). Based on the current assessment there is a very low probability that the limit reference points of $1.5*F_{MSY}$ at the current catch levels will be exceeded in 3 or 10 years.

- **Biomass**: Current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (Fig. 1). Based on the current assessment, there is a low probability that the spawing stock biomass, at the current catch levels, will be below the limit reference point of $0.4*SB_{MSY}$ in 3 or 10 years.

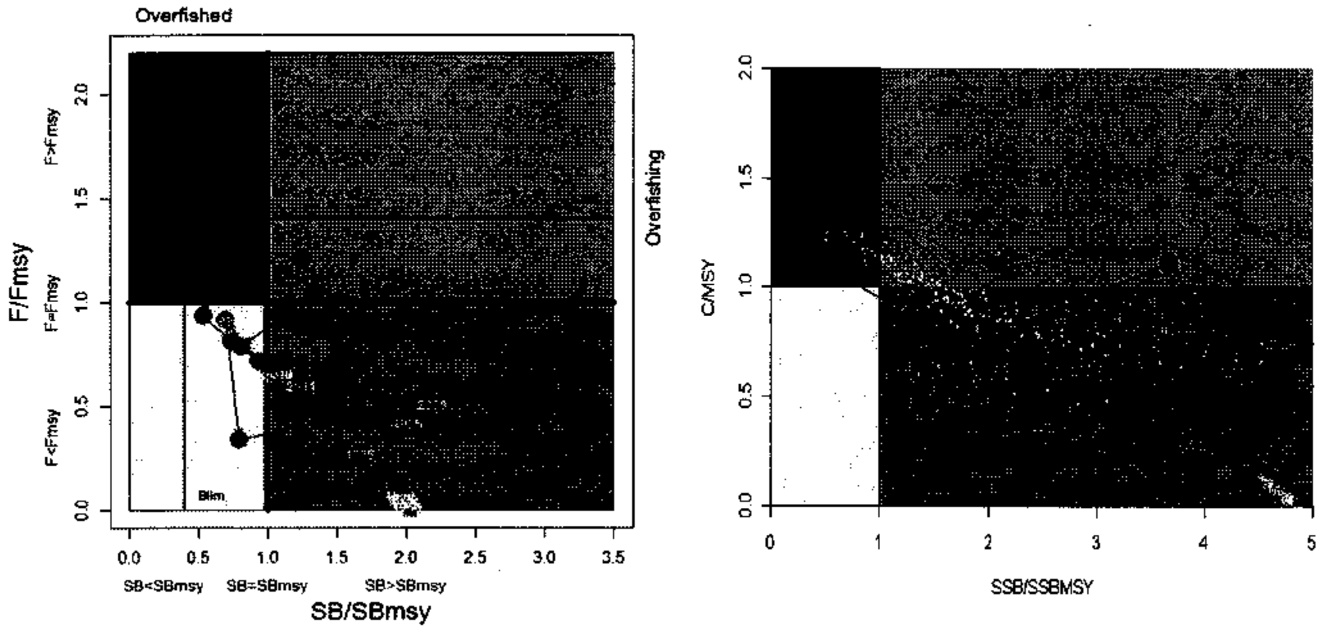


Fig. 1. Skipjack tuna: 2012 SS3 Indian Ocean assessment Kobe plot (left; mean values of the weighted models used in the analysis in 2012). Circles indicate the trajectory of the point estimates for the SB ratio and F/FMSY ratio for each year 1950–2011. 2011 SS3 Aggregated Indian Ocean assessment Kobe plot (right). Black circles indicate the trajectory of the weighted median of point estimates for the SB ratio and C/MSY ratio for each year 1950–2009. Probability distribution contours are provided only as a rough visual guide of the uncertainty (e.g. the multiple modes are an artifact of the coarse grid of assumption options). Due to numerical problems in the F_{MSY} calculations for this population, the proxy reference point C/MSY is reported instead of F/F_{MSY}, which should be interpreted with caution for the reasons given under Table 1 above

TABLE 2. Skipjack tuna: 2011 SS3 Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Weighted probability (percentage) of violating the MSY-based reference points for five constant catch projections (2009 catch level, ± 20% and ± 40%) projected for 3 and 10 years. Note: from the 2011 stock assessment using catch estimates at that time

Reference point and projection timeframe	Alternative catch projections (relative to 2009) and weighted probability (%) scenarios that violate reference point				
	60% (274,000 t)	80% (365,000 t)	100% (456,000 t)	120% (547,000 t)	140% (638,000 t)
$SB_{2013} < SB_{MSY}$	<1	5	5	10	18
$C_{2013} > MSY$ (proxy for F_{2009}/F_{MSY})	<1	<1	31	45	72
$SB_{2020} < SB_{MSY}$	<1	5	19	31	56
$C_{2020} > MSY$ (proxy for F_{2009}/F_{MSY})	<1	<1	31	45	72

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Skipjack tuna (*Katsuwonus pelamis*) in the Indian Ocean is currently subject to a number of Conservation and Management Measures adopted by the Commission:

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

FISHERIES INDICATORS

Skipjack tuna – General

Skipjack tuna (*Katsuwonus pelamis*) life history characteristics, including a low size and age at maturity, short life and high productivity/fecundity, make it resilient and not easily prone to overfishing. Table 3 outlines some of the key life history traits of skipjack tuna.

TABLE 3. Skipjack tuna: Biology of Indian Ocean skipjack tuna (*Katsuwonus pelamis*)

Parameter	Description
Range and stock structure	Cosmopolitan species found in the tropical and subtropical waters of the Indian, Pacific and Atlantic Oceans. It generally forms large schools, often in association with other tunas of similar size such as juveniles of yellowfin tuna and bigeye tuna. The tag recoveries from the RTTP-IO provide evidence of rapid, large scale movements of skipjack tuna in the Indian Ocean, thus supporting the current assumption of a single stock for the Indian Ocean. Skipjack recoveries indicate that the species is highly mobile, and covers large distances. The average distance between skipjack tagging and recovery positions is estimated at 640 nautical miles. Skipjack tuna in the Indian Ocean are considered a single stock for assessment purposes.
Longevity	7 years
Maturity (50%)	Age: females and males <2 years. Size: females and males 41–43 cm. Unlike in *Thunnus* species, sex ratio does not appear to vary with size. Most of skipjack tuna taken by fisheries in the Indian Ocean have already reproduced.
Spawning season	High fecundity. Spawns opportunistically throughout the year in the whole inter-equatorial Indian Ocean (north of 20°S, with surface temperature greater than 24°C) when conditions are favourable.
Size (length and weight)	Maximum length: 110 cm FL; Maximum weight: 35.5 kg. The average weight of skipjack tuna caught in the Indian Ocean is around 3.0 kg for purse seine, 2.8 kg for the Maldivian baitboats and 4–5 kg for the gillnet. For all fisheries combined, it fluctuates between 3.0–3.5 kg; this is larger than in the Atlantic, but smaller than in the Pacific. It was noted that the mean weight for purse seine catch exhibited a strong decrease since 2006 (3.1 kg) until 2009 (2.4 kg), for both free (3.8 kg to 2.4 kg) and log schools (3.0 kg to 2.4 kg).

Sources: Collette & Nauen 1983, Froese & Pauly 2009, Grande et al. 2010, Dortel et al. 2012, Eveson et al. 2012
NOAA http://www.nmfs.noaa.gov/fishwatch/species/atl_skipjack.htm 14/12/2011

Skipjack tuna: Fisheries and catch trends

Catches of skipjack increased slowly from the 1950s, reaching around 50,000 t during the mid-1970s, mainly due to the activities of fleets using pole-and-lines and gillnets (Table 4; Fig. 2). The catches increased rapidly with the arrival of the purse seiners in the early 1980s, and skipjack became one of the most important commercial tuna species in the Indian Ocean. Annual catches peaked at over 600,000 t in 2006 (Fig. 2). Though preliminary, the catch levels estimated for 2011, at around 400,000 t, represent the lowest catches recorded since 1998.

The increase in skipjack tuna catches by purse seiners (Table 4; Fig. 3) is due to the development of a fishery in association with Fish Aggregating Devices (FADs). In recent years, 85% of the skipjack tuna caught by purse seine vessels is taken from around FADs (Table 4; Fig. 2). Catches by purse seiners increased steadily since 1984 with the highest catches recorded in 2002 and 2006 (>240,000 t). The catches dropped in the years 2003 and 2004, probably as a consequence of high purse seine catch rates on free schools of yellowfin tuna during those years. In 2007 purse seine catches declined by around 100,000 t, from those taken in 2006. The constant increase in catches and catch rates of purse seiners until 2006 are believed to be associated with increases in fishing power and in the number of FADs (and the technology associated with them) used in the fishery. The sharp decline in purse seine catches since 2007coincided with a similar decline in the catches by Maldivian baitboats.

Table 4. Skipjack tuna: Best scientific estimates of the catches of skipjack tuna (*Katsuwonus pelamis*) by gear and main fleets [or type of fishery] by decade (1950–2009) and year (2002–2011), in tonnes (Data as of September 2012). Catches by decade represent the average annual catch, noting that some gears were not used for all years (refer to Fig. 2)

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BB	9,497	13,368	22,797	40,538	77,729	111,118	124,300	116,672	114,567	140,346	147,391	106,509	98,819	77,555	69,032	69,032
FS				1,626	1,602	897	22,801	30,992	18,565	43,123	34,954	24,198	16,277	10,458	8,853	8,906
LS				3,776	8,147	13,385	215,781	180,556	137,882	168,012	211,940	120,925	128,596	148,717	144,139	123,012
OT	6,596	16,809	30,752	52,490	101,765	185,519	137,693	172,988	204,444	195,670	223,817	211,689	205,587	208,144	199,899	197,291
Total	**16,093**	**30,177**	**53,549**	**98,430**	**189,244**	**310,918**	**500,575**	**501,209**	**475,457**	**547,151**	**618,102**	**463,321**	**449,278**	**444,874**	**421,923**	**398,240**

Pole-and-Line (BB); Purse seine free-school (FS); Purse seine associated school (LS); Other gears nei (OT)

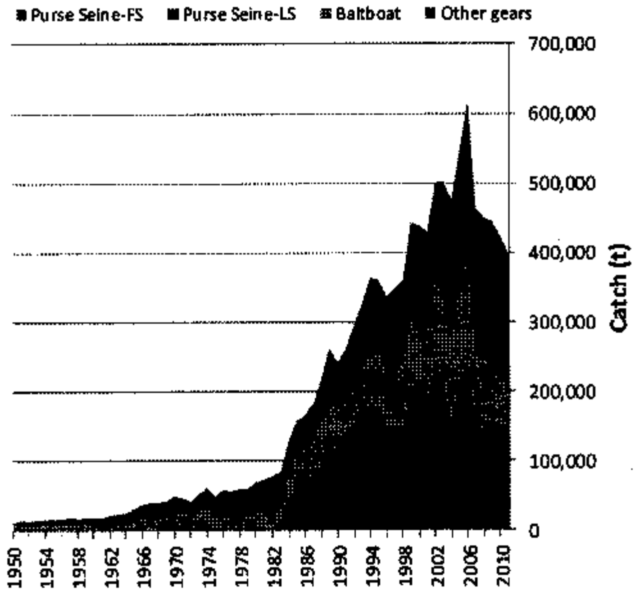


Fig. 2. Skipjack tuna: Annual catches of skipjack tuna by gear (1950–2011) (Data as of September 2012)

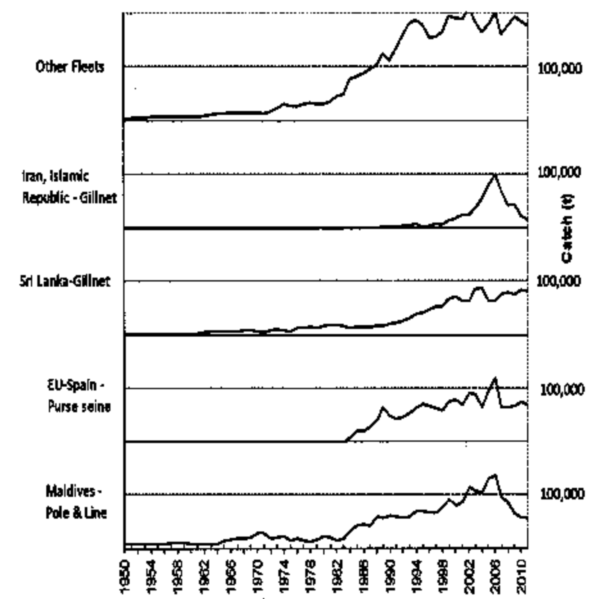


Fig. 3. Skipjack tuna: Catches of skipjack tuna by fleet by year (1950–2011) (Data as of September 2012)

The Maldivian fishery (Fig. 3) has effectively increased its fishing effort with the mechanisation of its pole-and-line fleet since 1974, including an increase in boat size and power and the use of anchored FADs since 1981. Skipjack tuna represents some 75% of its total catch, and catch rates regularly increased between 1980 and 2006, the year in which the maximum catch was recorded for this fishery (≈135,000 t). The catches of skipjack tuna have declined since, with catches in recent years estimated to be at around 55,000 t, representing less than half the catches taken in 2006.

Several fisheries using gillnets have reported large catches of skipjack tuna in the Indian Ocean (Fig. 2), including the gillnet/longline fishery of Sri Lanka, driftnet fisheries of Iran and Pakistan, and gillnet fisheries of India and Indonesia. In recent years gillnet catches have represented as much as 20 to 30 % of the total catches of skipjack tuna in the Indian Ocean. Although it is known that vessels from Iran and Sri Lanka (Fig. 3) have been using gillnets on the high seas in recent years, reaching as far as the Mozambique Channel, the activities of these fleets are poorly understood, as no time-area catch-and-effort series have been made available for those fleets to date.

The majority of the catches of skipjack tuna originate from the western Indian Ocean (Fig. 4). Since 2007 the catches of skipjack tuna in the western Indian Ocean have dropped considerably, especially in areas off Somalia, Kenya, Tanzania and around the Maldives. The drop in catches are considered by the SC to be partially explained by the drop in catch rates and fishing effort by some fisheries due to the effects of piracy in the western Indian Ocean region, including all industrial purse seiners and fleets using driftnets from Iran (Fig. 3) and Pakistan; and the drop in the catches of skipjack tuna by Maldives baitboats (Fig. 3) following the introduction of handlines to target large specimens of yellowfin tuna.

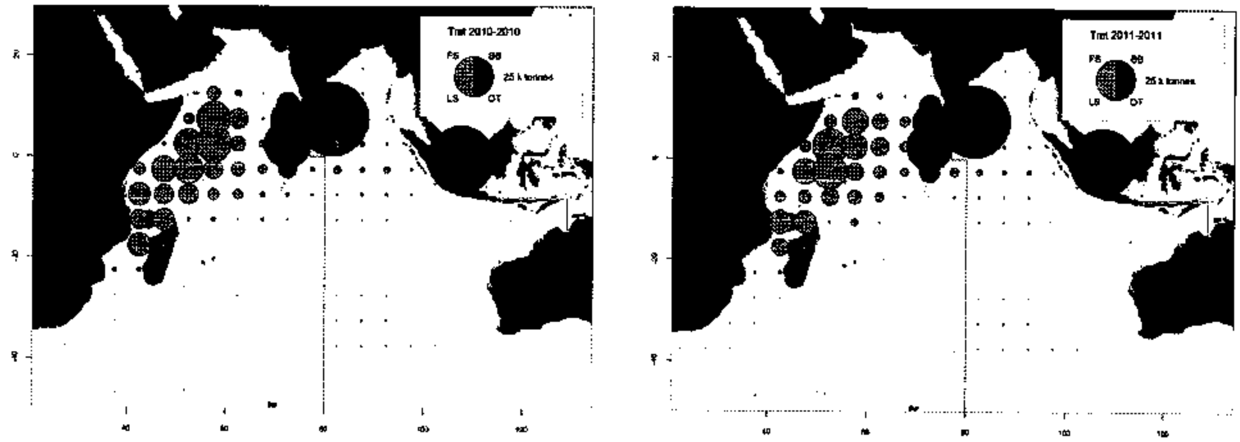


Fig. 4. Skipjack tuna: Time-area catches (total combined in tonnes) of skipjack tuna estimated for 2010 (left) ad 2011 (right) by gear. Purse seine free-schools (FS), Purse seine associated-schools (LS), pole-and-line (BB), and other fleets (OT), including longline, drifting gillnets, and various coastal fisheries. Data as of September 2012. The catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned, in particular driftnets from Iran and Pakistan, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Comoros, Indonesia and India.

Skipjack tuna – uncertainty of catches

Retained catches: Generally well known for the industrial fisheries but are less certain for many artisanal fisheries (Fig. 5), notably because:

- catches are not being reported by species
- there is uncertainty about the catches from some significant fleets including the coastal fisheries of Sri Lanka, Comoros and Madagascar.
- There has been a decline in the quality of skipjack tuna data in recent years (2010 and 2011) and that this decline is likely to have a detrimental impact on any stock assessment.

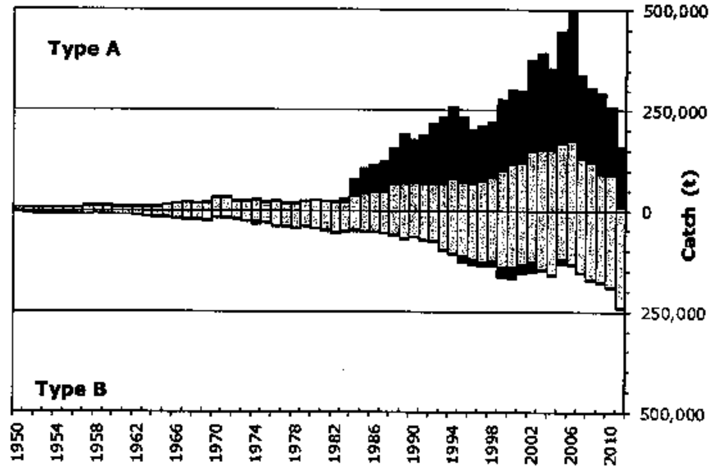


Fig. 5. Skipjack tuna: Uncertainty of annual catch estimates for skipjack tuna (Data as of September 2012). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC

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

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

Changes to the catch series: There have been no major changes to the catches of skipjack tuna, as a whole, since the WPTT in 2011. However, the IOTC Secretariat used new information compiled during 2011-12 to rebuild the catch series for the coastal fisheries operated in some countries, in particular Madagascar, Sri Lanka, and India. In general, the new catches of skipjack tuna estimated by the IOTC Secretariat are lower than those used in the past by the WPTT.

CPUE Series: Catch and effort data are available from various industrial and artisanal fisheries. However, these data are not available from some important fisheries or they are considered to be of poor quality for the following reasons:

- no data are available for the gillnet fisheries of Iran and Pakistan
- the poor quality effort data for the gillnet/longline fishery of Sri Lanka
- no data are available from important coastal fisheries using hand and/or troll lines, in particular Indonesia, India, Madagascar and Comoros.

Skipjack tuna – Effort trends

Total effort from purse seine vessles flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2010 and 2011 are provided in Fig. 6. The total number of fishing trips by vessels flagged to the Maldives by 5 degree square grid, type of boat and gear, for the years 2010 and 2011 are provided in Fig. 7.

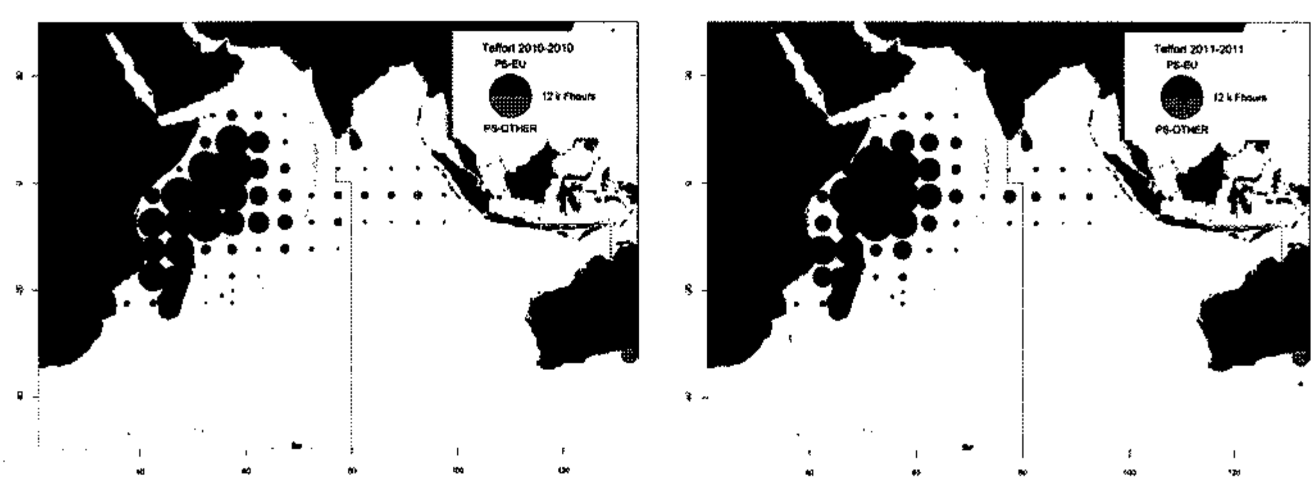


Fig. 6. Number of hours of fishing(Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

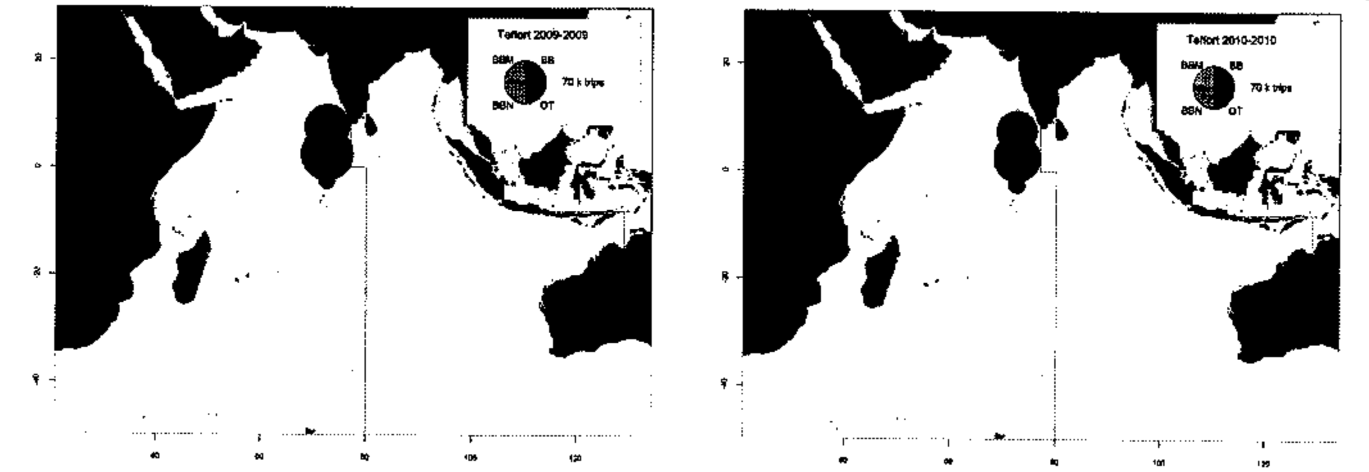


Fig. 7. Number of fishing trips by vessels flagged to the Maldives by 5 degree square grid, type of boat and gear, for the years 2009 (left) and 2010 (right) (Data as of September 2012)
BBN (blue): Baitboat non-mechanized; BBM (Green): Baitboat mechanized; BB (Red): Baitboat unspecified; UN (Purple): Unclassified gears
Note that the above maps were derived using the available catch-and-effort data in the IOTC database, which is limited to the number of baitboat calls (trips) by atoll by month for Maldivian baitboats for the period concerned. Note that some trips may be fully devoted to handlining, trolling, or other activities (data by gear type are not available since 2002). No data are available for the pole-and-line fisheries of India (Lakshadweep) and Indonesia.

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

The CPUE series available for assessment purposes are listed below, although only the standardised pole-and-line series from 2004 to 2009 was used in the stock assessment model for 2012. The other two series were explored (shown in Fig. 8).

- Maldives nominal pole and line: 1970–2003 from document IOTC–2012–WPTT14–29 Rev_1.
- Maldives standardised pole-and-line: (2004–2009): Series1 (PL – preferred) from document IOTC–2011–WPTT13–29 and 31 and IOTC–2012–WPTT14–29 Rev_1.
- EU,France purse seine free school data (1991–2010): Series from document IOTC–2011–WPTT13–20 and IOTC–2012–WPTT14–29 Rev_1. This series was not used in the assessment because it was not standardised and likely subject to problems as noted in the sections above.

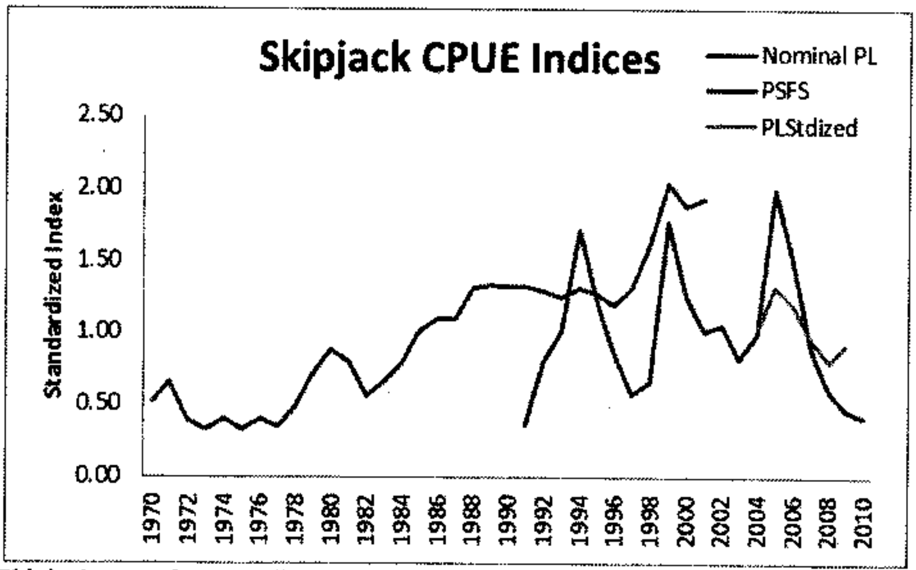


Fig. 8. Skipjack tuna: CPUE Indices based on different fisheries, and methods examined

The EU purse seine free-school CPUE is not a good indicator of the skipjack tuna population abundance as this fishery is seasonal and mainly located in the Mozambique Channel. As such, it would not be as representative as the

Maldivian pole-and-line CPUE series of the overall population abundance. The FAD-associated school purse seine fishery should be used in future assessments which may better represent the abundance index trends of the population.

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

Trends in average weight cannot be assessed before the mid-1980s and are incomplete for most artisanal fisheries thereinafter, namely hand lines, troll lines and many gillnet fisheries (Indonesia) (Fig. 9).

Catch-at-Size table: CAS are available but the estimates are uncertain for some years and fisheries due to:

- the lack of size data before the mid-1980s
- the paucity of size data available for some artisanal fisheries, notably most hand lines and troll lines (Madagascar, Comoros) and many gillnet fisheries (Indonesia, Sri Lanka).

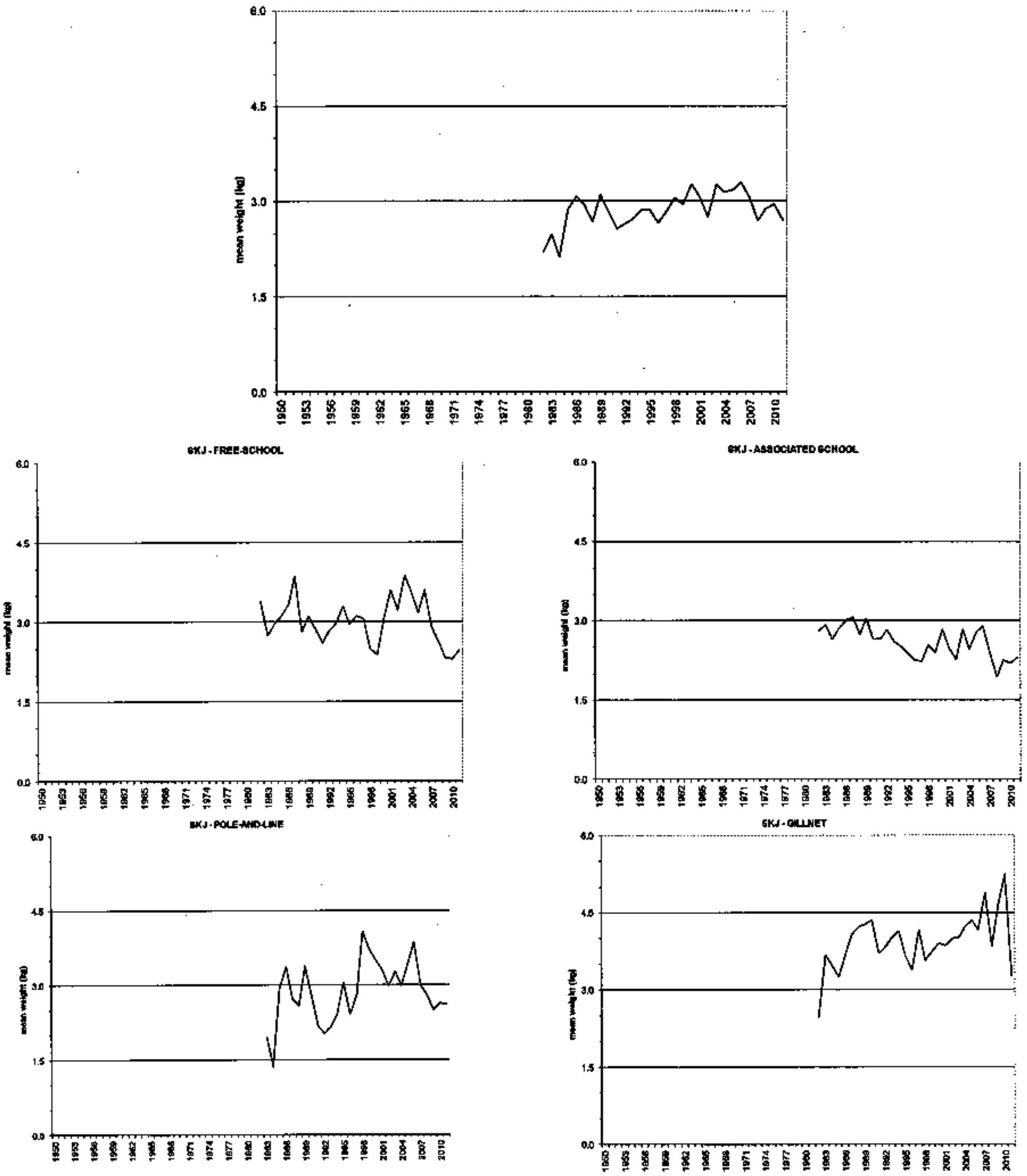


Fig. 9. Skipjack tuna: Changes in average weight (kg) of skipjack tuna from 1950 to 2011 – all fisheries combined (top) and by main fleet (Data as of September 2012)

Skipjack tuna – Tagging data

A total of 101,212 skipjack (representing 50.2% of the total number of fish tagged) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them, 77.4%, were released during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and were released around Seychelles, in the Mozambique Channel and off the coast of Tanzania, between May 2005 and September 2007 (Fig. 10). The remaining were tagged during small-scale tagging projects, and by other institutions with the support of IOTC, around the Maldives, India, and in the south west and the eastern Indian Ocean. To date, 15,729 (15.5%), have been recovered and reported to the IOTC Secretariat. Around 78% of the recoveries were from the purse seine fleets operating from the Seychelles, and around 20% by the pole-and-line vessels mainly operating from the Maldives. The addition of the data from the past projects in the Maldives (in 1990s) added 14,506 tagged skipjack tuna to the databases, or which 1,960 were recovered mainly in the Maldives.

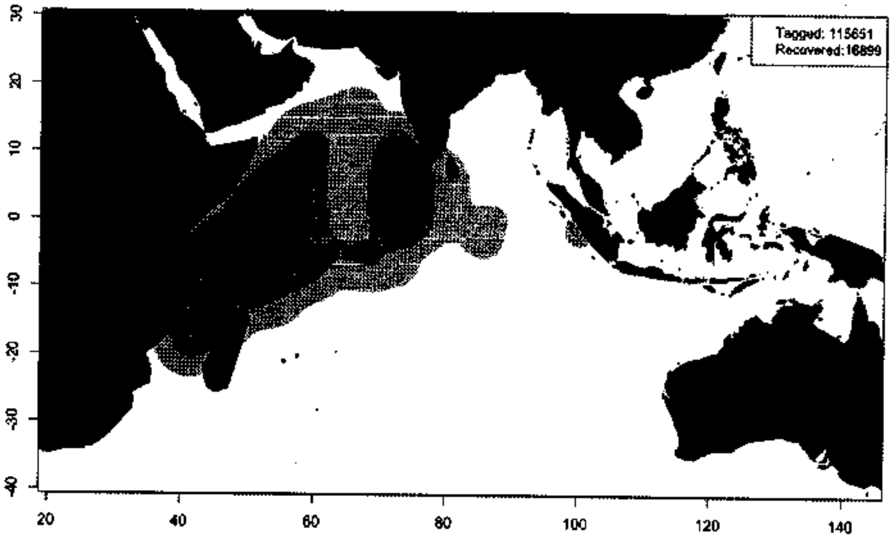


Fig. 10. Skipjack tuna: Densities of releases (in red) and recoveries (in blue) (Data as of September 2012)

STOCK ASSESSMENT

Despite the difficulties facing the assessment of skipjack tuna in the Indian Ocean, the comparison of various fishery indicators with their historical levels may provide a basis to infer the status of the stock in the absence of traditional reference points. However, the interpretation of the fishery indicator trends should take into account several caveats and incorporate expert knowledge.

In general the indicators obtained for skipjack tuna in this study are partially conflicting and highly variable. The average size indicators from the purse seine fleets have dropped for both free and associated schools in recent years. In the long term, however, there does not appear to be an overall major change in mean weight. For the pole-and-line fishery, the average weight indices have also been decreasing over the last three years. However, the gillnet fishery showed an increasing trend during recent years.

The catch rates on associated schools are increasing for both the EU,Spain and EU,France fleets. It is difficult to interpret these results, however, it seems that the increase in catch rate is associated with a decrease in effort which could be interpreted as a positive signal. It is possible that the high catch rates for associated schools may be caused by hyperstability (i.e. the aggregating effect of the FADs is masking decreasing population numbers), which is not relevant for free schools of tuna.

The advice on the status of skipjack tuna in 2012 was derived from models using an integrated statistical assessment method from 2011 and 2012. Model formulations were explored to ensure that various plausible sources of uncertainty were explored and represented in the final result. In general, the data did not seem to be sufficiently informative to justify the selection of any individual model, and the results of different model runs were presented.

Table 5. Skipjack tuna: Key management quantities from the 2012 SS3 assessment, for the aggregate Indian Ocean

Management Quantity	Aggregate Indian Ocean
2011 catch estimate	398,240 t
Mean catch from 2007–2011	435,527 t
MSY (95% CI)	478,190 t (358,900–597,500 t)
Data period used in assessment	1950–2011
F_{2011}/F_{MSY} (95% CI)	0.80 (0.68–0.92)
B_{2011}/B_{MSY}	–
SB_{2011}/SB_{MSY} (95% CI)	1.2 (1.01–1.43)
B_{2011}/B_0	–
SB_{2011}/SB_0 (95% CI)	0.45 (0.25–0.65)
$B_{2011}/B_{1950,\ F=0}$	–
$SB_{2011}/SB_{1950,\ F=0}$	0.45 (0.25–0.65)

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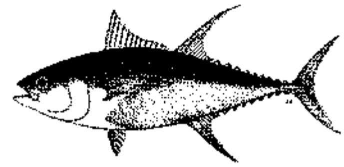
APPENDIX XII
EXECUTIVE SUMMARY: YELLOWFIN TUNA

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



Status of the Indian Ocean yellowfin tuna (YFT: *Thunnus albacares*) resource

TABLE 1. Yellowfin tuna: Status of yellowfin tuna (*Thunnus albacares*) in the Indian Ocean

Area[1]	Indicators			2012 stock status determination
Indian Ocean	Catch 2011:	302,939 t		
	Average catch 2007–2011:	302,064 t		
		Multifan	ASPM	
	MSY (1000 t):	344 t (290–453 t)	320 (283–358 t)	
	$F_{current}/F_{MSY}$:	0.69 (0.59–0.90)	0.61 (0.31–0.91)	
	$SB_{current}/SB_{MSY}$:	1.24 (0.91–1.40)	1.35 (0.96–1.74)	
	$SB_{current}/SB_0$:	0.38 (0.28–0.38)	-	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
* These values are obtained from the MFCL base case assessment.

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. The stock assessment model results for 2012 do not differ substantively from the previous (2011) assessment; however, the final overall estimates of stock status differ somewhat due to the refinement in the selection of the range of model options due to increased understanding of key biological parameters (primarily natural mortality). The stock assessment model used in 2012 suggests that the stock is currently not overfished (SB_{2010}>SB_{MSY}) and overfishing is not occurring (F_{2010}<F_{MSY}) (Table 1 and Fig. 1). Two trajectories are presented that compare the Kobe plots obtained from the MFCL and ASPM assessments. While the MFCL assessment indicates that fishing mortality is below the limit and target reference points during the whole time series, the ASPM model run indicates that the target reference points may have been exceeded during the period of high catches in the mid 2000's (2003–2006). However, estimates of total and spawning stock biomass show a marked decrease from 2004 to 2009 in both cases, corresponding to the very high catches of 2003–2006. Recent reductions in effort and, hence, catches resulted in a slight improvement in stock status in 2010. Spawning stock biomass in 2010 was estimated to be 38% (31–38%) (from Table 1) of the unfished levels.

The following key points should be noted:

- The Maximum Sustainable Yield estimate for the whole Indian Ocean is 344,000 t with a range between 290,000–453,000 t for MFCL; 320,000 t with a range between 283,000 and 358,000 t for ASPM (Table 1), and annual catches of yellowfin tuna should not exceed the lower range of MSY (300,000 t) in order to ensure that stock biomass levels could sustain catches at the MSY level in the long term.
- Recent recruitment estimated by MFCL is estimated to be considerably lower than the whole time series average. If recruitment continues to be lower than average, catches below MSY would be needed to maintain stock levels. However, although recent recruitment estimated by ASPM are similar to MFCL estimates, the ASPM recruitment trend are estimated to be at a lower level without any declining trend.
- provisional reference points: Noting that the Commission in 2012 agreed to Recommendation 12/14 *on interim target and limit reference points*, the following should be noted:

- **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, and therefore below the provisional limit reference point of $1.4*F_{MSY}$ (Fig. 1).
- **Biomass**: Current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (Fig. 1).

Outlook (Based on MultifanCL). Estimates of stock status using 2011 data are not considered reliable in Multifan. The potential yields from the fishery have also declined over the last five years as an increased proportion of the catch is comprised of smaller fish, primarily from the purse seine FAD fishery. The main mechanism that appears to be behind the very high catches in the 2003–2006 period is an increase in catchability by surface and longline fleets due to a high level of concentration across a reduced area and depth range. This was likely linked to the oceanographic conditions at the time generating high concentrations of suitable prey items that yellowfin tuna exploited. A possible increase in recruitment in previous years, and thus in abundance, cannot be completely ruled out, but no signal of it is apparent in either data or model results. This means that those catches probably resulted in considerable stock depletion.

In an attempt to provide management advice independent of the MSY construct, the recent levels of absolute fishing mortality estimated from region 2 were compared to the natural mortality level. It is considered that the tagging data provides a reasonable estimate to fishing mortality for the main tag recovery period (2007–09). The estimates of fishing mortality for the main age classes harvested by the purse-seine fishery are considerably lower than the corresponding levels of natural mortality and on that basis, recent fishing mortality levels are not considered to be excessive.

The decrease in longline and purse seiner effort in recent years has substantially lowered the pressure on the Indian Ocean stock as a whole, indicating that current fishing mortality has not exceeded the MSY-related levels in recent years. If the security situation in the western Indian Ocean were to improve, a rapid reversal in fleet activity in this region may lead to an increase in effort which the stock might not be able to sustain, as catches would then be likely to exceed MSY levels. Catches in 2010 (299,000 t) are within the lower range of MSY values The current assessment indicates that catches of about the 2010 level are sustainable, at least in the short term. However, the stock is unlikely to support substantively higher yields based on the estimated levels of recruitment from over the last 15 years.

In 2011, the WPTT undertook projections of yellowfin tuna stock status under a range of management scenarios for the first time, following the recommendation of both the Kobe process and the Commission, to harmonise technical advice to managers across RFMOs by producing Kobe II management strategy matrices. The purpose of the table is to quantify the future outcomes from a range of management options (Table 2). The table describes the presently estimated probability of the population being outside biological reference points at some point in the future, where "outside" was assigned the default definitions of $F>F_{MSY}$ or $SB<SB_{MSY}$. The timeframes represent 3 and 10 year projections (from the last data in the model), which corresponds to predictions for 2013 and 2020. The management options represent three different levels of constant catch projection: catches 20% less than 2010, equal to 2010 and 20% greater than 2010.

The projections were carried out using 12 different scenarios based on similar scenarios used in the assessment for the combination of those different MFCL runs: LL selectivity flat top vs. dome shape; steepness values of 0.7, 0.8 and 0.9; and computing the recruitment as an average of the whole time series vs. 15 recent years (12 scenarios). The probabilities in the matrices were computed as the percentage of the 12 scenarios being $SB>SB_{MSY}$ and $F<F_{MSY}$ in each year. In that sense, there are not producing the uncertainty related to any specific scenario but the uncertainty associated to different scenarios.

There was considerable discussion on the ability of the WPTT to carry out the projections with MFCL for yellowfin tuna. For example, it was not clear how the projection redistributed the recruitment among regions as recent distribution of recruitment differs from historic; which was assumed in the projections. The WPTT agreed that the true uncertainty is unknown and that the current characterization is not complete; however, the WPTT feels that the projections may provide a relative ranking of different scenarios outcomes. The WPTT recognised at this time that the matrices do not represent the full range of uncertainty from the assessments. Therefore, the inclusion of the K2SM at this time is primarily intended to familiarise the Commission with the format and method of presenting management advice.

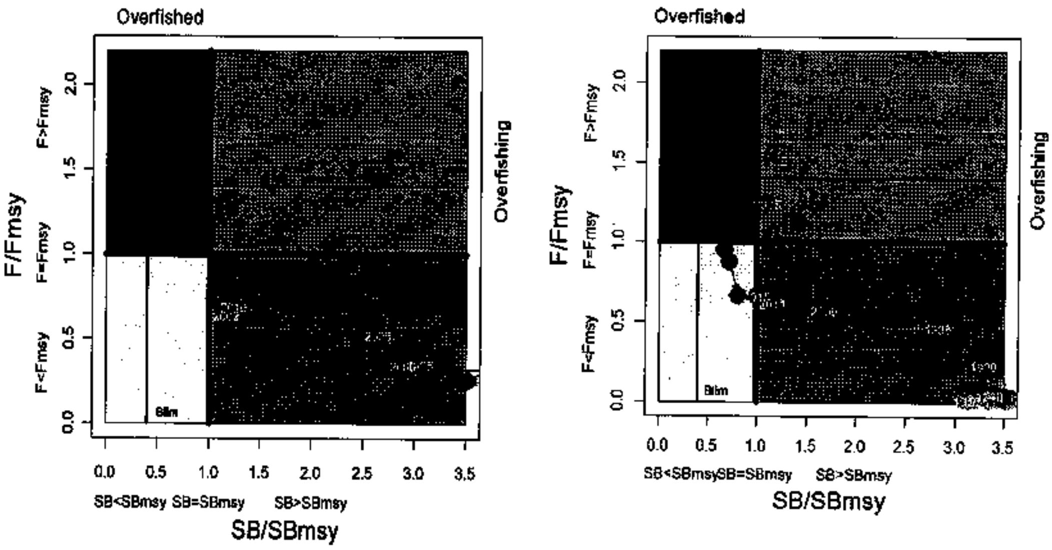


Fig. 1. Yellowfin tuna: MULTIFAN-CL Indian Ocean yellowfin tuna stock assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1972–2010 for a steepness value of 0.8. The left panel is output obtained from the base case run in MFCL. The right panel is obtained from the ASPM base case model run with steepness value of 0.9.

TABLE 2. Yellowfin tuna: 2011 MULTIFAN-CL Indian Ocean yellowfin tuna stock assessment Kobe II Strategy Matrix. Percentage probability of violating the MSY-based reference points for five constant catch projections (2010 catch level, ± 20% and ± 40%) projected for 3 and 10 years. In the projection, however, 12 scenarios were investigated: the six scenarios investigated above as well as the same scenarios but with a lower mean recruitment assumed for the projected period. Note: from the 2011 stock assessment using catch estimates at that time.

Reference point and projection timeframe	Alternative catch projections (relative to 2010) and probability (%) of violating reference point				
	60% (165,600 t)	80% (220,800 t)	100% (276,000 t)	120% (331,200 t)	140% (386,400 t)
$SB_{2013} < SB_{MSY}$	<1	<1	<1	<1	<1
$F_{2013} > F_{MSY}$	<1	<1	58.3	83.3	100
$SB_{2020} < SB_{MSY}$	<1	<1	8.3	41.7	91.7
$F_{2020} > F_{MSY}$	<1	41.7	83.3	100	100

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Yellowfin tuna (*Thunnus albacares*) in the Indian Ocean is currently subject to a number of conservation and management measures adopted by the Commission:

- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area*
- Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 12/07 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and*

Cooperating Non-Contracting Parties

- Recommendation 10/13 *On the implementation of a ban on discards of skipjack tuna, yellowfin tuna, bigeye tuna, and non targeted species caught by purse seiners*
- Resolution 12/13 *for the conservation and management of tropical tunas stocks in the IOTC area of competence.*

FISHERIES INDICATORS

General

Yellowfin tuna *(Thunnusalbacares)* is a cosmopolitan species distributed mainly in the tropical and subtropical oceanic waters of the three major oceans, where it forms large schools. Table 3 outlines some of the key life history traits of yellowfin tuna relevant for management.

TABLE 3. Yellowfin tuna: Biology of Indian Ocean yellowfin tuna (*Thunnus albacares*)

Parameter	Description
Range and stock structure	A cosmopolitan species distributed mainly in the tropical and subtropical oceanic waters of the three major oceans, where it forms large schools. Feeding behaviour has been extensively studied and it is largely opportunistic, with a variety of prey species being consumed, including large concentrations of crustaceans that have occurred recently in the tropical areas and small mesopelagic fishes which are abundant in the Arabian Sea. It has also been observed that large individuals can feed on very small prey, thus increasing the availability of food for this species. Archival tagging of yellowfin tuna has shown that this species can dive very deep (over 1000 m) probably to feed on meso-pelagic prey. Longline catch data indicates that yellowfin tuna are distributed throughout the entire tropical Indian Ocean. The tag recoveries of the RTTP-IO provide evidence of large movements of yellowfin tuna, thus supporting the assumption of a single stock for the Indian Ocean. The average distance travelled by yellowfin between being tagging and recovered is 710 nautical miles, and showing increasing distances as a function of time at sea.
Longevity	9 years
Maturity (50%)	Age: females and males 3–5 years. Size: females and males 100 cm.
Spawning season	Spawning occurs mainly from December to March in the equatorial area (0-10°S), with the main spawning grounds west of 75°E. Secondary spawning grounds exist off Sri Lanka and the Mozambique Channel and in the eastern Indian Ocean off Australia.
Size (length and weight)	Maximum length: 240 cm FL; Maximum weight: 200 kg. Newly recruited fish are primarily caught by the purse seine fishery on floating objects. Males are predominant in the catches of larger fish at sizes than 140 cm (this is also the case in other oceans). The sizes exploited in the Indian Ocean range from 30 cm to 180 cm fork length. Smaller fish (juveniles) form mixed schools with skipjack tuna and juvenile bigeye tuna and are mainly limited to surface tropical waters, while larger fish are found in surface and sub-surface waters. Intermediate age yellowfin tuna are seldom taken in the industrial fisheries, but are abundant in some artisanal fisheries, mainly in the Arabian Sea.

Sources: Froese & Pauly 2009

Yellowfin tuna – Fisheries and catch trends

Catches by gear, area, country and year from 1950 to 2011 are shown in Figs. 2, 3 and 4. Contrary to the situation in other oceans, the artisanal fishery component in the Indian Ocean is substantial, taking 20–30% of the total catch. Catches of yellowfin tuna remained more or less stable between the mid-1950s and the early-1980s, ranging between 30,000 and 70,000 t, owing to the activities of longliners and, to a lesser extent, gillnetters. The catches increased rapidly with the arrival of the purse seiners in the early 1980s and increased activity of longliners and other fleets, reaching over 400,000 t in 1993 (Table 4; Fig. 2). Catches of yellowfin tuna between 1994 and 2002 remained stable, between 330,000 and 350,000 t. Yellowfin tuna catches during 2003, 2004, 2005 and 2006 were much higher than in previous years with the highest catches ever recorded in 2004 (over 520,000 t) and average annual catch for the period at around 470,000 t. Yellowfin tuna catches dropped markedly after 2006, with the lowest catches recorded in 2009. Catch levels in 2011 are estimated to be at around 300,000 t, although they represent preliminary figures.

Table 4. Yellowfin tuna: Best scientific estimates of the catches of yellowfin tuna (*Thunnus albacares*) by gear and main fleets [or type of fishery] by decade (1950–2009) and year (2002–2011), in tonnes (Data as of September 2012). Catches by decade represent the average annual catch, noting that some gears were not used for all years

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
FS			18	32590	64942	89761	77,058	137,492	168,799	124,024	85,021	53,529	74,990	36,263	32,022	36,591
LS			17	18090	56304	61909	61,934	86,585	59,597	69,873	74,454	43,843	41,453	51,565	73,387	76,460
LL	21990	41257	29513	33889	66689	57032	53,125	55,727	86,597	117,324	70,388	51,240	25,973	20,014	18,139	19,027
LF			615	4286	47570	32955	34,425	31,290	31,303	34,083	30,741	30,642	29,675	22,776	24,390	26,152
BB	1795	1490	4693	6830	11005	15675	17,291	17,150	15,686	16,235	17,302	15,569	17,975	16,719	12,755	12,755
GI	2376	6838	11395	18560	54805	74081	57,363	82,354	101,902	85,053	88,414	68,543	73,437	70,918	91,722	85,754
HD	681	1170	2660	6823	18854	31346	33,857	31,379	39,337	36,824	30,126	30,438	30,036	24,914	20,600	20,612
TR	630	1066	3185	5489	10366	17929	13,828	13,272	19,824	14,545	17,299	22,238	28,225	24,271	24,545	24,909
OT	118	130	497	686	851	1165	670	1,170	1,581	1,286	1,546	1,228	1,564	1,036	747	679
Total	**27,589**	**51,951**	**52,593**	**127,242**	**331,386**	**381,854**	**349,551**	**456,419**	**524,626**	**499,247**	**415,291**	**317,270**	**323,328**	**268,476**	**298,307**	**302,939**

Purse seine free-school (FS); Purse seine associated school (LS); Deep-freezing longline (LL); Fresh-tuna longline (LF); Pole-and-Line (BB); Gillnet (GI); Hand line (HD); Trolling (TR); Other gears nei (OT)

Although some Japanese purse seiners have fished in the Indian Ocean since 1977, the purse seine (Figs. 2 and 3) fishery developed rapidly with the arrival of European vessels between 1982 and 1984. Since then, there has been an increasing number of yellowfin tuna caught, with a larger proportion of the catches made of adult fish, as opposed to bigeye tuna catches, of which the majority refers to juvenile fish. Purse seine vessels typically take fish ranging from 40 to 140 cm fork length (FL) and smaller fish are more common in the catches taken north of the equator. Catches of yellowfin tuna increased rapidly to around 130,000 t in 1993, and subsequently they fluctuated around that level, until 2003–05 when they were substantially higher (over or close to 200,000 t). The amount of effort exerted by the EU purse seine vessels (fishing for yellowfin tuna and other tunas) varies seasonally and from year to year.

The purse seine fishery is characterised by the use of two different fishing modes (Table 4; Fig. 2). The fishery on floating objects (FADs), which catches large numbers of small yellowfin tuna in association with skipjack tuna and juvenile bigeye tuna, and a fishery on free swimming schools, which catches larger yellowfin tuna on multi-specific or mono-specific sets. Between 1995 and 2003, the FAD component of the purse seine fishery represented 48–66% of the sets undertaken (60–80% of the positive sets) and accounted for 36–63% of the yellowfin tuna catch by weight (59–76% of the total catch). The proportion of yellowfin tuna caught (in weight) on free-schools during 2003–06 (64%) was much higher than in previous or following years (at around 50%).

The longline fishery (Table 4; Figs. 2 and 3) started in the early 1950's and expanded rapidly over throughout the Indian Ocean. Longline gear mainly catches large fish, from 80 to 160 cm FL, although smaller fish in the size range 60 – 100 cm (FL) have been taken by longliners from Taiwan,China since 1989 in the Arabian Sea. The longline fishery targets several tuna species in different parts of the Indian Ocean, with yellowfin tuna and bigeye tuna being the main target species in tropical waters. The longline fishery can be subdivided into a deep-freezing longline component (large scale deep-freezing longliners operating on the high seas from Japan, Korea and Taiwan,China) and a fresh-tuna longline component (small to medium scale fresh tuna longliners from Indonesia and Taiwan,China). The total longline catch of yellowfin tuna reached a maximum in 1993 (≈200,000 t). Catches between 1994 and 2004 fluctuated between 85,000 t and 120,000 t. The second highest catches of yellowfin tuna by longliners were recorded in 2005 (≈150,000 t). As was the case for the purse seine fleets, since 2005 longline catches have declined with current catches estimated to be at around 45,000 t, representing a three-fold decrease from the catches taken in 2005. The SC believes that the recent drop in longline catches could be related, at least in part, with the expansion of piracy in the northwest Indian Ocean, which has led to a marked drop in the levels of longline effort in one of the core fishing areas of the species (Fig. 5).

Catches by other gears, namely pole-and-line, gillnet, troll, hand line and other minor gears, have increased steadily since the 1980s (Table 4; Figs. 2 and 3). In recent years the total artisanal yellowfin tuna catch has been around 140,000–160,000 t, with the catch by gillnets (the dominant artisanal gear) at around 80,000 t. During the year 2004 the catches by artisanal gears attained its maximum over the time series, peaking at 180,000 t.

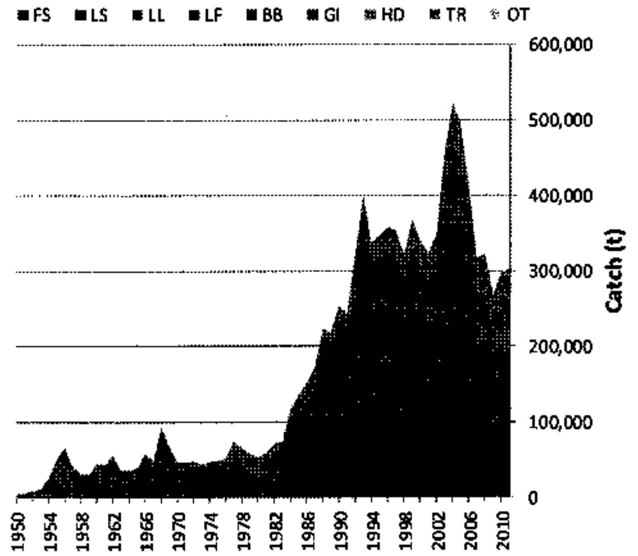


Fig. 2. Yellowfin tuna: Catches of yellowfin tuna by gear by year estimated for the WPTT (1950–2011). Data as of September 2012. Purse seine free-school (FS); Purse seine associated school (LS); Deep-freezing longline (LL); Fresh-tuna longline (LF); Pole-and-Line (BB); Gillnet (GI); Hand line (HD); Trolling (TR); Other gears nei (OT)

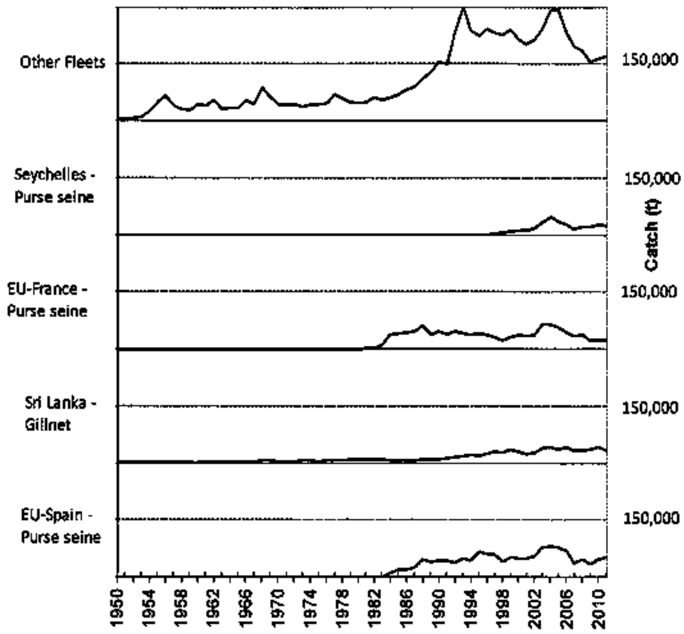


Fig. 3. Yellowfin tuna: Catches of yellowfin tuna by fleet by year estimated for the WPTT (1950–2011) (Data as of September 2012)

Yellowfin tuna catches in the Indian Ocean during 2003, 2004, 2005 and 2006 were much higher than in previous years (Fig. 2), while bigeye tuna catches remained at their average levels. Purse seiners currently take the bulk of the yellowfin tuna catch, mostly from the western Indian Ocean (Table 5) around Seychelles and off Somalia (R2) and Mozambique Channel (R3); Fig. 5). In 2003 and 2004, total catches by purse seine vessels in this area were around 225,000 t — about 50% more than the previous largest purse seine catch, which was recorded in 1995. Similarly, artisanal yellowfin tuna catches have been near their highest levels and longliners have reported higher than normal catches in the tropical western Indian Ocean during this period.

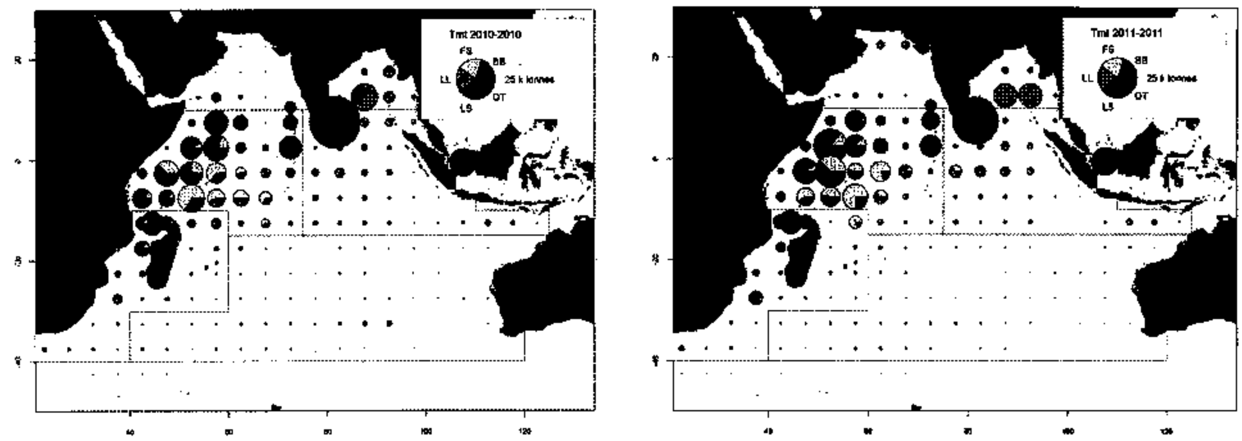


Fig. 4. Time-area catches (total combined in tonnes) of yellowfin tuna estimated for 2010 (left) and 2011 (right) by gear. Longline (LL), Purse seine free-schools (FS), Purse seine associated-schools (LS), pole-and-line (BB), and other fleets (OT), including drifting gillnets, and various coastal fisheries. Data as of September 2012. The catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned, in particular driftnets from Iran and Pakistan, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Yemen, Oman, Comoros, Indonesia and India

Table 5. Yellowfin tuna: Best scientific estimates of the catches of yellowfin tuna (*Thunnus albacares*) by area by decade (1950–2009) and year (2002–2011), in tonnes. Data as of September 2012. Catches by decade represent the average annual catch. The areas are presented in Fig. 5

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
R1	1,912	4,502	7,506	18,021	79,714	90,252	81,265	90,744	134,533	136,556	106,021	80,660	75,150	60,035	68,998	71,660
R2	11,869	23,064	21,137	73,042	135,201	175,180	154,305	254,089	261,289	240,184	189,622	122,182	132,649	100,288	110,034	116,774
R3	643	7,299	4,169	7,470	24,425	27,828	28,634	25,251	29,579	28,471	28,019	28,909	27,011	25,864	25,407	25,817
R4	997	1,919	1,639	1,321	3,555	3,503	4,618	4,255	5,878	4,780	3,218	1,349	1,449	1,501	1,866	1,707
R5	12,169	15,168	18,142	27,389	88,491	85,092	80,728	82,082	93,348	89,252	88,409	84,166	87,076	80,792	92,002	86,977
Total	**27,590**	**51,953**	**52,592**	**127,243**	**331,386**	**381,855**	**349,550**	**456,420**	**524,627**	**499,242**	**415,289**	**317,267**	**323,336**	**268,479**	**298,307**	**302,935**

Areas: Arabian Sea (R1); Off Somalia (R2); Mozambique Channel (R3); South Indian Ocean (R4); East Indian Ocean (R5). See Fig. 22 for areas. Totals from Table 3 and 4 may differ, due to rounding

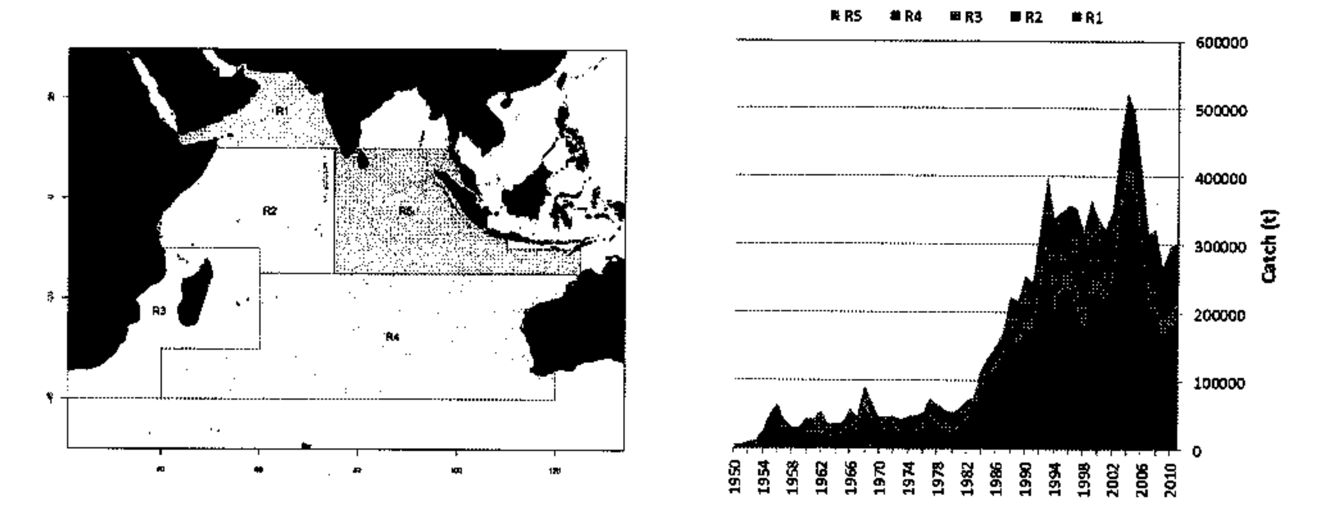


Fig. 5. Yellowfin tuna: Catches of yellowfin tuna by area (left) by year (right) estimated for the WPTT (1950–2011) (Data as of September 2012). Catches outside the areas presented in the Map were assigned to the closest neighbouring area. Arabian Sea (**R1**); Off Somalia (**R2**); Mozambique Channel (**R3**); South Indian Ocean (**R4**); East Indian Ocean (**R5**)

In recent years the catches of yellowfin tuna in the western Indian Ocean have dropped considerably, especially in areas off Somalia, Kenya and Tanzania and in particular between 2007 and 2011 (Fig. 6). The drop in catches is the consequence of a drop in fishing effort due to the effect of piracy in the western Indian Ocean region. Even though the activities of purse seiners have been affected by piracy in the Indian Ocean, the effects have not been as marked as with longliners, for which current levels of effort are close to nil in the area impacted by piracy. The main reason for this is the presence of security personnel onboard purse seine vessels of the EU and Seychelles, which has made it possible for purse seiners under these flags to continue operating in the northwest Indian Ocean.

Yellowfin tuna – uncertainty of catches

Retained catches: Generally well known (Fig. 6); however, catches are less certain for:

- many coastal fisheries, notably those from Indonesia, Sri Lanka, Yemen, Madagascar, and Comoros
- the gillnet fishery of Pakistan
- non-reporting industrial purse seiners and longliners (NEI), and longliners of India.

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

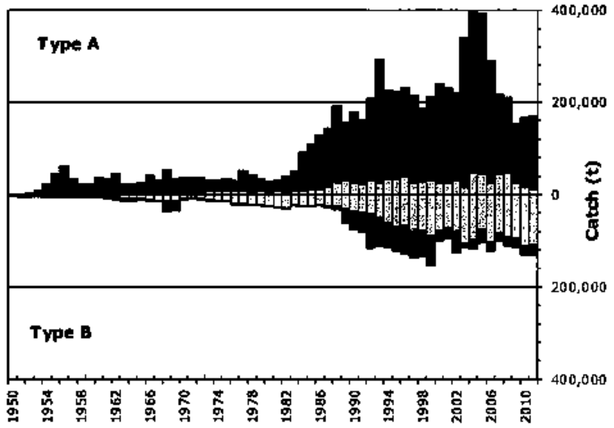


Fig. 6. Yellowfin tuna: Uncertainty of annual catch estimates for yellowfin tuna (Data as of September 2012). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (Type A) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets

Changes to the catch series: There have not been significant changes to the total catches of yellowfin tuna since the WPTT in 2011.

However, the IOTC Secretariat used new information compiled during 2011–12 to rebuild the catch series for the coastal fisheries operated in some countries, in particular Madagascar, Sri Lanka, and India. In general, the new catches of yellowfin tuna estimated by the IOTC Secretariat are lower than those used in the past by the WPTT.

CPUE Series: Catch-and-effort data are available from the major industrial and artisanal fisheries. However, these data are not available for some important fisheries or they are considered to be of poor quality for the following reasons:

- no data are available for the fresh-tuna longline fishery of Indonesia, over the entire time series, and data for the fresh-tuna longline fishery of Taiwan,China are only available since 2006
- no data are available for the gillnet fisheries of Iran and Pakistan
- the poor quality effort data for the significant gillnet/longline fishery of Sri Lanka
- no data are available from important coastal fisheries using hand and/or troll lines, in particular Yemen, Indonesia, Madagascar and Comoros.

Yellowfin tuna – Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid in 2010 and 2011 are provided in Fig. 7, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2010 and 2011 are provided in Fig. 8. The total number of fishing trips by vessels flagged to the Maldives by 5 degree square grid, type of boat and gear, for the years 2009 and 2010 are provided in Fig. 9.

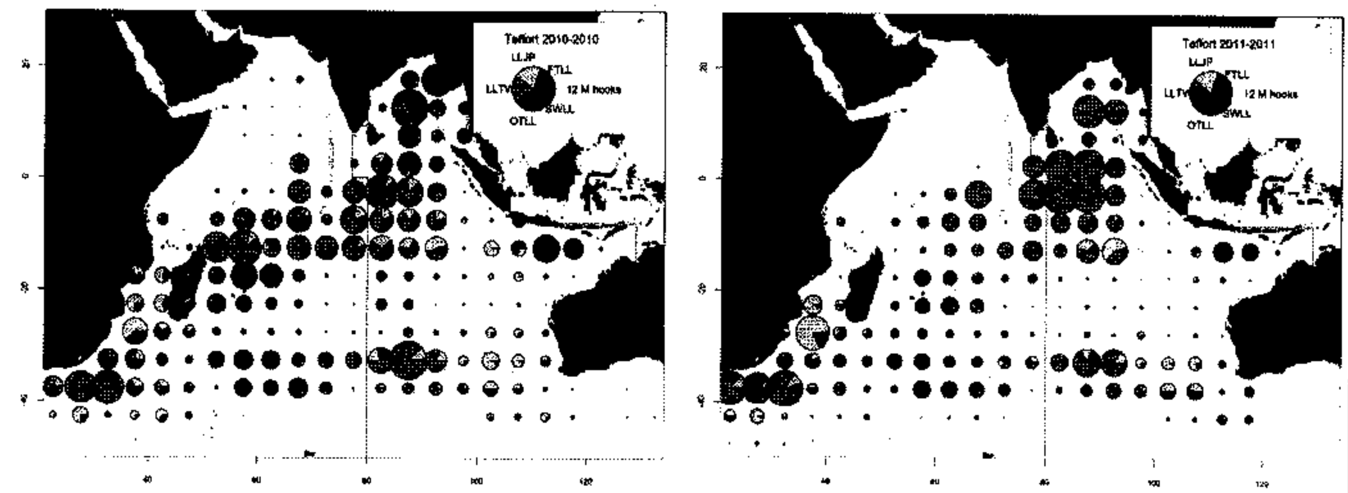


Fig. 7. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

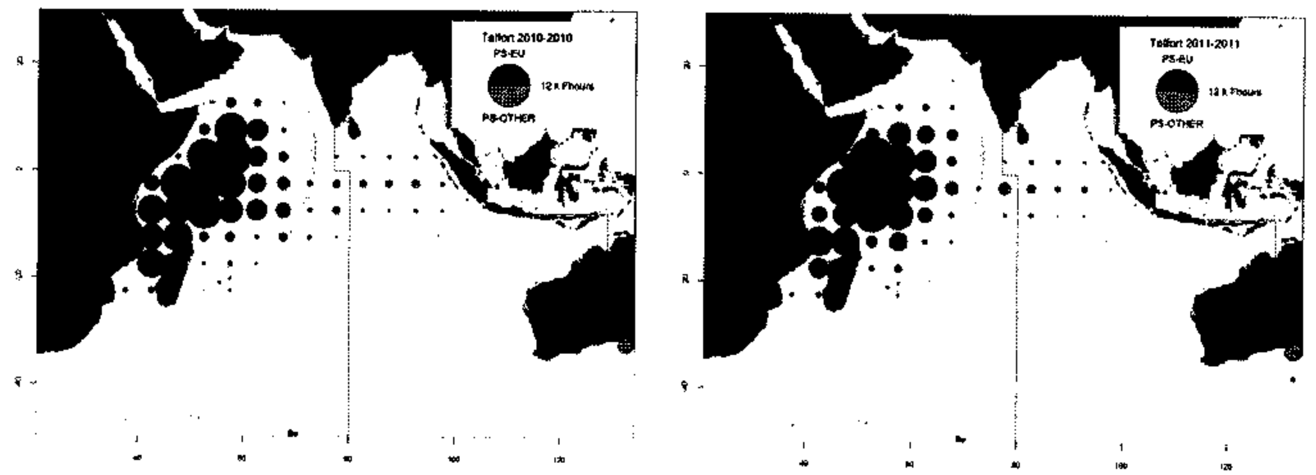


Fig. 8. Number of hours of fishing(Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

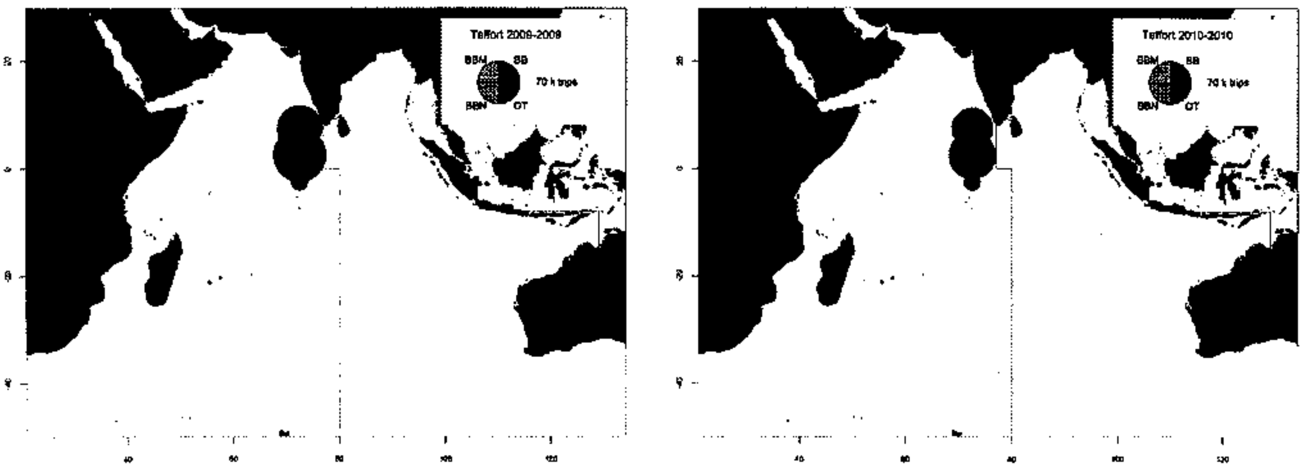


Fig. 9. Number of fishing trips by vessels flagged to the Maldives by 5 degree square grid, type of boat and gear, for the years 2009 (left) and 2010 (right) (Data as of September 2012)
BBN (blue): Baitboat non-mechanized; BBM (Green): Baitboat mechanized; BB (Red): Baitboat unspecified; UN (Purple): Unclassified gears
Note that the above maps were derived using the available catch-and-effort data in the IOTC database, which is limited to the number of baitboat calls (trips) by atoll by month for Maldivian baitboats for the period concerned. Note that some trips may be fully devoted to handlining, trolling, or other activities (data by gear type are not available since 2002). No data are available for the pole-and-line fisheries of India (Lakshadweep) and Indonesia

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

For the longline fisheries (LL fisheries in regions 1–5; Fig. 10), CPUE indices were derived using generalised linear models (GLM) from the Japanese longline fleet (LL regions 2–5) and for the Taiwanese longline fleet (LL region 1) to be used in the stock assessment. Standardised longline CPUE indices for the Taiwanese fleet were available for 1979–2008. The GLM analysis used to standardise the Japanese longline CPUE indices was refined for the 2011 and 2012 assessments to include a spatial (latitude*longitude) variable. The resulting CPUE indices were generally comparable to the indices derived from the previous model and were adopted as the principal CPUE indices for the 2012 assessment (Fig. 11). There is considerable uncertainty associated with the Japanese CPUE indices for region 2 in the most recent year (2010) and no CPUE indices are available for region 1 for 2009–10.

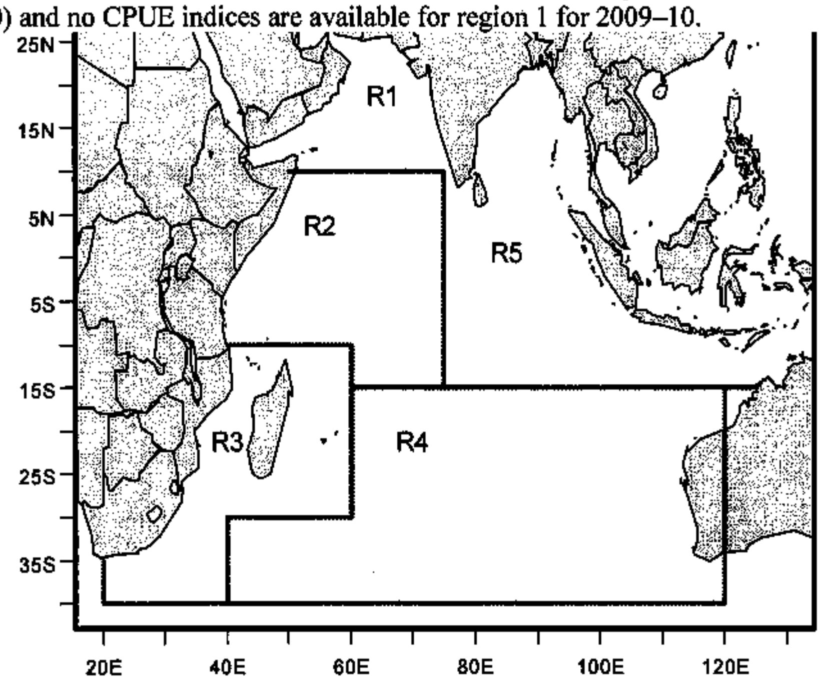


Fig. 10. Spatial stratification of the Indian Ocean for the MFCL assessment model

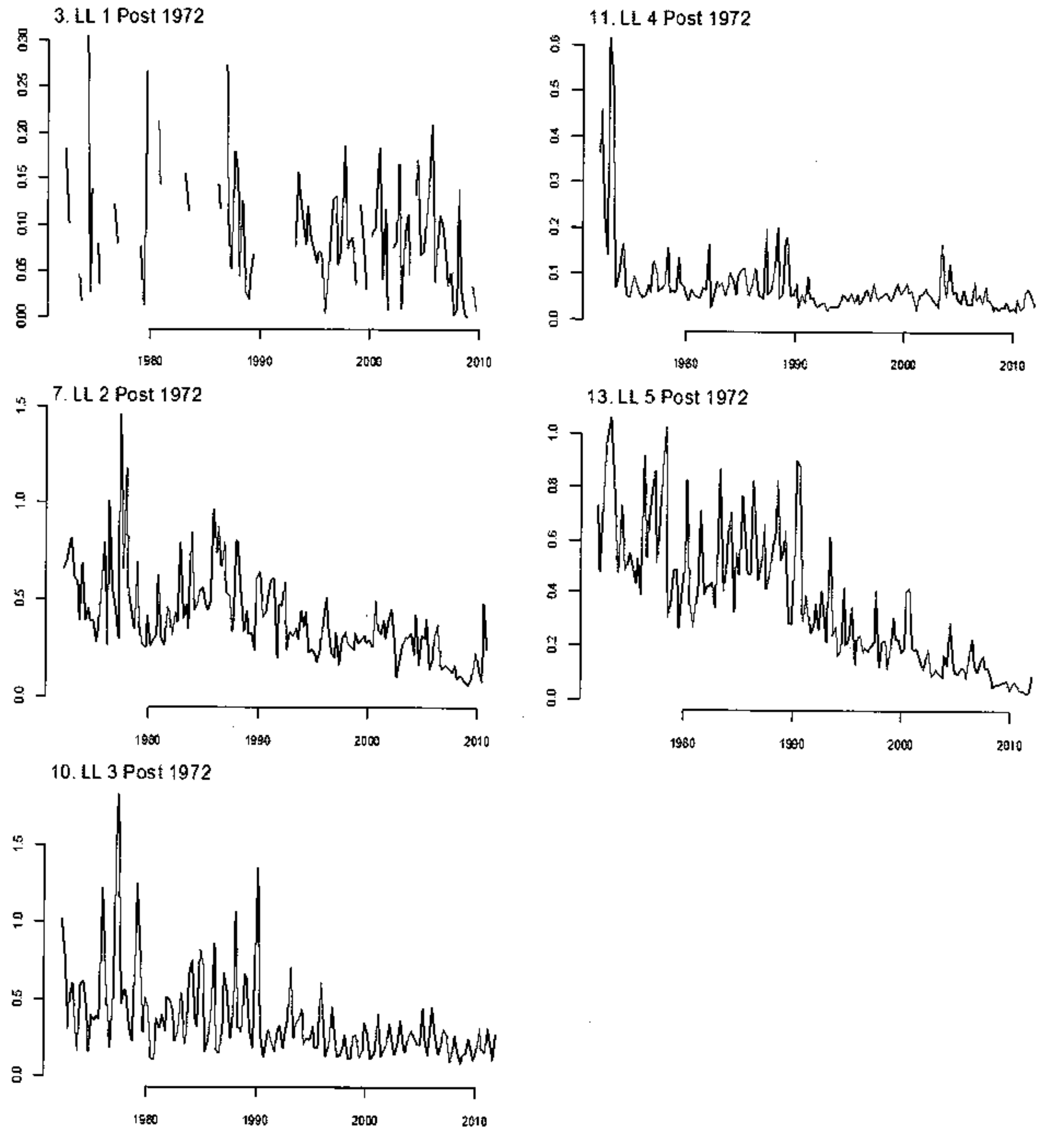


Fig. 11. Yellowfin tuna: Quarterly GLM standardised catch-per-unit-effort (CPUE) for the principal longline fisheries (LL 1 to 5) scaled by the respective region scalars.

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

Trends in average weight: Can be assessed for several industrial fisheries but they are very incomplete or of poor quality for some fisheries, namely hand lines (Yemen, Comoros, Madagascar), troll lines (Indonesia) and many gillnet fisheries (Fig. 12).

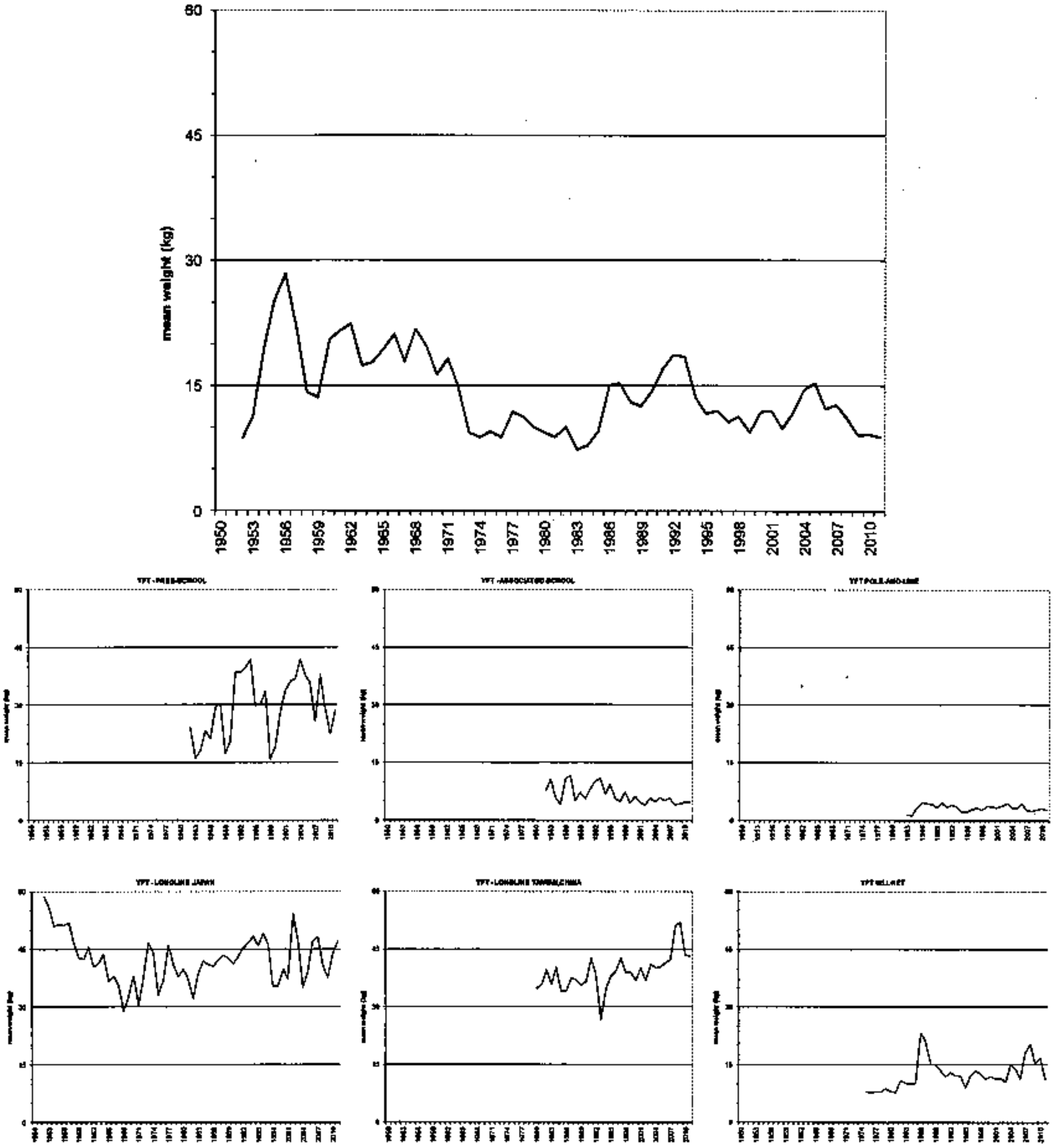


Fig. 12. Yellowfin tuna: Changes in average weight (kg) of yellowfin tuna from 1950 to 2011 – all fisheries combined (top) and by main fleet (Data as of September 2012)

Catch-at-Size table: This is available although the estimates are more uncertain in some years and some fisheries due to:

- size data not being available from important fisheries, notably Yemen, Pakistan, Sri Lanka and Indonesia (lines and gillnets) and Comoros and Madagascar (lines)
- the paucity of size data available from industrial longliners from the late-1960s up to the mid-1980s, and in recent years (Japan and Taiwan,China)
- the paucity of catch by area data available for some industrial fleets (NEI, Iran, India, Indonesia, Malaysia).

Yellowfin tuna – tagging data

A total of 63,328 yellowfin tuna (representing 31.4% of the total number of specimens tagged) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them (86.4%) were released during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and were released around Seychelles, in the Mozambique Channel, along the coast of Oman and off the coast of Tanzania, between May 2005 and September 2007 (Fig. 13). The remaining were tagged during small-scale tagging projects, and by other institutions with the support of IOTC Secretariat, in Maldives, India, and in the south west and the eastern Indian Ocean. To date, 10,662 (16.8%), have been recovered and reported to the IOTC Secretariat. More than 87% of these recoveries we made by the purse seine fleets operating in the Indian Ocean, while around 8.5% were made by pole-and-line and less than 1% by longline vessels. The addition of the data from the past projects in the Maldives (in 1990s) added 3,211 tagged skipjack to the databases, or which 151 were recovered, mainly from the Maldives.

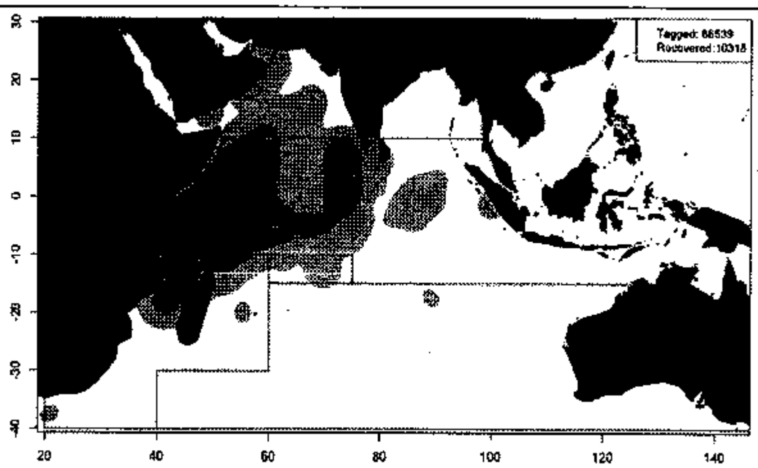


Fig. 13. Yellowfin tuna: Densities of releases (in red) and recoveries (in blue). The red line represents the stock assessment areas (Data as of September 2012)

STOCK ASSESSMENT

A range of quantitative modelling methods were applied to the yellowfin tuna assessment in 2012, ranging from the non-spatial, age-structured production model (ASPM) to the age and spatially-structured MULTIFAN-CL and SS3 analysis. The different assessments were presented to the WPTT in documents IOTC–2012–WPTT14–38, 39 and 40 Rev_2.

Management advice for yellowfin tuna is based on the 2012 MFCL stock assessment based upon the base case analysis with short term recruitment with alternative steepness of the stock-recruitment relationship of 0.7, 0.8 and 0.9 (Table 6) and the ASPM based case using steepness of 0.9. A major limitation of the ASPM model is that it is not spatially structured and thus does not allow the internal incorporation of tagging data, although it does externally by using the improved catch-at-age table and natural mortality estimates based on tagging data.

The following is worth noting with respect to the MFCL (MULTIFAN-CL) modelling and estimation approach used in 2012:

- The main features of the model in the 2012 assessment included a fixed growth curve (with variance) with an inflection, an age-specific natural mortality rate profile (M), the modelling of 25 fisheries including the separation of two purse seine fisheries into three time blocks, using logistic and cubic spline functions to estimate longline selectivities, separation of the analysis into five regions of the Indian Ocean as well as the three steepness parameters for the stock recruitment relationship (h=0.7, 0.8 and 0.9).
- In addition to another year of data, the 2012 assessment included several changes to the previous assessment: the longline CPUE indices were modified (Japanese updated with latest year which included information about latitude and longitude in the standardisation process for Regions 2–5 was supplied except for Region 2 in 2011; no update was available for the Taiwan,China index for Region 1; All of the analyses were conducted using a new version of MFCL provided by the Secretariat of the Pacific Community.

The problems identified in the catch data from some fisheries, and especially on the length frequencies in the catches of various fleets, a very important source of information for stock assessments. Length frequency data is almost unavailable for some fleets, while in other cases sample sizes are too low to reliably document changes in abundance and selectivity by age. Moreover, in general, catch data from some coastal fisheries is considered as poor.

The results of the MFCL model were studied in detail to improve the understanding of the estimated population dynamics and address specific properties of the model that were inconsistent with the general understanding of the yellowfin tuna stock and fisheries. The main issues identified are as follows:

- The model estimates a strong temporal decline in recruitment and in biomass within the eastern equatorial region (Region 5). This declining trend in recruitment is driven by the decline in the Japanese longline CPUE indices over the model period. There are limited data to reliably estimate recruitment in the region as the size data included in the model are considered uninformative. Consequently, the resulting recruitment and biomass trends may be unreliable. A participant noted that during this period the Taiwan,China longline fleet, a fleet more active than the Japanese longline fleet in this area, showed a stable nominal CPUE trend and high stable catches.

- The model estimates limited movement between the two equatorial regions. This is consistent with the low number of tag recoveries from the eastern equatorial region, an area from where recovery rates are difficult to estimate but probably low. Nonetheless, the low movement rate is consistent with the oceanographic conditions that prevailed during the main tag recovery period (see papers IOTC–2012–WPTT14–9 and 31). The model assumes a constant movement pattern throughout the model period and estimated movement pattern may not persist under different oceanographic conditions.
- Similarly, movement rates between the western equatorial region and the Arabian Sea (Region 1) were estimated to be very low. Although various recoveries crossing the border limit of 10°N line in both directions may suggest a higher mixing rate, the observation is consistent with the tag release/recovery observations (few tag releases from Region 2 were recovered in Region 1 and vice versa). However, reporting rates of most fisheries operating in Region 1 are estimated to be low and this may underestimate the low mixing rate observed by the model.
- The model estimated that fishing mortality rates within the western equatorial region did not increase during 2002–2006 period to the extent that would be anticipated given the large increase in catch from the purse seine fishery during that period (on average 470,000 t: well above all estimated MSY values). The large increase of catch, previously described due mainly to a catchability increased, will suggest an expected corresponding increase in fishing mortality well above the level of F_{MSY}. The explanation for this is that the longline standardised CPUE remained relatively constant during the period of high purse seine catch and in the subsequent years. To fit to the longline CPUE indices during this period the model increases the level of recruitment in the period that precedes the high purse seine catches which may be considered unreliable. This recruitment pattern was evident in all model options. However, further examination of the size frequency data is warranted to confirm that this recruitment trend is consistent with the other fisheries data. The status of the yellowfin tuna stock assessed by the model during the period of very high catches (2003–2006), estimated to be in the middle of the green area of the Kobe plot, was questioned by some participants.

The final base model option for the 2012 assessment incorporated the 5–region spatial structure, full selectivity of the older age classes by the longline fishery and estimated (average) natural mortality within the MFCL model, and a period of 4 quarter for tag mixing. For sensitivity analysis, a tag mixing period of 2 quarters was also analysed. In both cases three values of steepness (0.7, 0.8 and 0.9) were considered plausible. The estimated level of natural mortality was considerably higher than the level of natural mortality assumed in previous assessments. However, the estimated level of natural mortality was generally consistent with an external analysis of the tag release/recovery data (IOTC–2012–WPTT14–32), especially for younger ages, and with levels of natural mortality assumed for the assessment of yellowfin tuna by other RFMOs.

Biomass was estimated to have declined to about the B_{MSY} level, while fishing mortality rates had remained well below the F_{MSY} level. The base model estimated recent (1997–2011) recruitment levels that were considerably lower (approximately 25%) than the long term level of recruitment. This resulted in an apparent inconsistency between the annual trend in MSY based fishing mortality and biomass reference points and the observed catch trajectory. Biomass was estimated to have declined to about the B_{MSY} level, while fishing mortality rates had remained well below the F_{MSY} level. This pattern was evident for the range of steepness values considered for the stock-recruitment relationship. The recruitment trend may be an artefact of the model as there are limited data to reliably estimate the time series of recruitment and, hence, the model has considerable freedom to estimate recruitments to account for the observed decline in the longline CPUE abundance trend. The resulting estimates of MSY (380,000–450,000 t) are considerably higher than levels of catch sustained from the fishery and are considered to be overly optimistic. Similarly, the corresponding estimates of stock status are considered to be highly uncertain or unreliable.

It is considered more appropriate to formulate stock status advice based on the more recent period of recruitment on the basis that the level of recruitment from the early period is highly uncertain and that, at least in the short-term, recruitment would be more likely to be in line with recent levels. Estimating the stock status based on the recent (average 1997–2011) recruitment level resulted in lower MSY values, levels of fishing mortality that were comparable to the base model, and a more optimistic level of biomass relative to B_{MSY}.

The potential yield from the stock from different harvesting patterns was investigated by comparing alternative age specific patterns of fishing mortality that corresponded to the estimated selectivity of the main fisheries. A shift in the strategy to exclusively harvest the stock by longline or free-school purse seine would result in a substantial increase (50%) in the overall yield from the fishery relative to current yields. Conversely, a harvest pattern consistent with the purse seine FAD based fishery would result in a large (42%) reduction in overall yields. A shift to a gillnet based harvest pattern had a neutral effect relative to current yield. This analysis simply illustrates the relative yield per recruit of the individual fisheries, however, the results are theoretical and do not consider the complex nature of the operation of this multi-gear/multi-species fishery or the practicalities of substantially changing the harvest pattern.

Table 6. Key management quantities from the MFCL assessment, for the agreed scenarios of yellowfin tuna in the Indian Ocean. The range values represent the point estimates of different scenarios analysis (6 scenarios showing long term and short term recruitment with three values of steepness as well as the sensitivity analysis with 2 quarter for tag mixing, long- and short term recruitment and 0.8 value of steepness). The range is described by the range values between those scenarios.

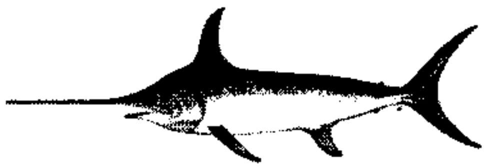
Management Quantity	**Indian Ocean**
2011 catch estimate	302,939 t
Mean catch from 2007–2011	302,064 t
MSY	344,000 t (290,000–453,000 t)
Data period used in assessment	1972–2011
F_{2010}/F_{MSY}	0.69 (0.59–0.90)
B_{2010}/B_{MSY}	1.28 (0.97–0.1.38)
SB_{2010}/SB_{MSY}	1.24 (0.91–1.40)
B_{2010}/B_0	n.a.
SB_{2010}/SB_0	0.38 (0.28–0.38)
$B_{2010}/B_{0,\,F=0}$	n.a.
$SB_{2010}/SB_{0,\,F=0}$	n.a.

LITERATURE CITED

Froese R, Pauly DE (2009) *FishBase,* version 02/2009, FishBaseConsortium, <www.fishbase.org>

APPENDIX XIII
EXECUTIVE SUMMARY: SWORDFISH

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



Status of the Indian Ocean swordfish (SWO: *Xiphias gladius*) resource

TABLE 1. Swordfish: Status of swordfish (*Xiphias gladius*) in the Indian Ocean

Area[1]	Indicators		2012 stock status determination
Indian Ocean	Catch 2011: Average catch 2007–2011:	19,631 t 21,870 t	
	MSY (4 models): F_{2009}/F_{MSY} (4 models): SB_{2009}/SB_{MSY} (4 models): SB_{2009}/SB_0 (4 models):	29,900–34,200 t 0.50–0.63 1.07–1.59 0.30–0.53	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. All models suggest that the stock is above, but close to a biomass level that would produce MSY and current catches are below the MSY level. MSY-based reference points were not exceeded for the Indian Ocean population as a whole ($F_{2009}/F_{MSY} < 1$; $SB_{2009}/SB_{MSY} > 1$). Spawning stock biomass in 2009 was estimated to be 30–53% (from Table 1; Fig. 1) of the unfished levels.

Outlook. The decrease in longline catch and effort in recent years has lowered the pressure on the Indian Ocean stock as a whole, indicating that current fishing mortality would not reduce the population to an overfished state. There is a low risk of exceeding MSY-based reference points by 2019 if catches reduce further or are maintained at current levels until 2019 (<11% risk that $B_{2019} < B_{MSY}$, and <9% risk that $F_{2019} > F_{MSY}$) (Table 2). The following key points should be noted:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is 29,900–34,200 t (range of best point estimates from Table 2) and annual catches of swordfish should not exceed this estimate.
- if the recent declines in effort continue, and catch remains substantially below the estimated MSY of 30,000–34,000 t, then management measures are not required which would pre-empt current resolutions and planned management strategy evaluation. However, continued monitoring and improvement in data collection, reporting and analysis is required to reduce the uncertainty in assessments.
- the Kobe strategy matrix illustrates the levels of risk associated with varying catch levels over time and could be used to inform management actions.
- advice specific to the southwest region is provided below, as requested by the Commission.
- provisional reference points: Noting that the Commission in 2012 agreed to Recommendation 12/14 *on interim target and limit reference points*, the following should be noted:
    a. **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, but below the provisional limit reference point of $1.4*F_{MSY}$ (Fig. 1).
    b. **Biomass**: Current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (Fig. 1).

TABLE 2. Swordfish: Aggregated Indian Ocean assessment - Kobe 2 Strategy Matrix, indicating a range of probabilities across four assessment approaches. Probability (percentage) of violating the MSY-based reference points for five constant catch projections (2009 catch level, ± 20% and ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to 2009) and probability (%) of violating reference point**				
	60% (12,502 t)	**80%** (16,670 t)	**100%** (20,837 t)	**120%** (25,004 t)	**140%** (29,172 t)
$B_{2012} < B_{MSY}$	0–4	0–8	0–11	2–12	4–16
$F_{2012} > F_{MSY}$	0–1	0–2	0–9	0–16	6–27
$B_{2019} < B_{MSY}$	0–4	0–8	0–11	0–13	6–26
$F_{2019} > F_{MSY}$	0–1	0–2	0–9	0–23	7–31

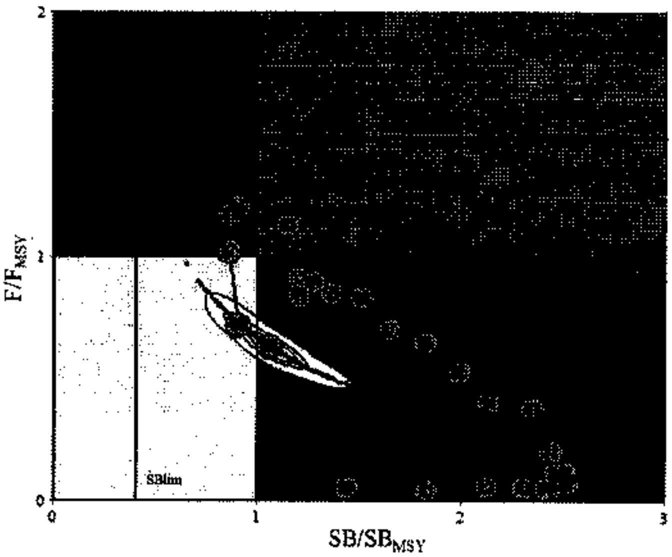


Fig. 1. Swordfish: ASPIC Aggregated Indian Ocean assessment Kobe plot (95% Confidence surfaces shown around 2009 estimate). Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2010. Target (Ftarg and SBtarg) and limit (Flim and SBlim) reference points are shown.

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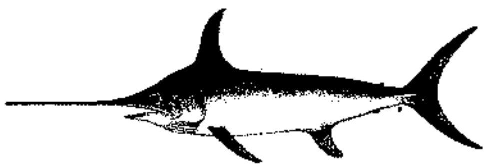


Status of the southwest Indian Ocean swordfish (SWO: *Xiphias gladius*) resource

TABLE 3. Swordfish: Status of swordfish (*Xiphias gladius*) in the southwest Indian Ocean

Area[1]	**Indicators**		**2012 stock status determination**
Southwest Indian Ocean	Catch 2011:	6,559 t	
	Average catch 2007–2011:	6,939 t	
	MSY (3 models):	7,100 t–9,400 t	
	F_{2009}/F_{MSY} (3 models):	0.64–1.19	
	SB_{2009}/SB_{MSY} (3 models):	0.73–1.44	
	SB_{2009}/SB_0 (3 models):	0.16–0.58	

[1]Boundaries for southwest Indian Ocean stock assessment are defined in IOTC–2011–WPB09–R.

Colour key	Stock overfished (SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing (F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		

SOUTHWEST INDIAN OCEAN – MANAGEMENT ADVICE

Stock status. Most of the evidence provided to the WPB indicated that the resource in the southwest Indian Ocean has been overfished in the past decade and biomass remains below the level that would produce MSY (B_{MSY}). Recent declines in catch and effort have brought fishing mortality rates to levels below F_{MSY} (Table 3). The catches of swordfish in the southwest Indian Ocean increased in 2010 to 8,046 t, which equals 120.5% of the recommended maximum catch of 6,678 t agreed to by the SC in 2011. If catches are maintained at 2010 levels, the probabilities of violating target reference points in 2012 are less than 18% for F_{MSY} and less than 30% for B_{MSY} (Table 4), which is considered low.

Outlook. The decrease in catch and effort over the last few years in the southwest region has reduced pressure on this resource. However, in 2010, catches exceeded the maximum recommended by the WPB09 and SC14 in 2011 (6,678 t), with 8,046 t caught in this region. The WPB09 estimated that there is a low risk of exceeding MSY-based reference points by 2019 if catches reduce further or are maintained at 2009 levels (<25% risk that B_{2019} < B_{MSY}, and <8% risk that F2019 > F_{MSY}). There is a risk of reversing the rebuilding trend if there is any increase in catch in this region (Table 4). The following key points should be noted:

- the Maximum Sustainable Yield estimate for the southwest Indian Ocean is 7,100–9,400 t (range of best point estimates from Table 3).
- catches in the southwest Indian Ocean should be maintained at levels at or below those observed in 2009 (6,678t), until there is clear evidence of recovery and biomass exceeds B_{MSY}.
- in 2010, catches have exceeded the maximum recommended by the WPB09 and SC14 (6,678 t), with 8,112 t caught in this region.
- the Kobe strategy matrix illustrates the levels of risk associated with varying catch levels over time and could be used to inform management actions.
- provisional reference points: Noting that the Commission in 2012 agreed to Recommendation 12/14 *on interim target and limit reference points*, the following should be noted:
    a. **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, and thus, below the provisional limit reference point of 1.4*F_{MSY}.
    b. **Biomass**: Current spawning biomass is considered to be below the target reference point of SB_{MSY}, and therefore, below the limit reference point of 0.4*SB_{MSY} (Fig. 1).

TABLE 4. Swordfish: Southwest Indian Ocean assessment - Kobe 2 Strategy Matrix, indicating a range of probabilities across three assessment approaches. Probability (percentage) of violating the MSY-based reference points for five constant catch projections (2009 catch level, ± 20% and ± 40%) projected for 3 and 10 years

Reference point and projection timeframe	**Alternative catch projections (relative to 2009) and probability (%) of violating reference point**				
	60% (12,502 t)	**80%** (16,670 t)	**100%** (20,837 t)	**120%** (25,004 t)	**140%** (29,172 t)
$B_{2012} < B_{MSY}$	0–15	0–20	0–25	0–30	12–32
$F_{2012} > F_{MSY}$	0–1	0–5	0–8	0–18	13–34
$B_{2019} < B_{MSY}$	0–15	0–20	0–25	0–32	18–34
$F_{2019} > F_{MSY}$	0–1	0–5	0–8	0–18	19–42

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Swordfish in the Indian Ocean is currently subject to a single direct conservation and management measure adopted by the Commission: Resolution 12/11 *On The implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties.* This Resolution applies a freezing of fishing capacity for fleets targeting swordfish in the Indian Ocean to levels applied in 2007. The Resolution limits vessels access to those that were active (*effective presence*) or under construction during 2007, and were over 24 metres overall length, or under 24 meters if they fished outside the EEZs. At the same time the measure permits CPCs to vary the number of vessels targeting swordfish, as long as any variation is consistent with the national fleet development plan submitted to the IOTC, and does not increase effective fishing effort. This Resolution is effective for 2012 and 2013.

- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's).*
- Resolution 10/08 *Concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Recommendation 10/13 *On the implementation of a ban on discards of skipjack tuna, yellowfin tuna, bigeye tuna, and non targeted species caught by purse seiners.*
- Resolution 11/04 *On a regional observer scheme*
- Resolution 12/03 *On the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 12/07 *Concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 12/11 *On The implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*

FISHERIES INDICATORS

General

Swordfish (*Xiphias gladius*) is a large oceanic apex predator that inhabits all the world's oceans (Fig. 2). Throughout the Indian Ocean, swordfish are primarily taken by longline fisheries, and commercial harvest was first recorded by the Japanese in the early 1950's as a bycatch/byproduct of their tuna longline fisheries. Swordfish life history characteristics, including a relatively late maturity, long life and sexual dimorphism, make the species vulnerable to over exploitation. Table 5 outlines some of the key life history traits of swordfish specific to the Indian Ocean.

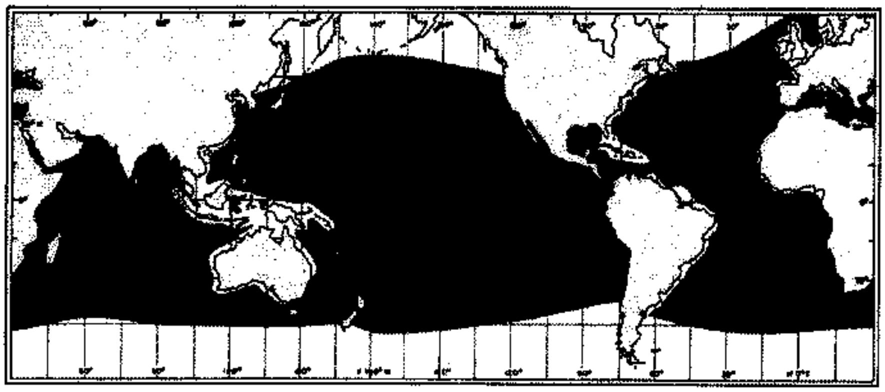


Fig. 2. Swordfish: The worldwide distribution of swordfish (Source: Nakamura 1984)

TABLE 5. Swordfish: Biology of Indian Ocean swordfish (*Xiphias gladius*)

Parameter	Description
Range and stock structure	Entire Indian Ocean down to 50°S. Juvenile swordfish are commonly found in tropical and subtropical waters and migrate to higher latitudes as they mature. Large, solitary adult swordfish are most abundant at 15–35°S. Males are more common in tropical and subtropical waters. By contrast with tunas, swordfish is not a gregarious species, although densities increase in areas of oceanic fronts and seamounts. Extensive diel vertical migrations, from surface waters during the night to depths of 1000 m during the day, in association with movements of the deep scattering layer and cephalopods, their preferred prey. A recent genetic study did not reveal any structure within the Indian Ocean with the markers used, however the hypothesis of a population structuring at the regional level cannot be discarded and needs to be investigated using different markers or approaches. Results obtained from the markers used may simply be a matter of the resolving power of the markers used, which may simply have been insufficient for detecting population subdivision. Spatial heterogeneity in stock indicators (catch–per–unit–effort trends) indicates the potential for localised depletion of swordfish in the Indian Ocean.
Longevity	30+ years
Maturity (50%)	Age: females 6–7 years; males 1–3 years Size: females ~170 cm LJFL; males ~120 cm LJFL
Spawning season	Highly fecund batch spawner. May spawn as frequently as once every three days over a period of several months in spring. Known spawning ground and season are: tropical waters of Southern hemisphere from October to April, including in the vicinity of Reunion Island.
Size (length and weight)	Maximum: 455 cm lower-jaw FL; 550+ kg total weight in the Indian Ocean. Sexual dimorphism in size, growth rates and size and age at maturity - females reach larger sizes, grow faster and mature later than males. Most swordfish larger than 200 kg are female. Recruitment into the fishery: varies by fishing method; ~50 cm LJFL for longline fisheries. By one year of age, a swordfish may reach 90 cm lower-jaw FL (~15 kg). The average size of swordfish taken in Indian Ocean longline fisheries is between 40 kg and 80 kg (depending on latitude). L-W relationships for the Indian Ocean are: females TW=0.00002409*LJFL^2.86630, males TW=0.00006289*LJFL**2.66196, both sexes mixed TW=0.00001443*LJFL^2.96267. TW in kg, LJFL in cm

Sources: Froese & Pauly 2009, Muths et al. 2009, Poisson & Fauvel 2009, Bach et al. 2011, Romanov, Romanova, 2012

Swordfish: Catch trends

Swordfish are caught mainly using longlines (95%) and drifting gillnets (4%) (Table 6, Fig. 3). Between 1950 and 1980, catches of swordfish in the Indian Ocean slowly increased in tandem with the level of coastal state and distant water fishing nation longline effort targeting tunas and sharks (Figs. 3, 4). Swordfish were not targeted by industrial longline fisheries before the early 1990's, however with the introduction of night fishing using longlines baited with squid and light sticks, catches increased post 1990.

Since 2004, annual catches have declined steadily (Fig. 4), largely due to the continued decline in the number of active Taiwan,China longliners in the Indian Ocean (Fig. 5). Annual catches since 2004 have been dominated by the Taiwan,China and EU fleets (Spain, UK, France and Portugal), with the fishery extending eastward due to the effects of piracy actions (Fig. 5, Table 7).

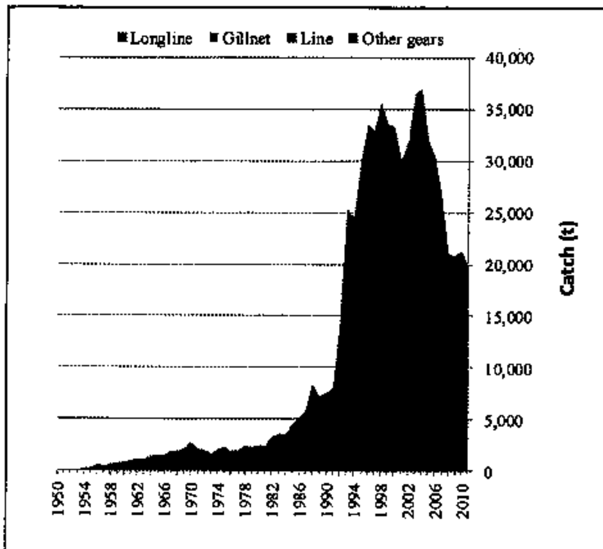


Fig. 3 Swordfish: Catches of swordfish per gear and year recorded in the IOTC database (1960–2011)

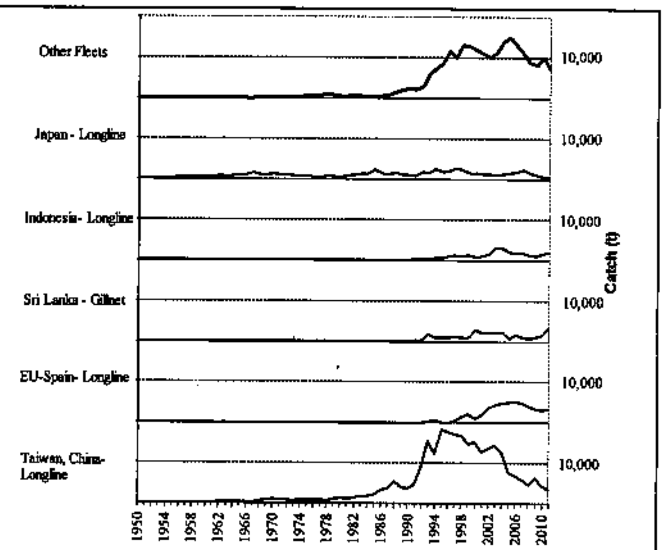


Fig. 4. Swordfish: Catches of swordfish by fleet recorded in the IOTC database (1960–2011)

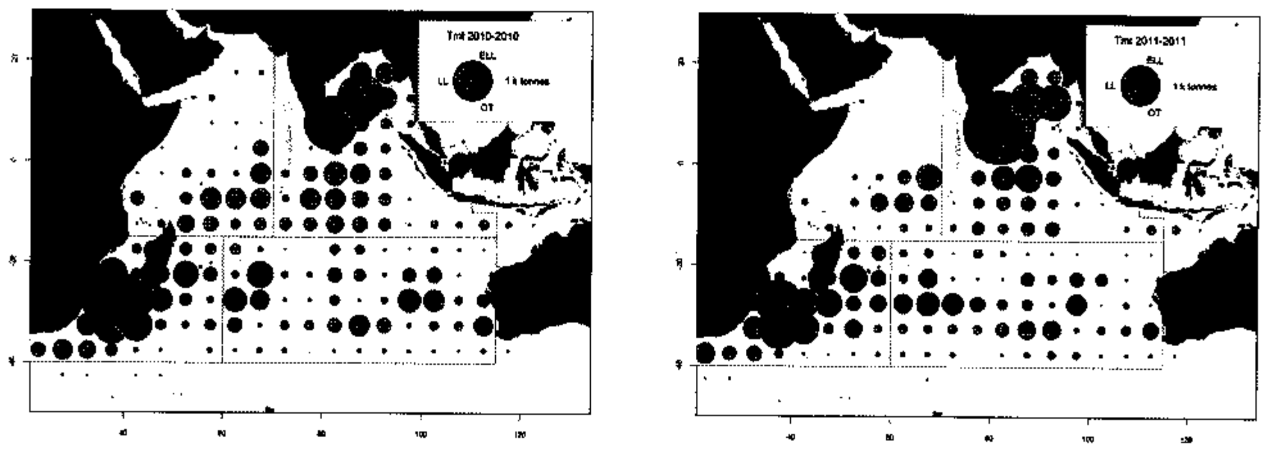


Fig. 5a–b. Swordfish: Time-area catches (total combined in tonnes) of swordfish as reported for the longline fleets of Japan (JPN), Taiwan,China (TWN), and EU-Spain (ESP), the latter directed at swordfish, for 2010 and 2011 by type of gear. Red lines represent the boundaries of the areas used for the assessments of swordfish (Data as of October 2012)

TABLE 6. Swordfish: Best scientific estimates of the catches of swordfish by type of fishery for the period 1950–2011 (in metric tons) (Data as of October 2012)

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
ELL	-	-	-	9	1,846	9,998	8,903	9,470	12,740	14,966	12,998	11,534	8,196	8,155	9,518	7,790
LL	283	1,426	2,134	4,337	21,576	17,632	20,450	24,262	21,686	15,318	14,775	13,255	10,546	11,257	9,440	7,909
OT	41	42	47	319	1,097	2,288	2,560	2,693	2,578	1,615	2,546	1,823	2,203	1,425	2,369	3,932
Total	**323**	**1,468**	**2,181**	**4,665**	**24,519**	**29,918**	**31,913**	**36,424**	**37,004**	**31,900**	**30,319**	**26,612**	**20,945**	**20,837**	**21,327**	**19,631**

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

TABLE 7. Swordfish: Best scientific estimates of the catches of swordfish by fishing area for the period 1950–2011 (in metric tons) (Data as of October 2012)

Area	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NW	85	534	637	1,444	7,195	9,362	12,066	14,622	11,928	10,694	10,001	8,080	5,916	3,649	2,025	1,260
SW	14	258	468	753	8,685	7,621	7,466	4,092	6,305	9,779	8,826	7,376	6,185	6,531	8,046	6,559
NE	187	467	750	2,098	5,653	6,787	5,988	8,278	8,401	5,176	6,919	5,913	5,269	7,551	7,446	8,472
SE	37	209	326	371	2,986	6,149	6,393	9,431	10,370	6,250	4,572	5,242	3,575	3,106	3,810	3,339
Total	**323**	**1,468**	**2,181**	**4,666**	**24,519**	**29,919**	**31,913**	**36,423**	**37,004**	**31,899**	**30,318**	**26,611**	**20,945**	**20,837**	**21,327**	**19,630**

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

Swordfish: Uncertainty of time–area catches

Retained catches are fairly well known (Fig. 6); however catches are uncertain for:

- Drifting gillnet fisheries of Iran and Pakistan: To date, Iran has not reported catches of swordfish for its gillnet fishery. Although Pakistan has reported catches of swordfish they are considered to be too low for a driftnet fishery (catches of swordfish in recent years represent less than 2% of the total catches of swordfish in the Indian Ocean).
- Longline fishery of Indonesia: The catches of swordfish for the fresh tuna longline fishery of Indonesia may have been underestimated in recent years due to insufficient sampling coverage. Although the new catches estimated by the Secretariat are thought to be more accurate, swordfish catches remain uncertain, especially in recent years (where they represent around 6% of the total catches of swordfish in the Indian Ocean).
- Longline fishery of India: India has reported very incomplete catches and catch-and-effort data for its longline fishery. Although the new catches estimated by the Secretariat are thought to be more accurate, catches of swordfish remain uncertain (catches of swordfish in recent years represent less than 3% of the total catches of swordfish in the Indian Ocean).
- Longline fleets from non-reporting countries (NEI): The Secretariat had to estimate catches of swordfish for a fleet of longliners targeting tunas or swordfish and operating under flags of various non-reporting countries. The catches estimated since 2006 are, however, low (they represent around 6% of the total catches of swordfish in the Indian Ocean).
- There have not been significant changes to the catch series of swordfish since the WPB in 2010. Changes since the last WPB refer to revisions of historic data series for the artisanal fisheries of Indonesia and India. These changes, however, did not lead to significant changes in the total catch estimates.
- Discards are believed to be low although they are unknown for most industrial fisheries, mainly longliners. Discards of swordfish may also occur in the driftnet fishery of Iran, as this species has no commercial value in this country.

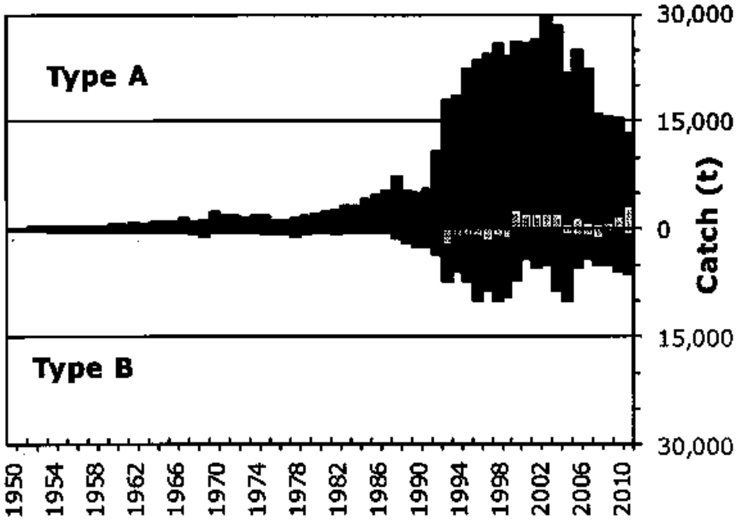


Fig. 6. Swordfish: Uncertainty of annual catch estimates for swordfish (Data as of October 2012). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat),

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

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

In general, the amount of catch for which size data for the species are available before 2005 is still very low and the number of specimens measured per stratum has been decreasing in recent years.

- Average fish weight (Fig. 7) can be assessed for several industrial fisheries although they are incomplete or poor quality for most fisheries before the early-80s and in recent years (low sampling coverage and time-area coverage of longliners from Japan). The average weights of swordfish are variable but show no clear trend. It is considered encouraging that there are no clear signals of declines in the size-based indices, but these indices should be carefully monitored, as females mature at a relatively large size, therefore, a reduction in the biomass of large animals could potentially have a strong effect on the spawning biomass.
- Catch-at-Size(Age) data are available but the estimates are thought to have been compromised for some years and fisheries due to:
    - the uncertainty in the catches of swordfish for the drifting gillnet fisheries of Iran and the fresh-tuna longline fishery of Indonesia.
    - the total lack of size data before the early-70s and poor coverage before the early-80s and for most artisanal fisheries (Pakistan, India, Indonesia).
    - the paucity of size data available from industrial longliners since the early-1990s (Japan, Philippines, India and China).
    - the lack of time-area catches for some industrial fleets (Indonesia, India, NEI).
    - the paucity of biological data available, notably sex-ratio and sex-length-age keys.

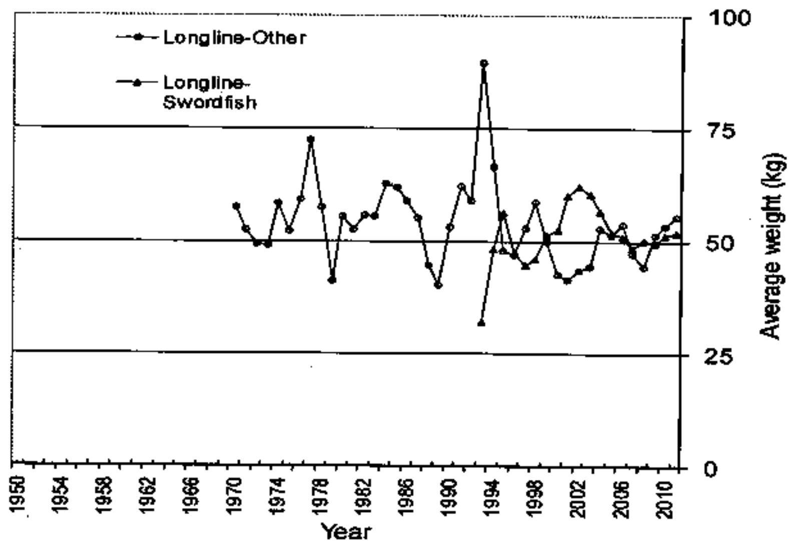


Fig. 7. Swordfish: Average weight of swordfish (kg) estimated from the size samples available for longliners targeting swordfish (1993–2011) and other longliners (1970–2011). NOTE: Average weights are shown only for years in which 300 or more specimens were sampled for length

Swordfish: Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid for 2010 to 2011 are provided in Fig. 8, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2010 and 2011 are provided in Fig. 9.

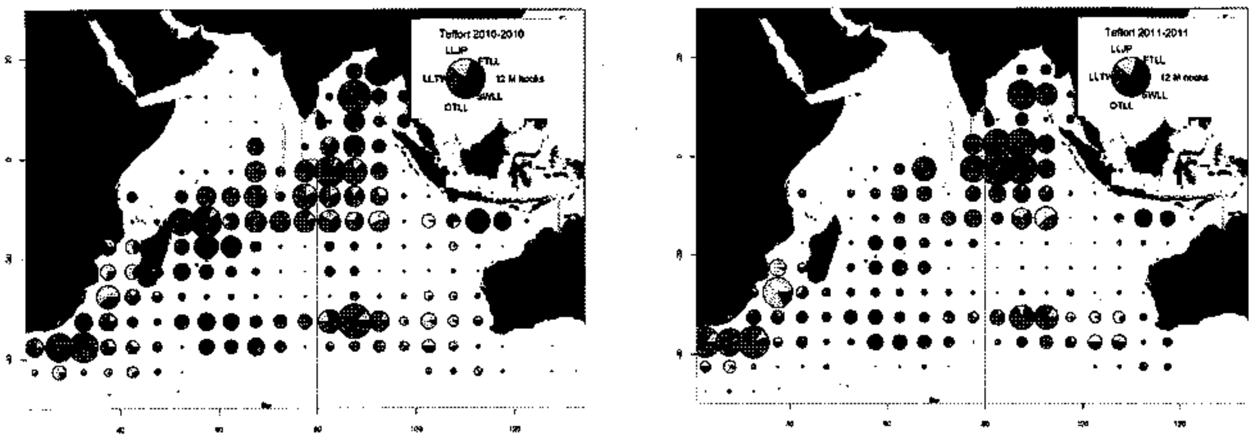


Fig. 8. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

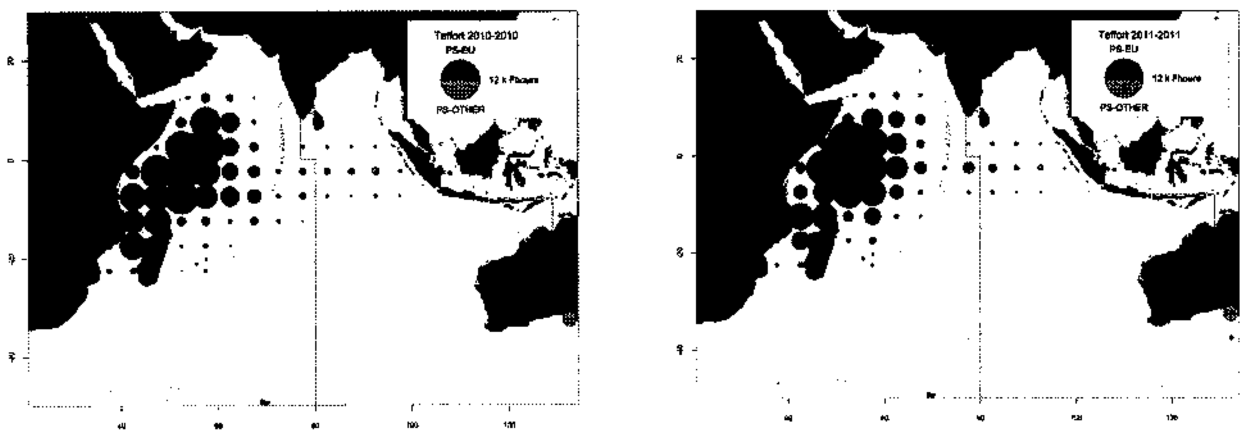


Fig. 9. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

Swordfish: Catch–per–unit–effort (CPUE) trends

The following CPUE series were used in the stock assessment models for 2011 (Figs. 10 and 11), while the relative weighting of the different CPUE series were left to the individual analyst to determine and justify.

- Japan data (1980–2009): Series 3.2 from document IOTC–2011–WPB09–14, which includes fixed latitude and longitude effects, plus environmental effects.
- Taiwan,China data (1995–2009): Model 10 from document IOTC–2011–WPB09–23, which includes fixed latitude and longitude effects, plus environmental effects.

- EU,Spain data (2001–2009): Series 5 from document IOTC–2011–WPB09–23, calculated for the southwest area only (includes sub-region factors and species ratio factors) area and run 1 for the assessment of whole Indian Ocean.
- EU,La Reunion data (1994–2000): Same series as last year (IOTC–2010–WPB–03).

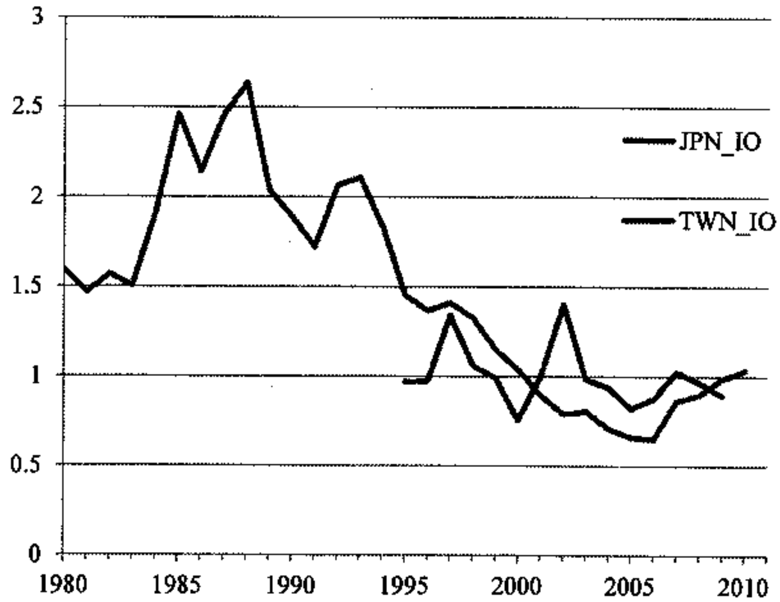
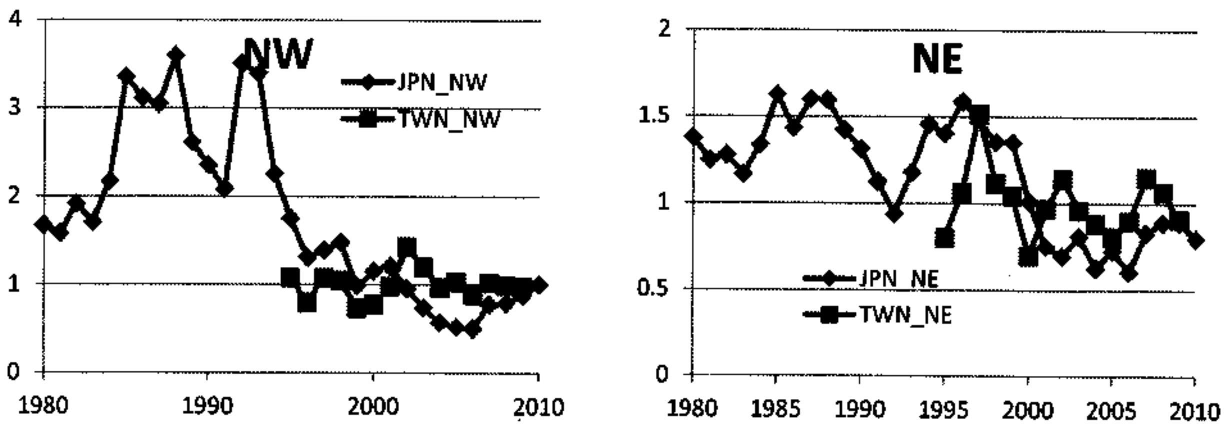


Fig. 10. Swordfish: Aggregate Indian Ocean CPUE series for swordfish. Series have been rescaled relative to their respective means from 1995–2010



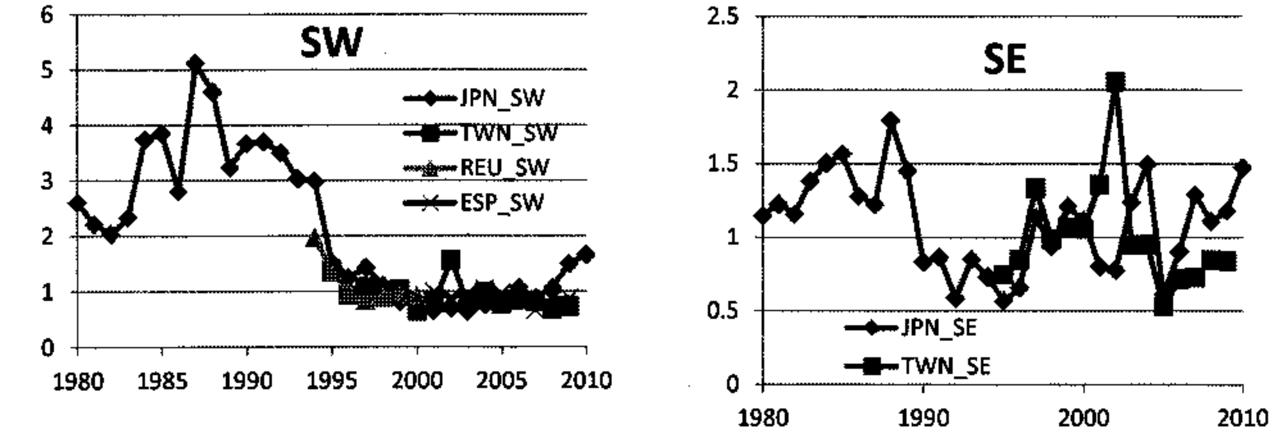


Fig. 11. Swordfish: CPUE series for Indian Ocean swordfish assessments by sub-region. Series have been rescaled relative to their respective means (for different overlapping time periods). NW – north-west; SW – south-west; NE – north-east; SE – south-east Indian Ocean.

STOCK ASSESSMENT

The stock structure of the Indian Ocean swordfish resource remains under investigation, but currently uncertain. The southwest region was identified as a management unit of particular concern, because it seems to be more depleted than other regions in the Indian Ocean, and may have limited mixing with other regions.

The range of quantitative modelling methods were applied to the swordfish assessment in 2011, ranging from the highly aggregated ASPIC surplus production model to the age-, sex- and spatially-structured SS3 analysis. The different assessments were presented to the WPB in documents IOTC–2011–WPB09–17, 18, 19 and 20. Each model is summarised in the report of the Ninth Session of the WPB (IOTC–2011–WPB09–R).

There is value of comparing different modelling approaches. The structured models are capable of a more detailed representation of complicated population and fishery dynamics, and integrate several sources of data and biological research that cannot be considered in the simple production models. However, there are a lot of uncertainties in basic swordfish biology (e.g. growth rates, M, stock recruitment relationship), and it is difficult to represent all of these uncertainties. In contrast, the production models often provide robust estimates regardless of uncertainties in basic biological characteristics. However, sometimes the ASPIC model can have difficulty fitting long time series, and production models in general cannot represent some important dynamics (e.g. arising from complicated recruitment variability).

The swordfish stock status was determined by qualitatively integrating the results of the various stock assessments undertaken in 2011. The WPB treated all analyses as equally informative, and focussed on the features common to all of the results, as well as the latest catch and effort trends (Tables 1 and 8).

TABLE 8. Swordfish: Key management quantities from the 2011 Stock Synthesis 3 assessments, for the aggregate and southwest Indian Ocean. Values represent the 50th (5th–95th) percentiles of the (plausibility-weighted) distribution of maximum posterior density estimates from the full range of the models examined

Management Quantity	Aggregate Indian Ocean	Southwest Indian Ocean
2011catch estimate	19,631 t	6,559 t
Mean catch from 2007–2011	21,870 t	6,939 t
MSY	29,900– 34,200	7,100 t–9,400 t
Data period used in assessment	1951–2009	1951–2009
F_{2009}/F_{MSY}	0.50 (0.23–1.08)	0.64 (0.27–1.27)
B_{2009}/B_{MSY}	–	–
SB_{2009}/SB_{MSY}	1.59 (0.94–3.77)	1.44 (0.61–3.71)
B_{2009}/B_0	–	–
SB_{2009}/SB_0	0.35 (0.22–0.42)	0.29 (0.15–0.43)

$B_{2009}/B_{0,\,F=0}$	–	–
$SB_{2009}/SB_{0,\,F=0}$	–	–

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APPENDIX XIV
EXECUTIVE SUMMARY: BLACK MARLIN

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

Status of the Indian Ocean black marlin (BLM: *Makaira indica*) resource

TABLE 1. Black marlin: Status of black marlin (*Makaira indica*) in the Indian Ocean

Area[1]	Indicators		2012 stock status determination
Indian Ocean	Catch 2011:	6,890 t	Uncertain
	Average catch 2007–2011:	6,292 t	
	MSY (range):	unknown	
	F_{2011}/F_{MSY} (range):	unknown	
	SB_{2011}/SB_{MSY} (range):	unknown	
	SB_{2011}/SB_0 (range):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No quantitative stock assessment is currently available for black marlin in the Indian Ocean; due to a lack of fishery data and poor quality of available 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 data poor status on which to base a more formal assessment are a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

Outlook. Longline catch and effort for black marlin in recent years has continued to increase to a total of 7,021 tonnes in 2010. Although a lower catch of 6,890 tonnes was caught in 2011, the pressure on the Indian Ocean stock as a whole remains highly uncertain. Thus, there remains insufficient information to evaluate the effect this will have on the resource. The following key points should be noted:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches of black marlin are highly uncertain and need to be reviewed.
- improvement in data collection and reporting is required to assess the stock.
- research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Black marlin (*Makaira indica*) 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 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's).*

- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Resolution 11/04 *on a regional observer scheme*
- Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 12/07 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*

FISHERIES INDICATORS

Black marlin: General

Black marlin (*Makaira indica*) is a large oceanic apex predator that inhabits tropical and subtropical Indo-Pacific oceans. Table 2 outlines some key life history parameters relevant for management. There is limited reliable information on the catches of black marlin and no information on the stock structure or growth and mortality in the Indian Ocean.

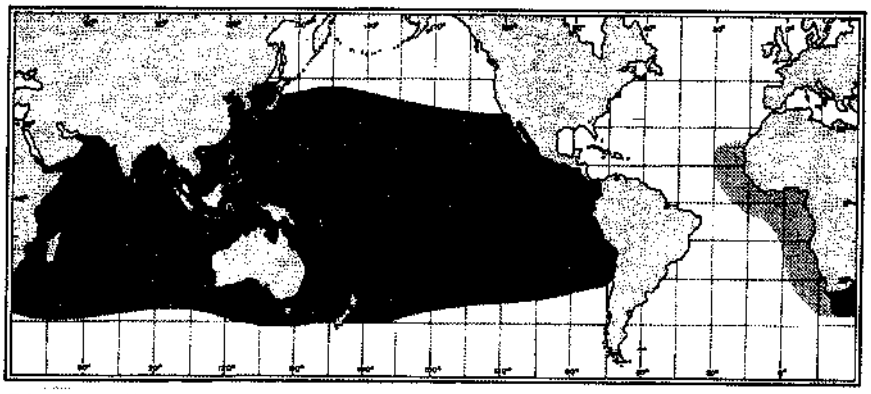

Fig. 1. Black marlin: The worldwide distribution of black marlin (Source: Nakamura 1984)

TABLE 2. Black marlin: Biology of Indian Ocean black marlin (*Makaira indica*)

Parameter	Description
Range and stock structure	Little is known on the biology of the black marlin in the Indian Ocean. Black marlin is a highly migratory, large oceanic apex predator that inhabits tropical and subtropical waters of the Indian and Pacific oceans. Some rare individuals have been reported in the Atlantic Ocean but there is no information to indicate the presence of a breeding stock in this area. Black marlin inhabits oceanic surface waters above the thermocline and typically near land masses, islands and coral reefs; however rare excursions to mesopelagic waters down to depths of 800 m are known. Thought to associate with schools of small tuna, which is one of its primary food sources (also reported to feed on other fishes, squids and other cephalopods, and large decapod crustaceans). No information on stock structure is currently available in the Indian Ocean; thus for the purposes of assessment, one pan-ocean stock is assumed. Long distance migrations at least in the eastern Indian Ocean (two black marlins tagged in Australia were caugh off east Indian coast and Sri Lanka) support a single stock hypothesis. It is known that black marlin forms dense nearshore spawning aggregations, making this species vulnerable to exploitation even by small-scale fisheries. Spatial heterogeneity in stock indicators (catch–per–unit–effort trends) for other billfish species indicates that there is potential for localised depletion.
Longevity	No data available for the Indian Ocean. In the Pacific (Australia) 11–12 years.
Maturity (50%)	Age: unknown Size: females around 100 kg; males 50 to 80 kg total weight
Spawning season	No spawning grounds have been identified in the Indian ocean. Spawning hotspot off eastern Australia apparently has no links with Indian Ocean stock. Spawning individuals apparently prefer water temperatures above 26–27°C. Highly fecund batch spawner. Females may produce up to 40 million eggs.
Size (length and weight)	Maximum: In other oceans can grow to more than 460 cm FL and weigh 800 kg total weight. In the Indian Ocean it reach at least 360 cm LJFL. Young fish grow very quickly in length then put on weight later in life. In eastern Australian waters black marlin grows from 13 mm long at 13 days old to 180 cm and around 30 kg after 13 months. Sexual dimorphism in size, growth rates and size and age at maturity - females reach larger sizes, grow faster and mature later than males. In the Indian Ocean documented maximum size for females: 306 cm LJFL, 307 kg total weight; males: 280 cm LJFL, 147 kg total weight. Most black marlin larger than 200 kg are female.

	Recruitment into the fishery: varies by fishing method; ~60 cm LJFL for artisanal fleets and methods. The average size of black marlin taken in Indian Ocean longline fisheries is not available. L-W relationships for the Indian Ocean are: females TW=0.00000010*LJFL**3.7578, males TW=0.00002661*LJFL**3.7578, both sexes mixed TW=0.00000096*LJFL**3.35727, TW in kg, LJFL in cm. However these relationships were obtained from small sample sizes (n=75), therefore it should be treated with caution.

Sources: Nakamura 1985, Cyr et al. 1990, Gunn et al. 2003, Speare 2003; Sun et al. 2007, Froese & Pauly 2009, Romanov & Romanova 2012, Domeier & Speare 2012

Black marlin: Catch trends

Black marlin are caught mainly by drifting longlines (44%) and gillnets (49%) with remaining catches taken by troll and hand lines (Table 3, Fig. 2). Black marlin are not targeted by industrial fisheries, but are targeted by some artisanal and sport/recreational fisheries. Black marlin are also known to be taken in purse seine fisheries, but are not currently being reported. In recent years, the fleets of Taiwan,China (longline), Sri Lanka (gillnet), Indonesia (gillnets) and India (gillnets) are attributed with the highest catches of black marlin (Fig. 3). The minimum average annual catch estimated for the period 2007 to 2011 is 6,292 t (Table 3), although this figure is considered to be a gross underestimate due to under reporting and misidentification.

Between the early-1950s and the late-1980s part of the Japanese fleet was licensed to operate within the EEZ of Australia, and reported very high catches of black marlin in that area, in particular in waters off northwest Australia. In recent years, deep-freezing longliners from Japan and Taiwan,China have reported lower catches of black marlin, mostly in waters off the western coast of India and, to a lesser extent, the Mozambique Channel (Fig. 4).

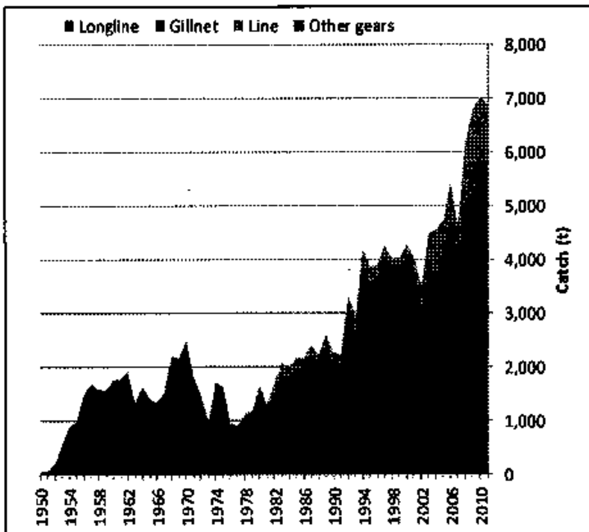

Fig. 2. Black marlin: Catches of black marlin per gear and year recorded in the IOTC Database (1960–2011)

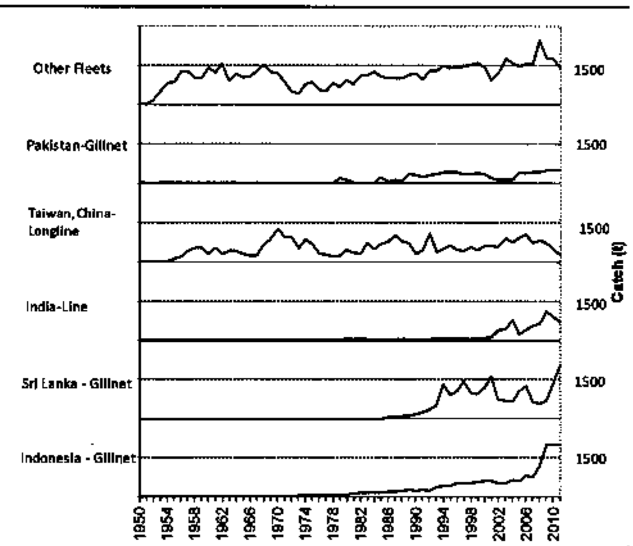

Fig. 3. Black marlin: Catches of black marlin by fleet recorded in the IOTC Database (1960–2011)

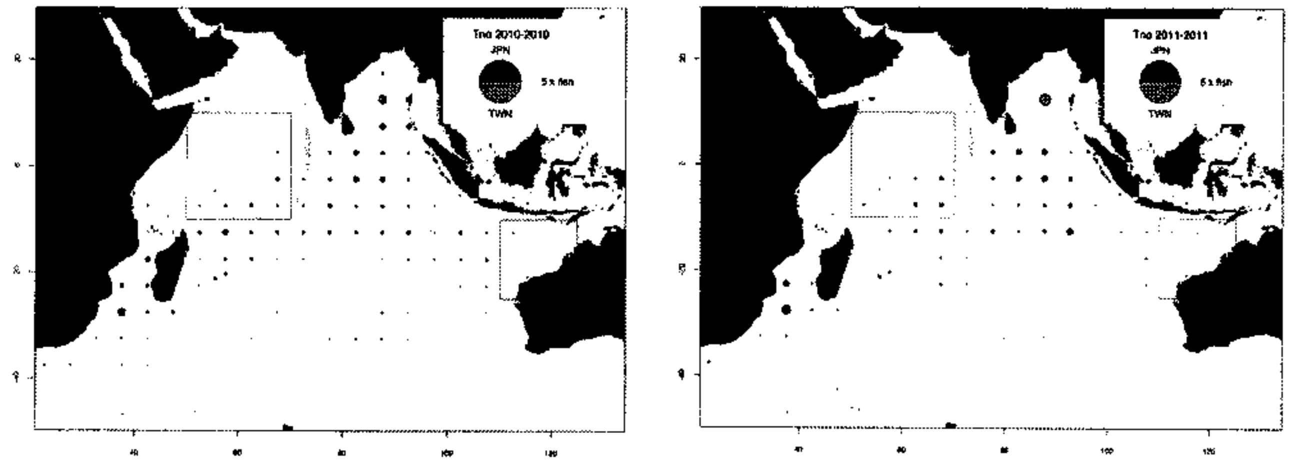

Fig. 4a–b. Black marlin: Time-area catches (in number of fish) of black marlin as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for 2010 and 2011 by fleet. Red lines represent the boundaries of the marlin hot spots identified by the WPB (Data as of October 2012)

TABLE 3. Best scientific estimates of the catches of black marlin by type of fishery for the period 1950–2011 (in metric tonnes) (Data as of October 2012)

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
LL	846	1,633	1,288	1,371	1,500	1,896	1,431	2,286	2,003	2,000	2,106	1,842	2,620	1,802	1,465	1,559
GN	47	60	118	491	1,769	2,278	1,634	1,626	1,629	2,259	2,687	2,062	2,469	3,412	4,185	3,835
HL	15	19	25	176	240	683	446	568	920	461	643	721	1,055	1,566	1,371	1,496
OT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**908**	**1,712**	**1,431**	**2,038**	**3,510**	**4,856**	**3,512**	**4,480**	**4,552**	**4,721**	**5,437**	**4,625**	**6,143**	**6,780**	**7,021**	**6,890**

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

Black marlin: Uncertainty of time–area catches

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

Retained catches are uncertain for some fisheries (Fig. 5), due to the fact that:

- catch reports often refer to total catches of all three marlin species combined; catches by species are estimated by the Secretariat for some artisanal (gillnet/longline fishery of Sri Lanka and artisanal fisheries of India, Iran and Pakistan) and industrial (longliners of Indonesia and Philippines) fisheries.
- catches of non-reporting industrial longliners (India, NEI) and the gillnet fishery of Indonesia are estimated by the Secretariat using alternative information.
- catches are likely to be incomplete for industrial fisheries for which the black marlin is not a target species.
- conflicting catch reports: Longline catches from the Republic of Korea are reported as nominal catches, and catch and effort reports are conflicting, with higher catches recorded in the catch and effort table. For this reason, the Secretariat revised the catches of black marlin for the Republic of Korea over the time-series using both datasets. Although the new catches estimated by the Secretariat are thought to be more accurate, catches of black marlin remain uncertain for this fleet.
- a lack of catch data for most sport fisheries.
- the catch series used by the WPB in 2011 and that to be used for the WPB in 2012 are slightly different, following an increase in the catches estimated in recent years for the fleets of India (longline and trolling), and Indonesia (gillnet).
- Discards are unknown, but considered to be low for most industrial fisheries, mainly longliners. This species is usually kept for crew consumption if not marketed. Discards of black marlin may also occur in the driftnet fishery of I.R. Iran, as this species has no commercial value in this country.

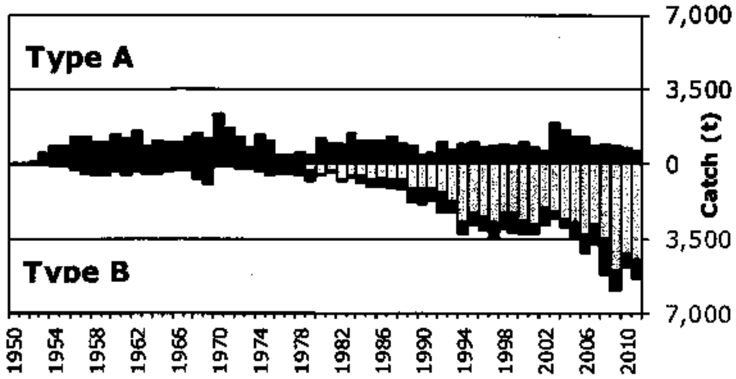

Fig. 5. Black marlin: Uncertainty of annual catch estimates for black marlin (Data as of October 2012). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (Type A) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets

Black marlin: Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid in 2010 and 2011 are provided in Fig. 6, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2010 and 2011are provided in Fig. 7.

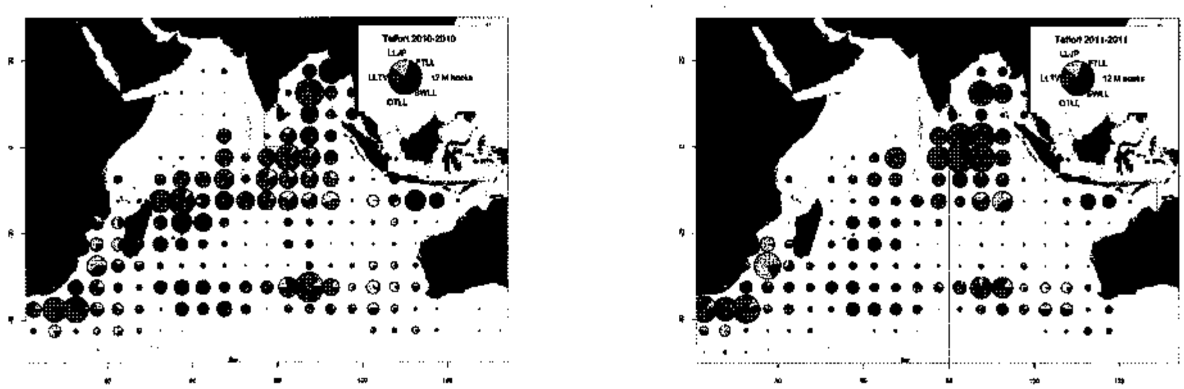

Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of November 2012)
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

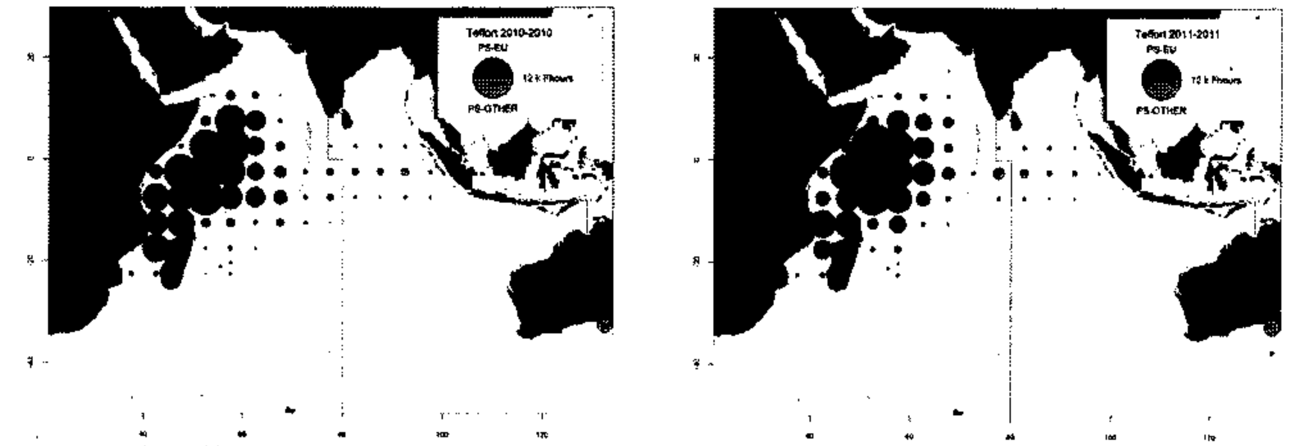

Fig. 7. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

Black marlin: Catch–per–unit–effort (CPUE) trends

Catch rate time series for the longline fleets of Japan and Taiwan,China (Fig. 8) show a similar decreasing trend from 1960's until the end of 2000's. There is no available data for the longline fleet of Taiwan,China for the 1950's and part of the 1960's. Catch rates as calculated based on Japanese dataset show a strong decreasing trend in the early 1950's, in the very beginning of the commercial fisheries. Nevertheless it is important to highlight the doubts on the reliability of the results based on aggregated data sets not fully reviewed by experts on Japanese longline fisheries. The sharp decline between 1952 and 1958 in the Japanese black marlin CPUE series does not reflect the trend in abundance.

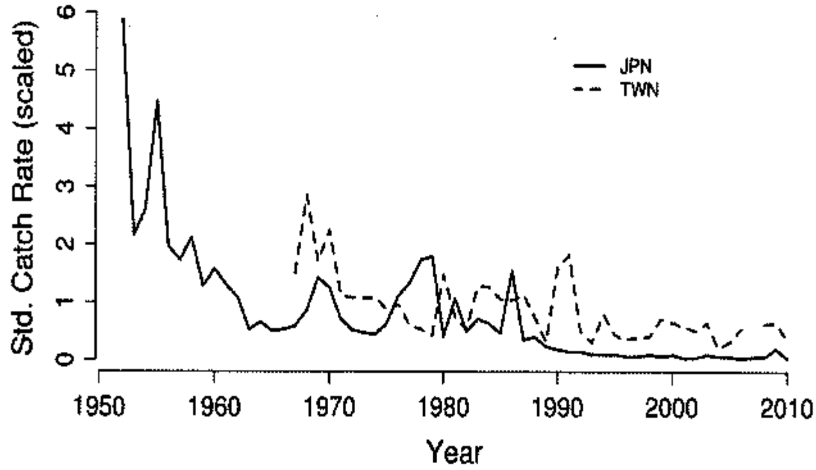

Fig. 8. Black marlin: Standardised catch rates of black marlin for Japan (JPN) and Taiwan,China (TWN) as calculated based on the IOTC catch and effort aggregated dataset. Values were scaled with respect to the mean of 1970–1979 period

No catch and effort data are available from sports fisheries, other than for partial data from the sports fisheries of Kenya; or other artisanal (gillnet fisheries of Iran and Pakistan, gillnet/longlines of Sri Lanka, gillnets of Indonesia) or industrial fisheries (NEI longliners and all purse seiners).

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

Average fish weight can only be assessed for the longline fishery of Japan since 1970 and Taiwan,China since 1980. The number of specimens measured on Japanese longliners in recent years is, however, very low (Fig. 9).

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

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

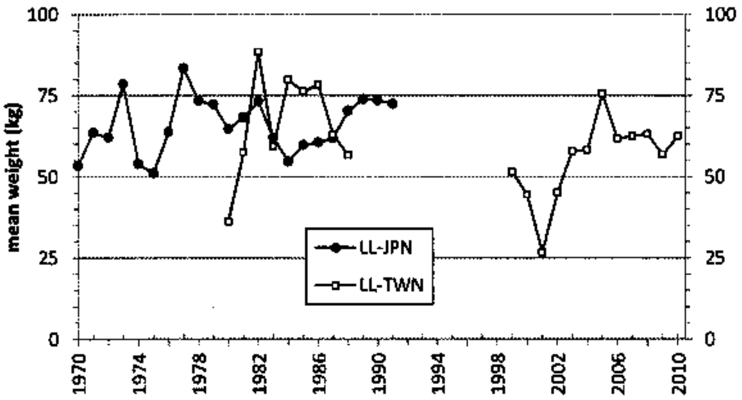

Fig. 9. Black marlin: Average weight of black marlin (kg) estimated from the size samples available for longliners of Japan (1970–2009) and Taiwan,China (1980–2010). Note: Average weights are shown only for years in which 300 or more specimens were sampled for length

Stock Assessment

No quantitative stock assessment for black marlin in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Billfish. However, a preliminary estimation of stock indicators was attempted on the longline catch and effort datasets from Japan and Taiwan,China that represent the best available information. Standardised CPUE exhibited dramatic declines since the beginning of the Japanese longline fishery (Fig. 7) and catches in the initial core areas have also decreased substantially. However, there is considerable uncertainty about the degree to which these indicators, prior to 1958, represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trend. 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. Black marlin (*Makaira indica*) stock status summary

Management Quantity	Aggregate Indian Ocean
2011 catch estimate	6,890 t
Mean catch from 2007–2011	6,292 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2011}/F_{MSY} (80% CI)	–
B_{2011}/B_{MSY} (80% CI)	–
SB_{2011}/SB_{MSY}	–
B_{2011}/B_{1958} (80% CI)	–
SB_{2011}/SB_{1958}	–
$B_{2011}/B_{1958, F=0}$	–
$SB_{2011}/SB_{1958, F=0}$	–

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APPENDIX XV
EXECUTIVE SUMMARY: BLUE MARLIN

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

Status of the Indian Ocean blue marlin (BUM: *Makaira nigricans*) resource

TABLE 1. Blue marlin: Status of blue marlin (*Makaira nigricans*) in the Indian Ocean

Area[1]	Indicators		2012 stock status determination
Indian Ocean	Catch 2011:	12,115 t	Uncertain
	Average catch 2007–2011:	9,443 t	
	MSY (range):	unknown	
	F_{2011}/F_{MSY} (range):	unknown	
	SB_{2011}/SB_{MSY} (range):	unknown	
	SB_{2011}/SB_0 (range):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No quantitative stock assessment is currently available for blue marlin in the Indian Ocean which is considered developed enough for the provision of management advice. Due to a lack of reliable fishery data and poor quality of available data for several gears, only very preliminary stock indicators can be used. The standardised longline CPUE series suggest that there was a decline in the early 1980s, followed by a constant or slightly increasing abundance over the last 20 years. This contrasts with the majority of non-standardised indicators which suggest a decline in abundance since the 1980s. Therefore the stock status is determined as being uncertain (Table 1). However, aspects of species biology, productivity and fisheries combined with the data on which to base a quantitative assessment is a cause for concern.

Outlook. The decrease in longline catch and effort in recent years has lowered the pressure on the Indian Ocean stock as a whole, although 2011 catches increased substantially to 12,115 t. There is insufficient information to evaluate the effect this will have on the resource at this point in time. Given the concerning results obtained from the preliminary stock assessments carried out in 2012 for blue marlin, the data and other inputs for stock assessment urgently needs to be revised so that a new assessment may be carried out in 2013. The following key points should be noted:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches of blue marlin are highly uncertain and need to be reviewed as problems in the catch series from the main fleets catching blue marlin were identified in 2012.
- improvement in data collection and reporting is required to further improve the assessment of the stock.
- research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Blue marlin 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 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's).*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Resolution 11/04 *on a regional observer scheme*
- Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 12/07 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*

FISHERIES INDICATORS

General

Blue marlin (*Makaira nigricans*) is a large oceanic apex predator that inhabits tropical and subtropical waters of the Indian and Pacific oceans. Table 2 outlines some key life history parameters relevant for management.

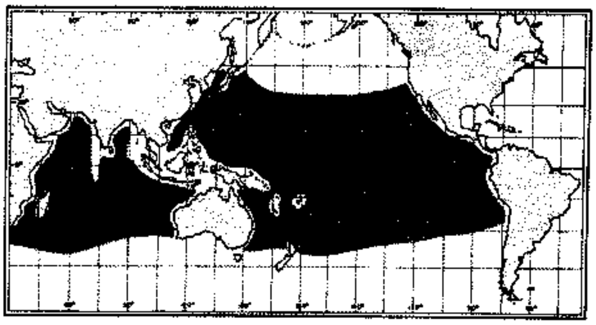


Fig. 1. Blue marlin: The worldwide distribution of blue marlin (Source: Nakamura 1984).

TABLE 2. Blue marlin: Biology of Indian Ocean blue marlin (*Makaira nigricans*).

Parameter	Description
Range and stock structure	Little is known on the biology of the blue marlin in the Indian Ocean. Blue marlin is a highly migratory, large oceanic apex predator that inhabits tropical and subtropical waters of the Indian and Pacific oceans. It is capable for long-distance migrations: in the Pacific Ocean a tagged blue marlin is reported to have travelled 3000 nm in 90 days. In the Indian Ocean a blue marlin tagged in South Africa was recaptured after 90 days at liberty off the southern tip of Madagascar crossing Mozambique Channel and travelling 1398 km with average speed 15.5 km/day. Other tagging off western Australia revealed potential intermixing of Indian Ocean and Pacific stocks: one individual was caught in the Pacific Indonesian waters. Blue marlin is a solitary species and prefers the warm offshore surface waters (>24°C); it is scarce in waters less than 100 m in depth or close to land. The blue marlin's prey includes octopuses, squid and pelagic fishes such as tuna and frigate mackerel. Feeding takes place during the daytime, and the fish rarely gather in schools, preferring to hunt alone. No information on stock structure is currently available in the Indian Ocean; thus for the purposes of assessment, one pan-ocean stock is assumed. However, spatial heterogeneity in stock indicators (catch–per–unit–effort trends) for other billfish species indicates that there is potential for localised depletion.
Longevity	~28 years; Females n.a.; Males n.a.
Maturity (50%)	**Age**: 2–4 years; females n.a. males n.a. **Size**: females ~50 cm LJFL (55 kgs whole weight); males ~80 cm LJFL (40 kgs total weight).
Spawning season	No spawning grounds have been identified in the Indian ocean. Females may produce up to 10 million eggs. In the Pacific ocean, blue marlin are thought to spawn between May and September off the coast of Japan.
Size (length and weight)	Maximum: Females 430 cm FL; 910 kgs whole weight; males 300 cm FL; 200 kgs whole weight. Young fish grow very quickly in length then put on weight later in life. Sexual dimorphism in size, growth rates and size and age at maturity - females reach larger sizes, grow faster and mature later than males. L-W relationships for the Indian Ocean are: females TW=0.00000026*LJFL^3.59846 males TW=0.00001303*LJFL^2.89258, both sexes mixed TW=0.00000084*LJFL^3.39404. TW in kg, LJFL in cm

n.a. = not available. Sources: Nakamura 1985, Cry et al. 1990, Shimose et al. 2008, Froese & Pauly 2009, Romanov & Romanova 2012

Blue marlin: Catch trends

Blue marlin are caught mainly by drifting longlines (60%) and gillnets (30%) with remaining catches recorded under troll and hand lines (Table 3, Fig. 2). Blue marlin is an important target for several artisanal and sport/recreational fleets. Blue marlin are also known to be taken in purse seine fisheries, but are not currently being reported. The reported catches of blue marlin are higher than those of black marlin and striped marlin combined, although this is highly uncertain due to under reporting and misidentification. In recent years, the fleets of Taiwan,China (longline), Indonesia (longline and gillnet), Sri Lanka (gillnet) and India (gillnet) are attributed with the highest catches of blue marlin (Fig. 3). The distribution of blue marlin catches has changed since the 1980's with most of the reported catch now taken in the western areas of the Indian Ocean. However, non-reporting of catches by gillnet fleets in the northern Indian Ocean masks the true level of harvest in the Indian Ocean.

Catch trends for blue marlin are variable; this may reflect the variability of targeting by longline fleets and the level of reporting for other gears. The catches of blue marlin by drifting longline fisheries were more or less stable until the mid-80's, at around 3,000 t, steadily increasing since then. The largest catches were recorded in 1997 (~11,000 t). Longline catches have been recorded by Taiwan,China and Japan fleets and, recently, Indonesia and several NEI fleets (Fig. 3). In recent years, deep-freezing longliners from Japan and Taiwan,China have reported most of the catches of blue marlin in waters of the western and central tropical Indian Ocean and, to a lesser extent, the Mozambique Channel and the Arabian Sea (Fig. 4).

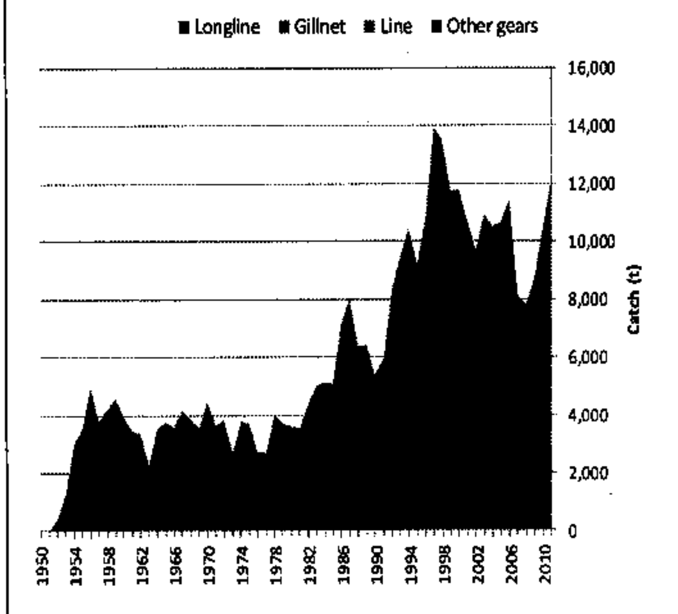


Fig. 2. Blue marlin: Catches of blue marlin per gear and year recorded in the IOTC database (1950–2011)

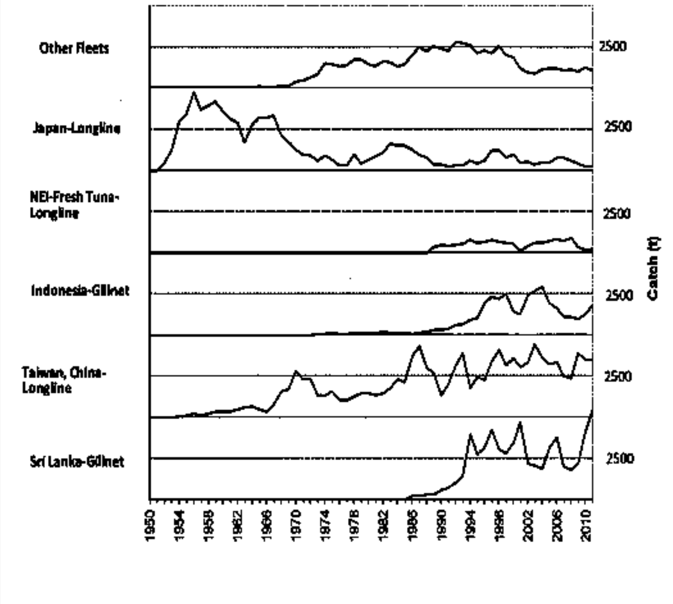


Fig. 3. Blue marlin: Catches of blue marlin by fleet recorded in the IOTC database (1950–2011)

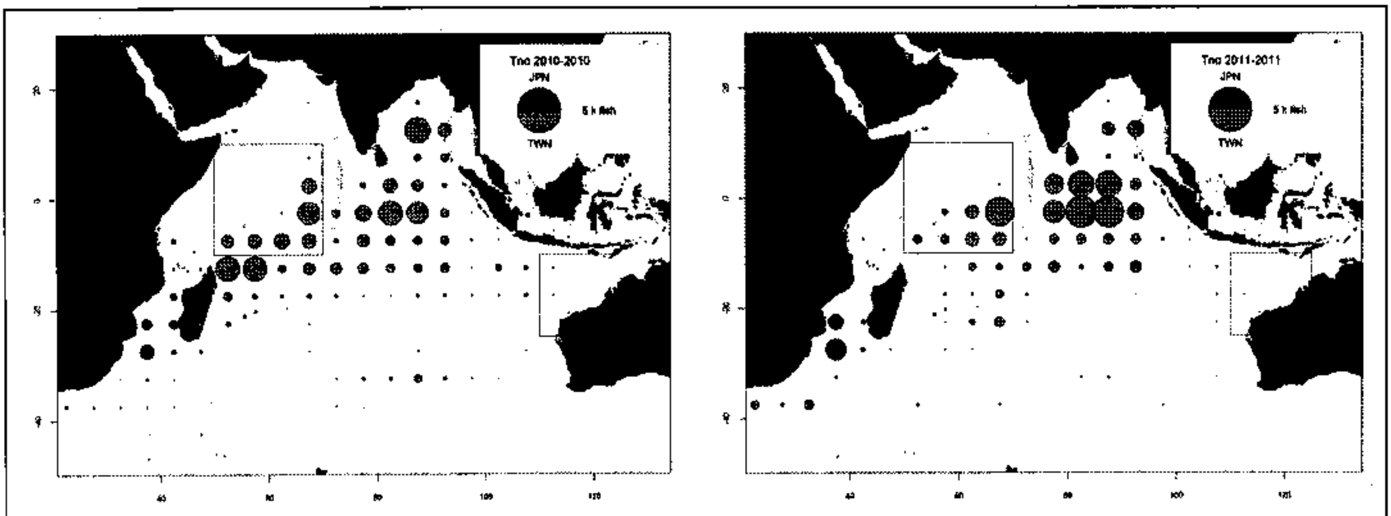


Fig. 4a–b. Blue marlin: Time-area catches (in number of fish) of blue marlin as reported for the longline (LL) fisheries of Japan (JPN) and Taiwan,China (TWN) for 2010 and 2011 by fleet. Red lines represent the boundaries of the marlin hot spots identified by the WPB

TABLE 3. Blue marlin: Best scientific estimates of the catches of blue marlin by type of fishery for the period 1950–2011 (in metric tonnes) (Data as of October 2012)

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
LL	2,563	3,513	3,477	4,964	7,122	7,216	7,455	8,796	8,516	7,432	7,559	6,014	5,848	6,395	6,186	6,586
GN	3	4	10	192	2,419	2,787	2,219	2,124	1,972	3,188	3,843	2,061	1,922	2,281	4,261	5,512
HL	11	23	33	312	340	32	23	33	26	42	33	15	34	35	47	16
OT	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**2,576**	**3,540**	**3,521**	**5,468**	**9,881**	**10,036**	**9,698**	**10,953**	**10,513**	**10,662**	**11,436**	**8,090**	**7,805**	**8,711**	**10,494**	**12,115**

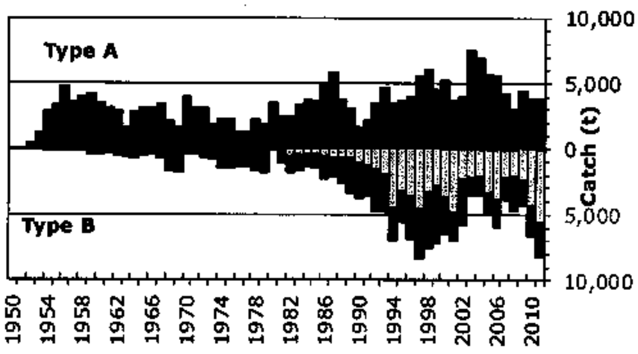
Fisheries: Gillnet (GN); Longline (LL); Hook-and-Line (HL), including handline, trolling, baitboat, and sport fisheries; Other gears (OT)

Blue marlin: Uncertainty of time–area catches

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

Retained catches are poorly known for most fisheries (Fig. 5) due to:

- catch reports often refer to total catches of all three marlin species combined; catches by species are estimated by the Secretariat for some artisanal (gillnet/longline fishery of Sri Lanka and artisanal fisheries of India, Iran and Pakistan) and industrial (longliners of Indonesia and Philippines) fisheries.
- catches of non-reporting industrial longliners (India, NEI) and the gillnet fishery of Indonesia are estimated by the Secretariat using alternative information.
- catches are likely to be incomplete for industrial fisheries for which the blue marlin is not a target species.
- conflicting catch reports: Longline catches from the Republic of Korea are reported as nominal catches, and catch and effort reports are conflicting, with higher catches recorded in the catch and effort table. For this reason, the Secretariat revised the catches of blue marlin for the Republic of Korea over the time-series using both datasets. Although the new catches estimated by the Secretariat are thought to be more accurate, catches of blue marlin remain uncertain for this fleet.
- a lack of catch data for most sport fisheries.
- There have not been significant changes to the catches of blue marlin since the WPB in 2011.
- Discards are unknown for most industrial fisheries, mainly longliners. Discards of blue marlin may also occur in the driftnet fishery of I.R. Iran, as this species has no commercial value in this country.



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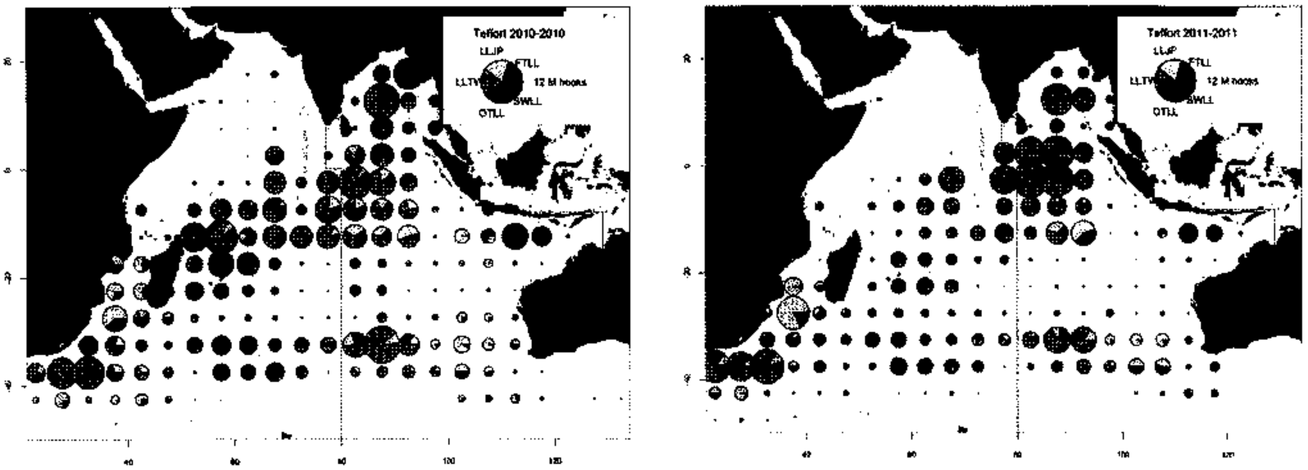
Blue marlin: Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid in 2010 and 2011 are provided in Fig. 6, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2010 and 2011 are provided in Fig. 7.



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LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
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OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

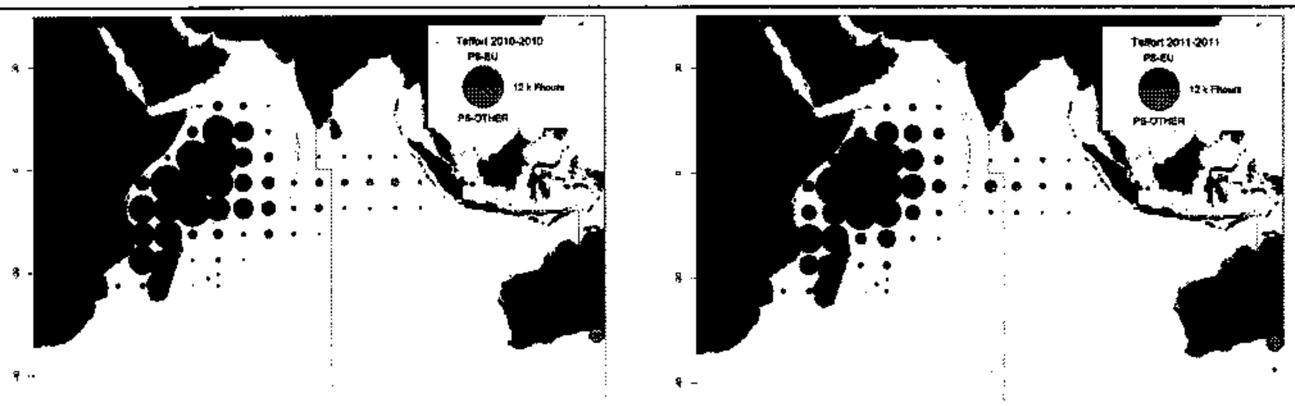

Fig. 7. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

Blue marlin: Catch–per–unit–effort (CPUE) trends

Catch rate time series for the longline fleet of Japan (Fig. 8) show a decreasing trend from the mid-1950's until the early 1960s. There is no available data for the longline fleet of Taiwan,China for the 1950's and part of the 1960's. Catch rates as calculated based on Japanese dataset show a strong decreasing trend in the early 1950's, in the very beginning of the commercial fisheries. Nevertheless it is important to highlight the doubts on the reliability of the results based on aggregated data sets not fully reviewed by experts on Japanese longline fisheries. The sharp decline between 1952 and 1956 in the Japanese blue marlin CPUE series does not reflect the trend in abundance, although the gradual decline identified since 1970 until 2011 is more likely to represent actual declines in stock abundance (Fig. 8). The catches and CPUE series estimated for blue marlin were very different between the longline fleets of Japan and Tawain,China. In particular the longline fleet data for Taiwan,China was highly variable and warranted further investigation and documentation.

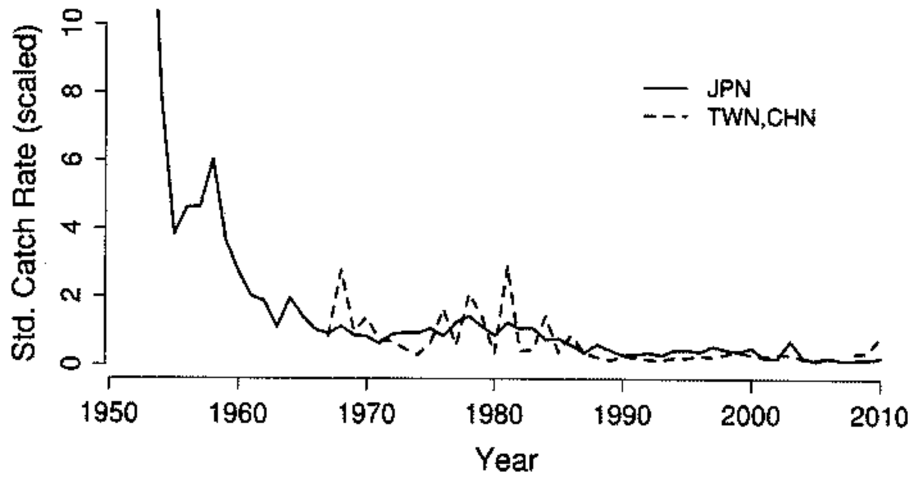

Fig. 8. Blue marlin: Standardised catch rates of blue marlin for Japan (JPN) and Taiwan,China (TWN) as calculated based on the IOTC catch and effort aggregated dataset. Values were scaled with respect to the mean of 1970–1979 period

Of the blue marlin CPUE series available for assessment purposes, the Japanese NCEP series should be used in the stock assessment model (Fig. 9).

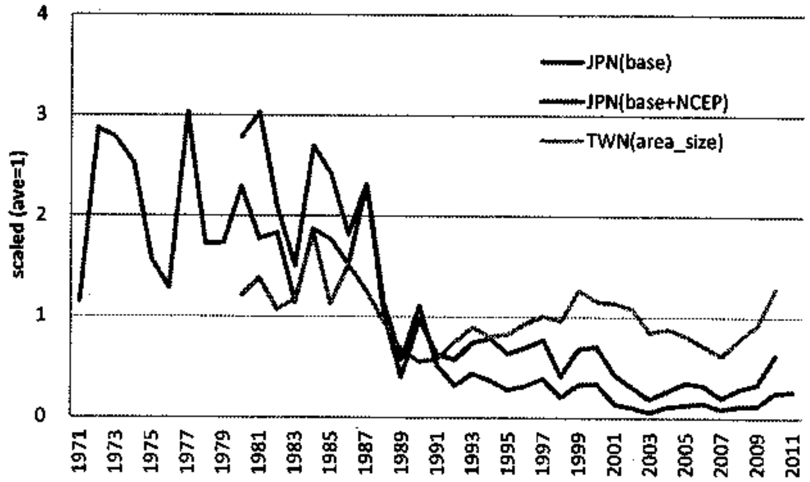

Fig. 9. Blue marlin: Comparison of the multiple CPUE series for longline fleets of Japan and Taiwan,China

The recent data for the longline fleet of Taiwan,China, in particular for 2010, should be examined in detail to determine if the increased catches are a function of relocated effort into areas where blue marlin were not previously targeted, or an alternative reason.

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

Average fish weight can only be assessed for the longline fishery of Japan since 1970 and Taiwan,China since 1980. However, the number of specimens measured on Japanese longliners in recent years is very low and miss-identification of striped and blue marlin may be occurring in the Taiwanese longline fishery; the length frequency distributions derived from samples collected on longliners from Taiwan,China differ greatly from those collected on longliners flagged in Japan (Fig. 6).

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

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

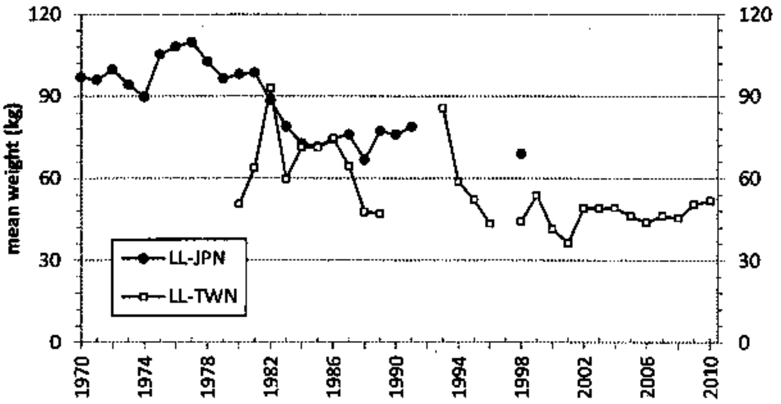

Fig. 6. Blue marlin: Average weight of blue marlin (kg) estimated from the size samples available for longliners of Japan (1970–2009) and Taiwan,China (1980–2010). Note: Average weights are shown only for years in which 300 or more specimens were sampled for length

STOCK ASSESSMENT

In 2012, a range of quantitative modelling methods (ASPIC, Bayesian Production Model, and Surplus Production with catchability changes over decades) were applied to the blue marlin. The assessments carried out in 2012 were preliminary and the results were developed for exploratory and discussion purposes only.

Alternative approaches should be explored using the following in 2013:

- More effort should be made in examining the standardised CPUE data for use in the assessments as these are the basis for assessments without any age/length data available.
- Age/Length data over time should be collected so that alternative approaches could be examined.
- Examining whether a constant or variable catchability (q) is dependent on how well the CPUE is standardised. If the standardisation does not account for the changes, then using variable catchabilities should occur in the assessment.
- Finer spatial resolution and fisheries structure should probably be taken into account in the assessment.

The preliminary estimation of stock indicators attempted on the longline catch and effort datasets from Japan and Taiwan,China represent the best available information (described above). However, there is considerable uncertainty about the degree to which these 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. Blue marlin: Blue marlin (*Makaira nigricans*) stock status summary

Management Quantity	Aggregate Indian Ocean
2011 catch estimate	12,115 t
Mean catch from 2007–2011	9,443 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2011}/F_{MSY} (80% CI)	–
B_{2011}/B_{MSY} (80% CI)	–
SB_{2011}/SB_{MSY}	–
B_{2011}/B_{1971} (80% CI)	–
SB_{2011}/SB_{1971}	–
$B_{2011}/B_{1971, F=0}$	–
$SB_{2011}/SB_{1971, F=0}$	–

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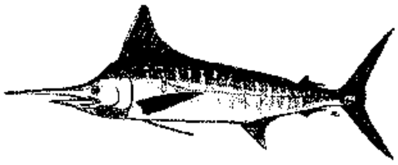
APPENDIX XVI
EXECUTIVE SUMMARY: STRIPED MARLIN

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



Status of the Indian Ocean striped marlin (MLS: *Tetrapturus audax*) resource

TABLE 1. Striped marlin: Status of striped marlin (*Tetrapturus audax*) in the Indian Ocean

Area[1]	**Indicators**		**2012 stock status determination**
Indian Ocean	Catch 2011:	1,885 t	Uncertain
	Average catch 2007–2011:	2,245 t	
	MSY (range):	unknown	
	F_{2011}/F_{MSY} (range):	unknown	
	SB_{2011}/SB_{MSY} (range):	unknown	
	SB_{2011}/SB_0 (range):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No quantitative stock assessment is currently available for striped marlin in the Indian Ocean which is considered developed enough for the provision of management advice. Due to a lack of reliable fishery data and poor quality of available data for several gears, only very preliminary stock indicators can be used. The standardised CPUE series suggest that there was a sharp decline in the early 1980s, followed by slower decline since 1990. This contrasts with the majority of non-standardised indicators which suggest a decline in abundance since the 1980s. Therefore stock status remains uncertain (Table 1). However, aspects of the biology, productivity and fisheries for this species combined with the data poor status on which to base a quantitative assessment are a cause for considerable concern.

Outlook. The decrease in longline catch and effort in recent years has lowered the pressure on the Indian Ocean stock as a whole, however there is insufficient information to evaluate the effect this will have on the resource. Given the concerning results obtained from the preliminary stock assessments carried out in 2012 for striped marlin, the data and other inputs for stock assessment urgently needs to be revised so that a new assessment may be carried out in 2013. The following key points should be noted:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches of striped marlin are highly uncertain and need to be reviewed as problems in the catch series from the main fleets catching striped marlin were identified in 2012.
- improvement in data collection and reporting is required to further improve the assessment of the stock.
- research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Striped marlin (*Tetrapturus audax*) 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 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's).*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*

- Resolution 11/04 *on a regional observer scheme*
- Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 12/07 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*

FISHERIES INDICATORS

Striped marlin: General

Striped marlin (*Tetrapturus audax*) is a large oceanic apex predator that inhabits tropical and subtropical Indo-Pacific oceans (Fig. 1). Table 2 outlines some key life history parameters relevant for management. There is limited reliable information on the catches of this species and no information on the stock structure or growth and mortality in the Indian Ocean.

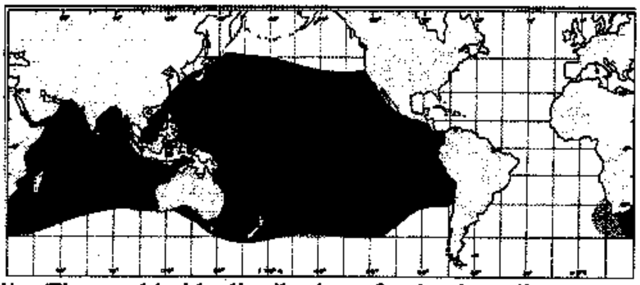


Fig. 1. Striped marlin: The worldwide distribution of striped marlin (Source: Nakamura, 1984)

TABLE 2. Striped marlin: Biology of Indian Ocean striped marlin (*Tetrapturus audax*)

Parameter	Description
Range and stock structure	A large oceanic apex predator that inhabits tropical and sub-tropical waters of the Indian and Pacific oceans. Some rare individuals have been reported in the Atlantic Ocean but there is no information to indicate the presence of a breeding stock in this area. Its distribution is different from other marlins in that it prefers more temperate or cooler waters however in the Indian Ocean it is common in tropical zone: off the east African coast (0-10°S), the south and western Arabian Sea, the Bay of Bengal, and north-western Australian waters. Several transoceanic migrations were reported in the Indian Ocean (the longest is from Kenya to Australia). Therefore a single stock hypothesis apparently is most appropriate for stock assessement and management.
Longevity	~10 years. Females and males n.a.
Maturity (50%)	Age: 2–3 years. Females and males n.a.
Spawning season	Highly fecund batch spawner. Females may produce up to 20 million eggs. Usually spawn in the vicinity of oceanic islands, seamounts or coastal areas, associated with local increases in primary productivity. In the Indian Ocean larvae of this species was recorded off the Somalian coast, around Reunion and Mauritius and off north-western Australia.
Size (length and weight)	In the Indian Ocean documented maximum size for females 314 cm LJFL and 330 kg TW, for males 292 cm LJFL, 185 kg TW. However males longer than 260 cm LJFL are rare. Young fish grow very quickly in length then put on weight later in life. Striped marlin is the smallest of the marlin species; but unlike the other marlin species, striped marlin males and females grow to a similar size. L-W relationships for the Indian Ocean are: females TW=0.00000009*LJFL**3.76598 males TW=0.00005174*LJFL**2.59633, both sexes mixed TW=0.00000039*LJFL**3.50024, TW in kg, LJFL in cm.

n.a. = not available. Sources: Nakamura 1985, Gonzalez-Armas et al. 1999, Hyde et al. 2006, Froese & Pauly 2009, Kadagi et al. 2011, Romanov & Romanova 2012

Striped marlin: Catch trends

Striped marlin are caught almost exclusively by drifting longlines (98%) with remaining catches recorded by gillnets and troll lines (Table 3, Fig. 2). Striped marlin are also known to be taken in purse seine fisheries, but are not currently being reported. Catch trends for striped marlin are variable; however, this may reflect the level of targeting by longline fleets and the level. The catches of striped marlin by drifting longlines have been changing over time, between 2,000 t and 7,000 t (Fig. 2), although this is highly uncertain due to under reporting and misidentification.

Longline catches have been recorded by Taiwan,China, Japan, Republic of Korea fleets and, recently, Indonesia and several NEI fleets (Fig. 3). Taiwan,China and Japan have reported large drops in the catches of striped marlin for its longline fleets since the mid-1980's and mid-1990's, respectively. The reason for such decreases in catches is not fully understood. Between the early 1950s and the late 1980s part of the Japanese fleet was licensed to operate within the EEZ of Australia, reporting relatively high catches of striped marlin in the area, in particular in waters off northwest Australia. High catches of the species were also reported in the Bay of Bengal during this period, by both Taiwan,China and Japanese longliners. The distribution of reported striped marlin catches has changed since the 1980's with most of the catch now taken in the western areas of the Indian Ocean (Fig. 4). However, non-reporting of catches by the gillnet and troll line fisheries masks the true level of harvest in the Indian Ocean.

These changes of fishing area and catches over the years are thought to be related to changes in the type of access agreements to EEZs of coastal countries in the Indian Ocean, rather than changes in the distribution of the species over time. However, since 2007, catches in the northwest Indian Ocean have dropped markedly, in tandem with a reduction of longline effort in the area as a consequence of maritime piracy off Somalia (Fig. 4).

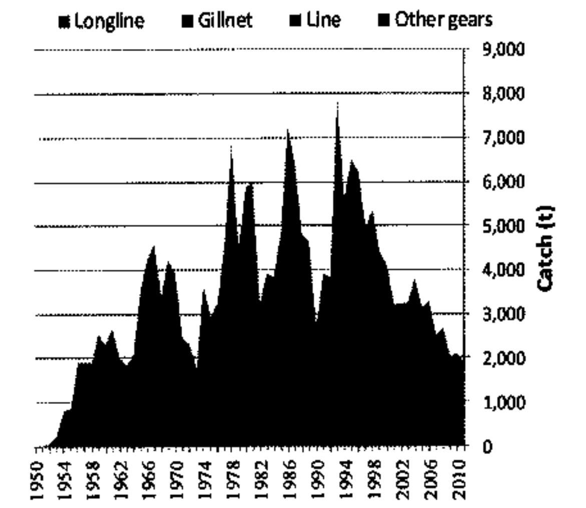


Fig. 2. Striped marlin: Catches of striped marlin per gear and year recorded in the IOTC database (1960–2011)

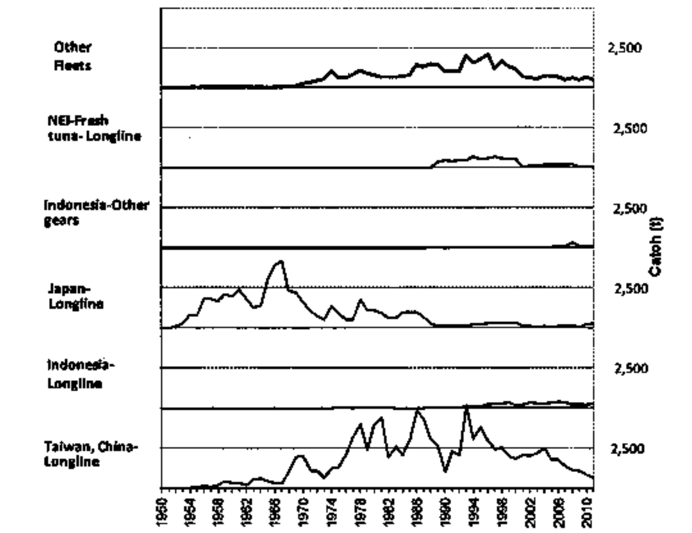


Fig. 3. Striped marlin: Catches of striped marlin by fleet recorded in the IOTC database (1960–2011)

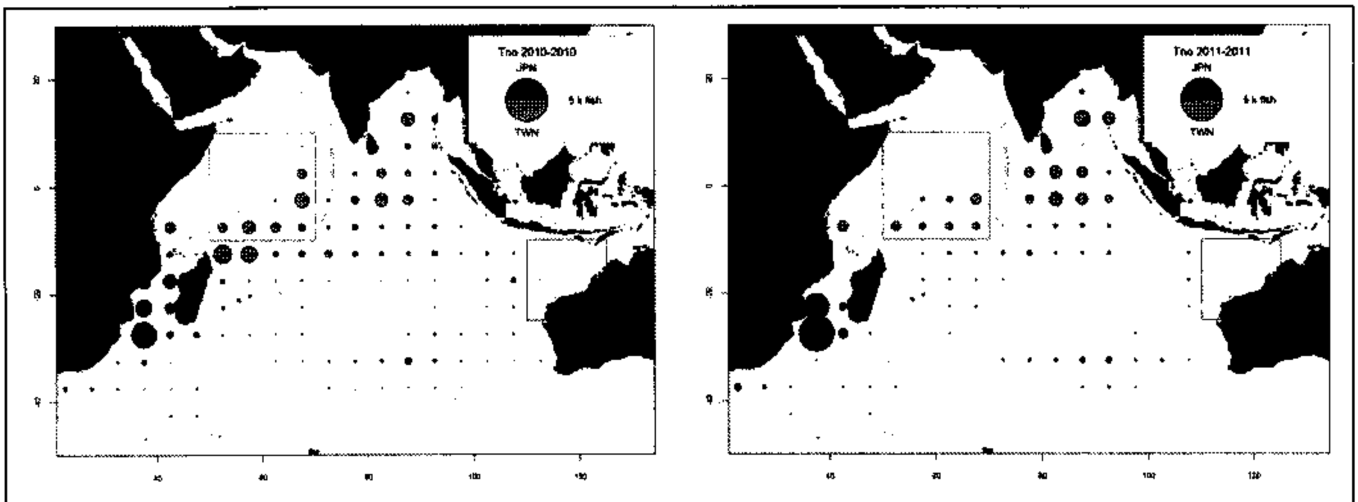


Fig. 4a–b. Striped marlin: Time-area catches (in number of fish) of striped marlin as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for 2010 and 2011 by fleet. Red lines represent the boundaries of the marlin hot spots identified by the WPB (Data as of October 2012)

TABLE 3. Striped marlin: Best scientific estimates of the catches of striped marlin by type of fishery for the period 1950–2011(in metric tonnes) (Data as of October 2012)

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
LL	1,024	3,077	3,612	5,039	5,038	2,936	3,113	3,113	3,708	2,943	3,071	2,403	2,258	1,837	1,889	1,756
GN	2	3	6	24	59	117	65	66	74	81	125	96	351	132	149	115
HL	-	-	1	11	47	71	41	66	39	115	69	15	83	63	62	15
OT	-	-	2	-	-	0	0	-	0	-	-	-	-	-	-	-
Total	**1,026**	**3,080**	**3,622**	**5,074**	**5,145**	**3,124**	**3,220**	**3,245**	**3,822**	**3,139**	**3,266**	**2,514**	**2,692**	**2,032**	**2,100**	**1,885**

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

Striped marlin: Uncertainty of time–area catches

Retained catches are reasonably well known for the main industrial fleets (Fig. 5) although they remain uncertain for many smaller fleets:

- Catch reports refer to total catches of all three marlin species; catches by species have to be estimated by the IOTC Secretariat for some industrial fisheries (longliners of Indonesia and Philippines).
- Catches of non-reporting industrial longliners (India, NEI) estimated by the IOTC Secretariat using alternative information. As they are not reported by the countries concerned, catches are likely to be incomplete for some industrial fisheries for which the striped marlin is seldom the target species.
- Conflicting catch reports: The catches for longliners flagged to the Republic of Korea, reported as nominal catches and catches and effort, are conflicting with higher catches recorded in the catch and effort table. For this reason, the IOTC Secretariat revised the catches of striped marlin over the time-series using both datasets. Although the new catches estimated by the IOTC Secretariat are thought to be more accurate, catches of striped marlin remain uncertain for this fleet.
- There have not been significant changes to the catches of striped marlin since the WPB in 2011.
- Discards are thought to be low although they are unknown for most industrial fisheries, mainly longliners. Discards of striped marlin may also occur in the driftnet fishery of Iran, as this species has no commercial value in this country.

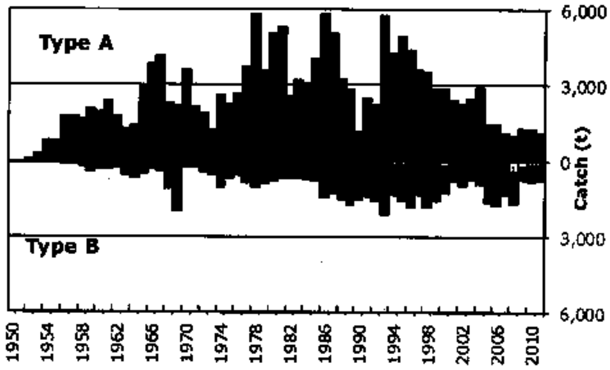


Fig. 5. Striped marlin: Uncertainty of annual catch estimates for striped marlin (Data as of October 2012). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (Type A) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets

Striped marlin: Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid for 2010 and 2011 are provided in Fig. 6, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2010 and 2011 are provided in Fig. 7.

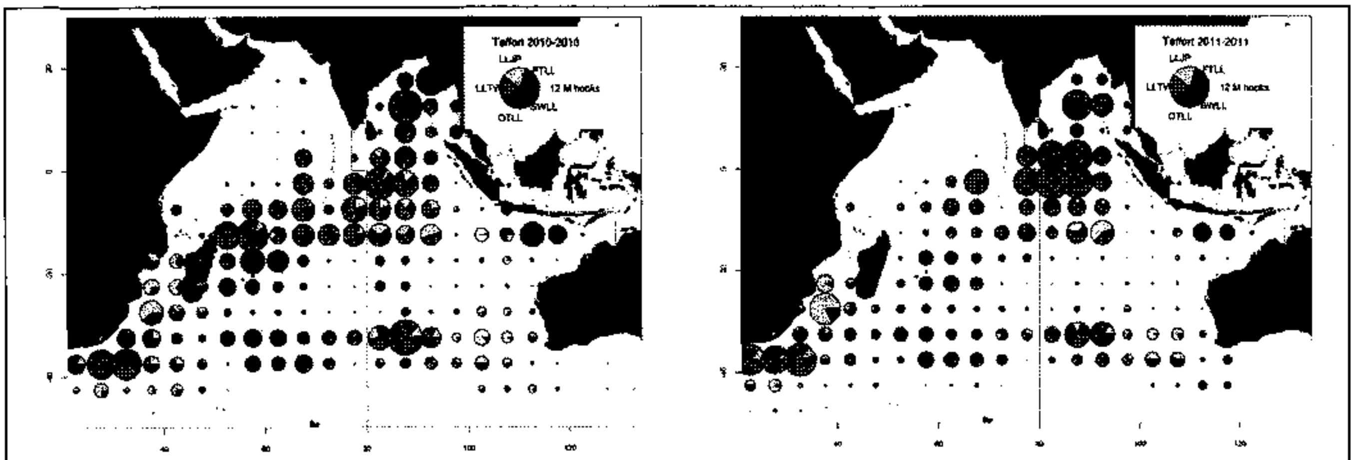


Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

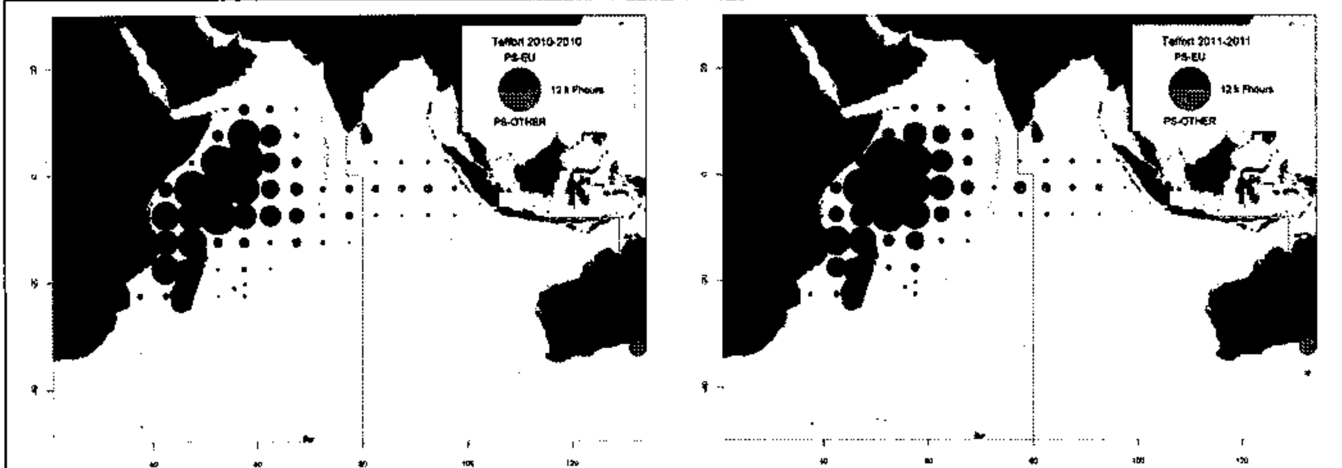


Fig. 7. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

Striped marlin: Catch–per–unit–effort (CPUE) trends

Standardised CPUE series have not yet been developed. Nominal CPUE series are however available from some industrial longline fisheries (primarily the Japanese longline fleet; Figs. 7 and 8) although catches are thought to be incomplete (catches of non-target species are not always recorded in logbooks). No catch and effort data are available from sports fisheries, other than for partial data from the sports fisheries of Kenya; or other artisanal (gillnet fisheries of I.R. Iran and Pakistan, gillnet/longlines of Sri Lanka, gillnets of Indonesia) or industrial fisheries (NEI longliners and all purse seiners).

Catch rate time series for the longline fleet of Japan (Fig. 8) show a variable but decreasing trend from the mid-1950's until the early 1990s. Catch rates as calculated based on Japanese dataset show a strong decreasing trend in the late-1950's, in the very beginning of the commercial fisheries. Nevertheless it is important to highlight the doubts on the reliability of the results based on aggregated data sets not fully reviewed by experts on Japanese longline fisheries. The sharp decline between 1952 and 1960 in the Japanese striped marlin CPUE series does not reflect the trend in abundance, although the gradual decline identified since 1960 until 2011 is more likely to represent actual declines in stock abundance (Fig. 8).

The catches and CPUE series estimated for striped marlin were very different between the longline fleets of Japan and Taiwan,China. In particular the longline fleet data for Taiwan,China was highly variable and warranted further investigation and documentation. There is no available data for the longline fleet of Taiwan,China for the 1950's and part of the 1960's.

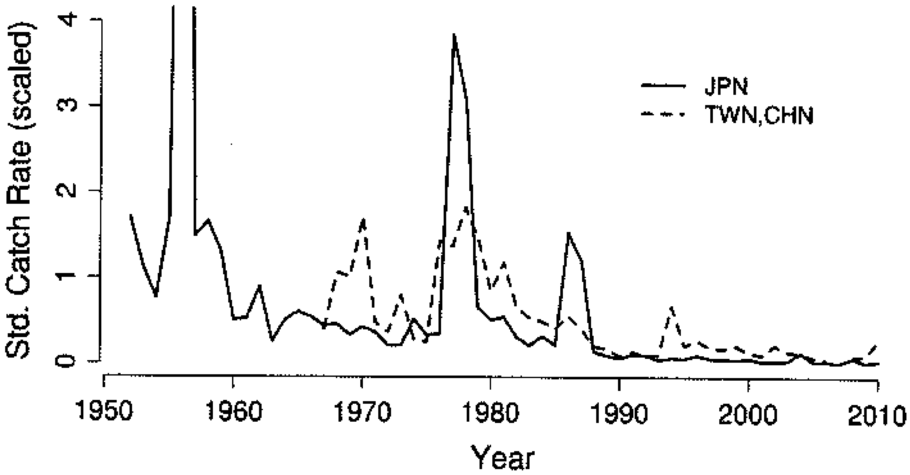


Fig. 8. Striped marlin: Standardised catch rates of striped marlin for Japan (JPN) and Taiwan,China (TWN,CHN) as calculated based on the IOTC catch and effort aggregated dataset. Values were scaled with respect to the mean of 1970–1979 period

Of the striped marlin CPUE series available for assessment purposes, the Taiwan,China series should be used in stock assessment models (Fig. 9).

The recent data for the longline fleet of Taiwan,China, in particular for 2010, should be examined in detail to determine if the increased catches are a function of relocated effort into areas where striped marlin were not previously targeted, or an alternative reason.

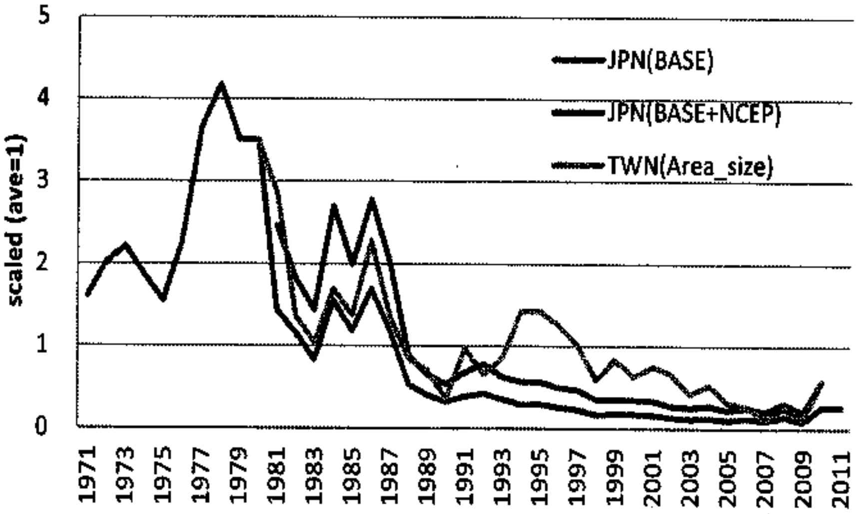


Fig. 9. Striped marlin: Comparison of the multiple CPUE series for longline fleets of Japan and Taiwan,China

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

Average fish weight can only be assessed for the longline fishery of Japan since 1970 and Taiwan,China since 1980. However, the number of specimens measured on Japanese longliners in recent years is very low and miss-identification of striped and blue marlin may be occurring in the Taiwanese longline fishery; the length frequency distributions derived from samples collected on Taiwanese longliners differ greatly from those collected on longliners flagged in Japan (Fig. 10).

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

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

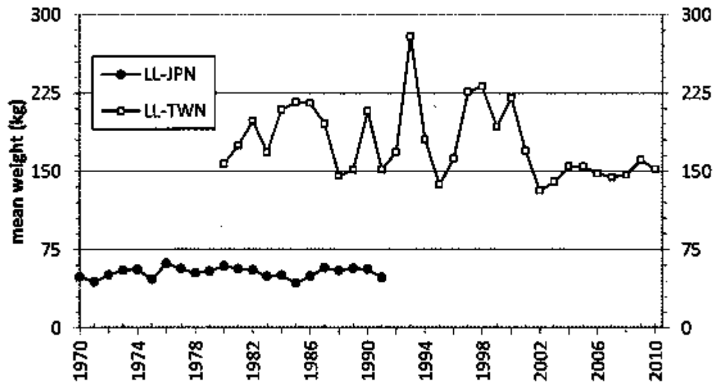


Fig. 10. Striped marlin: Average weight of striped marlin (kg) estimated from the size samples available for longliners of Japan (1970–2009) and Taiwan,China (1980–2010). Note: Average weights are shown only for years in which 300 or more specimens were sampled for length

STOCK ASSESSMENT

In 2012, a range of quantitative modelling methods (ASPIC, Bayesian Production Model, and Surplus Production with catchability changes over decades) were applied to the striped marlin. The assessments carried out in 2012 were preliminary and the results were developed for exploratory and discussion purposes only.

Alternative approaches should be explored using the following in 2013:

- More effort should be made in examining the standardised CPUE data for use in the assessments as these are the basis for assessments without any age/length data available.
- Age/Length data over time should be collected so that alternative approaches could be examined.
- Examining whether a constant or variable catchability (q) is dependent on how well the CPUE is standardised. If the standardisation does not account for the changes, then using variable catchabilities should occur in the assessment.
- Finer spatial resolution and fisheries structure should probably be taken into account in the assessment.

The preliminary estimation of stock indicators attempted on the longline catch and effort datasets from Japan and Taiwan,China represent the best available information (described above). However, there is considerable uncertainty about the degree to which these 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. Striped marlin (*Tetrapturus audax*) stock status summary

Management Quantity	Aggregate Indian Ocean
2011 catch estimate	1,885 t
Mean catch from 2007–2011	2,245 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2011}/F_{MSY} (80% CI)	–
B_{2011}/B_{MSY} (80% CI)	–
SB_{2011}/SB_{MSY}	–
B_{2011}/B_{1971} (80% CI)	–
SB_{2011}/SB_{1971}	–
$B_{2011}/B_{1971, F=0}$	–
$SB_{2011}/SB_{1971, F=0}$	–

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Romanov EV (2002) Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. Fish Bull 100(1):90–105

Romanov E, Romanova N (2012) Size distribution and length-weight relationships of some billfish (marlins, spearfish and swordfish) in the Indian Ocean. IOTC–2012–WPB10–18, 12 p

APPENDIX XVII
EXECUTIVE SUMMARY: INDO-PACIFIC SAILFISH

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

Status of the Indian Ocean Indo-Pacific sailfish (SFA: *Istiophorus platypterus*) resource

TABLE 1. Indo-Pacific sailfish: Status of Indo-Pacific sailfish (*Istiophorus platypterus*) in the Indian Ocean

Area[1]	**Indicators**		**2012 stock status determination**
Indian Ocean	Catch 2011: Average catch 2007–2011:	32,503 t 27,103 t	Uncertain
	MSY (range): F_{2011}/F_{MSY} (range): SB_{2011}/SB_{MSY} (range): SB_{2011}/SB_0 (range):	unknown unknown unknown unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No quantitative stock assessment is currently available for Indo-Pacific sailfish in the Indian Ocean; due to a lack of fishery data and poor quality of available 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 data poor status on which to base a more formal assessment are a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

Outlook. The increase in longline catch and effort in recent years is a substantial cause for concern for the Indian Ocean stock as a whole, however there is not sufficient information to evaluate the effect this will have on the resource. The following key points should be noted:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches of Indo-Pacific sailfish are highly uncertain and need to be reviewed.
- improvement in data collection and reporting is required to assess the stock.
- research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Indo-Pacific sailfish (*Istiophorus platypterus*) 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 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Resolution 11/04 *on a regional observer scheme*
- Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 12/07 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of*

competence and access agreement information

- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*

FISHERIES INDICATORS

Indo-Pacific sailfish: General

Indo-Pacific sailfish (*Istiophorus platypterus*) is a large oceanic apex predator that inhabits tropical and subtropical Indo-Pacific oceans. Table 2 outlines some key life history parameters relevant for management. There is limited reliable information on the catches of this species and no information on the stock structure or growth and mortality in the Indian Ocean.

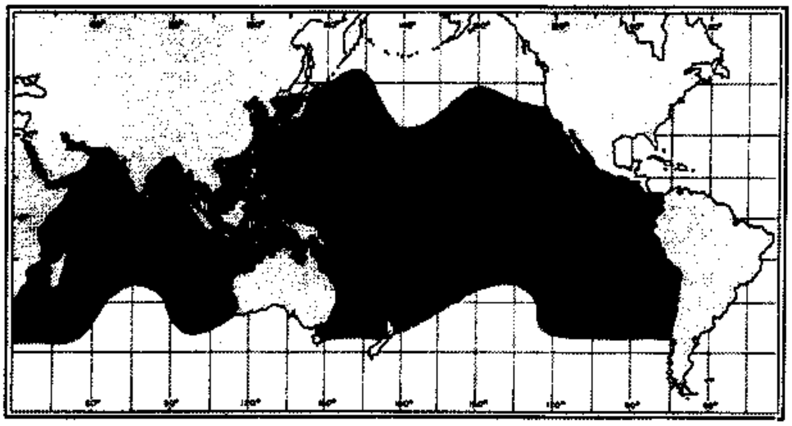

Fig. 1. Indo-Pacific sailfish: The worldwide distribution of Indo-Pacific sailfish (Source: Nakamura, 1984)

TABLE 2. Indo-Pacific sailfish: Biology of Indian Ocean Indo-Pacific sailfish (*Istiophorus platypterus*)

Parameter	Description
Range and stock structure	Found throughout the tropical and subtropical regions of the Pacific and the Indian Oceans. It is mainly found in surface waters above the thermocline, close to coasts and islands in depths from 0 to 200 m. Indo–Pacific sailfish is a highly migratory species and renowned for its speed and (by recreational fishers) for its jumping behaviour — one individual has been reported burst swimming at speeds in excess of 110 km/h. The stock structure of Indo-Pacific sailfish in the Indian Oceans is uncertain: apparently there are local reproductively isolated stocks. At least one stock was reported in the Persian Gulf with no or very little intermixing with open Indian Ocean stocks. However outside of the Gulf no stock differentiation has been determined; thus for the purposes of assessment, one pan-ocean stock is assumed. However, spatial heterogeneity in stock indicators (catch–per–unit–effort trends) for other billfish species indicates that there is potential for localised depletion.
Longevity	Females: 11–13 years; Males: 7–8 years
Maturity (50%)	**Age**: females n.a.; males n.a. **Size**: females n.a.; males n.a.
Spawning season	Spawning in Indian waters occurs between December to June with a peak in February and June. In subtropical waters of the southern hemisphere spawning is associated with warmer months: in Mozambique Channel and around Reunion Island high percentage of ripe females occurs in December.
Size (length and weight)	Maximum: 350 cm FL and weight 100 kg total weight. The Indo-Pacific sailfish is one of the smallest-sized billfish species, but is relatively fast growing. Individuals may grow to over 3 m and up to 100kg, and live to around 7 years. Young fish grow very quickly in length then put on weight later in life. Sexual dimorphism in size, growth rates and size and age at maturity - females reach larger sizes, grow faster and mature later than males. Females: 300 cm LJFL, 50+ kg total weight; Males: 200 cm LJFL, 40+ kg total weight in the Indian Ocean. Recruitment into the fishery: varies by fishing method, apparently at age 0+ and size less than 100 cm LJFL for artisanal fleets. The average weight of fish caught in the Kenyan sports fishery is ~25 kgs whole weight.

n.a. = not available.

Sources: Nakamura 1985, Hoolihan 2003, 2004, 2006, Speare 2003, Hoolihan & Luo 2007, Sun et al. 2007, Froese & Pauly 2009, Ndegwa & Herrera 2011

Indo-Pacific sailfish: Catch trends

Indo-Pacific sailfish is targeted by artisanal fisheries in the Maldives, Yemen and Sri Lanka and by sport/recreational fisheries including in Kenya, Mauritius and Seychelles. Indo-Pacific sailfish is caught mainly by gillnets (78%) with remaining catches reported from troll and hand lines (15%), longlines (7%) or other gears (Table 3, Fig. 2). I.P. sailfish are also known to be taken in purse seine fisheries, but are not currently being reported. The minimum average annual catch estimated for the period 2007 to 2011 is 27,103 t, however this figure is highly uncertain due to under reporting and misidentification. In recent years, the countries attributed with the highest catches of Indo-Pacific sailfish are situated in the Arabian Sea (India, Iran, Pakistan and Sri Lanka). Smaller catches are reported for line fishers in Comoros and Mauritius and by Indonesia longliners.

Catches of Indo-Pacific sailfish greatly increased since the mid-1990's in response to the development of a gillnet/longline fishery in Sri Lanka (Fig. 3) and, especially, the extension in the area of operation of Iranian gillnet vessels to areas beyond the EEZ of I.R. Iran. The catches of Iranian gillnets (Fig. 3) increased dramatically, more than six-fold, after the late 1990's.

Catches of Indo-Pacific sailfish by drifting longlines (Table 3) and other gears do not show any specific trends in recent years. However, it is likely that longline fleets under report catches of this species due to its little commercial value. In recent years, deep-freezing longliners from Japan have reported catches of Indo-Pacific sailfish in the central western Indian Ocean, between Sri Lanka and the Maldives and the Mozambique Channel (Fig. 4).

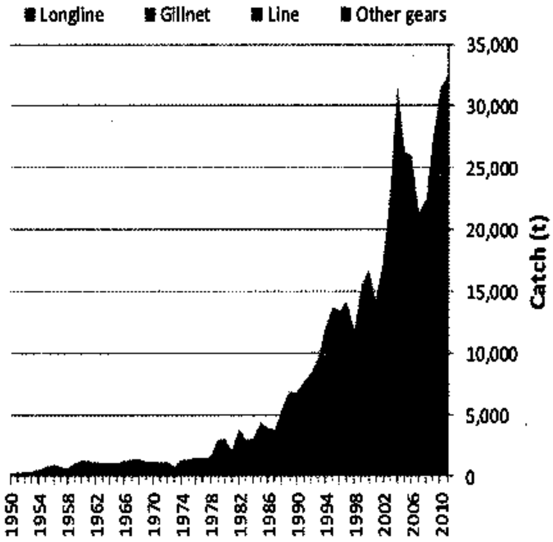

Fig. 2. Indo-Pacific sailfish: Catches of Indo-Pacific sailfish per gear and year recorded in the IOTC Database (1960–2011)

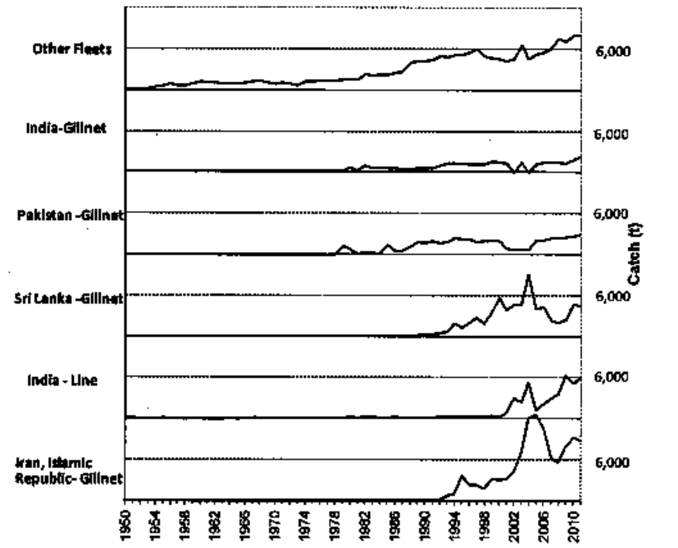

Fig. 3. Indo-Pacific sailfish: Catches of Indo-Pacific sailfish by fleet recorded in the IOTC Database (1960–2011)

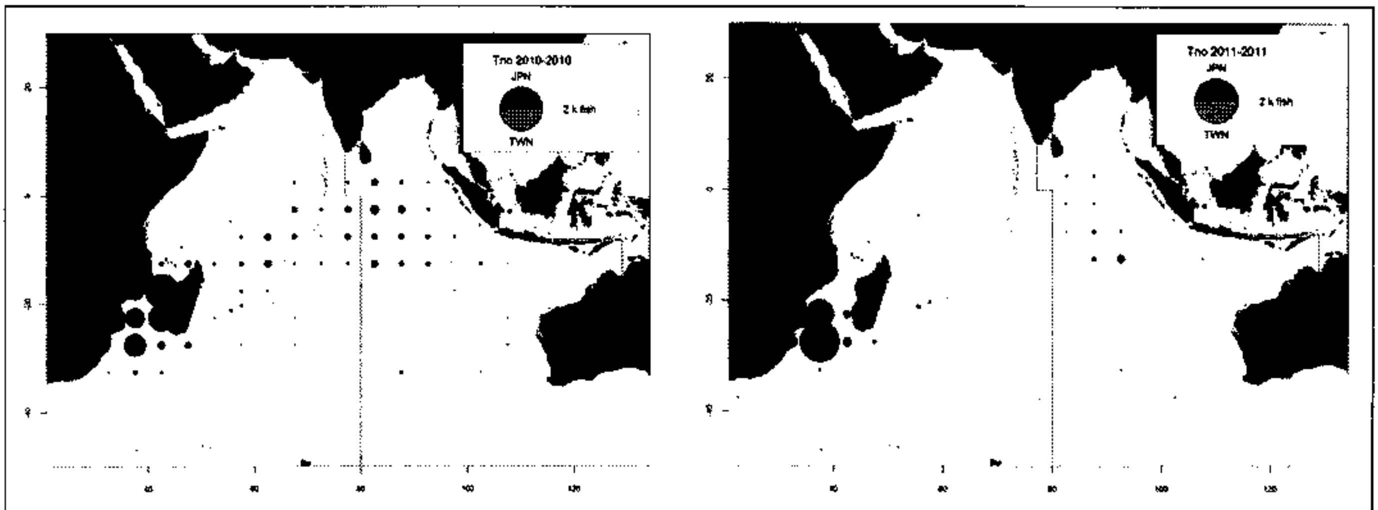

Fig. 4a–b. Indo-Pacific sailfish: Time-area catches (in number of fish) of Indo-Pacific sailfish as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for 2010 and 2011 by fleet. Data as of October 2012

TABLE 3. Indo-Pacific sailfish: Best scientific estimates of the catches of Indo-Pacific sailfish by type of fishery for the period 1950–2011 (in metric tonnes). Data as of October 2012

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
LL	299	773	449	342	1,425	1,418	1,144	2,035	933	1,395	1,396	2,055	2,263	1,291	1,163	1,172
GN	165	186	549	2,390	7,620	16,001	10,722	16,486	23,053	20,505	19,612	14,064	14,111	17,646	22,685	23,003
HL	155	233	378	1,211	2,244	5,188	4,940	4,558	7,310	4,367	5,052	5,206	6,075	8,814	7,629	8,329
OT	-	9	48	19	1	55	297	-	240	-	-	-	12	-	-	-
Total	**618**	**1,202**	**1,424**	**3,963**	**11,290**	**22,662**	**17,102**	**23,080**	**31,535**	**26,267**	**26,059**	**21,325**	**22,461**	**27,752**	**31,476**	**32,503**

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

Indo-Pacific sailfish: Uncertainty of time–area catches

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

Retained catches are poorly known for most fisheries (Fig. 5) due to:

- Catch reports often refer to total catches of all billfish species combined; catches by species are estimated by the Secretariat for some artisanal (gillnet/longline fishery of Sri Lanka and artisanal fisheries of India and Pakistan) and industrial (longliners of Indonesia and Philippines) fisheries.
- Catches of IP sailfish reported for some fisheries may refer to the combined catches of more than one species of billfish, in particular marlins and shortbill spearfish (gillnet fishery of Iran and many coastal fisheries).
- Catches likely to be incomplete for some artisanal fisheries (gillnets of Pakistan, pole and lines of Maldives) due to under-reporting.
- Catches are likely to be incomplete for industrial fisheries for which the Indo-Pacific sailfish is not a target species.
- A lack of catch data for most sport fisheries.
- There have not been significant changes to the catches of Indo-Pacific sailfish since 2011.
- Discards are unknown for most industrial fisheries, mainly longliners (for which they are presumed to be moderate-high).

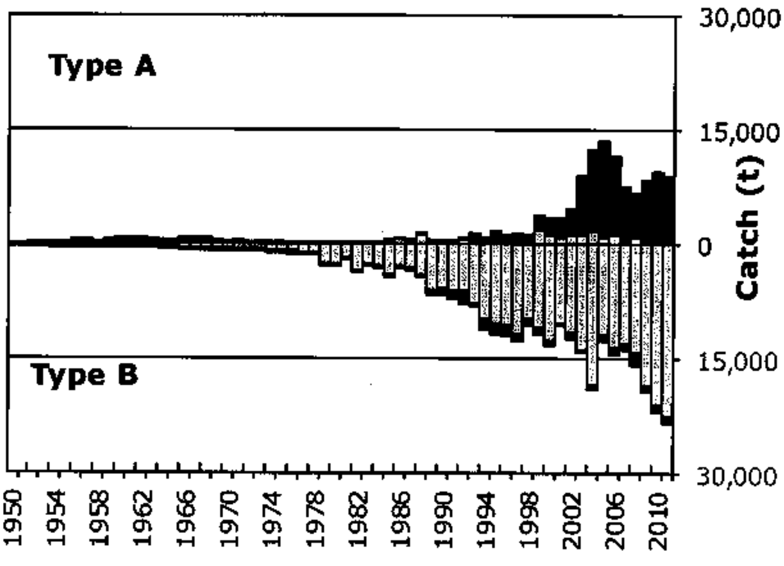

Fig. 5. Indo-Pacific sailfish: Uncertainty of annual catch estimates for Indo-Pacific sailfish. (Data as of October 2012). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (Type A) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets

Indo-Pacific sailfish: Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid from 2007 to 2011 are provided in Fig. 6, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2007 to 2010 are provided in Fig. 7.

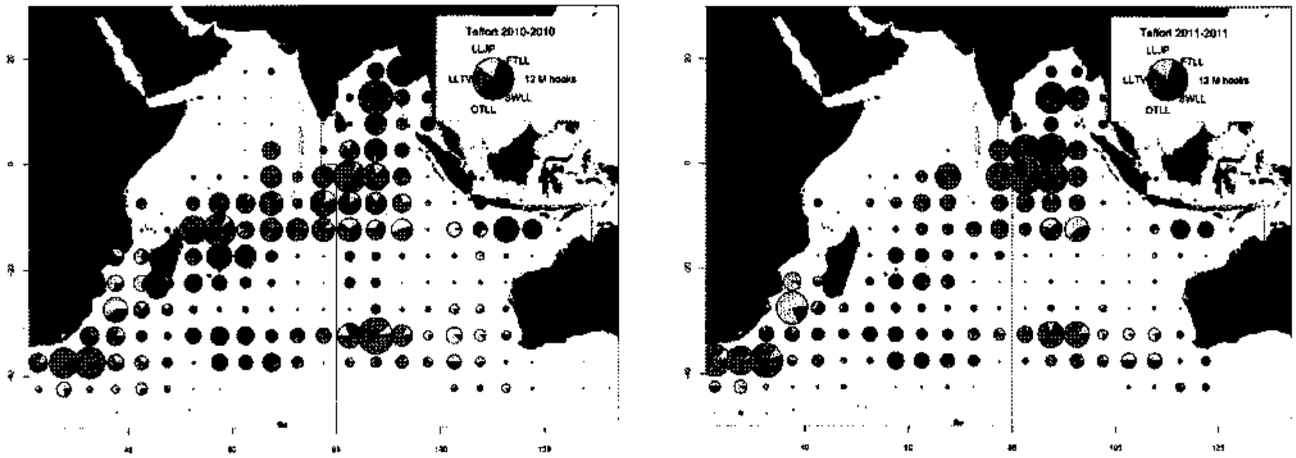

Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

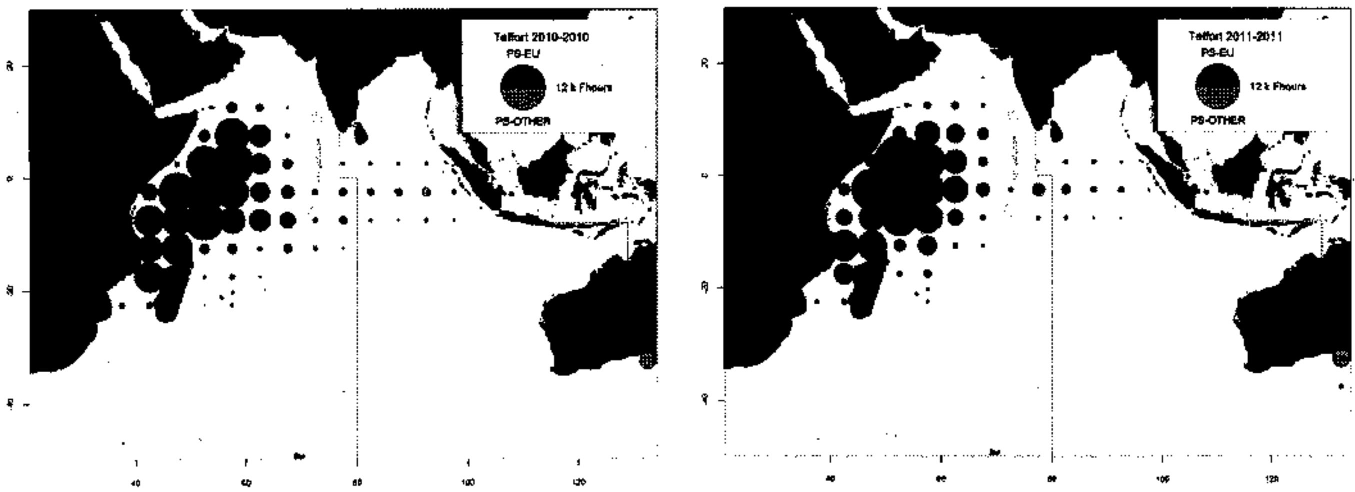

Fig. 7. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2010 (left) and 2011 (right) (Data as of October 2012)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

Indo-Pacific sailfish: Catch–per–unit–effort (CPUE) trends

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

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

Average fish weight can only be assessed for the longline fishery of Japan since 1970 and the gillnet/longline fishery of Sri Lanka since the late 1980s (Fig. 8). The number of specimens measured on Japanese longliners in recent years is, however, very low. Furthermore, the specimens discarded might be not accounted for in industrial fisheries, where they are presumed to be of lower size (possible bias of existing samples).

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

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

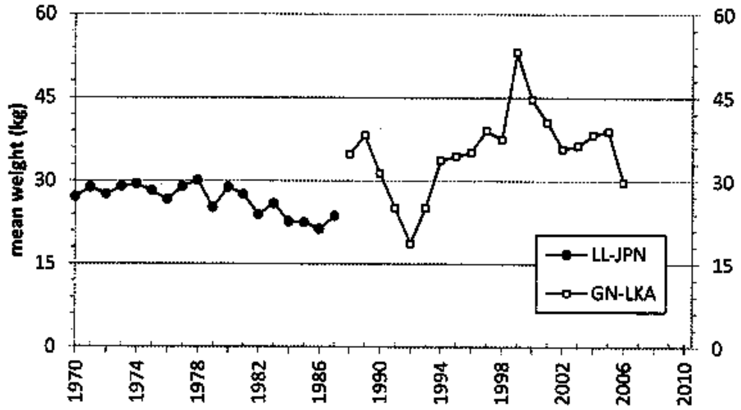

Fig. 8. Indo-Pacific sailfish: Average weight of Indo-Pacific sailfish (kg) estimated from the size samples available for longliners of Japan (1970–2009) and gillnets of Sri Lanka (1980–2010). Note: Average weights are shown only for years in which 300 or more specimens were sampled for length

STOCK ASSESSMENT

No quantitative stock assessment for Indo-Pacific sailfish in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Billfish. 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 sailfish (*Istiophorus platypterus*) stock status summary

Management Quantity	Aggregate Indian Ocean
2011 catch estimate	32,503 t
Mean catch from 2007–2011	27,103 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2011}/F_{MSY} (80% CI)	–
B_{2011}/B_{MSY} (80% CI)	–
SB_{2011}/SB_{MSY}	–
B_{2011}/B_0 (80% CI)	–
SB_{2011}/SB_0	–
$B_{2011}/B_{0,F=0}$	–
$SB_{2011}/SB_{0,F=0}$	–

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APPENDIX XVIII
EXECUTIVE SUMMARY: BULLET TUNA

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

Status of the Indian Ocean bullet tuna (BLT: *Auxis rochei*) resource

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

Area[1]	Indicators		2012 stock status determination
Indian Ocean	Catch[2] 2011:	4,949 t	
	Average catch[2] 2007–2011:	2,961 t	
	MSY:	unknown	
	F_{2011}/F_{MSY}:	unknown	
	SB_{2011}/SB_{MSY}:	unknown	
	SB_{2011}/SB_0:	unknown	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]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}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. There remains considerable uncertainty about stock structure and about the total catches. 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 following should be noted:

- 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 in the Indian Ocean is currently subject to a number of Conservation and Management Measures adopted by the Commission:

- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area*
- Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 12/07 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of*

competence and access agreement information

- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*

FISHERIES INDICATORS

Bullet tuna: 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. Bullet tuna: 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, Kahraman 2010, Widodo et al. 2012

Bullet tuna – Fisheries and catch trends

Bullet tuna is caught mainly by gillnet, handline, and trolling, across the broader Indian Ocean area (Table 3; 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[1].

TABLE 3. Bullet tuna: Best scientific estimates of the catches of bullet tuna by type of fishery for the period 1950–2011 (in metric tonnes) (Data as of October 2012)

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Purse seine	-	3	10	81	164	200	210	209	169	169	208	213	214	199	171	226
Gillnet	5	9	35	92	694	908	1,186	469	922	545	1,127	1,453	1,089	1,356	2,322	3,970
Line	12	16	72	187	495	595	553	541	473	478	596	808	729	686	617	754
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**17**	**28**	**117**	**360**	**1,353**	**1,704**	**1,948**	**1,219**	**1,565**	**1,192**	**1,932**	**2,474**	**2,032**	**2,241**	**3,110**	**4,949**

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 around 2,000 t until the mid-2000's. The highest reported catches of bullet tuna were taken in 2011 with 4,950 t estimated as being landed. The high catches of bullet tuna recorded since 2006, compared to previous years, are thought to be highly uncertain. 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 Secretariat.

[1] The uncertainty in the catch estimates has been assessed by the IOTC Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of unreporting fisheries for which catches had to be estimated.

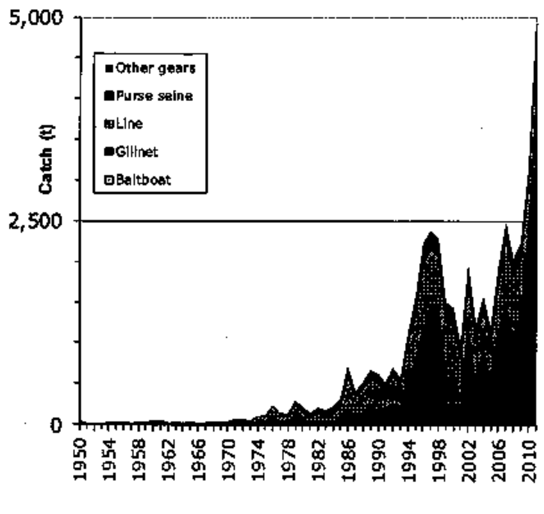


Fig. 1. Bullet tuna: Annual catches of bullet tuna by gear recorded in the IOTC Database (1950–2011)

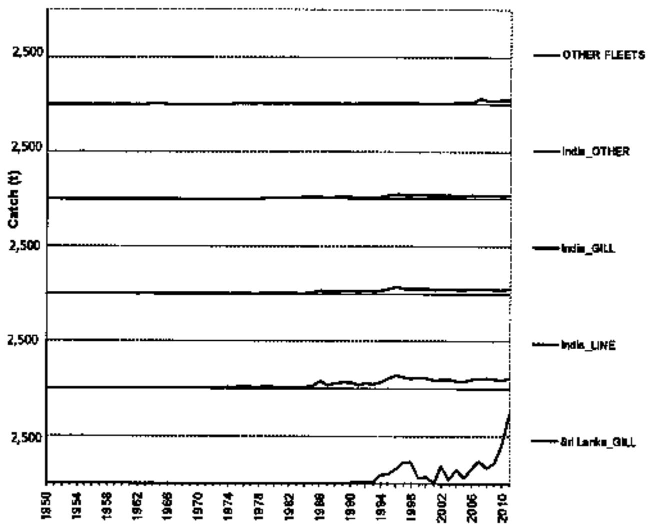


Fig. 2. Bullet tuna: Catches of bullet tuna recorded in the IOTC database for main fishing fleets (1950–2011)

In recent years, the countries attributed with the highest catches of bullet tuna are Sri Lanka and India (Fig. 2). Length frequency data for bullet tuna is only available for some Sri Lanka fisheries and periods.

Bullet tuna – Uncertainty of catches

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

- Aggregation: Bullet tuna are usually not reported by species being aggregated with frigate tunas or, less frequently, other small tuna species.
- Mislabelling: Bullet tuna are usually mislabelled as frigate tuna, their catches reported under the latter species.
- Underreporting: 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 tunas 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.

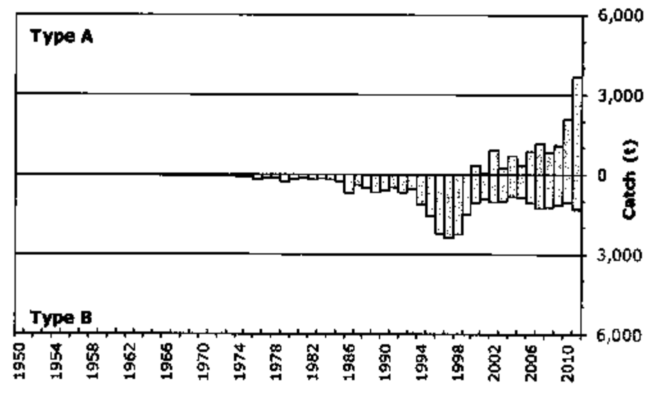


Fig. 3. Bullet tuna: Uncertainty of annual catch estimates for bullet tuna (1950–2011). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the 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 (Data as of October 2012)

- Discard levels are moderate for industrial purse seine fisheries. The EU recently reported discard levels of bullet tuna for its purse seine fleet, for 2003–07, estimated using observer data.
- Changes to the catch series: The catch series of bullet tuna has changed substantially since the WPNT meeting in 2011, following reviews of catches of frigate tuna and bullet tuna for the coastal fisheries in India, with an

increased proportion of frigate tuna to the previously reported total catches of both frigate tuna and bullet tuna.

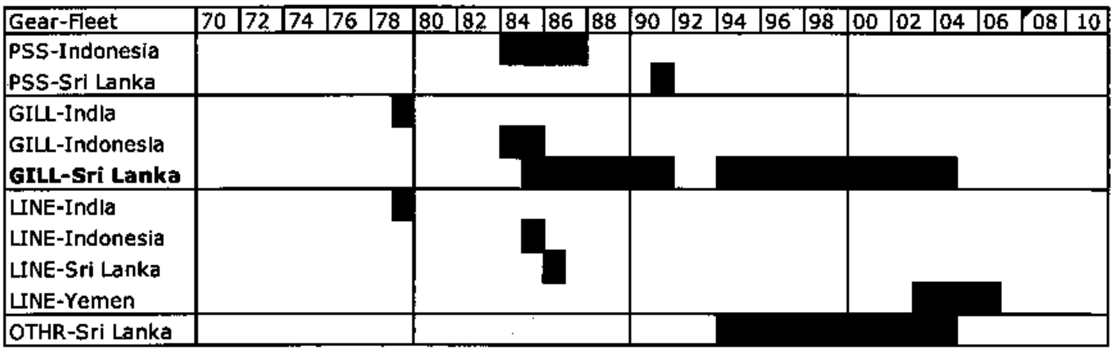
Bullet tuna – Effort trends

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

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

Catch-and-effort series are not available for most fisheries (Table. 4) and, when available, they 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. 5).

TABLE. 4. Bullet tuna: Availability of catches and effort series, by fishery and year (1970–2011)[2]. Note that no catch and effort data are available for the period 1950–78



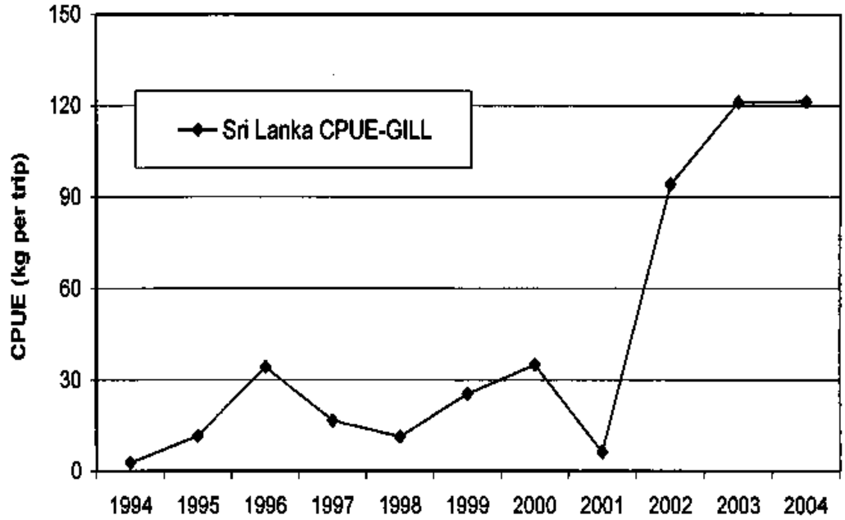


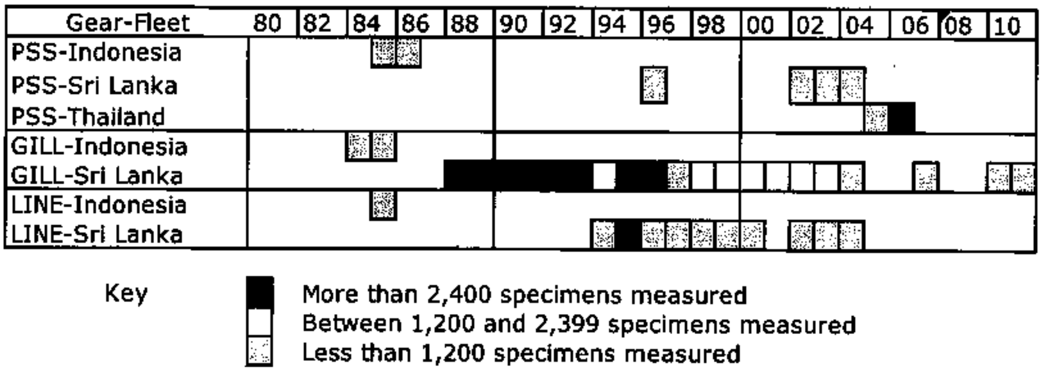
Fig. 5. Bullet tuna: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004)

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 (Table 5).
- Catch-at-Size(age) data 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. Length distributions derived from the data available for some selected fisheries are shown in Fig. 6
- Sex ratio data have not been provided to the Secretariat by CPCs.

[2] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

TABLE. 5. Bullet tuna: Availability of length frequency data, by fishery and year (1980–2011)[3]. Note that no length frequency data are available for the period 1950–83



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
2011 catch estimate	4,949 t
Mean catch from 2007–2011	2,961 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2011}/F_{MSY} (80% CI)	–
B_{2011}/B_{MSY} (80% CI)	–
SB_{2011}/SB_{MSY}	–
B_{2011}/B_0 (80% CI)	–
SB_{2011}/SB_0	–
$B_{2011}/B_{0,F=0}$	–
$SB_{2011}/SB_{0,F=0}$	–

[3] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

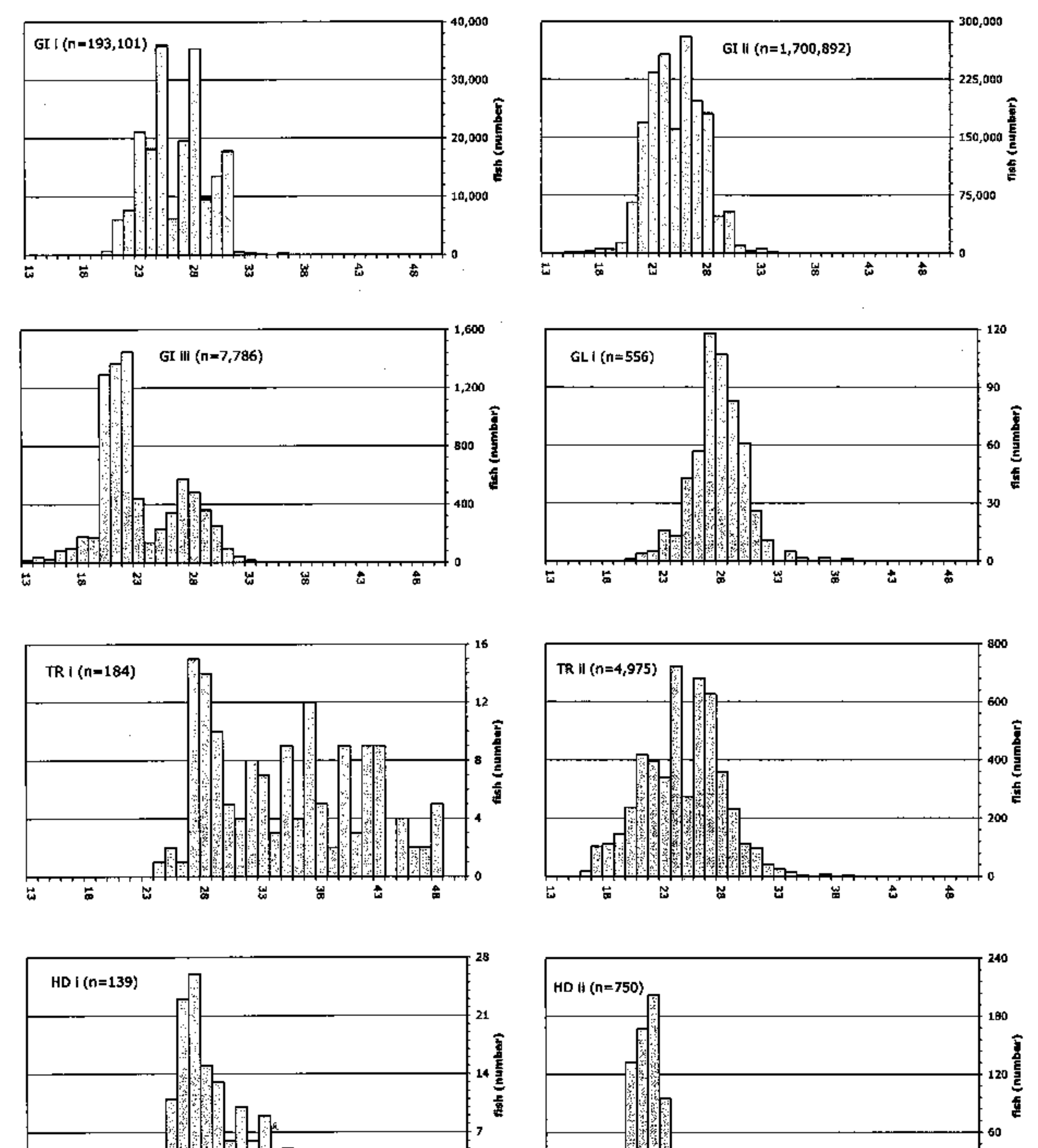


Fig. 6. Bullet tuna: Length frequency distributions (total amount of fish measured by 1cm length class by decade) derived from the data available at the IOTC Secretariat for selected fisheries and periods. GI: Gillnet fisheries: i. Sri Lanka 1980–89, ii. Sri Lanka 1990-99, iii. Sri Lanka 2000–06. GL: Gillnet and longline combination: i. Sri Lanka 2000–06. TR: Troll line fisheries: i. Sri Lanka 1980–89, ii. Sri Lanka 1990–99. HD: Hand line fisheries: i. Sri Lanka 1990–99, ii. Sri Lanka 2000–06

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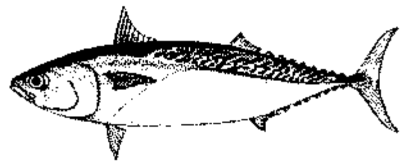
Widodo AA, Satria F, Barata A (2012) Catch and size distribution of bullet and frigate tuna caught by drifting gillnet in Indian Ocean based at Cilacap fishing port-Indonesia. IOTC–2012–WPNT02–12

APPENDIX XIX
EXECUTIVE SUMMARY: FRIGATE TUNA

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



Status of the Indian Ocean frigate tuna (FRI: *Auxis thazard*) resource

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

Area[1]	**Indicators**		**2012 stock status determination**
Indian Ocean	Catch[2] 2011:	83,210 t	
	Average catch[2] 2007–2011:	75,777 t	
	MSY:	unknown	
	F_{2011}/F_{MSY}:	unknown	
	SB_{2011}/SB_{MSY}:	unknown	
	SB_{2011}/SB_0:	unknown	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]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}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. There remains considerable uncertainty about stock structure and about the total catches. 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 following should be noted:

- 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 in the Indian Ocean is currently subject to a number of Conservation and Management Measures adopted by the Commission:

- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area*
- Resolution 12/03 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 12/07 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of*

competence and access agreement information
- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*

FISHERIES INDICATORS

Frigate tuna: 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. Frigate tuna: 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 – Fisheries and catch trends

Frigate tuna is taken from across the Indian Ocean area using gillnets, pole-and-lines, handlines and trolling gear (Table 3; Fig. 1). This species is also an important incidental catch for industrial purse seine vessels and is the target of some ring net fleets. The catch estimates for frigate tuna were derived from very small amounts of information and are therefore highly uncertain[4].

The catches provided in Table 3 are based on the information available at the IOTC Secretariat and the following observations on the catches cannot currently be verified. 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, and remaining at the same level over the following ten years. Catches increased substantially 2005, with current catches at around 80,000 t (Table 3; Fig. 2). The catches of frigate tuna have been higher in the east since the late 1990's, with ¾ of the catches of frigate tuna taken in the eastern Indian Ocean in recent years.

In recent years, the countries attributed with the highest catches are Indonesia (65%), India (14%), Iran (7%), and Sri Lanka (5%) (Table 3; Fig. 2).

[4] The uncertainty in the catch estimates has been assessed by the IOTC Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fleets for which catches had to be estimated.

TABLE 3. Frigate tuna: Best scientific estimates of the catches of frigate tuna by type of fishery for the period 1950–2011 (in metric tonnes) (Data as of October 2012)

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Purse seine	-	12	891	6,433	16,228	30,473	24,052	25,214	29,826	27,602	31,262	33,701	41,257	39,637	39,674	40,097
Gillnet	265	407	1,252	3,689	10,456	14,926	12,025	11,971	11,023	10,509	14,399	20,880	22,401	24,651	28,525	32,121
Line	447	666	1,197	2,916	5,658	5,265	5,374	5,038	4,745	4,600	5,298	5,584	5,486	5,810	5,015	6,149
Other	1,782	2,580	3,304	3,957	6,852	6,078	6,175	6,266	5,542	6,345	4,818	5,285	6,050	6,878	4,842	4,843
Total	**2,494**	**3,666**	**6,644**	**16,995**	**39,194**	**56,742**	**47,626**	**48,489**	**51,134**	**49,055**	**55,778**	**65,449**	**75,194**	**76,976**	**78,056**	**83,210**

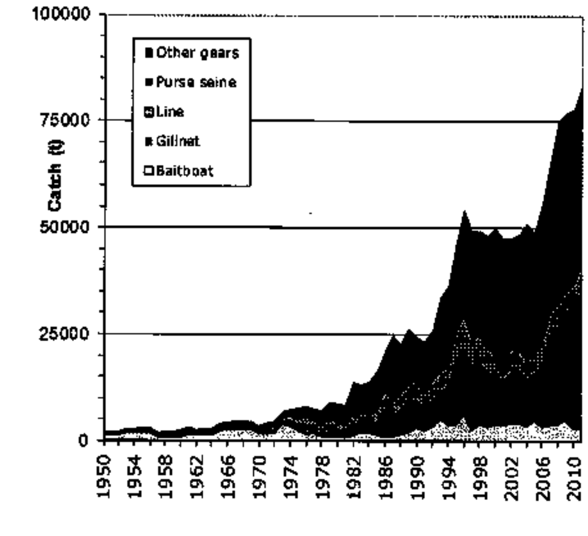


Fig. 1. Frigate tuna: Annual catches of frigate tuna by gear recorded in the IOTC Database (1950–2011)

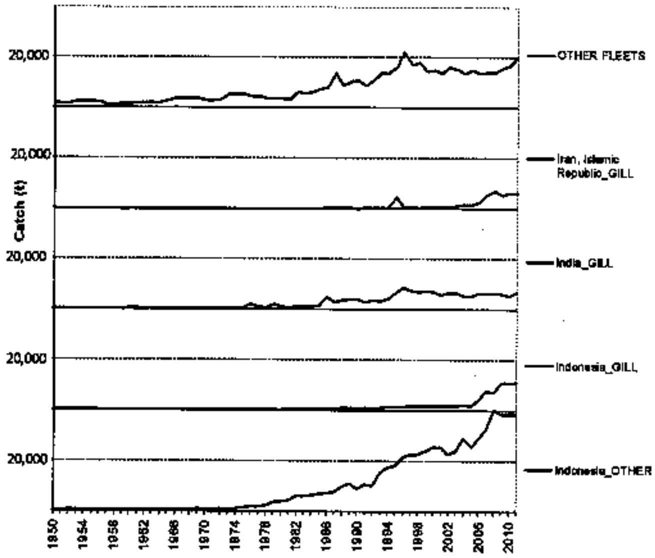


Fig. 2. Frigate tuna: Catches of frigate tuna recorded in the IOTC Database for main fishing fleets (1950–2011)

Frigate tuna – uncertainty of catches

Retained catches are highly 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 Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004 by gear and species. The catches estimated for the frigate tuna represent around 65% 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 14% of the total catches of this species in the Indian Ocean.
- Artisanal fisheries of Myanmar (and Somalia): None of these countries have ever reported catches of frigate tuna to the IOTC Secretariat. 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 2003–07, estimated using observer data.

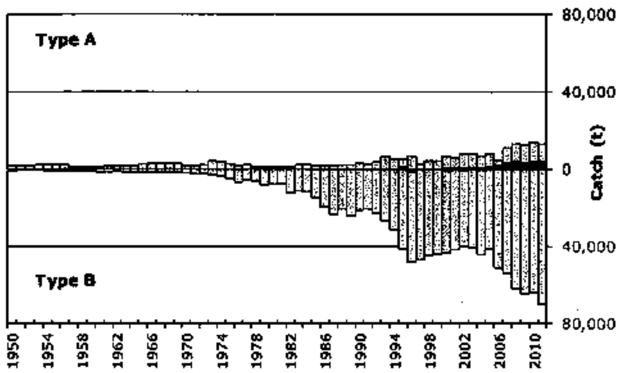


Fig. 3. Frigate tuna: Uncertainty of annual catch estimates for frigate tuna (1950–2011). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by 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 (Data as of October 2012)

- Discard levels are moderate for industrial purse seine fisheries. The EU recently reported discard levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.
- Changes to the catch series: The catch series of frigate tuna has not changed substantially since the WPNT meeting in 2011.

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 (Fig. 4). 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 hand and troll lines (Table 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.

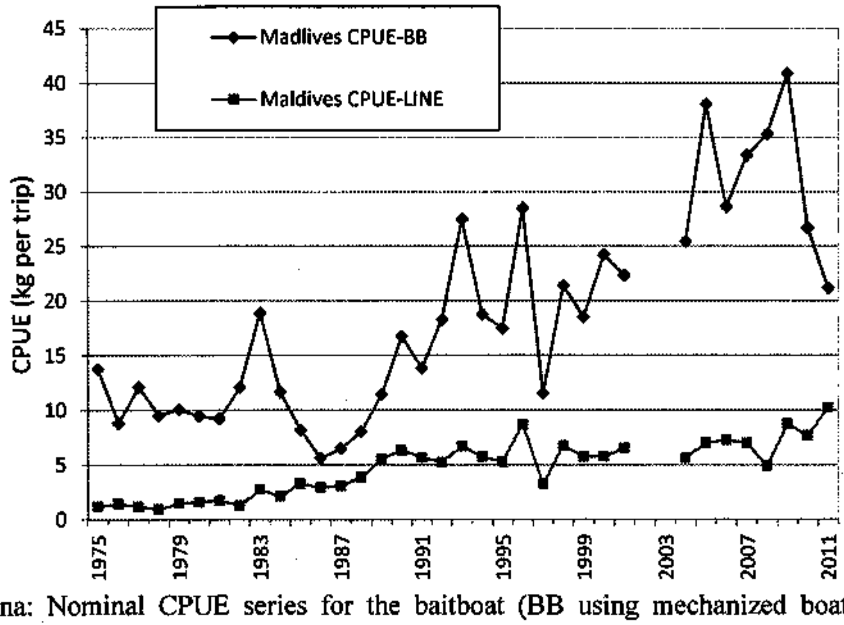
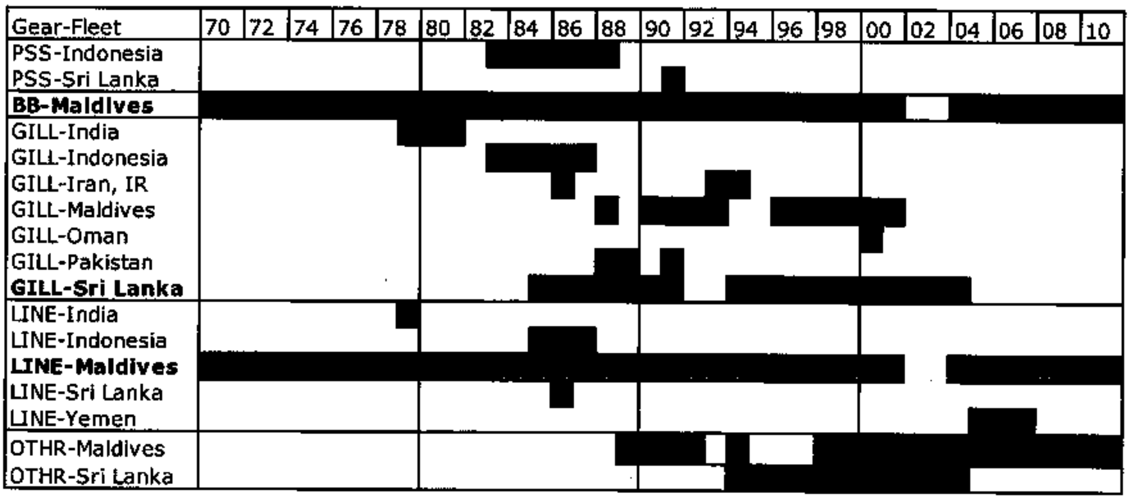


Fig. 4. Frigate tuna: Nominal CPUE series for the baitboat (BB using mechanized boats) and line (LINE, including handlines and trolling using mechanized boats) fisheries of Maldives derived from the available catches and effort data (1975–2011)

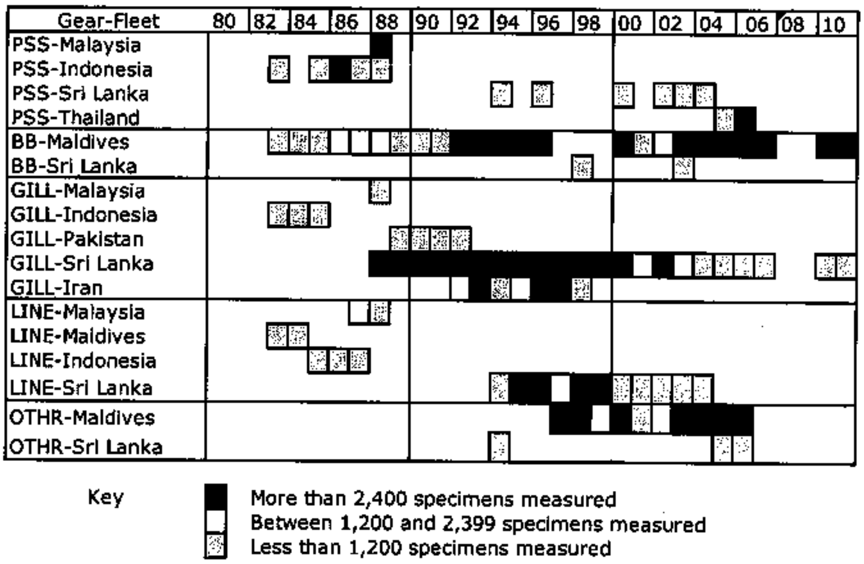
TABLE 4. Frigate tuna: Availability of catches and effort series, by fishery and year (1970–2011)[5]. Note that no catches and effort are available for the period 1950–69 in the IOTC Secretariat databases



Frigate tuna – 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 and Maldivian pole-and-lines but the amount of specimens measured has been very low in recent years (Table 5). 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.

TABLE 5. Frigate tuna: Availability of length frequency data, by fishery and year (1980–2011)[6]. Note that no length frequency data are available for the period 1950–82



- The size of frigate tunas taken by the Indian Ocean fisheries typically ranges between 20 and 50 cm depending on the type of gear used, season and location (Fig. 5). The fisheries operating in the Andaman Sea (coastal purse seines and troll lines) tend to catch frigate tuna of small to medium size (15–40 cm) while the gillnet, baitboat and other fisheries operating in the Indian Ocean catch usually larger specimens (25–50 cm).

[5] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

[6] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

- Catch-at-Size(Age) data are not available for the frigate tuna due to the paucity of size data available from most fleets (Table 3) and the uncertain status of the catches for this species (Fig. 3). Length distributions derived from the data available for some selected fisheries are shown in Fig. 5.
- Sex ratio data have not been provided to the Secretariat by CPCs.

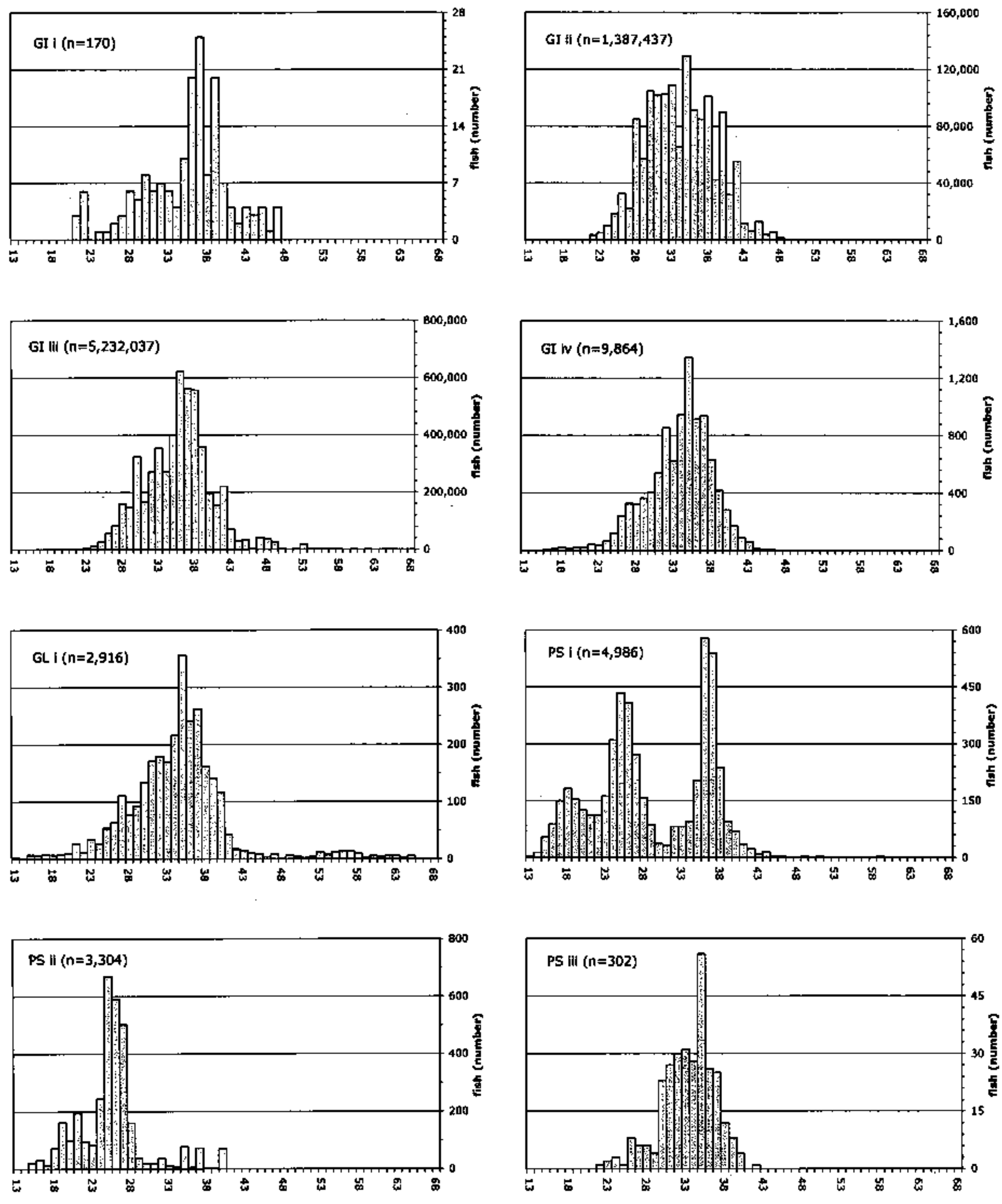


Fig. 5. Frigate tuna: Length frequency distributions (total amount of fish measured by 1 cm length class by decade) derived from the data available at the IOTC Secretariat for selected fisheries and periods. GI: Gillnet fisheries: i. Indonesia 1980–89, ii. Sri Lanka 1980–89, iii. Sri Lanka 2000–06, iv. Sri Lanka 2000–06. GL: Gillnet and longline combination: i. Sri Lanka 2000–06. PS: Coastal purse seine fisheries: i. Indonesia 1980–89, ii. Malaysia 1980–89, iii. Sri Lanka 2000–06 (ring net)

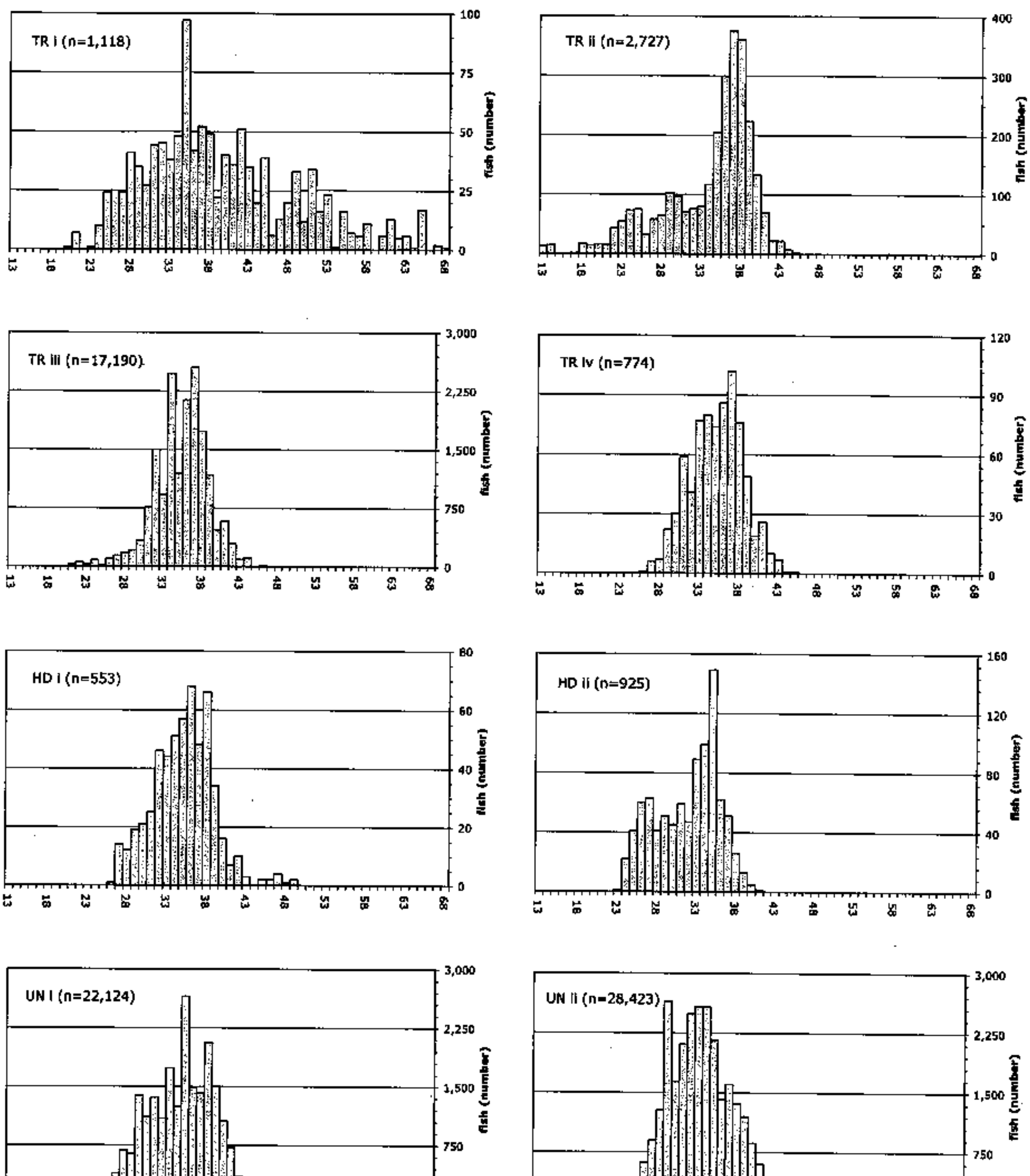


Fig. 5 (cont). Frigate tuna: Length frequency distributions (total amount of fish measured by 1cm length class by decade) derived from the data available at the IOTC Secretariat for selected fisheries and periods. TR: Troll line fisheries: i. Indonesia 1980–89, ii. Malaysia 1980–89, iii. Sri Lanka 1990–99, iv. Sri Lanka 2000–06. HD: Hand line fisheries: i. Sri Lanka 1990–99, ii. Sri Lanka 2000–06. UN: Unclassified fisheries (mainly pole and line): i. Maldives 1990-99, ii. Maldives 2000–06

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 6. Frigate tuna (*Auxis thazard*) stock status summary

Management Quantity	**Aggregate Indian Ocean**
2010 catch estimate	83,210 t
Mean catch from 2006–2010	75,777 t
MSY (80% CI)	unknown
Data period used in assessment	–
F_{2011}/F_{MSY} (80% CI)	–
B_{2011}/B_{MSY} (80% CI)	–
SB_{2011}/SB_{MSY}	–
B_{2011}/B_0 (80% CI)	–
SB_{2011}/SB_0	–
$B_{2011}/B_{0,\ F=0}$	–
$SB_{2011}/SB_{0,\ F=0}$	–

LITERATURE CITED

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

APPENDIX XX
EXECUTIVE SUMMARY: KAWAKAWA

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

Status of the Indian Ocean kawakawa (KAW: *Euthynnus affinis*) resource

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

Area[1]	Indicators		2012 stock status determination
Indian Ocean	Catch[2] 2011:	143,393 t	
	Average catch[2] 2007–2011:	134,314 t	
	MSY:	unknown	
	F_{2011}/F_{MSY}:	unknown	
	SB_{2011}/SB_{MSY}:	unknown	
	SB_{2011}/SB_0:	unknown	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]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}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. There remains considerable uncertainty about stock structure and about the total catches. A preliminary surplus production assessment undertaken in 2012 indicates that the Indian Ocean stock may be fully exploited/over exploited and the current spawning stock size levels may be at optimal spawning stock size. However, further exploratory analysis of the data available should be undertaken in preparation for the next WPNT meeting before the assessment results are used for stock status determination. 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 following should be noted:

- 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 in the Indian Ocean is currently subject to a number of Conservation and Management Measures adopted by the Commission:

- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area*

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

FISHERIES INDICATORS

Kawakawa: General

Kawakawa (*Euthynnusaffinis*) 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. Kawakawa: 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. Fish form the dominant prey item (76.7%). *Sardinella longiceps, Encrasicholina devisi, Decapterus* spp. and *Nemipterus* spp. are the major food items. No information is available on stock structure of kawakawa in Indian Ocean.
Longevity	9 years
Maturity (50%)	**Age:** n.a; females n.a. males n.a. **Size:** females and males ~38–50 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). Spawning is prolonged with peaks during June and October.
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, Abdussamad et al. 2012, Kaymaram & Darvishi 2012

Kawakawa – Fisheries and catch trends

Kawakawa is caught mainly by coastal purse seines, gillnets and, to a lesser extent, handlines and trolling (Table 3; 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[7] (Fig. 2).

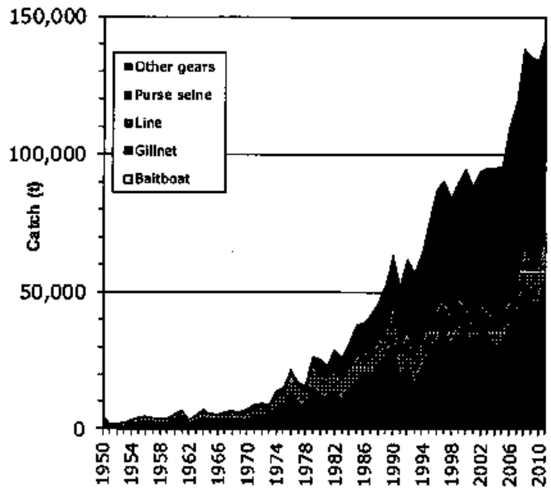
TABLE 3. Best scientific estimates of the catches of kawakawa by type of fishery for the period 1950–2011 (in metric tonnes) (Data as of October 2012)

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Purse seine	100	385	1,809	9,487	32,303	56,275	46,863	49,163	53,563	52,262	60,772	63,524	70,433	71,567	71,494	69,207
Gillnet	1,908	3,411	8,055	16,754	27,630	37,542	35,484	35,359	30,302	31,340	37,589	41,616	50,676	46,533	46,107	56,601
Line	1,423	2,007	4,414	8,449	11,590	11,054	10,018	8,882	9,757	9,893	10,453	11,462	15,357	15,041	13,749	15,093
Other	0	60	277	737	1,576	2,002	1,852	2,006	1,897	2,188	1,546	2,539	2,286	2,483	3,310	2,492
Total	**3,431**	**5,863**	**14,555**	**35,427**	**73,098**	**106,873**	**94,216**	**95,410**	**95,520**	**95,683**	**110,360**	**119,141**	**138,752**	**135,625**	**134,660**	**143,393**

The catches provided in Table 3 are based on the information available at the IOTC Secretariat and the following observations on the catches cannot currently be verified. Annual estimates of catches for the kawakawa increased

[7] The uncertainty in the catch estimates has been assessed by the IOTC Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of unreporting fisheries for which catches had to be estimated.

markedly from around 10,000 t in the mid-1970's to reach the 50,000 t mark in the mid-1980's and 143,000 t in 2011, the highest catches ever recorded for this species. In recent years the majority of the catches of kawakawa have been taken in the East Indian Ocean.



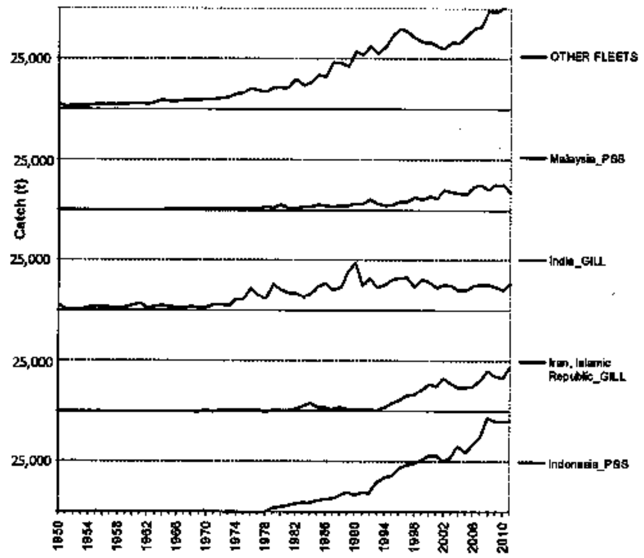


Fig. 1. Kawakawa: Annual catches of kawakawa by gear recorded in the IOTC database (1950–2011)

Fig. 2. Kawakawa: Catches of kawakawa recorded in the IOTC Database for main fishing fleets (1950–2011).

In recent years, the countries attributed with the highest catches are Indonesia (38%), India (17%), Iran (14%), Malaysia (8%) and Thailand (6%) (Fig. 2).

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 38% 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 17% of the total catches of this species in the Indian Ocean in recent years.
- Artisanal fisheries of 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 (e.g. 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 2003–07, 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 2003–07, estimated using observer data.
- The catch series of kawakawa has not changed substantially since the WPNT meeting in 2011.

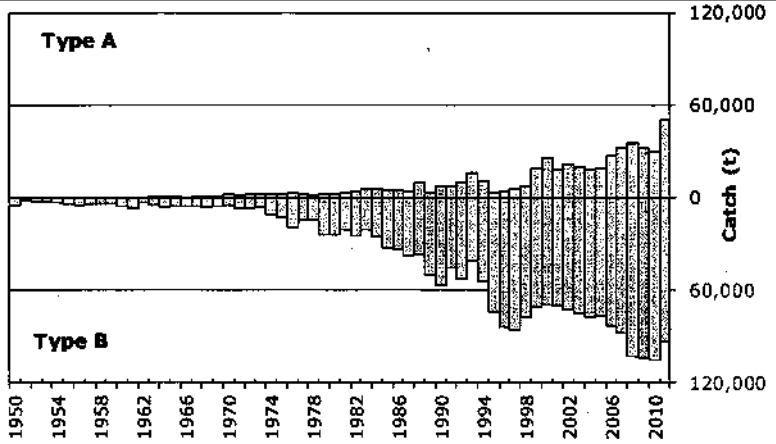


Fig. 3. Kawakawa: Uncertainty of annual catch estimates for kawakawa (1950–2011). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC 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 (Data as of October 2012)

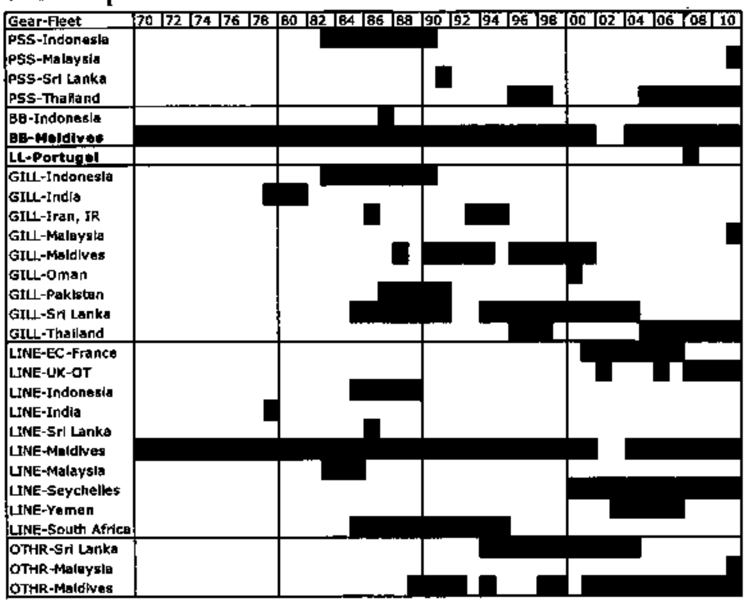
Kawakawa – Effort trends

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. 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 (Table 4). 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.

TABLE 4. Kawakawa: Availability of catches and effort series, by fishery and year (1970–2011)[8]. Note that no catch and effort data are available for the period 1950–69 in the IOTC Secretariat databases



[8] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

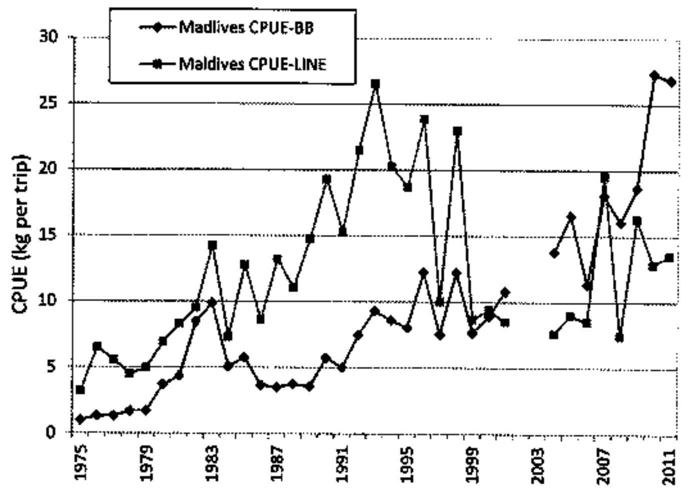
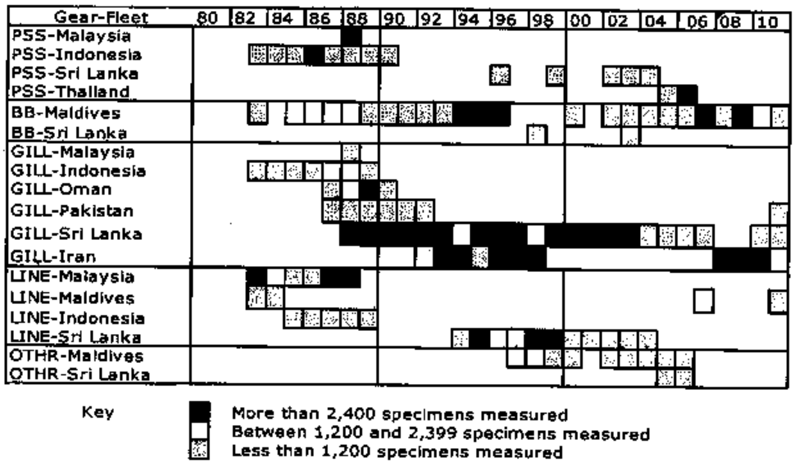


Fig. 4. Kawakawa: Nominal CPUE series for the baitboat (BB) and troll line (TROL) fisheries of Maldives (1975–2011) derived from the available catches and effort data

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

- The size of kawakawa taken by the Indian Ocean fisheries typically ranges between 20 and 60 cm depending on the type of gear used, season and location (Fig. 5). 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).
- 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 (Table 5). 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-Sizeage) data are not available for the kawakawa due to the paucity of size data available from most fleets (Table 5) and the uncertain status of the catches for this species. Length distributions derived from the data available for some selected fisheries are shown in Fig. 56.
- Sex ratio data have not been provided to the IOTC Secretariat by CPCs.

TABLE 5. Kawakawa: Availability of length frequency data, by fishery and year (1980-2011)[9]. Note that no length frequency data are available for the period 1950–82



[9] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

ANNEX 132

Chagos News, No. 41, January 2013

Chagos News

The Periodical Newsletter of the Chagos Conservation Trust and Chagos Conservation Trust US
No 41 January 2013 ISSN 2046 7222

Editorial

Two expeditions to Chagos in 2010, two in 2012 and again two in 2013. The research agenda for Chagos is really ramping up as the archipelago's importance as an unspoilt scientific reference site becomes more widely known. The data being gathered is used by scientists from many countries as they try to understand the impacts that mankind is having on the planet. But unless we reduce the global atmospheric CO_2 within a worryingly short time then research in Chagos and the few other well protected MPAs may become a case of recording the demise of the world's coral reefs which are so crucial to the preservation of biodiversity.

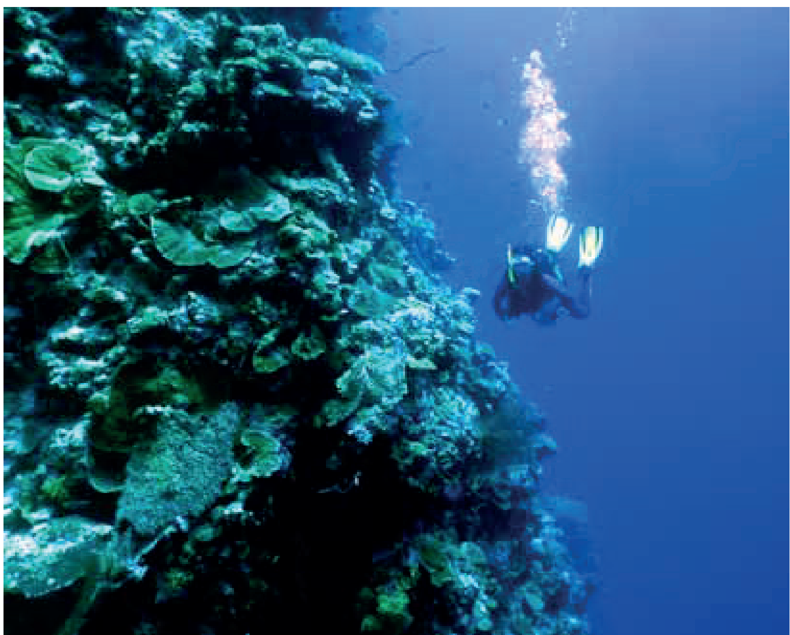
Last week Lord Stern announced from Davos that he had underestimated the risks of global warming in earlier IPCC reports and that he should have been much stronger about the risks to the world of global warming by 4 or 5 degrees centigrade. For those who would like to know more about how that might affect the planet, the book *Six Degrees* by Mark Lynas describes some very chilling likely scenarios.

So the research in Chagos becomes even more urgent and important and it is being disseminated through papers in research journals and by what is becoming an annual CCT conference.

The CCT website contains a lot of information about the research that has been carried out over the years, and future expeditions will post Information there. All back issues of *Chagos News* have now been placed on the website and reading through them from the beginning draws a very interesting picture of not only the development of CCT but also of the environmental research and conservation work that has been done in the Chagos over the years. As this year is the 20th anniversary of the founding of CCT as The Friends of Chagos, this is perhaps a good time to review our achievements.

We are also very much looking forward to an exhaustively researched history of the Chagos by Nigel Wenban Smith. Nigel was a past chairman of CCT and he has retained a keen interest in the archipelago. The book, which should be published this year, will be announced on the website when it is ready.

Anne Sheppard



The Chagos Marine Reserve: Building on Success

On 27th November 2012 there was a joint meeting of the Chagos Conservation Trust and the Zoological Society of London, with the support of the Pew Environment Group. Over one hundred people attended the conference day and the talks were enthusiastically received.

The friendly and informal drinks reception afterwards by the beautiful tanks in the Aquarium Building allowed people to mix and discuss many topical Issues.

The conference organiser, Prof Charles Sheppard, summarises the idea behind the conference in the article below and the talks themselves are presented.

Some of the conference delegates during a coffee break *Photo Anne Sheppard*

The BIOT marine reserve – Next Generation

Professor Charles Sheppard
University of Warwick.

We are in an unprecedented position regarding research on the reefs and islands of the Chagos Archipelago. From a long period of more or less sporadic research, never knowing when, or even if, the next grant might come, we now have several major expeditions planned. Work on these will expand our knowledge, continue time-series of information on several key aspects, and start some new projects which relate to issues identified in the draft contribution to a future conservation and management plan which was submitted to the BIOT administration. This set out the priorities for the future management of the Chagos marine reserve . On the islands, work now underway or planned includes: rehabilitation of large plots of derelict coconut plantations in Diego Garcia (which is proving to be remarkably successful), bird research on several key issues including the Important Bird Areas, and a new rat eradication programme in a northern island. These have applications in for funding, or already have funding, from numerous organizations, enthusiastic NGOs and researchers from the UK and overseas. We have never been in such a good scientific position – scores of scientists are involved in one way or another. The new outreach and training programme for those who have a Chagossian heritage is also underway – hopefully the first of several.

Coordination of all this is more complicated now, and is being done through several vehicles including the principal investigators of the expeditions, and we relate strongly also with the Big Oceans Network in a number of ways.

Later articles amplify these and more. Here I describe briefly some of my own results from the expedition of 2012, and summarize some of the results that are not going to be covered in later articles about the conference.

Activity	Impacting agent	Action	Effect on corals
Boating	Fuel	Hydrocarbon release	Tissue stress and reduced larval competence
Boating	Antifouling paint	Copper release	Reduced larval competence
Habitation	Sewage	Nutrification	Increased algal growth
Habitation	Sewage	Introduction of bacteria and viruses	New pathogens, more marine diseases
Habitation	Fishing	Reduction of herbivorous fish	Increased algal growth
Habitation	Coastal construction, increased dredging	Increased turbidity and/or sedimentation	Tissue stress in large corals, reduced settlement
Climate change	Increased SST	Bleaching events	Pulsed severe mortality
Climate change	Ocean acidification	Lowered aragonite production	Reduced larval competence
Habitation, climate and environmental change	Physical disturbance, fertilised water column, changed oceanic fronts	Increased predator outbursts	Increased frequency and severity of mortality

Figure 1. From Riegl et al. Some of the major causes of reef decline.

A new paper based largely on work done in Chagos (Riegl et al, 2012) is a good starting point for observing issues and effects which are likely to reduce or harm the reefs of Chagos in the future. It is complex, but the gist is clear enough and explains why the reefs are as good as they are: no surprise perhaps that it is attributed to the lack of so many of those common factors that damage reefs (Figure 1), and also show that not very much of the latter would be needed to materially affect them.

We have begun a series of measurements of juvenile corals, the next generation of corals to sustain and build the reefs of this archipelago and the results show (Figure 2) very high densities of juveniles. This must be one of the main reasons why the corals have recovered so well from the rise in water temperature in 1998 (Figure 3).

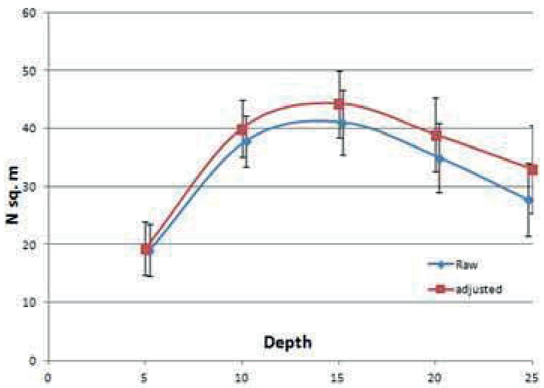


Figure 2. Numbers of juveniles per sq m at different depths in Diego Garcia's ocean facing reefs, in 2012

It took a decade for corals to recover to the states that they were in immediately before the wipeout of 1998, but they have recovered and this is in contrast to many other reef areas in the Indian Ocean which suffer severe human impacts such as dredging, industrial pollution and of course overfishing. But while for Chagos 1998 saw the biggest destruction of corals, temperature rise is inexorable and we cannot tell the future, other than to say that Chagos is best placed to delay the adverse effects of it. There have been in fact several more minor bleaching events which did not lead to coral death since then, and very recently the year 2010 was shown to be the warmest ever recorded in global terms, although in the central Indian Ocean things were not quite so bad as they were further east. So, monitoring the temperature of sea water continues and we have deployed 10 or more temperature recorders at various depths between 5 and 25 metres around these atolls, in the lagoons and on the ocean facing slopes. We have now built up a tremendous record of temperature readings every two hours in various places since 2006. Although we have lost one or two of these temperature loggers, our record at retrieving them, and indeed finding them again considering they get covered in coral growth, is pretty good. We have already published some unusual discoveries such as that of cold deep water upwelling during warm periods which doubtless has helped the Chagos corals, but now I am waiting to consolidate all this perhaps in a few years time, before

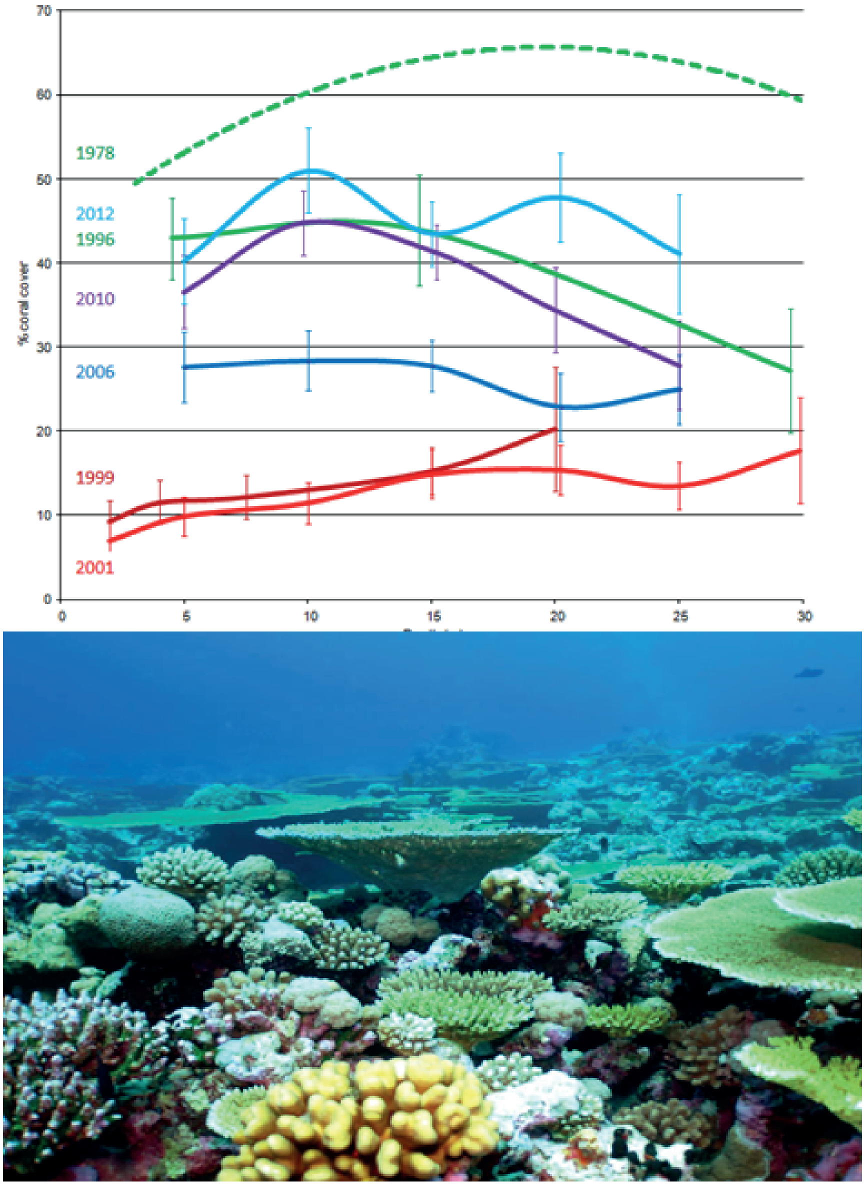
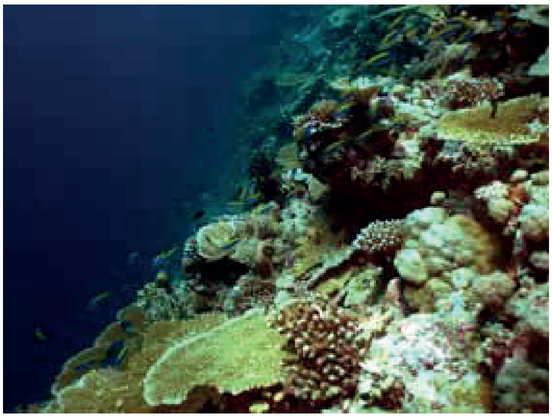


Figure 3. Graph showing recovery over about a decade of coral cover on ocean facing reefs in Chagos. (from Sheppard et al 2013). *Photo Anne Sheppard*

delving into this further.

Other publications recently have shown other possible reasons for why corals have recovered so well in Chagos. Yang et al. (2012) is a good starting point for this. It shows a possible change in the kinds, called clades, of the symbiotic algae held in many of the corals, algae which are more adapted to some of the new conditions. Again, like many of these programmes, this is in its infancy and is continuing.



Healthy seaward facing reef in Salomons Atoll
Photo Anne Sheppard

Two recent publications have shed a little more light on the 'position' of Chagos in the Indian Ocean. Briggs and Bowen (2011) look at this for reef fish, and Obura (2012) looks at it from a coral perspective. For fishes, Chagos is seen to straddle pretty well the East and West Indian Ocean, while for corals Chagos sits very firmly in the Western Indian Ocean group of sites. More work on this is continuing. Other papers, by Vogler et al. (2012) show that the crown of thorns starfish is from the Southwest Indian ocean group, and another paper, which we hope will be out soon, likewise shows that the very common species *Stylophora pistillata* is a southwestern Indian Ocean form of this coral, which we expect is a different species in fact. The coconut crab similarly is connected, as are turtles, with the Western Indian Ocean, in the former case Chagos being a recipient of larvae *from* the West about 10 times more frequently than it exports larvae *to* the West.

Some of these results are due to appear any week now in a new book in the series *Coral reefs of the World,* this one being … *of the UK Overseas Territories* (Sheppard (ed) 2013).

In Diego Garcia some experimental plots on restoration of native hardwood seedlings where there used to be coconut plantation, have shown some remarkably successful but sometimes complicated results. Freed of the competition and shading from palm trees, sometimes unwanted – weedy - species suddenly thrive, but where this does not happen, or where they are removed, native hardwoods are doing extremely well (Figure 4).

Figure 4. Part of an experimental plot where hardwoods were planted after removal of coconut. The fences are to prevent the wild donkeys from browsing on the young trees. *Photo Pete Carr*

In 2012 we visited again a remarkable but small and threatened mangrove stand in the North of Peros Banhos (Figure 5). It is threatened because coconuts are encroaching in the area. Without active management soon these will disappear.

Figure 5. part of the mangrove stand in Peros Banhos. Red-foot boobies are nesting in the trees. *Photo Pete Carr*

With others, I am increasingly concerned about erosion of many parts of many of these islands. In the south of Diego Garcia broaching of the raised land rim that surrounds almost all of these islands now takes place episodically at the highest spring tides. Tens of millions of US dollars are being spent by the US government to harden some shorelines in front of important infrastructure but the uninhabited parts of Diego Garcia, and of course all the northern atolls, are very unlikely to receive any attention at all in this respect. Many islands throughout the archipelago are showing some encroachment. We all know that palm trees topple into the sea everywhere, now and again, and this adds to the attractiveness of a tropical beach. But the attrition is sometimes considerable: noticeably enlarging chunks are being taken out of islands in Northwest Peros Banhos and

Figure 6. Top: lemon shark foraging over grass, after flooding at high tide. Bottom: The car park at 'Turtle Cove' a day or two later.
Photo Charles Sheppard

In southern Diego Garcia I photographed a group of four or five small lemon sharks foraging for food over the roadside grass (Figure 6), but in several large areas much of the land was inundated with saltwater during these high tides too, such as the car park in the far south (Figure 6 bottom). It was not particularly stormy either, and both these sites were in a sheltered lagoon. The highest tides are certainly increasing in net effect, and it is not consoling to know that the next IPCC report looks like it is going to increase the predicted global mean sea level rise by about four fold. We know that Chagos experiences average sea level rises of less than the global average, but it is still likely to be four times greater than we thought previously.

Earthquakes are important in Chagos too it seems and these may cause small vertical changes in elevation at localized sites. Henstock and Minshull (2004) state that the present rate of seismicity is higher than the long-term average; indeed it is 3 to 10 times more. I have long wondered about the little island Resurgent in the Three Brothers group which has appeared since Moresby's survey of 150 years ago, and about old reports that Blenheim atoll, which is now completely awash, used to have three vegetated islands on it. There has been a considerable cluster of small earthquakes in the southern part of the Great Chagos Bank, attributed to stretching of the crust.

We are engaging strongly now with the "Big Ocean Network", the grouping of the largest marine protected areas in the world. We expect to increasingly exchange views and information about both the science of such large areas and its management in future.

Our contribution to a future conservation and science management plan was placed on the CCT website in 2012. All feedback received has been incorporated appropriately. It is hoped that the BIOT website will be up and running shortly, which might show the final version of this.

Future research progresses well, but it is all expeditionary in nature, based from the *Pacific Marlin* (except for when Diego Garcia work only is done). The great advantage of this ship-based approach is that we can cover this huge area very effectively. A long time ago several of us investigated potential possibilities of having a research station based perhaps on Diego Garcia or

Figure 7. Vache Marine, in southern Peros Banhos, where it is hoped to carry out a vegetation restoration and rat eradication project soon.

perhaps on a northern atoll. In present economic conditions, and indeed even before the monetary crisis, it was concluded that such a facility would be very underused and therefore most likely would not be viable, nor even the optimum base from which to carry out the research over this very large area. We have concluded that, for the present, continued and expanded use of the *Pacific Marlin* is the way to go.

In February 2013 we will start some filming in the northern islands and reefs as part of the outreach programme. On each expedition now we take at least one assistant who has Chagossian heritage assisting one or other of the teams in their projects and we hope to continue with this, sometimes for terrestrial work and sometimes, as in 2012, with underwater work. More on this in a later article.

Finally I would comment that proposals are in for another rat eradication project, focusing this time on the small island of Vache Marine in Peros Banhos (Figure 7). This is being done in conjunction with the Royal Botanic Gardens Kew and the RSPB, organized by Peter Carr in Diego Garcia.

We have entered a new, structured, and exciting time for conservation research in this remarkable archipelago. We hope to build on both the number of scientists around the world who have participated, to involve more Chagossians in the work, and continue to help to conserve what appears to be the world's largest network of reefs which is in very good condition.

Quis custodiet ipsos custodes?

The fish do!

Briggs and Bowen (2011) A realignment of marine biogeographic provinces with particular reference to fish distributions. *Journal of Biogeography*

Henstock TJ and Minshall TA. (2004). Localized rifting at Chagos Bank in the India-Capricorn plate boundary zone *Geology* **32**:237–240.

Obura D (2012) The Diversity and Biogeography of Western Indian Ocean Reef-Building Corals. *PLoS ONE* **7**(9): 14 pp.

Riegl BM, Sheppard CRC, Purkis SJ (2012) Human Impact on Atolls Leads to Coral Loss and Community Homogenisation: A Modeling Study. *PLoS ONE* **7**(6) 11 pp

Sheppard CRC et al. 2013. Coral reefs of the Chagos Archipelago, Indian Ocean. In Sheppard CRC (ed) *Coral Reefs of the UK Overseas Territories*. Springer, Germany

Sheppard CRC (editor) 2013. *Coral Reefs of the United Kingdom Overseas Territories***.** Springer book series Coral Reefs of the World, Volume 4..

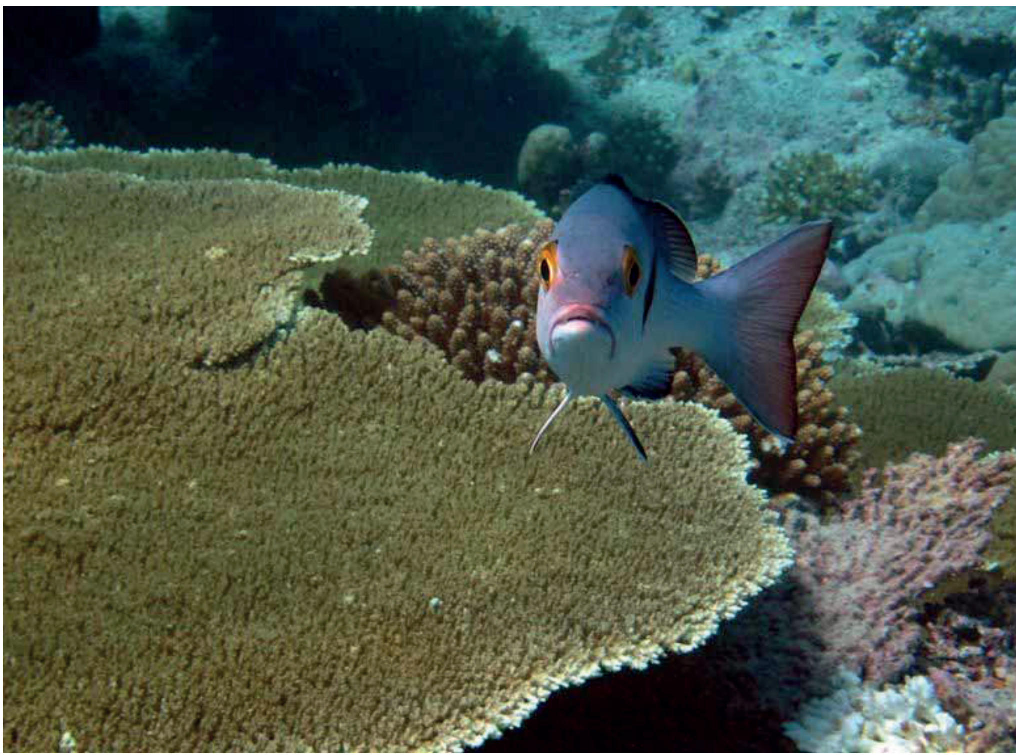
Sheppard CRC 2012. Sharks on the lawn: the reality of rising sea-level on Indian Ocean Islands. *Ocean Challenge*,**19**, p 17.

Vogler C, Benzie J, Barber PH, Erdmann MV, Ambariyanto, Ambariyanto, Sheppard C,Tenggardjaja K, Gerard K, Worheid G. (2012) Phylogeography of the Crown-of-Thorns Starfish in the Indian Ocean. *PLoS ONE* **7**(8) 10pp

Yang S-Y, Keshavmurthy S, Obura D, Sheppard CRC, Visram S, et al. (2012) Diversity and Distribution of Symbiodinium Associated with Seven Common Coral Species in the Chagos Archipelago, Central Indian Ocean**.** *PLoS ONE* **7**(5) 9 pp

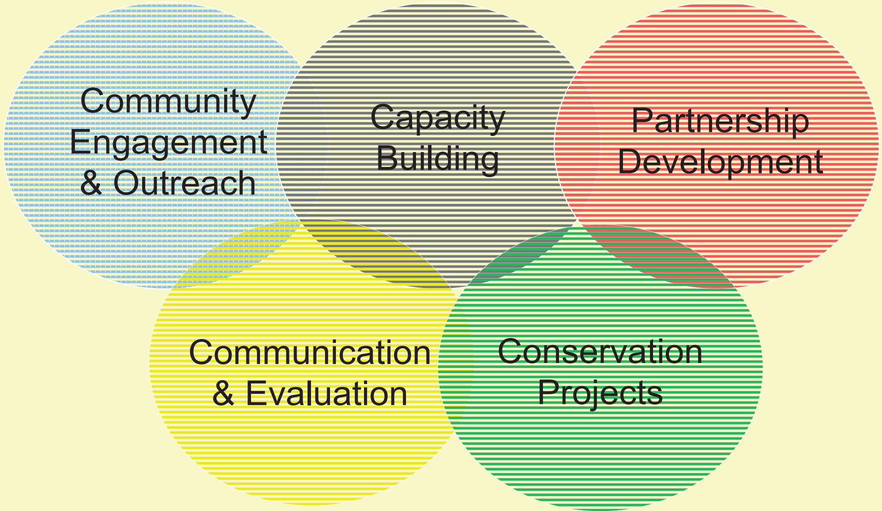
A grapsid crab- one of the most common inhabitants of the reef flat.
Photo Anne Sheppard

A crab of the genus *Ocypoda* which along with the hermit crabs are common inhabitants of the sandy beaches
Photos Anne Sheppard



Chagossian Community Environment Project

Xavier Hamon
Rebecca Short
Rudy Pothin
Zoological Society of London



Regular readers of Chagos News will remember being introduced to the joint CCT/ZSL Chagos Community Environment Project early in 2012, aimed at raising awareness and building capacity within the Chagossian communities of the UK. A presentation at the CCT 2012 conference by Outreach Officer Xavier Hamon of the progress made 8 months into this project was met with deserved applause and proclamations of optimism for the future.

The multi-faceted project involved a number of streams of activity designed to engage the community at large with the project and the archipelago's environment, build capacity for Chagossian involvement in future conservation in Chagos, develop new partnerships and transform these into on-the-ground projects with Chagossians at their heart.

The trainees demonstrated their enthusiasm throughout coral identification, bird monitoring, sustainable fisheries theory and practice, island restoration techniques and numerous other disciplines. The final session gave the trainees a chance to experience SCUBA with a try dive held at the London School of Diving

All of the trainees have shown amazing fervour throughout the course, engaging fully with classroom and practical sessions alike, always seeking to learn more.

To mark the end of the course an award ceremony was held where trainees received an emphatic well done (as well as certificates and medals). Generously hosted by the Ramada Plaza Hotel in Crawley, the red carpet décor served to create an appropriately premiere-esque feel to the first showing of a film made throughout the project, with input from the trainees and showcasing the project as a whole.

This film can be viewed at: www.zsl.org/chagosfilm

Their increased awareness of how fragile the Chagos environment is and methods of protection has inspired their tagline -
'Join us in preserving our Chagossian heritage, from the land to the sea and the sea to the land'.
All those involved with the project now hope that they can take this tagline and begin to inspire others within and beyond the Chagossian communities.

One in particular will be doing so in February as he becomes the sixth Chagossian to join research teams out in the archipelago itself.

Working with Pete Carr, Yannick Mandarin from Crawley will be assisting in bird surveys and monitoring of parasites in Sooty Tern populations, with a view to discovering more about their mobility and island use.

For the rest of the graduates, a number of bursaries and opportunities have been created to further their skills and maintain momentum in communicating their message. It is hoped that these trainees will now not only be directly involved in conservation projects on the ground in Chagos, but also become stewards of their own outreach objectives, and maybe even begin a career in conservation.

To keep up to date with how the project progresses, for more information or if you feel you could contribute please visit our webpage www.zsl.org/chagoscommunity or email rebecca.short@zsl.org or rudy.pothin@zsl.org

Turtle Research in Chagos – January 2013 Update

***Dr Graeme Hays*[1]**
***Dr Jeanne Mortimer*[2], *Dr Nicole Esteban*[1]**
[1]*Swansea University,* [2]*University of Florida*

With support from a small "Darwin" grant award from the UK Department of the Environment, Food and Rural Affairs (DEFRA) and FCO, and the Chagos Scientific Advisory Group (SAG), a small team visited Chagos for three weeks in October 2012 to continue sea turtle conservation and research work. The main objective for this visit was to initiate research to assess the movements of juvenile and adult turtles and continue the monitoring of juvenile turtles in the lagoon and nesting activity on the beaches. Research focussed on Diego Garcia due to the short duration of the visit.

On the nesting beaches, activities included attachment of satellite tags to eight nesting green turtles (carapace lengths ranging from 101.5 – 111.5cm) to assess the extent of post-nesting movements, and the burial of 30 temperature loggers at a range of nest depths in various nesting habitats to measure sand temperature for one year to enable informed predictions of hatchling sex ratio in the Chagos Archipelago. At Turtle Cove, a sheltered creek in the southern part of the lagoon in Diego Garcia, monitoring of the population status of green and hawksbill turtles continued from previous visits in 1996, 1999 and 2006 and more than 60 immature hawksbill turtles and a couple of green turtles were caught, tagged, measured and weighed, and dozens more untagged turtles were encountered. Electronic tags were attached to 10 of the juvenile hawksbill turtles (carapace lengths ranging from 36.2 to 70cm) to allow their diving and horizontal movements in the lagoon to be assessed. Prior to this visit, Antenor Nestor Guzman, Environment Department, USN NAVFAC had been conducting regular nesting beach surveys at Diego Garcia in collaboration with Jeanne, and these will continue. Nestor was also involved with the deployment of the temperature loggers, and will be monitoring their position in the coming months to ensure that they don't wash away.

The start of the visit coincided with a typhoon, providing ample time for meetings and a well-attended evening presentation to members of the military and civilian community on Diego Garcia. These events resulted in well over 100 people (from the US and UK military as well as civilian contractors) joining the research team with great enthusiasm to assist on day and night work in the lagoon and on nesting beaches. The achievements and overall success of the visit was greatly enhanced due to the support received from these volunteers.

A green turtle equipped with a satellite tag, returning to the water at dawn

Jeanne Mortimer with a hawksbill turtle at Turtle Cove, returning to shore to flipper tag and measure the turtle.

The turtle research team with volunteer Clayton Halpain

Locations of eight green turtles on 16 November 2012, showing tracks for previous three days; at that date four turtles were still close to the nesting beach.

Locations of two green turtles in Chagos in mid -January: one has travelled to the Great Chagos Bank, one was still close to the nesting beach. By this date the other six tagged turtles had departed to distant foraging grounds.

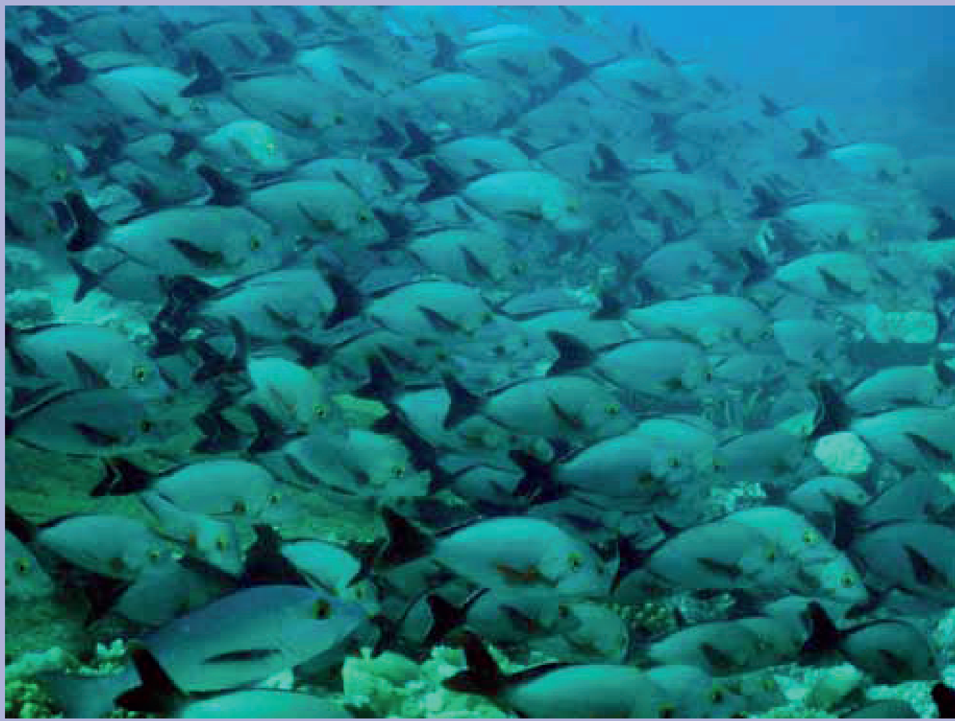
The team departed from Diego Garcia with the hope that the satellite tags would continue to transmit, revealing foraging grounds for the green turtles. As we approach February 2013, all eight tags continue to send a huge amount of information. While some turtles are still at Diego Garcia, others have travelled more than 3000 km to mainland Africa, while others have travelled to the Seychelles. We are in the process of working up these data and expect the first scientific publications, including detailed maps of the routes followed, to appear later this year. The success of the satellite tags has massively exceeded our expectations. As we pay for the data received (akin to receiving a monthly phone bill from the space agency), we have now exhausted the funds in our small Darwin grant. So we are now trying to quickly source some funds to cover the costs of the ongoing satellite tracking data collection.

At Turtle Cove, eight of the captured turtles had already been marked with tags first attached during earlier visits. Data analysis has shown that during the intervening years the turtles have grown an average of about 1cm per year. This shows how slowly the turtles grow and how long lived they are. They probably only mature when they are several decades old which emphasises the importance of long -term conservation. Relatively fewer previously tagged turtles have been found in Turtle Cove than during earlier visits in 1999 and 2006. In those years, a much higher proportion of the turtles encountered had already been tagged. The relatively lower rate of recaptured turtles this year might be an artefact of increased numbers of turtles now living in Turtle Cove. In 2006, Jeanne noticed that there were more turtles in Turtle Cove than in either 1996 or 1999. There appear to be even higher numbers of turtles in 2012. This increase in turtle numbers at Turtle Cove can be attributed to the long-term protection that the US military base and BIOT legislation have afforded the turtles of the Chagos archipelago. Initial analysis of the data-sets coming back from the range of data-loggers attached to juvenile hawksbill turtles are revealing patterns of behaviour of these small turtles. They feed during the day, but at night sleep on the seabed, doing dives of up to 45 minutes between breaths.

Following the success of this visit, the team hopes to acquire funding to return to Diego Garcia in late 2013 to continue with research and, in particular, to excavate the temperature loggers buried on the nesting beach, download data and re-bury them for long term monitoring of nest incubation temperature. At the same time, it is hoped that discussions will continue in preparation of a project application to fund a much longer-term project running over several years and funding further visits as well as funding the provision of resources on Diego Garcia to continue and expand the turtle conservation and research work.

The condition and stability of reef fish assemblages in the Chagos Archipelago

Dr Nicholas Graham
James Cook University
Australia



A large school of paddletail snapper in the Chagos Archipelago.
Photo: Anne Sheppard

Through various work across coral reefs of the western Indian Ocean, colleagues and I have shown that fish biomass on these coral reefs tends to peak at around 1,200 kg/ ha. One of the best examples of this is from long-term time series of reef fish biomass build-up in Kenya's marine national park network. After 20-25 years, the biomass within these parks stopped increasing and levelled off at 1,200 kg/ha. This value was therefore assumed to be the maximum that these reefs could support. However, it was noted that most marine parks in the region are quite small and are found along populated coastlines and are therefore embedded within large areas of heavy fishing pressure. My presentation at the Zoological Society of London (ZSL) put these findings in the western Indian Ocean into context, by comparing these other nation's fish biomass values to fish biomass values I recorded in Chagos. The fish biomass at Chagos was up to 6 times greater than that in the rest of the Indian Ocean, and included much more biomass from fish that were high up the food chain and of larger body size. These data form the basis of a forthcoming paper in the journal BioScience (Graham & McClanahan in press).

I went on to compare reef fish biomass among atolls within Chagos, showing that the biomass of reef fish around Diego Garcia was generally lower than the biomass at the northern atolls. There is a recreational fishery around Diego Garcia, and even light fishing such as this has been shown to be detrimental to fish biomass in other locations. Although it is very hard to pinpoint that the recreational fishing is driving these differences, the fact that higher trophic level and larger fish are more scarce in Diego Garcia than the northern atolls is suggestive of fishing impacts. More details on these data can be found in a forthcoming book chapter (Graham et al. in press). The chapter also updates a time series on the relative abundance of reef sharks in Chagos. These data, collected during scientific dives in the archipelago, extend from 1975 to 2012. Shark abundances had dropped by ~90% after the 1970s, most likely due to increased fishing for shark fin. The numbers have not recovered, but there are weak signs that a little recovery may be occurring. Importantly, this will be dependent on how well the Chagos marine protected area is enforced and complied with.

The final part of my talk assessed the impact of the 1998 coral mortality event on the reef fish communities in Chagos. This large disturbance event caused substantial reductions in the abundance and diversity of reef fish communities in some other parts of the Indian Ocean, such as the Seychelles. However, in Chagos the impacts were much smaller. Only obligate coral feeding fishes showed some reductions in abundance by 2006. The rapid recovery of corals in Chagos, combined with the lack of other human impacts (e.g. fishing), are the most likely reasons for the lack of impact.

Interestingly, by 2012 the fish communities, including the obligate coral feeding fishes, were abundant. A study of specialisation of these coral feeding fishes has shown that the more specialised a species is the more abundant they are, suggesting some sort of competitive advantage of this specialisation (Pratchett et al. in press). This is the first time this has been shown, again highlighting the novel scientific insights a largely untouched location such as Chagos can offer.

More details on these findings can be found in the following publications, all of which should be published in the first half of 2013:

A grey reef shark at Diego Garcia. *Photo: Nick Graham*

Graham NAJ, McClanahan TR (in press) The last call for marine wilderness? BioScience

Graham NAJ, Pratchett MS, McClanahan TR, Wilson SK (in press) The status of coral reef fish assemblages in the Chagos Archipelago, with implications for protected area management and climate change. In: Sheppard CRC (ed) Coral reefs of the United Kingdom Overseas Territories. Springer

Pratchett MS, Graham NAJ, Cole AJ (in press) Specialist corallivores dominate butterflyfish assemblages in the Chagos Archipelago, central Indian Ocean. *Journal of Fish Biology*

Obligate coral feeding butterflyfishes in the Chagos Archipelago.
Photo: Morgan Pratchett.

Pervasive Plastics

As can be seen from the data presented in Prof Jim Readman's article in this issue of *Chagos News,* plastic is very pervasive in our oceans.

The diagram opposite shows just how long some common materials persist in the environment.

Hopefully, in the not too distant future, instead of having to recycle large amounts of plastic from your weekly shop, there will either be much less or none at all.

Island Restoration in Chagos

Colin Clubbe
Royal Botanic Gardens, Kew
Peter Carr
University of Warwick

Argusia argentea (L.f.) Heine (beach heliotrope). *Photo Anne Sheppard*

Introduction
The five coral atolls that form the Chagos Archipelago comprise some 55 islands set within the 640,000 km^2 Chagos Marine Reserve. The islands vary enormously in land area with many <1 ha, some 10-100 ha, a few >100 ha and Diego Garcia at 2,720 ha accounting for over half the archipelago's total land mass.

As currently circumscribed we recognise 45 species of vascular plants, comprising 41 seed plants and 4 ferns, as native to Chagos. There are no known endemic plant species in the Chagos and all these native species are relatively widely distributed across the Indian Ocean Islands and neighbouring continental land masses. This is probably a consequence of the relatively little time for colonisation and speciation on islands that have been above water for probably less than a few thousand years. The current vegetation cover of the islands reflects past exploitation, no activity with greater impact than the conversion of much of the native vegetation to coconut (*Cocus nucifera* L.) during the plantation era together with the widespread introduction of rats.

Developing a Restoration Strategy for Chagos
We are developing a restoration strategy for Chagos which involves both looking back to try and establish what the natural vegetation of the Chagos would have been like before Man's settlement and looking forward to determine what our restoration goals are.
We can recognise six broad categories of native vegetation:

Beach Pioneers: a handful of small, creeping, herbaceous species on the shore line, highly salt tolerant, which trap and stabilise the sand starting the process of island building. Typical beach pioneers are *Boerhavia repens* L. and *Sida pusilla* Cav. which are important components of the beach flora of most islands within the archipelago.

Boerhavia repens L.
Photo Colin Clubbe

Littoral Hedge: as the sand stabilises seedlings and saplings of small shrubs become established forming the characteristic littoral hedge of the beach crest of many islands. Two of the most widespread species are *Scaevola taccada* (Gaertn.) Roxb. (scavvy) and *Argusia argentea* (L.f.) Heine (beach heliotrope). The littoral hedge provides nesting sites for many birds including the Red-footed Booby (*Sula sula* L.)

Sublittoral Thicket: behind the beaches in well drained areas a community of small trees may develop, the Sublittoral Thicket, comprising species such as *Ochrosia oppositifolia* (Lam.) K.Schum. and *Cordia subcordata* Lam., rarely more than 5m tall which also provide important roosting sites for many birds including the Red-footed Booby.

Cordia subcordata Lam.
Photo Anne Sheppard

Climax Forest: where more moist undisturbed conditions pertain, climax forest may be established which represents the most luxuriant and complex vegetation found on the islands. These forests comprise mature trees which can reach over 20m tall and support a range of different species including *Pisonia grandis* R. Br. The soft humus which builds up in mature forests provides the only nesting sites for the Audubon Shearwater (*Puffinus lherminieri* Lesson) which burrows in the soft humus to lay their eggs. Other important forest trees include *Barringtonia asiatica* (L.) Kurz (fish poison tree) which

Birds nest fern Asplenium nidus L.
Photo Anne Sheppard

also provide important roosts for the Red-footed Booby; *Calophyllum inophyllum* L. (takamaka) widely exploited for boat building in the past; and *Intsia bijuga* (Colebr.) Kuntze. The climax forest provides the greatest diversity of niches for roosting and breeding birds including Common White Tern (*Gygis alba* Sparman), Lesser Noddy (*Anous tenuirostris* Temminck) and Brown Noddy (*Anous stolidus* L.). The mature forests also support a relatively wide range of shade-tolerant ferns and fern allies – both epiphytic and ground dwelling, especially *Asplenium nidus* L. and *Psilotum nudum* (L.) P. Beauv.

Savanna: where the hydrology prevents tree establishment savanna-like open areas are established, dominated by grasses, sedges and small herbs. These communities are very important for ground-nesting birds including Brown Booby (*Sula leucogaster* Boddaert) and Sooty Tern (*Sterna fuscata* L.).

Mangrove Woodlands: where saline conditions persist mangrove woodlands may establish, but this is a very rare vegetation community in the Chagos context – discovering the one on Moresby Island was the botanical highlight of the 2010 scientific expedition, as the only documented case of mangrove prior to this is a small area on Eagle Island which is drying out and desperately in need of restoration.

Healthy mangrove forest on Moresby Island *Photo Anne Sheppard*

Non-native Vegetation

The native vegetation has been supplemented by the introduction of non-native species ever since the islands were first discovered by the Portuguese. Useful plants were introduced during the plantation era, but many other species arrived by accident, along with early arrival of rats which have had a disastrous impact, especially on nesting seabirds. Ornamental introductions to beautify downtown Diego Garcia and other casual introductions increased during the 1970s. Currently there are about 232 non-natives, of which 128 have only been recorded on Diego Garcia.

Mayflower *Tabebuia pallida* (Lindl.) Miers
Photo Anne Sheppard

Around the Settlements you can see the evidence of these early introductions of useful plants that were grown for food including taro (*Colocasia esculenta* (L.) Schott), the starchy root vegetable native to SE Asia; pawpaw (*Carica papaya* L.), the tropical fruit native to the tropical Americas and first cultivated in Mexico; cucumber tree (*Averrhoa bilimbi* L.) used in cooking especially to flavour fish, thought to be native to Indonesia. These species don't really pose any threats to the native flora and fauna and are not really spreading to any great degree.

Taro *Colocasia esculenta* (L.)
Photo Anne Sheppard

The biggest negative impact on the native flora was the gradual conversion of most of the terrestrial land on the accessible islands to coconut plantations for the extraction of copra oil. Since the collapse of the coconut oil industry and the abandonment of the coconut plantations and with the consequent lack of any management these areas have become impenetrable coconut forests which prevent virtually any other species getting established, except more coconuts. An adult coconut can produce 80-100 nuts per year. The nuts drop from the mature trees and germinate *in situ* to form a 2-3m impenetrable mass. Perhaps the only organism to benefit is the coconut crab (*Birgus latro* L.) the world's largest terrestrial arthropod, reaching over one metre in leg span and 3.5-4 kilos in weight. The coconut crabs, threatened over much of their range, on Chagos comprise one of the most undisturbed populations in the world.

There are no records of the origins of other non-native plant introductions but many are becoming a

Coconut crab (*Birgus latro* L.)
Photo Anne Sheppard

problem as they spread and negatively impact native communities. For example, the fast growing tree, *Tabebuia pallida* (Lindl.) Miers (white cedar or mayflower), native to the Caribbean, is spreading invasively at East Point on Diego Garcia, and *Casuarina equisetifolia* L. whose main native distribution is SE Asia, Australasia and the Pacific is widespread on many of the islands in Peros Banhos.

Restoration Activities

Our restoration goals are to move from the invasive dominated Chagos present to a more species-diverse native-dominated future by:

1. Rescuing threatened habitats with mangroves being our key habitat priority and

2. Restoring native habitats with a priority for rat eradication and coconut removal to re-establish climax forest to replace coconut plantations.

We are currently fund-raising to start a programme of mangrove restoration. The newly discovered mangrove woodland on Moresby Island looks to be comprised of old trees with no current regeneration which may be the result of years of accumulated coconut debris which may have affected the tidal flow of the water. The habitat needs rehabilitating by first removing years of accumulated coconut debris. In addition, propagation material needs to be collected to establish a nursery to enable material to be produced for experimental re-introduction of young mangroves.

On Eagle Island the mangrove looks in a really poor state. It is being strangled by surrounding coconuts and by many over-topping vines. In addition the hydrology has been seriously undermined, possibly by the formation of a sand barrier which has prevented any tidal movement of water which mangroves need for healthy growth. Some areas are drying out whilst others areas are becoming flooded with fresh water as evidenced by the establishment of colonies of the fresh-water sedge, *Eleocharis geniculata* (L.) Roem. & Schult. So here we are looking at serious habitat restoration which is likely to require engineering work to re-establish tidal water flow, removal of coconuts and climbers, at the same time collecting propagation material, establishing a nursery so that we can trial some experimental re-introduction of young mangroves. If this programme doesn't start soon we are very likely to completely lose the Eagle Island mangrove ecosystem within the next decade.

Collecting coconuts from the ground before clearing the area for restoration work.
Photo Anne Sheppard

The second major restoration challenge is the conversion of coconut plantation back to species-rich forest. On Diego Garcia work has already started with the very successful Barton Point Restoration project in the Nature Reserve on the Eastern arm of Diego Garcia. Here coconut trees are being removed and native species planted and the results monitored to assess success. The techniques developed at Barton Point have proved really successful – clearing coconuts, corralling them and covering them in dead fronds to prevent regeneration, and planting out seedlings/saplings of native species grown specifically for the purpose or relocated seedlings from neighbouring natural seedling beds. Any indigenous plants present under the coconut canopy are retained. Initial results look really encouraging and a management plan for the area is being developed. The work on Diego Garcia is being scaled-up by using large diggers to enable clearance of larger areas and fencing them off to keep feral donkeys out. It will be fascinating to see how this develops.

On the outer islands in addition to coconuts we have the extra challenge of rat eradication. Rats are a major problem on many islands and have a huge impact on the resident bird populations, eating both eggs and young chicks. They also eat seeds and reduce plant establishment. Eradication plans are being formulated with advice from RSPB and NZ rat eradication experts. The February 2013 expedition includes a feasibility study for rat eradication from Ile Vache Marine in Peros Banhos. In the longer term a programme of rat eradications and island rehabilitations is being planned and fund-raised for.

So what does the future hold for the Chagos Islands? We have techniques available to swing the pendulum back from the current invasive-dominated state to more native -species rich communities. Our involvement with the Chagossian Community Environment Project (see this Issue) has provided participants with an introduction to botany and the plants and habitats of the Chagos Archipelago. These conservation trainees have proved that we have future conservation practitioners amongst them and we've incorporated their participation into our restoration funding proposals. Collectively our aim is to establish more species-rich forests supporting a wide range of native wildlife and a better future for the thousands of birds that nest in Chagos.

Pollution, Microplastics, Litter and Human Induced Impacts in Chagos

Professor Jim Readman
Plymouth Marine Laboratory

The geographical and ecological isolation of the Chagos Archipelago render it of special interest with respect to 'baseline' measurements and the threat of any potential effects of pollutants. Prior to a 1996 scientific expedition, however, there were negligible data in the open literature concerning the extent of contamination of the archipelago. Sediment samples during the 1996 event were analysed for hydrocarbons, steroids, organochlorines and toxic metals. Subsequent expeditions have further investigated the possible existence of persistent organic pollutants (POPs) and contaminants potentially linked to the military base on Diego Garcia. Indeed, associated with this base is regular sampling with many analyses in accredited US laboratories for over one hundred contaminants including metals and organic substances. In addition to the chemical contaminants, results from beach litter and tar ball surveys together with preliminary microplastic assessments were described.

Concentrations of potential Pollutants

Oil and combustion products
Oils contain a complex mixture of hydrocarbons and combustion processes result in the formation of toxic hydrocarbons. Analyses of the hydrocarbons in the sediment samples collected in 1996 revealed a dominance of hydrocarbons with odd carbon numbers and branched compounds of natural/biogenic origin mainly from planktonic plants. There was negligible evidence of contamination from petroleum with hydrocarbon levels similar to those reported for Antarctic sediments. An unresolved complex mixture of material in the analyses is often taken as a measure of chronic oil contamination: this was only measurable in one sample that came from the inhabited Diego Garcia and that was ten times less than concentrations reported for unpolluted UK estuaries.

Although oil slicks have not been reported in the Chagos region, tar balls were observed at eight beaches/islands throughout the archipelago in 1996, at three in 2006 and were not evident in 2010. This decrease may reflect improved international ship ballast cleaning measures over that time period throughout the Indian Ocean. No tar balls have been reported in Diego Garcia.

Sewage
The sediments collected in 1996 in Diego Garcia were also analysed for steroids. No evidence of sewage contamination, as would have been demonstrated by the presence of the faecal steroid coprostanol, was observed. Indeed, coprostanol was below the limit of detection at all stations, including Diego Garcia. Natural sterols dominated all sediments examined and compositional ratios were consistent with the input of organic matter derived primarily from planktonic or benthic algal sources, with a small terrestrial component.

Organochlorines - Persistant Organic Pollutants (POPs)
These compounds gained notoriety through Rachel Carson's book "Silent Spring", published in 1962. This exposed the hazards associated with the pesticide DDT which can biomagnify and contaminate food chains, harming animals, particularly at the higher trophic levels, including humankind. POPs are organic compounds or mixtures that share four characteristics; high toxicity; persistence; potential for bioaccumulation; and ability for long -range transport. Examples include the pesticides lindane and dieldrin and industrial polychlorinated biphenyls (PCBs) used in transformers and electrical components. In response to concerns relating to the protection of human health and that of the environment, the United Nations Stockholm Convention on POPs was adopted in 2001 and, following appropriate notification, became binding international law for those participating governments in 2004.

Sedimentary PCBs and organochlorine pesticides in Chagos were investigated in the 1996 expedition. Only some PCB congeners were above the detection limits of the analytical technique. Total PCB concentrations were much lower than those reported for deep and remote sediments, such as the Sargasso Sea and the Mediterranean basin. The predominance of the lower chlorinated PCB congeners and lindane suggest atmospheric deposition as the main route of introduction for organochlorine compounds into the sediments.

Flame retardants and polyfluorinated compounds

Whilst organochlorine POPs are of particular concern, other persistent compounds are emerging that also exhibit global ubiquity. Of these, flame retardants and polyfluorinated compounds (PFCs) [e.g. perfluorooctanesulfonate (PFOS), a synthetic fluorosurfactant used in abundance for many years as a fabric protector/stain repellent (Scotchgard®)] are important and have warranted inclusion in the Stockholm Convention. In addition, some can be linked closely with aviation, and hence potentially to Diego Garcia. To investigate this issue, in 2010 coastal sediment samples were collected for analyses from Diego Garcia, (the inhabited atoll) and from selected uninhabited atolls and islands.

Of the brominated, chlorinated and organo-phosphorus flame retardants analysed, only Dechlorane Plus® (a polychlorinated flame retardant) was recorded above the limits of quantification. This compound occurred in eight of the 20 sediment samples analysed, albeit at low concentrations (≤ 38.4 pg.g-1 dry sediment). Seven of the eight samples were from Diego Garcia with its associated military base, so elevated concentrations may not be surprising. The eighth sample was from Salomon Atoll, Ile Boddam, adjacent to a jetty/yacht anchorage. For comparison, concentrations of the compound recorded in the Great Lakes (USA and Canada) range from 14 to 4,390 pg.g-1 dry sediment.

The polyfluorinated compounds are used for a variety of purposes. Ionic polyfluorinated compounds were only detected in one of the twenty sediment samples. PFOS, PFHxS and PFOA, at low concentrations (2.4, 0.028 & 0.105 ng.g-1 dry weight, respectively), were recorded in a sample from Diego Garcia adjacent to a landfill and burn pit site. For comparison, ∑PFC concentrations of < LOQ to 85 ng.g-1 dry weight have been reported for Arctic Lakes in Canada.

Figure 1. Great Chagos Bank, eastern side of Eagle Island. Collecting sediment samples at low tide for subsequent analyses of PFOS and related compounds.
Photo Charles Sheppard

Herbicides and antifouling agents

Antifouling biocides on boats and ships provide a threat at very low concentrations, especially to the algal symbionts of corals. In 2006, replicate water samples were taken from fourteen coastal locations focussed around the Diego Garcia lagoon but also including oceanic reference sites. Samples were analysed for the popular antifouling booster biocides Irgarol®1051, chlorothalonil, dichlorofluanid and Sea Nine 211®, together with triazine herbicides (atrazine, simazine and ametryn). Results revealed negligible contamination, with levels generally below the limit of detection. Only in two harbour samples was an antifoulant (Irgarol®1051) detected, at very low concentrations. With respect to the antifouling agents and herbicides analysed, it was considered that they pose no chemical threat to the coral communities. Further investigations were, however, suggested into which antifouling products/herbicides are used in the region.

Toxic metals

Metals were analysed in surface sediments and biota collected during the 1996 expedition. Concentrations of copper, zinc, cadmium, lead, chromium and nickel were exceptionally low. Analyses of the biota revealed that lead and chromium (non-essential elements) levels were also very low. Concentrations of cadmium in invertebrates were similar to those found in open ocean areas.

Copper and zinc concentrations were, however, elevated in hermit crabs and clams. The elevated copper concentrations probably originate from the historical fungicide treatments previously used in coconut agriculture.

Contamination by solid waste

Shoreline debris

Despite their near pristine status in terms of chemical contaminants, Chagos beaches accumulate surprisingly high densities of solid debris. Observations were made in 1996, 2006, and 2010 at 20 sites in the outer atolls, and one in Diego Garcia as part of rapid environmental assessments. Median levels of the number of litter pieces were high (score 4) in all years; this corresponds to 1,000 to 9,999 items (geometric mean 3,162) per terrestrial portion of a site inspection quadrat, i.e. 500m (along the beach) to 250 m 'inland' from the shore. Items were mainly macro- plastics, polystyrene (Styrofoam) and rope, much being lost fishing gear or debris discarded from ships, most commonly of south-east Asian origin. Levels in Diego Garcia in all years were two orders of magnitude less than in other atolls, reflecting periodic clean-up events in that inhabited atoll. The method did not determine size categories or weight; most items were a few cm in size or less, but several northern islands, which are uninhabited, appear to collect substantial volumes of larger flotsam. Similar numbers are found in remote Pacific atolls where ocean current gyres are the main transport vector. Driftwood and lost timber from ships was low on beaches in all years, but decreased over time from 1996 to 2006, attributed to use for fuel by illegal fishing camps on the islands during this period of increasing fishing pressure. While these are unsightly, they have the potential also to impede nesting turtles in some areas.

Microplastics

Plastic debris now contaminates marine habitats from the poles to the equator. Whilst most attention has addressed debris items that are visible to the naked eye, attention is increasingly being focussed towards smaller particles termed microplastics. Small fragments such as these have the potential to be ingested by a wide range of organisms. They can also accumulate and transport pollutants. Widespread contamination of shorelines and the water column with microscopic plastics including brightly coloured granular and fibrous fragments has been reported.

Quantitative sampling for microplastics was undertaken using sediment collected from the low water mark at 20 sites in Chagos during 2010. Six samples were from remote, uninhabited atolls (Salomon, Peros Banhos, Great Chagos Bank and Egmont Atoll) while fourteen were from Diego Garcia. Synthetic polymers were found at all 20 sites (Table 4) including nylon, polyethylene, polyester, polypropylene and rayon, with an average size of 1.5mm ± 1.6mm (mean ± 1SD; range 30μm – 4mm). There was no significant difference in particle size between Diego Garcia and the northern atolls. The abundance of synthetic pieces was 4.55 ± 2.74 (mean ± 1SD) fragments per 50ml of sediment and was toward the upper end of the range reported from other locations worldwide. Hence it is apparent that microplastic contamination in the Chagos Archipelago is both widespread and relatively high compared to other locations.

Table 1 Number of synthetic fragments of microplastics at each site. (uninhabited sites are indicated by shading)

Sample Location	Number of synthetic fragments (per 50ml sediment)
Salomon Atoll	4
Pevos Banhos Atoll	6
Great Chagos Bank Middle Brother	6
Great Chagos Bank Eagle Island	13
Great Chagos Bank Danger Island	3
Egmont Atoll	5
Diego Garcia	2
Diego Garcia (seaward east of atoll)	3
Diego Garcia (back of Barachois)	2
Diego Garcia (beach rock at edge of lagoon)	3
Diego Garcia (atoll seaward)	5
Diego Garcia (turtle cove)	2
Diego Garcia (turtle cove Barachois)	6
Diego Garcia (southern tip of atoll)	5
Diego Garcia (off landfill site)	1
Diego Garcia (end of runway)	3
Diego Garcia (entrance to small boat harbour)	9
Diego Garcia (lagoon beside accommodation blocks)	5
Diego Garcia (nearby pipe running into sea)	5
Diego Garcia (yacht club)	3

There were some differences in relative abundance among sites with significantly more pieces at uninhabited sites compared to the inhabited military facility at Diego Garcia and the greatest number of synthetic pieces at the uninhabited Great Chagos Bank Eagle Island site. The reason for this spatial pattern is not clear but the results clearly indicate the potential for microplastics to accumulate in remote locations.

Figure 3. Sampling sites in northern atolls. Top: Great Chagos Bank - Middle Brother beach. A sample was collected nearby. Bottom: Peros Banhos - Ile du Coin beach. The line of the old jetty can be seen in the distance, a sample was taken on the shore there.
Photo Anne Sheppard

Holothurian (sea cucumber) poaching

Besides loss of an important natural resource in Chagos, concern arises over potential harmful ecological effects of poaching holothurians. Being largely detritus feeders, holothurians play an important role in the recycling system of sedimentary habitats, including sandy banks and lagoons of coral reefs; they 'condition' the substratum. Also, commercially fished holothurians have important functions in nutrient recycling, which increases the benthic productivity of coral reef ecosystems. Thus, removal of these animals through fishing may reduce the overall productivity of affected coral reefs.

Holothurians likely play a pivotal role in maintaining ecosystem integrity and resilience of coral reef systems.

Holothurians are particularly susceptible to overfishing. The evidence for heavy poaching in Chagos is substantial. Photographs of part of a haul comprising an estimated 5,000-7,000 holothurians on Eagle Island, a Strict Nature Reserve is one example. Significantly higher populations were observed (in 2006 though not in 2010) on the populated atoll of Diego Garcia, with poaching reducing numbers on the uninhabited outer atolls. Reduction in total holothurian abundance (all species) has also been observed in Salomon atoll between 2006 (2142 individuals) and 2010 (1661 individuals) from a complete census of a large transect 18.8 km x 4 m encircling Salomon atoll.

Figure 4. Sampling sites in Diego Garcia for antifouling analyses.

Summary

From a chemical contaminant perspective, the marine environment surrounding the Chagos Archipelago can be considered as pristine. It is certainly as uncontaminated, or less contaminated, than all other sites measured in e.g. the Antarctic or Sargasso Sea. In this respect too, therefore, it provides a useful global reference site. There is evidence, unsurprisingly, of poaching which could have ecological consequences (e.g. that of holothurians).

Holothurian on sand. Of the species commonly taken by the poachers
Photo Anne Sheppard

The Endemic Chagos Clownfish

Anne Sheppard
University of Warwick

You might think that the Chagos Archipelago, like the similarly isolated Galapagos Islands and the Hawai'ian Archipelago amongst others, would have an abundance of endemic species. However it is in fact quite the opposite case – Chagos appears to have very few endemic species. This is possibly due to Chagos' position, sitting between the South-East Asian Eastern Indian Ocean and the East African Western Indian Ocean and on a thoroughfare between the two. This position stops the isolation necessary for endemism to occur.

Of the very few Chagos endemics, the Chagos Clownfish *Amphiprion chagosensis* is uncommon in Chagos - especially when you have a camera with you! But Professor Charles Sheppard, while looking through some photographs he had taken a few years ago, wondered if these might be of the elusive fish.

The photographs were sent to fish biologists Dr Chas Anderson and Dr Nick Graham for identification, who confirmed that they were indeed *A. chagosensis.*

Photos Charles Sheppard

Small Life, Hidden Life: Reef Cryptofauna of the Chagos Archipelago

Catherine Head
University of Oxford

Coral reefs are thought to be the most species rich marine ecosystem, and the majority of this biodiversity lies within the so-called reef cryptofauna, the communities of animals that live hidden within the coral framework, e.g. crabs, brittle stars, and shrimp. The cryptofauna are a functionally important suite of animals but are understudied. This project assesses the diversity of select groups of the reef cryptofauna in the Indo-Pacific to better understand their role in coral reef ecosystem function and resilience. Chagos forms the scientific “baseline” for the project, representing one of the most undisturbed reef ecosystems globally, against which other reefs in the region will be compared.

On this year’s Chagos scientific expedition we collected cryptofauna samples from dead coral heads across the Archipelago. These samples will not only allow us to assess species richness but will also allow the investigation of evolutionary patterns of reef cryptofauna, as well as identification of whether losses in species diversity on disturbed reefs disproportionately target specific functional groups or phylogenetic clades. Here we will present some preliminary results focusing on a subset of the cryptofauna, the Caridae (shrimp and snapping shrimp). We will also look to the future outlining what we are currently working on and plan to achieve from the project.

Pulling Back the Blue Curtain in the Chagos: Using Underwater Video Technology to Explore Communities Below 15m

Dr Heather Koldewey,
Dr Matthew Gollock and Dr Kirsty Kemp, ZSL
Prof Jessica Meeuwig,
Dr Tom Letessier, Phil Bouchet, Lloyd Groves, Gabe Vianna, University of Western Australia

Following the establishment of the Chagos Marine Reserve, legal commercial fishing ceased within the reserve's boundaries in October 2010. This provides a large refuge from exploitation for mobile pelagic predators such as tuna and sharks, many of which are internationally threatened. However, debate persists on whether mobile species are sufficiently "resident" within the marine reserve boundary for this protection to be effective. Fundamental to resolving this so far largely data-free debate is the collection of baseline information on the status of key open-ocean indicator species, such as yellowfin tuna and blue sharks, with respect to their distribution and movements, relative abundance, size structure, sex and maturity. Such pelagic species are difficult to monitor given their mobility and patchy distribution.

Open ocean habitats are, by their very nature, remote, and consequently difficult and expensive to access, monitor and manage. This similarly applies to the species that exist, be it permanently or transiently, in these regions. Understanding population structure has traditionally relied heavily on either commercial catch data or fisheries independent but destructive surveys, neither of which is appropriate for a no-take marine reserve such as Chagos.

In a collaborative project between the Zoological Society of London (ZSL) and the University of Western Australia (UWA), a monitoring programme in Chagos for open-ocean species is being developed, particularly for those formerly targeted by the fishery that are vulnerable in much of the Indian Ocean. This has required some innovative approaches, based on the use of underwater video technology and tagging fish. Baited remote underwater videos (BRUVs) are a well-established method to monitor species using equipment that sits on the sea floor. Through careful selection of sites and the number of BRUVs deployed, data can be gathered on diversity, the location and relative abundance of different species, and through repeated sampling, changes in abundance. During the February/March 2012 expedition, BRUVs were deployed on the seabed at over 150 locations around the archipelago to depths of 80m giving us an insight into parts of Chagos never previously explored. The most exciting of these deployments was during the discovery of a new seamount which was named Sandes Seamount after the Captain of the Pacific Marlin and recorded for the first time using a BRUV http://www.zsl.org/conservation/news/seamount,991,NS.html .

In order to be able to monitor species in the open ocean, our project has developed a pelagic version of the BRUVS, known as the SISSTA (Stereo Imaging System for Shark and Tuna Assessment) which was trialled off Dirk Hartog Island in Western Australia in April 2012. By testing different depths, attractants and the techniques to deploy and retrieve the camera units, the first surveys were run using this new technique in Chagos by November 2012. Data are now being analysed, but novel findings included the first sighting of a false killer whale in Chagos. Next steps will be to establish systems for longer term deployment and remote monitoring.

This first open-ocean expedition in November 2012 also included research on shark satellite tagging, oceanography, acoustics and open ocean bird surveys. A blog on the CCT website provided updates http://www.chagos-trust.org/news/ and more detailed articles will feature in the next Chagos News.

Our results to date offer encouraging results in scientifically validating the no-take status of the Chagos marine reserve, particularly with regards to shark and tuna conservation, and ensure it fulfils its role as a unique scientific reference site for marine biodiversity. Such research has broader implications in assessing how the growing number of large protected areas will affect ocean productivity and biodiversity.

Acknowledgements
Australia's National Environmental Research Program, the BIOT Administration, BIOT Commissioner's Representative and Commander of British Forces Cdr Richard Marshall, the Executive Officer Major John Lugg, DEFRA, Blue Marine Foundation, Chagos Conservation Trust, DG21 LLC, Bertarelli Foundation, MRAG Ltd., Natural Environment Research Council, Branch Health Clinic (Diego Garcia), the crew of the Pacific Marlin, Project Ocean, the BIOT Scientific Advisory Group, Selfridges Ltd and the UK Foreign and Commonwealth Office.

Big Ocean Network and the Future of Chagos:

Dr Randall Kosaki
Papahanaumokuakea Marine National Monument

In November I spoke of the forthcoming collaborative research agenda and on February 1, 2013, the members of the Big Ocean Network will release the Big Ocean Research Agenda. This research plan represents a framework for shared research that addresses the unique scientific needs and challenges of large-scale MPAs. As a member of Big Ocean, Chagos will continue to expand engagement in collaborative research with scientists from other large MPA sites who share scientific interests, challenges, and management needs.

Big Ocean, a network of the world's largest marine managed areas, was established in December 2010 with the goal of improving the management of very large MPAs through sharing information, expertise and resources. The Big Ocean Research Agenda is an outgrowth of a Big Ocean Think Tank meeting held at the International Congress for Conservation Biology (ICCB) held in New Zealand in December 2011 (see *Chagos News* no. 39 for details). The Think Tank highlighted various unique features of conducting research in large-scale MPAs.

The primary aims of this shared research agenda are to capitalize on collaborative and comparative research opportunities that are based on the scientific needs shared by large-scale MPAs, and to identify a set of research priorities to be jointly addressed by Big Ocean sites. The Research Agenda notes that large-scale MPAs contain entire, diverse and relatively pristine ecosystems, as well as larger scale natural processes which cannot be studied in their entirety in smaller regions.

Three main categories of research activities were identified as being most relevant and shared amongst large-scale MPAs:

- **biological and ecological characterization**, including studies on the abundance and distribution of organisms, habitats and ecosystems;
- **connectivity,** including biological, physical and anthropogenic connectivity; and
- **monitoring** of temporal trends, including patterns caused by both anthropogenic sources and natural variability.

In other words, these three research themes focus on characterizing what natural resources are present at the sites, how these natural resources are connected to each other as well as to external sources, and how these natural resources change over time

Like many of the remote, archipelagic-scale MPAs of the Big Ocean Network, Chagos is one of the greatest natural laboratories on earth, and represents an ideal control site to which local anthropogenic impacts at less pristine sites can be compared. Nowhere is this comparative power more valuable than in the study of climate change and its impacts to coral reef ecosystems.

Indeed, one of the first major collaborations resulting from the Big Ocean Research Agenda will be a study of coral disease, bleaching, and resilience on a broad geographic scale, and across a large gradient of human use and impact. In coordination with other Big Ocean sites (including the Papahanaumokuakea Marine National Monument, and the Phoenix Islands Protected area), Chagos scientists will be collecting baseline data on the prevalence of these coral afflictions for a comparison to other Indo-Pacific sites impacted by local anthropogenic stressors. Using these remote, pristine MPAs as control sites will enable scientists to differentiate between the impacts of specific local stressors and global-scale drivers of bleaching and disease. Ultimately, identification of these key stressors and risk factors will allow the managers of compromised reefs to improve reef health by reducing the impacts of local human activities.

The Big Ocean Research Agenda can be downloaded from the Big Ocean web site at bigoceanmanagers.org. Additional information about each of the member sites is also available at this web site.

Chagos News CCT AGM 2012

Courtesy of the Zoological Society of London the Trust held its 2012 AGM in their Huxley theatre on Tuesday 27th November directly after the conference ***Building on Success*** reported elsewhere in this issue.

The Chairman gave highlights of his annual report, Carol Garner presented an update on CCT-US and John McManus gave the view from BIOT administration. Full minutes etc will be posted on the website.

Executive Committee Officers and Members were elected and now are:
Alan Huckle, Chairman,
Richard Martin, Treasurer,
Hayley Tam, Membership Secretary,
Simon Hughes, Secretary,
Birgitta Bostrom,
Pete Carr,
Colin Clubbe,
Chris Davies,
Rachel Jones,
Heather Koldewey,
Sam Purkis,
Pete Raines,
Anne Sheppard,
Charles Sheppard,
John Turner,
Elisabeth Whitebread.

Alan Huckle, CCT Chairman addresses the AGM. *Photo Anne Sheppard*

CCT- US Report on CCT Annual Meeting November 27, 2012

Carol Garner,
Secretary CCT US

It was with great pleasure that I was invited to represent Chagos Conservation Trust US (CCT- US) by attending the Chagos Conservation Trust (CCT) Annual General Meeting in London on November 27, 2012. Prior to the Annual Meeting I attended the conference: **The Chagos Marine Reserve: Building on Success** hosted by CCT and the Zoological Society of London. I found the conference programs to be most informative on a variety of topics that reinforces our mission and goals to support the environmental preservation of the Chagos Archipelago.

During the AGM immediately following the conference, I was allotted time on the full agenda to present the CCT- US 5-Year Business Plan and new brochure.

As the Plan explains:

Short term goals *– In the near-term, CCT – US will build a membership base and begin fund-raising to instigate projects in the Archipelago.*

Long term goals *– Funds raised by the CCT – US will be put to good use to expand and support selected initiatives. CCT – US will continue to support any project that helps to preserve the natural biodiversity found within the archipelago and scientific and conservation efforts undertaken to tell us more about these islands, remove invasive plant and animal species, and restore native vegetation. These initiatives will be an important contri bution to the conservation of global biodiversity. Through academic, public and private sector partnerships, CCT-US will support conservation based research, education and outreach programs.*

Business Goals *- CCT – US business goals are derived from our conservation and preservation mission, and are consistent with both the flexibility and constraints imposed by our 501(c)(3) not for profit/charitable status. Business goals are the essence of the more global business plan. We have identified 5 business goals for our 5-year plan. The fiscal year (FY) 2012 plan represents only the remaining 6 months of FY 2012 (July-December). Each business goal is described by a set of activities. As appropriate, revenues accruing from or attributable to these activities provide fiscal parameters and objectives.*

Goal #1:Build CCT – US Membership

We will expand our membership base to allow us to facilitate conservation, preservation and education activities in the Chagos Archipelago and the Chagos MPA.

Goal #2: Perform Fund-Raising for Environmental Projects in Chagos

CCT – US will expand our membership base to allow us to facilitate conservation, preservation and education activities in the Chagos Archipelago and the Chagos MPA.

Goal #3: Promote Education and Awareness of Chagos Environmental Issues

CCT – US will support education and awareness in the scientific and academic communities, perform community service in environmental conservation in schools and with conservation groups, and attend and present at conferences focusing on conservation and protection of the rich biodiversity of the Chagos Archipelago and its surrounding waters.

Goal #4: Sustain Presence and Outreach

CCT – US (in cooperation with CCT) will continue to promote marine conservation and expand relationships with influential organizations such as the Big Ocean network, The New England Aquarium, The Marine Conservation Society, The Nature Conservancy, The Living Oceans Foundation, The Pew Environment Group, The Zoological Society of London, and other appropriate marine conservation nongovernmental organizations (NGOs). These important relationships need to be maintained to facilitate broad understanding of the need to preserve the environment. We will use our web site as a tool to enhance all outreach projects and record and publish scientific research and information. There will be an increasing need to attend relevant conferences to address and promote Chagos conservation. Films and publications could be produced as finances and/or opportunities permit.

Goal #5: Support Scientific Contributions to Preservation of the Chagos Environment

CCT – US will promote and contribute to the organization of practical monitoring, conservation and scientific work in Chagos. The archipelago lies at the center of the Indian Ocean and is vulnerable to exactly the same physical pressures from global environmental change as other reefs in the same ocean. Chagos is, however, unique in that it boasts 25,000 km^2 of reefs with very low human impacts. This provides a unique opportunity to examine the effects of global warming without the additional (human) effects of pollution, over fishing and other extractive processes. To date, science in the archipelago has been funded through a combination of grants awarded to UK universities by the UK government.

Alistair Gammell, UK Director Global Ocean Legacy, Pew Environment Group and Carol Garner, Secretary and Co Founder CCT-US

These visits, though sparse until now, span three decades and deliver an excellent record of the wax and wane of the reef system's coral and fish. With more funding, monitoring could become regular, more extensive and thus more valuable in ensuring the effective management of the MPA. Specific opportunities for habitat restoration and conservation have been identified on Diego Garcia and in the outer islands. Larger island restoration projects may be developed and supported by tax-deductible contributions.

This Business Plan shall be reviewed at least annually, and shall be consistent with the CCT – US annual budget.

I want to thank CCT for their invitation and support making it possible for me to attend this meeting.

Climate Change – it isn't us is it?

Everyone will be aware that there are some 'climate change deniers', those who still argue that mankind is not responsible for the raised atmospheric CO_2 which is leading to global climate change and ocean acidification—two big and potentially fatal problems for coral reefs as well as many other, if not all, Earth's ecosystems.

You may be one of them or you may be one of those who are frustrated by the lack of action by governments to do anything about it. The logical argument below was written by Professor Dennis Hubbard and to me it represents a wise and sensible stance that everyone should be able to agree on – although it is probably not a logical stance that the deniers take.

With thanks to Prof Hubbard for permitting Chagos News to reprint it.

Let's start with what we know:

1) The sun has a HUGE effect; in fact, it's largely what has driven major climate cycles.

2) CO_2 and a host of other things are "greenhouse gases", etc. and they do cause temperature increases - how much we can argue about later.

3) CO_2 levels have risen by a measurable amount; there is a significant amount of "old" carbon in this; so it's related to burning fossil fuels.

4) The rate of sea level (SL) rise was largely slowing through much of the 19th century, save those pesky "little ice ages", and later the flat spot in the 1960s (largely due to reflectivity of particulates related to increased coal consumption)

5) SL rise has accelerated by *ca* 0.009 mm/yr since 1860 and has increased (conservatively) two-fold in that time.

6) During past SL rises, sometimes CO_2 goes up first and sometimes temperature leads the way; these are inter-related inasmuch as CO_2 drives up temperature but higher temps also increase CO_2; nature is fickle that way. [but see note below for more recent information]

I'm sure I've missed a few, but that's enough to start with.

So, for now, let's set aside the issue of whether solar forcing or CO_2 is the main driver or not. If we combine the points above that we can hopefully agree on, then we go to the following:

Projections have been shown to have errors, but most upgrades have produced worse projections and not better ones. Recent performance seems to be ahead of most models. A recent synthesis of all available Holocene core data demonstrates that over half of the world's coral reefs built at rates below the PRESENT rate of SL rise - so there is already a problem that was not there a century ago and is worsening. And... those reefs didn't have to deal with **Homo stupidus.* New York just went underwater. Perhaps this is within the statistical limits of error (I just don't know that yet); higher sea levels will exacerbate these two examples and countless more.

So...... if we can agree that these are bad things for humans, the economy and all the other stuff that usually gets a priority in the discussion,

then:

The accelerating SL rise is a problem regardless of the cause (the pattern tells me that the recent blip can't be explained only by solar forcing). Anthropogenic contributions are at least a measurable PART of this pattern. These are the only ones we can do anything about unless someone comes up with a way to control solar output or we want to tinker with geo-engineering. Therefore, lowering our CO_2 emissions is in our best interest both socially and economically.

To me, this is the proverbial gorilla in the room that gets lost in the quibbling about things that we are not going to convince one another about.

To me, the data show that the anthropogenic signal is a measurable and significant part of the pattern we are seeing today. Compared to the energetics of the 125,000-year cycle, this is a pimple, but on a human timescale (which we are talking about), CO_2 is playing a disproportionate role in the short run (centuries to millennia) and some pretty well informed folks argue that the CO_2 part of the signal has overwhelmed the solar component for the time being. I'm not going there for now, but IF they are right, we are really screwed. If they aren't, then we're still back to the realities that derive from my six points above and the reality that carbon emissions are the only part we can control.

I don't have time or the space here to convince you that anthropogenic CO_2 is the dominant signal at present, but hopefully we can agree that however important resolving this might be in the long run scientifically, we are experiencing events that we don't like – and anthropogenically created CO_2 plays SOME role in that pattern whether or not the sun is still the dominant player in all of this. If we agree on my underlying point, then we need to move forward to get folks focused on this. If not, then we'll just have to face the fact that one of us has to be wrong.

So, we're down to Pascal's wager - originally designed to address the existence of God, but equally applicable here. We have a binary question:

IS anthropogenic CO_2 playing a measurable and negative role in climate regulation?

Answers: Yes – No. The validity of our answers are likewise binary, we are either right or wrong.

If you argue no and are correct, then climate may self-regulate but all the crap we put into the air will significantly deteriorate the air and water and there will be disproportionate increases in suffering and economic costs regardless of any possible climate ties. If you are wrong, we will probably reach a tipping point where no amount of money will allow us to reverse whatever comes from our denials.

This is the equivalent or Pascal's "eternal damnation" option.

In contrast, if I argue yes and am right, then we can perhaps do something to reverse this trend. Arguing from an economic perspective, the discount rate would support the idea that it's cheaper to not break it using today's dollars than it is to fix it using tomorrow's. If I am wrong, I am perfectly happy to say, "gee, it wasn't us after all, but we have cleaner air, water and a better environment. Don't I feel stupid".

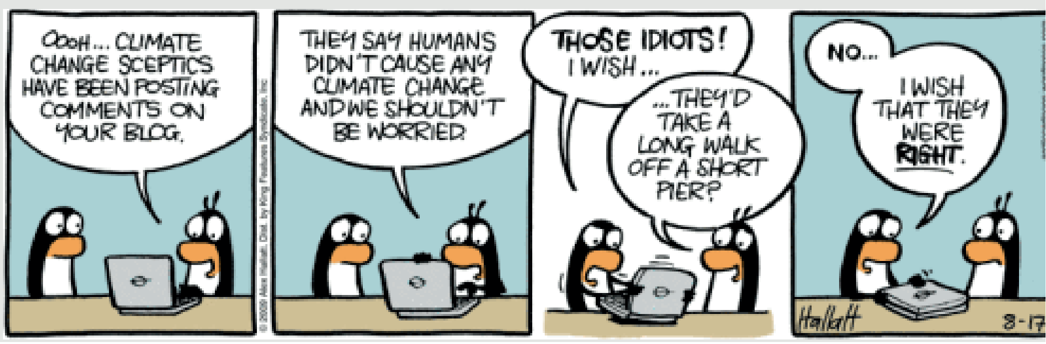
This was Pascal's "excess of morality".

So, whether I've convinced you of anything or not, I hope that you will at least agree that I am not blindly taking what the conspiracy is selling. I am a pragmatist. While I believe that we have a significant role in all of this, I am less worried about quantifying it or arguing over how it stacks up against everyone else's favorite climate driver. I feel that doing science is a privilege, so I will continue to take advantage of that luxury by looking at all the data and changing my perspectives as the data get better. However, that privilege comes with a responsibility to not "fiddle while the planet burns".

Dennis Hubbard
Dept of Geology-Oberlin College
Oberlin OH 44074

* so this is probably an optimistic characterization.

Note: Shakun JD et al. 2012. Global warming preceded by increasing carbon dioxide concentrations during the last deglaciation. *Nature* **484**: 49-55.



Shipwreck and Artwork

Howard L. Resnikoff Boston and Gloucester, USA
Nigel Wenban-Smith London and Gloucestershire, GB

Both editions of *Peak of Limuria* reproduce a painting of the East Point settlement on Diego Garcia in 1819. It shows survivors of the *Admiraal Evertsen*, a Dutch warship which sank off the atoll on 9 April 1819, strolling around the settlement as the plantation workers go about their daily tasks. In the background lies the American brig *Pickering*, which has rescued everyone aboard. Here it is:

Figure 1. Painting, by 'WLV', of the settlement at East Point showing the brig *Pickering* in the lagoon.
Who was WLV?

In *Peak of Limuria*, this painting is ascribed to Lieutenant Verhuell (*sic*). The two of us were intrigued by this picture for different reasons and only became known to each other through the intervention of Major Ted Morris, that wonderful spider at the centre of every Chagos student's web. One was investigating the *Pickering* and all who sailed in her; the other the history of the Chagos. The first knew all about Captain Ver Huell's voyage in command of the *Admiraal Evertsen* but was puzzled to find this painting on Morris's website, since it was neither in the collections of his art in Dutch museums nor known to the editors of Ver Huell's memoirs; the second was equally puzzled to find a different painting of the same scene, undoubtedly by Ver Huell, in the same edition of his memoirs. Let readers spot the difference!

Figure 2. Painting of the settlement at East Point by Q.M.R. Ver Huell. 39.6 cm × 56.5 cm. National Maritime Museum, Rotterdam.

The context of the *Evertsen*'s voyage was the end of the Napoleonic wars. An 80-gun ship of the line, she had been sent from Holland in 1815 as the head of a small squadron of men-of-war to restore Dutch sovereignty in the Dutch East Indies after the British, who had captured the Dutch colonies after the Netherlands was conquered by Napoleon, returned them. Now, in 1819, having succeeded in her mission, she was returning to Holland with a precious cargo: Commissioner-General Cornelis Elout and Rear-Admiral Arnold Buyskes, respectively the highest ranking civilian and military official in the colonies, and the civilian Hendrik Doeff, the former president of the Dutch East India Company concession in Japan, who had perforce remained in Japan for 17 years because of the raging world-wide war. Only now, with the war over, was Doeff able to return home with his pregnant wife, but he had made his enforced stay productive by writing the first dictionary between Japanese and a European language. These distinguished passengers and Captain Ver Huell had collected a treasure trove of anthropological artefacts from the Indies and Japan that would be lost.

Ver Huell was not the only member of the crew of the *Admiraal Evertsen* to write about his experiences. Doeff wrote a fascinating account of his time in Japan and the disastrous voyage. Also, at least two of the ship's Lieutenants – H. P. N. 't Hooft and W. L. Veerman – kept journals recording the ship's last voyage.

Finally, the ship's own log has survived, together with a series of official reports on the disaster. Here, we need concern ourselves only with the circumstances of the ship's sinking, her crew's rescue and the artistic records born of those events. Books in preparation, on the exploits of the *Pickering* and on the history of the Chagos Archipelago, will reveal much more about American merchant brig's activities in the Indian Ocean during the nineteenth century and about life on Diego Garcia, including observations made by the Dutch during their six-week sojourn.

Admiraal Evertsen had been in difficulties since passing through the Sunda Strait. She lost the top part of her mainmast and was leaking seriously. Continuous pumping had managed to get her into the most isolated part of the Indian Ocean where, finally, Admiral Buyskes made the decision to divert to the nearest land – the island of Diego Garcia. The dispirited and exhausted crew succeeded in bringing her to the atoll but the heavily laden ship, its hold filled with water, seemed unlikely to be able to make it across the coral reef at the lagoon's entrance. It was then that the *Evertsen* saw an American brig – the *Pickering* – in the lagoon and fired a gun to attract her intention. *Pickering* was on a three year sealing voyage from Boston under Captain Samuel B. Edes, an experienced China trader. She had dropped a sealing gang on Prince Edward Island in the Southern Ocean and was plying the transport trade while waiting for them to collect skins and oil. It was purely by chance that *Pickering* was in the lagoon to fill her water casks and load a cargo of coconuts.

Captain Edes boarded *Evertsen*, was appalled by her condition, and advised Rear Admiral Buyskes that she could not make it across the coral reef into the lagoon. She could not go but neither could she stay. While the implied irrevocable decision was debated, the *Evertsen* drifted farther away from the island. Over Captain Ver Huell's objections, Buyskes and the other officers concurred with Edes' counsel and the order to abandon ship was issued. *Pickering*'s cargo was dumped overboard and the more than 300 crew and passengers piled into *Pickering.* They were too many for *Pickering* to take to the nearest port – Mauritius; they would be brought to Diego Garcia where half would have to remain while the other half would be transported to Mauritius.

Obviously, no-one was making sketches of the last hours of the *Admiraal Evertsen,* most of them shrouded in darkness. However, both Captain Ver Huell and Lieutenant 't Hooft recreated the scene in imaginative paintings made later (fig.3 and fig.4 respectively). But we should remember that none of the great sea paintings ever was painted *en plein aire* – in the heat of the action.

Figure 3. Q.M.R. Ver Huell, *Leaving His Majesty's Ship Admiraal Evertsen off Diego Garcia.*
40.3 cm × 53.5 cm. National Maritime Museum, Rotterdam.

Ver Huell emphasized the orderly departure from the stricken ship, an aspect for which he could claim some credit. 't Hooft's picture, on the other hand, is less formulaic. It gives priority to sea and wind conditions and the drama of the whole situation. In particular, he shows the sails of the Dutch ship being blown in every direction and brings out the power of the rollers

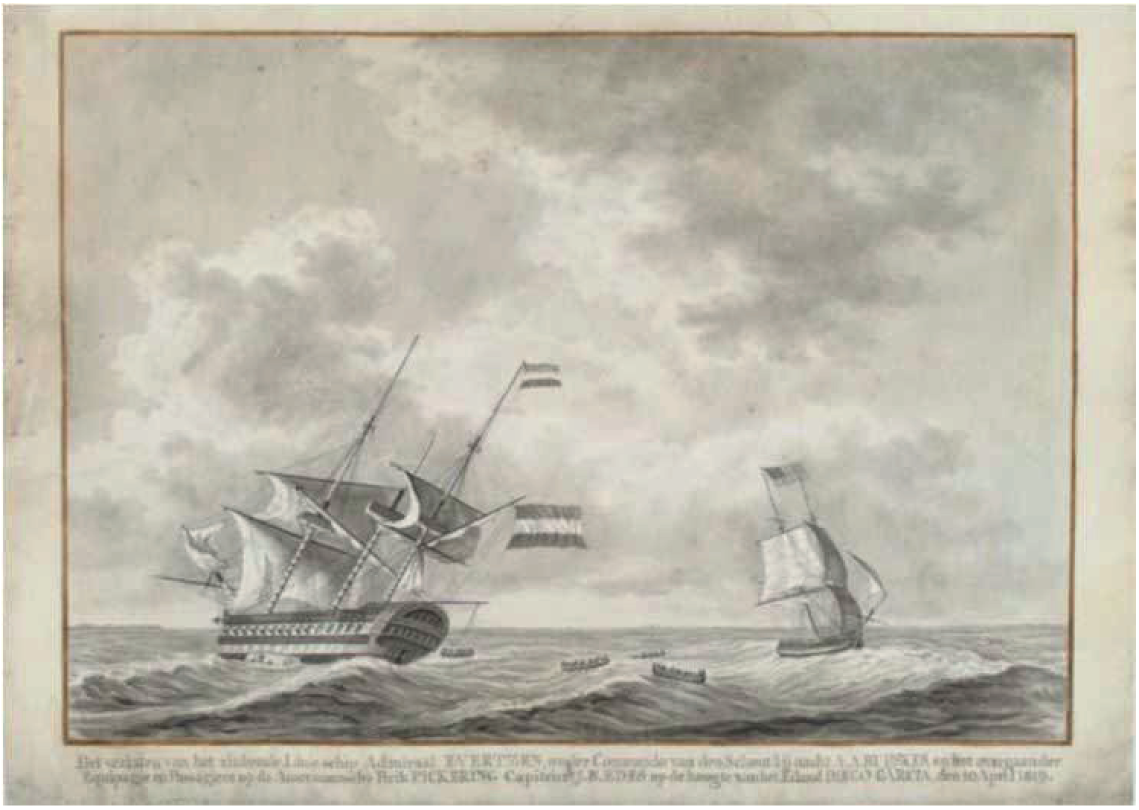


Figure 4. H.P.N. 't Hooft, *The Rescue of the Crew of the Ship of the Line Admiraal Evertsen*.
37.2 cm × 50.2 cm. National Maritime Museum, Rotterdam.

The styles of ‘t Hooft and Ver Huell were very different but both are very much more refined than what one sees in figure 1. The clumsy handling of the Dutch flag and the unsophisticated rendering of the clouds differentiates fig.1 from both marine paintings. The differences between figure 1 and Ver Huell’s painting of the scene from essentially the same vantage point are legion. It seems clear that neither Ver Huell nor ‘t Hooft painted figure 1.

Who, then, might have been responsible?

Figure 5. Extract from figure 1 showing initials ‘WLV’.

Some circumstantial evidence is provided by the log kept by one of the Dutch officers left on the island with Ver Huell, where an entry for 13 May 1819 reads “made sketch of the island”. More interestingly, close examination of the first painting shows that there are initials at the bottom right hand corner, which appear to be ‘WLV’; cp. fig.5. ‘W. L. Veerman’ was a second lieutenant on the *Evertsen*’s roster and had responsibility for the ship’s log. And Veerman had been left on the island with Ver Huell to be transported to Mauritius with the second group of survivors. Problem solved! This Veerman was surely Willem Leonardus Veerman, who was born in 1793 and died on 9 July 1824 while captain of the Dutch frigate *Algiers* at Smyrna (Izmir), Turkey after a 4 week illness. He was a recipient of the ‘Ridder der Militaire Willems Orde’, the highest Dutch military honor, for his bravery in helping put down a mutiny in the Moluccas in 1817 during his service on *Evertsen*.

Our evidence is all circumstantial but there are many elements and all the pieces dovetail. We have no doubt that a more detailed search of the roster of the *Admiraal Evertsen* will reveal only one officer with the initials ‘WLV’; only one 2nd Lieutenant W. L. Veerman; only one Willem Leonardus Veerman.

There remains the question of when and where figures 1 and 2 (and indeed, figures 3 and 4) were painted.

Based on the information available to us, it is impossible to say. Nevertheless, the log note “made sketch of the island” strongly suggests to us that the survivors had sketchbooks and drawing materials. Although Rear Admiral Buyskes had forbidden the crew to take more than the merest essentials when they abandoned *Evertsen* we know that Ver Huell arranged for a servant to save his ‘sketchbooks’. Sketchbooks can be small or large; intended for simple drawings or high quality watercolors. Ver Huell could well have saved his watercolors and brushes. And he might well have shared them with ‘t Hooft in the days before *Pickering* first went to Mauritius, and with his compatriot Veerman during the tiresome weeks while they awaited her return to Diego Garcia. Moreover, for naval officers in Age of Sail, the ‘merest essentials’ certainly included materials for keeping up the logbook, which was the legal record of the vessel and her voyage, and an essential element in providing information for future sailors. This was the responsibility of ‘t Hooft and of Veerman separately, so one might believe that both of them had made independent efforts to save drawing materials and paper.

Indeed, ‘t Hooft kept a journal on the voyage from Diego Garcia to Mauritius that incorporates a 3-page fold-out drawing with light green and brown watercolor washes of the approach to Mauritius. We suppose someone could argue that Captain Edes supplied the materials on *Pickering*; given the weight of evidence, we find that unlikely.

Figure 6. BIOT Postage stamp commemorating the rescue by the brig *Pickering*

In 1991 the British government issued a postage stamp commemorating *Pickering*’s rescue of the crew and passengers of the *Admiraal Evertsen* (fig.6). The designer of the stamp copied a portion of Veerman’s painting.

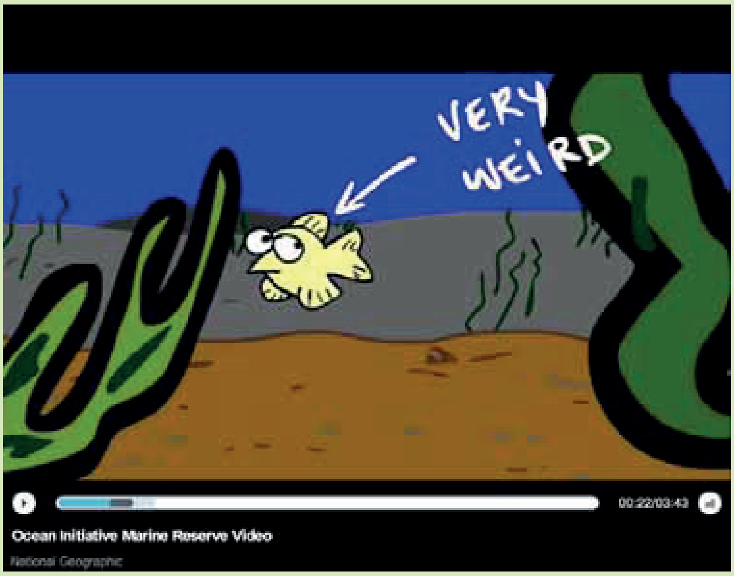
As with most attempts to uncover historical truth, each revelation leads to new questions. Why is the large Dutch flag displayed as the ensign – the position reserved for the national flag – on *Pickering*? Was this Veerman’s conceit? Or had some arrangement been made that temporarily transferred *Pickering*’s nationality to the Netherlands?

Finally, did Veerman paint other views of Diego Garcia that have been obscured by the mists of time?

National Geographic have produced a short film which explains the benefits of marine protected areas. It is simple and would be useful to explain the concept to young children (who often grasp the idea more quickly than adults).

The video can be viewed at

http://education.nationalgeographic.com/education/multimedia/what-marine-reserve/?ar_a=1&ar_r=999



Chagos Scientific Research Expedition to Northern Atolls
Outline

21th February – 12th March 2013

PRIFYSGOL
BANGOR
UNIVERSITY

ZSL
LIVING CONSERVATION

THE UNIVERSITY OF
WARWICK

DARWIN
INITIATIVE

Overview

Between 21th February – 12th March 2013 a scientific research expedition will take place in the Chagos Archipelago (British Indian Ocean Territory). Most of the cash funding comes via DEFRA's Darwin Initiative, but the expedition is supported and facilitated also by the BIOT Administration and numerous other institutions including Chagos Conservation Trust and institutions of all participants. Fourteen scientists and supporting team members will participate. Our research plans prioritise the continuation of long-term monitoring programmes for the large BIOT marine reserve, and continue to establish the best and most resource-efficient methods to monitor and manage the area. The work includes both shallow reef and island work and is designed to assist the BIOT administration in understanding and managing the world's largest fully no-take MPA, maintaining this extraordinarily rich area of marine and terrestrial biodiversity.

Research Objectives

These are in no particular order, with access determined sometimes by weather conditions, slippage in programmes (or the reverse), and taking opportunities when something unexpected occurs (e.g. investigation of the unexpected outbreak of the coral predator 'Crown-of-Thorns' off Eagle Island in 2012). We have always previously succeeded in achieving most goals and more, thanks also to the enthusiastic support from the cfficers and Crew of the *Pacific Marlin*.

1. Long-term monitoring of reef condition in the Indian Ocean (Charles Sheppard, John Turner, Anne Sheppard, Ronan Roche, Morgan Pratchett)

There are two long-term reef monitoring programmes that involve measurement of reef changes over time. One has involved coral cover measurements since 1978, including coral recovery assessments following the climate change driven mortality of 15 years ago. The value of this routine, ongoing project has been to show that coral recovery patterns in Chagos are unmatched by most other places in the world, and that the value of this area is extremely important in the context of the ocean. Furthermore few places have coral cover data over such a long period and over such a significant time for coral reefs, which is scientifically of considerable importance.

We will conduct repeat measurements at the same locations across Chagos to contribute to the longest time series of reef condition data in the Indian Ocean – this being valuable because a 'trajectory' yields far more information than does a one-off set of measurements. Archival video will be recorded at permanent monitoring sites for future comparison, and for comparison with video records first made 7 years ago, at a time when the reefs were just beginning to recover from major bleaching events.

Now that recovery is complete - following the 1998 bleaching event, but perhaps only until another warming episode – we will expand monitoring to measure juvenile coral recruitment, which is the basis of the next generation of reef and island building corals.

In addition, growth and growth rates of selected and dominant forms of corals will be measured. This is an indication of coral 'health' in broadest terms, and good growth (which is apparent though unquantified) underpins the growth of reefs and islands as a whole.

2. **Technology development for monitoring fish and shark assemblages across the Chagos shelf (Gary Fletcher)**

Deployment of video systems during both pelagic and coastal expeditions in Chagos during 2012 in order to study the fish and shark assemblages of the coral reefs yielded extremely positive results. However, these deployments were limited only to 2-3 hours and as such only provided a snapshot of the species and associated habitats of interest. As such, solutions to allow longer term-monitoring will be developed as part of the present expeditions. This will improve the techniques, and the efficiency of their data collection, that are presently being utilised and also allow satellite up-link of these units to allow real-time analysis of data. Once these sentient units are complete, it will offer a low-cost monitoring system that, when deployed as a network, will greatly expand the area that can be observed. While the primary focus for these units is the monitoring of large, especially pelagic fish, which have previously remained a significant gap in our understanding of the BIOT region, they can easily be deployed to monitor shallower ecosystems.

3. **Coral reef biodiversity (Catherine Head, Morgan Pratchett, Michelle Gaither, Daniel Wagner)**

Our understanding of biodiversity of smaller species groups is extremely poor in comparison with that of some groups such as reef-forming corals, fish and some bottom-dwelling invertebrate mega-fauna, despite making up the largest component of coral reef diversity. This project develops the work which was started in 2012 and focuses on assessment of the diversity of select groups of reef crypto-fauna and examines the relationship between these and reef-forming corals, fish and conspicuous mega-fauna on the relatively pristine reefs. To assess the number of small bottom-dwelling invertebrate species and their abundance at sites within the Chagos Archipelago dead coral heads and coral rubble will be collected on exposed and sheltered sides of the reef slope. Samples will be analysed using a combination of morphological and molecular methods, including novel DNA barcoding methods. These will be compared with the diversity of corals, fish and conspicuous megafauna, established using conventional survey methods.

The broader scope of this project involves biodiversity assessments over varying scales of human impacted reefs at locations across the Indian and Pacific Oceans enabling a trans Indian–Pacific Ocean biodiversity and connectivity comparison to be made with the Chagos Archipelago.

In addition, standard blocks of settlement plates will be deployed for collection a year later, to help understand new recruitment of biota to the reefs.

4. **Long-term monitoring of bird populations (Pete Carr, Yannick Mandarin)**

We will continue the long-term monitoring and research of the important breeding seabird colonies on the ten designated and two proposed Important Bird Areas (IBAs). The focus of the monitoring and research is to unravel the breeding phenology of the seabirds of BIOT in order to determine whether the present specific island designation for IBAs (as opposed to island clusters) is the best long-term conservation management strategy for breeding seabirds in BIOT (collaborative project with RSPB), and, what triggers breeding of seabirds in BIOT?

5. **Monitoring physical parameters on Chagos reefs (Charles Sheppard, Anne Sheppard)**

We will continue the collection and replacement of currently deployed temperature loggers which have recorded a set of two-hourly sea temperature measurements taken at many depths and locations, some since early 2006. Analysis of these data is helping to determine what physical factors assist in maintaining the good condition of Chagos reefs.

6. **Video transects of reefs (John Turner, Ronan Roche)**

Many sites have been used for recording for many years. Several were filmed along transect lines in 2006. These form permanent records for later lines of work. These transects will be recorded again.

7. **Structural complexity of coral reef communities (John Turner and Ronan Roche)**

Recovered reefs have increased in their structural complexity, and this will be measured by assessing rugosity (the roughness) of the coral canopy, and identifying the types of coral that most contribute to creating that structure at habitat scale.

8. **Filming of BIOT marine reserve (Jon Schleyer)**

High definition video will be taken of the underwater, terrestrial and aerial wildlife and environment of the BIOT marine reserve, as well as the scientific efforts and research being undertaken by the expedition. The focus will be on natural history, to document for future use and reference, and for outreach as decided by the BIOT Government.

9. **Sample collection (Anne Sheppard)**

Important, value-for-money aspects of previous expeditions have been the collection of material for other research programmes in other parts of the world, including for laboratories and collaborating scientists in UK, USA, Germany and Taiwan. This will be continued.

10. **Sea cucumber recovery (Anne Sheppard)**

Heavy poaching in earlier years greatly reduced the population of these animals, one of whose functions on the reef is essentially to clean sand. In 2012 signs were evident of recovery with large numbers of juveniles spotted on a couple of locations. These will be measured systematically this time in order to determine the rate and extent of recovery of this key group of organisms.

11. Reef fish connectivity work (Michelle Gaither)

The position of the Chagos Archipelago in the geographic centre of the Indian Ocean indicates that its reefs may act as a stepping stone between the habitat-rich regions to the east and west: a role that would have important biodiversity consequences throughout the region. New collections during the proposed expedition, coupled with the samples previously collected from elsewhere in the Indian Ocean, can shed light on the level and direction of migration within the region and allow us to address several questions of evolutionary and conservation importance, including 1) Is there cryptic diversity in the Chagos archipelago? 2) How important is Chagos as a stepping stone between the western and eastern Indian Ocean? 3) Are populations of reef fish in the BIOT more affliated with locations to the west, as suspected from oceanographic current patterns, or to the north, as predicted from geographic proximity? This work began in 2009, will continue in 2013 and subsequently.

Participants

Dr John Turner, Bangor University, School of Ocean Sciences,
Principal grant holder of Darwin Award.
Professor Charles Sheppard, University of Warwick,
BIOT Commissioner's Environment Advisor and Expedition Leader.
Dr Jon Bailey, Expedition doctor, medical logistics.
Peter Carr, University of Warwick
Jason Davis, Maintenance and Supply Manager BOS contract
Gary Fletcher, Zoological Society of London
Dr Michelle Gaither, California Academy of Sciences
Catherine Head, University of Oxford
Yannick Mandarin, Assistant to Peter Carr
Professor Morgan Pratchett, James Cook University
Dr Ronan Roche, Bangor University, School of Ocean Sciences
Jon Schleyer, Filming, outreach, Expedition logistics
Anne Sheppard, University of Warwick
Dr Daniel Wagner, NOAA, Hawaii

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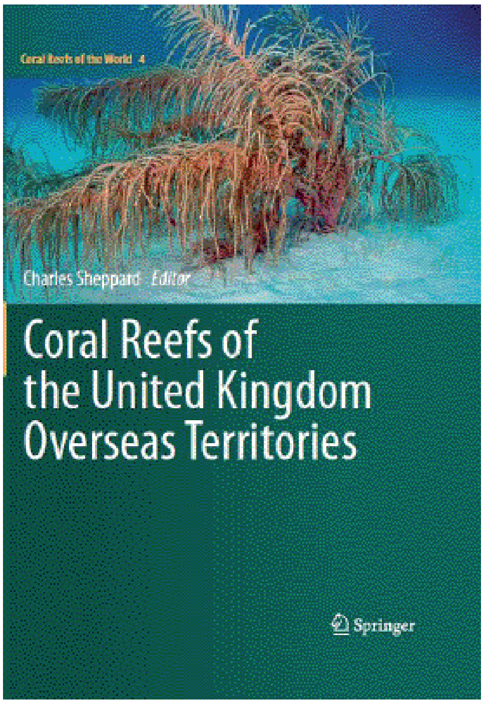

Coral Reefs of the United Kingdom Overseas Territories

Book Series: **Coral Reefs of the World – Volume 4**

Charles Sheppard - *Editor*
School of Life Sciences, University of Warwick, Coventry, United Kingdom

Key words:

- Coral reef ecology
- Marine Biodiversity
- Marine protected areas
- Reef conservation
- UK Overseas Territories

About this book

- *This volume presents new and successful management methods for threatened marine ecosystems*
- *A description of the importance and immense biological wealth of these coral reefs*
- *Aspects such as geology, oceanography, climate, biogeography, biodiversity, connectivity and pollution are detailed*
- *Distinctly presents reefs and deep-water coral communities (taxonomy), marine protected areas and status of coral reef fish assemblages*

The tropical UK Territories have extensive coral reefs. Huge parts of these areas are exceptionally rich, productive and diverse. Their marine biodiversity exceeds that of the UK itself, and several are already, or are planned to be, strictly protected. Some of these areas serve as reference sites for many other countries with damaged reefs and they are oases of tropical marine biodiversity in a fast-degrading world. This book reviews all of the UK reefs, from those scarcely known to those where substantial research has already been performed.

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ANNEX 133

IOTC Technical Committee on Allocation Criteria Meeting, Muscat, Oman 18-20 February 2013

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

IOTC–2013–TCAC02–R[E]

Report of the Second Technical Committee on Allocation Criteria

Muscat, Oman 18–20 February, 2013

DISTRIBUTION:
- Participants in the Session
- Members of the Commission
- Other interested Nations and International Organizations
- FAO Fisheries Department
- FAO Regional Fishery Officers

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IOTC 2013. Report of the Second Technical Committee on Allocation Criteria. Muscat, Oman 18–20 February 2013. *IOTC–2013–TCAC02–R[E]: 81 pp.*

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

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ACRONYMS

CFFA	Coalition for Fair Fisheries Arrangement
CMM	Conservation and Management Measure (of the IOTC; Resolutions and Recommendations)
CPCs	Contracting parties and cooperating non-contracting parties
EEZ	Exclusive Economic Zone
FAD	Fish-aggregating device
FAO	Food and Agriculture Organization of the United Nations
GI	Greenpeace International
IOMAC	Indian Ocean Marine Affairs Cooperation
IOTC	Indian Ocean Tuna Commission
ISSF	International Seafood Sustainability Foundation (ISSF)
MPF	Meeting Participation Fund
MSE	Management Strategy Evaluation
MSY	Maximum sustainable yield
NGO	Non-governmental organization
SC	Scientific Committee of the IOTC
SWIOFP	Southwest Indian Ocean Fisheries Project
TAC	Total Allowable Catch
TCAC	Technical Committee on Allocation Criteria
UNCLOS	United Nations Convention on the Law of the Sea
WWF	World Wide Fund for Nature (a.k.a World Wildlife Fund)

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EXECUTIVE SUMMARY

The Second Session of the Technical Committee on Allocation Criteria (TCAC02) was held in Muscat, Oman, from 18 to 20 February 2013, Chaired by Mr Mauree Daroomalingum. A total of 82 individuals attended the Session, comprised of 69 delegates from 23 Member countries, and 1 delegate from 1 Cooperating Non-Contracting Party, as well as 9 delegates from 5 observer organisations and 3 invited experts.

General discussion and workplan

(para. 38.) The TCAC **RECOGNISED** the mandate it received from Resolution 12/13 includes the consideration of alternative management measures. However, it noted that it was not in a position to discuss alternative measures in detail at the current meeting, and therefore **REQUESTED** that the Commission task the Scientific Committee with examining alternative management measures in combination with clear management objectives. The Commission should ensure that it specifies the level of reduction or the long term management objectives to be achieved with the alternative measures, as these will, in turn, guide and facilitate the analysis of the SC.

The following are the recommendations arising from the TCAC02 meeting:

Legal advice

(para. 35.) The TCAC **AGREED** that there was a need for a legal expert to be present at the next TCAC meeting to offer advice to the TCAC. As such, the TCAC **RECOMMENDED** that the Commission allocated the necessary funds for this purpose, either for an external legal expert or for the FAO legal office to commit a suitable expert.

Meeting Participation Fund

(para. 42.) The TCAC **NOTED** that the attendance by delegates from developing CPCs to the TCAC in 2013 (24 delegates from 15 Members, and 1 delegate from a CNCP) was largely due to the IOTC MPF, adopted by the Commission in 2010 (Resolution 10/05 on the establishment of a Meeting Participation Fund for developing IOTC Members and non-Contracting Cooperating Parties), and **RECOMMENDED** that the Commission maintain this fund into the future.

Review of the draft and adoption of the report of the second technical committee on allocation criteria

(para. 43.) The TCAC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from TCAC02, provided at Appendix XIV.

1. OPENING OF THE SESSION

1. The Second Session of the Technical Committee on Allocation Criteria (TCAC02) was held in Muscat, Oman, from 18 to 20 February 2013, Chaired by Mr. Mauree Daroomalingum. A total of 82 individuals attended the Session, comprised of 69 delegates from 23 Member countries,1 delegate from 1 Cooperating Non-Contracting Party, 9 delegates from 5 observer organisations and 3 invited experts. The list of participants is provided at Appendix I.

2. On behalf of His Excellency, Dr. Fauad bin Ja'far Al-Sajwani, Minister of Agriculture and Fisheries, Government of the Sultanate of Oman, Dr. Ahmed Mohammed Al-Mazrouai, Director General of Fisheries Development, welcomed the participants to Oman and declared the meeting open. The Chair Mr. Mauree Daroomalingum, joined in welcoming participants to the TCAC02 and declared the meeting open.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

3. The TCAC adopted the Agenda provided at Appendix II with the addition of a second agenda item under section 7, to discuss the general principles of allocation criteria, thereby building upon the work of the TCAC01. The documents presented to the TCAC02 are listed in Appendix III.

4. It was recalled that this Technical Committee had been called by the Commission in Resolution 10/01 (superseded by Resolution 12/13), with the objective to discuss and recommend an allocation quota system, or any other relevant measures, for the management of tuna and tuna-like resources in the Indian Ocean.

3. ADMISSION OF OBSERVERS

5. Pursuant to Article VII of the Agreement establishing the IOTC, the TCAC admitted the following observers, as defined in Rule XIII of the IOTC Rules of Procedure:
   a. Rule XIII.5. *The Commission may invite, upon request, non-governmental organizations having special competence in the field of activity of the Commission to attend such of its meetings as the Commission may specify. The list of the NGOs wishing to be invited will be submitted beforehand by the Secretary to the Members of the Commission. If one of the Members of the Commission objects giving in writing its reasons within 30 days, the matter will then be subject to decision of the Commission out of session by written procedure.*
      i. Coalition for Fair Fisheries Arrangement (CFFA)
      ii. Greenpeace International (GI)
      iii. International Seafood Sustainability Foundation (ISSF)
      iv. Southwest Indian Ocean Fisheries Project (SWIOFP)
      v. World Wide Fund for Nature (a.k.a World Wildlife Fund, WWF)

   Invited experts
   b. Rule XIII.9. *The Commission may invite consultants or experts, in their individual capacity, to attend the meetings or participate in the work of the Commission as well as the Scientific Committee and the other subsidiary bodies of the Commission.*
      i. Taiwan, Province of China

4. OUTCOMES OF THE SIXTEENTH SESSION OF THE COMMISSION

6. The TCAC **NOTED** paper IOTC–2013–TCAC02–03, which provided an overview of the decisions and requests made by the Commission at its Sixteenth Session, held from 22–26 April 2012, as well as the Fifteenth Session, held from 18–26 March 2011, specifically relating to the work of the TCAC.

7. The TCAC **NOTED** that as the TCAC02 meeting had been delayed from 2012 until 2013, at its Sixteenth Session, the Commission did not consider any quota allocation options.

8. The TCAC **NOTED** the outcomes of the Fifteenth Session of the Commission relevant to the TCAC, in particular, the Commission's comments on the recommendations made by the first TCAC (extracts from the S15 report):
   - The Commission addressed the guiding principles for a possible allocation process agreed to by the TCAC01 in its 2011 report. The Commission **endorsed** the guiding principles, noting the following. (Para. 98 of the S15 Report)
   - The Commission **noted** that the implementation of a quota system will rely on the capacity of each CPC to estimate catches, close to real-time and as accurately as possible, for the species and fisheries concerned. (Para. 99 of the S15 Report)

- In this regard, the Commission **encouraged** CPCs to work towards streamlining their statistical systems to make sure that estimates of catches as per the required resolution and time frame can be produced in the near future. (Para. 100 of the S15 Report)
- The Commission **invited** CPCs to work with the Secretariat to achieve these objectives, where required. (Para. 101 of the S15 Report)
- The Commission **noted** that the implementation of a quota system may take several years, and the Commission may need to consider alternative management measures until such a time that a quota system is in place. In this regard, the Commission **recalled** that paragraph 13 of IOTC Resolution 10/01 states that "*The Commission shall adopt an allocation quota system or any other relevant measure for the yellowfin and bigeye tunas at its plenary session in 2012*". (Para. 102 of the S15 Report)
- The Commission **agreed** that the TCAC while devoting most of its efforts to develop a mechanism for quota allocation shall also consider appropriate alternative management measures. In this regard the Commission stressed the need for all IOTC CPCs to work intersessionally towards achieving this objective as soon as possible. (Para. 103 of the S15 Report)
- The Commission **noted** paper IOTC–2011–S15–05 outlining the recommendations of the Indian Ocean Marine Affairs Cooperation (IOMAC). (Para. 104 of the S15 Report)
- The Commission **requests** that the Scientific Committee provide advice to the Commission that adds to the information currently available or already requested of the Scientific Committee regarding the take of juvenile yellowfin tuna, bigeye tuna and other species, and on alternative management measures, including an assessment of the impact of current purse seine activities, including the size/fishing capacity (and gear types i.e. mesh size etc.) of vessels, and the potential implications that may arise for tuna and tuna-like species. Such advice should include options for capping purse seine effort and use in conjunction with drifting FADs in the Indian Ocean. (Para. 105 of the S15 Report)

9. The TCAC **AGREED** to develop advice in response to each of the requests made by the Commission at its 15th Session, and also via Resolution 12/13 *For the conservation and management of tropical tunas stocks in the IOTC area of competence*, throughout the course of the TCAC02 meeting.

5. OUTCOMES OF THE FIFTEENTH SESSION OF THE SCIENTIFIC COMMITTEE

10. The TCAC **NOTED** paper IOTC–2013–TCAC02–04, which provided an overview of the main outcomes of the Fourteenth and Fifteenth Sessions of the Scientific Committee relevant to the TCAC, in particular on the use of alternative management measures (e.g. time-area closures; impacts of catching bigeye tuna and yellowfin tuna juveniles and spawners; FAD closures).

5.1 Outlook on Time-Area Closures

11. The TCAC **NOTED** the evaluation of the IOTC time-area closure by the SC in 2011 and 2012. The evaluation included an estimation of what the maximum potential loss of catches would be under different scenarios of the time-area closure, as estimated from the catch statistics of the IOTC. The estimation was based on the historical IOTC database as no information was available for the specific closed periods of 2011 (February for longline, November for purse seine) when the measure took effect. The longline effort had already been entirely redistributed to other areas and the purse seine data for November were not yet available.
12. The TCAC **NOTED** that the results emphasized that catch reduction expected from the current time-area closure was negligible. The results of the study indicated that the current area closures, including an IOTC closure of only two, one month closures (one month for purse seine and one month for longline), is likely to have little impact on stock status, whether effort is eliminated or redistributed. The study examined scenarios to investigate the impacts of a 12 month closure of the current IOTC time-area closure. Some benefits to the status of yellowfin tuna stocks were predicted if it is assumed that effort (and catch) is eliminated, but where effort is redistributed such a closure had negligible impact on stock status.
13. The TCAC **NOTED** that the current closure is likely to be ineffective, as fishing effort will be redirected to other fishing grounds in the Indian Ocean. The positive impacts of the moratorium within the closed area would likely be offset by effort reallocation. For example, the SC in 2012 noted that longline fishing effort has been redistributed to traditional albacore fishing grounds in recent years, thereby further increasing fishing pressure on this stock.
14. **NOTING** that the objective of Resolution 12/13 is to decrease the overall pressure on the main targeted stocks in the Indian Ocean, in particular yellowfin tuna and bigeye tuna, and also to evaluate the impact of the

current time/area closure and any alternative scenarios on tropical tuna populations, the level of reduction or the long term management objectives to be achieved with the current or alternative time area closures and/or alternative measures need to be specified, as these are not contained within Resolution 12/13. This will, in turn, guide and facilitate the analysis of the effectiveness of the measure.

5.2 Impacts of Catching Bigeye Tuna and Yellowfin Tuna Juveniles and Spawners

15. The TCAC **NOTED** that the most direct measure of impact of fishing fleets on juveniles could be obtained by looking at the catches of juvenile yellowfin tuna and bigeye tuna by gear, as presented in SC report for 2012. It was **NOTED** that the estimates of catches of juvenile fish are doubtful for some gears, for which catch-at-length information is severely limited or almost non-existent.

16. The TCAC **NOTED** 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 SC reports.

17. The TCAC **NOTED** that a complete analysis of the likely impact of the juveniles and spawners caught by any fishery in the Indian Ocean and of any management plan should be carried out within the context of the work on MSE that the SC has agreed to carry out in the future. This could, if necessary, also quantify the impact of such measures not only on the stocks, but also on the fleets, including likely economic impact on activities dependent on the fleets affected.

18. The TCAC **NOTED** 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, and that the SC intended on undertaking 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.

19. The TCAC **NOTED** that multi-gear yield-per-recruit analyses may be able to evaluate the impact of catching bigeye tuna and yellowfin tuna juveniles and spawners by gear.

20. The TCAC **NOTED** that more effective time-area closures, than that currently in place, may reduce the catches of both juvenile and spawners of bigeye tuna and yellowfin tuna assuming that effort is not reallocated to other regions.

6. THE AVAILABILITY, COMPLETENESS AND QUALITY OF CATCH DATA FOR ALL FLEETS IN THE IOTC DATABASE

21. The TCAC **NOTED** paper IOTC–2013–TCAC02–05, which provided an overview of the availability, completeness and quality of data for all fleets in IOTC database. Determining the reliability of catch data held at the IOTC Secretariat is an important preliminary step in the determination of baseline calculations.

22. The TCAC **NOTED** that some of the key elements that need to be available for an allocation process or for the development of alternative management measures include time series estimates of catches by 1) country; 2) spatial distribution (within Exclusive Economic Zones and on the high seas); 3) temporal distribution (year, month); and 4) fleet type (e.g. gillnet, longline; pole-and-line; purse seine).

23. The TCAC **NOTED** that levels of uncertainty in the catch data can be reduced if IOTC Resolutions are implemented by all CPCs, in particular: Resolution 12/03 *On The Recording Of Catch And Effort By Fishing Vessels In The IOTC Area Of Competence*, and if this information is reported to the IOTC Secretariat annually, as stipulated in: Resolution 10/02 *Mandatory Statistical Requirements For IOTC Members And Cooperating Non-Contracting Parties (CPC's)*.

24. The TCAC **NOTED** that while there are uncertainties in the data available at the IOTC Secretariat, none of the uncertainties, in isolation or in combination, should be considered enough of a reason not to move towards an allocation system or for the development of alternative management measures. Although some of the issues identified are likely to compromise the quality of the estimates to some degree, the final estimates of catch are not thought to be substantially affected by these issues.

25. The TCAC **NOTED** that the levels of uncertainly in the catch data available are already being incorporated into annual MSY estimates by the Scientific Committee. As levels of uncertainty in the data are further reduced, a future allocation process could incorporate a review process to periodically update baseline catch estimates to feed into an allocation formula.

7. PROPOSALS FOR AN ALLOCATION QUOTA SYSTEM AS STATED IN RESOLUTION 12/13 (SUPERSEDED RES. 10/01)

7.1 Proposals provided by Members

26. The TCAC reviewed the following five proposals submitted before the 30 day pre-meeting deadline, with the addition of a sixth proposal introduced by Indonesia immediately prior to the meeting. The proposals are annexed to this report.

- ***Proposal A (Japan)*** (IOTC–2013–TCAC02–PropA Rev_1) – Appendix IV
- ***Proposal B (Seychelles)*** (IOTC–2013–TCAC02–PropB) – Appendix V
- ***Proposal C (European Union)*** (IOTC–2013–TCAC02–PropC) – Appendix VI
- ***Proposal D (I.R. Iran)*** (IOTC–2013–TCAC02–PropD Rev_1) – Appendix VII
- ***Proposal E (Mozambique)*** (IOTC–2013–TCAC02–PropE) – Appendix VIII. The following statement was made by Mozambique: "*Mozambique wishes to note that in its verbal presentation it updated its comments to address the revised proposal of Seychelles, and further noted its support for the addition of the disadvantaged States set aside. Further, Mozambique proposed an enhanced Set Aside quota in the Seychelles proposal to include the new entrants as well as the updated catches, artisanal catches and fleet development plans as these become available to the Commission. Mozambique also notes it will continue to issue the same number of licenses until the real level of catches in Mozambique's waters are determined. Further, Mozambique notes it wishes to highlight the need for one CPC to update its catches in Mozambique's fisheries waters before it can agree to any implementation of the allocation criteria to ensure that Mozambique has a level playing field for the latter exercise.*"
- ***Information proposal INF01 (Indonesia)*** (IOTC–2013–TCAC02–INF01) – Appendix IX.

7.2 Guiding legal text

27. The TCAC **RECALLED** Article V, paragraphs 1 and 2d, and Article XVI of the IOTC Agreement, as provided at Appendix X.

28. The TCAC **RECALLED** Part V of the United Nations Convention on the Law of the Sea (UNCLOS) on Exclusive Economic Zones; specifically Articles 55, 56, 63 and 64, as provided at Appendix X.

7.3 Allocation criteria - Position paper from 16 Indian Ocean coastal states

29. A group of 16 Indian Ocean coastal states presented a list of seven guiding principles that may be adopted in formulating an allocation system or any other relevant measure(s) for the IOTC for the consideration of TCAC02. The seven principles are:
    1. Sustainable fishery.
    2. Exclusive Rights of the Indian Ocean coastal States in their EEZs.
    3. Special consideration for small, vulnerable economies and developing Coastal States of the Indian Ocean.
    4. Food and livelihood security.
    5. Equitable utilization and conservation of the resources.
    6. Recognize and take account of the rights of all CPCs on the high seas.
    7. Tuna management process shall be consistent with International laws.

30. Mindful of the unique nature of the fisheries in the region and complexities involved in developing a comprehensive scheme of allocation criteria, the Group also **ENCOURAGED** examining alternative management measures. The complete proposal is provided at Appendix XI.

31. The TCAC **NOTED** that Some CPCs, including some Indian Ocean coastal states indicated that the proposal shown in Appendix XI would not be acceptable, notably some important principles were not included in the proposal (e.g. catch history and compliance…). Furthermore, some CPCs highlighted that exclusive rights expression does not exist in the international law.

7.4 Allocation criteria –TCAC guiding principles

32. The TCAC **RECALLED** that the process of establishing allocation criteria is complex, nevertheless, progressing on the basis of common ground in the positions expressed at the meeting, including an agreement on basic principles that shall guide further developments of an approach to allocation, was of high importance.

33. Some CPCs **RECALLED** the position stated in TCAC01 indicating the advantages of a mechanistic approach including transparency, in which allocations are calculated on the basis of a system that incorporates the basic principles enunciated below, as opposed to a list of criteria that would require extensive negotiations at each allocation cycle.

34. The TCAC **NOTED** a statement from the European Union and France provided at Appendix XII.

7.5 Legal advice

35. The TCAC **AGREED** that there was a need for a legal expert to be present at the next TCAC meeting to offer advice to the TCAC. As such, the TCAC **RECOMMENDED** that the Commission allocated the necessary funds for this purpose, either for an external legal expert or for the FAO legal office to commit a suitable expert.

8. Proposals for Alternative Management Measures as Stated in Resolution 12/13 (Superseded Res. 10/01)

8.1 Proposal F (Sri Lanka)

36. The TCAC **NOTED** the proposal from Sri Lanka (IOTC–2013–TCAC02–PropF), provided at Appendix XIII.

8.2 General discussion and workplan

37. The TCAC **ACKNOWLEDGED** the constructive nature of the new elements presented during the debate in 2013. To continue with the development of an allocation mechanism incorporating these elements, further inter-sessional work is required, including convening another TCAC Meeting before the IOTC Session in 2014. CPCs are encouraged to conduct inter-sessional consultations with the goal of working towards a revised proposal that could be supported by all CPCs. These further developments should be accompanied by examples that would facilitate the understanding of the consequences of the different formulations to all participants in the allocation process.

38. The TCAC **RECOGNISED** the mandate it received from Resolution 12/13 includes the consideration of alternative management measures. However, it noted that it was not in a position to discuss alternative measures in detail at the current meeting, and therefore **REQUESTED** that the Commission task the Scientific Committee with examining alternative management measures in combination with clear management objectives. The Commission should ensure that it specifies the level of reduction or the long term management objectives to be achieved with the alternative measures, as these will, in turn, guide and facilitate the analysis of the SC.

9. Other Business

9.1 Date and place of the Third Session of the Technical Committee on Allocation Criteria

39. The TCAC was unanimous in its thanks to Oman for hosting the TCAC02 and commended Oman on the warm welcome, the excellent facilities and assistance provided to the IOTC Secretariat in the organisation and running of the Session.

40. The TCAC **AGREED** to organise the next Session in the first quarter of 2014. The exact dates and meeting venue will be confirmed and communicated by the Secretariat at a later date.

9.2 Election of a Chairperson and Vice-Chairperson for the next biennium

41. The TCAC **CALLED** for nominations for the positions of Chair and Vice-Chair for the next biennium. Mr. Mauree Daroomalingum (Mauritius) was nominated and re-elected as Chair of the TCAC for the next biennium.

9.3 Meeting Participation Fund

42. The TCAC **NOTED** that the attendance by delegates from developing CPCs to the TCAC in 2013 (24 delegates from 15 Members, and 1 delegate from a CNCP) was largely due to the IOTC MPF, adopted by the Commission in 2010 (Resolution 10/05 on the establishment of a Meeting Participation Fund for developing

IOTC Members and non-Contracting Cooperating Parties), and **RECOMMENDED** that the Commission maintain this fund into the future.

10. Review of the Draft and Adoption of the report of the Second Technical Committee on Allocation Criteria

43. The TCAC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from TCAC02, provided at Appendix XIV.

44. The report of the TCAC02 was **ADOPTED** on the 20 February 2013.

APPENDIX I
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APPENDIX II
AGENDA OF THE SECOND TECHNICAL COMMITTEE ON ALLOCATION CRITERIA

Date: 18–20 February, 2013

Location: Muscat, Oman

Time: 0900–1700 daily

Chair: Mr Mauree Daroomalingum; **Vice-Chair**: Vacant

1. **OPENING OF THE SESSION** (Chair)

2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Chair)
   - IOTC–2013–TCAC02–01: Draft agenda for the Second Technical Committee on Allocation Criteria
   - IOTC–2013–TCAC02–02: Draft list of documents for the Second Technical Committee on Allocation Criteria

3. **ADMISSION OF OBSERVERS** (Chair)
   The Third Session of the Commission decided that its subsidiary bodies would be open to the participation of observers from Member parties of FAO, from international organisations and from non-governmental organisations, which had attended previous meetings or were admitted to attend Commission Sessions.

4. **OUTCOMES OF THE SIXTEENTH SESSION OF THE COMMISSION**
   - IOTC–2013–TCAC02–03: Outcomes of the Sixteenth Session of the Commission relevant to the TCAC (IOTC Chair).

5. **OUTCOMES OF THE FIFTEENTH SESSION OF THE SCIENTIFIC COMMITTEE**
   Noting that at the 15th Session of the Commission, the Commission requested *"that the Scientific Committee provide advice to the Commission that adds to the information currently available or already requested of the Scientific Committee regarding the take of juvenile yellowfin tuna, bigeye tuna and other species, and on alternative management measures, including an assessment of the impact of current purse seine activities, including the size/fishing capacity (and gear types i.e. mesh size etc.) of vessels, and the potential implications that may arise for tuna and tuna-like species. Such advice should include options for capping purse seine effort and use in conjunction with drifting FADs in the Indian Ocean"* (para. 105 of the S15 report).
   - IOTC–2013–TCAC02–04: Outcomes of the Fifteenth Session of the Scientific Committee relevant to the TCAC (SC Chair).

6. **THE AVAILABILITY, COMPLETENESS AND QUALITY OF CATCH DATA FOR ALL FLEETS IN THE IOTC DATABASE**
   Noting that at the 15th Session of the Commission, the Commission "*endorsed the request from the Technical Committee that the Secretariat prepares, for the next meeting of the Committee, a document on the availability, completeness and quality of catch data for all fleets in IOTC database*" (para. 95 of the S15 report).
   - IOTC–2013–TCAC02–05: Report on the availability, completeness and quality of catch data for all fleets in the IOTC database.

7. **PROPOSALS FOR AN ALLOCATION QUOTA SYSTEM AS STATED IN RESOLUTION 12/13 (superseded Res. 10/01)**
   - IOTC–2013–TCAC02–PropA Rev_1: Proposal on IOTC Quota Allocation Criteria (Japan)
   - IOTC–2013–TCAC02–PropB: On establishing a quota allocation system for the main targeted species in the IOTC area of competence (Seychelles)
   - IOTC–2013–TCAC02–PropC: On establishing a quota allocation system for the main targeted species in the IOTC area of competence (European Union)
   - IOTC–2013–TCAC02–PropD Rev_1: On establishing allocation criteria for the main target species in the IOTC area of competence (I.R. Iran)
   - IOTC–2013–TCAC02–PropE: On establishing a quota allocation system for the main targeted species in the IOTC area of competence (Mozambique)

8. PROPOSALS FOR ALTERNATIVE MANAGEMENT MEASURES STATED IN RESOLUTION 12/13 (superseded Res. 10/01)

Noting that at the 15th Session of the Commission, the Commission "*agreed that the Technical Committee on Allocation Criteria while devoting most of its efforts to develop a mechanism for quota allocation shall also consider appropriate alternative management measures. In this regard the Commission stressed the need for all IOTC CPCs to work intersessionally towards achieving this objective as soon as possible*" (para. 103 of the S15 report).

- IOTC–2013–TCAC02–PropF: Use of alternative management measures in lieu of a quota allocation system for the main target species in the IOTC area of competence (Sri Lanka).

9. OTHER BUSINESS

9.1 Date and place of the Third Session of the Technical Committee on Allocation Criteria (Chair)

9.2 Election of a Chairperson and Vice-Chairperson for the next biennium (Chair)

9.3 Meeting participation fund

10. REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE SECOND TECHNICAL COMMITTEE ON ALLOCATION CRITERIA

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC–2013–TCAC02–01	Draft agenda of the Second Technical Committee on Allocation Criteria	26 September, 2012
IOTC–2013–TCAC02–02	Draft list of documents	26 September, 2012
IOTC–2013–TCAC02–03	Outcomes of the Sixteenth Session of the Commission (Chair)	31 January, 2012 (not updated in 2013)
IOTC–2013–TCAC02–04	Outcomes of the Fifteenth Session of the Scientific Committee relevant to the TCAC (SC Chair)	Presentation at TCAC02 only
IOTC–2013–TCAC02–05	Report on the availability, completeness and quality of catch data for all fleets in the IOTC database (Secretariat)	26 September, 2012
Proposals for allocation quota system		
IOTC–2013–TCAC02–PropA Rev_1	Proposal on IOTC Quota Allocation Criteria (Japan)	26 September, 2012 & 16 January, 2013
IOTC–2013–TCAC02–PropB	On establishing a quota allocation system for the main targeted species in the IOTC area of competence (Seychelles)	26 September, 2012
IOTC–2013–TCAC02–PropC	On establishing a quota allocation system for the main targeted species in the IOTC area of competence (European Union)	26 September, 2012
IOTC–2013–TCAC02–PropD Rev_1	On establishing allocation criteria for the main targeted species in the IOTC area of competence (I.R. Iran)	26 September, 2012, 19 January, 2013& 15 February, 2013
IOTC–2013–TCAC02–PropE	On establishing a quota allocation system for the main targeted species in the IOTC area of competence (Mozambique)	18 January, 2013
Proposals for alternative management measures		
IOTC–2013–TCAC02–PropF	Use of alternative management measures in lieu of a quota allocation system for the main target species in the iotc area of competence (Sri Lanka)	19 January, 2013
Information papers		
IOTC–2013–TCAC02–INF01	Quota allocation system for Indian Ocean tuna fisheries (Indonesia)	5 February, 2013

APPENDIX IV
JAPAN – PROPOSAL A

DRAFT PROPOSAL ON IOTC QUOTA ALLOCATION

1. Basic principles

(1) Transparency
- Objective figures should be used as much as possible in the criteria

(2) Predictability
- Players need to predict what will happen in the medium to long term under the new criteria

(3) Progressiveness
- Radical change should be avoided

(4) Sustainable fishery development
- Due consideration should be given to sustainable fishery development of developing countries

2. Factors to be considered in allocating quota

Category A (main factors)

(1) Historical catches of members and cooperating non-members (CPCs)

(2) Fishery development plans of developing CPCs

Category B (adjustment factors)

(3) Legal status (member or cooperating non-member)

(4) Degree of compliance with conservation and management measures

(5) Degree of compliance with financial contribution

(6) Degree of contribution to research and data collection

(7) Degree of allocation utilization

3. How to allocate

(1) Total Allowable Catch (TAC) will be established based on scientific recommendation of the Scientific Committee.

(2) The share of each CPC will be decided based on its historical catches on a flag basis. The past ten years will be used as base years.

(3) 3% of TAC will be reserved for fishery development of developing CPCs and new entrants (hereinafter called "Development Reserve").

(4) TAC minus Development Reserve will be allocated among CPCs in accordance with shares. This allocation will become "a basic allocation".

(5) The basic allocation of each CPC will be adjusted by multiplying the following percentages:

(a) Member or cooperating non-member
- Member: 100%
- Cooperating non-member: 95%

(b) Number of non-compliance with conservation and management measures
- Zero: 100%
- One or more (except for overharvest of allocation): 95%
- 90% will be applied to any overharvest of allocation in addition to payback.

(c) Financial contribution
- Allocation will be cut half if a CPC's arrear is greater than the amount equal to the most recent two years' financial contribution unless otherwise decided by the Commission.

(d) Contribution to research and data collection
- Contribution authorized by the Scientific Committee:less than 105%

(e) Unused allocation
- Less than 50% utilization of the each year's allocation for three years: 90%

(6) 50% of the reduced portion as a result of (a) to (e) above will go to Development Reserve. The remaining 50%

will be kept unused. The use of this 50% will be decided by the Commission, taking into account scientific advice.

(7) The Commission will decide allocation for each year at annual meetings in accordance with the above process.

4. Fishery Development of Developing CPCs

(1) The percentage of Development Reserve (3%) will be increased by 1% every year until it reaches 12% (in 9 years). Further increase will be subject to decision of the Commission.

(2) If TAC increases, 30% of the increased portion will go to Development Reserve. 70 % of the increased portion will be allocated on a pro rata basis.

(3) A new entrant who can utilize Development Reserve will be limited to developing coastal country in the Indian Ocean. Such a new entrant needs to become a CPC and submit its fishery development plan. The maximum use of a new entrant should be limited under 100 tonnes.

(4) A new entrant shall comply with all management and conservation measures adopted by the Commission. If such a new entrant does not ensure compliance with them, its utilization will be suspended until it becomes a formal member.

(5) Allocation of Development Reserve among developing CPCs will be decided by the Commission, taking into account fishery development plans.

5. Temporary transfer of allocation

(1) Any transfer of allocation from one CPC to another CPC will be subject to approval of the Commission.

(2) Only formal members can transfer its allocation to others.

(3) Temporary transfer of allocation will not affect shares.

APPENDIX V
SEYCHELLES – PROPOSAL B

DRAFT: ON ESTABLISHING A QUOTA ALLOCATION SYSTEM FOR THE MAIN TARGETED SPECIES IN THE IOTC AREA OF COMPETENCE

Background

This proposal responds to IOTC Resolution 10/01 which requires CPCs to adopt a quota allocation system (or other relevant measure) at its plenary session in 2012 for the yellowfin and bigeye tunas and Swordfish. It is a **revision** to Proposal B submitted by the Republic of Seychelles to the IOTC Technical Committee on Allocation Criteria held in Nairobi on 16-18th February 2011, hereafter referred to as the 'Nairobi meeting'. As in the first proposal, allocation criteria are presented within a quota allocation system. A **revised** Explanatory Note (Addendum 1) accompanies and should be read in conjunction with this proposal.

The revised proposal maintains recognition of the legitimate sovereign rights and aspirations of coastal states, in particular small island developing coastal states and territories and small and vulnerable economies, and the interests of distant water fishing nations that have historically fished in the IOTC area of competence. However, the revised proposal responds to several concerns raised by coastal states at the Nairobi meeting, in particular the need to define mechanisms ~~by which all coastal states may benefit from a quota share regardless of catch history.~~

We continue to propose a hybrid scheme based on catch per area in the EEZs and fishing zones of coastal states, and on historical levels of catch by all eligible flag state fishing vessels on the high seas. As more than 50% of historical catches have been taken on the high seas this does not disadvantage distant water fishing nations that have historically invested in the Indian Ocean fisheries whilst by considering where the fish are caught it recognises the sovereign rights of coastal states to a share of the resource. *A zonal attachment basis for quota allocation systems is well established in regional institutional agreements and international policy discourse* (see Annex 2).

Recognising that the lack of historical catch data has often arisen from extenuating socio-political circumstances rather than lack of participation in the fisheries, coastal states lacking a significant catch history, here defined as 'disadvantaged States', will share a portion of the overall TAC on the basis of socio-economic criteria.

The revised proposal continues to ensure that, in the short term, the status quo is approximately maintained whilst over the longer term the development plans of coastal states can be realised. By providing an objective framework to clearly define the baseline allocation to each CPC at the start of the quota allocation system, it avoids uncertainty that would follow from having less clearly defined criteria that require negotiation at the start of each new quota allocation period. It thus provides a sound basis for sustainable management of fish stocks.

The Indian Ocean Tuna Commission (IOTC)

RECOGNISING that based on past experience in the fishery, the potential production from the resource can be negatively impacted by excessive fishing effort;

TAKING INTO ACCOUNT the available scientific information and advice, in particular the IOTC Scientific Committee conclusions whereby the yellowfin and bigeye tuna stocks might have been over or fully exploited in recent years;

RECOGNISING that during the 13th IOTC scientific meeting held in Seychelles from 6 to 10 December 2010, the Scientific Committee recommended that yellowfin and bigeye tuna catches should not exceed the MSY levels which have been estimated at 300,000 tonnes for yellowfin and at 102,000 tonnes for bigeye tuna;

RECOGNISING that IOTC Resolution 10/01 requires the development of a quota allocation system for yellowfin and bigeye tuna stocks and for swordfish stocks;

ACKNOWLEDGING that the implementation of a TAC without a quota allocation system would result in an inequitable distribution of the catches and fishing opportunities among the CPCs and non CPCs;

FURTHER RECOGNISING that the tuna artisanal fisheries sector needs strengthening in terms of catch statistics reporting in order to more closely follow the catch situations and notwithstanding improvement in the industrial fishery catch statistics reporting requirements;

TAKING INTO ACCOUNT the sovereign rights of coastal states for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, within their respective exclusive zones in accordance with Article 56 (1) of the United Nations Convention on the Law of the Sea, Montego Bay of 10 December 1982;

NOTING the importance of applying the precautionary approach for the management of the tropical tuna and swordfish stocks, in particular yellowfin and bigeye tuna in the Indian Ocean;

NOTING the 13th Scientific Committee recommendation to develop a Compliance Monitoring Scheme;

ADOPTS, in accordance with the provisions of Article IX, paragraph 1 of the Agreement establishing the IOTC, the following:

PART 1[1]

GENERAL PROVISIONS

1. *Use of terms*

1.1. For the purposes of this proposal:

a) The term 'CPC' will be used as shorthand to include all IOTC members and Cooperating non contracting parties to IOTC.

b) 'Disadvantaged CPC' are defined as those coastal States with a baseline nominal catch proportion of less than 3% (averaged across all IOTC species with a TAC), but excluding CPCs that have historically operated flagged vessels over 24 m on the high seas in the IOTC area of competence and excluding CPCs categorised as 'developed' by UN criteria (section 3 and 4).

c) 'Fish' means all or any identified species of highly migratory fish stocks covered by the IOTC convention.

d) The 'Quota Allocation System' is the totality of the mechanism described in this proposal for allocating resource rights, implementation and management (monitoring, compliance etc) of those rights

e) The 'Total Allowable Catch' (TAC) is the upper limit for the sum of all CPC catches of a fish species in a particular year within the IOTC area of competence (section 4).

f) The 'Effective TAC' is the total allowable catch minus any 'Set Aside' amount agreed by the Commission at the start of the quota allocation period (e.g. to allow for new entrants) (section 5).

g) The 'Supplementary TAC' is the portion of the Effective TAC removed for the group of Disadvantaged CPCs (section 5).

h) The 'Adjusted TAC' is the Effective TAC minus the Supplementary TAC (section 5).

i) The 'Baseline Nominal Catch Proportion' is the long-term base allocation proportion (%) to each eligible CPC defined at the start of the programme in 2012 before any deductions are applied (Section 6).

[1] Note: Substantive revisions are highlighted in yellow

j) The 'Baseline Supplementary Allocation Proportion' is the long-term base allocation (%) to each eligible Disadvantaged CPC defined at the start of the programme in 2012 before any deductions are applied (Section 6).

k) The 'Adjusted Nominal Catch Proportion' is the nominal allocation proportion (% to a CPC after adjustments to the baseline to accommodate factors such as new entrants to the fishery or permanent trade of quota, if permitted (Section 7).

l) The 'Nominal Catch Allocation' is the nominal allocation at the start of any specific quota allocation period before any adjustments for membership or compliance (see section 8).

m) The 'Supplementary Catch Allocation' is the nominal allocation to Disadvantaged CPCS at the start of any specific quota allocation period, before any adjustments for membership or compliance, and is derived from the Baseline Supplementary Allocation Proportion (Section 8).

n) The 'Preliminary Catch Allocation' is the nominal allocation to Disadvantaged CPCs prior to addition of the Supplementary Catch Allocation and is derived from the Baseline Nominal Catch Proportion (Section 8).

o) The 'Effective Allocated Catch Limit' is the catch allocated to a CPC for a specific quota allocation period after deductions and/or additions (section 8).

p) The 'Historical Reference Period' defines the period for which historical data will be analysed in setting the baseline nominal catch proportion (section 3).

q) 'The 'Quota Allocation Period' is the short term allocation period, that may be varied, during which the Effective Allocated Catch Limit applies.

r) The term 'Quota' will be used as shorthand to describe the effective allocated catch limit allocated to a particular CPC.

s) 'Transfer' refers to a temporary exchange of an allocation or part allocation, including renting such allocation to a third party (section 10).

t) 'Trade' means the permanent purchase or exchange of a quota allocation (section 10).

u) 'Artisanal vessels' refers to any vessel within a coastal CPC that fishes for tuna or tuna like species and that is less that 24 m in length and therefore not on the IOTC list of authorised vessels. CPC artisanal vessels are only authorised to fish inside the EEZ of the CPC.

v) 'Artisanal catch' refers to the catch of tuna and / or tuna like species taken by artisanal vessels.

2. *Objective*

2.1. The objective of this proposal is to:

- define the rights allocation mechanism (allocation criteria) amongst members and cooperating non contracting parties of IOTC to a share of the catch of any fish for which IOTC sets a total allowable catch limit (currently recommended for yellowfin tuna, big-eye tuna and swordfish); and,
- define the mechanism for implementing the quota allocation system, identifying the duties of the responsible party amongst the different bodies and CPCs of IOTC

3. *Application and Eligibility for receiving quota*

3.1. The defined historical reference period for determining eligibility to the quota allocation system and for setting the baseline nominal catch proportion will be from 1981 to the December 2010, the latter date being the most recent information available to IOTC prior to adoption of the quota allocation system in 2012 as required in Resolution 10/01.

3.2. The rights allocation mechanism defined in this proposal relates to a single species allocation. The same mechanism will be applied to each IOTC fish species for which a TAC has been agreed by the Commission.

3.3. A proportion of the total allowable catch will be set aside for new coastal state entrants only. The level of the catch to be '*Set Aside*' for new entrants will be agreed by the Commission at start of the quota allocation system and will be reviewed and adjusted as appropriate at the end of each quota allocation period.

3.4. The balance of the TAC remaining after removal of the Set Aside will be the Effective TAC to be allocated to all eligible CPCs. A portion of the Effective TAC will be removed as a Supplementary TAC to be allocated to Disadvantaged CPCs, and the remaining portion, the Adjusted TAC, will be allocated to all eligible CPCs.

3.5. New entrant Distant Water Fishing Nations will not be excluded from the fishery and can enter the fishery if they meet the membership criteria and have rented or purchased quota made available by another CPC for transfer or trade. They will not be eligible to receive any set aside.

3.6. A ***baseline nominal catch proportion*** (%) for each fish species will be allocated to <u>all</u> coastal states within the IOTC area of competence, irrespective of membership status, and to all existing distant water fishing nations with a catch history during the defined reference period within the IOTC Area of Competence that are currently members or Cooperating non contracting parties of IOTC. (See Section 6 for the control rules for defining the baseline nominal catch proportion).

3.7. A ***baseline supplementary catch proportion*** (%) for each fish species will be allocated to all coastal states defined as Disadvantaged CPCs within the IOTC area of competence, irrespective of membership status (See Section 6 for the control rules for defining the baseline supplementary catch proportion)

3.8. When setting the ***effective allocated catch limit*** only full member CPCs can receive 100% quota allocation before other adjustments. Cooperating non contracting parties will be eligible to receive only 80% of the nominal catch before other adjustments. Non members will not be eligible to receive an effective allocated catch limit.

3.9. The TAC, Effective TAC (including Supplementary TAC and Adjusted TAC) and effective allocated catch limits will be set for a Quota Allocation Period of three years in the first instance to allow fleets to plan accordingly enabling greater economic stability. The effective allocated catch limit will only be varied during that three year period if the Science Committee indicates that the status of the stock has significantly changed and the TAC must be adjusted early. The Quota Allocation Period will be reviewed by the Commission after three years with advice from the Science Committee and subsequent periods set may be varied as appropriate.

PART 2

RIGHTS ALLOCATION

4. *Setting the Total Allowable Catch: Defining a Management Procedure*

4.1. The *Assessment/Management Procedure* for setting the TAC will be defined by the Science Committee and its associated Working Groups specifically the Working Group on Tropical Tunas and the Working Group on Billfish, based on best available science and stock status. It will take into account any uncertainty in the stock assessments and set the level of TAC accordingly. This procedure will define the mechanism for setting the Total Allowable Catch. It will also define whether the TAC for a species relates to the whole of the IOTC area of competence, or to sub areas for the species in question.

4.2. The assessment/management procedure will define the frequency with which stock assessments shall be undertaken with reference to stock status and both targeted and incidental catch levels, and any indicators that might trigger the need for a stock assessment earlier than planned if assessments are not to be undertaken annually.

5. *Setting the Effective Total Allowable Catch and apportioning between Supplementary TAC and Adjusted TAC*

5.1. After applying the management procedure and having set the TAC for the fish species for the quota allocation period, the agreed set aside amount will be subtracted.

5.2. A proportion of the Effective TAC will be removed as a Supplementary TAC for Disadvantaged CPCs, with the proportion calculated by dividing the combined EEZ area of Diasadvantaged CPCs by the total area of the IOTC area of competence. The remaining portion of the Effective TAC is termed the Adjusted TAC.

5.3. The Supplementary TAC and Adjusted TAC (see 'K' and 'L' in Table 5) will be allocated amongst all eligible CPCs according to the control rules defined in Sections 6 to 8.

6. *Setting the Baseline Nominal Catch Proportion and the Baseline Supplementary Allocation Proportion*

6.1. A hybrid scheme based on catch per area in the EEZs of coastal states and on historical catch levels by all eligible flag state fishing fleets on the high seas will be applied to set the baseline nominal catch proportion.

6.2. The following control rules will be applied to each species for which a TAC has been set to establish the baseline nominal catch proportion:

1. The total catch taken by all CPC vessels in the EEZ of each coastal state (including that CPCs artisanal catches) will be calculated for the reference period (1981-2010). (A, see Annex 1, Table 1, transcribed to Table 2)

2. The proportion of the total catch taken in each EEZ, will be calculated [(Total Catch in Country EEZ during reference period / total catch in IOTC area of competence during reference period)*100%] (B, Annex 1, Table 1, Table 2)

3. The total high seas catch by flag state during the reference period will be calculated (C, Annex 1 Table 1, Table 2).

4. The high seas catch by flag state (from C) will be calculated as a proportion of the sum of the total catch in the IOTC area of competence during the reference period (from A) [(Total Catch by flag state from the high seas during reference period / sum total catch in IOTC area of competence during reference period)*100%] (D, Annex 1, Table 1, Table 2)

5. The baseline nominal proportion of the catch (unadjusted) attributable to each country will be calculated based on the sum of the catch in the EEZ plus the catch by flag state on the high seas (i.e. B+D). This will be called the baseline nominal catch proportion (E, Annex 1, Table 2)

6.3. Disadvantaged CPCs will develop a scheme based on socio-economic criteria in order to calculate the baseline supplementary allocation proportion (F, Annex 1, Table 2)

6.4. The baseline nominal catch proportion is set once only at the start of the quota allocation system and is based on historical catches by location up to that point in time. Likewise, the baseline supplementary allocation proportion is set once only and will be based on socio-economic criteria established at the start of the quota allocation system. The first and all future quota allocations will start from these baselines.

7. *Adjusted Nominal Catch Proportion and Adjusted Supplementary Allocation Proportion*

7.1. All quota allocations are derived from application of control rules for the effective allocated catch limit to the baseline proportions. However, there are three factors that may result in a need to adjust the baseline as an intermediate step prior to setting the quota:

(i) Due to the fact that artisanal catches have been poorly reported to date, it may be necessary to make an adjustment after 5 years to incorporate more accurate artisanal catch data after implementing recommendations for artisanal fishery data reporting in Resolution 10/01. At present the IOTC catch and effort database estimates artisanal catches. It will only be necessary to update the baseline nominal proportion if those estimates differ significantly from the improved estimates of artisanal catch that become available.

(ii) Over time, coastal State CPCs may cease to be classified as 'Disadvantaged' according to the criteria applied here and will no longer benefit from Supplementary TAC. The mechanisms to review eligibility for Supplementary TAC should be defined on adoption of this system.

(iii) To accommodate any permanent trade of quota between CPCs should this be permitted in future (see paragraph 10.2)

Any adjustments will be called the 'Adjusted Nominal Catch Proportion' and the 'Adjusted Supplementary Allocation Proportion'. In terms of the former, the original historical reference period will not be adjusted in such circumstances.

7.2. At the start of the quota allocation system no adjustments will be made to the baseline proportions and control rules are not defined here for making adjustments. This will only become necessary depending on future decisions of the Commission with respect to the permanent trade of quota (see paragraphs 10.2). The present control rules therefore only refer to the Baseline Nominal Catch Proportion and Baseline Supplementary Allocation Proportion.

8. *Setting the Nominal Catch Allocation, the Preliminary Catch Allocation and the Effective Allocated Catch Limit*

8.1. The baseline nominal catch proportion and baseline supplementary allocation proportion are set only once at the start of the quota allocation system. The effective allocated catch limit is calculated at the start of every quota allocation period. The Effective Allocated Catch Limit is not necessarily in proportion to the baseline proportions. It is the quota (catch-limit) allocated to a CPC for a specific period after application of a number of control rules.

8.2. To calculate the Nominal Catch Allocation for each CPC the following control rules are applied (see Annex 1 Table 5).

1. The product of the baseline nominal catch proportion and the Adjusted TAC provides the Nominal Catch Allocation for non-Disadvantaged CPCs and the Preliminary Catch Allocation for Disadvantaged CPCs.
2. The product of the baseline supplementary allocation proportion and the Supplementary TAC provided the Supplementary Catch Allocation for Disadvantaged CPCs only.
3. For Disadvantaged CPCs, the final Nominal Catch Allocation is the sum of the Preliminary Catch Allocation (6) and the Supplementary Catch Allocation.

8.3. To calculate the Effective Allocated Catch Limit for each CPC the following control rules (see Annex 1 Tables 3-5) must be applied in the order shown.

1. *Membership status:* Adjustment 1. Membership status (H, Table 4) determines eligibility to receive a quota (see paragraph 3.8) and the relevant proportions are recorded in Column I (Table 4) [members entitled to 100% quota before other adjustments; cooperating non contracting parties, 80%; non members, 0%].
2. *Compliance*: Adjustment 2. The Standard Compliance Table (Annex 1 Table 3, see paragraphs 13.1 - 13.5) is applied to determine any reduction of allocation to any particular CPC due to non compliance. The balance of quota (G, Table 3) that remains to be allocated after penalty deductions for non compliance is expressed as a proportion and is summarised in Column J in Table 5 for all CPCs.. The product of Adjustment 1 (I) and Adjustment 2 (G) is the combined adjustment, J, and it is applied to the nominal catch allocations (M1, M2) to determine the effective allocated catch limit after penalty adjustments, N [M1 or M2 x J, tonnes, Table 5].

'Penalty deductions' are treated as follows:

- CPC: held in a CPC specific set aside (O, Table 5) and can be reclaimed by the CPC once either membership status has been confirmed, or full compliance has been demonstrated to the satisfaction of the Compliance Committee;
- Non Member: the full nominal catch allocation of non members will be assigned to an unallocated balance (P, Table 5) for redistribution as a 'bonus' to eligible CPCs

3. *Reallocation of unallocated balance of quota*: Final Adjustment. The sum of any unallocated balance of quota will be reallocated in equal parts to all remaining fully compliant CPCs eligible to receive a quota for that period. This is the 'bonus' allocation, Q (Table 5) [(Sum of unallocated balance, P / Number of fully compliant CPCs eligible for a quota), tonnes]
4. *Final effective Allocated catch limit, i.e. CPC Quota*: The final effective allocated catch limit, or CPC quota for the current quota allocation period is the sum of the effective allocated catch limit (N) and any bonus applied (Q) (R, tonnes, Table 5).

PART 3
IMPLEMENTATION

9. *Utilisation of a quota*

9.1. The effective allocated catch limit is the quota allocated to a particular CPC. CPCs will be free, subject to appropriate bilateral agreements in the case of waters within coastal state EEZs, to take their quota anywhere within the area to which the TAC for the species in question relates i.e. the IOTC area of competence or sub areas. The Science Committee will monitor the spatial distribution of catches in order to ensure that this does not lead to excessive fishing in any one particular area or part of the stock (e.g. on juveniles).

9.2. In the event that CPCs have received more quota than they can fish themselves they may transfer all or part of their quota to one or more CPCs to take on their behalf anywhere in the IOTC area of competence. They may also choose to allocate part of any surplus to a voluntary CPC set aside for one or more years, and that may or may not be taken up during that quota allocation period.

9.3. CPCs receiving a quota will be responsible for defining how that quota will be allocated amongst its fleet and for monitoring and ensuring compliance of the uptake of the quota by its fleet.

9.4. With the exception of artisanal vessels, only vessels on the IOTC record of authorised vessels will be eligible to receive a quota from their flag state. CPCs will however need to indicate the number, size and fishing gear of artisanal vessels fishing for tuna.

9.5. Where a quota is transferred or traded, the CPC receiving the quota will take over responsibility for monitoring and ensuring compliance of the uptake of the quota by it's fleet.

10. *Trade and transfers of a quota between CPCs*

10.1. The transfer of quota or part of a quota between CPCs is permitted. Quota may not be transferred to any third party that is not an IOTC member or cooperating non contracting party.

10.2. For the first fifteen years of the quota allocation system, or three quota allocation periods, whichever is greater, the trade of quota or part of a quota between CPCs is NOT permitted. After this time, this will be reviewed by the Commission and a decision made as to whether permanent trade of quota will be permitted. Permanent trade between CPCs has the effect of modifying the baseline nominal catch proportion, by removing it from one CPC and adding it to another. Appropriate control rules will need to be developed if permanent trade of quota is to be permitted in future.

11. *Reallocation of quota between years*

11.1. Underutilised quota in any one year by any CPC will NOT be added to that CPC allocation for the following year.

11.2. The Compliance Committee will define the sanctions to be imposed in the case that a CPC exceeds its quota in any one year. This will be reflected in the Standard Compliance Table.

12. *Obligations of CPCs receiving a quota*

All recipients of a quota

12.1. Receipt of a quota carries the obligation to adhere to and report on the rules of implementation of the quota system as defined in this proposal and to adhere to and apply all other relevant IOTC conservation and management measures.

12.2. The Compliance Committee of IOTC will arbitrate to address any disputes that may arise (e.g. arising from application of the allocation criteria) and ensure that quota is utilised appropriately.

12.3. CPCs anticipating to receive a quota will submit a Utilisation Plan to the IOTC Secretariat at least 30 days prior to the Commission Meeting detailing how that quota will be utilised amongst vessels flagged to that CPC, or any transfers anticipated, or any voluntary set aside.

Coastal States quota

12.4. During the first fifteen years of the quota allocation system coastal states that receive a quota allocation that exceeds their current capacity to fish may transfer their quota to flag state CPCs that have fishing capacity, for example, to those that have fished during the historical reference period in their zone thereby maintaining the status quo and ensuring economic stability of the existing fishing fleet. Where existing agreements occur between DWFNs and coastal states for access to resources and that overlap with the introduction of the quota allocation system, these will remain in place without duplication, and with amendments to reflect permitted catch levels consistent with combined quota allocations.

12.5. The terms of the transfer (rent) of the allocation are for negotiation between the Coastal State and fishing flag state and will be undertaken subject to market forces. The Compliance Committee will address any disputes that may arise and ensure that quota is utilised appropriately.

12.6. At the start of the quota allocation system Coastal States will update their fleet development plans (Resolutions 03/01; 09/02) which will be linked to the quota allocated to them. Over the first fifteen year period any uptake of quota by coastal states will also be reflected against the report on the implementation of their fleet development plan. As the coastal state develops its own capacity to fish during this period, it will reduce the amount of quota offered for transfer accordingly.

High Seas quota

12.7. In respect of the baseline nominal catch proportion and the effective allocated catch (quota) allocated to flag state CPCs in any subsequent year in respect of historical levels of catch on the high seas up to 2012 (the 'high seas quota' see Annex 1, Table 1), the Commission agrees that all transfers of 'high seas' quota will be undertaken subject to market forces.

New Entrants / Set Aside

12.8. The set aside allocation will only be available to new Coastal State entrants that have attained the status of Cooperating non contracting party or full Member and the same control rules for allocation as defined above will be applied. As part of their application to IOTC new applicants shall also indicate the amount of quota they wish to receive from that available in the set aside. The Compliance Committee will review that application and the Commission will decide on the level of the set aside allocated to the new entrant. New DWFN may enter the fishery through transfer or trade of quota.

12.9. New entrants, like any other CPC, will be able to rent additional quota that may be made available for transfer by another party.

13. *Compliance*

13.1. The record of compliance in the application of IOTC conservation and management measures by the CPCs wishing to participate in the quota allocation process will be evaluated annually against a Standard Compliance Table (Annex 1, Table 3). The standard compliance table will be harmonised with other compliance rules defined by the Compliance Committee. Application of the standard compliance table is amongst the criteria used to set the Effective Allocated Catch Limit for each quota allocation period. Where the quota allocation period is more than one year (e.g. 3 years) this allows the uptake of any CPC quota held as a penalty in the CPC specific set aside to be taken up during the quota allocation period once compliance is demonstrated at the next Compliance Committee meeting (i.e. the next year), thus the penalty will apply for a minimum of one year.

13.2. In addition to conservation and management measures, the standard compliance tables will also include details on payment of contributions to IOTC. Failure to pay IOTC contributions in any year will result in a sliding scale of penalties with a 20% reduction in quota for the first year, 40% for the second year in arrears, and will disqualify that CPC from receiving a quota allocation for that quota allocation period where the CPC is three or more years in arrears.

13.3. There will be one standard compliance table produced each year for each participating CPC – these tables will collate and summarise the data already generated by the Secretariat each year for the review of the Compliance Committee. Additionally it will collate and summarise any additional reporting requirements related to monitoring and control of this quota allocation system that may be introduced from time to time.

13.4. A summary table will be prepared by the Secretariat that indicates the eligibility of each CPC to participate in the quota allocation scheme each year, and the level of any reduction in quota that will be applied that year arising from sanctions applied in respect of failure to comply with IOTC conservation and management measures (Annex 1, Table 4).

13.5. It is proposed that the Compliance Committee reviews and finalises the proposed standard compliance table, and level of sanctions during its meeting in 2012.

14. *Monitoring implementation*

14.1. The Compliance Committee meeting held prior to the Commission Plenary Session in 2012 will discuss any additional requirements that are necessary to administer and monitor the quota allocation scheme over and above the current mandatory requirements for reporting against IOTC conservation and management measures. CPCs are encouraged to submit proposals one month prior to the meeting.

15. *Duties of the IOTC, the Secretariat, its various bodies and of CPCs*

15.1. The following table provides a timeline for implementation of the quota allocation system and identifies the duties of the different bodies of the Commission.

Responsible body and actions to be taken	**Month**
Technical meeting on quota allocation: • Agree proposal on allocation criteria and allocation system. • Recommend proposal to Commission	1
Commission Meeting : • Adopt proposed quota allocation criteria and a quota allocation system for implementation (specific parameters to be applied within the system can be further developed and adopted after the system is agreed);	2

• Agree the factors to be taken into consideration when developing a management procedure for the TAC;	
IOTC Secretariat and CPCs • The Secretariat to develops and validates with CPC's their historical catch record, as soon as possible for years 1981-2010.	6
WPB and WPTT: • Develop a management procedure for setting the TAC for billfish and tuna species	8, 9
Science Committee: • Review, approve and recommend the management procedure to the Commission	11
CPCs: • Submit proposals to the Compliance Committee for additional monitoring and control requirements needed to administer the quota allocation system and indicate how they would be reflected in the standard compliance table.	13
Compliance Committee: • Review proposals for additional monitoring and control related to implementation of the quota allocation system and recommend them to the Commission • Agree the sanctions to be applied in the standard compliance table, update the table to reflect additional monitoring and control requirements, and recommend them to the Commission	14
Commission • Adopt the management procedure for setting the TAC • Agree the historical reference period for application by subsidiary bodies in calculation of the baseline nominal catch proportion. • Agree parameters used in the control rules to set the effective allocated catch limit (Membership, compliance, etc) • Agree the level of set aside if any. • Define the quota allocation period to be applied.	14
WPB and WPTT: • Apply management procedure and set the TAC for Yellowfin tuna, big-eye tuna and swordfish	20, 21
IOTC Secretariat: • Apply control rules for the agreed reference period to determine the baseline nominal catch proportion by CPC	22
Science Committee: • Review, approve and recommend the TAC derived by WPTT to the Commission • Review and approve the estimates of baseline nominal catch proportion.	23
CPCs • Fulfil all mandatory reporting requirements as required under IOTC conservation and management measures • Submit Utilisation Plan to IOTC detailing how the quota will be utilised (i.e. mechanism of allocation amongst domestic fleets, level of transfers anticipated and to which CPC, etc) • Submit revised fleet development plans.	Variable deadlines
IOTC Secretariat • Complete usual generation of reports on compliance with IOTC conservation and management measures submitted • Complete the Standard Compliance Table • Confirm that CPC plans for utilisation of quota conform to rules defined in Part 3 of the proposal.	25

Compliance Committee: • Review completed standard compliance table and agree its application for the allocation of quotas – Recommend to the Commission. • Review summary of CPC utilisation plans and for any that do not conform, recommend course of action to the Commission.	26
Commission: • Adopt the level of TAC set for Yellowfin tuna ,big-eye tuna and swordfish • Adopt the completed standard compliance table • Agree CPC utilisation plans (with revisions as appropriate)	26
IOTC Secretariat • Apply agreed level of TAC and control rules and derive effective allocated catch limits per CPC (quota). • Inform each CPC of its quota for the present quota allocation period.	27
CPCs • Utilise quota according to agreed utilisation plan • Submit any complaints to the Compliance Committee • Comply with all IOTC conservation and management measures and ensure that quota allocations are not exceeded.	From 27
Compliance Committee • Review complaints and require CPCs to act according to decisions of the Committee	28
All bodies • Report on and review the implementation of the quota allocation system on an annual basis during the defined quota allocation period.	Annual cycle

Annex 1: Standard tables to be applied in the quota allocation system for IOTC.

Table 1: Setting the Baseline nominal Catch Proportion (%): For each species for which the Commission has agreed a TAC, and for the defined reference period, to calculate the total catch (A) and proportion (%) of the total catch (B) in the EEZ of coastal states within the IOTC area of competence and the total high seas catch by flag states that have fished during the reference period (C)

Table 2: Setting the baseline nominal catch proportion: Application of the values derived in Table 1 to set the baseline nominal catch proportion (E). A baseline supplementary allocation proportion for Disadvantaged CPCs has been added to the system (F) but requires agreement on quantitative socio-economic criteria to define proportions

Table 3: Standard Compliance Table, to set the level of reduction of the nominal catch for each CPC due to non compliance, G. This Table will be completed by the Compliance Committee during its meeting in 2012 when the level of sanctions for non compliance will be agreed. Over time the Standard Compliance Table is expected to evolve. Comments and examples are provided for guidance only.

Table 4: Summary of eligibility of each CPC to receive a full quota based on membership status (H,I) and compliance with IOTC conservation and management measures (G), and calculation of the combined adjustment (J) to be applied to the nominal catch allocation when setting the effective allocated catch limit.

Table 5: Setting the Effective allocated catch limit and final quota allocation, indicating the nominal catch allocations (M1,M2), effective allocated catch limit (N) and penalty CPC set-aside (O), the bonus allocation (Q) and final quota allocated to each CPC (R) for the quota allocation period.

Table 1: Setting the Baseline nominal Catch Proportion (%): For each species for which the Commission has agreed a TAC, and for the defined reference period, to calculate the total catch (A) and proportion (%) of the total catch (B) in the EEZ of coastal states within the IOTC area of competence and the total high seas catch by flag states that have fished during the reference period (C).

			Catches within Coastal State EEZ within the IOTC area of competence																									C. TOTAL HIGH SEAS BY FLAG STATE	D. FLAG STATE HIGH SEAS CATCH (C) AS A % OF THE SUM TOTAL LANDED CATCH (A)
		Country	e.g. Australia																										
Flag-States fishing (note, only necessary to retain those that fished during Reference Period)	Coastal state within IOTC area of competence	e.g. Australia																											
	Distant Water fishing Nation	e.g. Japan																											
		A. TOTAL CATCH IN ZONE OF COUNTRY																											
		B. % OF CATCH IN ZONE OF COUNTRY																											

Table 2: Setting the baseline nominal catch proportion. Application of the values derived in Table 1 to set the baseline nominal catch proportion (E). A baseline supplementary allocation proportion for Disadvantaged CPCs has been added to the system (F) but requires agreement on quantitative socio-economic criteria to define proportions.

	Country	A. Total catch in zone of country for reference period (mt)	B. Proportion of total catch taken by zone (%)	C. Total high seas catch taken by flag state for period	D. High seas catch taken by flag state (in C) as a proportion of the sum total landed catch (in A)	E. Baseline Nominal catch proportion (B+D)	F. Baseline Supplementary allocation proportion (Disadvantaged CPCs only)
Coastal State within IOTC area of competence	e.g. AUSTRALIA						
Distant Water fishing Nation	e.g. JAPAN						
	HIGH SEAS		n%				
	TOTAL		100.00%		n%	100.000%	

Table 3: Example Standard Compliance Table, to set the level of reduction of the nominal catch for each CPC due to non compliance, G. This Table will be completed by the Compliance Committee when the level of sanctions for non compliance will be agreed. Over time the Standard Compliance Table is expected to evolve. Comments and examples are provided for guidance only.

Standard Compliance Table for: ***(CPC)***			***Year***
Relevant Conservation and management measures	**Compliance (Data reported to IOTC standards) (Y/N)**	**Comments (e.g. reported, but not to IOTC standards)**	**Proposed level of reduction in quota allocation for failure to comply with this measure.**
Payment of membership fees			(e.g. 20% reduction of quota for each year's non payment with 100% reduction after 3 years)
Attendance at IOTC meetings			
Reporting of mandatory statistics (08/01) and other reporting requirements [authorised vessels (07/02); fleet development plans (03/01 & 09/02); port inspections (05/03); Bigeye tuna statistical document programme (01/06); VMS (06/03); transhipment by large-scale fishing vessels (08/02); Observer schemes (10/04)]			(e.g. Variable sanctions for different elements of the mandatory reporting requirements)
CPC vessels listed on IUU list (09/03)			(e.g. A higher level of sanction if CPC does not demonstrate control of its flag vessels according to IOTC standards)
Any new mandatory reporting requirements defined by the compliance committee for monitoring and enforcing the quota allocation system scheme			(e.g. A high level of sanction - CPC must demonstrate ability to enforce the quota allocation system)
Total deductions to quota for this CPC this year [sum of all above – if greater than 100%, apply 100%]			(Sum of all above)
G. Balance (proportion) of quota to be allocated this period [i.e (100-total deductions)/100]			**G, transfer this value to Table 4 for each CPC**

Table 4: Summary of eligibility of each CPC to receive a full quota based on membership status (H,I) and compliance with IOTC conservation and management measures (G), and calculation of the combined adjustment (J) to be applied to the nominal catch allocation when setting the effective allocated catch limit.

	Country	H. Membership status	I. Adjustment 1 based on membership Status	G. Adjustment 2 : Balance of quota to be allocated after total penalty deductions arising from the Standard Compliance Table (Table 3))	J. Combined Adjustment 1 and 2 to be applied in setting the effective allocated catch limit (I*G)	Summary explanation of factors leading to deductions and any particular issues / uncertainties to be drawn to the attention of the Compliance Committee / Commission.
Proportion of baseline nominal catch retained for each category of CPC		Member	1.0			
		Coop NCP	0.8			
		Non Member	0.0			
Coastal State within IOTC area of competence	e.g. Australia	Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
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		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Coop NCP	0.8			
		Coop NCP	0.8			
		-	0.0			
		-	0.0			
		-	0.0			
		-	0.0			
		-	0.0			
Distant Water fishing Nation		Member	1.0			
		Member	1.0			
			1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Member	1.0			
		Coop NCP	0.8			
		Coop NCP	0.8			

Table 5: Setting the Effective allocated catch limit and final quota allocation, indicating the nominal catch allocations (M1,M2), effective allocated catch limit (N) and penalty CPC set-aside (O), the bonus allocation (Q) and final quota allocated to each CPC (R) for the quota allocation period. (Note that the colours applied to each column correspond to those in Boxes 1-4 of the explanatory note)

	Country	H. Membership status	E. Baseline Nominal catch proportion (From Table 2) %	F. Baseline Supplementary allocation proportion (From Table 2) %	M1. Nominal catch allocation (tonnes) [E*K] and Preliminary catch allocation for disadvantaged CPCs	M2. Nominal catch allocation (tonnes) for disadvantaged CPCs from Supplementary catch allocation [F*L] + Preliminary catch allocation [M1]	J. Combined adjustments 1 and 2 to be applied in setting the effective allocated catch limit (from Table 4)	N. Effective allocated catch limit after adjustments 1 and 2 applied for allocation period [M1*J or M2*J]	O. [illegible]	P. Unallocated balance	Q. Bonus allocation - from equal redistribution of unallocated balance (Sum of P) to eligible CPCs [sum of P / number eligible CPCs]	R. Final CPC allocation for this quota allocation period [effective allocated catch limit, N + bonus, Q]
	TAC set in year / quota allocation period in question								This applies only to members and coop NCPs	This applies only to non members	Only fully compliant members are eligible for the bonus	
	Agreed set aside											
	[illegible]											
	[illegible]											
	CPC ALLOCATIONS											
Coastal State within IOTC area of competence	e.g. Australia	Member										
		Member										
		Member										
		Member										
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		Member										
		Member										
		Coop NCP										
		Coop NCP										
		-										
		-										
		-										
		-										
		-										
Distant Water Fishing Nation		Member										
		Member										
		Exception										
		Member										
		Member										
		Member										
		Member										
		Member										
		Member										
		Member										
		Member										
		Coop NCP										
		Coop NCP										
	TOTAL, all CPCs											

Annex 2: An established basis for zonal attachment in quota allocation systems

The global framework of fisheries agreements and legislation (including UNCLOS, Compliance Agreement, Code of Conduct for Responsible Fisheries and the Fish Stocks Agreement) provides some guidance as to the distribution of shared resources between States. These agreements allow us to defined four parameters that should be considered in quota allocation;

- Traditional fishing patterns and practices (i.e. historical fishing activity);
- Geographical distribution (i.e. zonal attachment);
- Coastal state preferences for fishing; and
- Fisheries dependency (i.e. social characteristics).

Using historical fishing on a geographic basis as described in this proposed mechanism as principle for quota allocation allows for both historic fishing activity and zonal attachment to be considered.

These four criteria and their applicability to different situations vary greatly between fisheries and while historical activity and zonal attachment may be possible to define and document in a set of quantitative indicators, the more socially related concepts of coastal state preference and fisheries dependency may be required to be described by more subjective and qualitative indicators.

As an example some of the factors used to calculate the zonal attachment by ICES (1978) include the following which can be quantitatively defined:

- the spawning areas;
- the distribution of eggs and larvae;
- the occurrence of juvenile fish; and
- the occurrence and migrations of the fishable part of the stock.

Quota sharing arrangements in the North Atlantic have been shown to be dependent on both historical harvesting patterns and zonal attachment as the primary dividing principles for shared stocks starting in the 1980s (Engesæter, 1993). These have increasingly become sophisticated in their methodologies as data from the fisheries and computing power have become more widely available. Examples of international fisheries cooperation based on zonal attachment include the agreement between Norway and the European Union (Ramstad, 2001). This arrangement is based on agreement on the zonal attachment of seven shared stocks in the North Sea. The agreement between Norway and Russia for the stocks of the Barents Sea used historical catches as the basis initially for quota allocation, with later quota allocations using zonal attachment as the basis. These examples have been shown to work well in most demersal stocks as there have been no large scale changes in stock migration and distributions. With the herring fisheries of the North Atlantic it is more difficult as the sotcks are very dependent on environmental factors. It would be prudent therefore to consider longer time scales for straddling and migratory species where environmental factors are important in determining stock distributions and recruitment.

The FAO Expert Consultation on the management of shared fish stocks found that historically, the prime allocation criteria had been zonal attachment and historical catches (FAO, 2002). In relation to straddling fish stocks, zonal attachment was considered the critical factor in determining the segment of the stock within the EEZ(s), while historical fishing patterns were important in quota allocation for the high seas. In addition, the consultation noted various "supplementary" criteria that had been used, such as fisheries dependency, compliance and engagement in research and monitoring. The consultation also pointed out that the UN Fish Stocks Agreement did not provide guidance on the weights to be accorded to individual criteria. The weighting of these criteria would need to be determined on a fishery by fishery basis.

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Ramstad, S. (2001) Etableringen av et internasjonalt forvaltningsregime for norsk vårgytende sild. MPol thesis, Dept. of Political Science, University of Tromsø, Norway, 2001.

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Addendum 1

EXPLANATORY NOTE ON A REVISED PROPOSAL SUBMITTED BY REPUBLIC OF SEYCHELLES: 'ON ESTABLISHING A QUOTA ALLOCATION SYSTEM FOR THE MAIN TARGETED SPECIES IN THE IOTC AREA OF COMPETENCE'

VERSION: 3RD FEBRUARY 2012

INTRODUCTION

The IOTC Technical Meeting on Quota Allocation held in Nairobi in February 2011, hereafter referred to as the Nairobi Meeting, provided an opportunity for critical assessment of the quota allocation system submitted by the Republic of Seychelles. Based on the observations of delegates from other CPCs in plenary, and on discussions held in the sidelines of the technical meeting, a number of issues pertaining to the proposal by Seychelles were identified. This Explanatory Note details several important modifications that have made to the proposed quota allocation system by Seychelles in an attempt to address those issues.

Two critical areas for improvement were: (1) recognition of the need to allocate quota to all CPCs, even those lacking historical catch data, and (2) full incorporation of artisanal catches in the estimation of historical catch by area for the EEZs of coastal State CPCs. The revised quota allocation system proposed by Seychelles now explicitly incorporates these areas of concern in an objective and transparent framework.

In addition to these revisions and in response to concerns raised by distant water fishing nations (DWFN) at the Nairobi Meeting, we reiterate that the proposed system is designed so that, in the short term, the status quo is approximately maintained through trade in quota between CPCs. This will ensure economic stability for existing fleets, whilst over the longer term the development plans of coastal states can be realised in a phased and planned way.

Recognising the legitimate rights and aspirations of both coastal states and distant water fishing nations that have historically fished and invested in an area remains a significant challenge for developing equitable quota allocation systems. The revised framework presented here offers potential solutions to this challenge and specifically addresses the needs of small-island developing coastal states and territories and small and vulnerable economies.

This proposal describes a fair and transparent quota allocation system through a combination of suitable rights based quota allocation criteria and a phased implementation system. We continue to propose a hybrid scheme based on catch per area in the EEZs and fishing zones of Coastal States, and on historical levels of catch by all eligible flag state fishing vessels on the high seas. As more than 50% of historical catches have been taken on the high seas this does not disadvantage distant water fishing nations that have historically invested in the Indian Ocean fisheries whilst by considering where the fish are caught it recognises the sovereign rights of Coastal States to a share of the resource.

Further, the revisions made here explicitly recognise that a lack of historical catch information cannot constitute a barrier to obtaining a quota share if a system is to be demonstrated as equitable. In contrast to other proposals made at the Nairobi Meeting, we offer a mechanistic solution for calculating the proportion of quota that CPCs with limited or no historical catch are eligible for.

UNCLOS Article 56(1) defines coastal states sovereign rights within their EEZs. Coastal states have the necessary jurisdiction related to those sovereign rights giving them the power to regulate the terms of use relating to activities for the exploitation of the living resources in their EEZs. In the past this has included the sale of licences and agreements with third parties for them to fish inside the EEZ of a coastal zone for a defined period. Fixed term licences and agreements do not confer a future right to the resources within an EEZ. Any catch history within an EEZ indicates the resource availability within that EEZ and it is appropriate to attribute it to the coastal state that claims the sovereign rights. High seas catches by contrast are not claimed as sovereign rights and it may therefore be more appropriate to allocate quota on the basis of historical catch.

The global framework of fisheries agreements and legislation (including UNCLOS, Compliance Agreement, Code of Conduct for Responsible Fisheries and the Fish Stocks Agreement) provides some guidance as to the distribution of shared resources between States. These agreements allow us to defined four parameters that should be considered in quota allocation;

- Traditional fishing patterns and practices (i.e. historical fishing activity);
- Geographical distribution (i.e. zonal attachment);
- Coastal state preferences for fishing; and
- Fisheries dependency (i.e. social characteristics).

Using historical fishing on a geographic basis as described in this proposed mechanism as principle for quota allocation allows for both historic fishing activity and zonal attachment to be considered.

These four criteria and their applicability to different situations vary greatly between fisheries and while historical activity and zonal attachment may be possible to define and document in a set of quantitative indicators, the more socially related concepts of coastal state preference and fisheries dependency may be required to be described by more subjective and qualitative indicators.

As an example some of the factors used to calculate the zonal attachment by ICES (1978) include the following which can be quantitatively defined:

- the spawning areas;
- the distribution of eggs and larvae;
- the occurrence of juvenile fish; and
- the occurrence and migrations of the fishable part of the stock.

Quota sharing arrangements in the North Atlantic have been shown to be dependent on both historical harvesting patterns and zonal attachment as the primary dividing principles for shared stocks starting in the 1980s (Engesæter, 1993). These have increasingly become sophisticated in their methodologies as data from the fisheries and computing power have become more widely available. Examples of international fisheries cooperation based on zonal attachment include the agreement between Norway and the European Union (Ramstad, 2001). This arrangement is based on agreement on the zonal attachment of seven shared stocks in the North Sea. The agreement between Norway and Russia for the stocks of the Barents Sea used historical catches as the basis initially for quota allocation, with later quota allocations using zonal attachment as the basis. These examples have been shown to work well in most demersal stocks as there have been no large scale changes in stock migration and distributions. With the herring fisheries of the North Atlantic it is more difficult as the sotcks are very dependent on environmental factors. It would be prudent therefore to consider longer time scales for straddling and migratory species where environmental factors are important in determining stock distributions and recruitment.

The FAO Expert Consultation on the management of shared fish stocks found that historically, the prime allocation criteria had been zonal attachment and historical catches (FAO, 2002). In relation to straddling fish stocks, zonal attachment was considered the critical factor in determining the segment of the stock within the EEZ(s), while historical fishing patterns were important in quota allocation for the high seas. In addition, the consultation noted various "supplementary" criteria that had been used, such as fisheries dependency, compliance and engagement in research and monitoring. The consultation also pointed out that the UN Fish Stocks Agreement did not provide guidance on the weights to be accorded to individual criteria. The weighting of these criteria would need to be determined on a fishery by fishery basis.

In this revision, we first outline the major revisions that have been made to the Seychelles proposal. A summary of the quota allocation system proposed is provided in Boxes 1-5, noting that a number of the schematics in these boxes have been modified to incorporate the revisions and a new box has been added. Box 1 indicates the rights allocation mechanism. More details explaining how control rules for the quota allocation criteria will be applied are provided in Boxes 2 & 3 (the baseline nominal catch proportion and baseline supplementary allocation proportion) and Box 4 (the effective allocated catch limit, or quota). Box 5 describes the implementation of the quota allocation system. We also append the original text from the summary description of the system, further highlighting changes that have been made and including the original versions of the boxes to allow the reader to make clear comparisons.

MAJOR REVISIONS

In order to ensure all CPCs receive a quota share and that artisanal catch are incorporated, certain assumptions and definitions have been included in the revised framework. The modifications outlined below refer to the revised schematics (boxes) of the quota allocation system (see below).

a) Given that several coastal State CPCs lack or have limited historical IOTC records for catch in their EEZ, a situation that results from a number of constraints, the revised framework makes provision for allocation of an amount of quota based on criteria unrelated to historical catch. Coastal State CPCs lacking or with limited historical catch, termed 'disadvantaged CPCs', will benefit from a portion of the Effective Total Allowable Catch (TAC).

b) Disadvantaged CPCs are defined as those coastal States with a baseline nominal catch proportion of less than 3% (averaged across all IOTC species with a TAC). CPCs with flagged vessels over 24 m LOA that fish on the high seas in the IOTC area of competence will not be defined as disadvantaged CPCs even if their baseline nominal catch proportion is less than 3%. In addition, overseas territories of developed nations will not be defined as disadvantaged CPCs.

c) A portion of Effective TAC will be removed for the group of disadvantaged CPCs (dCPCs) as defined in (b) (Box 1). This portion is termed the Supplementary TAC (suppTAC) and will be calculated based on the following criterion:

$$\text{suppTAC} = \frac{\text{Combined EEZ area of dCPCs}}{\text{IOTC area of competence}} \times \text{Effective TAC}$$

d) The portion of the Effective TAC remaining after the removal of the Supplementary TAC is termed the Adjusted TAC. Based on the hybrid scheme of catch by area in coastal state EEZs & catch by flag state on the high seas, as per the original proposal, the Adjusted TAC will be used to calculate the nominal catch allocation for non-disadvantaged CPCs and a preliminary catch allocation for those disadvantaged CPCs with limited historical catches (Box 2).

e) The Supplementary TAC will be used to calculate a supplementary catch allocation for disadvantaged CPCs. The allocation will be shared among disadvantaged CPCs on the basis of verifiable and quantifiable socio-economic criteria. If a disadvantaged CPC also has a preliminary catch allocation on the basis of limited historical catch (see d), the supplementary catch allocation will be added to that allocation (Box 3). Importantly, the introduction of a Supplementary TAC ensures that all CPCs will be eligible for quota allocation, including those with zero historical catch. Suitable socio-economic criteria will be identified at the 2nd IOTC Technical on Quota Allocation.

f) Nominal artisanal catches reported to IOTC are considered as historical catches taken in the EEZs of the originating coastal State CPCs by domestic fleets, even though it is recognised that some artisanal catch has been taken of the high seas (Box 2)

Under the revised quota allocation system, Coastal State CPCs can receive quotas through at least one of the following mechanisms:

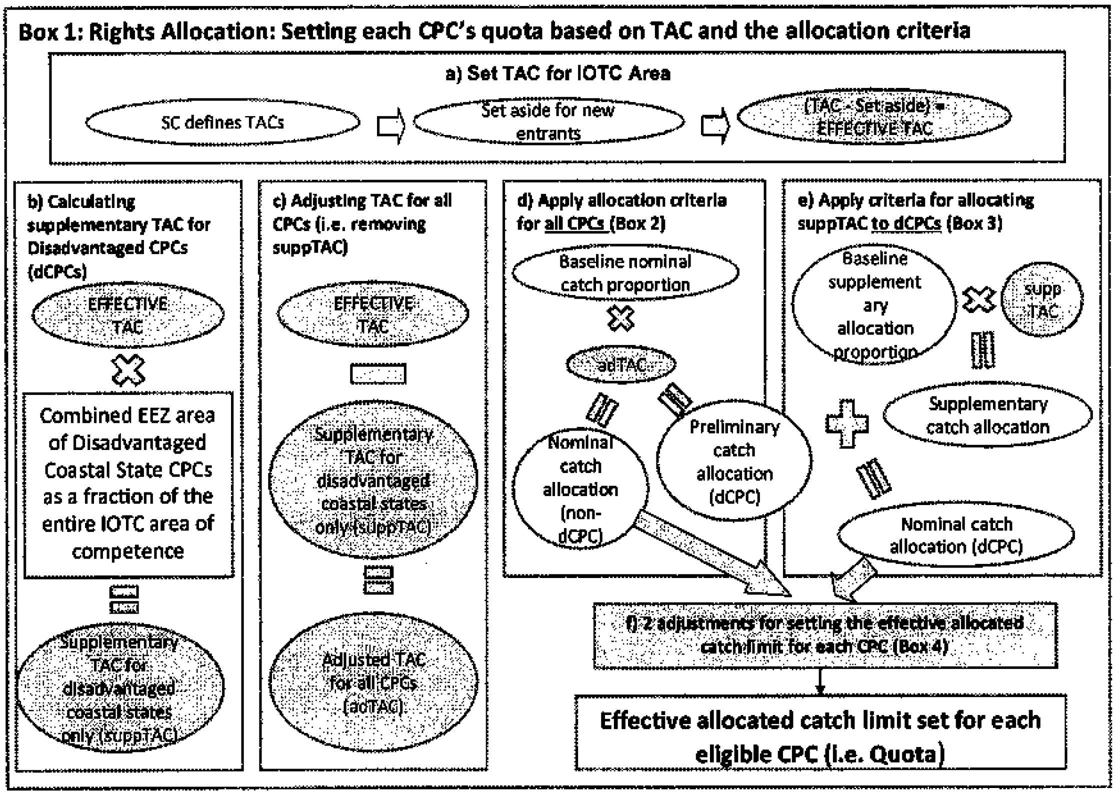
1. Quota allocation through the Supplementary TAC
2. Quota allocation through the Adjusted TAC on the basis of historical artisanal catch
3. Quota allocation through the Adjusted TAC on the basis of historical catch by foreign-flagged vessels licensed to fish in their EEZ

4. Quota allocation through the Adjusted TAC on the basis of historical catch by their flagged vessels that have fished on the high seas

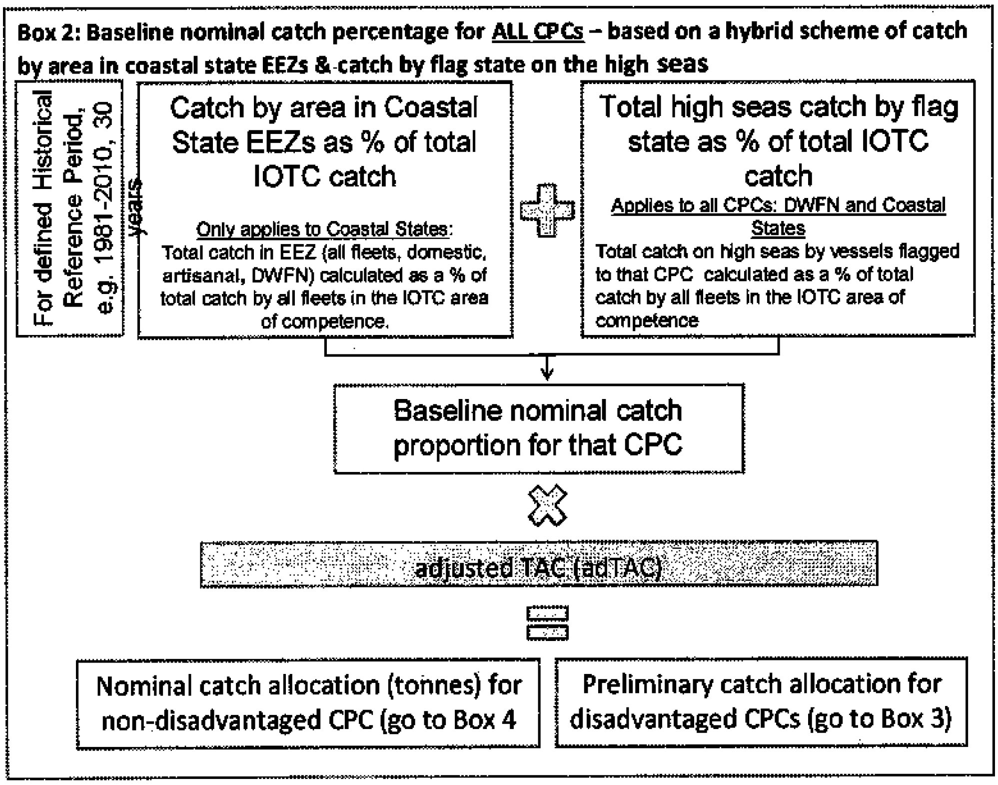
A summary of the quota allocation system proposed is provided in Boxes 1-5. The table below indicates which boxes have been modified or remain unchanged from the original proposal

Box 1	Overview of the rights allocation mechanism	Modified
Box 2	Rights allocation in detail: allocation based on historical catch	Modified
Box 3	Rights allocation in detail: allocation based on socio-economic criteria	New box
Box 4	Setting the effective allocated catch limit (quota)	Unchanged
Box 5	Implementation of the quota allocation system for any one CPC	Unchanged

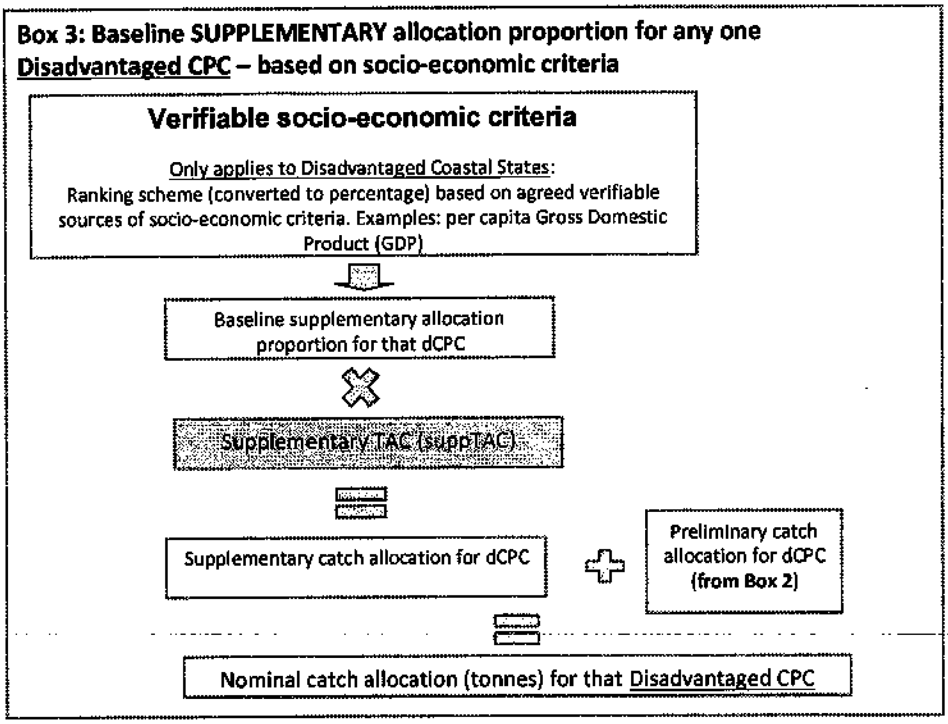
Seychelles quota allocation system proposal

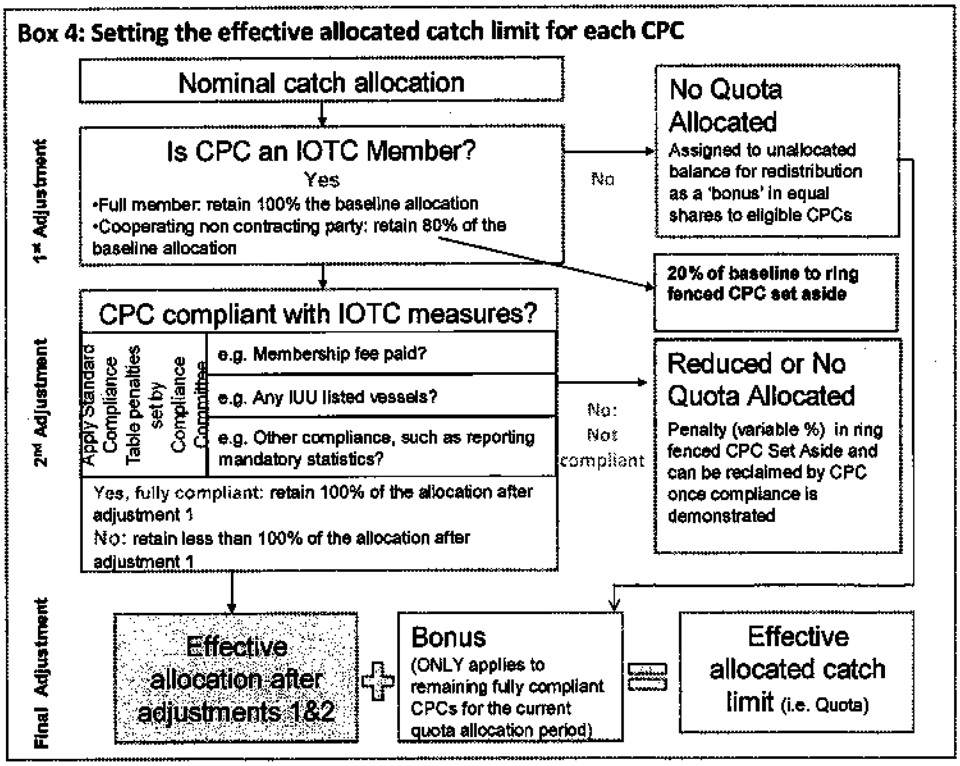


Rights allocation in more detail

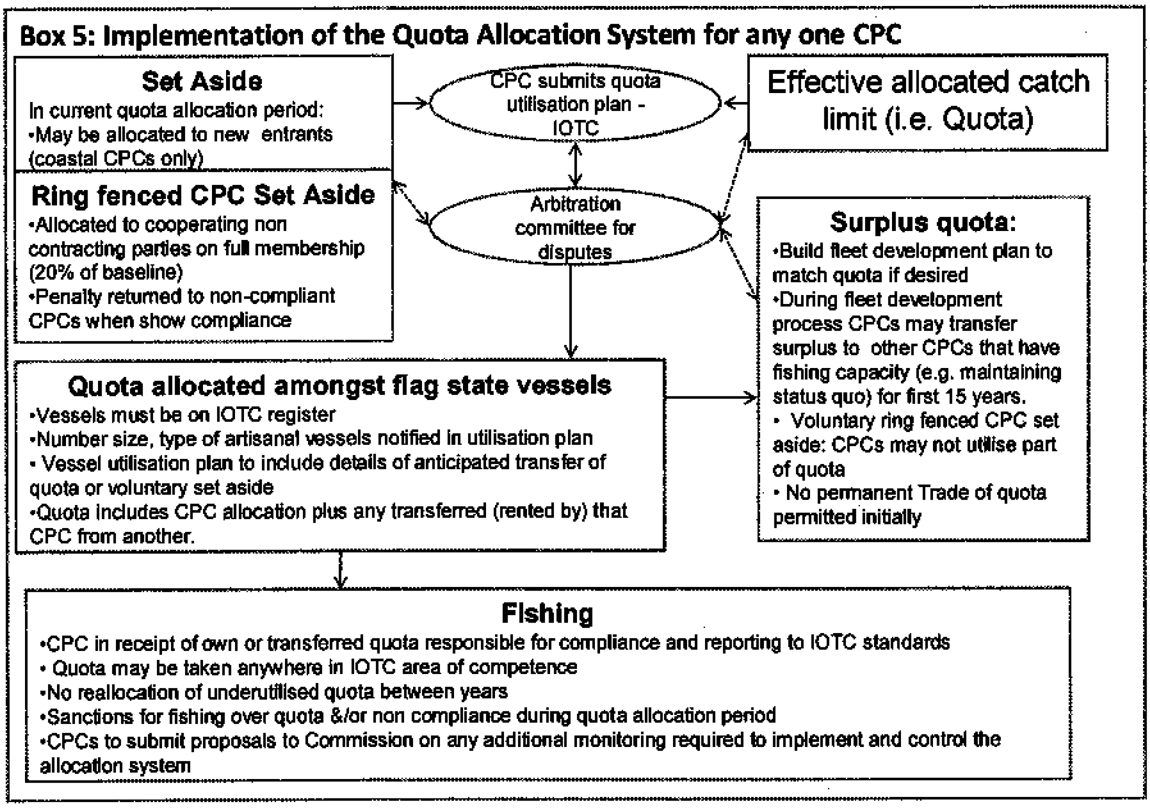


Rights allocation in more detail





Implementation and CPC responsibilities (Box 5)



Text and Boxes from Proposal B Submitted by the Republic of Seychelles to the 1st IOTC Technical Committee on Allocation Criteria (Nairobi on 16-18th February 2011) Highlighting Areas of Revision in the New Proposal

Text highlighted indicates revisions that have been made to the original explanatory note

A summary description of the system:

For any species for which the IOTC will apply a quota allocation system (e.g. yellowfin tuna, bigeye tuna) the system involves:

- **An assessment/management procedure to set the total allowable catch (TAC)** in the whole of the IOTC area of competence or sub areas as relevant for each species. Any set aside allocation for new coastal state members is subtracted from the TAC to give the Effective TAC before allocation amongst CPCs.

- **Revision note:** The Effective TAC will be split to provide for a Supplementary TAC to Disadvantaged CPCs and an Adjusted TAC for all CPCs (Page 2 of this document).

- **Application of allocation Criteria**

    - **Original Text:** Based on catches recorded during a defined historical reference period, applying control rules that set a baseline nominal catch proportion for all eligible CPCs (i.e. all coastal states and all distant water fishing nations that have fished in IOTC waters). The baseline is set only once in 2012. **Revised Text:** Based on catches recorded during a defined historical reference period and socio-economic criteria, applying control rules that set a baseline nominal catch proportion for all eligible CPCs (i.e. all coastal states and all distant water fishing nations that have fished in IOTC waters) and baseline supplementary allocation proportion for Disadvantaged CPCs. The baselines are set only once in 2012.

  - **Original Text:** Deriving the CPC nominal catch allocation for the current quota allocation period from the effective TAC and the baseline nominal catch proportion. **Revised Text:** Deriving the CPC nominal catch allocation for the current quota allocation period from the Adjusted TAC and Supplementary TAC and the baseline nominal catch proportion and baseline supplementary allocation proportion, respectively

  - Applying adjustments to the nominal catch allocation related to membership status and compliance with IOTC conservation and management measures.

  - The reallocation of any unallocated balance as a bonus to all fully compliant eligible CPCs. The final effective allocated catch , or quota, is thus derived for each CPC.

  - An arbitration committee will be formed to deal with disputes

- **Implementation – i.e. use of quota, fishing (amongst others)**

  - The quota will apply for a fixed Quota Allocation Period before it is recalculated (e.g. 3 years) to ensure economic stability and to enable fleet development.

  - Quota may be taken anywhere in the area to which the TAC for the species in question relates i.e. in the IOTC area of competence, or a defined sub area,

  - Only vessels on the IOTC register can utilise a quota

  - CPCs will submit quota utilisation plans to IOTC – for use by their own flagged vessels and listed artisanal fleet. Any surplus may be transferred (rented) to CPCs that have fishing capacity, for example those that have historically fished, thus maintaining the status quo in the short term. In the medium to longer term, fleet development plans will take effect for the uptake of that surplus. The Arbitration Committee will deal with disputes.

  - No reallocation of underutilised quota between years; sanctions may be imposed for CPCs exceeding quota

  - CPCs responsible for monitoring and compliance of fishing by their own fleet on their own quota and any quota rented (transferred) to them.

A summary of responsibilities and a timeline to achieve implementation by 2012 is presented in Section 15 of the Proposal.

Annex 1 provides more detailed explanation for the application of control rules to set the ***baseline nominal catch proportion*** for each of yellowfin tuna, bigeye tuna and swordfish.

This system:

- Provides a fair rights based distribution of benefits between coastal states and distant water fishing nations

- Incorporates historical fishing, zonal attachment and socio-economic dependency, all of which are recognised as core criteria for the design of quota allocation systems

- Through a fully mechanistic system, avoids the uncertainty involved in negotiating quota for coastal states lacking or with limited historical catch

- In the short term aims to maintain the status quo, providing economic stability

- In the longer term allows fleet development up to the level of any quota allocated to a CPC.

- Allows for new coastal state entrants by allocating a set aside
- Encourages full membership of IOTC by applying a sliding scale of allocations for members and cooperating non contracting parties; An exception will be made for Taiwan.China pending discussions on its membership, but this will be the only exception.
- Encourages full compliance with IOTC conservation and management measures, including payment of fees by setting sanctions (quota reductions) for non compliance.

Thus the system proposed has the potential to address more than just a means of sharing out the catch. It also has the potential to encourage full compliance with all of IOTC's conservation and management measures, making it a strong tool for the Commission.

Annex 1: Calculation of the Baseline Nominal Catch Proportion for yellowfin tuna, bigeye tuna and swordfish for an historical reference period of 1981-2008

The Proposal indicates that the IOTC Secretariat is responsible for applying the control rules (i.e. methodology for estimation) for the agreed reference period to determine the baseline nominal catch proportion by CPC. The Science Committee will review and approve the estimates derived for submission to the Commission. This Annex is presented for guidance only and is based on the estimation procedure described below. Refinements to this procedure are also indicated below and may be recommended by the Technical Meeting on quota allocation. The final baseline nominal proportion allocated to each CPC may differ from the figures shown based on any such refinements to the estimation procedure and on the historical reference period adopted. It is noted that IOTC have developed a tool that enables the calculation of catches on the high seas and in CPC EEZs that uses the same approach as that outlined below.

The data sources used for all calculations of catch by area, flag, gear and species were the individual IOTC catch and effort databases for the different gear types. It is important to use an agreed data source that has been submitted by IOTC Members and CNCPs and is readily available to all parties to enable verification and transparency throughout the process. Longline data are available by year, flag and by 5° x 5° grid, purse seine and bait boat (pole and line) by a 1° x 1° grid. In order to divide the Indian Ocean catch by EEZ relating to the coastal states and those catches taken on the high seas, a series of 5° x 5° and 1° x 1° grids were overlaid with a chart of the EEZ or equivalent definitions for the entire region. Zone definitions were taken from the Global Maritime Boundaries Database (GMDB). The approximate proportion of each zone within each individual grid square was determined by visual estimation manually and the process repeated until the entire Indian Ocean region (FAO Areas 51 and 57) had been covered. It is recommended that for transparency that the process of allocating the proportion of grid squares to coastal state zones is repeated using a detailed GIS to determine the exact proportion of each zone inside a grid square; the IOTC tool does this. Further refinements, such as allocating all catches in a grid square to the high seas where fishing is excluded from a coastal state EEZ except under license can also be made. At present IOTC does not have all such information and if this refinement is agreed during the Technical Meeting, CPCs should make the details available to the Secretariat.

Annual catch totals by species are then calculated for each gear type, coastal state zone and flag state in each grid square by multiplying the catch within a grid square by the proportion. For the purpose of this estimation the High Seas are considered the equivalent of a coastal state zone. The total catches for each coastal state zone for each species can then be calculated by adding the catch totals for all gears and all years within the defined period for each coastal state zone. Catches are assumed to be distributed uniformly throughout a grid square. These figures form the basis of Table 1. Artisanal catches (assumed to only occur in a coastal state's own zone) are estimated by the secretariat and have been included in the IOTC catch and effort database. The total catch in a particular zone and as a proportion of the total Indian Ocean catch overall can now be calculated (Columns A and B in Table 2) along with the total high seas catch and as proportion of the total Indian Ocean catch for all fishing nations (Columns C and D in Table 2). The baseline catch proportion is calculated as the proportions taken inside the zone of a state and taken by the state on the high seas added together (Column E in Table 2).

EU catch data are disaggregated in the IOTC catch databases as they have historically been reported as such (hence France, Spain, Portugal appear as separate lines in the tables). In Tables 2 and 5, catch data will be aggregated in the model so that all French, Portuguese and Spanish catches are included as "European Union". French catches that have been recorded separately for the French territories of Mayotte and Reunion will be recorded as French catches only for the calculation of coastal state allocation in these tables.

A further refinement could be to use logbook data submitted to CPCs by vessels licensed to fish in their zones. However such information is not currently publically available and will be more difficult to verify. It is therefore recommended that the approach described above, with refinements to improve the estimation, is employed using the publically available and agreed IOTC database. By taking an historical reference period the catch by area over time is averaged; the method applied similarly proportionately apportions catches by area. Furthermore, currently unreported elements such as artisanal catches are estimated within the IOTC database. Consequently even with accurate logbook data from the commercial and licensed part of the fishery there will still be an element of estimation in the procedure. Thus the above method provides a good approximation on which to base quota allocations and takes into account both commercial and artisanal catches. It provides a good basis for quota allocation.

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APPENDIX VI
EUROPEAN UNION – PROPOSAL C

DRAFT: ON ESTABLISHING A QUOTA ALLOCATION SYSTEM FOR THE MAIN TARGETED SPECIES IN THE IOTC AREA OF COMPETENCE

Background

The IOTC Resolution 10/01 taken in its plenary session, states the adoption of a quota allocation system, or any other relevant measure, for the management of the main targeted species falling under the IOTC competence. A technical committee meeting shall be held in February 2011 to discuss allocation criteria and to recommend a quota allocation system. In order to keep coherence, the quota allocation criteria and allocation system will be addressed in parallel.

This proposal recognises the legitimate rights and aspirations of both coastal states, in particular small island developing coastal states and territories and small and vulnerable economies; and, distant water fishing nations that have historically fished and invested in an area.

The Indian Ocean Tuna Commission (IOTC),

RECOGNISING that based on past experience in the fishery, the potential production from the resource can be negatively impacted by excessive fishing effort;

TAKING INTO ACCOUNT the available scientific information and advice, in particular the IOTC Scientific Committee conclusions whereby the yellowfin and bigeye tuna stocks might have been over or fully exploited in recent years;

RECOGNISING that IOTC Resolution 10/01 requires the development of a quota allocation system for yellowfin and bigeye tuna stocks;

FURTHER RECOGNISING that the tuna artisanal fisheries sector needs strengthening in terms of catch statistics reporting in order to more closely follow the catch situations and notwithstanding improvement in the industrial fishery catch statistics reporting requirements;

NOTING the importance of applying the precautionary approach for the management of the tropical tuna and swordfish stocks;

ADOPTS, in accordance with the provisions of Article IX, paragraph 1 of the Agreement establishing the IOTC, the following:

Main principles

1. A Total Allowable Catch (TAC) will be decided – for one or several years – by IOTC, notably according to scientific data and the recommendations of the Scientific Committee. A TAC will be established for the main targeted species that IOTC Members judge necessary for conservation and sustainability purposes and according to the best available scientific advice.

2. An allocation quota system setting fishing possibilities per flag State will be adopted for the period defined for the TAC application.

3. All IOTC CPCs, other coastal States and any other State with proved fishing interests in the Indian Ocean in the last 10 years will qualify to receive quota allocations according to the criteria defined herewith.

4. The baseline for allocation will be fixed on the average of historical catches for all eligible participants of the last [10 years].

5. IOTC Members shall set aside a range of 3–5% of the TAC per species.

6. An additional pool of fishing opportunities will be created by the application of the correction factors described in paragraph 8.

7. The global set aside (sum of 5 and 6) will be redistributed to CPCs having a fleet development plan, developing coastal States and Territories and new entrants, according to the criteria defined in the paragraph 11.

Correction factors

8. Some correction factors, namely based on compliance, will be applied to the individual allocation baseline.

a) Excluding factors:

i. Flag States and or fishing entities that are, at the moment of the implementation of an IOTC TAC and Quota system, neither Contracting parties nor Cooperating non-contracting parties[2] are ineligible (0%) for any individual quota.

ii. No IOTC fee payment for 3 or more years.

b) Limiting factors:

i. Cooperating non-contracting parties (80%).

c) Negative factors, reductions (percentage) applied to individual quota baselines:

i. Non compliance with IOTC requirements (in order of priority):

- data/catch reporting (…%);
- freezing capacity (…%);
- IUU Vessels (…%)
- VMS (…%);
- observer programme (…%),
- transhipments (…%).
- Delay to pay IOTC fee (…%).

ii. The correction factors mentioned in a) and b) will be deducted from individual quotas and added to the global set aside.

d) Positive factors:

i. Compliance status as defined by the Compliance Committee and agreed by the IOTC (…%).

ii. Clear improvement regarding IUU listed vessels situation as defined by the Compliance Committee and agreed by the IOTC or actions taken to scrap or permanently reassigned IUU vessels for purposes other than for fishing activities (…%).

iii. Implementation of scientific programs or funds provided for scientific research in support of the IOTC scientific activities (…%).

The positive factors will only be used to correct negative factors, they can be applied directly to individual quotas. An individual quota calculated after the application of all correction factors cannot exceed the individual allocation baseline.

[2] Exception will be represented by Chinese Taipei, which is also invited to voluntarily contribute to the IOTC budget in a form which would be legally acceptable within the IOTC context.

9. Once all individual quota allocation is decided, the negative and positive correction factors will be applied 2 years following the initial allocation. After this period the corrective factors will be recalculated [every two years/yearly], notably on the basis of the Compliance performances of each IOTC's CPC against the criteria established in point 8 (Ex.: if the quota system is agreed at the 2012 IOTC Plenary, the "compliance" correction factors will be applied firstly at the 2014 IOTC Plenary).

New corrective factors could be added to the system according to the IOTC decision.

Set aside redistribution

10. The set aside generated by factors described in a) and b) of the paragraph 8, not compensated by factors described in c) of the same paragraph would be added to the possible set aside as described in paragraph 5.

11. The global set aside will be attributed to i) CPCs states having implemented concretely their fleet development plans in accordance to the programme of implementation presented to IOTC, and reviewed by the Compliance Committee, ii) to developing coastal States or Territories according to a set of criteria to be agreed by IOTC, including GNI, the catch taken in the EEZ, the contribution of the fishing sector to the overall economy of the given State, the length of a coast line and iii) to new entrants following IOTC decision. If any set aside quota remains, it will be redistributed equally among all full compliant Members. The status of compliance of each individual Member will de established by the Compliance Committee and proposed to the IOTC for approval.

Voluntary transfers of quota

12. A Contracting Party or Cooperating non contracting Party (CPC) may partly or fully transfer a quota to another Contracting Party or Cooperating non contracting Party. A CPC intending to make a transfer shall make a prior notification to the IOTC Executive Secretary. The Executive Secretary shall forward this notification to all CPCs for information.

Reporting/Payback/Monitoring Implementation

13. Once all individual quotas are agreed and allocated, IOTC Members and Cooperating Non Members are to provide to the IOTC Secretariat estimated catches of targeted species which are subject to the TAC and Quota system on a quarterly basis, within thirty days of the end of last month of the relevant quarter. The IOTC secretariat will then immediately circulate such estimated quarterly based catches, aggregated by flag State, to all CPCs.

14. A payback penalisation for overfishing will be decided for implementation the first year this allocation system enters into force.

15. The Compliance Committee meeting held prior to the Commission Plenary Session in 2012 will discuss any additional requirements that are necessary to administer and monitor this quota allocation system over and above the current mandatory requirements for reporting against IOTC conservation and management measures. CPCs are encouraged to submit proposals one month prior to the meeting.

ALLOCATION CRITERIA

Total Allowable Catches (TAC)	To be decided by IOTC Plenary namely on the basis of science	
Set aside	Percentage of the TAC to be decided by IOTC Plenary	
Total baseline allocation	TAC – Set aside	
Individual quota	% of the total baseline allocation fixed individually on the basis of historical catches of the last 10 to 15 years (total Flag State catches/Total IOTC catches)	
Excluding factors:		
1. No IOTC membership	100 % reduction	
2. No IOTC payment for 3 or more years	100 % reduction	
Limiting factor:		
3. Cooperating non-contracting parties	Reduction of 20 % of the individual quota	
Correction factors to be applied individually. Negative factors:		
4. Freezing capacity/fishing effort limitation	Reduction (%) to be defined	
5. VMS	Reduction (%) to be defined	
6. Observers	Reduction (%) to be defined	
7. Transhipments	Reduction (%) to be defined	
8. IUU vessels	Reduction (%) to be defined	
9. Delay on the IOTC fee payment	Reduction (%) to be defined	
Positive factors (only applicable to compensate negative criteria):		
10. Compliance status	Criteria and increase (%) to be defined	
11. Improvement regarding IUU	Criteria and increase (%) to be defined	
12. Scientific research	Criteria and increase (%) to be defined	
Total Correction	Sum of the correction factors per member	
Corrected allocation	Individual quota x individual total correction factor	
Extra contribution to the set aside	Base line allocation - sum of individual corrected allocation	
Total set aside	Initial set aside + extra contribution to the set aside	
Final allocated individual quota	**For CPCs with concretely fleet dev. plans + developing coastal States + new entrants:** Corrected allocation + total set aside individually allocated + A minimal quota will be defined	**For other States:** Corrected allocation

APPENDIX VII
I. R. IRAN – PROPOSAL D

ON ESTABLISHING ALLOCATION CRITERIA FOR THE MAIN TARGETED SPECIES IN THE IOTC AREA OF COMPETENCE

Background

This proposal responds to IOTC Resolution 10/01 which adapted in March 2010 in Korea and agreed that a technical committee shall be held and discuss on allocation criteria or any other relevant measures, for the management of the main targeted species, including, Yellowfin, Bigeye tunas and Swordfish, under the IOTC competence areas.

On this way the 1st technical committee on allocation criteria held in Nairobi during 16-18 Feb, 2011. During the meeting five countries including EU, Indonesia, I. R. Iran, R. Korea and Seychelles presented their proposal and IOTC Members discussed about details of under developing system. 1st meeting noted that the process of establishing allocation criteria and agreement on basic principals are complex and the committee is unable to complete the task in the short time and agreed that more work is required and developing an allocation system needs another technical meeting.

Although based on 15th Session of the IOTC Scientific Committee report, the amount of three targeted species catch are less than calculated MSY but for more guarantee and protection of the species stocks against over fishing, the Commission members need to adopt conservation measures that would ensure the sustainability of the resources, while discussion on an allocation criteria continue.

The second technical committee meeting is going to be held during 18-20 February 2013, by hosting of Oman country and the IOTC members are going to discuss about allocation criteria, which they will adopt as a basic principles on the quota allocation system by the IOTC member countries.

Although a brief review on background of establishing allocation criteria for the main targeted species in shows some complication, but the progress that was made during only one meeting was great and this shows all the members have enough will to walk on this way. Surely the main object of the 2nd working group meeting will paying more carefully and attentively to the members concerns especially developing countries, which their fishermen and local people livelihood and jobs are influenced directly by the fishing activities in the Indian Ocean. On the other hand the working group shall be developed such a criteria which they cover members benefits and sustainability of tuna stocks and their fishery.

Achieving food security for world population is the main mission of FAO's efforts - to make sure people have regular access to enough high-quality food to lead active, healthy lives. Also FAO's mandate is to raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy. For these the 2nd technical committee on allocation criteria necessarily needs to consider main objectives of FAO, relevant regional fishery organizations missions and concerns of developing countries, which they are food security, responsible fisheries and livelihood of local people.

The Indian Ocean Tuna Commission IOTC

Noting that the main objective of the Commission is to promote cooperation among its Members with a view to ensuring, through appropriate management, the conservation and optimum utilization of stocks covered by this Agreement and encouraging sustainable development of fisheries based on such stocks.

Recognizing that based on past experiences in Tuna fisheries, the potential of production from the resources was impacted by excessive fishing effort and over fishing;

Noting the importance of applying the precautionary approach for the management of the tropical tuna and Swordfish stocks, in particular Yellowfin and Bigeye tuna in the Indian Ocean;

Taking into account the available scientific information and advice, in particular the IOTC scientific committee conclusion whereby the yellowfin, bigeye tuna and Swordfish stock might have been over exploited in recent years;

Recognizing that the 15th IOTC scientific committee meeting represented different species MSY levels, which have been estimated at 344 (290-453) thousands tones for yellowfin, at 114 (95-183) thousands tones for bigeye tuna and around 29 (29.9- 34.2) thousands tones for Swordfish. On this way 13th and 14th IOTC scientific committee had recommended that the catch of mentioned species should not exceed from MSY level,

Acknowledging that the awareness about MSY and TAC, without an appropriate allocation criteria and consequently quota allocation system would result in an inequitable distribution of the catches and fishing opportunities among the CPCs and cooperating non member CPCs;

In accordance with the provision of the 15th and 16th session of IOTC commission, 13th, 14th and 15th session of IOTC scientific committee and 1st session of technical committee on allocation and criteria reports, the recommended principals and criteria for the 2nd technical Committee on allocation criteria meeting by I. R. Iran are as a below:

1. Principles

1.1. Considering international law, and FAO missions and mandates, providing a desirable condition for food and food security in universal level is the main responsibility and duty of governments, regional and international organizations. The technical meeting on allocation criteria should to follow this mission as an approach in it's under developing system.

1.2. Realizing most of the current fishing activities in IOTC competence area have done by local people and majority of them rarely located in economical level.Also noting to role of tuna fisheries in occupation, livelihood and food security of local people, especially in developing countries and considering of social economic aspects of fishing activities. Surely without adoption this approach, not only developing of criteria but also implementation of under construction system will face with difficulties and a huge number of fishermen encounter with many problems such as joblessness and poverty.

1.3. Considering sustainable fisheries of tuna fish stocks (base on MSY level and TAC), developing an appropriate criteria, suitable allocation mechanism and implementation a responsible fisheries in IOTC competence areas are one of the main principles of the under developing system.

2–Allocation criteria

Base on I. R. of Iran proposal, there are seven main criteria which are noticeable on developing an equitable allocation criteria in the IOTC competence area. These criteria with conjunction MSY will lead the IOTC to make a decision about quotas for Swordfish, yellow fin and big eye tuna. On this way scientific research results and the regional expertise experiences, lead the Scientific committee to better understanding about total allowable catch and consequently sustainable fishing level in the IOTC competence area every year.

In order to develop equitable allocation criteria in IOTC competence areas, the 2nd technical committee on allocation criteria for the main targeted species shall consider all aspects of tuna fishing activities, social economic condition of countries and related laws and legislations. On this way, paying more attention to the FAO mission and mandate and IOTC objectives on establishing a mechanism for allocation criteria and management of responsible fisheries is a necessity..

Without any doubt, access to responsible fishery and conservation of tuna fish stocks need CPCs and cooperating none member countries assistance and contribution. For these the allocation criteria should be consider to all countries benefit specially in developing countries which their local people and fishermen livelihood and income totally corresponded with fishery. On the other hand the technical committee should be developing a kind of system which it will be able to conserve both tuna fish stocks and stockholders' benefits. Although there are many factors which have capability to use as criteria, but I.R. of Iran propose to the 2nd technical committee, the allocation criteria as below:

1- Food security and right for food,
2- Role of Tuna fisheries on social economic condition of fishermen,
3- History of tuna fishery
4- The right of Indian Ocean coastal states,
5- Responsible fishery,
6- Fishing fleet capacity
7- Compliance to IOTC regulations,

2.1. Food security and right for food

Food security and preparation enough food for human in an appropriate quality and quantity level is the main objective of human right and philosophy of FAO establishment. Basically the main intent of establishment of an international or regional organization like IOTC is having a kind of actions which lead our world and consequently all the countries to have a safe and healthy life. In addition the right for food is a main base for human rights which emphasizes on economic, social and cultural right as a pre requirement for human right.

Surely majority of current fishing activities in IOTC competence area are done by local fishermen who are working only for food and primary requirements of life. Available information shows only a few countries are having fishery in large scale level by powerful companies which are active not only in Indian Ocean but also in the other oceans. In fact the benefit of this kind of companies is huge and is not analogical with fishermen income in developing and less developing countries, where the fishermen fishing only for food.

In fact technical committee should to pay more attention to the fishermen's life in developing and less developed countries and should try to make a system which will secure their life level in quality. Through this criterion adoption a rate and base coefficient is recommended minimum in three levels.

2.2. Role of Tuna fisheries on social economic condition of fishermen

Without any doubt in order to develop a fair allocation criteria system, social-economic aspects of CPCs is the most important criterion which directly influenced local people's life. Base on available information, the livelihood of majority of coastal habitants in the IOTC competence area are closely corresponding with fishing activities. While during past years most of the governments, private sectors, companies, fishermen cooperatives and etc have invested a huge amount of money in different divisions, like construction of vessels, cold storage, processing centers and the other fishery sectors. Because of these investments and besides improving fishing activities, many prior and astern industries and jobs have been created for local people. The important point is that income of most jobs related with tuna fishing is located in economical border, so constraining a little pressure or changes in their activities, will be affected negatively their jobs, incomes, livelihood and life, the points that FAO completely have been avoided from it during its history.

On this way a close cooperation between countries and IOTC to analyze condition of each country is very necessary. So for implementation an allocation criteria system, the working group should to continue its survey on role of tuna fisheries on social economic condition of fishermen in each country. On the other hand, the number of fishermen, vessels, fishing harbors or landing places, processing centers, cold storage, refrigerator facilities, ship building factories, builders and traders of fishing equipments and devices, amount of investments by government or private sectors, local people and fishermen councils, existence fishery cooperatives, companies and etc are the most important factors which the technical committee should to consider them in this creation.

2.3. History of tuna fishery

The CPCs and cooperating non member countries history and background in tuna fishing activities through the IOTC competence area, is one of the main important creation, which needs to consider by technical committee during developing an allocation criteria system. Base on available information most of the IOTC members have historical right to fish in the IOTC competence area. In fact, these countries mostly belong to the Indian Ocean basin and historically are familiar with fishery in the area, depending capacities, concerns and problems. Also the countries have had a main role on establishment of Indian Ocean Tuna Commission and it's continuously progress in the region. They have had close cooperation with the commission and have gotten a big role in implementation of responsible fishery base on FAO and IOTC regulations in their fishing activities. They also invested a huge amount of money in fisheries field and dependence industries during past decades of their history and nowadays they have many dependant industries and jobs on tuna fishery in the IOTC competence area.

Based on I.R. of Iran, average catch of countries during past ten years (from 2010) is an appropriate period of time for setting their history as a base for this creation.

2.4. The right of Indian Ocean coastal states

Geographical location of countries the IOTC competence area is the other factor which gives to the Indian Ocean coastal states more priority and right. In the other hand recognizing the legitimate sovereign rights of Indian Ocean coastal states, their interest to distance water fishing and historically investment in the Indian Ocean fishery give them rights to have more priority in comparison with the countries from other regions.

In this creation I.R. of Iran recommend to allocation historical catches of coastal states to them, which are taken in their EEZ, and the rest of MSY allocate to all the IOTC members. In the other hand minimum 50% of MSY should allocate for coastal states and the rest of it allocate to all CPCs and cooperating non member countries, which they have right to fish in the open sea. Also under developing system shall to adopt such a system which no coastal states condition will be worse off than current situation and it will prepare better Social economic condition for coastal states fishermen who needs more supports and assist.

2.5. Responsible fishery

This criterion leads the CPCs and cooperating none member countries to have sustainable tuna fishery. The manual of responsible fishery has been printed by FAO and is available for all the countries. In addition many countries have implemented different aspects of FAO code of conduct, but in some cases they need more improvement. Control of fishing gears , their standards, establishing data collection system and producing useful information like amount of catch and their composition, fishing efforts, CPUE, port state measures, market state measures, combating with illegal, unreported and unregulated catch (IUU), implementation of VMS system and observer program, reduction of by-catch and protect endangered species like Sharks, marine mammals, turtles and other measures which lead the region to responsible and sustainable fisheries, are some of the responsible fishery elements.

On this way all the IOTC CPCs and cooperating none member countries which are active in the region shall develop a plan and implement it in their tuna fishing activities. Also the countries shall develop a documentation system with enough evidences that shows implementation and effectiveness of the system. On this way an appropriate manual for implementation of documentation, monitoring and control shall be develop and introduced by IOTC scientific committee which some of them are available. In addition all the countries shall implement this monitoring and control system with suitable documentation on all their eligible flag state vessels.

2.6. Fishing fleet capacity

CPCs fishing fleets have developed according to their fishery management system and are seen in different level from small scale fisheries to industrial vessels. A vessel is a unit for catch of fish and creative of job, with distinguished ability and capacity. Stability in number of vessels and promote their effectiveness will cause of occupation stability and guarantee food security and requirements of fishermen. So number of vessels, their capacity for fishing and number of fishermen is an important criterion which insures occupation and livelihood of fishermen especially in developing and less developed countries.

Considering to creating equitable opportunities to occupation of local people and fishermen and consequently sustainability in fisheries, conservation of fish stocks and food security; I.R.of Iran recommend, 2nd technical committee pay more attention to number of vessels, their technical specification and capacity for fishing (especially their engine power), number of created jobs, as a criterion.

2.7. Compliance to IOTC regulations

Base on responsible fisheries principals and regulations of the IOTC, the CPCs and cooperating non member countries should produce appropriate information and present them to IOTC. For better management of fishery, IOTC needs more cooperation, in access to detail of information, and assistance of countries in some studies or researches. In these cases the cooperation of CPCs and cooperating non member countries is necessary. In the other hand base on working groups, scientific committee, commission decisions and related resolutions, all the countries should to prepare related information and reports. Administration and management of Indian Ocean Tuna Commission needs financial supports. Base on current financial procedure, annually membership payment is one of the important financial resources for covering IOTC costs. So paying the membership is one of the important factors in evaluation of compliance with IOTC. The main purpose of this criterion is strengthening of IOTC commission authority in the area, implementation of unify and effective tuna fishing management system and gathering the CPCs and cooperating non member countries under IOTC umbrella.

3–Conclusion

In conclusion proposed criteria by I. R. of Iran have tried to cover all different aspects of equitable allocation criteria system in the IOTC competence area. Base on these criteria CPCs are going to make a decision about allocation criteria for three targeted species including, Yellow fin, Bigeye and Swordfish, under the IOTC competence area. According to was made decision during the 13th and 14th IOTC scientific committee meeting in 2010, the committee recommended the Yellowfin and Bigeye tuna catches should not exceed from MSY levels which have been estimated at 344 (290-453) thousands tones for Yellowfin, at 114 (95-183) thousands tones for Bigeye tuna and around 29 (29.9-34.2) thousands tones for Swordfish in 2011.

I. R. of Iran recommend to 2nd technical committee to follow establishment of an allocation criteria system in two steps. First the committee opens discussion on criteria and acceptation of them, then in the second step distinguishing and defining different factors in each creation and giving appropriate rate and coefficient for each factors.. On this way the recommended criteria by I. R. of Iran including:

1. Food security and right for food
2. Role of tuna fisheries on social economic condition of fishermen
3. History of tuna fishery
4. The right of Indian Ocean coastal states
5. Responsible fishery
6. Fishing fleet capacity
7. Compliance to IOTC regulations

APPENDIX VIII
MOZAMBIQUE – PROPOSAL F

ON ESTABLISHING A QUOTA ALLOCATION SYSTEM FOR THE MAIN TARGETED SPECIES IN THE IOTC AREA OF COMPETENCE

Background:
Mozambique notes that in accordance with Resolution 10/01 the Commission was to adopt an allocation quota system or any other relevant measure for the yellowfin and bigeye tunas at its plenary session in 2012. Various factors prevented this action. Consequently, Mozambique begs the indulgence of the Commission for this late submission, and notes that it only became a full member in 2012 and was in the midst of discussions with the European Union regarding an erroneous boundary line that was being used to define Mozambique waters which has unfortunately resulted in under-reporting of catches taken in Mozambique's waters for more than five years. This error and the updated catches are currently being addressed by the two parties so Mozambique can be on a level playing field for such allocation exercises in the future.

Further, Mozambique proposes that as the artisanal tuna catch records of coastal and small island states becomes better known that an 'allowance' be calculated from the individual allocations to accommodate this fishery. In the interim period, the Commission will take into account the initial estimates of artisanal catches in determining the 'set aside' allocation.

Considering the above, and the fact that Mozambique's membership status needs to be updated accordingly to a 'full contracting party', Mozambique wishes to state that it supports the Seychelles 'hybrid' proposal and further wishes to build on this proposal for coastal States while also recognizing historical fishing presence of distant water developing states and their benefits and impacts on coastal state economies. The Mozambique proposal is based on the following principles:

1. Support for the hybrid proposal of Seychelles whereby confirmed and updated catch histories, including artisanal fisheries, inside the EEZs of coastal and small island states remain with those coastal and small island states and the confirmed historical catches on the high seas remain with the flag state.
2. As catch histories are updated and amended in these areas in the future the base-line nominal catch proportions are also updated accordingly for the parties.
3. 'Rights" quotas shall be allocated by species and area.
4. A 'Set Aside' allocation from the total IOTC TAC by species, as agreed by the Commission, shall be established for new entrants, updating of historical catches, and to accommodate coastal State fleet development plans. The 'Set Aside' quota shall be pro-rated amongst all CPCs and released on an annual basis in the second half of the calendar year. Annual unused quotas shall not be carried over, but shall be forfeit to stock enhancement.
5. Developing coastal States and small island States with economies vulnerable to fishing pressures shall have priority access to tuna and tuna-like stocks as they build local fishing capacity.
6. A Membership and Compliance Adjustment Factor shall be set by the Commission and applied annually to fishing quotas with any surplus allocations to be placed in the 'Set Aside' allocation.
7. Current license levels for tuna be accommodated in the allocation criteria.
8. The quota allocation mechanism be implemented commencing in calendar year 2014.

With these principles, Mozambique proposes the following amendments to the Seychelles Proposal.

The Indian Ocean Tuna Commission (IOTC)

RECOGNISING that based on past experience in the fishery, the potential production from the resource can be negatively impacted by excessive fishing effort;

TAKING INTO ACCOUNT the available scientific information and advice, in particular the IOTC Scientific Committee conclusions whereby the yellowfin and bigeye tuna stocks might have been over or fully exploited in recent years;

RECOGNISING that during the 13th IOTC scientific meeting held in Seychelles from 6 to 10

December 2010, the Scientific Committee recommended that yellowfin and bigeye tuna catches should not exceed the MSY levels which have been estimated at 300,000 tonnes for yellowfin and at 102,000 tonnes for bigeye tuna;

RECOGNISING that IOTC Resolution 10/01 requires the development of a quota allocation system for yellowfin and bigeye tuna stocks and for swordfish stocks;

ACKNOWLEDGING that the implementation of a TAC without a quota allocation system would result in an inequitable distribution of the catches and fishing opportunities among the CPCs and non CPCs;

FURTHER RECOGNISING that the tuna artisanal fisheries sector needs strengthening in terms of catch statistics reporting in order to more closely follow the catch situations and notwithstanding improvement in the industrial fishery catch statistics reporting requirements;

TAKING INTO ACCOUNT the sovereign rights of coastal states for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, within their respective exclusive zones in accordance with Article 56 (1) of the United Nations Convention on the Law of the Sea, Montego Bay of 10 December 1982;

NOTING the importance of applying the precautionary approach for the management of the tropical tuna and swordfish stocks, in particular yellowfin and bigeye tuna in the Indian Ocean;
NOTING the 13th Scientific Committee recommendation to develop a Compliance Monitoring Scheme;

ADOPTS, in accordance with the provisions of Article IX, paragraph 1 of the Agreement establishing the IOTC, the following:

PART 1
GENERAL PROVISIONS

1. Use of terms

1.1. For the purposes of this proposal:

a) The term 'CPC' will be used as shorthand to include all IOTC members and Cooperating Non-Contracting parties to IOTC.
b) 'Fish' means all or any identified species of highly migratory fish stocks covered by the IOTC convention.
c) The 'Quota Allocation System' is the totality of the mechanism described in this proposal for allocating resource rights, implementation and management (monitoring, compliance, etc.) of those rights.
d) The 'Total Allowable Catch' (TAC) is the upper limit for the sum of all CPC catches of a fish species in a particular year within the IOTC area of competence.
e) The 'Effective TAC' is the total allowable catch minus any 'Set Aside' amount agreed by the Commission at the start of the quota allocation period (e.g. to allow for new entrants, artisanal fisheries, and tuna fleet development by developing coastal State and small island developing States to maximize the socio-economic benefits of the resources passing through their EEZs).
f) The 'Baseline Nominal Catch Proportion' is the long-term base allocation proportion (%) of the TAC by species to each eligible CPC defined at the start of the programme in 2013 before any deductions are applied or as adjusted as baseline catch data are amended as agreed by the Commission (see Section 6).
g) The 'Adjusted Nominal Catch Proportion' is the nominal allocation proportion (%) of the TAC by species to a CPC after adjustments to the baseline to accommodate factors such as new entrants to the fishery, artisanal fisheries, updated historical catch information, or permanent trade of quota, if permitted (Section 7).
h) The Nominal Catch Allocation' is the nominal allocation of the TAC by species at the start of any specific quota allocation period before any adjustments for membership or compliance.
i) The 'Effective Allocated Catch Limit' is the allocation of the TAC by species to a CPC for a specific quota allocation period after deductions and/or additions (see Section 8).
j) The 'Historical Reference Period' defines the period for which historical data will be analysed in setting the baseline nominal catch proportion.

k) The 'Quota Allocation Period' is the short term allocation period, that may be varied, during which the Effective Allocated Catch Limit applies.
l) The term 'Quota' will be used as shorthand to describe the effective allocated catch limit allocated to a particular CPC.
m) 'Transfer' refers to a temporary exchange of an allocation or part allocation, including renting such allocation to a third party.
n) 'Trade' means the permanent purchase or exchange of a quota allocation.
o) 'Artisanal vessels' refers to any vessel within a coastal CPC that fishes for tuna or tuna like species and that is less that 24 m in length and therefore not on the IOTC list of authorised vessels. CPC artisanal vessels are only authorised to fish inside the EEZ of the CPC. 'Artisanal catch' refers to the catch of tuna and / or tuna like species taken by artisanal vessels.

2. Objective

2.1. The objective of this proposal is to:
- define the rights allocation mechanism (allocation criteria) amongst members and cooperating non contracting parties of IOTC to a share of the catch of any fish for which IOTC sets a total allowable catch limit; and,
- define the mechanism for implementing the quota allocation system, identifying the duties of the responsible party amongst the different bodies and CPCs of IOTC.

3. Application and Eligibility for receiving quota

3.1. The defined historical reference period for determining eligibility to the quota allocation system and for setting the baseline nominal catch proportion will be from 1981 to December 2011, the latter date being the most recent information available to IOTC prior to adoption of the quota allocation system as required in Resolution 10/01.
3.2. The rights allocation mechanism defined in this proposal relates to a single species allocation. The same mechanism will be applied to each IOTC fish species for which a TAC has been agreed by the Commission.

3.3. A proportion of the total allowable catch will be set aside for new coastal state entrants, historical catch updates including artisanal fish catches, and coastal and small island States fleet develop enhancements. The level of the catch to be '*Set Aside*' for new entrants will be agreed by the Commission at start of the quota allocation system in 2014 and will be reviewed and adjusted as appropriate at the end of each quota allocation period. The balance of the TAC remaining will be the Effective TAC to be allocated to all eligible CPCs.

3.4. New entrant Distant Water Fishing Nations will not be excluded from the fishery and can enter the fishery if they meet the membership criteria and have rented or purchased quota made available by another CPC for transfer or trade. They will not be eligible to receive any set aside.

3.5. A ***baseline nominal catch proportion*** (%) for each fish species will be allocated to all coastal states within the IOTC area of competence, irrespective of membership status, and to all existing distant water fishing nations with a catch history during the defined reference period within the IOTC Area of Competence that are currently members or Cooperating non contracting parties of IOTC. (See Section 5 for the control rules for defining the baseline nominal catch proportion).

3.6. When setting the ***effective allocated catch limit*** only full member CPCs can receive 100% quota allocation before other adjustments. Cooperating non contracting parties will be eligible to receive only 80% of the nominal catch before other adjustments. Non members will not be eligible to receive an effective allocated catch limit.

3.7. The TAC, effective TAC and effective allocated catch limits will be set for a Quota allocation Period of three years in the first instance to allow fleets to plan accordingly enabling greater economic stability. The effective allocated catch limit will only be varied during that three year period if the Science Committee indicates that the status of the stock has significantly changed and the TAC must be adjusted early. The Quota Allocation Period will be reviewed by the Commission after three years with advice from the Science Committee and subsequent periods set may be varied as appropriate.

PART 2

RIGHTS ALLOCATION

4. Setting the Total Allowable Catch: Defining a Management Procedure

4.1. In 2011 the *Assessment/Management Procedure* for setting the TAC will be defined by the Science Committee and its associated Working Groups specifically the Working Group on Tropical Tunas and the Working Group on Billfish, based on best available science and stock status. It will take into account any uncertainty in the stock assessments and set the level of TAC accordingly. This procedure will define the mechanism for setting the Total Allowable Catch. It will also define whether the TAC for a species relates to the whole of the IOTC area of competence, or to sub areas for the species in question.

4.2. The assessment/management procedure will define the frequency with which stock assessments shall be undertaken with reference to stock status and both targeted and incidental catch levels, and any indicators that might trigger the need for a stock assessment earlier than planned if assessments are not to be undertaken annually.

5. Setting the Effective Total Allowable Catch

5.1. After applying the management procedure and having set the TAC for the fish species for the quota allocation period, the agreed set aside amount will be subtracted. The remaining Effective TAC (see 'J' in Table 5) will be allocated amongst all eligible CPCs according to the control rules defined in Sections 6 to 8.

6. Setting the Baseline Nominal Catch Proportion

6.1. A hybrid scheme based on catch per area in the EEZs of coastal states, appropriately updated for historical catches and an estimate of artisanal tuna fish catches in zone and on historical catch levels by all eligible flag state fishing fleets on the high seas will be applied to set the baseline nominal catch proportion in 2014.

6.2. The following control rules will be applied to each species for which an allocation has been set by the IOTC Commission:

1. The total catch taken by all CPC vessels in the EEZ of each coastal state (including that CPCs artisanal catches) will be calculated for the reference period (1981-2011). (A, see Annex 1, Table 1, transcribed to Table 2)
2. The proportion of the total catch taken in each EEZ, will be calculated [(Total Catch in Country EEZ during reference period / total catch in IOTC area of competence during reference period)*100%] (B, Annex 1, Table 1, Table 2)
3. The total high seas catch by flag state during the reference period will be calculated C, Annex 1 Table 1, Table 2).
4. The high seas catch by flag state (from C) will be calculated as a proportion of the sum of the total catch in the IOTC area of competence during the reference period (from A) [(Total Catch by flag state from the high seas during reference period / sum total catch in IOTC area of competence during reference period)*100%] (D, Annex 1, Table 1, Table 2)
5. The baseline nominal proportion of the catch (unadjusted) attributable to each country will be calculated based on the sum of the catch in the EEZ plus the catch by flag state on the high seas (i.e. B+D). This will be called the baseline nominal catch proportion (E, Annex 1, Table 2)

6.3. The baseline nominal catch proportion is set once only at the start of the quota allocation system (2014) and is based on historical catches by location up to that point in time. The first and all future quota allocations will start from this baseline.

7. The Adjusted Nominal Catch Proportion

7.1. All quota allocations are derived from application of control rules for the effective allocated catch limit to the baseline nominal proportion. However, there are three factors that may result in a need to adjust the baseline as an intermediate step prior to setting the quota:

(i) Due to the fact that artisanal catches have been poorly reported to date, it may be necessary to make an adjustment after 5 years to incorporate more accurate artisanal catch data after implementing recommendations for artisanal fishery data reporting in Resolution 10/01. At present the IOTC catch and effort database estimates artisanal catches. It will only be necessary to update the baseline nominal proportion if those estimates differ significantly from the improved estimates of artisanal catch that become available.

(ii) If historical catch levels in zone are proposed for updating from new historical catch data and accepted by the Commission, the baseline nominal catch proportion shall be updated accordingly for the coastal or small island developing state and for the CPC that under-reported, or misreported historical catches. (iii) To accommodate any permanent trade of quota between CPCs should this be permitted in future (see paragraph 10.2)

Any such adjustment will be called the 'Adjusted Nominal Catch Proportion'. The original historical reference period will not be adjusted in such circumstances, however, the Adjusted Nominal Catch Proportion shall be utilised for further allocations from the time of acceptance by the Commission of such adjustment.

7.2. At the start of the quota allocation system in 2014 no adjustments will be made to the baseline nominal catch proportion and control rules are not defined here for setting the 'Adjusted Nominal Catch Proportion'. This will only become necessary depending on future decisions of the Commission with respect to the exceptions noted in Paragraph 7.1 or as noted for permanent trade of quota (see paragraphs 10.2). The present control rules therefore only refer to the Baseline Nominal Catch Proportion.

8. *Setting the Nominal Allocated Catch and the Effective Allocated Catch Limit*

8.1. The baseline nominal catch proportion is set only once at the start of the quota allocation system. The effective allocated catch limit is calculated at the start of every quota allocation period. The first application will be in 2014 for the defined quota allocation period. The Effective Allocated Catch Limit is not necessarily in proportion to the baseline nominal catch proportion. It is the quota (catch-limit) allocated to a CPC for a specific period after application of a number of control rules.

8.2. To calculate the Nominal Allocated Catch for each CPC the following control rule is applied (see Annex 1 Table 5).

6. *Nominal Allocated Catch:* The product of the baseline nominal catch proportion (E) and the Effective TAC (J) is the nominal catch allocation, K, (see Table 5) [E x J, Tonnes]

8.3. To calculate the Effective Allocated Catch Limit for each CPC the following control rules see Annex 1 Tables 3-5) must be applied in the order shown.

7. *Membership status:* Adjustment 1. Membership status (G, Table 4) determines eligibility to receive a quota (see paragraph 3.6) and the relevant proportions are recorded in Column H (Table 4) [members entitled to 100% quota before other adjustments; cooperating non contracting parties, 80%; non members, 0%].

8. *Compliance*: Adjustment 2. The Standard Compliance Table (Annex 1 Table 3, see paragraphs 13.1 - 13.5) is applied to determine any reduction of allocation to any particular CPC due to non compliance. The balance of quota (F, Table 3) that remains to be allocated after penalty deductions for non compliance is expressed as a proportion and is summarised in Column F in Table 5 for all CPCs. The product of Adjustment 1 (H) and Adjustment 2 (F) is the combined adjustment, I (Column I in Table 4), and it is applied to the nominal catch allocation (K) to determine the effective allocated catch limit after penalty adjustments, L [K x I, tonnes, Table 5].

'Penalty deductions' are treated as follows:

- CPC: held in a CPC specific set aside (M, Table 5) for future years and can be reclaimed by the CPC once either membership status has been confirmed, or full compliance has been demonstrated to the satisfaction of the Compliance Committee. Until the CPC demonstrates 'full compliance', that portion of the allocation is placed in the unallocated balance for redistribution as a 'bonus' as noted below. If 'full compliance' cannot be demonstrated within three years, that portion of the CPC allocation is permanently removed from the CPC allocation and placed in the 'Set Aside' allocation for redistribution according to the applicable rules;
- Non Member: the full nominal catch allocation of non members will be assigned to an unallocated balance (N, Table 5) for redistribution as a 'bonus' to eligible CPCs

9. *Reallocation of unallocated balance of quota*: Final Adjustment. The sum of any unallocated balance of quota will be reallocated in equal parts to all remaining fully compliant CPCs eligible to receive a quota for that period. This is the 'bonus' allocation, P (Table 5) [(Sum of unallocated balance, N / Number of fully compliant CPCs eligible for a quota), tonnes]

10. *Final Effective Allocated Catch Limit, i.e. CPC Quota*: The final effective allocated catch limit, or CPC quota for the current quota allocation period is the sum of the effective allocated catch limit (L) and any bonus applied (P) (Q, tonnes, Table 5).

PART 3
IMPLEMENTATION

9. *Annual Establishment of CPC Final Effective Allocated Catch Limits*

9.1 The Secretariat shall develop the preliminary annual final effective allocated catch limits for endorsement by the Scientific Committee to the Commission for approval at the annual session.

9.2 The Commission adopt an inter-sessional mechanism to approve or adjust the endorsed allocations prior to 1 January each year.

10. *Utilisation of a quota*

10.1 The effective allocated catch limit is the quota allocated to a particular CPC. CPCs will be free, subject to appropriate bilateral agreements in the case of waters within coastal state EEZs, to take their quota anywhere within the area to which the TAC for the species in question relates i.e. the IOTC area of competence or sub areas. The Science Committee will monitor the spatial distribution of catches in order to ensure that this does not lead to excessive fishing in any one particular area or part of the stock (e.g. on juveniles).

10.2 In the event that CPCs have received more quota than they can fish themselves they may transfer all or part of their quota to one or more CPCs to take on their behalf anywhere in the IOTC area of competence. They may also choose to allocate part of any surplus to a voluntary CPC set aside for one or more years, and that may or may not be taken up during that quota allocation period. CPCs will also be free to enter joint ventures or charter arrangements to take their quotas and shall notify the Commission of such charter and joint venture arrangements which shall be accorded appropriate data and confidentiality status in accordance with the rules of the Commission.

10.3 CPCs receiving a quota will be responsible for defining how that quota will be allocated amongst it's fleet and for monitoring and ensuring compliance of the uptake of the quota by it's fleet, charter vessels or joint ventures.

10.4 With the exception of artisanal vessels, only vessels on the IOTC record of authorised vessels will be eligible to receive a quota from their flag state, or charter State. CPCs will however need to indicate the number, size and fishing gear of artisanal vessels fishing for tuna.

10.5 Where a quota is transferred or traded, the CPC receiving the quota will take over responsibility for monitoring and ensuring compliance of the uptake of the quota by it's fleet.

11. *Trade and transfers of a quota between CPCs*

11.1 The transfer of quota or part of a quota between CPCs is permitted. Quota may not be transferred to any third party that is not an IOTC member or cooperating non contracting party.

11.2 For the first fifteen years of the quota allocation system, or three quota allocation periods, whichever is greater, the trade of quota or part of a quota between CPCs is NOT permitted. After this time, this will be reviewed by the Commission and a decision made as to whether permanent trade of quota will be permitted. Permanent trade between CPCs has the effect of modifying the baseline nominal catch proportion, by removing it from one CPC and adding it to another. Appropriate control rules will need to be developed if permanent trade of quota is to be permitted in future.

12. *Reallocation of quota between years*

12.1 Underutilised quota in any one year by any CPC will NOT be added to that CPC allocation for the following year.

12.2 The Compliance Committee will define the sanctions to be imposed in the case that a CPC exceeds its quota in any one year. This will be reflected in the Standard Compliance Table.

13. *Obligations of CPCs receiving a quota*

All recipients of a quota

13.1 Receipt of a quota carries the obligation to adhere to and report on the rules of implementation of the quota system as defined in this proposal and to adhere to and apply all other relevant IOTC conservation and management measures.

13.2 The Compliance Committee of IOTC will arbitrate to address any disputes that may arise (e.g. arising from application of the allocation criteria) and ensure that quota is utilised appropriately.

13.3 CPCs anticipating to receive a quota will submit a Utilisation Plan to the IOTC Secretariat at least 30 days prior to the Commission Meeting detailing how that quota will be utilised amongst vessels flagged to that CPC, or any transfers anticipated, or any voluntary set aside.

Coastal States quota

13.4 During the first fifteen years of the quota allocation system (i.e. up to 2029) coastal states that receive a quota allocation that exceeds their current capacity to fish may transfer their quota to flag state CPCs that have fishing capacity, for example, to those that have fished during the historical reference period in their zone thereby maintaining the status quo and ensuring economic stability of the existing fishing fleet. Where existing agreements occur between DWFNs and coastal states for access to resources and that overlap with the introduction of the quota allocation system, these will remain in place without duplication, and with amendments to reflect permitted catch levels consistent with combined quota allocations.

13.5 The terms of the transfer (rent) of the allocation are for negotiation between the Coastal State and fishing flag state and will be undertaken subject to market forces. The Compliance Committee will address any disputes that may arise and ensure that quota is utilised appropriately.

13.6 At the start of the quota allocation system in 2014 Coastal States will update their fleet development plans (Resolutions 03/01; 09/02) which will be linked to the quota allocated to them. Over the first fifteen year period any uptake of quota by coastal states will also be reflected against the report on the implementation of their fleet development plan. As the coastal state develops its own capacity to fish during this period, it will reduce the amount of quota offered for transfer accordingly.

High Seas quota

13.7 In respect of the baseline nominal catch proportion defined in 2014 and the effective allocated catch (quota) allocated to flag state CPCs in any subsequent year in respect of historical levels of catch on the high seas up to 2014 (the 'high seas quota' see Annex 1, Table 1), the Commission agrees that all transfers of 'high seas' quota will be undertaken subject to market forces.

New Entrants / Set Aside

13.8 The set aside allocation will only be available to new Coastal State entrants that have attained the status of Cooperating non contracting party or full Member and the same control rules for allocation as defined above will be applied. As part of their application to IOTC new applicants shall also indicate the amount of quota they wish to receive from that available in the set aside. The Compliance Committee will review that application and the ~~Commission will decide on the level of the set aside allocated to the new entrant. New DWFN may enter the~~ fishery through transfer or trade of quota.

13.9 New entrants, like any other CPC, will be able to rent additional quota that may be made available for transfer by another party.

14. *Compliance*

14.1 The record of compliance in the application of IOTC conservation and management measures by the CPCs wishing to participate in the quota allocation process will be evaluated annually against a Standard Compliance Table (Annex 1, Table 3). The standard compliance table will be harmonised with other compliance rules defined by the Compliance Committee. Application of the standard compliance table is amongst the criteria used to set the Effective Allocated Catch Limit for each quota allocation period. Where the quota allocation period is more than one year (e.g. 3 years) this allows the uptake of any CPC quota held as a penalty in the CPC specific set aside to be taken up during the quota allocation period once compliance is demonstrated at the next Compliance Committee meeting (i.e. the next year), thus the penalty will apply for a minimum of one year.

14.2 In addition to conservation and management measures, the standard compliance tables will also include details on payment of contributions to IOTC. Failure to pay IOTC contributions in any year will result in a sliding scale of penalties with a 20% reduction in quota for the first year, 40% for the second year in arrears, and will disqualify that CPC from receiving a quota allocation for that quota allocation period where the CPC is three or more years in arrears.

14.3 There will be one standard compliance table produced each year for each participating CPC – these tables will collate and summarise the data already generated by the Secretariat each year for the review of the Compliance Committee. Additionally it will collate and summarise any additional reporting requirements related to monitoring and control of this quota allocation system that may be introduced from time to time.

14.4 A summary table will be prepared by the Secretariat that indicates the eligibility of each CPC to participate in the quota allocation scheme each year, and the level of any reduction in quota that will be applied that year arising from sanctions applied in respect of failure to comply with IOTC conservation and management measures (Annex 1, Table 4).

14.5 It is proposed that the Compliance Committee reviews and finalises the proposed standard compliance table, and level of sanctions during its meeting in 2013.

15. *Monitoring implementation*

15.1 The Compliance Committee meeting held prior to the Commission Plenary Session in 2013 will discuss any additional requirements that are necessary to administer and monitor the quota allocation scheme over and above the current mandatory requirements for reporting against IOTC conservation and management measures. CPCs are encouraged to submit proposals one month prior to the meeting.

16. *Duties of the IOTC, the Secretariat, its various bodies and of CPCs*

16.1 The following table provides a timeline for implementation of the quota allocation system and identifies the duties of the different bodies of the Commission.

Responsible body and actions to be taken	**Deadline / date of meeting**
Technical meeting on quota allocation: • Agree proposal on allocation criteria and allocation system. • Recommend proposal to Commission	
Commission Meeting : • Adopt proposed quota allocation criteria and a quota allocation system for implementation during 2012 (specific parameters to be applied within the system can be further developed and adopted in 2012); • Agree the factors to be taken into consideration when developing a management procedure for the TAC;	
IOTC Secretariat and CPCs • The Secretariat to develops and validates with CPC's their historical catch record, as soon as possible for years 1981-2010.	
WPB and WPTT: • Develop a management procedure for setting the TAC for billfish and tuna species	
Science Committee: • Review, approve and recommend the management procedure to the Commission	
CPCs: • Submit proposals to the Compliance Committee for additional monitoring and control requirements needed to administer the quota allocation system and indicate how they would be reflected in the standard compliance table.	
Compliance Committee: • Review proposals for additional monitoring and control related to implementation of the quota allocation system and recommend them to the Commission • Agree the sanctions to be applied in the standard compliance table, update the table to reflect additional monitoring and control requirements, and recommend them to the Commission	
Commission • Adopt the management procedure for setting the TAC • Agree the historical reference period for application by subsidiary bodies later in 2012 in calculation of the baseline nominal catch proportion. • Agree parameters used in the control rules to set the effective allocated catch limit (Membership, compliance, etc) • Agree the level of set aside if any. • Define the quota allocation period to be applied.	
WPB and WPTT: • Apply management procedure and set the TAC for Yellowfin tuna, big-eye tuna andSwordfish	
IOTC Secretariat: • Apply control rules for the agreed reference period to determine the baseline nominal catch proportion by CPC	
Science Committee: • Review, approve and recommend the TAC derived by WPTT to the Commission • Review and approve the estimates of baseline nominal catch proportion.	
CPCs • Fulfil all mandatory reporting requirements as required under IOTC conservation and management	

measures • Submit Utilisation Plan to IOTC detailing how the quota will be utilised (i.e. mechanism of allocation amongst domestic fleets, level of transfers anticipated and to which CPC, etc) • Submit revised fleet development plans.	
IOTC Secretariat • Complete usual generation of reports on compliance with IOTC conservation and • management measures submitted during 2011/12 • Complete the Standard Compliance Table • Confirm that CPC plans for utilisation of quota conform to rules defined in Part 3 of the proposal.	
Compliance Committee: • Review completed standard compliance table and agree its application for the allocation of quotas – Recommend to the Commission. • Review summary of CPC utilisation plans and for any that do not conform, recommend course of action to the Commission.	
Commission: • Adopt the level of TAC set for Yellowfin tuna ,big-eye tuna and swordfish • Adopt the completed standard compliance table • Agree CPC utilisation plans (with revisions as appropriate)	
IOTC Secretariat • Apply agreed level of TAC and control rules and derive effective allocated catch limits per CPC (quota). • Inform each CPC of its quota for the present quota allocation period.	
CPCs • Utilise quota according to agreed utilisation plan • Submit any complaints to the Compliance Committee • Comply with all IOTC conservation and management measures and ensure that quota allocations are not exceeded.	
Compliance Committee • Review complaints and require CPCs to act according to decisions of the Committee	
All bodies • Report on and review the implementation of the quota allocation system on an annual basis during the defined quota allocation period.	

ANNEX 1

STANDARD TABLES TO BE APPLIED IN THE QUOTA ALLOCATION SYSTEM FOR IOTC.

Table 1: Setting the Baseline nominal Catch Proportion (%): For each species for which the Commission has agreed a TAC, and for the defined reference period, to calculate the total catch (A) and proportion (%) of the total catch (B) in the EEZ of coastal states within the IOTC area of competence and the total high seas catch by flag states that have fished during the reference period (C)

Table 2: Setting the baseline nominal catch proportion: Application of the values derived in Table 1 to set the baseline nominal catch proportion (E)

Table 3: Standard Compliance Table, to set the level of reduction of the nominal catch for each CPC due to non compliance, F. This Table will be completed by the Compliance Committee during its meeting in 2013 when the level of sanctions for non compliance will be agreed. Over time the Standard Compliance Table is expected to evolve. Comments and examples are provided for guidance only.

Table 4: Summary of eligibility of each CPC to receive a full quota based on membership status (G, H) and compliance with IOTC conservation and management measures (F), and calculation of the combined adjustment (I) to be applied to the nominal catch allocation when setting the
effective allocated catch limit.

Table 5: Setting the Effective allocated catch limit and final quota allocation, indicating the nominal catch allocation (K), effective allocated catch limit (L) and penalty CPC set-aside (M), the bonus allocation (P) and final quota allocated to each CPC (Q) for the quota allocation period.

Note: Tables 2, 4 & 5 need to be updated to indicate Mozambique's Membership Status as a full Contracting Party/Member

ADDENDUM 1
EXPLANATORY NOTE

This Explanatory Note provides a summary and explanation of the quota allocation system presented by Republic of Seychelles to the Technical Meeting on Quota allocation held in Nairobi 16-18 February 2011.

Recognising the legitimate rights and aspirations of both coastal states, in particular small island developing coastal states and territories and small and vulnerable economies; and, distant water fishing nations that have historically fished and invested in an area is a challenge. This proposal draws on the experience of other tuna RFMOs presented at the Kobe 2 workshop on managing tuna fishing capacity in Brisbane during 2010, and on the particular situation of IOTC and tuna stocks in the Indian Ocean.

This proposal describes a fair and transparent quota allocation system through a combination of suitable rights based quota allocation criteria and a phased implementation system. We propose a hybrid scheme based on catch per area in the EEZs and fishing zones of Coastal States, and on historical levels of catch by all eligible flag state fishing vessels on the high seas. As more than 50% of historical catches have been taken on the high seas this does not disadvantage distant water fishing nations that have historically invested in the Indian Ocean fisheries whilst by considering where the fish are caught it recognises the sovereign rights of Coastal States to a share of the resource.

UNCLOS Article 56(1) defines coastal states sovereign rights within their EEZs. Coastal states have the necessary jurisdiction related to those sovereign rights giving them the power to regulate the terms of use relating to activities for the exploitation of the living resources in their EEZs. In the past this has included the sale of licences and agreements with third parties for them to fish inside the EEZ of a coastal zone for a defined period. Fixed term licences and agreements do not confer a future right to the resources within an EEZ. Any catch history within an EEZ indicates the resource availability within that EEZ and it is appropriate to attribute it to the coastal state that claims the sovereign rights.

High seas catches by contrast are not claimed as sovereign rights and it may therefore be more appropriate to allocate quota on the basis of historical catch.

In this proposal by the Republic of Seychelles, the combination of the quota allocation criteria and the implementation system proposed for use of the allocated quota enables an equitable system to be developed so that in the short term the status quo is approximately maintained, thus ensuring economic stability for existing fleets, whilst over the longer term the development plans of coastal states can be realised in a phased and planned way. The quota allocation system must be considered in its entirety.

The system proposed provides an objective framework to define quota allocation which is a strength of the proposal. A baseline allocation is clearly defined at the start of the quota allocation system in 2012, and once established removes uncertainty for all CPCs. Each CPC knows its baseline allocation that is achievable if fully compliant. Economic stability is thus provided and the ability to plan for future development, including the accumulation of additional, or sale of surplus quota as desired. It avoids uncertainty that would follow from having less clearly defined criteria that require negotiation at the start of each new quota allocation period. It thus provides a sound basis for sustainable management of fish stocks.

A summary of the quota allocation system proposed is provided in Boxes 1-4. Box 1 indicates the rights allocation mechanism. More detail explaining how control rules for the quota allocation criteria will be applied is provided in Box 2 (The baseline nominal catch proportion) and box 3 (the effective allocated catch limit, or quota). Box 4 describes the Implementation of the quota allocation system.

A summary description of the system:
For any species for which the IOTC will apply a quota allocation system (e.g. yellowfin tuna, bigeye tuna) the system involves:
An assessment/management procedure to set the total allowable catch (TAC) in the whole of the IOTC area of competence or sub areas as relevant for each species. Any set aside allocation for new coastal state members is subtracted from the TAC to give the Effective TAC before allocation amongst CPCs.

Application of allocation Criteria

- Based on catches recorded during a defined historical reference period, applying control rules that set a baseline nominal catch proportion for all eligible CPCs (i.e. all coastal states and all distant water fishing nations that have fished in IOTC waters). The baseline is set only once in 2012.
- Deriving the CPC nominal catch allocation for the current quota allocation period from the effective TAC and the baseline nominal catch proportion.
- Applying adjustments to the nominal catch allocation related to membership status and compliance with IOTC conservation and management measures.
- The reallocation of any unallocated balance as a bonus to all fully compliant eligible CPCs. The final effective allocated catch , or quota, is thus derived for each CPC.
- An arbitration committee will be formed to deal with disputes

Implementation – i.e. use of quota, fishing (amongst others:)

- ~~The quota will apply for a fixed Quota Allocation Period before it is recalculated (e.g. 3 years) to~~ ensure economic stability and to enable fleet development.
- Quota may be taken anywhere in the area to which the TAC for the species in question relates i.e. in the IOTC area of competence, or a defined sub area,
- Only vessels on the IOTC register can utilise a quota
- CPCs will submit quota utilisation plans to IOTC – for use by their own flagged vessels and listed artisanal fleet. Any surplus may be transferred (rented) to CPCs that have fishing capacity, for example those that have historically fished, thus maintaining the status quo in the short term. In the medium to longer term, fleet development plans will take effect for the uptake of that surplus. The Arbitration Committee will deal with disputes.
- No reallocation of underutilised quota between years; sanctions may be imposed for CPCs exceeding quota
- CPCs responsible for monitoring and compliance of fishing by their own fleet on their own quota and any quota rented (transferred) to them.

A summary of responsibilities and a timeline to achieve implementation by 2012 is presented in Section 15 of the Proposal.

Annex 1 provides fully worked up tables for the application of control rules to set the ***baseline nominal catch proportion*** for each of yellowfin tuna, bigeye tuna and swordfish, and provides a detailed explanation of the methodology used. The calculations of the baseline nominal catch proportion (Tables 1 and 2 of the Proposal itself) are based on an historical reference period of 1981- 2008, the latter being the latest information available within the IOTC database. Hence these tables are shown in this explanatory note but have been left blank in the proposal itself – the proposal indicates an historical reference period of 30 years, 1981-2010, and this dataset will be available by 2012.

Annex 2 provides hypothetical examples of setting the ***effective allocated catch limit,*** or quota (i.e. Tables 3-5 of the Proposal itself; actual examples can only be provided after details such as the level of sanctions to be applied have been defined by the Compliance Committee during 2012).
This system:

- Provides a fair rights based distribution of benefits between coastal states and distant water fishing nations
- In the short term aims to maintain the status quo, providing economic stability
- In the longer term allows fleet development up to the level of any quota allocated to a CPC.
- Allows for new coastal state entrants by allocating a set aside
- Encourages full membership of IOTC by applying a sliding scale of allocations for members and cooperating non contracting parties; An exception will be made for Taiwan. China pending discussions on its membership, but this will be the only exception.

- Encourages full compliance with IOTC conservation and management measures, including payment of fees by setting sanctions (quota reductions) for non compliance.

Thus the system proposed has the potential to address more than just a means of sharing out the catch.

It also has the potential to encourage full compliance with all of IOTC's conservation and management measures, making it a strong tool for the Commission.

ANNEX 1

CALCULATION OF THE BASELINE NOMINAL CATCH PROPORTION FOR YELLOWFIN TUNA, BIGEYE TUNA AND SWORDFISH FOR AN HISTORICAL REFERENCE PERIOD OF 1981-2008 (I.E. TABLES 1 AND 2 OF THE PROPOSAL FOR EACH SPECIES).

The Proposal indicates that the IOTC Secretariat is responsible for applying the control rules (*i.e.* methodology for estimation) for the agreed reference period to determine the baseline nominal catch proportion by CPC. The Science Committee will review and approve the estimates derived for submission to the Commission. This Annex is presented for guidance only and is based on the estimation procedure described below. Refinements to this procedure are also indicated below and may be recommended by the Technical Meeting on quota allocation. The final baseline nominal proportion allocated to each CPC may differ from the figures shown based on any such refinements to the estimation procedure and on the historical reference period adopted. It is noted that IOTC have developed a tool that enables the calculation of catches on the high seas and in CPC EEZs that uses the same approach as that outlined below.

The data sources used for all calculations of catch by area, flag, gear and species were the individual IOTC catch and effort databases for the different gear types. It is important to use an agreed data source that has been submitted by IOTC Members and CNCPs and is readily available to all parties to enable verification and transparency throughout the process. Longline data are available by year, flag and by 5° x 5° grid, purse seine and bait boat (pole and line) by a 1° x 1° grid. In order to divide the Indian Ocean catch by EEZ relating to the coastal states and those catches taken on the high seas, a series of 5° x 5° and 1° x 1° grids were overlaid with a chart of the EEZ or equivalent definitions for the entire region. Zone definitions were taken from the Global Maritime Boundaries Database (GMDB). The approximate proportion of each zone within each individual grid square was determined by visual estimation manually and the process repeated until the entire Indian Ocean region (FAO Areas 51 and 57) had been covered. It is recommended that for transparency that the process of allocating the proportion of grid squares to coastal state zones is repeated using a detailed GIS to determine the exact proportion of each zone inside a grid square; the IOTC tool does this.

Further refinements, such as allocating all catches in a grid square to the high seas where fishing is excluded from a coastal state EEZ except under license can also be made. At present IOTC does not have all such information and if this refinement is agreed during the Technical Meeting, CPCs should make the details available to the Secretariat.

Annual catch totals by species are then calculated for each gear type, coastal state zone and flag state in each grid square by multiplying the catch within a grid square by the proportion. For the purpose of this estimation the High Seas are considered the equivalent of a coastal state zone. The total catches for each coastal state zone for each species can then be calculated by adding the catch totals for all gears and all years within the defined period for each coastal state zone. Catches are assumed to be distributed uniformly throughout a grid square. These figures form the basis of Table 1. Artisanal catches (assumed to only occur in a coastal state's own zone) are estimated by the secretariat and have been included in the IOTC catch and effort database. The total catch in a particular zone and as a proportion of the total Indian Ocean catch overall can now be calculated (Columns A and B in Table 2) along with the total high seas catch and as proportion of the total Indian Ocean catch for all fishing nations (Columns C and D in Table 2). The baseline catch proportion is calculated as the proportions taken inside the zone of a state and taken by the state on the high seas added together (Column E in Table 2).

EU catch data are disaggregated in the IOTC catch databases as they have historically been reported as such (hence France, Spain, Portugal appear as separate lines in the tables, and Table 1 shows the disaggregated catch data). In Tables 2 and 5, these catch data have been aggregated in the model so that all French, Portuguese and Spanish catches are included as "European Union" (and thus Spain/Portugal appear as zero in Table 2 and 5). French catches that have been recorded separately for the French territories of Mayotte and Reunion are recorded as French catches only for the calculation of coastal state allocation in these tables.

A further refinement could be to use logbook data submitted to CPCs by vessels licensed to fish in their zones. However such information is not currently publically available and will be more difficult to verify. It is therefore recommended that the approach described above, with refinements to improve the estimation, is employed using the publically available and agreed IOTC database. By taking an historical reference period the catch by area over time is averaged; , the method applied similarly proportionately apportions catches by area. Furthermore, currently unreported elements such as artisanal catches are estimated within the IOTC database. Consequently even with accurate logbook data from the commercial and licensed part of the fishery there will still be an element of estimation in the procedure. Thus the above method provides a good approximation on which to base quota allocations and takes into account both commercial and artisanal catches. It provides a good basis for quota allocation.

Yellowfin – Table 1

Yellowfin – Table 2

Bigeye tuna – Table 1

Bigeye tuna – Table 2

Swordfish - Table 1

Swordfish – Table 2

Note:

1. All above tables need to be updated to indicate Mozambique's Membership Status as a full Contracting Party/Member.
2. All tables need to be updated with respect to historical catches in zone to correct the under-reporting due to use of an erroneous boundary under the EU Arrangements

ANNEX 2

Hypothetical worked examples applying control rules defined in the proposal to set the effective allocated catch limit for each species for each CPC (*i.e.* Table 4-5 of the Proposal).

All species – Table 4 using Hypothetical Standard Compliance Table outputs (F) to derive hypothetical values for the combined adjustment (I) to be applied to the nominal catch when setting the effective allocated catch limit.

Yellowfin – Table 5 Hypothetical example of CPC quota allocations and set aside using hypothetical input values

Bigeye tuna – Table 5 Hypothetical example of CPC quota allocations and set aside using hypothetical input values for the adjustments (I), from Table 4 above.

Swordfish – Table 5 Hypothetical example of CPC quota allocations and set aside using hypothetical input values for the adjustments (I), from Table 4 above.

Note:

1. All above tables need to be updated to indicate Mozambique's Membership Status as a full Contracting Party/Member.
2. All tables need to be updated with respect to historical catches in zone to correct the under-reporting due to use of an erroneous boundary under the EU Arrangements

APPENDIX IX
INDONESIA –PROPOSAL INF01

QUOTA ALLOCATION SYSTEM FOR INDIAN OCEAN TUNA FISHERIES

Proposed by INDONESIA Background The IOTC Resolution 10/01, which was adopted in 2010, requires the development of quota allocation system or any other relevant measure for the sound management of main targeted species falling under the IOTC competence, such as Yellowfin, Bigeye and Swordsfish stocks. To meet such requirement, the IOTC Technical Committee has invited proposal and held meeting to discuss the quota allocation system. This proposal is the revised version of the proposal submittted during the first IOTC Technical Committee meeting in Nairobi – Kenya on 16-18 February 2011. In this proposal in the development of the quota allocation system, Indonesia maintain the importance of historical engagement of the country in fishing the resources, the legitimate and aspiration of the coastal country and the socio-economic importance of fisheries activity for the country. The revised version is simpler in how the quota for each individual country will be allocated. In this revised version, Indonesia also continues to acknowledge the importance of allocating certain percentage of the resource as a reserve stock or for allocation for the new entrance and for the compliance to the IOTC resolution.

The Indian Ocean Tuna Commission

Recognizing – that based on past experience in the fishery, the potential production from the resource can be negatively impacted by excessive fishing effort;

Recognizing – that during the 13th and 14th IOTC scientific meeting, the committee recommended the Yellowfin and Bigeye tuna catches should not exceed the MSY levels which have been estimated at 357,000 tones for Yellowfin and at 114,000 for Bigeye and around 30,000 for Swordfish;

Recognizing – that IOTC Resolution 10/01 requires the development of quota allocation system for Yellowfin and Bigeye tuna stocks;

Taking into account – the soverign rights of coastal states for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, within their respective exclusive zones in accordance with Article 56 (1) of the United Nation Convention on the Law of the Sea, Montego Bay of 10 December 1982;

Taking into account – the available scientific information and advice, in particular the IOTC Scientific Committee conclusions whereby the Yellowfin and Bigeye tuna stocks might have been over or fully exploited in recent years;

Acknowledging – that the implementation of TAC without a quota allocation system would result in an inequitable distribution of the catches and fishing opportunities among the CPSs and non CPCs;

Noting – the importance of applying the precautionary approach for the management of the tropical tuna and swordfish stocks;

Noting – the 13th Scientific Committee recommendation to develop a Compliance Monitoring Scheme;

Adopts, in accordance with the provision of Article IX, paragraph 1 of the Agreement establishing the IOTC, the proposed quota allocation system is as follows.

Basic Principle and Consideration

1. Sustainable Fisheries – the development and implementation of quota allocation system should ensure the sustainability of fish stock. For that matter, the best available scientific data and method of analysis should be used to determine the MSY and TAC. A portion of the stock should be allocated to reserve stock or for the new entrance The sum of all countries quota should not exceed the TAC.

2. Distribution of Benefits – the utilization of the resources should be distributed among members that consider historical engagement, geographic location/proximity to the resources, the fisherman livelihood and the socio-economic level of development of the country

3. Membership and Compliance – the quota allocated for each country should be given to the member country based on their membership statute and their level of compliance to the IOTC resolutions.

Main Criteria for Allocation There are seven main criteria for quota allocation for each country, namely:
(1) Catch history
(2) Dependence of fisheries sector to the national economy
(3) Human Development Index
(4) Coastal state of Indian Ocean
(5) Bio-ecological Significancet waters within the national jurisdiction of the country (spawning area, nursery ground and strategic migration path)
(6) IOTC membership
(7) Compliance with IOTC rule and regulation

Step by Step Allocation
1. Total Allowable Catch (TAC)

- TAC is determined based on the best available data and method by the scientific panel of IOTC
- TAC is allocated for member country as well as for new entrance.
- 2.5% of the TAC will be allocated to stock reservation or for new entrance as a starting percentage and will be increase gradually up to 10%.

2. Quota Allocation for each country (QAi) is allocated based on the following simple formula:

QAi=Ave_Catchi $W1+W2+W3+W4+W5$ $CF1+CF2$ where Ave_Catchi is average catch (in tons) of the country reported to the IOTC for the last five years, $W1$ is dependence of fisheries sector to the national economy (high = 0.3, medium = 0.2, and low = 0.25), $W2$ is Human Development Index, HDI (underdeveloped=0.20, developing=0.15, develop=0.10), $W3$ is Coastal State of the Indian Ocean (yes = 0.25, no=0.15) $W4$ is Bio-ecological Significances (spawning ground, nursery ground, strategic migration path) within the country's ZEE (available = 0.25, none = 0.15) $CF1$ is IOTC membership (yes = 0.90, no = 0.85) $CF2$ is degree of compliance (full = 0.1, partial = 0.05, no = 0.0).
3. Adjusted Quota to MSY (Qi_adjust)

To ensure the total allocation for all the countries do not exceed the TAC, then the QAi must be adjusted, as follows: QAi_adjust=QAi $QA1+QA2+QA3+\cdots+QAn$ $\times TAC97.5$ where $TAC97.5$ is the total allowable catch after 2.5% deduction for the new entrance or to stock reservation.

APPENDIX X
GUIDING LEGAL TEXT FOR A FUTURE ALLOCATION SYSTEM

Article V, paragraphs 1 and 2d, and Article XVI of the IOTC Agreement.

Article V. Objectives, Functions and Responsibilities of the Commission

1. The Commission shall promote cooperation among its Members with a view to ensuring, through appropriate management, the conservation and optimum utilization of stocks covered by this Agreement and encouraging sustainable development of fisheries based on such stocks.

2. In order to achieve these objectives, the Commission shall have the following functions and responsibilities, in accordance with the principles expressed in the relevant provisions of the United Nations Convention on the Law of the Sea:

(d) to keep under review the economic and social aspects of the fisheries based on the stocks covered by this Agreement bearing in mind, in particular, the interests of developing coastal states;

Article XVI Coastal States' Rights
This Agreement shall not prejudice the exercise of sovereign rights of a coastal state in accordance with the international law of the sea for the purposes of exploring and exploiting, conserving and managing the living resources, including the highly migratory species, within a zone of up to 200 nautical miles under its jurisdiction.

Part V of the Convention of the Law of the Sea on Exclusive Economic Zones; Articles 55, 56, 63 and 64.

Article 55 Specific legal regime of the exclusive economic zone.
The exclusive economic zone is an area beyond and adjacent to the territorial sea, subject to the specific legal regime established in this Part, under which the rights and jurisdiction of the coastal State and the rights and freedoms of other States are governed by the relevant provisions of this Convention.

Article 56 Rights, jurisdiction and duties of the coastal State in the exclusive economic zone.

1. In the exclusive economic zone, the coastal State has:

(a) sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superadjacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds;

(b) jurisdiction as provided for in the relevant provisions of this Convention with regard to: (i) the establishment and use of artificial islands, installations and structures; (ii) marine scientific research; (iii) the protection and preservation of the marine environment;

(c) other rights and duties provided for in this Convention.

2. In exercising its rights and performing its duties under this Convention in the exclusive economic zone, the coastal State shall have due regard to the rights and duties of other States and shall act in a manner compatible with the provisions of this Convention.

3. The rights set out in this article with respect to the seabed and subsoil shall be exercised in accordance with Part VI.

Article 63 Stocks occurring within the exclusive economic zones of two or more coastal States or both within the exclusive economic zone and in an area beyond and adjacent to it.

1. Where the same stock or stocks of associated species occur within the exclusive economic zones of two or more coastal States, these States shall seek, either directly or through appropriate subregional or regional organizations, to agree upon the measures necessary to coordinate and ensure the conservation and development of such stocks without prejudice to the other provisions of this Part.

2. Where the same stock or stocks of associated species occur both within the exclusive economic zone and in an area beyond and adjacent to the zone, the coastal State and the States fishing for such stocks in the adjacent area shall seek, either directly or through appropriate subregional or regional organizations, to agree upon the measures necessary for the conservation of these stocks in the adjacent area.

Article 64 Highly migratory species.

1. The coastal State and other States whose nationals fish in the region for the highly migratory species listed in Annex I shall cooperate directly or through appropriate international organizations with a view to ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both within and beyond the exclusive economic zone. In regions for which no appropriate international organization exists, the coastal State and other States whose nationals harvest these species in the region shall cooperate to establish such an organization and participate in its work.

2. The provisions of paragraph 1 apply in addition to the other provisions of this Part.

APPENDIX XI

PROPOSAL OF THE LIKE-MINDED IOTC COASTAL STATES OF THE INDIAN OCEAN ON GUIDING PRINCIPLES FOR ALLOCATION CRITERIA

During the first Technical Committee Meeting on Allocation Criteria (TCAC01, Nairobi, 16-18 February 2011) a Group of Like-minded Coastal Sates of the Indian Ocean met at outside the plenary and noted that it was not possible, to agree at that stage, on a set of allocation criteria that may be used for developing a comprehensive quota system or any other relevant measures.

The Group met again on 18 February 2013, in Muscat, Oman, during the first day of the Second Technical Committee Meeting on Allocation Criteria (TCAC02, Muscat, 18-20 February 2013). The Group noted the increased harvesting pressure on the tuna resources in the IOTC area of competence.

The Group (listed below) considered and analysed the various proposals that has been submitted to the TCAC2 (see Annex 1).

1. Australia
2. Comoros
3. India
4. Indonesia
5. Iran
6. Kenya
7. Madagascar
8. Malaysia
9. Maldives
10. Mauritius
11. Mozambique
12. Oman
13. Seychelles
14. Sri Lanka
15. Tanzania
16. Thailand

These like-minded coastal States of the Indian Ocean propose the following Guiding Principles to be used for the deliberation and consideration for adoption at the TCAC02 and then used in any future allocation criteria or any other relevant measures for the IOTC Commission:

1. Sustainable fishery.
2. Exclusive Rights of the Indian Ocean coastal States in their EEZs.
3. Special consideration for small, vulnerable economies and developing Coastal States of the Indian Ocean
4. Food and livelihood security
5. Equitable utilization and conservation of the resources.
6. Recognize and take account of the rights of all CPCs on the high seas.
7. Tuna management process shall be consistent with International laws.

Mindful of the unique nature of the fisheries in the region and complexities involved in developing a comprehensive scheme of allocation criteria, the Group also encouraged examining alternative management measures.

18 February 2013

Annex 1 (to Appendix XI)
PRINCIPLES AND RESULTS

PRINCIPLES	JAPAN	SEYCHELLES	EUROPEAN UNION	IRAN	MOZAMBIQUE	SRI LANKA	INDONESIA
Sustainable fishery	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Exclusive Rights of Indian Ocean coastal States in their EEZs	**No**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**
Special consideration for small, vulnerable economies and developing Coastal States of the Indian Ocean	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Food Security and Livelihood	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Equitable utilization and conservation of the resources	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Recognize and take account of rights of all CPCs on the high seas	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Tuna Management processes shall be consistent with international law	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

APPENDIX XII

STATEMENT BY THE EUROPEAN UNION AND FRANCE ON THE WORK UNDERTAKEN BY THE DRAFTING GROUP ON COMMON PRINCIPLES AND CRITERIA FOR AN ALLOCATION SYSTEM

The EU and France on behalf of its Indian Ocean Territories having participated in the discussions of the drafting group invoked by the IOTC chairman in order to discuss and draft the common principles and criteria on an allocation system, highlight the main inferences of the drafting group.

The work undertaken by the mentioned group was based on the main principles supported by all members in the 1st meeting of the Technical Committee Allocation Criteria, which the drafting group tried to upgrade, and the principles proposed by the Like-Minded IOTC Coastal States in its proposal of 18 February 2013 and in the appendix VI (Basic Guiding Principles agreed by Like-Minded Coastal States) of the report of the Technical Committee on Allocation Criteria held in Nairobi in 16–18 February 2011.

Elements discussed and proposed to be taken into account for a quota allocation system are to:

a. ensure the sustainable utilisation of the resource,

b. allocate fair and equitable fishing opportunities to all participants,

c. recognise the rights of both Indian Ocean coastal states and distant water fishing nations,

d. take into account the aspirations of Indian Ocean coastal states, including to develop their fishing opportunities,

e. consider socio-economic factors, such as dependency of Indian Ocean coastal state economies, for the livelihood of their local communities on tuna and tuna-like fisheries and investments made in the tuna sector,

f. consider the weight of imports of tuna products on economies and on the global consumption of tuna products of Contracting Parties,

g. reflect the compliance record/status of each CPC,

h. consider incentives for compliance with IOTC Conservation and Management Measures,

i. enforce effectively rules against IUU fishing,

j. consider degree of sustainability of fishing methods with respect to ecosystem approach,

k. authorise the transferability (lease) of allocations,

l. consider food security issues, which shall include not only the catch of tuna and tuna-like species, but also their processing and trade.

The list of the elements of a quota allocation system supported by the first Technical Committee on Allocation Criteria (paragraph 29 of the document IOTC-2011-SS4-R[4]) remain the only principles endorsed by the Allocation Criteria Technical Committee.

No other elements have been adopted by the drafting group or by the technical Committee.

APPENDIX XIII
SRI LANKA – PROPOSAL F

USE OF ALTERNATIVE MANAGEMENT MEASURES IN LIEU OF A QUOTA ALLOCATION SYSTEM FOR THE MAIN TARGET SPECIES IN THE IOTC AREA OF COMPETENCE

1. Background:

IOTC Resolution 10/01 identifies the adoption of a quota allocation system or any other relevant measures for the management of the stocks of three main target species, yellowfin, bigeye and swordfish, falling under the IOTC area of competence.

The need for such management measures grew with time. Indian Ocean region, which was historically fished by several coastal CPCs for millennia, opened for distant water fleet operations in two stages, first in the early 50s and 60s and again in the early 80s. Advent of the distant water fleets and the technology transfer which ensued resulted in broad-basing the fishery operations, with the use of more efficient gear and vessels. Mindful of the expanding fleet operations and the severe pressure this would have on resources, importance of taking suitable measures to arrest the situation was realised. Thus, Indo Pacific Tuna Project (IPTP) based in Colombo, the precursor of IOTC was set up in mid-80s to create a scientific base for eventual measures towards resource management in the Indian Ocean.

Indian Ocean has distinct social and geographic characteristics. Majority of the IOTC Member Countries are Indian Ocean coastal states. The total population of these coastal states amounts to over 2 billion, or nearly 30% of the global population. Meanwhile, if you consider the total IOTC Membership, including the Distant Water Fishing Nations, the population size of the IOTC CPCs stands at around 4.2 billion or over 60% of the total global population. On the other hand, Indian Ocean lands only little over 20% of the total global tuna production of nearly 4.5 million metric tons. Thus it is evident that urgent measures have to be taken to support IOTC efforts in tuna resource management in the India Ocean as we have to find a formula to share around 20% of the global tuna resource among 60% of the global population. Thus, it is justifiable to grant some exclusivity to coastal CPCs as against DWFNs which enjoy wide access to the global resource base in other ocean areas coming under other RFMOs.

On the other hand, such a mechanism will be very important for most of the Indian Ocean coastal states as they are totally and exclusively dependent on the IOTC areas of competence for their fish. This is mainly due to the lack of technology, capital, know-how, skill levels and market access, which prevents them from venturing in to distant water fishing. Thus, indigenous fisheries have remained essentially artisanal in nature with poor CPU. However, they play an important role in the nutrition of the populations in many coastal states, while also providing employment and livelihood to a large number. Only a fraction of the fish caught in these fisheries finds their way to export markets, while most being used for domestic consumption. This is in sharp contrast to industrial fisheries which cater for ocean-based or land-based processing sectors which supply the global market with a wide range of processed products.

2. The Concept

The present proposal, while recognising the inalianable rights and aspirations of coastal states and the legitimate rights of the distant water fishing nations that have fished in the area for varying periods of time over the last six decades, notes that:

- Any management measure should be science based, transparent and should consider emerging ocean regimes, fisheries dynamics, socio-economic and technical aspects of fisheries;
- Though the management system will, understandably, have some commonalities with systems in other RFMOs, it should adequately address issues specific to the region;
- Due to complexities involved, the system has to evolve through not only scientific, but also a political consultation process to avoid any negative economic and social ramifications, which can even challenge the safety and sustainability of fleet operations in the IOTC area of competence;

- The system should have mechanisms to encourage development of domestic industry of coastal states on a sustainable basis, where applicable. This could be achieved by setting up a separate fund dedicated for the purpose;
- a mechanism to address the rights of Distant water Fishing nations based on the duration of their engagement in fishing in the IOTC area of competence over the last five decades;

3. Alternatives to QAS

As an alternative to QAS, and in line with resolution10/01, Sri Lanka wishes to propose implementation of appropriate alternative measures for conservation and management of tuna resources in the IOTC area of competence. Such a process should, inter alia, constitute modalities of easing pressure on the resources through a combination of appropriate measures, taking note of:

- The possible pressure a quota allocation system directed at the three targeted species could have on non-target species such as Skipjack, Albacore, Billfish and Sharks etc. possibly resulting in the depletion and even collapse of the stocks;
- An out-put control through allocation of quotas, which mostly suit temperate water fisheries targeting few selected species, may not suit multi-species multi-gear fisheries of the Indian Ocean, which involves trans boundary species such as tropical tunas.
- Application of QAS will also require a very strong Monitoring Control and Surveillance mechanism, which is yet another major challenge.
- As a direct consequence of setting catch limits through the allocation of quotas, the proportion of discards at sea could increase, creating a major obstacle for realising the anticipated management goals of establishing a QAS.
- On the other hand, poor availability of data and statistics, low institutional capacities, poor knowledge in fisheries dynamics, infrastructure constraints, noncompliance and poor enforcement of IOTC resolutions etc would pose a big challenge to successful implementation of a quota allocation system;
- the overcapacity of the industrial purse-seine fishery in the Indian Ocean which has had a negative impact on the resource base:
- intense IUU fishing contributing to overfishing, undermining efforts to conserve and manage tuna stocks, while also broad negative impact on the ecosystem;

As such, Sri Lanka views the use of alternative management measures as the most suitable alternative for managing the tuna and tuna like resources in the Indian Ocean. Thus, establishing an effective input control system may probably be a viable alternative for effective management or rebuilding the stocks. Going by similar measures being promoted and/or employed by other RFMOs, the following approaches could be considered in this regard;

1. Confining the carrying capacity of vessels operating in the IOTC area of competence. An eventual upper limit target of 1500 GRT may be a reasonable tonnage from a resource management angle.
2. To enforce regulatory measures on large-scale purse seine fishing vessel to alleviate negative impact on bigeye and yellowfin resources through landing of juveniles. It has been established that industrial purse seines put severe pressure on the resources as compared to other gears such as gillnets, longline, pole and line, and mini purse seines etc.
3. Enforcing a limitation of fishing capacity of CPCs as per IOTC resolutions 03/01, 06/05 and 07/05;
4. Establishing and expanding closed seasons / areas;
5. Regulating gear types/specifications;
6. Taking effective measures to eliminate IUU fishing within the IOTC area of competence;

Due to the growing demand for marine fish, tuna and tuna like species in particular, issues related to resource sustainability, fisheries management, fishing rights, quotas, market access etc. are bound to figure prominently in the global fisheries scenario in the future. Hence it is important for all the CPCs to take an informed decision on a crucial matter such as quota allocation with full knowledge on the scientific base for such a decision, long-term socio-economic ramifications and food-security of their populations. Hence, Sri Lanka feels it is the bounden duty of IOTC to ensure that any process of resource management in its area of competence.should be just and fair and in line with the aspirations of the Indian Ocean Coastal states.

APPENDIX XIV

RECOMMENDATIONS OF THE SECOND TECHNICAL COMMITTEE ON ALLOCATION CRITERIA

Note: Appendix reference refer to the Report of the Second Session of the Technical Committee on Allocation Criteria (IOTC–2013–TCAC02–R)

Legal advice

TCAC02.01 (para. 35.) The TCAC **AGREED** that there was a need for a legal expert to be present at the next TCAC meeting to offer advice to the TCAC. As such, the TCAC **RECOMMENDED** that the Commission allocated the necessary funds for this purpose, either for an external legal expert or for the FAO legal office to commit a suitable expert.

Meeting Participation Fund

TCAC02.02 (para. 42.) The TCAC **NOTED** that the attendance by delegates from developing CPCs to the TCAC in 2013 (24 delegates from 15 Members, and 1 delegate from a CNCP) was largely due to the IOTC MPF, adopted by the Commission in 2010 (Resolution 10/05 on the establishment of a Meeting Participation Fund for developing IOTC Members and non-Contracting Cooperating Parties), and **RECOMMENDED** that the Commission maintain this fund into the future.

Review of the draft and adoption of the report of the second technical committee on allocation criteria

TCAC02.03 (para. 43.) The TCAC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from TCAC02, provided at Appendix XIV.

ANNEX 134

Statement of China’s Ministry of Foreign Affairs dated 26 April 2013

Foreign Ministry Spokesperson Hua Chunying's Remarks on the Philippines' Efforts in Pushing for the Establishment of the Arbitral Tribunal in Relation to the Disputes between China and the Philippines in the South China Sea

2013/04/26

Q: At the request of the Philippines, an arbitral tribunal on the South China Sea disputes between China and the Philippines has been composed recently. What is China's comment on this?

A: On 22 January 2013, the Philippines sent China a note verbale, attached with a notification, to initiate arbitration proceedings against China regarding issues of the South China Sea. On 19 February, China stated its rejection of the request for arbitration by the Philippines and returned the latter's note verbale and the attached notification. The position of China, as indicated above, will not change.

Since the 1970s, the Philippines, in violation of the Charter of the United Nations and principles of international law, illegally occupied some islands and reefs of China's Nansha Islands, including Mahuan Dao, Feixin Dao, Zhongye Dao, Nanyao Dao, Beizi Dao, Xiyue Dao, Shuanghuang Shazhou and Siling Jiao. Firmly and consistently opposed to the illegal occupation by the Philippines, China hereby solemnly reiterates its demand that the Philippines withdraw all its nationals and facilities from China's islands and reefs.

The Philippines professed in the notification of 22 January 2013 that it "does not seek...a determination of which Party enjoys sovereignty over the islands claimed by both of them." On 22 January, however, the Philippines publicly stated that the purpose for initiating the arbitration was to bring to "a durable solution" the Philippines-China disputes in the South China Sea. These statements are simply self-contradictory. In addition, by initiating the arbitration on the basis of its illegal occupation of China's islands and reefs, the Philippines has distorted the basic facts underlying the disputes between China and the Philippines. In so doing, the Philippines attempts to deny China's territorial sovereignty and clothes its illegal occupation of China's islands and reefs with a cloak of "legality". The Philippines' attempt to seek a so-called "durable solution" such as this and the means it has employed to that end are absolutely unacceptable to China.

In accordance with international law, and especially the principle of the law of the sea that "land dominates the sea", determined territorial sovereignty is the precondition for, and basis of maritime delimitation. The claims for arbitration as raised by the Philippines are essentially concerned with maritime delimitation between the two countries in parts of the South China Sea, and thus inevitably involve the territorial sovereignty over certain relevant islands and reefs. However, such issues of territorial sovereignty are not the ones concerning the interpretation or application of the UN Convention on the Law of the Sea (UNCLOS). Therefore, given the fact that the Sino-Philippine territorial disputes still remain unresolved, the compulsory dispute settlement procedures as contained in UNCLOS should not apply to the claims for arbitration as raised by the Philippines. Moreover, in 2006, the Chinese Government made a declaration in pursuance of Article 298 of UNCLOS, excluding disputes regarding such matters as those related to maritime delimitation from the compulsory dispute settlement procedures, including arbitration. Therefore, the request for arbitration by the Philippines is manifestly unfounded. China's rejection of the Philippines' request for arbitration, consequently, has a solid basis in international law.

In the interest of maintaining the Sino-Philippine relations and the peace and stability in the South China Sea, China has been persistent in pursuing bilateral negotiations and consultations with the Philippines to resolve relevant disputes. It is a commitment undertaken by all signatories, the Philippines included, under the Declaration on the Conduct of Parties in the South China Sea (DOC) that disputes relating to territorial and maritime rights and interests be resolved through negotiations by sovereign states directly concerned therewith. The DOC should be implemented in a comprehensive and serious manner. China will adhere to the means of bilateral negotiations to resolve territorial and maritime delimitation disputes both in accordance with applicable rules of international law and in compliance with the spirit of the DOC.

Related News:

- Foreign Ministry Spokesperson Hua Chunying's Regular Press Conference on April 25, 2013

- Foreign Ministry Spokesperson Hua Chunying's Regular Press Conference on April 24, 2013
- Foreign Ministry Spokesperson Hua Chunying's Regular Press Conference on April 23, 2013
- Foreign Ministry Spokesperson Hua Chunying's Regular Press Conference on April 22, 2013
- Foreign Ministry Spokesperson Hua Chunying's Regular Press Conference on April 19, 2013
- Foreign Ministry Spokesperson Qin Gang's Remarks on the International Community's Assistance to the Earthquake-Hit Zone in Lushan, Sichuan
- Foreign Ministry Spokesperson Hua Chunying's Regular Press Conference on April 18, 2013
- Foreign Ministry Spokesperson Hua Chunying's Regular Press Conference on April 17, 2013

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ANNEX 135

Letter from Mauritius to CLCS Secretary dated 29 May 2013

PERMANENT MISSION OF THE REPUBLIC OF MAURITIUS TO THE UNITED NATIONS

MISSION PERMANENTE DE LA REPUBLIQUE DE MAURICE AUPRES DES NATIONS UNIES

My ref.: NY/COM6/CLCS

29 May 2013

Dear Sir,

Mauritius submission for an Extended Continental Shelf in the Chagos Archipelago Region

In my letter of 21 December 2012 I informed you that the Government of the Republic of Mauritius proposed to make a partial submission for an extended continental shelf in the Chagos Archipelago Region in June 2013.

However, since more time than expected is required to complete the submission, the Government of the Republic of Mauritius is now proposing to complete and lodge the submission by June 2014.

Yours truly,

Milan J.N. Meetarbhan
Ambassador
Permanent Representative

The Secretary
Commission on the Limits of the Continental shelf
Division for Ocean Affairs and the Law of the Sea (DOALOS)
United Nations
New York

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