

IOTC-2012-TCAC02-04[E]

OUTCOMES OF THE FOURTEENTH SESSION OF THE SCIENTIFIC COMMITTEE RELEVANT TO THE SECOND TECHNICAL COMMITTEE ON ALLOCATION CRITERIA (TCAC02)

PREPARED BY: SC CHAIR, FEBRUARY 2012

BACKGROUND OF THIS DOCUMENT

This document is prepared for Agenda 5 in the Second Technical Committee on Allocation Criteria (TCAC02) meeting, i.e.,

AGENDA 6. ACTIVITIES 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).*

() S15: 15th Session of the Commission (2011)*

PURPOSE OF THIS DOCUMENT

To inform the TCAC02 of the outcomes of the Fourteenth Session of the Scientific Committee held from 12–17 December 2011, specifically relating to the subjects of the TCAC02.

RELEVANT SUBJECTS RAISED DURING THE SC14 RELATING TO TCAC02

At the 14th Session of the Scientific Committee, participants considered that following 4 subjects (Box 1) are related to the work of the TCAC02 meeting. Summary of these 4 subjects are provided in Box 1 and relevant paragraphs and contents are quoted from the SC14 report and listed in p. 2-11 including 2 Appendices.

Box 1 Four subjects raised by SC14 relating to TCAC02

[A] Basic information for the TAC scheme (p.2-3 list relevant paragraphs and contents from the SC14 report)

[A1] Stock status and management advice of yellowfin and bigeye tuna

[A2] Close-to-real time data collection

[B] Alternative management measure (1): Purse seine FADs fisheries (p.3)

[B1] Evaluations of impacts of FADs by Y/R analyses and MSE

[B2] FADs closures

[C] Alternative management measure (2): Area closures (p.5)

[C1] Area closures

[D] Other relevant information (p.6)

[D1] Piracy effect on yellowfin and bigeye tuna stock

Summary

Four subjects were raised in SC14, which related to the TCAC02 meeting. Subject [A] is the essential and basic information, i.e., “Stock status and management advice of yellowfin and bigeye tuna” and “Close-to-real time data collection”. Both yellowfin and bigeye tuna stocks are now in the safe levels in terms of fishing pressures and population levels (see Appendix A and B for details on yellowfin and bigeye tuna respectively). “Close-to-real time data collection” is the essential requirement for the TAC scheme; however majority of CPCs need much more time to build such collection system. Subject [B] is the alternative management measure on “impact of juvenile yellowfin and bigeye catch by purse seine FADs fisheries”. SC14 suggested conducting multi-gear Yield Per Recruit (Y/R) analyses in the 15th Working Party on Tropical Tuna (WPTT15), this year, in order to evaluate the impact on yellowfin and bigeye tuna stocks. SC14 also suggested that the evaluation of the impact needs to be handled under the Management Strategy Evaluation (MSE) scheme. SC14 further suggested implementing FAD closures by referring to the successful result in WCPFC. Regarding subject [C] on “Area closures”, SC considers that the current area closures off Somalia are not effective then SC14 recommended that the Commission specify clear objectives as to what are the management objectives to be achieved. The last subject [D] on “Piracy effect” on yellowfin and bigeye tuna do not directly relate to the TAC issue, but this Piracy acts made significant reduction of the tuna longliners in the Indian Ocean, which might need to be considered to in the TAC scheme.

Appendix A: Stock status and management advice of yellowfin tuna (detail description) (p.8-10)

Appendix B: Stock status and management advice of bigeye tuna (detail description) (p.9-11)

LIST OF PARAGRAPHS AND CONTENTS OF 4 SUBJECTS RELATING TO TCAC02 (FROM THE SC14 REPORT)**Subject Basic information for the TAC scheme**

[A1] **Stock status and management advice of yellowfin & bigeye tuna** (extracted from Table 1 & Executive summary of the SC14 report)

[Yellowfin tuna]

Stock status. The stock assessment model (MULTIFAN-CL) used in 2011 suggests that the stock is currently not overfished ($B_{2009} > B_{MSY}$) and overfishing is not occurring ($F_{2009} < F_{MSY}$). Spawning stock biomass in 2009 was estimated to be 35% (31–38%) of the unfished levels. However, estimates of total and spawning stock biomass show a marked decrease over the last decade, accelerated in recent years by the high catches of 2003–2006.

Outlook. 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 (299,074 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 higher yields based on the estimated levels of recruitment from over the last 15 years.

The SC **RECOMMENDED** the following:

- The Maximum Sustainable Yield estimate for the whole Indian Ocean is 357,000 t with a range between 290,000–435,000 t, 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 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.

[Bigeye tuna]

Stock status. Both assessments (SS3 and ASPM) suggest 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. $S_{current}/S_{BMSY} > 1$ and $F_{current}/F_{MSY} < 1$) (Table 1 and Fig. 1). Current spawning stock biomass was estimated to be 34–40 % of the unfished levels.

Outlook. The recent declines in longline effort, particularly from the Japanese, Taiwan, China and Republic of Korea longline fleets, as well as purse seiner 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. Catches in 2010 (71,489 t) were lower than MSY values and catches in 2009 (102,664 t) were at the lower range of MSY estimates. The mean catch over the 2008–2010 period was 93,761 t which is lower than estimated MSY.

The SC **RECOMMENDED** the following:

- The Maximum Sustainable Yield estimate for the Indian Ocean ranges between 102,900 and 114,000 t (range expressed as the median value for 2010 SS3 and steepness value of 0.5 for 2011 ASPM). Annual catches of bigeye tuna should not exceed the lower range of this estimate which corresponds to the 2009 catches and last year management advice.
- If the recent declines in effort continue, and catch remains substantially below the estimated MSY of 102,900–114,000 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.

[A2] Close-to-real time data collection (Essence for the TAC scheme)**[Definition]**

Para160: The SC **NOTED** the actions undertaken by the IOTC Secretariat to address the request from the Commission on the ability of coastal countries in the IOTC region to report catch data for their artisanal fisheries in close-to-real time, in particular catch data for of yellowfin tuna and bigeye tuna. Two timeframes for the reporting of close-to-real-time catches are defined, depending on the type of fishery. For industrial fisheries, close-to-real-time reporting of catches occurs when catches are reported within 30 days of the day of capture. For artisanal fisheries, close-to-real-time reporting of catches occurs when catches are reported within 60 days of the day of capture. Artisanal fisheries are defined as those undertaken by vessels (or any other types of fishing crafts) with LOA less than 24m and operated full time within the EEZ of their flag states.

[Difficulties]

Para161: The SC **NOTED** that the report identifies deficiencies in data collection and reporting in the majority of the countries assessed noting that the reporting of catches as per the timeframes specified will not be possible in eleven out of the eighteen countries evaluated. Those countries will require significant amounts of time and resources to streamline their statistical systems if data by the proposed timeframe is to be reported in the future. Overall an estimated 35% of the combined catches of yellowfin tuna and bigeye tuna will not be reported in time unless the countries address the issues identified as a matter of priority. In the event of catches not being reported, the catches will need to be estimated. The use of such an approach will require the adoption of more conservative measures, to account for the uncertainty of the estimates, and mitigate the risk of exceeding any future catch limits set by the Commission.

[Problems in PS]

Para163: Noting that in the case of purse seine fleets the catches recorded in the logbooks are corrected for species composition after a delay of approximately three months, the SC **NOTED** that CPCs having purse seine vessels could provide preliminary estimates in a shorter timeframe based on the best information available. However, the SC acknowledged that the catches estimated close-to-real time may slightly differ from the final catches estimated for these fleets, requesting that the CPCs concerned conduct research to assess the difference between both estimates and report back to the SC in 2012.

Subject [B] Alternative management measure (1): Purse seine FADs fisheries**[B1] Evaluations of impacts of FADs by multi-gear Y/R analyses and MSE****[Evaluation by multi-gear Y/R analyses: yellowfin tuna]**

Para 43: The SC **NOTED** that Yield-per-recruit analyses are absent among the various methods used to assess the yellowfin tuna stock, whereas they are useful when there are several fleet components exploiting different age groups, and when gear regulations affecting age/size at first capture may be an important management tool. Therefore, the SC **AGREED** that the WPTT should be presented with such analytical approaches as part of the next assessment process.

[Evaluation by multi-gear Y/R analyses: bigeye tuna]

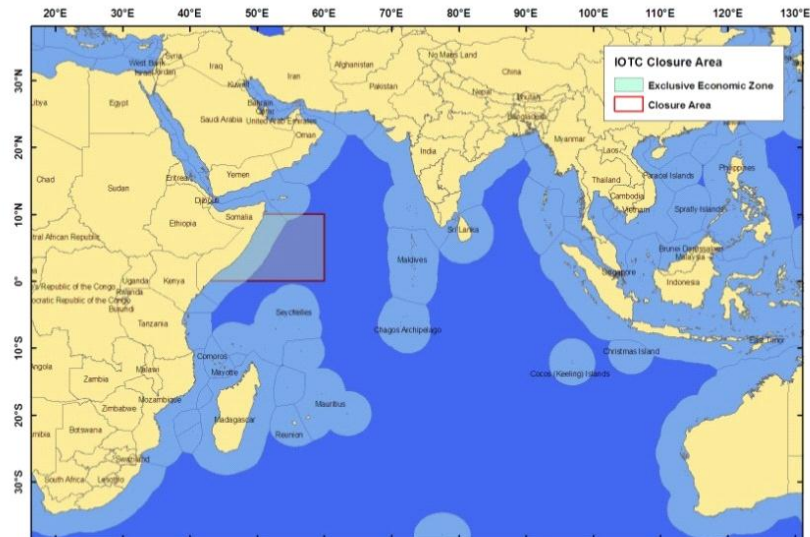
Para 50 (under bigeye section): The SC **SUGGESTED** that at future WPTT meetings, the WPTT consider developing a figure that shows the likely status of the stock under different fishing scenarios, i.e. with and without particular fleets and gears, providing that sufficient data is available, noting that size sampling for some fleets is considered unreliable. The WPTT should also consider developing yield per recruit plots.

[Evaluation under the MSE scheme]

Para 191: 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 Management Strategy Evaluation 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.

[B2] FADs closure**[Effective example in WCPFC]**

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

Subject [C] Alternative management measure (2): Area closures**[C1] Area closures**

Para 173: Noting that the request contained in Resolution 10/01 does not specify the expected objective to be achieved with the current or alternative time area closures, and that the SC and WPTT were not clear about the intended objectives of the time-area closure taking into account recent reduction of effort as well as recent likely recovery of the yellowfin tuna population, the SC **RECOMMENDED** that the Commission specify clear objectives as to what are the management objectives to be achieved with this and/or alternative measures. This will, in turn, guide and facilitate the analysis of the SC, via the WPTT in 2012 and future years.

Para 177: 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.

Para 178: The SC **RECOMMENDED** 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.

Para 179: Noting that the objective of Resolution 10/01 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 population, the SC **RECOMMENDED** 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, as these are not contained within the Resolution 10/01.

Para 181: The SC **NOTED** the results of the study which indicated that the current IOTC closure network with 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

Para 182: The SC **NOTED** that if there were to be a year-round closure of the IOTC area, in addition to the BIOT and Maldivian closures, and under the assumption that fishing effort was removed entirely, would result in the most beneficial conservation outcomes. However, if effort was reallocated under these scenarios, there would be little benefits to the stocks and possibly more fishing pressure in other areas of the distribution range of the stocks. Thus, taking into consideration the precautionary approach, the issues of potential effort reallocation will need to be considered.

Para 183: The SC **AGREED** that the current network of closures is unlikely to be sufficient to protect yellowfin tuna stocks without additional management measures (e.g. a quota allocation system).

Subject [D] Other relevant information**[D1] Piracy effect on yellowfin and bigeye tuna stock****[Bigeye tuna catch drop]**

Para 49: The SC **NOTED** that the recent drop in catches of bigeye tuna could be related to the expansion of piracy in the western tropical Indian Ocean, which has led to a marked drop in the levels of longline effort in the core fishing area of the species. The purse seine effort also declined substantially (30% in number of EU purse seiners) and this, combined with the drop of longline effort, had a positive effect on status of the stock. In addition, it was considered that during the period of record catches of yellowfin tuna (2003–2006), fishing effort on bigeye tuna was also reduced to a level which allowed rebuilding of the stock over several years.

[Effort reduction]

Para 122: The SC **NOTED** that many papers presented at the WPTT meeting in 2011 demonstrated clear impacts of piracy on fishing operations in the western Indian Ocean (Somali Basin). In particular, the impacts appear to have been greatest on the longline fleets with effort having declined to negligible levels in recent years by most fleets. Of the vessels from Taiwan, China, 10 have moved to the Atlantic Ocean. These originally targeted bigeye tuna, however according to information from observers; some of the remaining vessels have now moved south to target albacore. Japan reported a reduction of ~90 vessels since 2006, with 85 remaining in 2010 (preliminary numbers), which corresponds to a decrease of total catch of about 75–80%. 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 Korean active vessels, from 26 in 2006 to 13 in 2010, while the remaining vessels moved to the Southern Indian Ocean.

[Effect not significant in PS]

Para 123: The SC **NOTED** the number of purse seiners has decreased from 51 in 2006 to 35 in 2010 (30% reduction). There was also a large increase in the proportion of sets made on drifting FADs by the EU fleet (from 53 to 77%) and a parallel decline of sets made on free schools. For security reasons, the number of supply vessels has also decreased in comparison with previous years. Fishing effort of the EU purse seine fleet initially shifted east by at least 100 miles compared to the historic distribution of effort in the Somali basin, but the fleets progressively returned in the traditional area whilst military forces were set on board the vessels. However this situation halted the EU observer programme in 2008, but which resumed on EU, France and France (OT) vessels in 2011. Overall, the piracy situation did not significantly decrease the catch and the catch rates of the EU purse seine fleet.

APPENDIX A : STATUS OF YELLOW TUNA STOCK AND MANAEGMENT ADVICE (quoted from the Exective Summary in the SC14 report)

Stock status. The stock assessment model used in 2011 suggests that the stock is currently not overfished ($B_{2009} > B_{MSY}$) and overfishing is not occurring ($F_{2009} < F_{MSY}$) (Table 1 and Fig. 1). Spawning stock biomass in 2009 was estimated to be 35% (31–38%) (from Table 1) of the unfished levels. However, estimates of total and spawning stock biomass show a marked decrease over the last decade, accelerated in recent years by the high catches of 2003–2006. It was noted that the current assessment does not explain the high catches of yellowfin tuna from 2003 to 2006, as it does not show peaks in fishing mortality or biomass for this period. Recent reductions in effort and, hence, catches has halted the decline.

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.

Outlook. 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 (299,074 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 higher yields based on the estimated levels of recruitment from over the last 15 years.

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

Area ¹	Indicators – 2011 assessment		2011 stock status determination
			2009 ²
Indian Ocean	Catch 2010:	299,074 t	
	Average catch 2006–2010 (1000 t):	326,556 t	
	MSY:	357 (290–435)	
	F_{2009}/F_{MSY} :	0.84 (0.63–1.10)	
	SB_{2009}/SB_{MSY} :	1.61 (1.47–1.78)	
	SB_{2009}/SB_0 :	0.35 (0.31–0.38)	

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

²The stock status refers to the most recent years' data used for the assessment.

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

Indian Ocean stock – Management Advice

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 $B < B_{MSY}$. 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 $B > B_{MSY}$ 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.

The SC **RECOMMENDED** the following:

- The Maximum Sustainable Yield estimate for the whole Indian Ocean is 357,000 t with a range between 290,000–435,000 t (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 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.

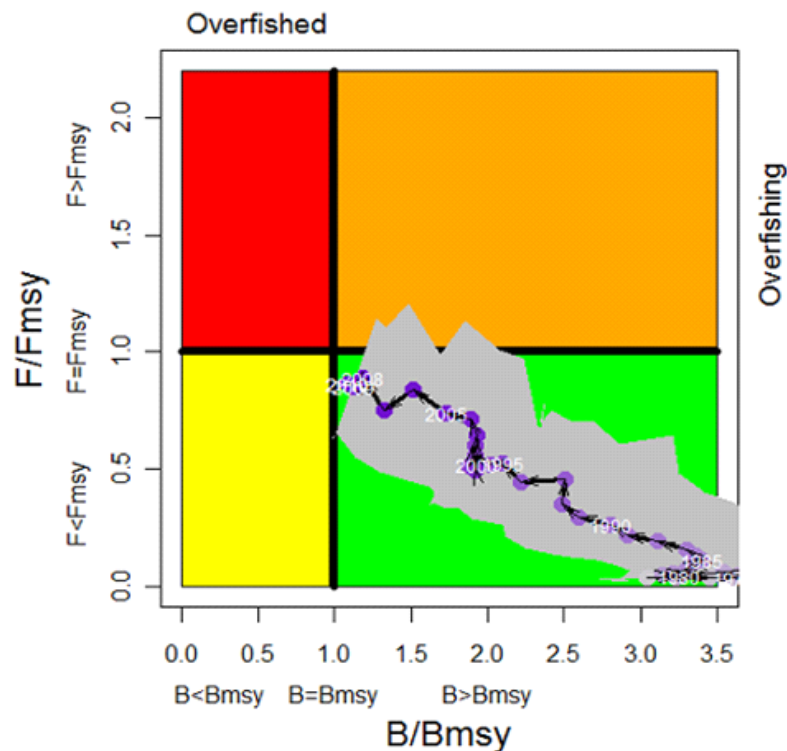


Fig. 1. MULTIFAN-CL Indian Ocean yellowfin tuna stock assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year 1972–2009. The equal weighted mean trajectory of the scenarios investigated in the assessment. The range is given by the different scenarios investigated.

TABLE 2. 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, $\pm 20\%$ and $\pm 40\%$) 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.

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)
$B_{2013} < B_{MSY}$	<1	<1	<1	<1	<1
$F_{2013} > F_{MSY}$	<1	<1	58.3	83.3	100
$B_{2020} < B_{MSY}$	<1	<1	8.3	41.7	91.7
$F_{2020} > F_{MSY}$	<1	41.7	83.3	100	100

There was considerable discussion on the ability of the WPTT to carry out projections with Multifan-FCL for yellowfin tuna. For example, it was not clear how the projection redistributed the recruitment among the different regions, as the recent recruitment distribution, assumed in the projections, was different from the historical one. The WPTT agreed that the true uncertainty remains 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 that, at this time, the Kobe 2 matrices do not represent the full range of uncertainty from the assessments. Therefore, the inclusion of these matrices at this time is primarily intended to familiarise the Commission with the format and method of presenting management advice.

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

Resolution 09/02 *On the implementation of a limitation of fishing capacity of contracting parties and cooperating non-contracting parties.*

Resolution 10/01 *for the Conservation and Management of tropical tunas stocks in the IOTC area of competence.*

Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's).*

Resolution 10/03 *concerning the recording of catch by fishing vessels in the IOTC area.*

Resolution 10/07 *concerning a record of licensed foreign vessels fishing for tunas and swordfish in the IOTC area.*

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.*

Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence.*

APPENDIX B : STATUS OF BIGEYE TUNA STOCK AND MANAEGMENT ADVICE (quoted from the Exective Summary in the SC14 report)

Stock status. Both assessments suggest 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.

Outlook. The recent declines in longline effort, particularly from the Japanese, Taiwan, China and Republic of Korea longline fleets, as well as purse seiner 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.

Catches in 2010 (71,489 t) were lower than MSY values and catches in 2009 (102,664 t) were at the lower range of MSY estimates. The mean catch over the 2008–2010 period was 93,761 t which is lower than estimated MSY.

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 management actions (Table 2). Based on the ASPM projections this year (2011) 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 71,489 t (maximum of 15% risk of $B < B_{MSY}$) or 2009 catches of 102,664 t (<40% risk that $B_{2020} < B_{MSY}$ and $F_{2020} > F_{MSY}$). Moreover, the SS3 projections from last year (2010) 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 102,664 t from 2009 (< 30% risk that $B_{2019} < B_{MSY}$ and < 25% risk that $F_{2019} > F_{MSY}$) (Table 1).

At this time, annual catches of bigeye tuna should not exceed 102,000 t. If the recent declines in effort continue, and catch remains substantially below the estimated MSY, 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.

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

Area ¹	Indicators – 2011 assessment			2011 stock status determination
				2009 ²
Indian Ocean		SS3 ³	ASPM ⁴	
	Catch:	102,000 t	71,500 t	
	Average catch last 5 years:	104,700 t	104,700 t	
	MSY:	114,000 (95,000–183,000 t)	102,900 t (86,600–119,300 t)	
	F_{curr}/F_{MSY} :	0.79 (0.50–1.22)	0.67 (0.48–0.86)	
	SB_{curr}/SB_{MSY} :	1.20 (0.88–1.68)	1.00 (0.77–1.24)	
	SB_{curr}/SB_0 :	0.34 (0.26–0.40)	0.39	

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

²The stock status refers to the most recent years' data used for the assessment.

³Central 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.

⁴Median 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.

Current period ($_{curr}$) = 2009 for SS3 and 2010 for ASPM.

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

Indian Ocean stock – Management Advice

The SC **RECOMMENDED** the following:

- The Maximum Sustainable Yield estimate for the Indian Ocean ranges between 102,900 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 management advice.
- If the recent declines in effort continue, and catch remains substantially below the estimated MSY of 102,900–114,000 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.

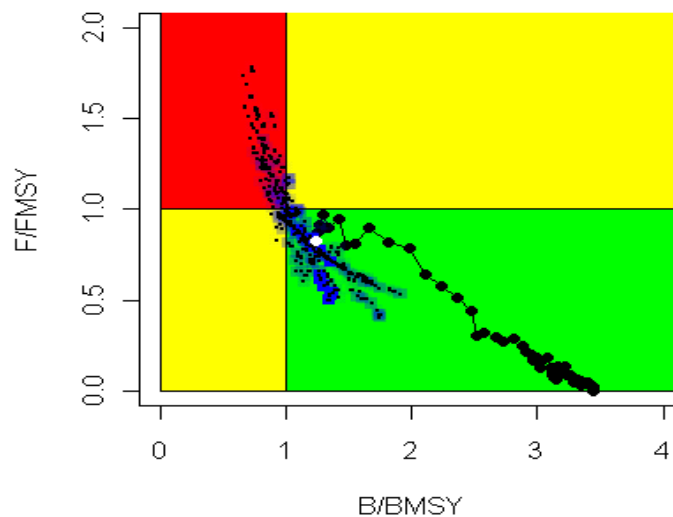


Fig. 1. SS3 Aggregated Indian Ocean assessment Kobe plot. Black circles represent the time series of annual median values from the weighted stock status grid (white circle is 2009). Blue squares indicate the MPD estimates for 2009 corresponding to each individual grid C model, with colour density proportional 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, $\pm 20\%$ and $\pm 40\%$) 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 plausible as these values but are not presented for simplification).

Reference point and projection timeframe	Alternative catch projections (relative to 2009) and probability (%) of violating reference point				
	2010 SS3				
	60%	80%	100%	120%	140%
	(61,200 t)	(81,600 t)	(102,000 t)	(122,400 t)	(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%	80%	100%	120%	140%
	(42,900t)	(57,200t)	(71,500t)	(85,800t)	(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 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area.*

Resolution 09/02 *On the implementation of a limitation of fishing capacity of contracting parties and cooperating non-contracting parties.*

Resolution 10/01 *for the conservation and management of tropical tunas stocks in the IOTC area of competence.*

Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's).*

Resolution 10/03 *concerning the recording of catch by fishing vessels in the IOTC area.*

Resolution 10/07 *concerning a record of licensed foreign vessels fishing for tunas and swordfish in the IOTC area.*

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.*

Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence.*