出國報告(出國類別：其他)

參加「印度洋鮪類委員會（IOTC）第 14 屆科學次委員會（SC14）會議」報告

服務機關：行政院農業委員會漁業署
姓名職稱：技正　周世欽
派赴國家：賽席爾
出國期間：100 年 12 月 10 日至 12 月 19 日
報告日期：100 年 12 月 25 日

摘要

本次印度洋鮪類委員會（IOTC）第 14 屆科學次委員會（SC14）會議於本（2011）年 12 月 12 至 17 日在塞席爾（Seychelles）國際會議中心舉行，共有 17 個國家或領地參加，觀察員包括 FAO、WWF、SWIOFP（西南印度洋漁業計畫）、MSC、ISSF、Birdlife International 及俄羅斯等，我國則以受邀專家（Invited experts）身份與會。有關本次會議重要結果如次：

一、長鰭鮪：過漁正在進行中，且有處於已經過漁狀態之風險。現今的漁獲量已經高於最大持續生產量（MSY）（29,900 噸，範圍：21,500-33,100 噸），維持獲增加努力量將造成未來資源量下降。

二、大目鮪：未處於已經過漁狀態且過漁正在進行中亦未發生。建議年度大目鮪漁獲量不要超過 MSY（102,900 噸，範圍：86,600-119.300 噸）。

三、正鰹：未處於已經過漁的狀態，MSY 爲 564,000 噸（範圍：395,000-843,000 噸）。建議漁獲量不要超過 2005-2009 年之平均水準（492,000 噸）。

四、黃鰭鮪：未處於已經過漁之狀態，且過漁並未進行中，惟有發生之風險。建議黃鰭鮪年度漁獲量不要超過 MSY 水準（357,000 噸，範圍：290,000-435,000 噸）之下界。

五、劍旗魚：未處於已經過漁狀態，且過漁亦未正進行中；建議年度漁獲量不要超過 MSY（31,000 噸，範圍：20,000-55,000 噸）水準。

六、IOTC 將參考中西太平洋漁業委員會（WCPFC）進行參考點之探討，以因應管理需求，未來將以限制性參考點及標的參考點爲主要討論重點。

七、混獲物種忌避措施部分，海鳥以支繩加重爲研究重點；另，澳洲推動鯊魚鰭自然結附（natural attached），惟日本以鯊魚鰭在結凍後相當鋒利，影響作業安全爲由，造成會中無法達成共識。

八、下屆 SC 主席及副主席分別由日本 Dr. Nishida 博士及塞席爾籍 Mr. Jan Robinson 接任。

九、有關 IOTC SC14 所建議各項科學研究議題，將視可行性及重要性規劃納入 2011 及 2012 年遠洋漁業相關科技計畫。

關鍵詞：印度洋鮪類委會，科學委員會，鮪旗魚類，資源評估

目次

壹、目的

「印度洋鮪類委員會(IOTC)爲負責印度洋鮪類資源管理之國際漁業組織，隸屬於聯合國糧農組織(FAO)。自 1996 年成立以來，該組織即積極對該洋區主要漁獲魚種進行資源評估，其中熱帶鮪類漁獲量大，且產值高，爲近年來該組織最關切之魚種。

印度洋爲我國鮪釣船主要作業漁場之一，近年來我國在該洋區作業之船隊規模大，年漁獲量達十萬公噸，位居各國前茅，IOTC 會議結果對我國產業極爲重要。由於目前各國際組織爲達資源永續利用之目標，正積極加強對各魚種資源的管理，並以漁獲配額爲管理手段。因此爲避免影響我國漁船於印度洋之作業權益，並善盡漁業國之責任，及獲取各國肯定支持我國科研之努力及對資源保育之貢獻，作爲未來爭取參與 IOTC 之基礎，我國乃派員參加本次會議。

貳、會議過程及結果

IOTC 第 14 屆科學委員會會議（SC）於本（2011）年 12 月 12 至 17 日在塞席爾（Seychelles）國際會議中心舉行。由法國籍 Dr. Francis Marsac 擔任主席，計有澳洲、日本、韓國、馬爾第夫、泰國、阿曼、歐盟法國、歐盟西班牙、歐盟葡萄牙、模里西斯、印尼、肯亞、印度、科莫羅群島、塞昔爾、斯里蘭卡、英屬地查哥斯群島等會員國代表出席，另有 FAO、WWF、SWIOFP（西南印度洋漁業計畫）、MSC、ISSF、Birdlife International 及俄羅斯以觀察員身分參與。我國則以受邀專家（Invited experts）身份與會，團員包括本署周世欽技正、南華大學葉裕民助理教授及對外漁業合作發展協會於仁汾組長等。

第 8 屆統計工作小組會議

本次 SC14 前之第 8 屆統計工作小組會議於本年 12 月 8 至 10 日於塞昔爾維多利亞港召開，參與國代表分別有馬爾地夫、阿曼、日本、泰國、法國、西班牙、澳洲、韓國、西南印度洋漁業計畫代表、日本海外漁業合作基金代表以及科學次委員會主席等，我國由對外漁協資訊組組長於仁汾代表參加，茲先將統計工作小組會議內容陳報如后：

12 月 8 至 10 日

一、 會議開始首先由 IOTC 資料負責人 Miguel Herrera 擔任主席，主席首先徵詢與會代表對此次議程之意見，在無其他異議後依照議程召開會議。

二、 第 13 屆科學次委員會及第 15 屆委員會會議對資料項目議題建議

由小組主席就去年科學次委員會會議及今年委員會會議討論有關資料議題作說明，其中科學次委員會會議建議本次統計小組會議討問有關區域性觀察員航次報告內容，委員會會議建議本次統計小組會議討論有關會員國繳交資料品質與時程、刺網漁業資料蒐集不全問題以及各項漁業訂定作業報表最低蒐集項目等。

三、 去年小組會議後各項統計議題進程

由小組主席摘要提示去年小組會議討論議題之工作進度，其中未解決項目包含印尼、印度及伊朗等國之漁獲資料蒐集、沿岸鮪種漁獲資料蒐集、日本漁獲體長資料回報量提昇、區域性觀察員名單提報、資源評估資料不確定性敏感度分析、魚種辨識圖鑑以及泰國圍網船大目鮪組成推估等。

四、 檢視與統計資料相關之管理措施建議案

由 IOTC 副秘書長就目前有效之管理建議案作簡單說明，其中 08/04 號案爲有關延繩釣漁業作業報表最低資料蒐集項目、10/02 號有關會員國及合作非會員國漁業資料提送、10/03 號案有關圍網作業報表最低資料蒐集項目、10/07 號有關捕撈鮪類及劍旗魚漁船船數提送、11/04 號有關 IOTC 區域性觀察員計畫以及 11/06 號有關刺網及鰹竿釣漁業作業報表最低資料蒐集項目等。

五、 檢視區域性觀察員航次報告格式

主席表示目前區域性觀察員航次報告資料提送項目包含有延繩釣支繩及鋼絲使用類型及數量、漁船電子設備類型及數量、1 度方格彙整資訊、海況、漁獲遭咬食情形、漁具遺失以及鉤形數量及尺寸等，因討論時間有限，顧希望與會代表提出技術性意見。

日本代表表示部分項目可能涉及漁船作業機密性，可能部分資訊觀察員無法取得，因此建議保持彈性，並非強制所有項目都要進行報告；鳥盟及澳洲代表則持反對意見，認爲觀察員應取得所有資訊，漁船應作業透明；我方發言支持日方看法，部分資料可能觀察員無法蒐集，且這是個別船航次觀測紀錄，報告之資訊非常詳細，如觀察員未蒐集到資料可能無法達到航次報告標準；法國代表發言表示 IOTC 要求之觀察員航次報告進度太快，應循序漸進達到要求；主席表示同意應保留彈性，但應有時程漸進達成，在與會代表無其他異議下通過觀察員航次報告資料項目保持彈性，如蒐集困難則可以保持空白，但應有期限要求會員國達到所有要求。

法國及西南印度洋計畫代表發言表示目前已經發展完成觀察員資料庫系統，未來可以將資料庫架構轉移給 IOTC 使用。

另外有關延繩釣使用鋼絲之資訊蒐集部分，澳洲及鳥盟代表仍建議會員國應加強相關資料蒐集提報，澳洲代表特別強調目前澳洲、南非及英屬地以禁用鋼絲釣線，也會在委員會提案要求 IOTC 海域內全面禁用，主席表示統計小組爲資料技術性會議，建議澳洲代表將此案建議由生態系小組提出。

六、 秘書處資料相關議題報告

由主席就目前秘書處資料蒐集議題進行報告，報告中與我國相關部分有小釣資料問題，主席補充說明台灣近年小釣資料回收率已經有顯著提升，1-2 年就可以完全解決，以希望台灣能在小釣資料蒐集上持續加強，另外秘書處統計人員檢查日本及我國提送之漁業資料，發現日本及我國提送之 task2 資料換算成單尾平均體重與提送體長資料換算之單尾平均體重有很大差異，由報告中看出我國近年之 task2 資料換算之大目鮪、黃鰭鮪及劍旗魚

體重偏小，經私下與主席討論，該問題可能在於放大過程中作業報表填報GG 重，放大後估算之漁獲尾數高估所致，主席同意我方說法，另對於歷史資料主席希望我方能再次檢視，我方回覆可能因先前報表回收率年間差異大，放大後導致各年的變異不同所致，回國後會檢視相關資料。

七、 會員國統計系統

由泰國報告有關普吉島外國漁船採樣資料蒐集情形，馬爾地夫報告有關該國鰹竿釣漁業資料蒐集情形以及阿曼報告漁業資料蒐集及處理系統。

八、 協助沿岸國資料蒐集工作與進度

由 OFCF 計畫專案人員進行報告，該計畫執行情況，該計畫下年度爲最後一年，日本代表表示希望小組做出建議維持該計畫，與會代表均表示該計畫應與以維持，但仍希望沿岸國能建立自主統計系統

九、 作業報表最低蒐集項目

澳洲代表報告有關各項漁業對應科學研究之建議最低資料蒐集項目，該案澳洲代表表示會在下屆委員會正式提出，小組主席表示目前委員會已經有建議案，因此該報告未與以討論。

針對各項漁業作業報表最低資料蒐集項目，有關延繩釣部份我國提意丟棄部分體重資料難以蒐集，記錄尾數即可，主席表示同意，因此丟棄部分改爲蒐集尾數或重量資訊以普遍適用在所有漁業上。

十、 其他事項

泰國代表私下表示仍希望能與我國達成港口採樣協議，我方表示該案我政府立場爲應在農業 MOU 架構下進行討論，泰方表示了解我方立場也建議在下週科學次委員會議期間與泰國漁業局國際司官員洽談，泰方另詢問未來是否有可能要求我國小釣船進港繳交報表，我方代表表示此爲可行項目，如在農業 MOU 項目下達成共識，泰方未來蒐集報表送交我國，是我方樂見之發展。

IOTC 第 14 屆科學委員會會議

IOTC 第 14 屆科學委員會會議（SC）由法國籍 Dr. Francis Marsac 擔任主席，計有澳洲、日本、韓國、馬爾第夫、泰國、阿曼、歐盟法國、歐盟西班牙、歐盟葡萄牙、模里西斯、印尼、肯亞、印度、科莫羅群島、塞昔爾、斯里蘭卡、英屬地查哥斯群島等會員國代表出席，另有 FAO、WWF、SWIOFP（西南印度洋漁業計畫）、MSC、ISSF、Birdlife International 及俄羅斯以觀察員身分參與，我國則以受邀專家（Invites experts）身份與會。謹將會議重要結果摘述如下：

12 月 12 日

一、 由主席 Dr. Francis Marsac 宣佈會議開始。

二、 主席 Dr. Francis Marsac 宣讀議程，在參與會員國對該議程無異議的情況下通過議程（IOTC–2011–SC14–01a,b、IOTC–2011–SC14–02）。此外，並

說明本次會議之會議文件編號暨網路設定。

三、 與會員國及受邀專家自我介紹（略）。

四、 由秘書處報告本年度第 15 屆委員會會議之各項進展與結論（IOTC–2011–SC14–03），並說明該委員會議所作之決定（IOTC–2011–SC14–04）。

五、 由秘書處說明本（2011）年度各項活動（IOTC–2011–SC14–05），本年度 IOTC 秘書處共舉行「旗魚」、「溫帶鮪類」、「熱帶鮪類」、「生態系及混獲」、「沿近海鮪類（neritic tuna，小鮪）」、「資料蒐集與統計」等工作小組會議，及本次的第 14 屆科學委員會；在受邀專家部份，除「第 14 屆科學委員會會議」及「資料蒐集與統計工作小組會議」外，前述各項會議之受邀專家包括：

1. 旗魚工作小組會議：Dr. Toshihide Kitakado（Tokyo University of Marine Science and Technology – Japan）。

2. 溫帶鮪類工作組會議：Dr. Simon Hoyle（Secretariat of the Pacific Community – SPC/OFP）。

3. 熱帶鮪類工作小組會議：Dr. Joe Powers（Louisiana State University – USA）與 Ms. Paige Eveson（CSIRO – Australia）。

4. 生態系及混獲工作小組會議：Dr. Evgeny Romanov（CAPRUN-ARDA – La Réunion）與 Dr. Enric Cortes（NMFS-NOAA – USA）。

5. 沿近海鮪類工作小組會議：Dr. Shane Griffiths（CSIRO - Australia）。

此外，亦舉開在能力建構工作會議（Capacity building workshop），以降低會員國間對於資源評估、資料蒐集與資料庫管理、漁業管理等相關議題之認知與實施缺口（Gap）。說明會議參與基金（Meeting Participation Fund）之使用情形。資料相關活動包括一般性及執法性與 IOTC-OFCF Project，前揭計畫計在 Comoros、Iran、Sri Lanka、Iran 等國舉行資料與統計議題之工作會議。另，網頁的更新，預計明年年初可以完工；標釋放流資料的維護與利用等等。

六、 國家報告（IOTC–2011–SC14–NR01 to 32），謹摘錄討論較爲詳細之國家報告部份重點：

1. 印尼（IOTC–2011–SC14–NR10）：SC 關心其統計資料的蒐集與繳交現況、鯊魚的忌避措施等。

2. 日本（IOTC–2011–SC14–NR12）：SC 關心其觀察員所蒐集之體長資料之空間分佈及採樣設計與方法，也就是體長資料的代表性問題，日本表示此觀察員計畫才開始不到一年，觀察員大部分是配置在南緯，目前只有 2 位配置在赤道；現階段的採樣設計與方法尚無設立標準，日後爲綜合考量。

3. 馬爾地夫（IOTC–2011–SC14–NR17）：SC 關心正鰹漁獲量近年大幅下

降，主要原因尚不明確。

4. 模里西斯（IOTC－2011－SC14－NR18）：長鰭鮪今年漁獲幾乎是過去的兩倍，SC 推測可能是索馬利亞海盜活動的影響，因爲許多本在西北印度洋作業的船隻往南移轉作業漁場，漁捕長鰭鮪。

5. 斯里蘭卡（IOTC－2011－SC14－NR24）：正鰹的漁獲量幾佔總漁獲量的 25%，但是因爲沒有 logbooks，所以無法得知漁獲區域，或是在 EEZ 內外的漁獲量也無法估計。另，鯊魚亦無種別漁獲量。

6. UK-BIOT（IOTC－2011－SC14－NR28）：海洋保護區設立，SC 關心其如何監控及其對漁業資源的影響，尤其是黃鰭鮪。

主席表示，本年國家報告爲格式修改後第一次會員國提交之成果，相信日後對於新的格式在撰寫上的適應將會更好，未來仍有改善空間。

此外，亦說明所轄會員國之海鳥及鯊魚行動計畫之制定進展（IOTC–2011–SC14–33）。該報告顯示大部分會員國皆尚未公佈該國之海鳥及鯊魚行動計畫，其中遠洋國家如中國及韓國等；有關我國部份則記載於 2006 年 5 月公告海鳥及鯊魚行動計畫，此爲完成之狀態，惟目前尚未計畫公告新版行動計畫。另，Birdlife International 表示除了延繩釣漁業會對海鳥造成衝擊外，也應瞭解刺網的衝擊。

七、 2011 年各項工作小組會議報告：

1. 第 9 屆旗魚工作小組會議報告（IOTC–2011–WPB09–R），由該小組主席 Mr. Jerome Bourjea 說明。

日本表示，對於該工作小組之各項進展表示肯定，惟各模式結果都有高度不確定性，且各模式結果亦有所差異，而各式模式結果如何篩選、如何呈現是討論的主題。最後主席決議不作篩選，將各模式結果整合呈現，如將各模式結果畫在一個 Kobe matrix 內，節省空間並便於比較。

歐盟表示，對於劍旗魚之資源評估相當成功，但也相當複雜。因爲涉及劍旗魚之漁業相當複雜，所以在各漁業的重要性方面需有相當的權重進行處理，而對於漁業別的權重處理，也是國際間接受之方式。此外，對於模式的選擇與測試、CPUE 標準化的測試、ASPIC 與產量模式（production model）的測試與應用，及其他模式的考量應用等，建議應在報告中說明。另，歐盟認爲 Kobe Matrix 不見得要是用到每個魚種。日本回應表示考慮劍旗魚一直以來都採用 ASPIC 進行資源評估，今年沒有什麼特殊理由要改變，所以建議仍詳細呈現 ASPIC 的評估結果。其他三個模式的結果只以 Kobe matrix 呈現，因 SS3 和其他模式結果差異頗巨，所以獨立畫一個 Kobe matrix。

12 月 13 日

2. 第 3 屆溫帶鮪類工作小組會議報告（IOTC–2011–WPTmT 03–R），由該小組主席 Dr. Zang Geun Kim 說明。

主席表示目前長鰭鮪資源處於不佳狀態，亦即資源近似過漁正在進行且已經過漁；主席請與會代表表示意見。歐盟表示此資源系群結構不確定，體長資訊少且有偏差，使得資源評估模式選用與應用上限制頗多，建議在南非奈米比亞海域針對小魚進行標釋放流實驗多掌握一些關鍵資訊。 因西北印度洋海域海盜活動的影響，許多努力量移入南印度洋，使得長鰭鮪漁獲量大增，漁價降低。尤其近年印尼長鰭鮪漁獲大增，幾近兩倍於以往的漁獲量。建議應從漁價經濟的角度理解評估結果的變動趨勢。

3. 第 13 屆熱帶鮪類工作組會議報告（IOTC–2011–WPTT 13–R），由該小組主席 Dr. Hilario Murua 說明。

日本代表質疑資料豐富的大目鮪評估用較簡單的 ASPM 評估模式，而資料貧乏的正鰹用複雜的 SS3 評估模式，而黃鰭鮪亦只用 Multifan-CL 評估，無其他模式進行相互比較。熱帶工作小組主席回覆長久以來大目鮪皆是採用 ASPM 評估模式，黃鰭鮪用 Multifan-CL 的原因是當初只有此評估工具可以將標釋放流資料內入整合分析，且今年雖有用 SS3 嘗試分析此資源但不成功。至於正鰹，SS3 雖然是複雜的模式，但是還是可以透過模式設定及資料需求降低以簡化模式。整體結論是，明年應還是需要針對正鰹進行正式評估，屆時希望相關 CPUE 序列可提供利於模式分析。黃鰭鮪資源評估結果與實際漁業現況頗不吻合，雖然目前評估結果似乎頗爲樂觀，但是仍有一些警訊，仍須密切注意加以研究。另建議日後應該將各漁業對於資源的衝擊作表格分析呈現，以瞭解對於資源漁業壓力的面貌。

歐盟報告「A comparison between stocks and between 2011 stock assessment results of yellowfin in the Indian and Eastern Pacific oceans（IOTC–2011–SC14–46）」：鼓勵跨洋區的科學性討論，至於討論形式等實施的細節還在討論階段。

4. 第 1 屆沿近海鮪類工作小組會議報告（IOTC–2011–WPNT 01–R），由秘書處人員代爲說明（小組主席 Dr. Prathibha Rohit 未出席）。本會議報告並無太多討論，不贅述。

5. 第 7 屆生態系及混獲工作小組會議報告（IOTC–2011– WPEB07–R），小組主席 Dr. Charles Anderson 缺席，由 SC 主席 Dr. Francis Marsac 說明，該小組建議漁業作業報表增列鯊種、鯊魚禁割鰭並刪除鰭身比管理規定、禁止延繩釣使用鋼絲釣線及鋼絲串線、會員國提交鯊種別漁獲量、延繩釣海鳥忌避措施縮減爲三項選二項(夜間投繩、避鳥繩及支繩加重)，以及海龜管理措施建議案文字修正等。

澳洲報告「Review of IOTC discussions and recommendations for shark conservation in the Indian Ocean（IOTC–2011–SC14–45）」，其報告內容主要建議 IOTC 作出禁割鰭及禁用鋼絲釣線與鋼絲串線等管理建議，該報告並未進行討論，然澳洲代表表示將在下年度委員會會議正式提出該報告。

有關混獲物種管理建議案，歐盟代表表示將在 2012 年宣布所屬漁船禁割鰭，澳洲亦提出會場中澳洲及台灣已經正式公告禁割鰭，日本代表表示該國已經與南非合作進行之繩加重實驗，塞昔爾代表認爲鯊魚管理案應由業界自主作技術創新而不應有太強烈之管理建議。

主席表示有關混獲物種部分應依序從鯊魚、海鳥及海龜作討論，海龜部分僅是管理規定文字修改(將原先建議案之「hard shelled turtles」改爲「marine turtles」以將革龜納入管理)，與會代表對此無特別意見。

鯊魚部分日本代表首先表示該國均有提報鯊種漁獲資料，且其他國際組織並無禁割鰭之建議案，作業報表部分增列鯊種應考慮到各國有關正式文件公告國內法問題不宜頻繁更動，混獲資訊由觀察員進行蒐集即可，韓國發言表示支持日方看法；歐盟表示下年度將推行電子報表，鯊種都有圖鑑所以辨種沒有問題；馬爾地夫代表提出管理成本概念，有新決議案就必須更動統計系統及教育漁民，要給會員國時間彈性做調整，斯里蘭卡代表發言表示支持馬爾地夫看法；澳洲代表發言表示如果委員會沒有決議案，業界不可能會有自主調整的可能，所以塞昔爾代表的說法不成立，另外禁用鋼絲部分主要針對商業性延繩釣，也理解要有時間彈性讓會員國作調整。

主席表示各國發言差異頗大，明顯沒有共識，日本代表表示願意提出 WPEB 小組建議案之修正文字供討論，主席表示同意，也建議由與會代表組成小組進行相關建議案文字討論。

12 月 14 日

接續昨日討論，主席提出目前鯊魚管理建議相關內容包含鰭身比 5%修正案。日本代表提出 WPEB 小組引用 IUCN 的資源評判基準不恰當，主席表示接受日本說法，但也提出 WPEB 只是引用作爲一般性的資訊，並無未用來做管理建議之參考依據。

有關鯊魚魚翅自然結附（natural attached）議題，日本提出建議文字，略以：「認爲對於鯊魚的利用，應鼓勵全漁利用，並確保相關漁獲統計資料的蒐集以及生物參數的獲得。目前應以 IOTC Resolution 05/05（鰭身比爲 0.5）爲實施標的，倘以自然結附作爲管理措施時，考量操作實務，冷凍後之魚翅將有如刀子一般鋒利，不利漁民之作業安全；此外，在解凍的過程，將降低漁獲物品質造成其價值下降。所以，SC 應建議會員國盡量取得最佳資料，包括種類辨識。」；澳洲代表提出鰭的部分應該還是要自然結附，但考量到安全顧慮也願意考慮日本所提文字修正，歐盟表示接受日本說法也接受澳洲說法，主席決議會後小組討論最終文字案，並提醒此案仍在無共識下處理。

有關海鳥忌避措施修正部分，日本表示需要內部討論因此建議下午休會後再討論，主席表示接受日本說法，另鳥盟提出 ICCAT 已經在本年度委員會修正海鳥忌避措施，WPEB 所提出就是依照 ICCAT 版本。

6. 第 8 屆資料蒐集及統計工作小組會議報告（IOTC–2011–

WPDCS08–R），由小組主席 Mr. Miguel Herrera 說明。

日本表示，有關觀察員需蒐集之資料包括：(1)延繩釣漁業之支繩及 wire leaders 種類與數量，(2)船上用的電子設備及數量，(3)作業漁場位置資訊（1 度方格），(4)海上之氣象狀況，(5)漁獲物被咬食之情況，(6)漁具遺落情況，(7)使用鉤數及鉤子的形狀；其中，日方無法接受第(3)項，作業位置爲漁船作業之機密，可能受到船長的限制，所以觀察員可能無法獲的較爲詳細的作業位置資料，建議以 5 度方格爲解析，至於其他項目可以接受，主席表示 5 度方格將建議委員會作修正。泰國、韓國、印尼等國皆支持日本提案。澳洲、歐盟及英屬地代表均發言表示這些是科學資料，應要求會員國強制提送；我方表示，觀察員派遣至小型延繩釣漁船紀錄相關資料，基本上是相當困難的，去年的經驗相當的不好，有 7 位觀察員派至小型延繩釣漁船執行任務，結果很多情況無法蒐集到作業資訊，7 位觀察員歸航後皆離職，也連帶影響到一半以上有經驗觀察員離職，反而對國家觀察員計畫帶來很大影響，主席表示文字部分希望會員國代表提供意見，之後再決定最終文字。

另有關鰹竿釣作業報表部分，馬爾地夫表示其中部分內容有意見，主席表示接受可做小幅修正。

統計小組主席表示目前有很多會員國未依照鮪員會規定繳交資料，這部分該如何處理？主席表示目前可能沒有強制方法。日本提出有關作業報表增列鯊種部分無法接受，主席表示會在之後會議討論。

統計小組下年度將不召開會議，與會代表無異議同意。

八、 更新「Kobe Process」：第 1 屆混獲聯席技術工作會議報告（IOTC－2011－SC14－06），混獲工作組主席 Dr. Charles Anderson 未出席，由主席 Dr. Francis Marsac 說明，會中並無討論。Kobe III 會議之建議（IOTC－2011－SC14－07），由主席 Dr. Francis Marsac 說明；歐盟代表對於 KOBE 會議進程表示失望。

九、 評估海盜對於船隊作業及漁獲量與努力量之影響

主席表示因爲索馬利亞海盜的問題，造成漁船作業漁場改變，熱帶鮪類漁獲量降低約 30%，努力量移到溫帶鮪類作業漁場，長鰭鮪漁獲量增。歐盟有 15%的圍網船隊在印度消失了。所以，海盜的影響仍需進一步就漁場作業及資源兩個層面加以探討。

十、 印度洋鮪類及類鮪類資源狀態

1. 長鰭鮪（IOTC–2011–SC14–08）

2010 年漁獲死亡率已大於最大持續生產量（MSY）水準，顯示過漁正在進行中；資源量略小於 MSY 水準，顯示該資源有處於已經過漁狀態之風險。

現今的漁獲量已經高於 MSY，維持獲增加努力量將造成未來資源量、CPUE、生產量等下降。

Management Quantity	**Aggregate Indian Ocean**
2010 catch estimate (1,000 t)	43.7
Mean catch from 2006–2010 (1,000 t)	41.1
MSY (1,000 t) (80% CI)	29.9 (21.5–33.1)
Data period used in assessment	1980–2010
F_{2010}/F_{MSY} (80% CI)	1.61 (1.19–2.22)
B_{2010}/B_{MSY} (80% CI)	0.89 (0.65–1.12)
SB_{2010}/SB_{MSY}	–
B_{2010}/B_{1980} (80% CI)	0.39 (n.a.)
SB_{2010}/SB_{1980}	–
$B_{2010}/B_{1980, F=0}$	–
$SB_{2010}/SB_{1980, F=0}$	–

會中僅有日本及 ISSF 對於執行摘要中之資源狀態表格表現方式需有一致性之呈現之建議。

2. 大目鮪（IOTC–2011–SC14–09）

最近之漁獲死亡率小於 MSY 水準，顯示資源並未處於過漁正在進行中的狀態；最近之親魚資源量大於 MSY 水準，顯示資源並未處於已經過漁的狀態。

建議年度大目鮪漁獲量不要超過 MSY。

Management Quantity	**2010 SS3**	**2011 ASPM**
2009 (SS3) and 2010 (ASPM) catch estimate (1,000 t)	102	71.5
Mean catch from 2006–2010 (1,000 t)	104.7	104.7
MSY (1,000 t)	114 (95–183)	102.9 (86.6–119.3)
Data period used in assessment	1952–2009	1950–2010
F_{curr}/F_{MSY}	0.79 (0.50 – 1.22)	0.67 (0.48–0.86)
B_{curr}/B_{MSY}	–	–
SB_{curr}/SB_{MSY}	1.20 (0.88 – 1.68)	1.00 (0.77–1.24)

B_{curr}/B_0	–	0.43 (n.a.)
SB_{curr}/SB_0	0.34 (0.26 – 0.40)	0.39
$B_{curr}/B_{0, F=0}$	–	–
$SB_{curr}/SB_{0, F=0}$	–	–

3. 正鰹（IOTC–2011–SC14–10）

2009 年之親魚資源量約爲 MSY 水準的 2.56 倍，顯示資源未處於已經過漁的狀態。

建議漁獲量不要超過 2005-2009 年之平均水準。

Management Quantity	**Aggregate Indian Ocean**
2009 catch estimate (1,000 t)	456
Mean catch from 2005–2009 (1,000 t)	492 [512]
MSY (1,000 t) (90% CI)	564 (395–843)
Data period used in assessment	1950–2009
C_{2009}/MSY (90% CI) (proxy for F_{2009}/F_{MSY})	0.81 (0.54–1.16)
B_{2009}/B_{MSY}	–
SB_{2009}/SB_{MSY} (90% CI)	2.56 (1.09–5.83)
B_{2009}/B_0	–
SB_{2009}/SB_0 (90% CI)	0.53 (0.29–0.70)
$B_{2009}/B_{1950, F=0}$	–
$SB_{2009}/SB_{1950, F=0}$	0.53 (0.29–0.70)

4. 黃鰭鮪（IOTC–2011–SC14–11）

2009 年之資源量及親魚資源量皆大於 MSY 水準，顯示資源並未處於已經過漁之狀態；2009 年之漁獲死亡率則略小於 MSY 水準，顯示資源亦未處於過漁正在進行之狀態，但仍有發生之風險。

建議黃鰭鮪年度漁獲量不要超過 MSY 水準之下界（約 300,000 t）。

Management Quantity	**Indian Ocean**
2010 catch estimate (1,000 t)	299.1
Mean catch from 2006–2010 (1,000 t)	326.6

MSY (1,000 t)	357 (290–435)
Data period used in assessment	1972–2010
F_{2009}/F_{MSY}	0.84 (0.63–1.10)
B_{2009}/B_{MSY}	1.46 (1.35–1.59)
SB_{2009}/SB_{MSY}	1.61 (1.47–1.78)
B_{2009}/B_0	0.49
SB_{2009}/SB_0	0.35 (0.31–0.38)
$B_{2009}/B_{0,\ F=0}$	0.58
$SB_{2009}/SB_{0,\ F=0}$	–

5. 南方黑鮪（IOTC–2011–SC14–12）

2011 年親魚資源量小於 MSY 水準，顯示過漁狀態已經存在；2011 年漁獲死亡率低於 MSY 水準，顯示過漁正在進行中之情況並未發生，但仍有過漁發生中之風險。

主席裁示略去不予討論。

SOUTHERN BLUEFIN TUNA SUMMARY (global stock)	
Maximum Sustainable Yield	34,500 t (31,100-36,500t)[1]
Reported (2010) Catch	9547 t
Current Replacement Yield	27,200 t (22,200–32,800 t)
Current (2011) Spawner Biomass	45,400 (31,022–72,700 t)
Current (2011) Depletion	0.055 (0.035–0.077)
Spawner Biomass (2011) Relative to SSB_{msy}	0.229 (0.146–0.320)
Fishing Mortality (2010) Relative to F_{msy}	0.76 (0.52–1.07)
Current Management Measures	Effective Catch Limit for Members and Cooperating Non-Members combined averaged 9449 t annually over 2010-2011.

6. 鮪類及鰆類（Neritic species）：報告計有 IOTC–2011–SC 14–13, 14, 15, 16, 17, 18 等 7 篇，主要探討種類包括：圓花鰹（bullet tuna）、扁花鰹（frigate tuna）、長腰鮪（longtail tuna）、印度-太平洋大鰆魚（Indo-Pacific king mackerel）、巴鰹（Kawakawa）、土魠魚（narrow-barred Spanish mackerel）等種類，前述種類並非我國印度洋鮪釣漁業重要魚種，且目前因資料缺乏故未進行資源評估，所以資源處於不確定之狀態，迅速通過。

7. 劍旗魚（IOTC–2011–SC14–19）

印度洋全區之劍旗魚 2009 年漁獲死亡率低於 MSY 水準，親魚資源量高於 MSY 水準，顯示該資源並未處於已經過漁狀態，且過漁亦未正在進行中。

西南印度洋劍旗魚之 2009 年漁獲死亡率低於 MSY 水準，親魚資源量高於 MSY 水準，顯示該資源並未處於已經過漁狀態（但有處於已經過漁狀態之風險），且過漁亦未正在進行中。

建議年度漁獲量不要超過 MSY 水準。

Management Quantity	**Aggregate Indian Ocean**	**Southwest Indian Ocean**
2009 catch estimate (1,000 t)	21.5	6.6 [6.7]
Mean catch from 2005–2009 (1,000 t)	26.4 [26.3]	7.8 [7.7]
MSY (1,000 t)	31 (20– 55)	9.4 (6.5–13.5)
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)
$B_{2009}/B_{0, F=0}$	–	–
$SB_{2009}/SB_{0, F=0}$	–	–

8. 白皮、黑皮、紅肉及印度太平洋雨傘等旗魚（IOTC–2011–SC14–20,21,22,23），因資料缺乏故未進行資源評估，所以資源處於不確定之狀態，迅速通過。

其他事項：有關觀察員名單及國家報告部份，業已提送 IOTC 秘書處副秘書長。

12 月 15 日

十一、 海龜、海鳥及鯊魚資源狀態

1. 海龜（IOTC–2011–SC14–24）

Common name	**Scientific name**	**IUCN threat status**
Flatback turtle	*Natator depressus*	Data deficient
Green turtle	*Chelonia mydas*	Endangered
Hawksbill turtle	*Eretmochelys imbricata*	Critically Endangered
Leatherback turtle	*Dermochelys coriacea*	Critically Endangered

Loggerhead turtle	*Caretta caretta*	Endangered
Olive ridley turtle	*Lepidochelys olivacea*	Vulnerable

日本表示，對於海鳥、海龜等資源狀態引用 IUCN 之結果感到不甚滿意，雖然海鳥及海龜並非 IOTC 管轄種類，所以引用 IUCN 結果，也沒有太大的意見；但是鯊魚 IOTC 之管轄魚種，所以引用 IUCN 評估結果並不適當，IUCN 之評估標準與目前漁業資源狀態判斷所用之生物參考點全然不同，如何適用？是具有相當的疑慮。對於 IUCN 的評估結果，IOTC 也不需要去背書。

澳洲表示某種程度同意日本看法，但目前這些物種 IOTC 並沒有進一步探討其資源狀態，所以適當的引用 IUCN 結果應可以說明資源的狀態。

主席裁示，日本的建議也是確實的，所以引用 IUCN 結果的部份將作註記。

2. 海鳥（IOTC–2011–SC14–25）

Common name	**Scientific name**	**IUCN threat status**
Albatross		
Atlantic Yellow-nosed Albatross	*Thalassarche chlororynchos*	Endangered
Black-browed albatross	*Thalassarche melanophrys*	Endangered
Indian yellow-nosed albatross	*Thalassarche car teri*	Endangered
Shy albatross	*Thalassarche cauta*	Near Threatened
Sooty albatross	*Phoebetria fusca*	Endangered
Tristan albatross	*Diomedea dabbenena*	Critically Endangered
Wandering albatross	*Diomedia exulans*	Vulnerable
White-capped albatross	*Thalassarche steadi*	Near Threatened
Petrels		
Cape/Pintado petrel	*Daption capense*	Least Concern
Great-winged petrel	*Pterodroma macroptera*	Least Concern
Grey petrel	*Procellaria cinerea*	Near Threatened
Northern giant-petrel	*Macronectes halli*	Least Concern
White-chinned petrel	*Procellaria aequinoctialis*	Vulnerable

Others		
Cape gannet	*Morus capensis*	Vulnerable
Flesh-footed shearwater	*Puffinus carneipes*	Least Concern

此部份與海龜同樣註記爲引用 IUCN 資料後，迅速通過。

3. 鯊魚（IOTC–2011–SC14–26,27,28,29,30,31,32）

日本表示，建議引用今年 WPEB 會議，在 4 天的時間內討論接近 90 篇報告，投入相當的努力。在 90 篇的報告中日本 Dr. Yokawa 的研究報告有針對 blue shark、shortfin mako shark 與 oceanic whitetip shark 進行 CPUE 標準化研究，相信這是日本投入的努力，而且也經過 WPEB 討論，所以建議將 Dr. Yokawa 所作之 blue shark、shortfin mako shark 與 oceanic whitetip shark 進行 CPUE 標準化研究結果圖，放入本次鯊魚的執行摘要中。韓國表示，資源評估結果配合 Kobe plot 表現，是相當重要的一件事，雖然這次 WPEB 雖然沒有這樣的進度，但是也有進行相關的資源指標研究，這是 WPEB 第一次做出貢獻，所以同意日本看法。此時，主席表示 WPEB 並未進行此項分析，日方回應此分析由日本科學家提出，並在 WPEB 中經過討論。惟澳洲認爲，有關鯊魚的執行摘要，乃爲 WPEB 之文件，雖然同意日本的說法，但是仍建議應維持目前的摘要報告，並進行文字修正，將日方所提相關成果以文字敘述即可。最後主席裁示，同意加入日本所提之 blue shark、shortfin mako shark 與 oceanic whitetip shark 進行 CPUE 標準化研究結果圖，並請日本將這些 CPUE 標準化作一說明後，將該等置入執行摘要內，並草擬說明文字供會中討論定案。

十二、 預警措施及管理策略評估之實施

1. 預警措施（IOTC–2011–SC14–35），由秘書處報告。

本報告主要強調生物參考點的設定以作爲預警措施施行之參考。所強調之參考點主要爲限制性參考點（limit reference point）及標的參考點（target reference point），並將前述之參考點應用以修正目前盛行之 Kobe plot。

印度首先表示，預警措施是否應從生態系之觀點加以考量，以與未來以生態系爲基礎之漁業管理結合。歐盟表示，實施預警措施，科學家對於資源狀態的診斷就相當重要了，要強化診斷的正確性，必須要強化統計資料的品質，並估計不確定性，以作整體的提昇。澳洲表示，參考點對於預警措施是具有相當的意義的，參考點有如扳機（trigger）一般，啓動相關之管理措施，所以澳洲支持本案。日本亦表示支持預警措施，並認爲目前以 MSY 爲基礎之參考點在漁業管理上是具有相當的風險，實有必要進一步探討限制性參考點，建議明年可以工作小組方式進行討論。隨後，UK、WWF 皆表示支持。韓國接續發言，支持預警措施，並認爲當資源評估所需資料不足時，應予應用預警措施，並同時改善資料

蒐集。歐盟表示韓國的建議相當好，建議預警措施與參考點之結合應逐步跳脫以 MSY 爲管理基礎。

主席說明，有關參考點之研究，WCPFC 已有相當討論，建議與 WCPFC 聯繫，以瞭解其研究進展，並進行討論。此外，影響參考點之因子尚有「陡度（steepness）」的設定，建議應通盤考量討論。

2. 管理策略評估（Management Strategy Evaluation，MSE）（IOTC–2011–SC14–36），由 Dr. Iago Mosqueira 報告。

馬爾地夫表示，爲此 MSE 背書，希望成立工作小組進行討論。日本表示，可以接受 MSE 的發展，但是 MSE 沒有實施個 3-5 年，對於資源的養護狀況並無法瞭解；比較好奇的是，如果發生類似日本的地震或海嘯的狀況，這時 MSE 要如應用？參考點的適用性又爲何？所以對於管理策略評估，建議應有各種的情境設定。ISSF 表示支持預警措施及 MSE，並建議委員會皆通過此二項議題，ISSF 將與 Dr. Iago 討論相關細節，未來將投入此方向之討論。日本表示可以指派科學家加入討論。韓國則支持日本，希望日本提出人選參與預警及管理策略評估議題成立之工作小組措施，並擔任小組副主席。

總結，會員國對於預警措施（Precautionary approach）及管理策略評估（MSE）的研究與落實均表示支持態度，雖然許多細節還待研究討論。目前 MSE 的研究開發的平台非常透明，易於合作分享，所以有興趣的科學家都歡迎參與。主席表示，日後會由 Dr. Iago Mosqueira 負責這部分的研究，一位日本科學家也會投入這方面的研究。

十三、 漁具別資料需求議題：由資料蒐集與統計工作小組主席 Mr. Miguel Herrera 報告（Annex VI of IOTC－2011－ WPDCS08－R）。

SC 主席表示有關漁具別之資料需求，依據本年資料蒐集及統計工作小組會議報告之附件 6 進行討論。

本次討論重點爲延繩釣及圍網漁業之 Logbook 中之鯊魚必需紀錄之種類。就此，日本重申依據去年委員會議通過之 5 種鯊魚，同意列入 Logbook 中，其餘的鯊魚種類及海龜、海鳥等資訊，建議由觀察員進行資料蒐集。隨後，韓國、泰國與印尼皆表示支持日本的建議。

此外，馬爾地夫與印尼皆表示去年才依據委員決議修改 Logbook，倘今年又要依決議修改 Logbook，將是很煩複的工作，建議最好不要在短期內一直更動。最後主席裁示同意日本建議，其他鯊魚種類可以透過觀察員計畫蒐集相關資料。

十四、 漁期漁季關閉（Time-area closure）議題：由熱帶鮪類工作小組主席 Dr. Hilario Murua 及 UK 代表 Dr. Chris Mees 報告（IOTC–2011– SC14–39, 40）。

日本表示，如果全區關閉，似乎是有效的；但是如果只有關閉 1-2 個月，效果爲何？建議釐清。此外，日本表示可以參考 WCPFC 對於公海關閉的模擬，來探討漁區漁期關閉的效果。此外，日本及歐盟皆認爲目前相關研

究皆顯示以目前時空禁漁措施而言，其效果並不顯著。爲瞭解日後修正方向，現階段利用模擬方法探求不同時空禁漁措施在不同假設（因時空禁漁措施，努力量移除或重新分佈）下的管理成效。

十五、 替代管理措施、圍網漁業之衝擊及鮪類幼魚漁獲量等議題（IOTC–2011–SC14–41）

有關圍網漁業之衝擊及鮪類幼魚漁獲量議題，日本及澳洲表示在 WCPFC 有進行相類似之研究，如 FAD 及鮪類幼魚之種類組成與漁獲量估計等研究，建議可以參考。

12 月 16 日

十六、 區域觀察員計畫實施（IOTC–2011–SC14–34），由秘書處報告。

韓國表示，有關觀察員名單，據了解應已報送 IOTC，若秘書處尚未收到，可能是國內對於此事的認知與溝通問題，會後將回國協調再行報送。

泰國表示，目前僅有 2 艘延繩釣船，詢問秘書處泰國是否可聘僱區域內合格之觀察員登船替泰國政府蒐集科學資料；秘書處回覆，會員國之間可以就觀察員派遣互相協調，如有其他會員國願意協助，就沒問題。主席詢問泰國是否有與其他會員國就觀察員派遣部分進行討論，最後泰國回覆將會儘快就觀察員部分做處理。

我國表示，有關觀察員名單已經報送 IOTC 秘書處，未來觀察員航次報告將透過與秘書處聯繫之網站進行提供，此外，再度重申有關小型鮪釣漁船之觀察員派遣事宜，去年的派遣觀察員至小型鮪釣漁船執行任務的經驗顯示，船上並無足夠空間可以進行觀測及相關生物採樣任務。此時，歐盟表示觀察員計畫涵蓋相當多的層面，各層面皆會衍生問題發生，所以在職行觀察員計畫時，應多加審慎。

塞昔爾表示目前塞島有自己觀察員計畫，也有相當完善的訓練計畫，如其他會員國有需要可以與塞昔爾聯繫。

印尼表示該國目前有 5 名科學觀察員，下年度將會增聘至 10 名，同時也會派遣到圍網船上進行科學資料蒐集，但對於觀察員資格審核，印尼提出由誰來進行觀察員資料審核?主席表示，這部分的確目前不清楚，未來應對觀察員審核程序做討論決定，秘書處回覆目前仍是由個別會員國自行做認證，只要提送名單秘書處都會接受。

歐盟另外表示先前海盜問題導致作業漁船必須佈署武裝保安人員，對於科學觀察員佈署有點困難。

其餘則由數個會員國如肯亞、斯里蘭卡、馬爾地夫、模里西斯、科莫羅等國報告該國之觀察員計畫情形。

西南印度洋計畫人員表示，該計畫已經訓練 40 名合格之觀察員，已經提供給 8 個會員國派遣使用。

十七、 資料蒐集與報告系統之評估（IOTC–2011–SC14–38），由 Mr. Miguel

Herrera 說明。

本報告重點爲因應未來委員會可能會對大目鮪及黃鰭鮪資源進行配額管理，請科學次委員會就會員國提報即時漁獲量資訊作檢視，該報告指出我國小釣船即時資料提送可能存有問題。

歐盟表示圍網漁獲中大目鮪及黃鰭鮪漁獲組成即時提報實際上有些困難，船長基本上僅能掌握大型黃鰭鮪及大目鮪漁獲資訊，另外沿岸國的統計不健全，例如葉門以及索馬利亞這些國家實際上也有漁業，應加強沿岸國的漁獲統計資料蒐集，秘書處回應實際上可以利用圍網漁業先前之魚種組成資訊做初步估算，待漁船卸魚有詳細組成資訊後再修正即可，針對歐盟所提葉門及索馬利亞兩國，近年這兩國有安全問題，考慮到人員安全而未派員協助，其他沿岸國都有計畫進行資料蒐集。

我國表示，有關我國小型鮪延繩釣漁業，目前已有規範要求進行每週漁獲量回報，同時近年來每年投入超過 50 萬美元計畫建立國內各港口資料蒐集系統，今年開始也在國內港口對印度洋回台冷凍漁獲進行體長資料蒐集，小釣漁業資料將會有大幅改善。

主席表示沿岸國漁獲統計資料蒐集仍是漁獲即時回報應加強改善的重點。

十八、 Progress in Implementation of the Recommendations of the Performance Review Panel（IOTC–2011–SC 14–37），由秘書處說明。

本報告主要係說明 Resolution 09/01 及其附件 I 各項之進展，由秘書處進行報告，主席表示僅需將與 SC 有關議題挑出即可，會中由會員國討論各項 SC 議題之回應。

十九、 2013 年各供作小組工作計畫暨工作小組開會時程安排（IOTC–2011–SC14–42）

IOTC 及其他 RFMOs 相關會議安排

1. IOTC Meetings:

- 2nd Technical Committee Meeting on Allocation Criteria: 4–6 March, 2012 (Maldives)
- 9th Session of the Compliance Committee: 18–20 April, 2012 (Australia)
- 16th Session of the Commission: 22–26 April, 2012 (Australia)
- Tagging symposium – 29–31 October, 2012 (Mauritius)

2. Other tuna Meetings:

- ICCAT SCRS meeting early October, 2012
- 17th Meeting of the CCSBT Scientific Committee 27–31 August, 2012
- 8th WCPFC SC meeting 7–15 August, 2012

3. 2012 及 2013 年會議安排

Meeting	2012		2013 (tentative)	
	Date	**Location**	**Date**	**Location**
WPTmT(溫帶鮪)	3–5 July (3d)	TBD (China?)	Early Aug (3d)	TBD (ICCAT SAA)
WPEB(生態系)	17–19 Sept (3d)	Cape town, South Africa – TBD	16–18 Sept (5d)	Bali, Indonesia
WPB(旗魚)	11–15 Sept (5d)	Cape town, South Africa – TBD	10–14 Sept (5d)	Bali, Indonesia
WPM(方法)	22–23 Oct (2d)	Port Louis, Mauritius	18–19 Oct (2d)	TBD
WPTT(熱帶鮪)	24–29 Oct (6d)	Port Louis, Mauritius	21–26 Oct (6d)	TBD
WPNT(沿近海鮪類)	Pending (3d)	Penang, Malaysia	Pending (3d)	TBD
WPDCS(資料蒐集與統計)	nil	nil	5–6 Dec	TBD
SC(科學委員會)	10–15 Dec (6d)	Victoria, Seychelles	9–14 Dec (6d)	TBD

各工作小組工作計畫（work plan）：

1. 旗魚工作小組（WPB）

- 劍旗魚資源結構及洄游範圍（基因研究）
- 劍旗魚資源結構及移動範圍（標示放流研究）
- 旗魚類之成長速率
- 體長資料分析
- 資源狀態指標研究
- 劍旗魚、旗魚累及與雨傘旗魚等之CPUE標準化研究
- 其他旗魚資源評估

- 西南海域被咬食研究

2. 溫帶鮪類工作小組（WPTmT）

   - 體長之資料分析
   - 成長速率及年齡結構分析
   - 資源狀態指標研究

3. 熱帶鮪類工作小組（WPTT）

   - 以Brownie-Peterson method進行分析(此可能爲2012年印度洋鮪類標示放流研討會議題）
   - 更新黃鰭鮪成長曲線（研究成果將在2012年印度洋鮪類標示放流研討會發表）

   熱帶鮪類資源評估時程

Species/year	2012	2013	2014	2015	2016	2017
Yellowfin tuna	Full	Update	Update	Full	Update	Update
Skipjack tuna	Update	Full	Update	Update	Full	Update
Bigeye tuna	Update	Update	Full	Update	Update	Full

4. 生態系及混獲工作小組（WPEB）

   - 鯊魚及海龜之生態風險評估
   - 污斑白眼鮫（Oceanic whitetip shark）資源評估
   - 咬食研究（延繩釣漁業）
   - 混獲忌避措施（鯊魚、海鳥(如支繩加重)、海龜及海洋哺乳類等）

5. 沿近海鮪類（neritic tuna）工作小組（WPNT）：略

6. 其他：Peer review process for IOTC stock assessments（IOTC–2011–SC14–44），由 SC 主席說明。

   日本表示，目前 RFMOs 對於管轄魚種資源評估的處理不太相同，例如 IATTC 由該組織的專家進行評估，WCPFC 大多由其科學委辦單位 SPC 負責，IOTC 則和 ICCAT 較爲相近，由各國科學家共同進行。同儕檢視主要係因爲資源評估之執行成果並非充分討論，所以必須以同儕檢視之方式進行，但是 IOTC 與 ICCAT 因爲由會員國科學家共同進行資源評估，並將相關研究成果經過類似研討方式討論，所以在資源評估結果的客觀性已經達到某種程度，所以對於同儕檢視程序，應審慎討論。

7. 主席與副主席選舉

SC 主席選舉結果由日本 Dr. Tom Nishida 當選，副主席爲賽席爾 Mr. Jan Robinson 擔任。

會外聯繫事項：與泰國漁業局國際科科長 Malinee Smithtithee 會談：我方人員像渠表示近年我國希望能在台泰農業 MOU 架構下達成港口採樣合作協議，然泰國漁業局表示需要上呈農業部才能在 MOU 架構下新增漁業合作項目，Smithtithee 科長表示，先前曾去台灣訪問，台泰間漁業可以直接對談，對於未來透過何種架構合作，並不是太大問題，但這問題希望我國能給泰方作內部上呈協調，但願意與我國保持聯繫，泰國遠洋漁業技術發展中心主任 Pirochana Saikliang 博士表示，樂見與我國有正式漁業事務交流，泰國也期待能由我方代訓海上觀察員。

12 月 17 日

8. 審閱本次第 14 屆科學委員會會議報告暨定稿

由 SC 主席逐段引導，會員國參與修正。會議於下午 5 時，SC 主席宣佈結束。

參、心得與建議

一、 本次會議主要魚種資源狀態及管理建議如次：

1. 長鰭鮪：2010 年漁獲死亡率已大於最大持續生產量（MSY）水準，顯示過漁正在進行中；資源量略小於 MSY 水準，顯示該資源有處於已經過漁狀態之風險。現今的漁獲量已經高於 MSY（29,900 t），維持獲增加努力量將造成未來資源量、CPUE、生產量等下降。

2. 大目鮪：最近之漁獲死亡率小於 MSY 水準，顯示資源並未處於過漁正在進行中的狀態；最近之親魚資源量大於 MSY 水準，顯示資源並未處於已經過漁的狀態。建議年度大目鮪漁獲量不要超過 MSY（102,900 t）。

3. 正鰹：2009 年之親魚資源量約爲 MSY 水準的 2.56 倍，顯示資源未處於已經過漁的狀態。建議漁獲量不要超過 2005-2009 年之平均水準。

4. 黃鰭鮪：2009 年之資源量及親魚資源量皆大於 MSY 水準，顯示資源並未處於已經過漁之狀態；2009 年之漁獲死亡率則略小於 MSY 水準，顯示資源亦未處於過漁正在進行之狀態，但仍有發生之風險。建議黃鰭鮪年度漁獲量不要超過 MSY 水準之下界（約 300,000 t）。

5. 劍旗魚：印度洋全區之劍旗魚 2009 年漁獲死亡率低於 MSY 水準，親魚資源量高於 MSY 水準，顯示該資源並未處於已經過漁狀態，且過漁亦未正在進行中。西南印度洋劍旗魚之 2009 年漁獲死亡率低於 MSY 水準，親魚資源量高於 MSY 水準，顯示該資源並未處於已經過漁狀態（但有處於已經過漁狀態之風險），且過漁亦未正在進行中。建議年度漁獲量不要超過 MSY（31,000 t）水準。

二、 IOTC 將參考 WCPFC 進行參考點之探討，以因應管理需求，未來將以限制性參考點及標的參考點爲主要討論重點。

三、 混獲物種忌避措施部分，海鳥以支繩加重爲研究重點；另，澳洲推動鯊魚

鰭自然結附(natural attached)，惟日本以鯊魚鰭在結凍後相當鋒利，影響作業安全爲由，造成會中無法達成共識。

四、 下屆 SC 主席及副主席分別由日本 Dr. Nishida 博士及塞席爾籍 Mr. Jan Robinson 接任。

五、 有關 IOTC SC14 所建議各項科學研究議題，將視可行性及重要性規劃納入 2011 及 2012 年遠洋漁業相關科技計畫。

肆、附件

附件一、我國代表團成員、議程及相關準備資料

我國代表團成員

單位	職稱	姓名
漁業署	技正	周世欽
南華大學	助理教授	葉裕民
中華民國對外漁業合作發展協會	組長	於仁汾

議程及相關準備資料

IOTC–2011–SC14–01b[E]

Draft Annotated Agenda for the Fourteenth Session of the Scientific Committee

Last updated: 20 November 2011
Date: 12–17 December, 2011
Location: International Conference Centre,
Victoria Mahé, Seychelles
Time: 09:00 – 17:00 daily
Chair: Dr. Francis Marsac

1. Opening of the Session (Chair)

2. Adoption of the Agenda and Arrangements for the Session (Chair)

IOTC–2011–SC14–01a: Draft agenda for the Fourteenth Session of the Scientific Committee.
IOTC–2011–SC14–01b: Draft annotated agenda for the Fourteenth Session of the Scientific Committee.
IOTC–2011–SC14–02: Draft list of documents.

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. Activities of the Commission (Secretariat)

IOTC–2011–SC14–03: Outcomes of the Fifteenth Session of the Commission (Secretariat).
IOTC–2011–SC14–04: Previous decisions of the Commission (Secretariat).

5. Activities of the IOTC Secretariat in 2011 (Secretariat)

IOTC–2011–SC14–05: Report of the Secretariat for 2011 (Secretariat).
The Secretariat will report on its activities during the 2011 calendar year. It will also outline the technical activities planned for 2012 regarding the acquisition, processing and dissemination of information regarding fisheries for tuna and tuna-like species in the Indian Ocean.

6. National Reports from CPCs (CPCs)

IOTC–2011–SC14–NR01 to NR32 (CPCs).
Discussions on improving/modifying the National Reporting Template.
IOTC–2011–SC14–33: Status of development and implementation of Nation Plans of Action for seabirds and sharks.

Purpose
To provide the Scientific Committee 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.
Recommendation/S
That the Scientific Committee **NOTE** the current status of development and implementation of National Plans of Action for sharks and seabirds, by each CPC.
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 due to be released by end of 2011. Seabirds: Threat Abatement Plan (longline fishery only) in review. No Plan for purse seine or other gears.
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		–	Sharks: Approved on 05-Feb-2009 and it is currently being implemented. Seabirds: Currently being finalised for adoption in the last quarter of 2011.
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 FOBP-IGO Seabirds: No information received by the Secretariat.
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 report submitted to COFI in Jan. 2011. Seabirds: NPOA–Seabird implementation report submitted to COFI in Jan. 2011.
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 but not yet 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: No update received by the Secretariat. Seabirds: No information received by the Secretariat.
Maldives, Republic of					Sharks: NPOA has been formulated and will be discussed with stakeholders in November 2011. Shark fishing was banned on 15th March 2010 based on scientific advice. The Government has spent ~US$5 million on a gear buyback scheme from Maldivian fishers. Seabirds: Development has not begun.
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.
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: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
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: No revision currently planned. Seabirds: Development has not begun.
United Kingdom		–		–	Chagos waters are a MPA closed to fishing except recreational fishing around Diego Garcia. Section 7 (10) (e) of the Fisheries (Conservation and Management) Ordinance refers to recreational fishing and requires sharks to be released alive.
Vanuatu					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
COOPERATING NON-CONTRACTING PARTIES					
Mozambique					Sharks: Development has not begun. Seabirds: Development has not begun.
Senegal		25-Sept-2006		–	Sharks: The Sub-Regional Fisheries Commission supported the development of a NPOA-sharks for Senegal in 2003. 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: Currently being drafted. Seabirds: Not currently under review.

Colour key	
NPOA Completed	
Drafting being finalised	
Drafting commenced	
Not begun	

7. Reports of the 2011 IOTC Working Party Meetings (Chairs)

7.1. IOTC–2011–WPB09–R: Report of the Ninth Session of the Working Party on Billfish

Executive Summary

The Ninth Session of the IOTC Working Party on Billfish (WPB) was held in Victoria, Mahé, Seychelles, from 4 to 8 July 2011. The meeting was attended by 27 individuals, including one invited expert, Dr. Toshihide Kitakado, from the Department of Marine Biosciences of the Tokyo University of Marine Science and Technology in Japan.

The following are a subset of the complete recommendations from the WPB09 to the Scientific Committee, which are provided at Appendix IV.

The WPB noted that the stock structure of the Indian Ocean swordfish resource is 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. (para. 121)

***Swordfish:* Indian Ocean Stock – Management Advice**

The WPB agreed to the following management advice for swordfish in the Indian Ocean, for the consideration of the Scientific Committee; (para. 135)

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% 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 $F_{2019}>F_{MSY}$).

***Swordfish:* Southwest Indian Ocean Resource – Management Advice**

The WPB agreed to the following management advice for the swordfish resource in the southwest Indian Ocean, for the consideration of the Scientific Committee; (para. 137)

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}.

Outlook. The decrease in catch and effort over the last few years in the southwest region has reduced pressure on this resource. There is a low risk of exceeding MSY-based reference points by 2019 if catches reduce further or are maintained at current levels (<25% risk that $B_{2019}<B_{MSY}$, and <8% risk that $F_{2019}>F_{MSY}$). There is a risk of reversing the rebuilding trend if there is any increase in catch in this region.

***Blue marlin*: Indian Ocean Stock – Management Advice**

The WPB agreed to the following management advice for the blue marlin resource in the Indian Ocean, for the consideration of the Scientific Committee; (para. 139)

Stock status. No quantitative stock assessment is currently available for blue marlin in the Indian Ocean, and due to a lack of reliable fishery data for several gears, only very preliminary stock indicators can be used. The standardised CPUE suggest that there was a decline in the early 1980s, followed by an increase in 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*. However, aspects of species biology, productivity and fisheries combined with a lack of fisheries 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, however there is not sufficient information to evaluate the effect this will have on the resource.

***Other marlins and sailfish*: Indian Ocean Stock – Management Advice**

The WPB noted that no quantitative stock assessment is currently available for marlins and sailfish 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*. However, aspects of the biology, productivity and fisheries for these species combined with the lack of data 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. (para. 141).

The WPB recommended that marlins and sailfish undergo CPUE analysis in 2012, with striped marlin taking priority over other species. (para. 108)

The WPB recommended that as a matter of priority, striped marlin be the subject of CPUE analysis in 2011, and that CPUE series be compared among fleets where possible. (para. 109)

The WPB recommended that a dedicated workshop on CPUE standardization, including issues of interest for other IOTC species should be carried out before the next round of stock assessments in 2012, and that where possible it should include a range of invited experts. (para. 118)

The WPB recommended that the Scientific Committee: (para. 147)

- note the draft resource stock status summaries for:
  i. Swordfish (*Xiphias gladius*) – Appendix VI
  ii. Blue marlin (*Makaira nigricans*) – Appendix VII

7.2. IOTC–2011–WPTmT03–R: Report of the Third Session of the Working Party on Temperate Tunas

Executive Summary

The Third Session of the Indian Ocean Tuna Commission (IOTC) WPTmT was held in Busan, Republic of Korea, from 20 to 22 September 2011. The meeting was attended by 16 individuals, including one invited expert, Dr. Simon Hoyle, from the Secretariat of the Pacific Community (SPC) – Oceanic Fisheries Program.

The following are a subset of the complete recommendations from the WPTmT03 to the Scientific Committee, which are provided at Appendix IV.

Albacore: **Indian Ocean Stock – Management Advice**

The WPTmT recommended the following management advice for albacore in the Indian Ocean, for the consideration of the Scientific Committee, noting that there remains considerable uncertainty about the relationship between abundance and the standardized CPUE series, and about the total catches over the past decade (para. 78).

Stock status. Trends in the Taiwan,China CPUE series suggest that the longline vulnerable biomass has declined to about 39% of the level observed in 1980. There were 20 years of moderate fishing before 1980, and the catch has more than doubled since 1980. Catches have increased substantially since the previous albacore assessment when there was considered to be a risk that $SB<SB_{MSY}$, so the risk will have increased further. It is considered likely that recent catches have been above MSY, recent fishing mortality exceeds F_{MSY} ($F_{2010}/F_{MSY}>1$). There is a moderate risk that total biomass is below B_{MSY} ($B_{2010}/B_{MSY}\approx1$).

Outlook. Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE. The impacts of piracy in the western Indian Ocean has resulted in the displacement of a substantial portion of longline fishing effort into the traditional albacore fishing areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on albacore will decline in the near future.

The WPTmT recommended that the Scientific Committee consider the following (para. 79):

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Current catches (average ~41,000 t over the last five years, ~44,000 t in 2010) likely exceed MSY (29,900 t, range: 21,500–33,100 t). Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.
- A Kobe 2 Strategy matrix was calculated to quantify the risk of different future catch scenarios (Table 3). However, a number of inconsistencies between the model and data were noted for future investigation.

The WPTmT recommended that a dedicated workshop on CPUE standardization, including issues of interest for other IOTC species should be carried out before the next round of stock assessments in 2012, possibly coordinated under the IOTC Working Party on Methods, and that where possible it should include a range of invited experts, including those working on CPUE standardisation in other ocean/RFMOs (para. 65).

The WPTmT recommended that the Scientific Committee note the draft resource stock status summary for albacore (*Thunnus alalunga*) – Appendix VI (para. 85).

The WPTmT agreed that there was an urgent need to carry out revised stock assessments for the albacore resource in the Indian Ocean in 2012, and recommended that the Scientific Committee consider recommending that the Commission consider approving funds for this purpose (para. 90).

7.3. IOTC–2011–WPTT13–R: Report of the Thirteenth Session of the Working Party on Tropical Tunas

Executive Summary

The Thirteenth Session of the Indian Ocean Tuna Commission's (IOTC) WPTT was held in Lankanfinolhu, North Malé Atoll, Republic of Maldives, from 16 to 23 October 2011. A total of 49 participants attended the Session including two invited experts, Dr. Joseph Powers (LSU–USA) and Ms. Paige Eveson (CSIRO–Australia).

The following are a subset of the complete recommendations from the WPTT13 to the Scientific Committee, which are provided at Appendix IV.

Skipjack tuna: Indian Ocean Stock – Management Advice

The WPTT **RECOMMENDED** the following management advice for skipjack tuna in the Indian Ocean, for the consideration of the Scientific Committee (para. 164).

Stock status. The weighted results suggest that the stock is not overfished ($B>B_{MSY}$) and that overfishing is not occurring (C<MSY used as a proxy for $F<F_{MSY}$). Spawning stock biomass

was estimated to have declined by approximately 47% in 2009 from unfished levels (Table 3).

The WPTT **RECOMMENDED** that the Scientific Committee consider the following (para. 165):

- The median estimates of the Maximum Sustainable Yield for the skipjack tuna Indian Ocean stock is 564,000 t (Table 3) and considering the average catch level from 2005–2009 was 492,000 t, catches of skipjack tuna should not exceed the average of 2005–2009.
- 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 4) illustrates the levels of risk associated with varying catch levels over time and could be used to inform management actions.

Yellowfin tuna: Indian Ocean Stock – Management Advice

The WPTT **RECOMMENDED** the following management advice for yellowfin tuna in the Indian Ocean, for the consideration of the Scientific Committee (para. 201).

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 6 and Fig. 26). Spawning stock biomass in 2009 was estimated to be 35% (31–38%) (from Table 6) 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. 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.

The WPTT **RECOMMENDED** that the Scientific Committee consider the following (para. 202):

- The Maximum Sustainable Yield estimate for the whole Indian Ocean is 357,000 t with a range between 290,000–435,000 t (Table 6), 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: Indian Ocean Stock – Management Advice

The WPTT **RECOMMENDED** the following management advice for bigeye tuna in the Indian Ocean, for the consideration of the Scientific Committee (para. 223).

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 $F_{current}/F_{MSY}<1$). Current spawning stock biomass was estimated to be 34–40% (Table 11) 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.

The WPTT **RECOMMENDED** that the Scientific Committee consider the following (para. 224):

- 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 11 for further description)). Annual catches of bigeye tuna should not exceed the lower range of this estimated 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 100,000–114 000 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.

The WPTT **RECOMMENDED** that a dedicated workshop on CPUE standardization, including issues of interest for other IOTC species should be carried out before the next round of stock assessments in 2012, and that 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 Japan, Republic of Korea and Taiwan, China, and supported by the IOTC Secretariat (para. 272).
The WPTT **RECOMMENDED** that the Scientific Committee note the new Vice-Chair, Dr. M. Shiham Adam (Maldives) of the WPTT for the next *biennium* (para. 294).

7.4. IOTC–2011–WPEB07–R: Report of the Seventh Session of the Working Party on Ecosystems and Bycatch

Executive Summary

The Seventh Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Ecosystems and Bycatch (WPEB) was held in Lankanfinolhu, North Malé Atoll, Paradise Island Resort and Spa, Republic of Maldives, from 24 to 27 October 2011. A total of 49 participants attended the Session, including two invited experts, Dr. Evgeny Romanov (CAPRUN-ARDA, La Réunion) and Dr. Enric Cortes (NMFS-NOAA USA). The following are a subset of the complete recommendations from the WPEB07 to the Scientific Committee, which are provided at (Appendix IV).

Sharks

The WPEB **NOTED** that the best way to reduce or avoid the practice of shark finning in the IOTC area, to encourage full utilisation, to ensure accurate catch statistics, and to facilitate the collection of biological information, would be to land all sharks with fins attached (which includes partially cut and folded). The majority of the WPEB **RECOMMENDED** such action be achieved through the replacement of IOTC Resolution 05/05 (5% shark fin: body weight ratio). However, the WPEB **NOTED** that such a recommendation would have practical implementation issues for some fleets and may degrade the quality of the product. The WPEB further **RECOMMENDED** that all CPCs strive to obtain and maintain the best possible data, including improved species identification. (para.154)

Recognizing the general lack of shark data being recorded and reported to the IOTC Secretariat, the WPEB **RECOMMENDED** that: (para.161)

- Resolution 10/02 is revised in order to include the list of most commonly caught elasmobranch species (Table 2) for which nominal catch data shall be reported as part of the statistical requirement for IOTC CPCs.
- that the list of shark species to be recorded in logbooks for all gears be modified as in Table 3.

Seabirds

Taking into account the information presented in working papers IOTC–2011–WPEB07–43, IOTC–2011–WPEB07–44 and IOTC–2011–WPEB07–54, the WPEB **AGREED** that a combination of weighted branchlines, bird scaring lines and night setting is best practice mitigation in reducing bycatch of seabirds to the lowest possible level in pelagic longline fisheries. The WPEB **RECOMMENDED** that Resolution 10/06 be amended to reflect this advice, and to incorporate the technical specifications outlined in the paragraphs above (paras. 203, 206, 208). (para.209)

The WPEB strongly **RECOMMENDED** that the Resolution 10/06 be amended in order to make the reporting of seabird interactions mandatory for vessels fishing for species under the IOTC mandate. In addition and as a matter of consistency, to increase the reporting of these interactions, the WPEB further **RECOMMENDED** that the recording of interactions with seabirds be included in the minimum requirements for logbooks for all fleets. (para.221)

Management Advice on the Status of Sharks, Seabirds and Marine Turtles

Sharks

Blue sharks

The WPEB **RECOMMENDED** the following management advice for blue sharks in the Indian Ocean, for the consideration of the Scientific Committee: (para.170)

Stock status. The current IUCN threat status of 'Near Threatened' applies to blue sharks globally (Table 4). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available for blue shark in the Indian Ocean therefore the stock status is highly uncertain. Blue sharks are commonly taken by a range of fisheries in the Indian Ocean and in some areas they are fished in their nursery grounds. Because of their life history characteristics – they are relatively long lived (16–20 years), mature at 4–6 years, and have relativity few offspring (25–50 pups every year), the blue shark is vulnerable to overfishing. Blue shark assessments in the Atlantic and Pacific oceans seem to indicate that blue shark stocks can sustain relatively high fishing pressure.

Oceanic whitetip sharks

The WPEB **RECOMMENDED** the following management advice for oceanic whitetip sharks in the Indian Ocean, for the consideration of the Scientific Committee: (para.171)

Stock status. The current IUCN threat status of 'Vulnerable' applies to oceanic whitetip sharks globally (Table 5). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available for oceanic whitetip sharks in the Indian Ocean therefore the stock status is highly uncertain. Oceanic whitetip sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived, mature at 4–5 years, and have relativity few offspring (<20 pups every two years), the oceanic whitetip shark is vulnerable to overfishing. Despite the lack of data, it is apparent from the information that is available that oceanic whitetip shark abundance has declined significantly over recent decades.

Scalloped hammerhead sharks

The WPEB **RECOMMENDED** the following management advice for scalloped hammerhead sharks in the Indian Ocean, for the consideration of the Scientific Committee: (para.172)

Stock status. The current IUCN threat status of 'Endangered' applies to scalloped hammerhead sharks globally and specifically for the western Indian Ocean (Table 6). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for scalloped hammerhead shark in the Indian Ocean therefore the stock status is highly uncertain. Scalloped hammerhead sharks are commonly taken by a range of fisheries in the Indian Ocean. They are extremely vulnerable to gillnet fisheries. Furthermore, pups occupy shallow coastal nursery grounds, often heavily exploited by inshore fisheries. Because of their life history characteristics – they are relatively long lived (over 30 years), and have relativity few offspring (<31 pups each year), the scalloped hammerhead shark is vulnerable to overfishing.

Shortfin mako sharks

The WPEB **RECOMMENDED** the following management advice for shortfin mako sharks in the Indian Ocean, for the consideration of the Scientific Committee: (para.173)

Stock status. The current IUCN threat status of 'Vulnerable' applies to shortfin mako sharks globally (Table 7). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for shortfin mako shark in the Indian Ocean therefore the stock status is highly uncertain. Shortfin mako sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (over 30 years), females mature at 18–21 years, and have relativity few offspring (<25 pups every two or three years), the shortfin mako shark is vulnerable to overfishing.

Silky sharks

The WPEB **RECOMMENDED** the following management advice for silky sharks in the Indian Ocean, for the consideration of the Scientific Committee: (para.174)

Stock status. The current IUCN threat status of 'Near Threatened' applies to silky sharks in the western and eastern Indian Ocean and globally (Table 8). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for silky shark in the Indian Ocean therefore the stock status is highly uncertain. Silky sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (over 20 years), mature at 6–12 years, and have relativity few offspring (<20 pups every two years), the silky shark is vulnerable to overfishing. Despite the lack of data, it is clear from the information that is available that silky shark abundance has declined significantly over recent decades.

Bigeye thresher sharks

The WPEB **RECOMMENDED** the following management advice for bigeye thresher sharks in the Indian Ocean, for the consideration of the Scientific Committee: (para.175)

Stock status. The current IUCN threat status of 'Vulnerable' applies to bigeye thresher shark globally (Table 9). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available for bigeye thresher shark in the Indian Ocean therefore the stock status is highly uncertain. Bigeye thresher sharks are

commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (+20 years), mature at 9-13 years, and have few offspring (2-4 pups every year), the bigeye thresher shark is vulnerable to overfishing.

Pelagic thresher sharks

The WPEB **RECOMMENDED** the following management advice for pelagic thresher sharks in the Indian Ocean, for the consideration of the Scientific Committee: (para.176)

Stock status. The current IUCN threat status of 'Vulnerable' applies to pelagic thresher shark globally (Table 10). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available for pelagic thresher shark in the Indian Ocean therefore the stock status is highly uncertain. Pelagic thresher sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (+ 20 years), mature at 8–9 years, and have few offspring (2 pups every year), the pelagic thresher shark is vulnerable to overfishing.

Seabirds

The WPEB **RECOMMENDED** the following management advice for seabirds in the Indian Ocean, for the consideration of the Scientific Committee: (para.222)

Stock status. No assessment has been undertaken by the IOTC WPEB for seabirds due to the lack of data being submitted by CPCs. However, the current International Union for Conservation of Nature (IUCN) threat status for each of the seabird species reported as caught in IOTC fisheries to date is provided in Table 12. It is important to note that a number of international global environmental accords (e.g. Convention on Migratory Species (CMS), Convention on Biological Diversity (CBD)), as well as numerous fisheries agreements obligate States to provide protection for these species. While the status of seabirds is affected by a range of factors such as degradation of nesting habitats and targeted harvesting of eggs, the level of mortality of seabirds due to fishing gear in the Indian Ocean is poorly known, although where there has been rigorous assessments of impacts in areas south of 25 degrees (e.g. in South Africa), very high seabird bycatch rates have been recorded in the absence of a suite of proven bycatch mitigation measures.

Marine turtles

The WPEB **RECOMMENDED** the following management advice for marine turtles in the Indian Ocean, for the consideration of the Scientific Committee: (para.247)

Stock status. No assessment has been undertaken by the IOTC WPEB for marine turtles due to the lack of data being submitted by CPCs. However, the current International Union for Conservation of Nature (IUCN) threat status for each of the marine turtle species reported as caught in IOTC fisheries to date is provided in Table 13. It is important to note that a number of international global environmental accords (e.g. Convention on Migratory Species (CMS), Convention on Biological Diversity (CBD)), as well as numerous fisheries agreements obligate States to provide protection for these species. While the status of marine turtles is affected by a range of factors such as degradation of nesting beaches and targeted harvesting of eggs and turtles, the level of mortality of marine turtles due to capture by gillnets and to a lesser extent purse seine fishing and longline is not known.

Other issues

Noting that depredation has been reported to be high in some areas of the Indian Ocean (e.g. 19% in the Seychelles longline fishery: IOTC–2011–WPB09–R), which is much higher than in other regions of the Indian Ocean and would lead to bias in the CPUE series, the WPEB **RECOMMENDED** that the main longline fleets in the Indian Ocean (Taiwan,China, Japan, Indonesia, EU,Spain, EU,Portugal) carry out research and monitoring programs aimed at determining the level of depredation in a range of areas and under different fishing conditions, and for the results to be presented at the next session of the WPEB. (para.269)

The WPEB **RECOMMENDED** that the Commission agree for a new position to be created at the IOTC Secretariat (Fishery Officer), with duties to focus on bycatch issues. (para.288)

The WPEB **RECOMMENDED** that the Scientific Committee note the re-elected Chair (Dr. Charles Anderson) and Vice-Chair (Dr. Evgeny Romanov) of the WPEB for the next *biennium*. (para.298)

7. Review of Data Available on Ecosystems and Bycatch

Data and reporting requirements

18. The WPEB **NOTED** each of the IOTC Resolutions relevant to bycatch species (notably Resolutions 05/05, 10/12, and 10/02 dealing with sharks, Resolution 10/06 on seabirds and Resolution 09/06 on marine turtles), including the data and reporting requirements (Table 1).

- Sharks: Contracting and non-Contracting Cooperating Parties (CPCs) are required to collect and report the same information as is collected and reported for tuna and tuna-like species (catch, effort and size frequency).
- Marine turtles: CPCs should collect and report information on the numbers of animals caught, where possible by species.
- Seabirds: CPCs should report any information available on interactions.

TABLE 1. IOTC data collection and reporting requirements for non-target species.

Sharks IOTC Resolution 05/05: *Concerning the conservation of sharks caught in association with fisheries managed by IOTC*	Paragraph 1: CPCs shall annually report data for catches of sharks, in accordance with IOTC data reporting procedures, including available historical data.
IOTC Resolution 10/02: *Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)*	Paragraph 3: The provisions, applicable to tuna and tuna-like species, shall also be applicable to the most commonly caught shark species and, where possible, to the less common shark species.
IOTC Resolution 10/12: *On the conservation of THRESHER SHARKS (family Alopiidae) caught in association with fisheries in the IOTC area of competence*	Paragraph 1: This measure shall apply to all fishing vessels on the IOTC Record of authorised Vessels. Paragraph 4: CPCs shall encourage their fishermen to record incidental catches as well as live releases. These data will be then kept at the IOTC secretariat. Paragraph 7: The Contracting Parties, Co-operating non-Contracting Parties, especially those directing fishing activities for sharks, shall submit data for sharks, as required by IOTC data reporting procedures (including estimates of dead discard and size frequencies), in advance of the 2011 Scientific Committee meeting.
Seabirds IOTC Resolution 10/06: *On reducing the incidental bycatch of seabirds in longline fisheries* IOTC Resolution 10/02: *Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)*	Paragraph 7: CPCs shall provide to the Commission, as part of their annual reports, all available information on interactions with seabirds, including bycatch by fishing vessels carrying their flag or authorised to fish by them. This is to include details of species where available to enable the Scientific Committee to annually estimate seabird mortality in all fisheries within the IOTC area of competence. Paragraph 3: …..The provisions, applicable to tuna and tuna-like species, shall also be applicable to the most commonly caught shark species and, where possible, to the less common shark species. CPCs are also encouraged to record **and provide data on species other than sharks and tunas taken as bycatch.**
Marine turtles IOTC Resolution 09/06: *On Marine Turtles* IOTC Resolution *10/02*: *Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)*	Paragraph 2: CPCs shall collect (including through logbooks and observer programs) and provide to the Scientific Committee all data on their vessels' interactions with marine turtles in fisheries targeting the species covered by the IOTC Agreement. CPCs shall also furnish available information to the Scientific Committee on successful mitigation measures and other impacts on marine turtles in the IOTC Area, such as the deterioration of nesting sites and swallowing of marine debris. Paragraph 3: ….The provisions, applicable to tuna and tuna-like species, shall also be applicable to the most commonly caught shark species and, where possible, to the less common shark species. CPCs are also encouraged to record **and provide data on species other than sharks and tunas taken as bycatch.**

Marine mammals IOTC Resolution 10/02: *Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)*	Paragraph 3: ….The provisions, applicable to tuna and tuna-like species, shall also be applicable to the most commonly caught shark species and, where possible, to the less common shark species. CPCs are also encouraged to record **and provide data on species other than sharks and tunas taken as bycatch.**

TABLE 2. List of the most commonly elasmobranch species caught.

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

TABLE 3. List of elasmobranchs species to be recorded in the logbook for longline, purse seine and gillnet fishing vessels.

For longline:	**For gillnet:**	**For purse seine:**
Blue Shark (*Prionace glauca*)	Blue Shark (*Prionace glauca*)	Oceanic Whitetip Shark (*Carcharhinus longimanus*)
Mako Sharks (*Isurus* spp.)	Mako Sharks (*Isurus* spp.)	Silky sharks (*Carcharhinus falciformis*)
Porbeagle Shark (*Lamna nasus*)	Other requiem sharks (*Carcharhinus spp.*)	Mantas and devils rays (Mobulidae)
Other requiem sharks (*Carcharhinus spp.*)	Oceanic Whitetip Shark (*Carcharhinus longimanus*)	Other sharks
Oceanic Whitetip Shark (*Carcharhinus longimanus*)	Hammerhead Sharks (Sphyrnidae)	Other rays
Hammerhead Sharks (Sphyrnidae)	Thresher Sharks (*Alopias* spp.)	
Thresher Sharks (*Alopias* spp.)	Tiger shark (*Galeocerdo cuvier)*	
Other sharks	Mantas and devils rays (Mobulidae)	
	Other sharks	
	Other rays	

7.5. IOTC–2011–WPNT01–R: Report of the First Session of the Working Party on Neritic Tunas

Executive Summary

The First Session of the Indian Ocean Tuna Commission (IOTC) WPNT was held in Chennai, India, from 14 to 16 November 2011. The meeting was attended by 28 individuals, including one Invited Expert, Dr. Shane Griffiths (CSIRO–Australia).

The following are a subset of the complete recommendations from the WPNT01 to the Scientific Committee, which are provided at Appendix XII.

The WPNT **RECOMMENDED** that the Scientific Committee note the management advice developed for each neritic tuna species as provided in the draft resource stock status summary for each neritic tuna species: (para. 86)

- longtail tuna (*Thunnus tonggol*) – Appendix VI
- narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix VII
- bullet tuna (*Auxis rochei*) – Appendix VIII
- frigate tuna (*Auxis thazard*) –Appendix IX
- kawakawa (*Euthynnus affinis*) – Appendix X
- Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XI

Noting that at present very little is known about the population structure and migratory range of most neritic tunas in the Indian Ocean, the WPNT **RECOMMENDED** that the Scientific Committee develop a research plan that includes two separate research lines; i) genetic research to determine the connectivity of neritic tunas throughout their distributions, and ii) tagging

research to better understand the movement dynamics, possible spawning locations, and post-release mortality of neritic tunas from various fisheries in the Indian Ocean. These should be considered high priority research projects for 2012 and 2013. (para. 89)

The WPNT **RECOMMENDED** that quantitative biological studies are required to determine maturity-at-age and fecundity-at-age relationships, and age and growth for all neritic tunas throughout their range. (para. 90)

The WPNT **RECOMMENDED** that where feasible, support should be provided by the IOTC Secretariat and other CPCs, to aid in the development of standardised CPUE series for each neritic tuna species. (para. 92)

The WPNT **AGREED** that there was an urgent need to carry out stock assessments for neritic tunas in the Indian Ocean, however at present the data held at the IOTC Secretariat would be insufficient to undertake this task. As such, the WPNT **RECOMMENDED** that the Scientific Committee consider recommending that the Commission consider allocating appropriate funds to further increase the capacity of coastal states to collect, report and analyse catch data on neritic tunas. (para. 94)

The WPNT **RECOMMENDED** that the Commission consider providing funds for IOTC scientists to develop stock status indicators and possibly stock assessments for neritic tunas, with narrow-barred Spanish mackerel, kawakawa and longtail tuna as priority species. (para. 99)

The WPNT **RECOMMENDED** that the Scientific Committee note the new Chair, Dr. Prathibha Rohit (India) and Vice-Chair, Mr. Farhad Kaymaram (I.R. Iran), of the WPNT for the next *biennium*. (para. 109)

7.6. IOTC–2011–WPDCS08–R: Report of the Eighth Session of the Working Party on Data Collection and Statistics

IOTC–2011–SC14–45: Review of IOTC discussions and recommendations for shark conservation in the Indian Ocean (Australia)

2 Aims

Australia, with the support of other interested Members, intends to present a proposal at IOTC 16 that would amend both Resolution 05/05 and Resolution 10/12. The proposal seeks to strengthen conservation and management arrangements for sharks caught in association with fisheries managed by the IOTC, in line with the discussion and recommendations of the WPEB and SC. The purpose of this paper is to present a synthesis of these discussions and recommendations, in order to provide the Commission with the necessary information to inform its deliberations on this matter.

There have been ongoing discussions at the IOTC's WPEB, SC and the Commission about Resolution 05/05. The discussions have centred on the following issues, and this paper is structured accordingly:

1. technical aspects of Resolution 05/05
2. scientific basis of the five per cent ratio of shark fin to body weight
3. need for improved data on shark catches
4. scientific basis for the prohibition of wire traces.

7 Recommendations made by the IOTC WPEB and SC

The WPEB has made consistent recommendations regarding catch reporting, attachment of shark fins to their respective carcasses, increased bycatch prevention through prohibition of wire traces, and promotion of research, education and training, in order to promote the effective conservation and management of sharks in the Indian Ocean.

In 2007, the WPEB recommended that data reporting for sharks mirror those for tuna species, working towards providing a comprehensive assessment process and indicators for the status of sharks. Furthermore, the WPEB recommended that additional information on shark fin ratios be provided for consideration to the SC (WPEB03, paragraph 42(1-3)).

In 2008, the WPEB provided comprehensive advice to the SC in regards to:

- technical reasoning for adopting Resolution 05/05
- information on the lack of scientific basis for the five per cent fin to body weight ratio
- the inability for Resolution 05/05 to achieve its stated objectives
- further opinions from shark experts.

Overall, the advice noted that the fin to body weight ratio should be abandoned in favour of landing sharks with their fins naturally attached, in an effort to cease shark finning and facilitate the collection of data to underpin shark stock assessments (WPEB04, paragraph 35). This was further reinforced by the WPEB sessions in 2009, 2010 and 2011.

In addition, the 2009 and 2010 sessions of the WPEB recommended that a digital photo

resource be developed for shark identification and that the status of shark stocks be assessed, to the extent possible, using information available from various fishery indicators (WPEB05, paragraph 52).

The SC has repeatedly endorsed the WPEB's recommendations and brought these recommendations before the Commission [SC10 Appendix IX; SC11, paragraph 57 (i-viii); SC12 Paragraphs 51, 198, 199 and 244(9); SC13, paragraphs 48, 49 (including Appendix III), 55, 57, 59 and 65]. The Commission has noted (IOTC13, paragraph 19) that: "there is no quantitative stock assessment or basic fishery indicators currently available for any of the sharks in the Indian Ocean therefore the stock status for all species is highly uncertain. In general, the life history characteristics of sharks; including that they are relatively long lived, typically take (at least) several years to mature, and have relativity few offspring, means that they are vulnerable to overfishing." The Commission has also noted the recommendations made by the WPEB and SC, including the recommendation to have sharks landed with fins naturally attached (IOTC13, paragraph 21), but has failed to act on these recommendations.

8 Summary

Australia, with the support of other interested Members, intends to present a proposal at IOTC 16 that would amend both Resolution 05/05 Concerning the conservation of sharks caught in association with fisheries managed by IOTC, and Resolution 10/12 On the conservation of thresher sharks (Family *Alopiidae*) caught in association with fisheries in the IOTC area of competence. The proposal will seek to strengthen conservation and management arrangements for sharks caught in association with fisheries managed by the IOTC, in line with the recommendations of the WPEB and SC. The proposal would simplify compliance and monitoring arrangements, while providing mechanisms to ensure the long-term sustainability of shark populations in the Indian Ocean.

Australia recognises that sharks are important regional food sources that provide food security and economic development benefits throughout the countries of the Indian Ocean rim. As such, Australia's proposal seeks to implement a management approach that will deliver conservation benefits for all shark species, while reducing the compliance burden on developing States.

Noting the ongoing concerns outlined by WPEB and SC for the sustainability of sharks in the Indian Ocean, the proposal will seek to:

- require fins to be naturally attached (including partially cut and folded), or attached by other mechanisms to the trunk, until the first landing [or transhipment]
- prohibit the use of wire traces.

Australia is seeking comments and views from Members and co-operating non-contracting parties to guide the drafting of a new shark Resolution, and welcomes discussion on the proposed Resolution at the WPEB, SC and Commission meetings.

IOTC–2011–SC14–46: A comparison between stocks and between 2011 stock assessment results of yellowfin in the Indian and Eastern Pacific oceans (European Union)

Summary

This paper makes a comparison between yellowfin stocks exploited in the Indian Ocean and in the Eastern Pacific ocean, their biology, their exploitation by fisheries and their stock status as they have been estimated in 2011 by IOTC and IATTC scientists. The paper shows good similarities in the biology and the exploitation of these 2 stocks by recent fisheries, but major divergences in all the stock assessment results, for instance concerning the stock sizes, the stock recruitment relationship and their exploitation rates. It is recommended that a joint working group between IOTC and IATTC scientists be organised to address this serious issue in order to understand the differences and reach more realistic assessment results. Such compatibility in the stock assessment parameters and results scales, for instance in the estimated levels of biomass, should be considered as a legitimate scientific goal, when these tuna stocks are showing major biological & fishery similarities.

8. Update on the Kobe Process (Chairs)

IOTC–2011–SC14–06: Report of the First Meeting of the Bycatch Joint Technical Working Group (Chair WPEB)

Purpose

To inform the Scientific Committee (SC) of the outcomes of the First Meeting of the Bycatch Joint Technical Working, noting that the Kobe process is not a decision making forum, but rather, that all recommendations are for discussion and decision by individual tuna RFMOs.

Background

The first meeting of the Bycatch Joint Technical Working Group (BJTWG) was held in La Jolla, USA on July 11, 2011 immediately prior to the KOBE III meeting. The meeting was held

in accordance with the Terms of Reference for the BJTWG which were adopted at the Kobe II Bycatch Workshop with the aim of discussing a range of bycatch issues impacting on each tRFMO.

Discussion

The BJTWG developed a series of recommendations under three broad headings, which the SC should consider:

1) Data Collection and Harmonization

a. The Working Group agreed that there should be minimum data standards, with data fields that are collected across all RFMOs with a view to allowing interoperability.
b. All members of all RFMOs are encouraged to improve the quality of data collection system to improve fisheries and bycatch assessments.
c. All members of all RFMOs are strongly encouraged to share data or information within RFMOs collected from observer and log book programs for the purposes of bycatch management and research.
d. The Working Group will prepare a short report on data harmonization using all existing data forms from all tuna RFMOs by December 31, 2011. To facilitate this process, the IATTC forms will be circulated for a comparison with the other tuna RFMOs.
e. Noting that there is a working group to be convened between IATTC and WCPFC on data harmonization, including bycatch, the Working Group recommends involving the other tuna RFMOs at this workshop.
f. Seabird identification: the tuna Secretariats will provide ACAP with existing seabird identifications, and ACAP will develop a standardized identification guides. The drafts of the identification guides will be reviewed by the Working Group working group and Tuna RFMO working groups.
g. Shark identification: the Working Group, with WCPFC and ICCAT taking the lead, will harmonize guidance for shark identification, in collaboration with the IUCN shark specialist group and others. (Note - IATTC shark ID guide is available in its website, and it provides a useful model for observer use).
h. Sea Turtle identification: The Secretariats will provide the Working Group Chair with the materials currently in use for turtle identification so these can be harmonized and distributed to all tuna RFMOs.
i. The Working Group should consider a process to develop harmonized marine mammal identification guides for the fisheries for which they are not available.

2) Sharks

a. The Working Group is concerned with the practice of intentional sets on whale sharks, in RFMOs where there is evidence of the practice occurring, and recommends that tuna RFMOs initiate research to determine the impact and outcome of this practice.
b. RFMOs should conduct risk assessment processes to develop their priorities for shark species which may need further assessment or mitigation. RFMOs may wish to consider the WCPFC key shark nomination processes (see Appendix C of the report).
c. RMFOs require their members and CPCs to record in the logbooks the number of sharks discarded. The Working Group to determine intersessionally.
d. RFMOs should take action to improve data collection on sharks and manta and devil rays in targeted industrial and artisanal fisheries. As an example, the Working Group noted that a fins naturally attached requirement would improve species identification and enforcement and should be considered as part of existing shark finning bans.
e. RFMOs should consider supporting studies to investigate post-release survival of sharks in longline fisheries in relation to hook type and duration of set, among other factors.
f. RFMOs should consider supporting studies to further develop shark bycatch mitigation strategies for longline fisheries.
g. RFMOs should evaluate the costs and benefits of banning the use of wire leaders in tuna longline fisheries.
h. RFMOs should develop handling and release protocols for all sharks and manta and devil rays, taking into consideration the safety of the crews.

3) Collaboration and Research

a. The Working Group agreed to meet to develop a centralized bibliographic bycatch database that includes information on mitigation, bycatch conservation and management measures adopted by the RFMOs and past assessments undertaken by RFMOs; with the effort will be led by ICCAT, IOTC, and WCPFC.
b. Each RFMO should designate/employ a dedicated bycatch staff person to work

collaboratively with other RFMOs to promote bycatch related work.

c. The Working Group should consider meeting in person every three years to prioritize research in line with the TOR of the Working Group.

d. The Working Group in consultation with experts should undertake a review of ecological risk assessments used by the RFMOs and provide recommendations to standardize these assessments across RFMOs

In addition, the BJTWG agreed to a list of 14 provisional research priorities for the consideration of each tRFMO.

Provisional Research Priorities

1) Sea turtle bycatch mitigation and distribution
2) Post-release survival of sharks, manta and devil rays, sea turtles, and seabirds
3) Best practices for handling and release techniques of all taxa listed above
4) Shark bycatch mitigation, primarily in longlines and also purse seines and gillnets
5) Seabird bycatch mitigation in artisanal fisheries
6) Sorting grids for small fish, tunas and other species
7) Economic benefits of reducing bycatch
8) Multi-taxa impacts of bycatch mitigation measures
9) Assess impacts of gillnets/driftnet fishing on bycatch species
10) Rate of marine mammal depredation and its relation to bycatch in longline fisheries
11) Review of Ecological Risk Assessment methods
12) Research to improve life history parameters, including biological parameters on all bycatch species.
13) Evaluate the feasibility of video and other electronic monitoring and other technology is the context of tuna RFMO.
14) Pursue observer coverage and adequate sampling of artisanal fisheries

The BJTWG noted that the discussions and conclusions from this meeting in no way supersede or take away from the "Proposals for Immediate Action" from Kobe 2 and the Kobe 2 Bycatch Workshop and requested that feedback from each tRFMOs be provided on each of the above recommendations and research priorities. As such, the SC may wish to consider developing a set of recommendations to the Commission to aid in their understanding of progress made to date, and ways to advance each of the BJTWG recommendations in the future. The complete report is provided at Appendix A.

RECOMMENDATION/S

That the Scientific Committee:

1) **NOTE** the outcomes of the first Bycatch Joint Technical Working Group
2) **NOTE** that the Kobe process is not a decision making forum, but rather, that all recommendations are for discussion and decision by individual tuna RFMOs.
3) **PROVIDE** the Commission with updates on progress already made by the IOTC for each recommendation and ways to advance each recommendation into the future, as appropriate.
4) **PROVIDE** the Working Party on Ecosystems and Bycatch with guidance on how the SC would like the recommendations progressed.

IOTC–2011–SC14–07: Recommendations arising from the KOBE III meeting (Chair SC)

Purpose

To inform the Scientific Committee (SC) of the recommendations arising from the third joint meeting of the tuna Regional Fisheries Management Organisations (KOBE III), which was held in La Jolla, California (USA) from July 11–15 2011.

Background

Participants to the KOBE III meeting discussed a range of issues from science and management to compliance and enforcement, with the aim of harmonisation among RFMOs. The meeting built on the work of Kobe II by reinforcing the mandate of the existing five tuna RFMOs and seeking to address issues at a global level where the work of the individual RFMOs is insufficient.

Discussion

Of the 16 recommendations arising from the KOBE III meeting, three were specific to the tRFMO scientific processes:

1) Recognizing that the five tuna Regional Fisheries Management Organizations (tRFMOs) have different data confidentiality rules, and noting this might curb the exchange of data across tRFMOs, Kobe III participants recommended that tRFMO Secretariats cooperate to develop common data confidentiality rules and a draft protocol for data sharing. The protocol will specify the types of data to be shared, how it can be used, and who can have access to it.

2) Emphasizing the potential of the Kobe II Strategy Matrix (K2SM) to communicate efficiently among all stakeholders and to assist in the decision-making process according to different levels of risk, but also recognizing that substantial uncertainties still remain in the assessments, Kobe III participants recommended that the Scientific Committees and Bodies of the tRFMOs develop research activities to better quantify the uncertainty and understand how this uncertainty is reflected in the risk assessment inherent in the K2SM.
3) Recognizing that a Management Strategy Evaluation (MSE) process needs to be widely implemented in the tRFMOs in the line of implementing a precautionary approach for tuna fisheries management, it is recommended that a Joint MSE Technical Working Group be created and that this Joint Working Group work electronically, in the first instance, in order to minimize the cost of its work.

The SC may wish to consider developing a set of recommendations to aid the Commission in understanding progress made to date, and ways to advance each KOBE III recommendation in the future. The complete set of recommendations from the KOBE III meeting are provided at Appendix A.

RECOMMENDATION

That the Scientific Committee:

1) **NOTE** the outcomes of the third joint meeting of the tuna Regional Fisheries Management Organisations (KOBE III)
2) **PROVIDE** the Commission with updates on progress already made by the IOTC for each recommendation
3) **PROVIDE** the Commission with options to progress each recommendation within the IOTC.

9. Examination of the Effects of Piracy on Fleet Operations and Subsequent Catch and Effort Trends (Chair)

9.1. *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).*

10. Status of Tuna and Tuna-Like Resources in the Indian Ocean (Chair)

10.1 Tuna – Highly migratory species

IOTC–2011–SC14–08: Status of the albacore resource

Stock status. Trends in the Taiwan,China CPUE series suggest that the longline vulnerable biomass has declined to about 39% of the level observed in 1980. There were 20 years of moderate fishing before 1980, and the catch has more than doubled since 1980. Catches have increased substantially since the previous albacore assessment when there was considered to be a risk that $SB<SB_{MSY}$, so the risk will have increased further. It is considered likely that recent catches have been above MSY, recent fishing mortality exceeds F_{MSY} ($F_{2010}/F_{MSY}>1$). There is a moderate risk that total biomass is below B_{MSY} ($B_{2010}/B_{MSY}\approx1$).

Outlook. Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE. The impacts of piracy in the western Indian Ocean has resulted in the displacement of a substantial portion of longline fishing effort into the traditional albacore fishing areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on albacore will decline in the near future.

The WPTmT **RECOMMENDED** that the Scientific Committee consider the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Current catches (average ~41,000 t over the last five years, ~44,000 t in 2010) likely exceed MSY (29,900 t, range: 21,500–33,100 t). Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.
- A Kobe 2 Strategy matrix was calculated to quantify the risk of different future catch scenarios. However, a number of inconsistencies between the model and data were noted for future investigation (matrix not presented here as a result).

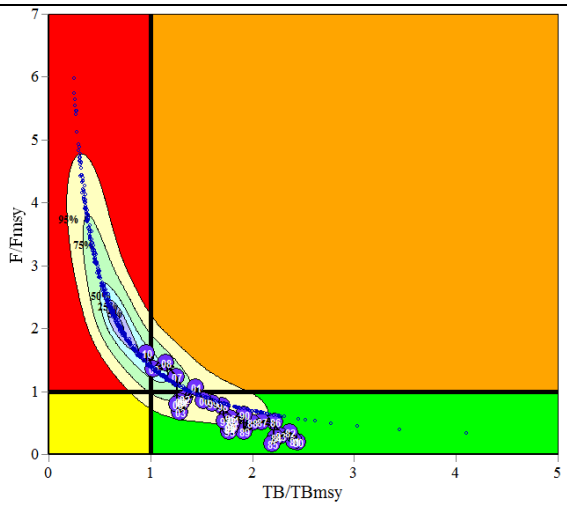

Fig. 1. ASPIC Aggregated Indian Ocean assessment Kobe plot (95% Confidence surfaces shown around 2010 estimate). Fixed B/K=0.9. Blue circles indicate the trajectory of the point estimates for the TB ratio and F ratio for each year 1980–2010 (Note: at this time the WPTmT had limited confidence in the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

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

Management Quantity	**Aggregate Indian Ocean**
2010 catch estimate (1000 t)	43.7
Mean catch from 2006–2010 (1000 t)	41.1
MSY (1000 t) (80% CI)	29.9 (21.5–33.1)
Data period used in assessment	1980–2010
F_{2010}/F_{MSY} (80% CI)	1.61 (1.19–2.22)
B_{2010}/B_{MSY} (80% CI)	0.89 (0.65–1.12)
SB_{2010}/SB_{MSY}	–
B_{2010}/B_{1980} (80% CI)	0.39 (n.a.)
SB_{2010}/SB_{1980}	–
$B_{2010}/B_{1980,\ F=0}$	–
$SB_{2010}/SB_{1980,\ F=0}$	–

IOTC–2011–SC14–09: Status of the bigeye tuna resource

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 $F_{current}/F_{MSY}<1$). Current spawning stock biomass was estimated to be 34–40 % 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. 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 $F_{2019}>F_{MSY}$).

The WPTT **RECOMMENDED** that the Scientific Committee consider the following:

- 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). Annual catches of bigeye tuna should not exceed the lower range of this estimated 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 100,000–114,000 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.

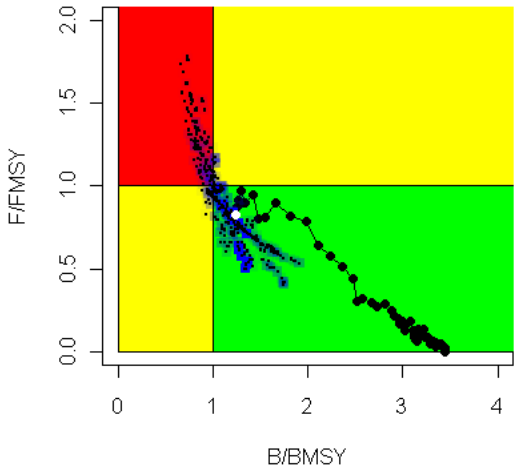

Fig. 1. SS3 Aggregated Indian Ocean assessment Kobe plot. Black circles represent the time series of annual median values from the weighted stock status grid (white circle is 2009). Blue squares indicate the MPD estimates for 2009 corresponding to each individual grid C model, with colour density proportional 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 5. 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 (1000 t)	102	71.5
Mean catch from 2006–2010 (1000 t)	104.7	104.7
MSY (1000 t)	114 (95–183)	102.9 (86.6–119.3)[2]
Data period used in assessment	1952–2009	1950–2010
F_{curr}/F_{MSY}[3]	0.79[1] Range[1]: 0.50 – 1.22	0.67 (0.48–0.86)[2]
B_{curr}/B_{MSY}[3]	–	–
SB_{curr}/SB_{MSY}[3]	1.20[1] Range[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] Range[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.

IOTC–2011–SC14–10: Status of the skipjack tuna resource

Stock status. The weighted results suggest that the stock is not overfished ($B>B_{MSY}$) and that overfishing is not occurring (C<MSY, used as a proxy for $F<F_{MSY}$). Spawning stock biomass was estimated to have declined by approximately 47% in 2009 from unfished levels.

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. However, 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 2009 (455,999 t) and 2010 (428,719 t) as well as the average level of catches of 2006–2010 (489,385 t) were lower than median value of MSY.

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, 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 2006–2010 average (489,385 t).

The WPTT **RECOMMENDED** that the Scientific Committee consider the following:

- The median estimates of the Maximum Sustainable Yield for the skipjack tuna Indian Ocean stock is 564,000 t and considering the average catch level from 2005–2009 was 492,000 t [512,305 t], catches of skipjack tuna should not exceed the average of 2005–2009.
- 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 illustrates the levels of risk associated with varying catch levels over time and could be used to inform management actions.

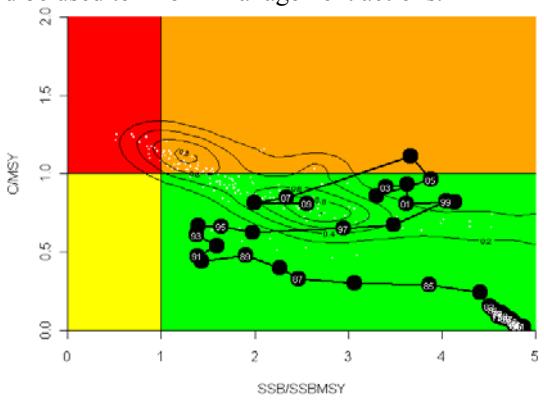

Fig. 1. SS3 Aggregated Indian Ocean assessment Kobe plot. Black circles indicate the trajectory of the weighted median of point estimates for the SB ratio and C/MSY ratio for each year 1950–2009. Probability distribution contours are provided only as a rough visual guide of the uncertainty (e.g. the 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 6. Key management quantities from the SS3 assessment, for the aggregate Indian Ocean. Estimates represent 50th (5th – 95th) percentiles from the weighted distribution of MPD results. 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 in Table 1.

Management Quantity	**Aggregate Indian Ocean**
2009 catch estimate (1000 t)	456
Mean catch from 2005–2009 (1000 t)	492 [512]
MSY (1000 t) (90% CI)	564 (395–843)
Data period used in assessment	1950–2009
C_{2009}/MSY (90% CI) (proxy for F_{2009}/F_{MSY})	0.81 (0.54–1.16)
B_{2009}/B_{MSY}	–
SB_{2009}/SB_{MSY} (90% CI)	2.56 (1.09–5.83)
B_{2009}/B_0	–
SB_{2009}/SB_0 (90% CI)	0.53 (0.29–0.70)
$B_{2009}/B_{1950, F=0}$	–

$SB_{2009}/SB_{1950, F=0}$	0.53 (0.29–0.70)

IOTC–2011–SC14–11: Status of the yellowfin tuna resource

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 ($F_{2009}<F_{MSY}$). 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. 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.

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. 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.

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.

The WPTT **RECOMMENDED** that the Scientific Committee consider 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.

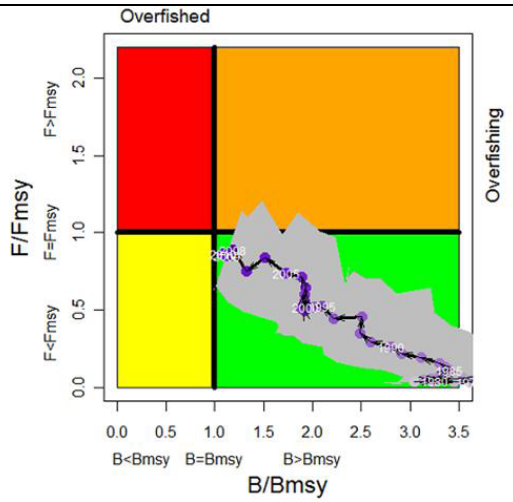

Fig. 1. MULTIFAN-CL Indian Ocean yellowfin tuna stock assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year 1972–2009. The equal weighted mean trajectory of the scenarios investigated in the assessment. The range is given by the different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

Table 6. Key management quantities from the MFCL assessment, for the agreed scenarios of yellowfin tuna in the Indian Ocean. Values represent an equal weighting mean of the scenarios investigated. The range is described by the range values between those scenarios.

Management Quantity	**Indian Ocean**
2010 catch estimate (1000 t)	299.1
Mean catch from 2006–2010 (1000 t)	326.6
MSY (1000 t)	357 (290–435)
Data period used in assessment	1972–2010
F_{2009}/F_{MSY}	0.84 (0.63–1.10)
B_{2009}/B_{MSY}	1.46 (1.35–1.59)
SB_{2009}/SB_{MSY}	1.61 (1.47–1.78)
B_{2009}/B_0	0.49
SB_{2009}/SB_0	0.35 (0.31–0.38)
$B_{2009}/B_{0,\ F=0}$	0.58
$SB_{2009}/SB_{0,\ F=0}$	–

IOTC–2011–SC14–12: Status and management of southern bluefin tuna (from CCSBT)

Report on Biology, Stock Status and Management of Southern Bluefin Tuna: 2011

3. Summary of Stock Status

The Extended Scientific Committee (ESC) advised that the current spawning stock biomass (SSB) remains very low (0.03-0.07 *SSB0*); however, the outlook for the stock is positive.

However, there have been several positive recent signals about the outlook for the spawning stock. These include:

Stock

- Reduction in the total reported global catch
- Current fishing mortality reduced and now below F_{MSY} (see ESC Report Figure 2, and Figure 5)
- Confirmation of increases in longline CPUE since 2007.

Recruitment

- Increased scientific aerial survey and SAPUE indices (reflective of improved recruitment of recent year classes)
- Increased abundance of 1 year old SBT observed in the scientific aerial survey for the past three years, and the troll survey in the most recent year.

Recent recruitments (2005-2011) are estimated to be higher than previous conditioning and above the estimated stock-recruit curve, in contrast to the weak cohorts of 1999-2002 (see ESC Report Figure 1). These estimates are driven by both the recent increases in CPUE and the scientific aerial survey data. Nevertheless, it will be sometime before the recent stronger recruitments enter the spawning stock. Model results indicate that the SSB is likely to increase after 2012.

Increases in a number of CPUE indices in the most recent years, such as the New Zealand

domestic fishery and Japanese longline fishery for age classes 4 and 5, suggest stronger year classes in recent years. Caution should nevertheless continue to be exercised in interpreting the longline CPUE data, where there is underlying uncertainty in the past data and potential changes in fishing operation patterns since 2006, which remains to be resolved.

The median constant catch projection under the current TAC (of 9449 t) for the base case show the interim rebuilding target of 0.2 SSB_0 being reached in 2024, and for the zero TAC case it is reached in 2020 (see ESC Report Figure 7). The faster than previously projected recovery of the future SSB is largely driven by the higher estimates of recruitment, CPUE and steepness. However, constant catch projections make no allowance for future conditions such as poor recruitments, and hence the ESC strongly recommended the adoption of an adaptive MP to properly deal with such circumstances.

The MP catch projections reach the interim rebuilding target of $0.2SSB_0$ with a 70% probability as specified by the tuning year. An earlier tuning year, lower maximum TAC change and no TAC increase in the first TAC setting period leads to faster rebuilding, lower catches and a lower probability of catch decreases in the short-term (see ESC Report Figures 8 & 9). Based on model results there is virtually no possibility of extinction of the stock under the recommended MP.

SOUTHERN BLUEFIN TUNA SUMMARY (global stock)	
Maximum Sustainable Yield	34,500 t (31,100-36,500t)[1]
Reported (2010) Catch	9547 t
Current Replacement Yield	27,200 t (22,200–32,800 t)
Current (2011) Spawner Biomass	45,400 (31,022–72,700 t)
Current (2011) Depletion	0.055 (0.035–0.077)
Spawner Biomass (2011) Relative to SSB_{msy}	0.229 (0.146–0.320)
Fishing Mortality (2010) Relative to F_{msy}	0.76 (0.52–1.07)
Current Management Measures	Effective Catch Limit for Members and Cooperating Non-Members combined averaged 9449 t annually over 2010-2011.

[1]Median and range from lower 5th to upper 95th percentile of 320 models contained in the base case.

10.2 Tuna and mackerel – Neritic species

IOTC–2011–SC14–13: Status of the bullet tuna resource
IOTC–2011–SC14–14: Status of the frigate tuna resource
IOTC–2011–SC14–15: Status of the longtail tuna resource
IOTC–2011–SC14–16: Status of the Indo-Pacific king mackerel resource
IOTC–2011–SC14–17: Status of the Kawakawa resource
IOTC–2011–SC14–18: Status of the narrow-barred Spanish mackerel resource

10.3 Billfish

IOTC–2011–SC14–19: Status of the swordfish resource

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 ($F2_{009}/F_{MSY}<1$; $SB_{2009}/SB_{MSY}>1$). Spawning stock biomass in 2009 was estimated to be 30–53% 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 $F_{2019}>F_{MSY}$).

Recommendations to the Scientific Committee

The WPB **agreed** that:

1) The Maximum Sustainable Yield estimate for the whole Indian Ocean is 29,900–34,200 t and annual catches of swordfish should not exceed this estimate.
2) 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.
3) The Kobe strategy matrix illustrates the levels of risk associated with varying catch levels

over time and could be used to inform management actions.
4) Advice specific to the southwest region is provided below, as requested by the Commission.

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}.

Outlook. The decrease in catch and effort over the last few years in the southwest region has reduced pressure on this resource. There is a low risk of exceeding MSY-based reference points by 2019 if catches reduce further or are maintained at current levels (<25% risk that $B_{2019}<B_{MSY}$, and <8% risk that $F_{2019}>F_{MSY}$). There is a risk of reversing the rebuilding trend if there is any increase in catch in this region.

Recommendations to the Scientific Committee

The WPB **agreed** that:

1) The Maximum Sustainable Yield estimate for the southwest Indian Ocean is 7,100–9,400 t.
2) Catches in the southwest Indian Ocean should be maintained at levels at or below those observed in 2009 (6,600 t) [6,678], until there is clear evidence of recovery and biomass exceeds B_{MSY}.
3) The Kobe strategy matrix illustrates the levels of risk associated with varying catch levels over time and could be used to inform management actions.

TABLE 8. Key management quantities from the 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
2009 catch estimate (1000 t)	21.5	6.6 [6.7]
Mean catch from 2005–2009 (1000 t)	26.4 [26.3]	7.8 [7.7]
MSY (1000 t)	31 (20– 55)	9.4 (6.5–13.5)
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)
$B_{2009}/B_{0,\ F=0}$	–	–
$SB_{2009}/SB_{0,\ F=0}$	–	–

IOTC–2011–SC14–20: Status of the black marlin resource

Stock status. No quantitative stock assessment is currently available for black marlin 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*. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

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 not sufficient information to evaluate the effect this will have on the resource.

The Scientific Committee considers the following:

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

IOTC–2011–SC14–21: Status of the blue marlin resource

Stock status. No quantitative stock assessment is currently available for blue marlin in the Indian Ocean, and due to a lack of reliable fishery data for several gears, only very preliminary stock indicators can be used. The standardised CPUE suggest that there was a decline in the early 1980s, followed by an increase in 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*. However, aspects of species

biology, productivity and fisheries combined with a lack of fisheries 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, however there is not sufficient information to evaluate the effect this will have on the resource.

The WPB **RECOMMENDED** that the Scientific Committee consider the following:

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

IOTC–2011–SC14–22: Status of the striped marlin resource

Stock status. No quantitative stock assessment is currently available for striped marlin 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*. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

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 not sufficient information to evaluate the effect this will have on the resource.

The Scientific Committee considers the following:

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

IOTC–2011–SC14–23: Status of the Indo-Pacific sailfish resource

Stock status. No quantitative stock assessment is currently available for Indo-Pacific sailfish 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*. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

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 not sufficient information to evaluate the effect this will have on the resource.

The Scientific Committee considers the following:

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

11. Status of Marine Turtles, Seabirds and Sharks in the Indian Ocean (Chair)

11.1 Marine turtles

IOTC–2011–SC14–24: Status of marine turtles

Status of marine turtles in the Indian Ocean – IUCN threat status for all marine turtle species reported as caught in fisheries within the IOTC area of competence

Common name	Scientific name	IUCN threat status
Flatback turtle	*Natator depressus*	Data deficient
Green turtle	*Chelonia mydas*	Endangered
Hawksbill turtle	*Eretmochelys imbricata*	Critically Endangered
Leatherback turtle	*Dermochelys coriacea*	Critically Endangered
Loggerhead turtle	*Caretta caretta*	Endangered
Olive ridley turtle	*Lepidochelys olivacea*	Vulnerable

Indian Ocean Stock – Management Advice

Stock status. No assessment has been undertaken by the IOTC WPEB for marine turtles due to the lack of data being submitted by CPCs. However, the current International Union for Conservation of Nature (IUCN) threat status for each of the marine turtle species reported as caught in IOTC fisheries to date is provided in Table 1. It is important to note that a number of international global environmental accords (e.g. Convention on Migratory Species (CMS), Convention on Biological Diversity (CBD)), as well as numerous fisheries agreements obligate States to provide protection for these species. While the status of marine turtles is affected by a

range of factors such as degradation of nesting beaches and targeted harvesting of eggs and turtles, the level of mortality of marine turtles due to capture by gillnets and to a lesser extent purse seine fishing and longline is not known.

Outlook. Resolution 09/06 *on marine turtles* includes an evaluation requirement (para. 9) by the Scientific Committee in time for the 2011 meeting of the Commission (para.10). However, given the lack of reporting of marine turtle interactions by CPCs to date, such an evaluation was not able to be undertaken. Unless IOTC CPCs become compliant with the data collection and reporting requirements for marine turtles, the WPEB will continue to be unable to address this issue. Notwithstanding this, it is acknowledged that the impact on marine turtle populations from fishing for tuna and tuna-like species may increase if fishing pressure increases, or if the status of the marine turtle populations worsens due to other factors such as an increase in fishing pressure from other fisheries or anthropological or climatic impacts.

The WPEB **RECOMMENDED** that the Scientific Committee consider the following:

- The available evidence indicates considerable risk to the status of marine turtles in the Indian Ocean.
- The primary source of data that drive the ability of the WPEB to determination a status for the Indian Ocean, total interactions by fishing vessels, is highly uncertain and should be addressed as a matter of priority.
- Current reported interactions are a known to be a severe underestimate: 7 interactions reported in 2009.
- Maintaining or increasing effort in the Indian Ocean without appropriate mitigation measures in place, will likely result in further declines in biomass.
- That appropriate mechanisms are developed by the Compliance Commission to ensure CPCs comply with their data collection and reporting requirements for marine turtles.

IOTC-2011-SC14-INFO03[E]

Protection of Leatherback Turtles (*Dermochelys Coriacea*) from Fishing Impacts in the Indian Ocean

Paper prepared by Australia

As recorded in the report of the twelfth session of the Indian Ocean Tuna Commission's (IOTC) Scientific Committee (SC), Resolution 09/06 *On Marine Turtles* applies to leatherback turtles (*Dermochelys coriacea*) in its entirety and that the term 'hard-shelled' should be removed from the resolution. The thirteenth Scientific Committee meeting endorsed this recommendation and in 2011, WPEB07 again recommended (paragraph 246) that Resolution 09/06 be revised so that the term 'hard-shelled' is deleted and replaced by 'marine', to ensure application of this resolution to all marine turtle species. The WPEB also noted the need to strengthen the resolution to ensure compliance with annual reporting (recommendation 16, paragraph 41).

Australia is concerned that the reference to 'hard-shelled' may not afford the same level of protection for leatherback turtles that is provided to other marine turtle species through the current IOTC resolution. Australia is also concerned that the text in Paragraph 4 of Resolution 09/06 may be a source of ambiguity and subsequently be a cause for non-compliance with the resolution.

The executive summary for leatherback turtles produced by the SC in conjunction with the Indian Ocean–South-East Asian Marine Turtle Memorandum of Understanding (IOSEA) notes that leatherback turtles are the most wide ranging marine turtle species and migrate significant distances throughout the world's oceans, including through the eastern and western Indian Ocean. The Food and Agriculture Organisation of the United Nations further notes that the Indian Ocean has a number of important nesting sites for leatherback turtles: Indonesia, South Africa, Sri Lanka and the Andaman and Nicobar Islands in the Bay of Bengal.

The SC noted the status of leatherback turtles is considered to be critically endangered by the IUCN. The SC continues to note that data on interactions with fishing gear remains largely preliminary, but that incidental catch is likely to be high, particularly in gillnet and longline fisheries. The SC has continued to note that members and cooperating non-contracting parties are not reporting marine turtle interactions with fishing operations which limits the understanding of the status of the species in the IOTC Area of Competence.

Recognising the concerns of turtle experts around the world and the critically endangered status of leatherback turtles, Australia considers that amending Resolution 09/06 to ensure that leatherback turtles are afforded the same level of protection as other marine turtle species, including the collection and submission of data and fostering the recovery of leatherbacks, if caught, is an important step in mitigating the impact of tuna fishing on other marine species.

Australia, with interested members, intends to put forward a proposal to the 16th Annual

Session of the Indian Ocean Tuna Commission to amend Resolution 09/06 to replace 'hard-shelled' to 'marine' and clarify the date for data reporting. Australia is seeking endorsement or co-sponsorship of the proposal from other members.

11.2 Seabirds

IOTC–2011–SC14–25: Status of seabirds

Status of seabirds in the Indian Ocean – IUCN threat status for all seabird species reported as caught in fisheries within the IOTC area of competence.

Common name	Scientific name	IUCN threat status
Albatross		
Atlantic Yellow-nosed Albatross	*Thalassarche chlororynchos*	Endangered
Black-browed albatross	*Thalassarche melanophrys*	Endangered
Indian yellow-nosed albatross	*Thalassarche car teri*	Endangered
Shy albatross	*Thalassarche cauta*	Near Threatened
Sooty albatross	*Phoebetria fusca*	Endangered
Tristan albatross	*Diomedea dabbenena*	Critically Endangered
Wandering albatross	*Diomedia exulans*	Vulnerable
White-capped albatross	*Thalassarche steadi*	Near Threatened
Petrels		
Cape/Pintado petrel	*Daption capense*	Least Concern
Great-winged petrel	*Pterodroma macroptera*	Least Concern
Grey petrel	*Procellaria cinerea*	Near Threatened
Northern giant-petrel	*Macronectes halli*	Least Concern
White-chinned petrel	*Procellaria aequinoctialis*	Vulnerable
Others		
Cape gannet	*Morus capensis*	Vulnerable
Flesh-footed shearwater	*Puffinus carneipes*	Least Concern

Stock status. No assessment has been undertaken by the IOTC WPEB for seabirds due to the lack of data being submitted by CPCs. However, the current International Union for Conservation of Nature (IUCN) threat status for each of the seabird species reported as caught in IOTC fisheries to date is provided in Table 1. It is important to note that a number of international global environmental accords (e.g. Convention on Migratory Species (CMS), Convention on Biological Diversity (CBD)), as well as numerous fisheries agreements obligate States to provide protection for these species. While the status of seabirds is affected by a range of factors such as degradation of nesting habitats and targeted harvesting of eggs, the level of mortality of seabirds due to fishing gear in the Indian Ocean is poorly known, although where there has been rigorous assessment of impacts in areas south of 25 degrees (e.g. in South Africa), very high seabird bycatch rates have been recorded in the absence of a suite of proven bycatch mitigation measures.

Outlook. *Resolution* 10/06 *On Reducing the Incidental Bycatch of Seabirds in Longline Fisheries* includes an evaluation requirement (para. 8) by the Scientific Committee in time for the 2011 meeting of the Commission. However, given the lack of reporting of seabird interactions by CPCs to date, such an evaluation cannot be undertaken at this stage. Unless IOTC CPCs become compliant with the data collection and reporting requirements for seabirds, the WPEB will continue to be unable to address this issue. Notwithstanding this, it is acknowledged that the impact on seabird populations from fishing for tuna and tuna-like species, particularly using longline gear may increase if fishing pressure increases. Any fishing in areas with high abundance of procellariiform seabirds is likely to cause incidental capture and mortality of these seabirds unless measures that have been proven to be effective against Southern Ocean seabird assemblages are employed.

The WPEB **RECOMMENDED** that the Scientific Committee consider the following:

- The available evidence indicates considerable risk to the status of seabirds in the Indian Ocean.
- The primary source of data that drive the ability of the WPEB to determination a status for the Indian Ocean, total interactions by fishing vessels, is highly uncertain and should be addressed as a matter of priority.
- Current reported interactions (two in 2009) are a known to be a severe underestimate.
- Maintaining or increasing effort in the Indian Ocean without refining and implementing

appropriate mitigation measures, will likely result in further declines in biomass.
- That appropriate mechanisms are developed by the Compliance Commission to ensure CPCs comply with their data collection and reporting requirements for seabirds.
- Resolution 10/06 on reducing the incidental bycatch of seabirds in longline fisheries includes an evaluation requirement (para. 8) by the Scientific Committee in time for the 2011 meeting of the Commission, noting that this deadline is now overdue.

11.3 Sharks

IOTC–2011–SC14–26: Status of blue sharks

Status of blue shark (*Prionace glauca*) in the Indian Ocean – IUCN threat status

Common name	Scientific name	IUCN threat status		
		Global status	WIO	EIO
Blue shark	*Prionace glauca*	Near Threatened	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean SOURCES: IUCN (2007, 2011)

Stock status. The current IUCN threat status of 'Near Threatened' applies to blue sharks globally (Table 1). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available for blue shark in the Indian Ocean therefore the stock status is highly uncertain. Blue sharks are commonly taken by a range of fisheries in the Indian Ocean and in some areas they are fished in their nursery grounds. Because of their life history characteristics – they are relatively long lived (16–20 years), mature at 4–6 years, and have relativity few offspring (25–50 pups every year), the blue shark is vulnerable to overfishing. Blue shark assessments in the Atlantic and Pacific oceans seem to indicate that blue shark stocks can sustain relatively high fishing pressure.

Outlook. 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 blue shark will decline in these areas in the near future, and may result in localised depletion.

The Scientific Committee considered the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Noting that current reported catches (probably largely underestimated) are estimated at an average ~8,924 t over the last five years, ~9,416 t in 2010, maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

IOTC–2011–SC14–27: Status of silky sharks

Status of silky shark (*Carcharhinus falciformis*) in the Indian Ocean – IUCN threat status

Common name	Scientific name	IUCN threat status		
		Global status	WIO	EIO
Silky shark	*Carcharhinus falciformis*	Near Threatened	Near Threatened	Near Threatened

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean SOURCES: IUCN (2007, 2011)

Stock status. The current IUCN threat status of 'Near Threatened' applies to silky sharks in the western and eastern Indian Ocean and globally (Table 1). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for silky shark in the Indian Ocean therefore the stock status is highly uncertain. Silky sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (over 20 years), mature at 6–12 years, and have relativity few offspring (<20 pups every two years), the silky shark is vulnerable to overfishing. Despite the lack of data, it is clear from the information that is available that silky shark abundance has declined significantly over recent decades.

Outlook. Maintaining or increasing effort will probably result in 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 silky shark will decline in these areas in the near future, and may result in localised depletion.

The Scientific Committee considered the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- Total catches are highly uncertain and should be investigated further as a priority.
- Noting that current reported catches (probably largely underestimated) are estimated at an average ~670 t over the last five years, ~1,153 t in 2010, maintaining or increasing effort will probably result in further declines in biomass.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

IOTC–2011–SC14–28: Status of oceanic whitetip sharks

Status of oceanic whitetip shark (*Carcharhinus longimanus*) in the Indian Ocean – IUCN threat status

Common name	Scientific name	IUCN threat status		
		Global status	WIO	EIO
Oceanic whitetip shark	*Carcharhinus*	Vulnerable	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean SOURCES: IUCN (2007, 2011)

Stock status. The current IUCN threat status of 'Vulnerable' applies to oceanic whitetip sharks globally (Table 1). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available for oceanic whitetip sharks in the Indian Ocean therefore the stock status is highly uncertain. Oceanic whitetip sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived, mature at 4–5 years, and have relativity few offspring (<20 pups every two years), the oceanic whitetip shark is vulnerable to overfishing. Despite the lack of data, it is apparent from the information that is available that oceanic whitetip shark abundance has declined significantly over recent decades.

Outlook. 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 oceanic whitetip sharks will decline in these areas in the near future, and may result in localised depletion.

The Scientific Committee considered the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Noting that current catches (probably largely underestimated) are estimated at an average ~265 t over the last five years, ~450 t in 2010, maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

IOTC–2011–SC14–29: Status of scalloped hammerhead sharks

Status of scalloped hammerhead shark (*Sphyrna lewini*) in the Indian Ocean – IUCN threat status.

Common name	Scientific name	IUCN threat status		
		Global status	WIO	EIO
Scalloped hammerhead	*Sphyrna lewini*	Endangered	Endangered	Least concern

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean SOURCES: IUCN (2007, 2011)

Stock status. The current IUCN threat status of 'Endangered' applies to blue sharks globally and specifically for the western Indian Ocean (Table 1). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for scalloped hammerhead shark in the Indian Ocean therefore the stock status is highly uncertain. Scalloped hammerhead sharks are commonly taken by a range of fisheries in the Indian Ocean. They are extremely vulnerable to gillnet fisheries. Furthermore, pups occupy shallow coastal nursery grounds, often heavily exploited by inshore fisheries. Because of their life history characteristics – they are relatively long lived (over 30 years), and have relativity few offspring (<31 pups each year), the scalloped hammerhead shark is vulnerable to overfishing.

Outlook. Maintaining or increasing effort will probably result in further declines in biomass and productivity. 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 scalloped hammerhead shark will decline in these areas in the near future, and may result in localised depletion.

The Scientific Committee considered the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The primary source of data that drive the assessment (total catches) is highly uncertain and should be investigated further as a priority.
- Noting that current reported catches (probably largely underestimated) are estimated at an average ~16 t over the last five years, ~22 t in 2010, maintaining or increasing effort will probably result in further declines in biomass and productivity.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

IOTC–2011–SC14–30: Status of shortfin mako sharks

Status of shortfin mako shark (*Isurus oxyrinchus*) in the Indian Ocean – IUCN threat status

Common name	Scientific name	IUCN threat status		
		Global status	WIO	EIO
Shortfin mako shark	*Isurus oxyrinchus*	Vulnerable	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean SOURCES: IUCN (2007, 2011)

Stock status. The current IUCN threat status of 'Vulnerable' applies to shortfin mako sharks globally (Table 1). Trends in the Japanese CPUE series suggest that the longline vulnerable biomass has declined from 1994 to 2003, and has been increasing since then. There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for shortfin mako shark in the Indian Ocean therefore the stock status is highly uncertain. Shortfin mako sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (over 30 years), females mature at 18–21 years, and have relativity few offspring (<25 pups every two or three years), the shortfin mako shark is vulnerable to overfishing.

Outlook. 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 shortfin mako shark will decline in these areas in the near future, and may result in localised depletion.

The Scientific Committee considered the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.

- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Noting that current reported catches are estimated (probably largely underestimated) at an average ~990 t over the last five years, ~738 t in 2010, maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

IOTC–2011–SC14–31: Status of bigeye thresher sharks

Status of bigeye thresher shark (*Alopias superciliosus*) in the Indian Ocean – IUCN threat status.

Common name	Scientific name	IUCN threat status		
		Global status	WIO	EIO
Bigeye thresher shark	*Alopias superciliosus*	Vulnerable	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean SOURCES: IUCN (2007, 2011)

Stock status. The current IUCN threat status of 'Vulnerable' applies to bigeye thresher shark globally (Table 1). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available for bigeye thresher shark in the Indian Ocean therefore the stock status is highly uncertain. Bigeye thresher sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (+20 years), mature at 9-13 years, and have few offspring (2-4 pups every year), the bigeye thresher shark is vulnerable to overfishing.

Outlook. Current longline fishing effort is directed to other species, however bigeye thresher sharks is a common bycatch these fisheries. Hooking mortality is apparently very high, therefore IOTC regulation 10/12 prohibiting retaining of any part of thresher sharks onboard and promoting life release of thresher shark are apparently ineffective for species conservation. Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE. However there are few data to estimated CPUE trends, in view of IOTC regulation 10/12 and reluctance of fishing fleet to report information on discards/non-retained catch. 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 other areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on bigeye thresher shark will decline in these areas in the near future, which may result in localised depletion.

The Scientific Committee considered the following:

- The available evidence indicates considerable risk to the status of the IO stock at current effort levels.
- Two important sources of data that inform the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Noting that current catches (probably largely underestimated) are estimated at an average ~4 t over the last five years, ~5 t in 2010, maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.
- The SC recommended that the Resolution 10/12 *on the conservation of thresher sharks (Family Alopiidae) caught in association with fisheries in the IOTC area of competence* is clarified in order for observers to be allowed to collect biological samples (vertebrae, tissues, reproductive tracts, stomachs) from sharks that are dead at haulback, whose retention is prohibited by the current Resolution.

IOTC–2011–SC14–32: Status of pelagic thresher sharks

Status of pelagic thresher shark (*Alopias pelagicus*) in the Indian Ocean – IUCN threat status.

Common name	Scientific name	IUCN threat status		
		Global status	WIO	EIO
Pelagic thresher shark	*Alopias pelagicus*	Vulnerable	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean SOURCES: IUCN (2007, 2011)

Stock status. The current IUCN threat status of 'Vulnerable' applies to pelagic thresher shark globally (Table 1). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available for pelagic thresher shark in the Indian Ocean therefore the stock status is highly uncertain. Pelagic thresher sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (+ 20 years), mature at 8-9 years, and have few offspring (2 pups every year), the pelagic thresher shark is vulnerable to overfishing.

Outlook. Current longline fishing effort is directed to other species, however pelagic thresher sharks is a common bycatch these fisheries. Hooking mortality is apparently very high, therefore IOTC regulation 10/12 prohibiting retaining of any part of thresher sharks onboard and promoting life release of thresher shark are apparently ineffective for species conservation. Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE. However there are few data to estimated CPUE trends, in view of IOTC regulation 10/12 and reluctance of fishing fleet to report information on discards/non-retained catch. 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 other areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on pelagic thresher shark will decline in these areas in the near future, which may result in localised depletion.

The Scientific Committee considered the following:

- The available evidence indicates considerable risk to the status of the IO stock at current effort levels.
- Two important sources of data that inform the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Noting that current catches (probably largely underestimated) are estimated at 2 t in 2010, maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.
- The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.
- The SC agreed three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.
- The SC recommended that the Resolution 10/12 *on the conservation of thresher sharks (Family Alopiidae) caught in association with fisheries in the IOTC area of competence* is clarified in order for observers to be allowed to collect biological samples (vertebrae, tissues, reproductive tracts, stomachs) from sharks that are dead at haulback, whose retention is prohibited by the current Resolution.

12. Implementation of the Regional Observer Scheme (Secretariat)

IOTC–2011–SC14–34: National Implementation of the regional observer scheme by CPCs (Secretariat).

The IOTC Regional Observer Scheme started on July 1st, 2010 (Resolution 10/04 – superseded by Resolution 11/04). CPCs should report on the action taken for its implementation in their respective countries.

Purpose

To inform the Scientific Committee (SC) of the status of implementation and reporting to the IOTC Secretariat of the Regional Observer Scheme (ROS) set out by Resolution 09/04 *on a Regional Observer Scheme*, and superseded by Resolution 11/04 *on a Regional Observer* Scheme at the 15th Session of IOTC in 2011.

Discussion

As from October 2011, four CPCs (France (OT), Japan, Madagascar and Seychelles) have submitted a list of accredited observers. Although incomplete for the European Union as a whole, the fleets from Portugal and France have submitted a list of accredited observers.

To date only two observer trip reports have been submitted to the Secretariat, one by China and the other by EU, Portugal.

Table 1 provides a summary of the status of implementation of the ROS by all IOTC CPCs

Recommendation

That the Scientific Committee:

1) **NOTE** the update on the implementation of the Regional Observer Scheme (ROS) and **EXPRESSED** its strong concerns 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.
2) **AGREE** such a low level of implementation and reporting is detrimental to its work, in particular regarding the estimation of incidental catches of non-targeted species, as requested by the Commission.
3) **RECOMMEND** the Commission consider how to address the lack of implementation of observer programmes for their fleets and reporting to the IOTC Secretariat as per the provision of Resolution 11/04 *on a Regional Observer Scheme*.

Update on the Implementation of the IOTC Regional Observer Scheme

CPCs	Progress	List of accredited observers submitted	Observer Trip Reports submitted
MEMBERS			
Australia	Australia has implemented an observer programme that complies with the IOTC Regional Observer Scheme.	No	No
Belize	No information received by the Secretariat.	No	No
China	China has an observer programme.	No	YES: 1
–Taiwan, China	No information received by the Secretariat.	No	No
Comoros	Comoros does not have vessel more than 24m on which observer should be placed. 3 observers were trained under the IOC Regional Monitoring Project.	No	No
Eritrea	No information received by the Secretariat.	No	No
European Union	EU has an observer programme on-board its purse-seine fleets, however the programme is limited due to the piracy activity in the western Indian Ocean. EU has or is developing observer programmes on-board its longline fleets, i.e. La Réunion, Spanish and Portuguese fleets.	Partial: EU,France: 7 EU,Portugal: 3	YES: 1
France (territories)	No information received by the Secretariat.	YES: 15	No
Guinea	No information received by the Secretariat.	No	No
India	India has not developed any observer programme so far.	No	No
Indonesia	No information received by the Secretariat.	No	No
Iran, Islamic Republic of	No information received by the Secretariat.	No	No
Japan	Japan has started its observer programme on the 1st of July 2010, and 14 observers are currently being deployed in the Indian Ocean.	YES: 14	No
Kenya	Kenya is developing an observer	No	No

	programme and 5 observers have been trained under the SWIOFP training.		
Korea, Republic of	Korea has an observer programme since 2002 with 3 observers being deployed in the Indian Ocean giving a14.5% coverage of the fishing operation in 2009.	No	No
Madagascar	Madagascar is developing an observer programme. Five and three observers have been trained respectively under the SWIOFP and the IOC projects.	YES: 8	No
Malaysia	No information received by the Secretariat.	No	No
Maldives, Republic of	Maldives vessels are monitored by field samplers at landing sites. Have in excess of 250 vessels larger than 24m.	No	No
Mauritius	Mauritius has not developed an observer programme, however, 5 and 3 observers have been trained respectively under the SWIOFP and the IOC projects.	No	No
Oman, Sultinate of	No information received by the Secretariat.	No	No
Pakistan	No information received by the Secretariat.	No	No
Philippines	No information received by the Secretariat.	No	No
Seychelles, Republic of	Seychelles is developing an observer programme. Four and three observers have been trained respectively under the SWIOFP and the IOC projects.	YES: 7	No
Sierra Leone	No information received by the Secretariat.	No	No
Sri Lanka	No information received by the Secretariat.	No	No
Sudan	No information received by the Secretariat.	No	No
Tanzania, United Republic of	No information received by the Secretariat.	No	No
Thailand	Thailand has not developed an observer programme so far.	No	No
United Kingdom	UK does not have any active vessels in the Indian Ocean.	N/A	N/A
Vanuatu	No information received by the Secretariat.	No	No
COOPERATING NON-CONTRACTING PARTIES			
Mozambique	No information received by the Secretariat.	No	No
Senegal	No information received by the Secretariat.	No	No
South Africa, Republic of	No information received by the Secretariat.	No	No

13. Implementation of the Precautionary Approach and Management Strategy Evaluation (Chair & Secretariat)

IOTC–2011–SC14–35: On the implementation of the precautionary approach (Secretariat)

Draft Proposal for a Resolution on implementation of the precautionary approach
The Indian Ocean Tuna Commission (IOTC),

RECALLING that Article 5, paragraph c, of the Agreement for the Implementation of the Provisions of the United Nations Convention of the Law of the Sea of December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA), establishes the application of the precautionary approach as a general principle for sound fisheries management.

FURTHER RECALLING that Article 6, and Annex II, of UNFSA provide guidelines for the implementation of the precautionary approach, including the adoption of provisional reference points when information for establishing reference points is absent or poor;

NOTING that Article 7.5 of the FAO Code of Conduct for Responsible Fisheries also recommends the implementation of the precautionary approach, *inter alia,* on the basis of stock-based target and limit reference points;

NOTING that recommendations 37 and 38 of the Performance Review Panel, adopted by the Commission as Resolution 09/01, indicate that pending the amendment or replacement of the IOTC Agreement to incorporate modern fisheries management principles, the Commission should implement the precautionary approach as set forth in the UNFSA;

MINDFUL that Paragraph 29.6 of the FAO Guidelines for the Eco-labelling of Fish and Fishery Products from Marine Capture Fisheries, revision 1, 2009, and other eco-certification initiatives highlight the implementation of the precautionary approach as an important criterion to assess the sustainability of a fishery;

RECALLING the time-closure adopted by the Commission towards the conservation of tropical tuna stocks, described in Resolution 10/01;

RECALLING that the IOTC Scientific Committee has initiated a process leading to a management strategy evaluation to improve upon the provision of scientific advice;

AGREES, in accordance with paragraph 1 of Article IX of the IOTC Agreement, to the following:

1. To apply the precautionary approach in accordance with all relevant internationally agreed standards and recommended practices and procedures, in particular with the guidelines set forth in the UNFSA, and to ensure a sustainable utilization of the resources as set forth in Article V of the IOTC Agreement;
2. In applying the precautionary approach, CPCs shall adopt, on the basis of the scientific advice supplied by the Scientific Committee,
   a. stock-specific reference points (including, but not necessarily limited to, target and limit reference points), relative to fishing mortality and biomass, and
   b. associated harvest control rules, that is, management actions to be taken if reference points are exceeded;

   Reference points and harvest control rules should be determined so that, according to the best available science, the risk of a negative impact on the sustainability of the resource is minimized. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures;
3. In the determination of appropriate reference points and harvest control rules, consideration must be given to major uncertainties, including the uncertainty about the status of the stocks relative to the reference points, uncertainty about biological and environmental events, and the effects of fishing on impact of fishing activities on non-target and associated or dependent species;
4. If an unanticipated event, such as a natural phenomenon has a significant adverse impact on the status of a stock or its associated environment, CPCs shall adopt conservation and management measures on an emergency basis to ensure that fishing activity does not exacerbate such adverse impacts.
5. Initially and as an interim measure, adopt provisional reference points and harvest control rules, following the advice of the Scientific Committee, until the Committee completes the evaluation of potential management strategies;
6. Instruct the Scientific Committee to continue with the development of a management strategy evaluation, with the objective to provide improved reference points, and associated harvest control rules for the application of appropriate management actions as the status of the stocks exceeds the reference points. The Scientific Committee will assess, through the management strategy evaluation process, the performance of harvest control rules and associated reference points tested in fulfilling the management objectives of the Commission;

7. After completion of the management strategy evaluation, the Scientific Committee should provide the Commission with recommended reference points for all major stocks, and cast future advice on the status of the stocks relative to the adopted reference points, on the basis of the best available scientific evidence;
8. The Scientific Committee will report on the progress of the management strategy evaluation process at the Commission Session in 2014.

IOTC–2011–SC14–36: Development of a Management Strategy Evaluation process for the IOTC (Secretariat)

*The Commission, at its 15th Session **endorsed** the development of a Management Strategy Evaluation (MSE) in the framework of IOTC and **requests** that this process be continued in 2011 (para. 43 of the S15 report).*

Introduction

The adoption of management plans for Indian Ocean tuna stocks appears to be in the IOTC agenda for the near future, as expressed by both Commission and Scientific Committee. Scientific backing for any management plan needs to be the result of careful and detailed work that attempts, to the best capacity of the IOTC scientific community, to acknowledge all sources of error and variability, explore possible measures robust to those uncertainties, and present this in a clear and direct manner to managers and stakeholders. The use of Management Strategy Evaluation, also termed Management Procedure approach (Rademeyer et al., 2007), was proposed as a way of developing management plans for IOTC stocks years ago (Basoon, 2002). MSE has been widely used in the years since, in various stocks and management settings, from EU waters (Rice & Conolly, 2007), to Southern Bluefin Tuna, whaling (Punt & Donovan, 2007), or even mammals (Bunnefeld et al., 2011). In this document, some issues relevant to the development and testing of management procedures for Indian Ocean tuna stocks are presented, and a number of suggestions are made on which way the IOTC scientific community could tackle this work successfully.

What to model

Evaluating a management procedure is a three step process, involving (1) the development and fitting of data to a model of the natural world, including the ability to generate future data, (2) the application of an estimation model to assess stock and fishery status against a set of indicators, and (3) a decision rule to choose an appropriate management action according to the value of those indicators. The first element is termed Operating Model (OM), and should generally consist of the best representation of the known dynamics of the natural and human fishery system. Although a strong temptation exists in the development of complex such as this models to incorporate every single process suspected to occur in nature, or for which we have some information (Hilborn & Walters, 1992), a pragmatic approach is certainly required when developing an OM and a simulation procedure for a system like the Indian Ocean tuna fisheries. No definite program from the possible range of models and approaches is presented here. Instead, a number of issues worth of attention are brought up to guide the initial discussion, to be continued by the relevant Working Parties of IOTC.

Operating model(s)

A model or set of models of the underlying true dynamics of the system forms the experimental basis for testing management strategies under simulation. A population model similar to those employed in stock assessment is commonly applied, or used in the initial phase, but it might also include associated species or even whole ecosystems (Smith et al., 2007). The models are then fit to the available data, a process sometimes called OM conditioning (Butterworth, 1999, Rademeyer et al., 2007). The essential question here is for the most influential processes in the system to be incorporated explicitly: their importance, and the uncertainty around their strength and direction, should be carefully assessed from available information and, if deemed significant and well established, should become part of the OM. This should apply for both the functional form and the parameter values employed (Butterworth & Punt, 1999) A first take at a simple OM for single stock is commonly based on a detailed stock assessment (Kell et al., 2007), such as those carried out for some IOTC stocks like yellowfin and bigeye. It is important to recognize that this could limit the range of scenarios that the simulations are able to cover, as certain processes are not included in the stock assessment model, or their uncertainty is absent or not well estimated. Subsequent work should focus on establishing a set of reference OMs, combined with the appropriate robustness trials, as outlined below. Some relevant thoughts on what an OM for IOTC stocks should include has already been brought up (Anganuzzi, 2002), and should form the basis for the necessary discussion, with the incorporation of all that has been learned about the tuna stocks of the Indian Ocean.

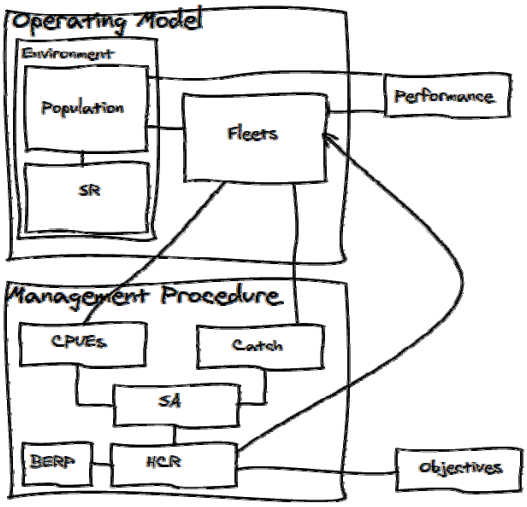

Figure 1: Diagram of MSE structure and main flows.

Robustness trials

A number of assumptions will be present in the OM, as is the case in any statistical model. Once a reference set of OMs as been chosen, they should be tested for robustness against a set of scenarios (Cooke, 1999). They should include more extreme situations than those present in the reference set, and should provide useful guidance on the limits under which the included assumptions still hold true. Rademeyer et al. (2007) provide a set of possible scenarios, which could be reinterpreted in IOTC terms as follows:

- past data: bias in CPUEs due to technological creep, errors in catch statistics for certain fleets
- future availability of data: data currently available not being provided, deterioration in data quality, role of tagging data
- resource dynamics: different growth models, alternative stock-recruitment curves, existence of sub-stocks
- environment: changes in productivity

One of the first tasks related to the development of OM for Indian Ocean stocks would be identify the range of factors assumed or known to affect population dynamics and catchability, compile the available information that would allow for their characterization (i.e. parametrization of some kind of model), and explore the possibilities of using those models to further widen the range of OM or to provide a set of robustness trials. Part of this discussion will have to be driven by the agreed management objectives, in order to prioritize those elements we are more interested in understanding. For example, if uncertainty on the exact role of efficiency on the Longline CPUEs is thought to be an important consideration, then the chosen OM should be robust against this factor and reproduce the dynamics of the resource in the absence of that information.

Management Procedure

The Management Procedure is formed by the combination of data collection, Stock Assessment (SA), and a Harvest Control Rule (HCR). The first provides with the necessary information, and issues on data quality are always important to consider. They are likely to have a significant effect in the ability of a HCR to behave as expected, and the costs and ability to collect it might need to match the objectives set for management in terms of, for example, permitted risks of dropping below reference points. To detect certain changes with a given probability will depend greatly on what data is available to infer population trends. The stock assessment element of the management procedure could be of lesser or greater complexity, but ideally should concentrate on using the most important elements of available information (CPUEs, catch data, ...). For reasons of computational speed, the SA model here is commonly far simpler than the population model used in the OM, and could even be substituted for certain stocks with a simple set of indicators. The trade-off between computational capacity and realism needs to be solved for each particular implementation, but recent examples exist in which simple models, such as biomass dynamics, have been shown to perform well enough for informing a HCR in tuna stocks (Kell et al., in press).

Economic indicators and feedback models

Evaluations of management plans under the EU Common Fisheries Policy, as carried out by

STECF (Scientific, Technical and Economic Committee for Fisheries), routinely include economic aspects. Yield and effort, as predicted in the model projections, is translated into income and costs, and the relative economic performance of different management options, once the well-being of the stocks is ensured, can be used to recommend among alternative plans (see, for example STECF, 2010b). Fully incorporating the impact and responses on and of the various fleets, of and to management measures, has been attempted in various EU research projects, for example, but the difficulty of accurately predicting responses to regulations, as well as price and cost dynamics, mean there has not been many examples in which predicted responses to management have been fully applied in choosing among management plans. Recent developments are pointing in an interesting direction, in which aggregated responses to management are being modelled as random processes, and attention is paid only to strong signals in costs and prices (Da Rocha et al., 2010). Data availability is likely to be a major concern in IOTC for any attempt at evaluating the performance of management plans in economic terms. The scale at which any indicator can be constructed is likely to be fairly large, and the complexity of the price dynamics, given the global nature of part of the tuna market, combined with the multiple small-scale markets in coastal countries, appears to make any attempt futile. The advantages of incorporating economics into the analysis are likely to come from its role in dialogue with the various stakeholders, so it might still be a viable and worth proposition to bring experts in the field into this modelling exercise.

Organizing the development

Development of a modelling exercise like the one proposed here is an arduous and complicated task, and even more so when carried out by a range of researchers across various disciplines and institutes. The core of the proposal here is to agree on a development model along the lines outlined below, and a simple set of procedures that attempt to ensure equal chances of participation, full transparency and accountability, a high quality final product, and a process that benefits from wide acceptance and participation.

Development framework

Development of a set of simulations like those required here, should be well planned and follow an agreed protocol, for example STECF (2010). Issues of procedure and responsibility should not stand in the way of achieving the agreed objectives. The current availability of internet tools for distributed development and collaboration allows for inter-seasonal work to be conducted despite distances and time-differences

Platform

The choice of an unified software platform would greatly benefit the ability of scientists to exchange ideas and their precise implementation, the capacity of the group to peer-review the process, and to benefit from outside contributions. The R statistical language (R Development Core Team, 2011) has become the de-facto lingua franca of statistical computing. Its edibility, relatively-smooth learning curve, and the availability of a wide range of contributions makes it a good choice for this task (Schnute et al., 2007). The usually-cited shortcomings of the language, most notably regarding speed, can be overcome by use of distributed High Performance Computing (clusters and grids), the combination of R with compiled languages (like C, C++ and Fortran), and by careful consideration of the data structures employed (Kell et al. 2007). Building on the advantages and richness of R, the FLR Project (Kell et al., 2007; http://flr-project.org) has developed a set of libraries containing data structures, methods and procedures that simplify the assemblage of many types of models and simulations of fisheries systems. It is currently being applied by working groups of various fisheries scientific and management organizations for tasks such as:

- Stock assessment using surplus production or age-structured models by ICCAT and ICES.
- Evaluation of the impact of policy decisions on European stock, by EC DG Mare on the new CFP.
- Analysis of management plans for swordfish, yellowfin and albacore by ICCAT.

This framework is under active development, with a core team comprised of 10 researchers from various institutes in Europe and elsewhere, and keeps an active community of users that engage via mailing lists and an open wiki website. A training program is now underway, with introductory courses on R and FLR, and advanced ones on stock assessment and MSE using FLR. See, for example, the information at ICES' Training Programme (http://www.ices.dk/iceswork/training/training.asp).

Organization and responsibilities

The development workflow that is necessary for the modelling exercise propose here is clearly different from the one Working Parties employ to conduct the yearly cycle of stock assessment.

There is a greater need for coordinated inter-sessional work, for coherent developments that are able to be incorporated into a larger modelling framework, and for progress to be achieved at a faster pace that what the usual yearly meetings allow. The usual structure for scientific work in IOTC, in which the members of a working Party is in charge of carrying out the necessary ground-level work that will later inform the discussions of the Scientific Committee, will possibly need to be supplemented by some arrangement providing basic support to the development work, probably carried out around the Working Party on Methods (WPM). An essential element in this arrangement will be the election or nomination of a coordinator that should act as central gatekeeper of the development process. The role of such co-ordinator is not to limit the input that WPM members are able to provide, but to ensure that common standards of quality, reliability, code efficiency and documentation are followed. Contributions made according to the set procedure (e.g. changes to existing code using a diff algorithm (http://en.wikipedia.org/wiki/Diff); new functions following the agreed guidelines on input/output, testing and documentation, ...) are then reviewed by the coordinator before being added to the common source code tree, and the necessary simulations are then run.

Distributed framework

Development of these simulations should make use of tools now commonly applied for distributed software development projects, such as the Linux kernel, or the R language. The basic elements are:

- A Version Control System (http://en.wikipedia.org/wiki/Revision_control), where source code, documentation, inputs and outputs are stored. All changes are recorded, so it is possible to undo modifications, track development along time, and have parallel versions where different approaches are tested.
- Access to some High Performance Computing system, such as a dedicated cluster or a grid server, allowing for efficient and quick runs of simulations and procedures
- A dedicated server that will automatically assemble code packages and run an standard set of tests at given intervals (e.g. daily or weekly). The test reports will be made available online.
- A set of web tool for communication, for example a wiki site for discussion and assembling of documents, a dedicated mailing list that receives notifications of changes to source code, runs of simulations, ...

Protocol

It would be useful for the smooth running of inter-sessional work to define a number of basic protocols, which should be more a reminder of steps than a rulebook, built around the main workflows that could be identified, like, for example:

- Submission of a new dataset: CPUEs, catch series, environmental variables. ...
- Reporting a bug in the code or an error in the output files
- Adding a new function or method to replace or complement existing ones
- Proposing a new set of outputs, plots or indicators to be extracted from simulation results

Dialogue and presentation

The impact on management of a MSE procedure is likely to depend on several factors. The political will to better manage the fisheries, and even the support of fishery stakeholders for doing so, is a necessary although not sufficient condition for achieving success (Holland, 2010). The first element in which stakeholder and manager input is required relates to the objectives for the fishery, both in terms of stock status and economic or yield expectations. Deciding on precise objectives for management is an essential component for the development of HCRs. Discussion on this issue could be best carried out in some multi-lateral meeting, where scientists, managers, industry and other stakeholders, can be introduced into the precise ways in which IOTC finally decides to conduct the development of management plans, feedback can be obtained on the issues of interest to various parties, and agreement could be attempted on the exact objectives that the plans should attempt to provide for. Given the likely diversity of the audience, an extra effort needs to be made to make the presentation of model and results as clear and attractive as possible. The issue of communication of scientific results, always difficult, is likely to be of major impact for the acceptance of modelling exercise on great complexity. Finally, some kind of external review process is probably appropriate, both in terms of internal quality assurance, and for external accreditation of results and methods.

Workplan and calendar

A realistic workplan, although one requiring substantial efforts by those involve, could be devised with a view to deliver a final set of results to the 16th Session of the Scientific Committee, in 2013.

- JAN-APR 2012 - Inter-sessional work

- FEB-JUN 2012 - Multilateral meeting on management objectives
- APR 2012 - Meeting of the Commission
- JAN-OCT 2012 - Inter-sessional work
- OCT 2012 - Meeting of the Working Party on Methods
  - Review of first results on exploration of OM uncertainties and robustness tests
  - Agreement on final reference set of OMs
- DEC 2012 - Meeting of the Scientific Committee
  - Presentation of OMs and exploration of most relevant uncertainties
  - Agreement on choice of OMs
  - Agreement on precise interpretation of HCR objectives and priorities
- APR 2013 - Meeting of the Commission
- OCT 2013 - Meeting of the Working Party on Methods
- DEC 2013 - Meeting of the Scientific Committee

14. Evaluation of Data Collection and Reporting Systems (Secretariat)

IOTC–2011–SC14–38: Evaluation of data collection and reporting systems for artisanal fisheries in the Indian Ocean (Secretariat).

Abstract

This report presents 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. 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.

15. Data Provision Needs – By Gear (Chair WPDCS)

The Commission, at its 15th Session **requested** *that the Scientific Committee in its 2011 Session, to evaluate the data provision needs for longline, purse seine, gillnet and pole-and-line gear types, notably regarding information relating to the vessel characteristics and the definition of the pole-and-line 'fishing event'. The evaluation is requested in order to ensure that consistent and uniform information is collected to assist the IOTC to fulfill its mandate. The Scientific Committee should make appropriate recommendations to the 2012 Commission meeting* (para. 45 of the S15 report).

16. Outlook on Time-Area Closures (Chair)

IOTC–2011–SC14–39: Evaluation of the IOTC time-area closure (Chair WPTT)

INTRODUCTION

At its 14th Session, the Commission adopted IOTC Resolution 10/01 "*For the Conservation and Management of tropical tuna stocks in the IOTC area of competence*"; which defines a time area closure (0 ° - 10° North and 40° - 60° East for the month of November for purse seine (PS) and February for longline (LL) fisheries) for 2011 and 2012 with the objective of decreasing the overall pressure of the main targeted stocks in particular yellowfin and bigeye. In addition, the Commission requested the Scientific Committee to undertake, at its 2011 meeting:

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;

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;

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;

d) any other advice on possible different management measures based on the Kobe II matrix, on the main targeted species under the IOTC competence.

Although this issue was discussed in the WPTT, no papers analysed the effects of the time-area closure on international waters on the Northwest Indian Ocean during the last meeting of IOTC WPPT and, thus, the WPTT agreed to carry out preliminary analysis to estimate potential effect of the time area closure on the bigeye and yellowfin population before the Scientific Committee meeting in December 2011.

Therefore, the objective of this paper is to estimate what the maximum potential loss of catches would be under different scenarios of time-area closure, as estimated from the catch statistics of IOTC.

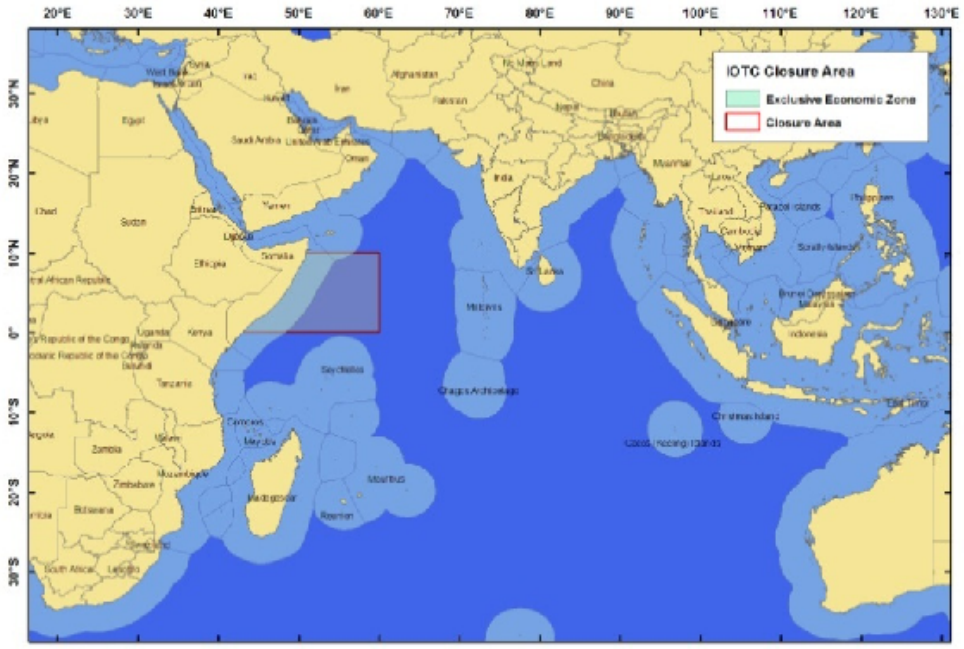

Figure 1.- IOTC closure area (Resolution 10/01).

MATERIAL AND METHODS

Options for a time-area closure of the purse-seine fishery and its short-term effects were assessed by the SC 2000, 2003 and more recently 2009 and 2010 following Commission requests (IOTC, 2000; IOTC, 2003; IOTC, 2010). Two possibilities for conducting such analyses were considered in those documents: (i) maximum 'potential loss', i.e. the maximum loss in catches that would be obtained assuming an extreme scenario where the effort exerted during the time-area closure will not be reallocated to other areas, and (ii) effort reallocation, where it is assumed that the effort that would not be exerted during the time-area closure would be reallocated to other areas of the Indian Ocean.

In the present work, the analysis is based on the simplest approach of maximum potential loss of catches, as estimated from the catch statistics of IOTC. The revision of catch information of main target species by area, time and fleet produced by IOTC Secretariat was used to carry out the analysis. Of the potential scenarios available, the different options examined for the analysis where the following:

Options for area

- Current Area (0-10N; up to 60E)
- Shrink of area to 0-5N; up to 60E
- Shrink of area to 5-10N: up to 60E
- Extension of area 5 degrees to the South (5S-10N; up to 60E)
- Extension of area 5 degrees to the North (0-15N; up to 60E)
- Extension of area 5 degrees North and South (5S-15N; up to 60E)
- Extension of area 10 degrees South (10S-10N; up to 60E)

Options for area

- Current period of closure (November PS and February LL)
- Period of closure extended to the month prior to the month of closure (2 months closure)
- Period of closure extended to the month after the month of closure (2 months closure)
- Period of closure extended to the months prior and after the month of closure (3 months closure)
- Period of closure extended to make it permanent (whole year)

Thus, we have 35 different scenarios of possible time/area closures affecting Purse seiner and longline fleet.

The potential maximum catch loss of PS/LL catches was estimated (i) in relation to total Indian Ocean to investigate the likely effect of moratorium in the populations and (ii) in relation to total Indian Ocean PS/LL catches to examine the likely effect of the moratorium on those fleets. The potential maximum catch loss was estimated for the following periods, species, and size categories:

- Periods: 2010, 2009, 2003-2006, and 2000-2002.
- By species and size classes: (i) YFT total, BET total, SKJ total, SWO total, and ALB total; and (ii) by species and size classes: juveniles and spawners YFT and BET with a maturity threshold around 90 cm-s (i.e. juveniles < 90 cm and spawners > 90 cm).

The reduction in catches with the objective of decreasing the overall pressure of the main targeted stocks, in particular yellowfin and bigeye as stated in the Resolution, were examined for yellowfin and bigeye by size class, and for all sizes pooled.

The following combinations give several options or tables for the 35 time/area closures investigated. In these tables, reduction in catches of yellowfin and bigeye are considered as a mean of mortality reduction, however, the loss of catches of other species such as skipjack, swordfish and albacore are considered as costs for those fleets as this yield will not be recovered in the event that effort is not relocated to other areas.

Moreover, as requested by the Commission the percentage of juveniles and adults taken by each fleet fishing in the Indian Ocean was investigated.

DISCUSSION

The results obtained in this exercises are similar to the analysis carried out for the 2010 SC which emphasized that catch reduction expected from the current time-area closure were negligible and considered that recent event in the Somali caused a major effort reduction than the closure. In particular, due to the piracy problems longliners do not operate anymore off the Somali coast and in the northwest India Ocean and the total purse seine vessels has been reduced in 30 % since 2006.

As stated in IOTC-SC-2011-14 it is difficult to estimate the effect of any time/area closure because there is currently a poor understanding of the dynamics of population and the dynamics of the fleet. In particular, the results presented here assumed an extreme assumption where all the fleet affected by the moratorium do not fish during the closure (i.e. no effort reallocation occurs); which seems to be an unrealistic scenario. Therefore, the effect of current closure is likely to be ineffective as it is likely that the effort will be redirected and reallocated to different fishing grounds and, hence, the positive effects of the moratorium in term of fishing mortality reduction would be offset due to effort reallocation in different areas; which consequences are difficult to assess. To some extent, this relocation of effort has already occurred, following the onset of piracy in the Indian Ocean. A large component of the deep-freezing longline fleet that operated in the western tropical Indian Ocean moved to other Oceans or to other areas in the Indian such as to waters in the South targeting yellowfin tuna or albacore. This was noted during the last IOTC Working Party on Temperate Tunas (IOTC, 2011), where concern was expressed at the effects that piracy may have on the stock of albacore, especially if fishing effort from the tropical longline fisheries continues to be relocated to the south Indian Ocean, where piracy is not a threat.

In this analysis, the catch reductions were calculated in relation to aggregate IO catch but also in relation to the aggregate PS/LL IO catch to investigate the effect of the moratorium on those fleets. It should be noted that even in scenarios where the reduction of fishing mortality is negligible the impact of those different scenarios on those fleet activity could be noticeable. Although the measure is directed to Purse seiner and Longline it would be also convenient to extend to other vessels that are operating in the current time/area closure to broaden any positive effect of the moratorium.

The objective of the resolution 10/01 is to decrease the overall pressure of the main targeted

stocks in particular yellowfin and bigeye as also request to evaluate the impact of current time/area closure and any alternative scenarios on tropical tuna population. However, the resolution does not specify the level of reduction or the long term management objectives to be achieved with the current or alternative time area closures. For example, in light of recent effort reduction due to piracy and the recent likely yellowfin and bigeye population status, it would be worth to guide and facilitate further analysis to define clear management objectives to be achieved with current and/or alternative management measures.

IOTC–2011–SC14–40: A preliminary investigation into the effects of Indian Ocean MPAs on yellowfin tuna, *Thunnus albacares*, with particular emphasis on the IOTC closed area (S. Martin, C. Edwards, L. Nelson and C. Mees)

The Commission, at its 15th Session reiterated the **request** *that the Scientific Committee should evaluate the time-area closure established in Resolution 10/01 for the conservation and management of tropical tunas stocks in the IOTC area of competence, in terms of its impacts on the stocks of tuna and tuna-like species* (para. 47 of the S15 report).

5. Summary and Conclusions

A network of large scale closures with a range of objectives, not all related to fisheries, were introduced in the Indian Ocean during 2010, encompassing the region occupied by IOTC managed tuna fisheries. This paper examines the impact of the network of closures on the status of yellowfin tuna stocks compared to a baseline of no closures and discusses management options related to the precautionary principle. We examine the extant situation with the IOTC area closed for one month of the year each to the longline (February) and purse seine (November) gear, and a scenario where the IOTC area is closed all year for both the longline and purse seine fisheries. In both of these scenarios the Chagos and Maldivian closures also applied year round. We considered only the extremes of potential changes in fishing behaviour: complete elimination of effort that may have occurred inside the closed areas, and total displacement and redistribution of effort, based on historic catch and effort in each area. As redistribution of effort was only simulated for the purse seine fleet, modelling this with longline redistributed effort is an area for further work. There is also scope to refine this to account for a better understanding of fleet dynamics including potential infringements of the closed areas. Further research would also be useful to examine the ecological basis of the network; the IOTC area largely protects juveniles whilst the Chagos and Maldives areas protect a greater proportion of adults. Would additional areas be useful for fisheries management purposes?

We applied an age structured simulation model of yellowfin tuna populated with the best currently available information which, despite uncertainties, enables the provision of precautionary management advice in the absence of other data. Model results suggest that the extant network with only a two month IOTC closure has little impact on yellowfin tuna stocks either with the effort eliminated or redistributed. However, with a year-round closure of the IOTC area, the network could deliver conservation benefits improving the status of yellowfin tuna stocks under the assumption of total elimination of effort from the network area. Under the assumption that fishing effort was removed entirely, stock biomass increased, particularly in the larger age classes. However, in the scenario of a year round IOTC closure with effort reallocated evenly outside the area (for the purse seine fleet only) there was little impact on yellowfin stock status; with no change in biomass although a change in the age distribution of the population occurred due to the protection of juveniles in the IOTC area. Our findings are supported by a complementary study on the impact of Pacific closures on bigeye tuna (Sibert *et. al*. 2011).

Adoption of a precautionary approach to management requires us to consider that effort would be redistributed. This analysis suggests that neither the extant network of closures, nor a scenario where the IOTC closure is extended year round will provide sufficient management benefits for the protection of yellowfin tuna stocks. It would therefore be precautionary to supplement closures with additional management measures, either to reduce fishing effort, which as we have seen has the potential to provide conservation benefits, or to apply catch controls such as the quota allocation system required in Resolution 10/01.

17. Alternative Management Measures; Impacts of the Purse Seine Fishery; Juvenile Tuna Catches (Chair)

17.1 The Commission, at its 15th Session **requested** *that the Scientific Committee provide clear advice outlining alternative management approaches which would provide effective protection of a possible southwest Indian Ocean swordfish stock* (para. 46 of the S15 report).

17.2 The Commission, at its 15th Session **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–2011–SC14–41: A preliminary investigation into the potential effects of limiting size at first capture of yellowfin tuna, *Thunnus albacares*, in the Indian Ocean (S. Martin, C. Edwards and C. Mees) (withdraw)

18. Progress in Implementation of the Recommendations of the Performance Review Panel (Secretariat)

IOTC–2011–SC14–37: Update on progress regarding resolution 09/01 – on the performance review follow–up (Secretariat and Chair)

The Commission, at its 15th Session **agreed** *that the Secretariat and Chair of each of the three Committee's should further develop the status table by including a work plan with proposed timelines and priorities. The Secretariat was tasked with ensuring the revised table is provided to the respective Committee's in advance of their next Sessions, in accordance with the rules of procedure* (para. 125 of the S15 report).

Purpose

To provide the Scientific Committee (SC) with an opportunity to update the current status of implementation for each of the recommendations arising from the Report of the IOTC Performance Review Panel.

Discussion

At the 15th Session of the Commission held in April 2011, members noted the status of implementation for each of the recommendations arising from the report of the performance review panel. Members agreed that the Secretariat and Chair of each of the three Committees should further develop the status table by including a work plan with proposed timelines and priorities.

Members tasked the Secretariat with ensuring that the revised table (Appendix A) is provided to the respective Committee's in advance of their next Sessions, in accordance with the rules of procedure.

The Commission agreed that each of the Committee's should carry out a comprehensive evaluation of the status and priority of each of the recommendations from the Performance Review, and for a revised document to be provided to the Commission at its next Session.

Recommendation/S

That the Scientific Committee:

1) **NOTE** the status of each of the recommendations from the performance review, as agreed to by the Commission at its 15th Session.
2) **REVIEW** and **UPDATE** the status table by including a work plan with proposed timelines and priorities for each recommendation relevant to the work of the Scientific Committee, for the Commission's consideration.

Update on Progress Regarding Resolution 09/01 – On the Performance Review Follow–Up (Note: Numbering and Recommendations as per Appendix I of Resolution 09/01)
Attachment I

19. Schedule and Priorities of Working Party and Scientific Committee Meetings for 2012 and Tentatively for 2013 (Secretariat)

IOTC–2011–SC14–42: Proposed schedule and priorities for IOTC Working Party and Scientific Committee meetings for 2012 and 2013 (Secretariat).

Schedule of IOTC Working Party and Scientific Committee meetings for 2012 and tentatively for 2013.

Meeting	**2012**		**2013 (tentative)**	
	Date	**Location**	**Date**	**Location**
Working Party on Temperate Tunas	??–?? Aug (3d)	TBD (China?)	??–?? Aug (3d)	TBD (ICCAT SAA)
Working Party on Ecosystems and Bycatch	20–24 Sept (5d)	Bali, Indonesia 'OR' Cape town, South Africa	25–29 Sept (5d)	TBD (La Réunion?)
Working Party on Billfish	26–30 Sept (5d)	Bali, Indonesia 'OR' Cape town, South	19–23 Sept (5d)	TBD (La Réunion?)

		Africa		
Working Party on Methods	20–21 Oct (2d)	Port Luis, Mauritius	??–?? Oct (8d)	TBD
Working Party on Tropical Tunas	22–27 Oct (6d)	Port Luis, Mauritius	??–?? Oct (8d)	TBD
Working Party on Neritic Tunas	??–?? Nov (3d)	Penang, Malaysia	??–?? Nov (3d)	TBD (Oman?)
Working Party on Data Collection and Statistics	31 Nov–1 Dec (2d)	Victoria, Seychelles	30–31 Nov (2d)	TBD
Scientific Committee	3–7 Dec (5d)	Victoria, Seychelles	2–7 Dec (6d)	TBD

Research recommendations and priorities for
IOTC Working Party meetings
Working Party on Billfish (WPB)
(Extracts from IOTC–2011–WPB09–R)
Research Recommendations and Priorities

(para. 151) The WPB **AGREED** that there was no urgent need to carry out stock assessments for the swordfish resources in the Indian Ocean in 2012, and **RECOMMENDED** that efforts over the coming year be focused on the other billfish species, in particular on striped marlin.

(para 152) The WPB **RECOMMENDED** the following core areas as priorities for research over the coming year;

- Swordfish stock structure and migratory range – using genetics
- Swordfish stock structure and movement rates – using tagging techniques
- Billfish species growth rates
- Size data analyses
- Stock status indicators – exploration of indicators from available data
- CPUE standardization – swordfish, marlins and sailfish
- Stock assessment – Istiophorids
- Depredation – focus on the southwest

Working Party on Temperate Tunas (WPTmT)
(Extracts from IOTC–2011–WPTmT03–R)
Research Recommendations and Priorities

CPUE standardisation

(para. 89) The WPTmT **AGREED** that there was an urgent need to investigate the CPUE issues as outlined in paragraph 61 and for this to be a high priority research activity for the albacore resource in the Indian Ocean in 2012.

Stock assessment

(para. 90) The WPTmT **AGREED** that there was an urgent need to carry out revised stock assessments for the albacore resource in the Indian Ocean in 2012, and **RECOMMENDED** that the Scientific Committee consider recommending that the Commission consider approving funds for this purpose.

Stock structure

(para. 91) Noting that at present very little is known about the population structure and migratory range of albacore in the Indian Ocean, other than the possible connectivity with the southern Atlantic, the WPTmT **RECOMMENDED** that the Scientific Committee develop a research plan that includes the determination of albacore stock structure, migratory range and movement rates in the Indian Ocean as a high priority research project, at its 2011 annual meeting.

Additional core topics for research

(para. 92) The WPTmT **RECOMMENDED** that the Scientific Committee add the following core topic areas as priorities for research over the coming year:

- Size data analyses
- Growth rates and ageing studies
- Stock status indicators – exploration of indicators from available data

• Collaborate with SPC-OFP to examine their current simulation approach to determine priority research areas.

Working Party on Tropical Tunas (WPTT)

(Extracts from IOTC–2011–WPTT13–R)

Research Recommendations and Priorities

(para. 278) The WPTT discussed various research priorities and **AGREED** to the following workplan and priorities for 2012:

CPUE standardisation

(para. 279) Noting the importance of the various CPUE indices for stock assessment of the tuna tropical species, the WPTT **AGREED** that there was an urgent need to investigate the CPUE issues as outlined in sections 8–10, for bigeye tuna, skipjack tuna and yellowfin tuna, and for these to be a high priority research activity for the tropical tuna resources in the Indian Ocean in 2012.

(para. 280) The WPTT **NOTED** that there are various levels of needs for each fleet. For example, while for pole-and-line and purse seine fleets, the data and methodological approach are considered key issues to be resolved before any attempt of CPUE standardization; longline CPUE standardization constraints (differences between fleets, spatial structure, materials, etc.) can be resolved and reviewed in a dedicated workshop with the presence of other tRFMO CPUE experts.

(para. 281) The WPTT **NOTED** the para. 272 above, outlining the need for a longline CPUE standardization workshop where operational data, under IOTC confidentiality rules, will be jointly analysed.

(para. 282) The WPTT **RECOMMENDED** that the Secretariat and Maldivian scientists continue the joint effort to standardize the Maldivian pole-and-line CPUE in preparation for assessment in 2012.

(para. 283) The WPTT **RECOMMENDED** that standardization of purse seine CPUE be made where possible using the operational data on the fishery, and that participants working on CPUE for the main fleets, attend the CPUE standardization workshop being organized by ISSF in Honolulu, Hawaii in 2012.

Stock assessment

(para. 284) Noting the difficulty of carrying out stock assessments for three tropical tuna species in a single year, the WPTT **RECOMMENDED** to a revised assessment schedule on a two- or three-year cycle for the three tropical tuna species as outlined in Table 13. Following the uncertainty remaining in the yellowfin tuna assessment the WPTT **AGREED** that priories for stock assessments in 2012 would be yellowfin tuna (Multifan-CL and SS3, and possibly others) with an update of fishery indicators for the other two species.

Table 13. New schedule proposed for tropical tuna species stock assessment to be recommended to the SC:

Species/ Assessment year	2012	2013	2014	2015	2016	2017
Yellowfin tuna	Full	Update	Update	Full	Update	Update
Skipjack tuna	Update	Full	Update	Update	Full	Update
Bigeye tuna	Update	Update	Full	Update	Update	Full

Note: the schedule may be change depending on the situation of the stock from various sources such as fishery indicators, Commission requests, etc.

Additional topics for research

(para.285) The WPTT **RECOMMENDED** that the Scientific Committee add the following core topic areas as priorities for research over the coming year in order of priority:

• An update of the Brownie-Peterson method for the 3 tropical tuna species (possible issue for the 2012 IO Tuna Tagging Symposium).

• An update YFT growth curve (work in progress to be presented to 2012 Tuna Tagging Symposium).

(para. 286) The WPTT **NOTED** that several analysis using tagging data will be carried out by external consultants for the Indian Ocean Tuna Tagging Symposium in 2012 and that this may affect the workplan of the WPTT (see para. 248). Therefore, the WPTT **URGED** the Steering Committee of the Tagging Symposium to present the core topics to be included in those analysis during next Scientific Committee meeting.

Working Party on Ecosystems and Bycatch (WPEB)

(Extracts from IOTC–2011–WPEB07–R)

Research Recommendations and Priorities

Employment of a Fisheries Officer – duties to include issues of bycatch

(para. 286) The WPEB **NOTED** the lack of data being submitted by CPCs on bycatch, as detailed throughout this report (IOTC–2011–WPEB07–R), the lack of development and implementation of regional observer programs, the lack of CPCs developing NPOAs for sharks and seabirds, and the high risk of some bycatch species to IOTC fisheries.

(para. 287) The WPEB **NOTED** the Terms of Reference for a bycatch officer, developed by the Scientific Committee in 2010 (provided at Appendix XI of the report of the thirteenth session of the Scientific Committee: IOTC–2010–SC13–R), and **AGREED** that it should be revised to include priorities, as well as possible duties in areas other than Ecosystems and Bycatch.

(para. 288) The WPEB **RECOMMENDED** that the Commission agree for a new position to be created at the IOTC Secretariat (Fishery Officer), with duties to focus on bycatch issues.

Additional core topics for research

(para. 289) The WPEB **RECOMMENDED** that the Scientific Committee add the following core topic areas as priorities for research over the coming year, noting that the first step will be for the Scientific Committee to establish priorities, taking into account data gaps, capacity among CPCs, and areas for implementation:

- ***Ecological Risk Assessment*** (i. Sharks, ii. Marine turtles)
- ***Stock status analyses*** (i. Oceanic whitetip shark)
- ***Depredation*** (i. Longline fishery depredation)
- ***Bycatch mitigation*** (i. Sharks, ii. Seabirds – line weighting, iii. Marine turtles, iv. Marine mammals)
- ***Capacity building***

  i. Scientific assistance to CPCs and specific fleets considered to have the highest risk to bycatch species (e.g. gillnet fleets and longline fleets).

Working Party on Neritic Tunas (WPNT)

(Extracts from IOTC–2011–WPNT01–R)

Research Recommendations and Priorities

Stock structure

(para. 89) Noting that at present very little is known about the population structure and migratory range of most neritic tunas in the Indian Ocean, the WPNT **RECOMMENDED** that the Scientific Committee develop a research plan that includes two separate research lines; i) genetic research to determine the connectivity of neritic tunas throughout their distributions, and ii) tagging research to better understand the movement dynamics, possible spawning locations, and post-release mortality of neritic tunas from various fisheries in the Indian Ocean. These should be considered high priority research projects for 2012 and 2013.

Biological information

(para. 90) The WPNT **RECOMMENDED** that quantitative biological studies are required to determine maturity-at-age and fecundity-at-age relationships, and age and growth for all neritic tunas throughout their range.

CPUE standardisation

(para. 91) The WPNT **AGREED** that there was an urgent need to develop standardised CPUE series for each neritic tuna species for the Indian Ocean as a whole or by sub-region as appropriate, once stock structure and management units have been determined.

(para. 92) The WPNT **RECOMMENDED** that where feasible, support should be provided by the IOTC Secretariat and other CPCs, to aid in the development of standardised CPUE series for each neritic tuna species.

(para. 93) The WPNT **ENCOURAGED** CPCs catching neritic tunas to participate in the CPUE standardisation workshop that will be organized by the IOTC Secretariat in 2012, pending approval by the Scientific Committee.

Stock assessment

(para. 94) The WPNT **AGREED** that there was an urgent need to carry out stock assessments for neritic tunas in the Indian Ocean, however at present the data held at the IOTC Secretariat would be insufficient to undertake this task. As such, the WPNT **RECOMMENDED** that the Scientific Committee consider recommending that the Commission consider allocating appropriate funds to further increase the capacity of

coastal states to collect, report and analyse catch data on neritic tunas.

20. Other Business (Chair)

20.1 Rules for the appointment of an invited expert

IOTC–2011–SC14–43: Proposed rules for the appointment of an invited expert (Chair SC).

Rules of Procedure for the selection of Invited Experts to attend IOTC Working Party meetings

Definition of an Invited expert

The role of an Invited Expert and the guiding principles for their selection are as follows (noting that Invited Experts are **NOT** consultants, as they are **unpaid**, other than for return **economy** airfares and DSA to attend a meeting):

Duties: (i) if possible/willing, to carry out tasks identified by the Working Party (WP) (to be identified separately for each meeting); (ii) as applicable, attend and contribute to discussions at any preparatory sessions (e.g. any pre-assessment workshops, noting that ideally, these may need to be carried out several months in advance of a WP meeting), and at the WP meeting;

Capacity: The invited expert must have recognized experience and skill in the subjects for which they are tasked;

Independence: The invited expert's advice on matters relating to tasks defined by the WP should be based on the principles of independence, impartiality and transparency. Therefore, the invited expert shall be invited in their personal capacity without representing any CPCs and/or stakeholder. Participation of experts based in IOTC developing coastal states shall be encouraged. Invited Experts should not be:

- directly involved with current IOTC stock assessments or CPUE standardisations.
- from a CPC where a scientist is presenting a stock assessment or CPUE standardization.

Confidentiality: Invited Experts shall not divulge any information, including data considered confidential by the Commission, as defined in IOTC Resolution 98/02.

Process for Selection

Process and timeline for the selection of an Invited Expert.

STEP	Action Item	Responsibility	Due date
1	Chair of the Working Party (WP) (Vice-Chair if Chair not available) to distribute an email to the IOTC Science contact list (consisting of the combined WP and SC mailing list/s), calling for Invited Expert nominations [excluding selection panel] The call for nomination will include a summary of the priority areas for contribution (identified during the previous WP meeting, in combination with requests from the SC and Commission), specific details to be provided by potential candidates (e.g. one page CV), and the selection timeline.	Chair of the WP (or Vice-Chair)	No later than 90 days prior to the commencement of the WP meeting or any other preparatory sessions as identified by the WP.
2	Deadline for nominations: two weeks from the call for nominations. Nominations should be made via return email to the IOTC Science contact list.	IOTC Science contact list	14 days after the call for nominations by the Chair (Step 1 above)
3	Selection panel, **consisting of the Chair and Vice-Chair of the Working Party, in consultation with the Chair of the Scientific Committee** to determine the most appropriate Invited Expert/s for the meeting, taking into consideration budgetary constraints, as advised by the Executive Secretary or his/her delegate. Potential Invited Expert to be	Selection panel	Within 5 days of the deadline for comments on candidates from participants

	contacted by the Chair to confirm availability.		
4	Chair of the Working Party (or Vice-Chair) to advise the IOTC Science contact list of the successful Invited Expert/s, and request the Secretariat to commence the travel process.	Chair of WP or alternate & Secretariat	Within 2 days of the selection meeting.
5	Working Party meeting	Participants	–

20.2 Guidelines for the appointment of a consultant

20.3 Peer review process for IOTC stock assessments

IOTC–2011–SC14–44: Peer review of IOTC stock assessments (Chair SC).

Peer Review of IOTC Stock Assessments

Purpose

To provide the Scientific Committee (SC) with information regarding peer review of stock assessments in other tRFMO's.

Background

In 2009, the IOTC performance review panel published a report outlining 75 recommendations to improve the functioning of the IOTC (Anon 20091). Recommendation 29 from the review states: "*Ongoing peer review by external experts should be incorporated as standard business practice of working parties and the Scientific Committee*." In 2010, the KOBEII workshop on the provision of scientific advice, held in Barcelona, Spain, recommended that "*Tuna RFMOs should promote peer reviews of their stock assessment works*." At the 2010 IOTC Scientific Committee meeting, "*the SC supported the principle of peer-reviews of stock assessments made by the WP. It was suggested that the chair of the SC with the chair of the WP set up a proposal for such a procedure, that will be discussed with the Secretariat in terms of budget and funding. Then, such a proposal will be discussed at the next SC meeting*." (para. 273 of the Sc13 Report).

Discussion

The following text and attachments are aimed at informing the SC of the processes used by the other tRFMO's when undertaking peer reviews of their stock assessments. The Secretariat makes no assertion about which process should be adopted by the IOTC.

ICCAT

Although ICCAT has undertaken peer review of their stock assessments in the past, at present there is no regular process in place due to budgetary restrictions. The matter of peer review was discussed at the working group on the organization of the Standing Committee on Research and Statistics (SCRS), in March 2011. Participants concluded that collaboration among tRFMOs scientific committees should be further enhanced, as such collaboration provides a sound basis for quality assurance through peer review and exchange of expertise and experience. The SCRS has determination that the best approach to peer review of its stock assessments is for direct participation by external reviewers at the ICCAT stock assessment meetings. At the ICCAT annual Commission meeting, held in November 2011, ICCAT adopted a resolution on "Best available Science", that includes references to peer reviews: "Strengthen peer review mechanisms within the SCRS by participation of outside experts (i.e. from other RFMOs or from academia) in the SCRS activities, particularly stock assessments" and "The next independent performance review of ICCAT should include an assessment of the functioning of the SCRS and its working groups through a total quality management process, including an evaluation of the potential role of external reviews."

IATTC

The IATTC commenced a peer review process in 2010 and plans to carry out peer review of their stock assessments every second year focusing on a different species each time. In 2010, IATTC underwent a review of its bigeye tuna stock assessment and in 2012 plans to review yellowfin tuna. The peer review is of the assessment methodology and not the assessment results, to ensure that the peer review is not tied to providing management advice in the year that the review is conducted. The review consists of the IATTC staff presenting the stock assessment and relevant areas of concern to a review panel consisting of three reviewers and a Chair. The review lasts around five days and the final product is a report written by the review panel. The peer review meeting is open to other interested parties to ensure a heighten level of transparency in the process. The Stock Assessment Review Meeting is not a formal subsidiary

body of the IATTC, but rather an informal working group convened by the Director of IATTC. The broad aims of the review meeting are to 1) provide an external peer review of the IATTC stock assessments; 2) to give the scientists of member countries and cooperating non-parties of the IATTC (CPCs) an independent view of these assessments; 3) to review the advice and recommendations from the assessment scientists; and 4) to provide an opportunity to prepare for the formal consideration of the status of the stocks at upcoming annual meetings of the Commission. The report from the 2010 bigeye tuna review is provided at Appendix A for reference.

WCPFC

The WCPFC has been discussing peer review mechanisms for its stock assessments for several years and had intended on undertaking a review of the yellowfin tuna stock assessment in 2010, without success. As a result, at the request of the SC in 2010, the WCPFC Secretariat prepared a background document outlining the various options available for peer review of the bigeye tuna stock assessment in 2012. The WCPFC document is provided at Appendix B for information. At its Scientific Committee meeting in 2011, the SC agreed that the peer review of the 2011 bigeye tuna assessment should be conducted in a way so as to contribute to future bigeye tuna assessments. The WCPFC SC agreed that the peer review panel be comprised of three independent reviewers. The panel would be selected and contracted early enough so that the 2011 assessment results (possibly including all the input data, modeling software, output of basic runs as well as all the sensitivity runs), can be given to the panel for advanced reviewing. The WCPFC SC agreed that in 2012, the Panel would hold a workshop to review the 2011 assessment and provide advice for future assessment work. The workshop would spend approximately two days on peer review of the 2011 assessment, and a further three days on reviewing and advising on various aspects of subsequent assessments. The Peer Review Panel should send the draft report of its results to Secretariat of the Pacific Community (SPC) for review and response. Once it is finalized, the report and response from SPC should be submitted to the WCPFC Executive Director, in advance of 2012 WCPFC SC meeting, where it will be considered. The WCPFC SC agreed that the peer review panel should be composed of three scientists that have significant expertise and experience on all aspects of stock assessments, preferably in relation to tuna stock assessments. The reviewers should **not be directly involved** with current WCPFC bigeye tuna assessments. The WCPFC Secretariat will approach the IATTC to request the provision of a reviewer. The WCPFC SC agreed to the following procedure and timeline for the 2012 peer review: While keeping the selection procedures open, transparent and time-efficient, the WCPFC SC agreed to the following: a) Each CCM [CPC equivalent] may recommend one candidate through their official WCPFC contacts by 15 October 2011; b) The Chair and Vice-Chair of the Commission, the SC Chair and the Executive Director will select five candidates for short listing, and circulate the shortlist with their CV to all of the official WCPFC contacts by 1 November 2011; c) The official WCPFC contacts will rank the five candidates with scores 1 (most preferred) to 5 (less preferred) and submit these rankings to the Science Manager by 20th November 2011. The three candidates who receive the lowest scores will form the Peer Review Panel, and will subsequently be contracted. If any of the three individuals are unable to undertake the review, the shortlisted candidate with the next lowest score will be invited to join the Peer Review Panel. The Peer Review Panel should be finalized by 15 January 2012. The WCPFC SC also agreed that the Peer Review Panel would need to be funded by the Commission for a total allocated budget of USD$30,000. The WCPFC SC adopted the terms of reference for peer review as provided at Appendix C.

CCSBT

The CCSBT Peer Review Panel report of 1998, includes a recommendation that a Stock Assessment Review Panel be formed to periodically review SBT stock assessments (Appendix D). As a result the CCSBT now has a process in place which revolves around an Independent Chair of their Scientific Committee and four Independent Scientific Advisory Panel Members, who review the work of Member scientists and provide independent views where necessary. All five positions are funded through the CCSBT annual budget to attend meetings. However, commencing in 2012 the full Independent Panel will not necessarily be used for all Scientific Meetings. For example, in 2012 only the Independent Chair and three Independent Panel Members will attend. This is due to a combination of budgetary constraints and the fact that the CCSBT Management Procedure has been finalised and adopted, meaning that the scientific process should be simplified in the future. The Advisory Panel terms of reference are:

- to participate in all meetings of the SC and other scientific meetings as requested by the

Commission;
- to help to consolidate parties' views to facilitate consensus;
- to incorporate their views in SC reports and provide to the SC and CCSBT in the form of a report of their own views on stock assessment and other matters.

20.4 IOTC Regional Tuna Tagging Programme – Tagging Symposium

21. Election of a Chairperson and Vice-Chairperson for the Next Biennium (Chair & Secretariat)

Rules of procedure of the IOTC: Rule X.6: *The Scientific Committee shall elect, preferably by consensus, a Chairperson and a Vice-Chairperson from among its members for two years. The Chairperson and the Vice-Chairperson shall be eligible for re-election for another two-year term.*

22. Review of the Draft, and Adoption of the Report of the Fourteenth Session of the Scientific Committee (Chair)

Attachment I
Update on Progress Regarding Resolution 09/01 – On the Performance Review Follow–Up (Note: Numbering and Recommendations as per Appendix I of Resolution 09/01)

ON THE IOTC AGREEMENT – A LEGAL ANALYSIS	RESPONSIBILITY	UPDATE/STATUS
1. The final conclusion of the Panel is that the Agreement is outdated and there are many areas for improvement. The weaknesses and gaps identified are, or have a potential to be, major impediments to the effective and efficient functioning of the Commission and its ability to adopt and implement measures aimed at long–term conservation and sustainable exploitation of stocks, according to model fisheries management instruments. More fundamentally, these deficiencies are likely to prevent the Commission from achieving its basic objectives.	*Commission and Members*	**Pending**: No new developments have taken place in this area.
2. Consequently, the Panel recommends that the IOTC Agreement either be amended or replaced by a new instrument. The decision on whether to amend the Agreement or replace it should be made taking into account the full suite of the deficiencies identified.	*Commission and Members*	**Pending**: No new developments have taken place in this area.
ON CONSERVATION AND MANAGEMENT	RESPONSIBILITY	UPDATE/STATUS
Data collection and sharing		
The Panel identified a poor level of compliance by many IOTC Members. with their obligations, notably those related to the statistical requirements on artisanal fisheries and sharks, and recommends that:		
3. The timing of data reporting be modified to ensure that the most recent data are available to the working parties and the Scientific Committee.	*Scientific Committee*	**Completed**: Currently CPCs are required to submit information on their flag vessels by 30th June every year. The same timeline is applicable for coastal CPCs who license foreign vessels.The timing of the Working Party on Tropical Tunas and the Working Party on Billfish are considered optimal so that assessments on the most recently available data can be completed and results reported to the Scientific Committee each year.
4. The deadline to provide data on active vessels be modified to a reasonable time in advance of the meeting of the Compliance Committee. This deadline is to be defined by the Compliance Committee.	*Compliance Committee*	**Completed**: Resolutions 10/07 and 10/08 have modified the reporting date for active vessels, which is now in the month preceding the meeting of the Compliance Committee. Resolution 10/08 establishes February 15th as the new deadline for submission of the list of active vessels for the previous year.
5. The scheduling of meetings of the working parties and Scientific Committee be investigated based on the experience of other RFMOs. This should bear in mind the optimal delivery of scientific advice to the Commission.	*Scientific Committee*	**Completed**: Given the large number of meetings of other RFMOs, it is becoming increasingly difficult to find a schedule of meetings that would be better than the one currently in practice. The Scientific Committee will continue to periodically review the timing of the Working Parties.
6. The Commission task the Scientific Committee with exploring alternative means of communicating data to improve timeliness	*Scientific Committee*	**Partially completed**: The Secretariat encourages members to utilise electronic means to expedite reporting. A study has been commissioned for

of data provision.		2011 to determine the feasibility of reporting near real–time for various fleets.
7. Non–compliance be adequately monitored and identified at individual Member level, including data reporting.	*Compliance Committee*	**Ongoing**: Reports on compliance with data reporting requirements have been regularly reviewed by the Compliance Committee, as well as discussed at the species Working Parties, the Working Party on Data Collection and Statistics and the Scientific Committee. For the Compliance Committee meeting of 2011, country–based reports have been prepared for this purpose.
8. The causes of non–compliance be identified in cooperation with the Member concerned.	*Compliance Committee*	**Ongoing**: The Terms of Reference of the Compliance Committee was revised in 2010 (Resolution 10/09) and provides for the assessment of compliance by CPCs. The Secretariat, via the Compliance Section, maintains contact with national officers to determine the reasons for non–compliance, in particular, concerning data reporting.
9. When the causes of non–compliance are identified and all reasonable efforts to improve the situation are exhausted, any Member or non–Member continuing to not –comply be adequately sanctioned (such as market related measures).	*Compliance Committee*	**Ongoing**: Resolution 10/10 provides the necessary framework in which to apply market related measures, following an appropriate process. Reductions in future quota allocation have been proposed as deterrents for non–compliance.
10. There is a need to improve the quality and quantity of the data collected and reported by the Members, including the information necessary for implementing the ecosystem approach. The most immediate emphasis should be placed on catch, effort and size frequency. The Panel also recommends that:	*Scientific Committee*	**Ongoing**: See below.
11. Support for capacity building be provided to developing States – the Commission should enhance funding mechanisms to build developing country CPCs' capacity for data collection, processing and reporting infrastructures, in accordance with the Commission requirements.	*Standing Committee on Administration and Finance and Finance*	**Ongoing**: Currently, the only funding available continues to be through the externally–funded IOTC–OFCF programme. Other sources and cooperative arrangements might be available in the future (e.g. SWIOFP, COI, etc.). The Secretariat continues to collaborate with these initiatives.
12. A regional scientific observer programme to enhance data collection (also for non–target species) and ensure a unified approach be established, building on the experience of other RFMOs, Regional standards on data collection, data exchanged and training should be developed.	*Scientific Committee*	**Completed**: Resolution 10/04 provides CPCs with the necessary framework for putting in place a scientific observer programme. The Regional Observers Scheme commenced July 1st 2010, and is based on national implementation. The Secretariat coordinated the preparation of standards for data requirements, training and forms.
13. Actions be taken so that fishing fleets, especially Maldives, Taiwan, Province of China and Yemen participate in data collection and reporting.	*Commission*	**Partially completed**: Maldives became a Cooperating non–Contracting Party to the IOTC at its 14th annual meeting and will be considered for CPC status at the 2011 meeting. Taiwan, Province of China, submits data from its fishing fleet on a regular basis. The fleets of Maldives and Taiwan,China comply with most of the IOTC mandatory data requirements. The security situation in Yemen continues to prevent a more direct joint working arrangement with national scientists on data collection issues.
14. A relationship with Taiwan, Province of China be developed in order to have data access when needed, to all its fleet data as	*Commission and Members*	**Ongoing**: Taiwan, Province of China, submits data from its fishing fleet on a regular basis and routinely allows access to historical data. It also continues to

well as historical series, and address the problems deriving from the current legal framework.		participate in the Regional Observer Programme to monitor transhipment at sea.
15. The Secretariat's capacity for data dissemination and quality assurance be enhanced, including through the employment of a fisheries statistician.	*Standing Committee on Administration and Finance via Scientific Committee Commission*	**Ongoing**: The existing post of Data Analyst was converted to a Fisheries Statistician to join the Data Section of the Secretariat.
16. A statistical working party be established to provide a more efficient way to identify and solve the technical statistical questions.	*Scientific Committee*	**Completed**: The Working Party on Data Collection and Statistics resumed its annual meeting in 2009.
17. The obligation incumbent to a flag State to report data for its vessels be included in a separate Resolution from the obligation incumbent on Members to report data on the vessels of third countries they licence to fish in their exclusive economic zones (EEZs).	*Compliance Committee*	**Completed**: Resolutions 10/07 and 10/08 address the reporting requirements of flag and coastal States responsibilities, with regards to vessels that are active in the IOTC Area.
In relation to non–target species, the panel recommends that: 18. The list of shark species for which data collection is required in Recommendation 08/04 be expanded to include the five species identified by the Scientific Committee (blue shark, shortfin mako, silky shark, scalloped hammerhead, oceanic whitetip), and apply to all gear types.	*Commission*	**Partially completed**: In 2010, the majority of the Working Party on Ecosystems and Bycatch recommended a list of eleven species or species–groups for inclusion in Resolution 08/04. All of these species or groups are considered easily identifiable by fishers. It is noted here that although silky shark is perhaps the most important shark bycatch species in tropical tuna fisheries, it is not easily identified by fishers, since it is readily confused with similar species. The Commission meeting in 2011 will be considering several proposals in this regard.
19. The Secretariat's capacity to provide support to developing States' Members should be enhanced.	*Commission and Standing Committee on Administration and Finance*	**Ongoing**: Resolution 10/05 provides a mechanism for financial support to facilitate scientists and representatives from IOTC Members and Cooperating non–Contracting Parties who are developing States to attend and/or contribute to the work of the Commission, the Scientific Committee and its Working Parties. The Secretariat has also collaborated directly and indirectly with other regional
20. Cooperative capacity building efforts amongst Members and, as appropriate external organisations, should be encouraged.	*Members and Secretariat*	**Ongoing**: See Recommendations 13 and 21.
21. Innovative or alternative means of data collection (e.g. port sampling) should be explored and, as appropriate, implemented.	*Scientific Committee*	**Ongoing**: The Secretariat has been implementing sampling programmes since 1999. The IOTC–OFCF Programme has supported sampling programmes and other means of data collection since 2002.
22. Avenues to collect data from non–Members should be explored.	*Secretariat*	**Ongoing**: The activities of the IOTC–OFCF Project have not been limited to IOTC members, and, in the past, have extended to important non–member fishing countries such as Yemen and Maldives.
Quality and provision of scientific advice		
23. For species with little data available, the Scientific Committee should be tasked with making use of more qualitative scientific methods that are less data intensive.	*Scientific Committee*	**In progress**: The species Working Parties have been using informal analyses of stock status indicators when data are considered insufficient to conduct full assessments for some time. However, a formal system that reviews those qualitative indicators and provides a recommendation on the current status,

		based on the weight–of–evidence has yet to be developed.
24. More emphasis should be given to adherence to data collection requirements.	*Compliance Committee*	**In progress**: The Working Party on Data Collection and Statistics and the species Working Parties evaluate the availability and quality of data, and makes recommendations to the Scientific Committee on how to improve data quality. The Compliance Committee receives a report on the timeliness and completeness of the reporting of the data required by the various Resolutions of the Commission for each country.
25. Confidentiality provisions and issues of accessibility to data by the scientists concerned needs to be clearly delineated, and/or amended, so that analysis can be replicated.	*Scientific Committee*	**Ongoing**: Input, output and executable files for the assessment of major stocks are archived with the Secretariat to allow replication of analyses. Access to operational data under cooperative arrangements, and those subject to confidentiality rules is still limited. In some cases the Secretariat is bound by the domestic data confidentiality rules of Members and Cooperating non–Contracting Parties.
26. The resources of the IOTC Secretariat should be increased. Even though some progress will be made with recruitment of the stock analysis expert, some additional professional staffing is required.	*Standing Committee on Administration and Finance on advice from Committees and the Commission*	**Pending**: The Commission declined the request for additional staff in 2010. The Secretariat will propose a budget for the 2011 and 2012 that includes additional professional staff, as recommended by the Scientific Committee.
27. To enhance the quality of scientific advice and the technical soundness of the papers being considered by the Scientific Committee and its working parties, and to encourage publication of IOTC scientific papers in relevant journals, future consideration should be given to the establishment of a scientific editorial board within the Scientific Committee	*Scientific Committee*	**Partially completed**: Not yet discussed by the Scientific Committee. However, guidelines for the presentation of stock assessment papers were revised and agreed to by the Scientific Committee in 2010.
28. An online IOTC Data Summary should be established	*Secretariat*	**Pending**: Budgetary provisions to be renewed for 2011.
29. Ongoing peer review by external experts should be incorporated as standard business practice of working parties and the Scientific Committee.	*Scientific Committee*	**Pending**: External experts are regularly invited to provide additional expertise, although this does not constitute a formal process of peer review. The Scientific Committee in 2010, agreed that once stock assessment models were considered robust, that peer review would be advantageous and funds will be requested to undertake peer reviews of stock assessments.
30. New guidelines for the presentation of more user friendly scientific reports in terms of stock assessments should be developed. In this respect, Kobe plots are considered to be the most desirable method of graphical presentation, especially to non–technical audience.	*Scientific Committee*	**Partially completed**: All recent stock assessment results have been presented using the Kobe plot, and the species Working Parties are progressing in presenting the Kobe matrix. The 2010 Scientific Committee report includes Kobe Matrices for both bigeye tuna and swordfish. The stock status table at the front of the Scientific Committee report was also revised in 2010 to reflect the Kobe plot format.
31. A special fund to support the participation of scientists from developing States should be established.	*Standing Committee on Administration and Finance*	**Completed**: A Meeting Participation Fund was established via Resolution 10/05. The Resolution provides a funding mechanism to facilitate scientists and other representatives from IOTC Members and Cooperating non–Contracting Parties (CPCs) who are developing States to attend and/or

		contribute to the work of the Commission, the Scientific Committee and its Working Parties. The fund is financed, initially, by accumulated funds, with no provisions for long–term support yet agreed.
32. The Commission should renew efforts to convene meetings of the Working Party on Neritic Tunas	*Commission*	**Pending**: Programmed for 2011/2012. Depended on resources of the Secretariat and availability of data.
Adoption of conservation and management measures		
33. As the IOTC has faced the management of the main targeted stock under its purview only through a regulation of the fishing effort; other approaches should be explored, such as those envisioned in Resolution 05/01, including catch limits, total allowable catch (TAC) or total allowable effort (TAE).	*Commission*	**In progress**: Resolution 10/01 provides the starting point in the process of moving towards a total allowable catch limit. The first meeting of the Technical Meeting on Allocation Criteria was held in Nairobi, Kenya from 16–18 February 2011. A further meeting in early 2012 was proposed and will be considered by the Commission in 2011.
34. Within the system of the freezing of fishing effort in terms of number of vessels and correspondent capacity in gross tonnage, a deadline should be agreed for the implementation of fleet development plans.	*Commission*	**Completed**: Some CPCs have cited the global financial crisis as the reason for their inability to implement their fleet development plan and have therefore signalled to the Commission that their plan will be revised. A deadline of 31st December, 2010, was set for submission of all revised or new fleet development plans.
35. IOTC should consider developing a framework to take action in the face of uncertainty in scientific advice.	*Scientific Committee and Commission*	**In progress**: The Scientific Committee has agreed that the development of a Management Strategy Evaluation process be initiated to provide better advice that would incorporate explicit consideration of uncertainty.
36. IOTC should use the full range of decision making processes available to it under the Agreement.	*Commission*	**Ongoing**: For the first time in its history of adopting conservation and management measures, the Commission took a vote on a proposed resolution during its 14th Annual Session.
37. The IOTC Agreement needs to be amended or replaced in order to incorporate modern fisheries management principles, such as the precautionary approach.	*Commission and Members*	**Pending.**
38. Pending the amendment or replacement of the Agreement, the Commission should implement the precautionary approach as set forth in the UNFSA.	*Commission*	**Pending**: see also Recommendation 35.
39. Measures to regulate shark fisheries should be considered by the Commission.	*Commission*	**In progress**: Resolution 05/05 provides the framework for combating the practice of shark finning and Resolution 10/12 is aimed at the conservation of sharks of the family Alopiidae. A number of proposals will be considered by the Commission at its 2011 meeting.
40. There is a need to develop and take into account modern principles for fisheries management, including ecosystem based approach, protection of marine biodiversity and reducing the harmful impacts of fishing on marine environment.	*Commission and Members*	**Ongoing**: Resolutions 09/05, 09/06 and 10/06 are all aimed at encouraging fishing practices that protect marine biodiversity and reducing the harmful impacts of fishing on the marine environment or on species that are incidentally caught in association with IOTC species.
41. These concepts should be integrated in the IOTC Agreement.	*Commission and Members*	**Pending.**
Capacity management		

42. IOTC should establish a stronger policy on fishing capacity to prevent or eliminate excess fishing capacity.	*Working Party on Fishing Capacity* *Scientific Committee* *Commission*	**Ongoing**: The Commission has since 2003 adopted a series of Resolutions (03/01, 06/05, 07/05 and 09/02) with the objective of addressing the issue of fishing capacity. However, to date these resolutions have not resulted in a strong control on fishing capacity, and the concern remains that overcapacity might result from this lack of control. The Secretariat is actively involved in developing the global vessels record for vessels fishing for tuna and tuna–like species that would contribute to the assessment of existing fishing capacity.
43. Loopholes in the current systems of fishing capacity limitation, such as the establishment of fleet development plans and exemptions for vessels less than 24 meters, should be closed.	*Working Party on Fishing Capacity* *Commission*	**Partially completed**: Resolution 09/02, and the decisions made at IOTC 14, establishing a new deadline to file fleet developments plans, aim at establishing firm capacity targets.
44. IOTC should endorse the recommendation of the Scientific Committee to create a Working Group on Fishing Capacity.	*Commission*	**Completed**: The first Working Party on Fishing Capacity was convened in 2009. In 2010 as no new documents were presented, it was amalgamated into the Working Party on Tropical Tunas as a theme session.
Compatibility of management measures		
45. IOTC Members should be invited to promptly implement IOTC conservation and management measures through their national legislation.	*Secretariat and Commission*	**Ongoing**: CPCs are reminded annually about the responsibility of integrating IOTC conservation and management measures in their national legislation. The Secretariat is cooperating with CPCs by assisting in the assessment of the legal needs to effectively implement IOTC measures.
Fishing allocations and opportunities.		
46. IOTC should explore the advantages and disadvantages of implementing an allocation system of fishing quota, expressed as TAC or TAE system. Such an investigation should include consideration of how significant catches by current non–Members would be accounted for.	*Commission*	**In progress**: Resolution 10/01 has begun the process of moving towards the implementation of a total allowable catch limit for IOTC species. A Technical Meeting on Allocation Criteria has discussed proposed guidelines and methods to allocate future quota.
ON COMPLIANCE AND ENFORCEMENT	RESPONSIBILITY	UPDATE/STATUS
Flag State duties		
47. Any amendment to or replacement of the IOTC Agreement should include specific provisions on Member's duties as flag States, drawing on the relevant provisions of the UNFSA.	*Commission and Members*	**Pending.**
Port State measures		
48. Any amendment to or replacement of the IOTC Agreement should include specific provisions on Member's duties as port States.	*Commission and Members*	**Pending.**
49. IOTC should explore the possible implementation of the FAO Model Scheme on Port State Measures.	*Commission*	**Completed**: see Recommendation 50.
50. The IOTC should duly note the outcome of the current process for establishment of a globally binding agreement on port State measures.	*Commission*	**Completed**: Resolution 10/11 is inspired by the FAO Port State Measures Agreement. By adopting this resolution, IOTC CPCs have agreed to implement the conditions of this agreement even before it becomes globally binding, and it became the first RFMO to do so.
Monitoring, Control and Surveillance		

51. IOTC should develop a comprehensive monitoring, control and surveillance (MCS) system through the implementation of the measures already in force, and through the adoption of new measures and tools such a possible on–board regional observers' scheme, a possible catch documentation scheme as well as a possible system on boarding and inspection.	*Compliance Committee*	**In progress**: IOTC already has an extensive number of MCS related measures. However, the implementation of these measures are the duty and responsibility of the CPCs. Proposals to introduce a catch documentation scheme, especially for the major IOTC species, have until now been rejected by CPCs. Resolution 10/04 – observers and field samplers are required monitor the unloading of catches.
Follow–up on infringements		
52. The current IUU resolution should be amended to allow the inclusion of vessels flagged to Members.	*Commission*	**Completed**: Resolution 09/03, which supersedes Resolution 06/03, was adopted for this purpose.
53. IOTC should explore options concerning the possible lack of follow–up on infringements by CPCs.	*Compliance Committee*	**Ongoing**: The Compliance Committee, under its revised terms of reference, will be in a better position to assess such cases.
54. IOTC should establish a sanction mechanism for non–compliance, and task the Compliance Committee to develop a structured approach for cases of infringement.	*Compliance Committee*	**In progress**: The Compliance Committee, under its revised terms of reference, shall develop a scheme of incentives and sanctions and a mechanism for their application to encourage compliance by all CPCs.
55. Provisions for follow–up on infringement should be included in any amended/replaced Agreement.	*Commission and Members*	**Completed**: The Compliance Committee, under its revised terms of reference, will be in a position to follow up on matters concerning each individual CPC.
Cooperative mechanisms to detect and deter non–compliance		
56. A structured, integrated approach to evaluate the compliance of each of the Members against the IOTC Resolutions in force should be developed by the Compliance Committee.	*Compliance Committee*	**In progress**: For the Compliance Committee meeting of 2011, country–based reports have been prepared for this purpose.
57. CPCs should be reminded of their duty to implement in their national legislations the conservation and management measures adopted by IOTC.	*Compliance Committee*	**Ongoing**: CPCs are reminded annually about the responsibility of integrating IOTC conservation and management measures in their national legislation. The Reports of Implementation, mandated in the IOTC Agreement, provide a mechanism to monitor progress of implementation at the national level.
58. The requirement to present national reports on the implementation of IOTC measures should be reinforced.	*Compliance Committee*	**Ongoing**: Reminders are sent to CPCs prior to the Commission meeting and a template has been developed by the Secretariat to facilitate the preparation of national reports on implementation of IOTC measures. Compliance with this requirement will be assessed in the country–based compliance reports.
59. The sense of accountability within IOTC seems to be very low; therefore more accountability is required. There is probably a need for an assessment of the performance of CPCs.	*Compliance Committee*	**Ongoing**: The revised terms of reference of the Compliance Committee will facilitate this assessment in the form of the country reports prepared for the 2011 session.
60. Establishment of formal mechanisms of MCS (e.g. observers programmes) should be considered	*Compliance Committee*	**Ongoing**: Resolution 08/02 provides for an observer programme to monitor at sea transhipments, but by placing observers only on carrier vessels. Resolution 10/04 establishes a Regional Observer Scheme that includes observers on board vessels, and port sampling for artisanal fisheries.
Market related measures		
61. As IOTC action in terms of measures relating to the exercise of rights and duties of its Members as market States are very weak, the non–binding market related measure should be transformed	*Commission*	**Completed**: Resolution 10/10 meets this requirement.

into a binding measure.		
62. The bigeye statistical document programme should be applied to all bigeye products (fresh and frozen). Catch documentation schemes for target species of high commercial value should be considered. Alternatively, expanding the scope of the current statistical document programme to address current loopholes should be considered.	*Commission*	**In progress**: A proposal for a resolution to introduce a catch documentation scheme, especially for the major IOTC species, was not endorsed by CPCs at its 14th Annual Session. A revised proposal will be considered during the 15th session in 2011.
ON DECISION MAKING AND DISPUTE SETTLEMENT	RESPONSIBILITY	UPDATE/STATUS
Decision making		
63. In order to improve the IOTC practices of decision making and adoption of measures, when every effort to achieve consensus has been exhausted, invoking the procedure of voting should be explored	*Commission*	**Ongoing**: Resolution 10/12 was voted upon by CPCs at the IOTC's 14th Annual Session. It was the first time that the voting procedure was used in IOTC for the adoption of a resolution.
64. Amending the objection procedure so that it is more rigorous, and in line with other RFMO Conventions, featuring restricted grounds for the bases to object is recommended.	*Commission and Members*	**Pending.**
Dispute settlement		
65. A provision on dispute settlement should be amended in line with the requirements of UNFSA.	*Commission and Members*	**Pending.**
ON INTERNATIONAL COOPERATION	RESPONSIBILITY	UPDATE/STATUS
Transparency		
66. The active vessels list should be made available on the IOTC website.	*Commission Secretariat*	**Completed**: Resolutions 07/02, 10/07 and 10/08. The lists of authorised and active vessels are hosted on the IOTC website.
67. The Commission, in consultation with the Scientific Committee, should review the availability of critical data sets used in development of scientific advice and take steps to assure that these data are held at the Secretariat and available for validation of analyses, subject to the appropriate confidentiality requirements.	*Commission*	**Ongoing**: See Recommendations on Data collection and sharing above.
Relationship to cooperating non Members		
68. The legal framework of the IOTC Agreement should be amended or replaced in order to enable fishing players active in the area to discharge their obligations in line with the UNFSA.	*Commission and Members*	**Pending**: In the meantime, alternative ways of participation of active fishing fleets in the activities of the Commission are being pursued.
Relationship to non cooperating non Members		
69. Although the IOTC has strengthened its action towards non–Members in order to have all important fishing players included under its remit, diplomatic approaches should be made by IOTC Members to non–Members with active vessels in the area.	*Commission*	**Ongoing**: The Secretariat has been active in contacting relevant non–Members to encourage their participation. Recent examples include the Maldives and Mozambique. The Secretariat has also responded to queries, briefed representatives about membership from the DPR of Korea, United Arab Emirates, Republic of Yemen and Somalia.

70. When non–cooperation is identified and all reasonable efforts to improve the situation are exhausted, any non–Members continuing not to not cooperate should be adequately sanctioned by, for example, market related measures.	*Compliance Committee*	**Ongoing**: Resolution 10/10 provides the necessary framework in which to apply market related measures. Actions are to be taken by the Compliance Committee, under its revised terms of reference.
Cooperation with other RFMOs		
71. IOTC should establish mechanisms for a mutual recognition of IUU lists with other RFMOs.	*Commission*	**Partially completed**: This issue is addressed in the Resolutions dealing with capacity transfers insofar as to vessels found on IUU lists of other tuna RFMOs should not be flagged by CPCs.
72. IOTC should develop cooperative mechanisms, such as MoUs, to work in a coordinated manner on issues of common interest, in particular non–target species and an ecosystem approach with other RFMOs especially with SIOFA.	*Commission*	**Ongoing**: The Secretariat is active in identifying opportunities for collaboration, for the consideration of the Commission.
73. IOTC should annually agree on a Member attending other tuna RFMO meetings as an observer on its behalf and reporting back to the Commission on matters of interest	*Commission*	**Ongoing**: Pending annual financial approval by the Commission.
Special requirements of developing States		
74. A specific fund to assist capacity building should be put in place.	*Standing Committee on Administration and Finance*	**Complete.** A Meeting Participation Fund was established via Resolution 10/05.
75. Members, that are Parties of UNFSA, should make use of the part VII Fund, established under UNFSA.	*Members*	**Ongoing**: Regular reminders are sent to CPCs.
Participation		
76. Financial support, in particular for attendance in the scientific activities to developing States, is needed.	*Standing Committee on Administration and Finance*	**Partially completed**: A Meeting Participation Fund was established via Resolution 10/05. The Resolution provides a funding mechanism to facilitate scientists and other representatives from IOTC Members and Cooperating non–Contracting Parties (CPCs) who are developing States to attend and/or contribute to the work of the Commission, the Scientific Committee and its Working Parties. The fund is financed, initially, by accumulated funds, with no provisions for long–term support yet agreed.
77. The legal framework of the IOTC should be amended or replaced in order to enable fishing players active in the area to discharge their obligations in line with the UNFSA.	*Commission and Members*	**Pending.**
ON FINANCIAL AND ADMINISTRATIVE ISSUES		UPDATE/STATUS
Availability of resources for RFMO activities –efficiency and cost–effectiveness		
78. The IOTC Agreement as well as financial management rules should be amended or replaced in order to increase Members' as well as Secretariat's control of all the budget elements, including staff costs of the budget. This would also improve transparency.	*Standing Committee on Administration and Finance Commission and Members*	**Pending.**
79. Prior to the Commission assuming full control of the budget, the	*Commission*	**Completed**: The meeting of the Commission has moved back towards the

Commission meeting at which the budget is considered should be held as close as possible to the commencement of the financial year to which this budget relates and if possible in advance of that year.		beginning of the financial year, thus reducing the difficulties of operating without a budget.
80. A fee system should be considered as a possible funding mechanism for possible new activities.	*Commission*	**Pending**: The IOTC Regional Observer Program (monitoring transhipment at sea) is fully funded by the participants through such a fee system.
81. The agreed external financial audit should be implemented as soon as possible, and should include a focus on whether IOTC is efficiently and effectively managing its human and financial resources, including those of the Secretariat.	*Standing Committee on Administration and Finance Commission*	**Pending.**

附件二、IOTC SC14 會議報告初稿

Report of the Fourteenth Session of the IOTC Scientific Committee

Mahé, Seychelles, 12–17 December 2011

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EXECUTIVE SUMMARY

Will be based only on the Report Paras QUOTED only.

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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	Advice to Commission
Major stocks: These are the main stocks being exploitation by industrial and artisanal fisheries throughout the Indian Ocean, both on the high seas and in the EEZ of coastal countries. These stocks are those that have received, in general, the highest fishing pressure in the region.					
Albacore *Thunnus alalunga*	Catch 2010: 43,711 t Average catch 2006–2010: 41,074 t MSY (1 model): 29,900 t (21,500–33,100 t) F_{2010}/F_{MSY}: >1 SB_{2010}/SB_{MSY}: ≈ 1 SB_{2010}/SB_{1980}: 0.39	2007			The available evidence indicates considerable risk to the stock status at current effort levels. The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority. Current catches likely exceed MSY. Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.
Bigeye tuna *Thunnus obesus*	SS3[3] / ASPM[4] Catch (1000 t): 102.0 t / 71.5 t Average catch last 5 years: 104.7 t / 104.7 t MSY (1000 t): 114 (95–183 t) / 102.9 t (86.6–119.3 t) F_{curr}/F_{MSY}:[5] 0.79 (0.50–1.22) / 0.67 (0.48–0.86) SB_{curr}/SB_{MSY}:[5] 1.20 (0.88–1.68) / 1.00 (0.77–1.24) SB_{curr}/SB_0:[5] 0.34 (0.26–0.40) / 0.39	2008			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.
Skipjack tuna *Katsuwonus pelamis*	Catch 2010: 428,719 t Average catch 2006–2010: 489,385 t MSY: 564,000 t (395,000–843,000 t) C_{2009}/MSY: 0.81 (0.54–1.16) SB_{2009}/SB_{MSY}: 2.56 (1.09–5.83) SB_{2009}/SB_0: 0.53 (0.29–0.70)				Annual catches of skipjack tuna should not exceed 512,305 t. If the recent declines in effort continue, and catch remains substantially below the estimated MSY, then immediate 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.
Yellowfin tuna *Thunnus albacares*	Catch 2010: 299,074 t Average catch 2006–2010: 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)	2008			Annual catches of yellowfin tuna should not exceed 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.
Swordfish (whole IO) *Xiphias gladius*	Catch 2010: 18,956 t Average catch 2006-2010: 23,799 t MSY: 29,900 t–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	2007			Annual catches of swordfish should not exceed 30,000 t. If the recent declines in effort continue, and catch remains substantially below the estimated MSY, 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.
Swordfish (southwest IO) *Xiphias gladius*	Catch 2009: 6,513 t Average catch 2006-2010: 7,112 t MSY: 7,100 t–9,400 t F_{2009}/F_{MSY}: 0.64–1.19 SB_{2009}/SB_{MSY}: 0.73–1.44				Annual catches in the southwest Indian Ocean should be maintained at levels at or below those observed in 2009 (6,678), until there is clear evidence of recovery and biomass exceeds B_{MSY}.

[1] This indicates the last year taken into account for assessments carried out before 2010

Stock	Indicators	Prev[1]	2010	2011	Advice to Commission
	SB_{2009}/SB_0: 0.16–0.58				
Billfish (other than swordfish) : This category includes species that are not usually targeted by most fleets, but are caught as bycatch of the main industrial fisheries. They are important for localised small-scale and artisanal fisheries (e.g. sailfish in the northern Arabian Sea and the Persian Gulf) or as targets in recreational fisheries (e.g. marlins)					
Black marlin *Makaira indica*	Catch 2010: 5,018 t Average catch 2006–2010: 4,689 t MSY: Unknown				No quantitative stock assessment are currently available for these species in the Indian Ocean. The Maximum Sustainable Yield estimates for the whole Indian Ocean is unknown and annual catches urgently need to be reviewed. Improvement in data collection and reporting is required to assess these stocks. However, aspects of species biology, productivity and fisheries combined with a lack of fisheries data on which to base quantitative assessments is a cause for concern.
Indo-Pacific blue marlin *Makaira mazara*	Catch 2010: 11,261 t Average catch 2006–2010: 9,508 t MSY: Unknown				
Striped marlin *Tetrapturus audax*	Catch 2010: 1,921 t Average catch 2006–2010: 2,542 t MSY: Unknown				
Indo-Pacific Sailfish *Istiophorus platypterus*	Catch 2010: 25,498 t Average catch 2006–2010: 22,151 t MSY: Unknown				
Neritic tunas: These are important species for small-scale and artisanal fisheries, almost always caught within the EEZs of IO coastal states. They are caught only occasionally by industrial fisheries. Catches are often reported as aggregates of various species, making it difficult to obtain appropriate data for stock assessment analyses.					
Bullet tuna *Auxis rochei*	Catch 2010: 4,188 t Average catch 2006–2010: 2,884 t MSY: Unknown				No quantitative stock assessment is currently available for these species in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. However, aspects of the biology, productivity and fisheries for these species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern. The continued increase of annual catches for most of these species in recent years has 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 resource. The apparent fidelity of these species to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion.
Frigate tuna *Auxis thazard*	Catch 2010: 71,023 t Average catch 2006–2010: 64,245 t MSY: Unknown				
Narrow-barred Spanish mackerel *Scomberomorus commerson*	Catch 2010: 124,107 t Average catch 2006–2010: 116,444 t MSY: Unknown				
Kawakawa *Euthynnus affinis*	Catch 2010: 128,871 t Average catch 2006–2010: 122,895 t MSY: Unknown				
Longtail tuna *Thunnus tonggol*	Catch 2010: 141,937 t Average catch 2006–2010: 115,973 t MSY: Unknown				
Indo-Pacific king mackerel *Scomberomorus guttatus*	Catch 2010: 37,257 t Average catch 2006–2010: 37,980 t MSY: Unknown				

Stock	Indicators	Prev[1]	2010	2011	Advice to Commission
Sharks: Although they are not part of the 16 species directly under the IOTC mandate, sharks are frequently caught in association with other species as bycatch, and for some fleets are often as much a target as tuna. 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 tuna fisheries, but the list is not exhaustive.					
Blue shark *Prionace glauca*	unknown Unknown				There is a paucity of information available for these species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available. Therefore the stock status is highly uncertain. The available evidence indicates considerable risk to the stock status at current effort levels. The primary source of data that drive the assessment (total catches) is highly uncertain and should be investigated further as a priority.
Silky shark *Carcharhinus falciformis*	unknown Unknown				
Oceanic whitetip shark *Carcharhinus longimanus*	unknown Unknown				
Scalloped hammerhead shark *Sphyrna lewini*	unknown Unknown				
Shortfin mako *Isurus oxyrinchus*	unknown Unknown				
Bigeye thresher shark (*Alopias superciliosus*)	unknown Unknown				
Pelagic thresher shark (*Alopias pelagicus*)	unknown Unknown				

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 ($F_{year}/F_{MSY} \leq 1$)		

1. OPENING OF THE MEETING

1. The Fourteenth Session of the Indian Ocean Tuna Commission's (IOTC) Scientific Committee (SC) was held on Mahé, Seychelles, from 12 to 17 December 2011. A total of 53 individuals attended the Session, comprised of 42 delegates from 14 Member countries and 0 delegates from Cooperating Non-Contracting Parties, as well as 10 observers and invited experts. The list of participants is provided at Appendix I.

2. The meeting was opened on 12 December, 2011 by the Chair Dr. Francis Marsac (EU), who subsequently welcomed participants to the Seychelles. The Chair informed participants that his term as Chair and that of the Vice-Chair had expired at the 2010 SC meeting, however, under exceptional circumstances, both positions had been extended for 2011. However, a new Chair and a new Vice-Chair will need to be elected at the end of the current meeting.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

3. The SC **ADOPTED** the Agenda provided at Appendix IIAppendix2. The documents presented to the SC are listed in Appendix III.

3. ADMISSION OF OBSERVERS

4. The SC **NOTED** that at the Third Session of the Commission, Members 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 (Rule XIII.9 of the Rules of Procedure).

5. The SC **ADMITTED** the following observers to the Fourteenth Session of the SC: Birdlife International, South West Indian Ocean Fisheries Project, World Wildlife Fund (World Wide Fund for Nature), Food and Agriculture Organisation of the United Nations, Russian Federation, the International Seafood Sustainability Foundation and the Marine Stewardship Council.

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

4. ACTIVITIES OF THE COMMISSION

7. The SC **NOTED** paper IOTC–2011–SC14–03 which outlined the decisions and requests made by the Commission at its Fifteenth Session, held from 18–22 March 2011, specifically relating to the work of the SC, including the six Conservation and Management Measures (five Resolutions and one Recommendation) 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.

8. The SC **NOTED** paper IOTC–2011–SC14–04 which outlined a number of Commission decisions, in the form of previous Resolutions that require a response from the Scientific Committee in 2011, and **AGREED** to develop advice to the Commission in response to each request during the current session.

5. ACTIVITIES OF THE IOTC SECRETARIAT IN 2011

9. The SC **NOTED** paper IOTC–2011–SC14–05 which provided an overview of the work undertaken by the IOTC Secretariat in 2011, including the following key activities: 1) First Working Party on Neritic Tunas; 2) First Capacity Building Workshop aimed at bridging the gap between IOTC science and management; 3) First stock assessment for skipjack tuna; and 4) the continued increase in participation at IOTC scientific meetings by developing coastal states, including via the submission of working papers.

10. The SC **NOTED** with thanks, the outstanding contributions of the staff of the IOTC Secretariat to the science process in 2011, in particular through the contributions of the stock assessment expert, the facilitation of invited experts and in support of the working party and SC meetings.

11. The SC **RECOMMENDED** that while the recruitment process for a new stock assessment expert at the IOTC Secretariat is being finalised, the Secretariat hire an individual/s to fill the staffing gap. This was considered to be particularly important given the upcoming tagging symposium in late 2012.

6. NATIONAL REPORTS FROM CPCS

12. The SC **NOTED** the 25 National Reports presented by CPCs 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**: Nil comments.
    - **Belize**: Not presented orally.
    - **China**: Not presented orally.
    - **Comoros**: Nil comments.
    - **Eritrea**: The SC **EXPRESSED** its disappointment that Eritrea did not provide a National Report and urged Eritrea to fulfil its reporting obligations to the IOTC.
    - **European Union**: The SC **NOTED** that species composition sampling of the EU purse seine fleets is being adapted to better reflect the changes in fishing strategies. However, the EU indicated that the sampling scheme has not undergone major structural changes. The SC was informed that the EU observer program resumed in 2011 with a coverage rate of 11%, in collaboration with TAAF (Terres Australes et Antarctiques Françaises). Finally, the SC recognised that marlins are not well sampled by the EU purse seine fleets and therefore, the SC requested that improvements be made in this regard.
    - **France (territories)**: Not presented orally.
    - **Guinea**: The SC **EXPRESSED** its disappointment that Guinea did not provide a National Report and urged 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, it was noted that there remains substantial improvements to be made and higher quality data needs to be provided by India in 2012.
    - **Indonesia**: The SC **NOTED** that the current level of observer coverage is less than 1% for Indonesian vessels and is based on port samplers in the port of Benoa. Currently, the program consists of five port samplers, however it was indicated that Indonesia plans to double the level of covered in 2012, compared to 2010. Indonesia acknowledged that it has had problems implementing the sampling scheme designed by the IOTC-OFCF to comply with the IOTC mandatory requirements for data provision. Key actions under the Indonesian NPOA-sharks have begun to be implemented in East Lombok, since this location is considered one of the main places where sharks are landed.
    - **Iran, Islamic Republic of**: Not presented orally.
    - **Japan**: The SC **NOTED** the comment from Japan that its longline fleet operating in the Indian Ocean does not target sharks. 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 and to report progress at the next SC meeting.
    - **Kenya**: The SC **NOTED** that additional information on the composition of recreational fisheries catches from Kenya are available, although the size composition is not yet available for all IOTC species, namely billfishes, as many are released alive and are not measured.
    - **Korea, Republic of**: The SC **NOTED** the improved seabird identification reports, from 2009 to 2010, was most likely due to improved observer training as well as improved identification skills by the vessel captains.
    - **Madagascar**: Not presented orally.
    - **Malaysia**: Not presented orally.
    - **Maldives, Republic of**: The SC **NOTED** the substantial declines in the catches of skipjack tuna by the Maldives in recent years (>50% decline from 2006 to 2010), and acknowledged that this trend was of great concern given that the Maldives accounts for approximately 80% of the

skipjack tuna catch in the Indian Ocean. There might be multiple causes for such a decline (environmental changes, high fuel price, lower tuna biomass etc.) but there are not well understood and further investigation is needed.

- **Mauritius**: The SC **NOTED** the sharp increase in albacore catches reported from 2008 (2,024 t) to 2009 (4,293 t) and requested Mauritius to investigate the possible cause of the increase (among others, double reporting with flag states) and report back to the SC.
- **Oman, Sultanate of**: The SC **EXPRESSED** its disappointment that Oman did not provide a National Report and urged Oman to fulfil its reporting obligations to the IOTC.
- **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**: The SC **EXPRESSED** its disappointment that the Philippines did not provide a National Report and urged the Philippines to fulfil its reporting obligations to the IOTC.
- **Seychelles, Republic of**: The SC **NOTED** that the Seychelles report did not follow the new reporting format and requested that Seychelles follow the new template in 2012.
- **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 none of the >3,000 Sri Lankan fishing vessels authorised and capable of fishing on the high seas have any form of VMS, and logbooks are only being used by a very small proportion of vessels. As a result, 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. The SC **NOTED** that Sri Lanka agreed to provide an explanation of the large increase in shark catches reported from 2009 to 2010, and reporting catches by species rather than as an aggregated shark catch, in 2012. The SC **NOTED** that improvements have been made regarding data collection, monitoring and reporting, and encouraged Sri Lanka to continue to improve these systems as quickly as possible.
- **Sudan**: The SC **EXPRESSED** its disappointment that Sudan did not provide a National Report and urged Sudan to fulfil its reporting obligations to the IOTC.
- **Tanzania, United Republic of**: Not presented orally.
- **Thailand**: Nil comments.
- **United Kingdom (BIOT)**: The SC **NOTED** that the potential impacts of Marine Protected Areas (MPAs) in the Indian Ocean will be discussed under Agenda item 16 later in the meeting. A research plan associated with the no-take area, and engagement with existing research projects within the region is underway. The SC recalled the exceptional location of the BIOT to study movements of tuna between the east and west Indian Ocean using tagging techniques.
    i. The SC **NOTED** the following statement made by the Republic of Mauritius: "Mauritius does not recognize the so-called British Indian Ocean Territory. The Chagos Archipelago was illegally excised from the territory of Mauritius prior to its independence in violation of UN General Assembly resolutions 1514 (XV) of 14 December 1960 and 2066 (XX) of 16 December 1965."
    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**: Not presented orally.
- **Mozambique**: Not presented orally.
- **Senegal**: Not presented orally.
- **South Africa, Republic of**: Not presented orally.

Recommendation/s

13. 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 proving the reports by all CPCs, the SC **RECOMMENDED** that the Commission note that in 2011, 25 reports were provided by CPCs, up from 15 in 2010 and 14 in 2009 (Table 2). The SC stressed the importance of the submission of National Reports by all CPCs and urged those CPCs who did not met their reporting obligations in this regard (7), to provide a National Report to the SC in 2012.

Table 2. CPC submission of National Reports to the Scientific Committee in 2010 and 2011.

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

*Cooperating non-contracting party in 2011. Green = submitted. Red = not submitted. Green hash = submitted as part of EU report, although needs to be separate. n.a. = not applicable.

Discussions on improving/modifying the National Reporting Template

14. The SC **AGREED** that the National Reporting template should be maintained in its current format for 2012 and be reviewed annually for potential improvements.

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

15. The SC **NOTED** paper IOTC–2011–SC14–33 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.

16. 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.

17. 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 offered assistance to CPCs wishing to assess the impacts of gillnet fishing in their national fisheries.

18. 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 2012, 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.

19. The SC **NOTED** 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. REPORT OF THE 2011 IOTC WORKING PARTY MEETINGS

7.1 Report of the Ninth Session of the Working Party on Billfish

20. The SC **NOTED** the report of the Ninth Session of the Working Party on Billfish (IOTC–2011–WPB09–R), including the consolidated list of recommendations provided as an appendix to the report. The SC expressed its satisfaction on improved attendance and participation by national scientists working on billfish fisheries (27 participants in 2011 compared to 12 in 2010), particularly from the main fleets targeting swordfish (EU,Spain, EU,Portugal and Indonesia).

21. The SC **NOTED** that a 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 (Models used: SS3, ASPIC, BMAP, ASIA; see report of the WPB09 for descriptions).

22. The SC **NOTED** that the stock structure of the Indian Ocean swordfish resource is 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. However the magnitude of depletion does not appear to be as extreme as analyses in previous years have suggested. The limited movements and subsequent viscosity of the swordfish resource in a localized area is not an exceptional situation as it has been observed in most swordfish fisheries globally, leading to sharp CPUE declines and apparent localized depletion.

23. Noting the Commission's request to provide clear advice outlining alternative management approaches which would provide effective protection of a possible southwest Indian Ocean swordfish stock (IOTC–2011–S15–R, para. 46), the SC **AGREED** that a separate Executive Summary for swordfish in the southwest Indian Ocean be provided to the Commission, noting the work currently in progress to determine the level of connectivity between swordfish in the southwest with the wider Indian Ocean.

24. 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. The SWIOFP representative agreed to present a progress report at the next WPB meeting. The SC also **NOTED** that EU,France is conducting the IOSSS which aims at understanding the stock structure of swordfish in the Indian Ocean using genetic markers. Progress updates were provided at the WPB sessions in 2010 and 2011.

25. The SC **ACKNOWLEDGED** the outstanding contributions of the outgoing Chair of the Working Party on Billfish, Mr. Jan Robinson, and thanked him for his leadership over the past four years.

7.2 Report of the Third Session of the Working Party on Temperate Tunas

26. The SC **NOTED** the report of the Third Session of the Working Party on Temperate Tunas (IOTC–2011–WPTmT03–R), including the consolidated list of recommendations provided as an appendix to the report.

27. The SC **NOTED** that the assessment of the albacore stock was conducted with a single model in 2011(ASPIC, a surplus production model). While most of the catches of albacore have traditionally

come from the western Indian Ocean, in recent years a larger proportion of the catch has come from the eastern Indian Ocean. The catches of albacore in recent years have come almost exclusively from vessels flagged in Indonesia and Taiwan,China, although the catches of albacore reported for the fresh tuna longline fishery of Indonesia have increased considerably since 2003 to around 17,000 t, which represents approximately 40% of the total catches of albacore in the Indian Ocean.

28. The SC **NOTED** that the catches of albacore estimated for the fresh tuna longline fishery of Indonesia in recent years are thought to be uncertain, as they cannot be verified using data collected through port sampling, and that to date, the IOTC Secretariat has not received catch-and-effort data for this fishery. The SC was also informed that misidentification between yellowfin tuna and albacore might occur in the Indonesian catches which may contribute to the rise of declared albacore catches in recent years. However, the catch levels estimated by the IOTC Secretariat also account for other sources such as the export declarations from Bali and canning factories receiving the products abroad. Finally, the SC urged Indonesia to undertake a thorough examination of the sampling procedure at landing sites as soon as possible.

29. The SC **NOTED** the difficulties faced by Indonesian scientists and managers in terms of commercial catches being transhipped at sea and highlighted the need for logbooks to be utilised on all commercial fishing vessels, noting that this is already a mandatory requirement for IOTC CPCs.

30. The SC **NOTED** that 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.

31. Noting that at present very little is known about the population structure and migratory range of albacore in the Indian Ocean, other than the possible connectivity with the southern Atlantic, the SC **AGREED** that the determination of albacore stock structure, migratory range and movement rates in the Indian Ocean should be considered as high priority research projects for 2012, and for these to be included in the IOTC scientific workplan to be discussed under Agenda item 19.

32. Noting the request by the Commission at its 15th Session for a new assessment of albacore to be undertaken in 2011 (para. 37 of the S15 report), the SC **RECOMMENDED** that the Commission note that although a new assessment was undertaken in 2011, there remains considerable uncertainty about the relationship between abundance and the standardized CPUE series, and about the total catches over the past decade and that the WPTmT has limited confidence in the assessment undertaken. Thus, there is an urgent need to carry out a revised stock assessment for the albacore resource in the Indian Ocean in 2012, and the Commission should consider allocating funds for this purpose, noting that individual CPCs are finding it difficult to justify expending the necessary resources to undertake stock assessments.

7.3 Report of the Thirteenth Session of the Working Party on Tropical Tunas

33. The SC **NOTED** the report of the Thirteenth Session of the Working Party on Tropical Tunas (IOTC–2011–WPTT13–R), including the consolidated list of recommendations provided as an appendix to the report. The SC expressed its satisfaction on improved attendance and participation by national scientists working on tropical tuna fisheries (49 participants in 2011 compared to 39 in 2010).

Skipjack tuna

34. The SC **ACKNOWLEDGED** the excellent work undertaken by the IOTC Secretariat's stock assessment expert and other collaborators in undertaking the first fully quantitative assessment of skipjack tuna in the Indian Ocean.

35. The SC **NOTED** that the skipjack tuna stock was assessed using a single model in 2011 (SS3, a statistical integrated model). The model estimates a steep biomass decline between 1980 and 1990 followed by a steep biomass increase. At this stage, there are no CPUE series during this period to inform the model. The catch increased in this period due to the onset of purse seine fishing and industrialization of the Maldivian pole and line fishery and thus, trends in recruitment are required to explain the biomass patterns. The biomass/recruitment trends were supported only by the length frequency data, and it is not likely that these data are sufficiently informative to estimate this trend. Furthermore, the trend is not evident in the nominal CPUE series from either the pole and line or purse seine fisheries.

36. The SC **NOTED** that the CPUE series from the EU fleet targeting free schools of skipjack tuna could be extended back to 1983. It was noted, however, that this nominal series would not take into account changes in fishing/gear efficiency and so could still be unsuitable as an index of abundance for the earlier years. These restrictions also apply to the post–1991 series. However, it should be taken into account that the free school catch of purse seiners is relatively small in comparison to FAD-associated fishing (less than 10%) and the fishery is seasonal, located mainly in the Mozambique Channel during the first quarter of the year.

37. The SC recognised that skipjack tuna assessments are generally difficult to conduct in most fisheries, mainly because reliable standardised CPUE series cannot be obtained from the purse seine fleets which provide the bulk of skipjack tuna catches globally. In the particular case of the Indian Ocean, there are additional reasons related to artisanal fisheries. Those fisheries which contribute greatly to the skipjack tuna catches (~55%) are sampled with a large degree of uncertainty and are characterized by a lack of, or poor reporting in a number of CPCs (notably Pakistan, Sri Lanka, Indonesia, Comoros, Madagascar). The lack of quality data usually leads to assessments being limited to rough fisheries indicators instead of formal and quantitative approaches.

38. The SC **AGREED** that further investigation of the existing data irregularities, and expansion of the logbook programme to improve CPUE analyses for skipjack tuna in the Indian Ocean be carried out in 2012.

Yellowfin tuna

39. The SC **NOTED** that the yellowfin tuna stock was assessed using a single model in 2011 (MULTIFAN-CL, a statistical integrated model). While the biomass trends were very similar between the 2010 and 2011 assessments, the estimates of stock productivity and thus, the status, differed. There were several reasons for this: there was poor convergence in the 2010 assessment, thus the fits were suboptimal and alternative solutions were near optimal. Refitting the 2010 assessment is now more optimistic. Also, fitting the 2010 model to 2011 data was more optimistic. Thus, revisiting of key parameters and the inclusion of the latest year of data in the 2011 assessment appeared to be important. These issues are difficult to explore in the MFCL framework.

40. The SC **NOTED** that the WPTT reviewed several alternative model structures and parameter formulations for the model that were presented in the assessment. These included: the new longline model structure for Region 5; alternative Japanese CPUE indices; a single region model where all 5 Regions were collapsed into one; a Region 2 model estimated separately from other Regions; the 5 values of steepness and alternative tag mixing periods (1–4 quarters). Additionally, an attempt was made to estimate age-specific M's. In regards to the latter, this parameter was not well estimated and the WPTT adopted the low M profile as the most appropriate way to proceed.

41. The SC **NOTED** the large uncertainty in the assessment when considering the model outputs (biomass and recruitment trends, movements across areas). The surprisingly low level of natural mortality estimated from tag-recovery data has large impacts on the dynamics of the stock. Similarly, the longevity considered in the analysis (7 yrs) might be too low and should be set at a higher value. Finally, the model does not reflect any high fishing mortality rate when record catches of yellowfin tuna were taken between 2003 and 2006, suggesting that some processes might not be well captured by the current model.

42. The SC **NOTED** that some of the key biological parameters used in stock assessment (natural mortality, growth, movements) need further work from the IOTC tag-recovery dataset and **AGREED** that results be presented at the Tagging Symposium which will be held in Mauritius in October or November 2012.

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.

44. The SC **NOTED** 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.

Bigeye tuna

45. The SC **NOTED** the bigeye tuna stock was assessed using a single model in 2011 (ASPM). With respect to the modelling approach used in 2011, 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.

46. The SC **NOTED** that uncertainty in natural mortality was not considered, and **AGREED** that it was essential to include uncertainty in the steepness parameter as a minimum requirement for the provision of management advice.

47. The SC **NOTED** that 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 due to the expansion of artisanal fleets offshore in areas where bigeye tuna is recognised to be abundant.

48. The SC **NOTED** that the 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.

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.

50. The SC **REQUESTED** 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.

Other relevant papers

51. The SC **NOTED** paper IOTC–2011–SC14–46 which provided a comparison between yellowfin tuna stocks and 2011 stock assessment results for the Indian and Eastern Pacific oceans. Although many similarities exist in the biological characteristics of both stocks and the geographical size of the fisheries, the assessment produced by models of the same nature gives very diverging results. Some explanation might be related to environmental signals which differ from one ocean to another but some other reasons may also exist.

52. The SC **NOTED** the suggestion by the author that an ad hoc working party between IOTC and IATTC stock assessment experts be held, in order to clarify issues presented above, and **AGREED** that at present, an ad-hoc working group would not be desirable, but rather, for scientists to work collaboratively via other means (electronically) and for this matter to be revisited at the next SC meeting in 2012, following the Tagging Symposium tentatively scheduled for November 2012.

53. The SC **NOTED** paper IOTC–2011–SC14–INF07 which outlined some of the outcomes of the FAD symposium held in Tahiti, from 28 November to 2 December, 2011.

7.4 Report of the Seventh Session of the Working Party on Ecosystems and Bycatch

54. The SC **NOTED** the report of the Seventh Session of the Working Party on Ecosystems and Bycatch (IOTC–2011–WPEB07–R), including the consolidated list of recommendations provided as an appendix to the report. The SC expressed its satisfaction on improved attendance and participation by national scientists working on ecosystem and bycatch topics (49 participants in 2011 compared to 37 in 2010).

Definitions of scientific terms

55. The SC **CONSIDERED** the need to develop and agree to a set of definitions for the most commonly used scientific terms in IOTC Conservation and Management Measures (CMM) and **REQUESTED**

the IOTC Secretariat to develop definitions in this regard, and for these to be posted to the IOTC website for reference by those drafting CMM proposals for the consideration of the Commission. The SC indicated that it may wish to modify these incrementally in the future.

56. The SC **AGREED** that the IOTC currently utilises the following definition for bycatch: All species, other than the 16 species listed in Annex B of the IOTC Agreement, caught or interacted with by fisheries for tuna and tuna-like species in the IOTC area of competence.

Status of catch statistics

57. The SC **RECOMMENDED** that the Commission note the status of catch statistics for the main species of sharks, by major fisheries (gears), for the period 1950–2010, as provided in Appendix VI: Tables a–c. Although some CPCs have reported more detailed data on sharks in recent years, including time-area catches and effort, and length frequency data for the main commercial shark species, the SC expressed strong **CONCERN** that the information on retained catches and discards of sharks contained in the IOTC database remains very incomplete.

58. The SC **NOTED** that despite the adoption of IOTC Resolutions 05/05 and 08/01, recently superseded by Resolution 10/02, the levels of reporting of data on sharks and other bycatch species remains very poor and prevents useful analyses of that data.

59. Noting that despite the mandatory reporting requirements detailed in Resolutions 05/05, 08/04, 09/06, 10/02, 10/03, and 10/06, 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.

60. The SC **RECOMMENDED** that the current IOTC Resolution 08/04 concerning the recording of catch by longline fishing vessels in the IOTC area, Resolution 10/03 concerning the recording of catch by fishing vessels in the IOTC area and Resolution 10/02 mandatory statistical requirements for IOTC members and cooperating non-contracting parties be amended in order to include a clear list of shark and marine turtle species or group of species, that should be recorded and reported to the IOTC Secretariat as per the IOTC requirements for target species.

61. 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 organizations, 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 WPEB **RECOMMENDED** that the Scientific Committee considers presenting a proposal to the Commission for this activity, including a budget.

On Resolution 98/02 Data confidentiality policy and procedures

62. Noting that CPCs have begun to submit observer trip reports and observer data to the IOTC Secretariat, and that confidentially rules contained apply to these data (Cf. Resolution 11/04, para. 12), the SC **RECOMMENDED** that Resolution 98/02 be amended in order to clearly incorporate observer data in the data confidentiality policy of the IOTC.

Species identification cards – Sharks, seabirds and marine turtles

63. The SC **NOTED** that the IOTC Secretariat has finalised the IOTC identification cards for sharks, seabirds and marine turtles and **COMMENDED** the Secretariat for its work.

64. The SC **RECOMMENDED** that the Commission agree to allocate additional funds from the IOTC accumulated funds, or other sources, be allocated to print and distribute the identification cards for sharks, seabirds and marine turtles to developing coastal states.

Sharks – ERA

65. Noting the general lack of catch data on sharks, the SC strongly **RECOMMENDED** that an ERA is conducted for sharks caught in fisheries targeting tuna and tuna-like species in the Indian Ocean before the next session of the WPEB. In order to do so, the SC **RECOMMENDED** that the Commission allocate specific funds for such an analysis. Should a Fishery Officer be recruited at the IOTC Secretariat, he/she may be in a position to coordinate this task.

Sharks – Wire leaders/traces

66. 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.

Sharks – Resolution 05/05 concerning the conservation of sharks caught in association with fisheries managed by IOTC

Fin to body weight ratio

67. 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 – Resolution 10/02 *Mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC'S)*:

68. Noting that the collection and reporting of data on sharks as per the IOTC Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPCs)* is very poor at the moment, the SC **RECOMMENDED** that Resolution 10/02 is reinforced by including specific requirements in the provision of nominal catch data for a list of most commonly caught shark species (Table 3). The SC **NOTED** that nominal catch data can be derived from logbook data, observer data or port sampling scheme. Furthermore, the Resolution should be strengthened by amending the provision of catch-and-effort and size data to be applicable to sharks species as well as other bycatch, noting that these data can be derived from logbook or observer data.

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

Sharks – On Resolution 10/12 on the conservation of thresher sharks (family Alopiidae) caught in association with fisheries in the IOTC area of competence

69. Noting that Resolution 10/12 *on the conservation of thresher sharks (family Alopiidae) caught in association with fisheries in the IOTC area of competence* prohibits the retention of any part or whole carcass of thresher sharks and that the collection of biological samples on dead individuals would increase the scientific knowledge of these species, the SC **RECOMMENDED** that Resolution 10/12 be amended in order to allow observers to collect biological samples (vertebrae, tissues, reproductive tracts, stomachs) from thresher sharks that are dead at haulback.

Seabirds

70. The SC **AGREED** that the current area of application for seabird bycatch mitigation measures contained in Resolution 10/06, i.e. south of 25^0C, was supported by the available evidence and should not be revised at this point.

71. The SC **AGREED** that three measures ─ weighting of branchlines, night setting of longlines and use of bird scaring lines ─ are proven and recommended measures for use in pelagic longline gear, and that other measures, including the three which are currently included in Resolution 10/06 ─ blue-dyed squid bait, offal discharge control and use of a line shooting device ─ are not considered to be effective mitigation measures following ACAPs review of available mitigation measures for the following reasons:
    - Blue dyed squid bait has been insufficiently researched and cannot be recommended.
    - Line shooting device. There is no experimental evidence that line shooters reduce seabird bycatch in pelagic longline fisheries; therefore, they should not be considered a seabird bycatch mitigation option, although they will continue to be used on many vessels because they are considered to improve fishing efficiency.
    - Offal discharge control. Appropriate management of offal is encouraged as good operating practice but is not considered a primary mitigation measure in pelagic fisheries as there are much smaller quantities of fish waste derived from fishing operations, in direct contrast to the situation in demersal fisheries. The inclusion of offal management as a mitigation measure in Resolution 10/06 most likely has been taken from use of this measure in CCAMLR and other demersal longline fisheries, where it is much more important.

72. The SC **AGREED** that:
    - A combination of weighted branchlines, bird scaring lines and night setting are best practice mitigation in reducing bycatch of seabirds to the lowest possible level in pelagic longline fisheries. These measures should be applied in high risk areas within the IOTC area of competence.
    - Currently, no single mitigation measure can reliably prevent the incidental mortality of seabirds in most pelagic longline fisheries. The most effective approach is to use the measures described in combination. Other factors such as safety, practicality and the characteristics of the fishery should also be recognised when framing conservation measures.
    - The current recommended minimum standards for branchline weighting configurations are:
        i. Greater than 45 g weight attached within 1 m of the hook; or
        ii. Greater than 60 g weight attached within 3.5 m of the hook; or
        iii. Greater than 98 g weight attached within 4m of the hook.
    - Positioning weight farther than 4 m from the hook is not recommended.

73. The SC **NOTED** that for bird scaring lines (BSL), ACAP best practice advice recognises that vessel size is an important determinant in their practical use, with respect to the aerial extent that can be achieved, and the ability to deploy single or twin BSLs. For vessels that exceed 35 m in length, an aerial extent of 100 m and use of two BSLs is recommended; for smaller vessels an aerial extent of 75 m and use of a single BSL is recommended.

74. Taking into account the information presented at the WPEB (WPEB working papers IOTC–2011–WPEB07–43, IOTC–2011–WPEB07–44 and IOTC–2011–WPEB07–54) and to the SC, the SC **AGREED** that a combination of weighted branchlines, bird scaring lines and night setting is best practice mitigation in reducing bycatch of seabirds to the lowest possible level in pelagic longline fisheries. The SC **AGREED** that Resolution 10/06 be amended to reflect this advice, and to incorporate the technical specifications outlined in the paragraphs above (paras. 71 to 73).

75. The SC further **NOTED**, in agreement with the WPEB, that if this proposal was accepted, together with the proposal to remove blue-dyed squid bait, line shooters and offal discharge control from the existing measure, the ‘two column’ approach used in Resolution 10/06 would be abandoned in favour

of an approach that specifies the three measures to be applied in areas of seabird interaction risk (**Table 4**), of which two shall be implemented by the vessels operating south of 25°S.

Table 4. Seabird bycatch mitigation measures

Mitigation measure	Description
Night setting with minimum deck lighting	No setting between nautical dawn and before nautical dusk. Deck lighting to be kept to a minimum
Bird scaring lines (Tori lines)	Bird scaring lines shall be deployed before longline setting starts and for the entire setting operation to deter birds from approaching the branch line
Line weighting	Line weights to be deployed on the branch line prior to setting

76. The SC **AGREED** that at this stage, line weighting should be seen as an adaptive management response to the seabird bycatch problem. Continued refinement of line weighting configurations (mass, number and position of weights and materials) through controlled research and application in fisheries, is highly desirable to find configurations that are most safe, practical and effective. The regimes recommended above should be implemented in working fisheries, monitored through observer programmes, and reviewed and modified if found to be inadequate in reducing bycatch to acceptable levels.

77. The SC **AGREED** that the specifications for the design and deployment of bird scaring lines (tori lines) be amended in order to take into account different specifications depending on the size of the longline fishing vessel, as follows:

Bird-scaring line design

1. The bird-scaring line shall be a minimum aerial extent of 100 m in length for vessels that exceed 35 m in length and of 75 m in length for vessel less or equal to 35 m in length. If the bird-scaring line is less than 150 m in length, it will include an object towed at the seaward end to create tension to maximise aerial coverage. The section above water shall be a strong fine line of a conspicuous colour such as red or orange.

Deployment of bird scaring lines

1. The line shall be deployed before longlines enter into the water.
2. The vessels exceeding 35 m in length should deploy two lines with an aerial extent of 100 m minimum. The vessels that are less or equal to 35 m in length could deploy a single line with an aerial extent of 75 m minimum. To achieve this coverage the line shall be suspended from a point a minimum of 5 metres above the water at the stern on the windward side of the point where the branch line enters the water.

78. The SC further **NOTED** the benefits for the IOTC to harmonize its Conservation and Management Measure for seabirds with that from ICCAT (Supplementary recommendation by ICCAT on reducing incidental bycatch of seabirds in ICCAT longline fisheries, PA4-813A/2011), as there are a number of longline fishing vessels operating in both the Atlantic and Indian Ocean south of 25°S.

79. The SC **AGREED** that Resolution 10/06 be strengthened in order to make the reporting of seabird interactions mandatory for vessels fishing for species under the IOTC mandate.

80. The SC **AGREED** that any amendment to Resolution 10/06 should allow sufficient time for orderly implementation, to allow training and redevelopment of gears and operations.

Recommendations

81. The SC **RECOMMENDED** that the Commission consider revising Resolution 10/06 *On Reducing the Incidental Bycatch of Seabirds in Longline Fisheries*, noting the technical specifications and other considerations outlined and agreed to by the SC in paragraphs 71 to 73 of the report of the SC14.

82. The SC **AGREED** that seabird identification can be very difficult, even for trained scientific observers, and **RECOMMENDED** that observers take photographs of seabirds caught by fishing vessels and submit them to seabird experts, or to the IOTC Secretariat, for confirmation of identification.

83. As a matter of consistency and to increase the reporting of seabird interactions, the SC **RECOMMENDED** that the recording of interactions with seabirds (as a group) be included in the minimum requirements for logbooks for all fleets.

Marine turtles

84. The SC **NOTED** that the lack of data from CPCs on interactions and mortalities of marine turtles in the Indian Ocean is a significant concern, resulting in an inability of the WPEB to estimate levels of marine turtle bycatch.

85. Noting the general lack of data on incidental catch of marine turtles, the SC **RECOMMENDED** that an ERA be conducted for marine turtles caught in fisheries targeting tuna and tuna-like species in the Indian Ocean before the session of the WPEB where marine turtles will be a priority. In order to do so, the SC **RECOMMENDED** that the Commission allocate specific funds for such an analysis.

86. Noting that reporting of interactions with marine turtles is already mandatory through Resolution 09/06 which states "*CPCs shall collect (including through logbooks and observer programs) and provide to the Scientific Committee all data on their vessels' interactions with marine turtles in fisheries targeting the species covered by the IOTC Agreement"* (Res.09/06, para.2), and in order to increase the reporting of interactions, the SC **RECOMMENDED** that the recording of marine turtles caught as bycatch is included in the minimum requirements of logbooks or through observer programmes for all fleets fishing in the IOTC area.

87. The SC **NOTED** that there is an urgent need to quantify the effects of fisheries for tuna and tuna-like species in the Indian Ocean on non-target species, and it is clear that little progress on obtaining and reporting data on interactions with marine turtles has been made. This data is imperative to allow the IOTC to respond and manage the adverse effects on marine turtles, and other bycatch species.

88. The SC **RECOMMENDED** that current IOTC Resolution 09/06 *on Marine Turtles* be strengthened to ensure that CPCs report annually on the level of incidental catches of marine turtles by species.

89. Noting that paragraph 4 of Resolution 09/06 *on Marine Turtles* currently refers to "hard shelled turtles", which could potentially be read to exclude leatherback turtles, and noting the WPEB and the Scientific Committee's previous agreement (and recommendation to the Commission) that the resolution does apply to leatherback turtles in its entirety, the SC **RECOMMENDED** that the Commission revise Resolution 09/06 *on marine turtles* so that the term "hard-shelled" be deleted and replaced by "marine" to ensure application to all marine turtle species.

Redundant/obsolete Conservation and Management Measures

90. The SC **RECOMMENDED** that the Commission revoke the following Conservation and Management Measures, noting that they have either been superseded by a new Resolution adopted by the Commission, but were not specifically revoked (Recommendation 05/09 and 05/08), or the CMM was to carry out a specific scientific task which is now complete (Resolution 00/02):
    - Recommendation 05/09 *On incidental mortality of seabirds*
    - Recommendation 05/08 *On sea turtles and Resolution 09/06 On marine turtles*
    - Resolution 00/02 *On a survey of predation of longline caught fish*.

Other relevant papers

91. The SC **NOTED** paper IOTC–2011–SC15–45 which provided a review of IOTC discussions and recommendation for shark conservation in the Indian Ocean. In particular, the SC **NOTED** Australia's intention to present a proposal at the 16th Session of the Commission that would amend both Resolution 05/05 and Resolution 10/12. The proposal will seek to strengthen conservation and management arrangements for sharks caught in association with fisheries managed by the IOTC, in line with the discussion and recommendations of the WPEB and SC.

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

92. The SC **NOTED** the report of the First Session of the Working Party on Neritic Tunas (IOTC–2011–WPNT01–R), including the consolidated list of recommendations provided as an

appendix to the report. The meeting was attended by 28 participants, including 9 recipients of the Meeting Participation Fund. The SC **AGREED** that the outcomes of the meeting will form the basis of a productive and dynamic group of national scientists focused on neritic tuna and tuna-like stocks which are known to be critically important to many of the Indian Ocean coastal states. The SC expressed its satisfaction that the first meeting of this working party had finally been held after several failed attempts, and thanked all of those responsible for the organisation and successful delivery of the meeting outcomes.

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

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

7.6 Report of the Eighth Session of the Working Party on Data Collection and Statistics

95. The SC **NOTED** the report of the Eighth Session of the Working Party on Data Collection and Statistics (IOTC–2011–WPDCS08–R), including the consolidated list of recommendations provided as an appendix to the report.

IOTC Observer Trip Report Template

96. Noting that in 2010, the SC requested that the WPDCS discuss collection and reporting by observers of the data items below:
    - Information on the type and numbers of branch lines and wire leaders used (longline)
    - Information on the number and type of electronic equipment used on board
    - Area resolution (1 degree square at present)
    - Information on the state of the sea and weather conditions
    - Information on depredation
    - Information on lost fishing gear
    - Information on the number of hooks used by type and size.

97. and noting the difficulties that some observers may have in collecting and reporting of the data items that are requested in the observer trip report template (seven items listed in para. 96), and further noting that collecting this information may compromise access to other basic data on board longline vessels, the SC **RECOMMENDED** that the Commission allow for some flexibility in the collection and reporting of these data, until such a time where the CPCs concerned are in a position to collect and provide this information. Noting that the use of monofilament leaders may allow sharks to escape by biting through the line (removing the hook), in contrast to wire leaders which are not prone to 'bite-off', the SC **RECOMMENDED** that, where possible for fleets that have not already prohibited the use of wire leaders, the number of 'bite-off' per leader type is added to the longline hauling information recorded by the observer (currently in the IOTC observer form FORM 4-LL – Fishing Event Longline).

98. Noting that the current observer trip reporting template includes summaries of catch and bycatch by 1° square as required in Resolution 11/04, and that there is no summary of the effort exerted during the trip at the same scale, the SC **RECOMMENDED** that a new table is added to the observer trip reporting template that would ensure effort during the trip is recorded, as follows:

Year	Month	Square (1°x1°)	Effort deployed
			Longline: number of hooks deployed *Purse seine on free-schools: number of fishing sets* *Purse seine on associated schools: number of fishing sets, and number of new FADs deployed* *Gillnet: number of panels deployed* *Pole-and-line: number of fishing days* *Handline: number of fishing days* *Troll-line: number of fishing days*

99. The SC **RECOMMENDED** that the observer trip report is submitted in an electronic format, where possible, noting that the forms/tables in the observer trip report template are for illustrative purposes and that the complete information required could be reported in a different format.

100. Noting that at present, the observer reporting template includes obligatory reporting of information concerning waste management on board the fishing vessel (MARPOL), the SC **RECOMMENDED** that the reporting of this information be made optional, as most fishing vessels are already bound by this international regulation.

101. Noting that the reporting of transhipment events have to be reported through the IOTC Transhipment Programme, and that the IOTC Transhipment Programme applies only where transhipments involve a fishing vessel with LOA 24 m or greater and carrier vessels, pointing out that transhipments between fishing vessels, in particular, fresh-tuna longliners, are very common, the SC **AGREED** that in order to avoid duplication, observers under the IOTC Regional Observer Scheme can refrain from reporting Transhipments when those events are recorded by observers under the IOTC Transhipment Programme, **RECOMMENDING** that this is incorporated into the observer report.

102. The SC **AGREED** that from a technical point of view the existing standards for the collection and reporting of data by observers are appropriate, and **ENDORSED** the data requirements of the observer trip report template with the amendments recommended in paragraphs 97 to 101.

Review of IOTC Minimum Requirements for Operational Catch and Effort Data (Logbook Templates)

103. The SC **NOTED** the agreement reached by the WPDCS on revised logbook templates, which is discussed in detail under section 15 below.

Activities under the IOTC-OFCF Project

104. Acknowledging the value of projects such as the IOTC-OFCF in the region, the SC **NOTED** with thanks the support offered by the IOTC-OFCF project since 2002, and strongly **RECOMMENDED** that the activities carried out under the IOTC-OFCF project, including the IOTC-OFCF project itself, continue into the future.

Common topics among IOTC Working Party's

Meeting participation fund

105. The SC **NOTED** that the increased attendance by national scientists from developing CPCs to IOTC Working Party's in 2011 was partly due to the IOTC Meeting Participation Fund (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.

106. The SC **RECOMMENDED** that the Commission consider the problems encountered by potential MPF recipients in 2011. Specifically, there were a number of fully funded recipients who could not attend the various IOTC meetings at the last moment due to internal/domestic administrative processes (including but not limited to South Africa, I.R. Iran). In some cases this resulted in loss of the Commission's MPF funds due to late cancellations.

Dedicated workshop on CPUE standardisation

Noting the combined recommendations from the WPB, WPTmT and WPTT to hold a dedicated workshop on CPUE standardization in 2012, the SC **RECOMMENDED** that a dedicated, informal workshop on CPUE

standardization, including issues of interest for other IOTC species, should be carried out before the next round of stock assessments in 2013, and that 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 Japan, Republic of Korea and Taiwan,China, and supported by the IOTC Secretariat. The SC **NOTED** the CPUE workshop organised by ISSF and scheduled to be held late March 2012 in Hawai'i, USA, and urged national scientists working on CPUE standardisations to attend where possible.

Definition of overfishing

107. The SC **NOTED** the recommendations from the WPB, WPTmT and WPTT to:
    - **NOTE** the current definition of overfishing used by the IOTC, where fishing mortality is in excess of F_{MSY} ($F_{curr}/F_{MSY} > 1$) is considered overfishing;
    - **NOTE** that fishing mortality in excess of F_{MSY} is not always defined as overfishing (within tRFMOs) if the stock is well above the B_{MSY} level, although no specific threshold has been defined;
    - **CONSIDER** the current definition of overfishing ($F_{curr}/F_{MSY} >1$), and determine that if in situations where the biomass of a given stock is well above B_{MSY}, but $F_{curr}/F_{MSY} >1$, under what circumstances should a stock be classified as subject to overfishing;

108. The SC **AGREED** that the current definition of overfishing ($F_{curr}/F_{MSY} >1$) should be maintained, irrespective of the level of biomass of a particular stock. Any future modification to the definitions, including the possible introduction of alternative reference points and harvest controls rules, should be addressed through the IOTC Management Strategy Evaluation process, as agreed by the Commission in 2011.

Increased workload and staffing at the IOTC Secretariat

109. The SC, **NOTING:**
    - the recommendation of the first BJTWG meeting and the KOBE II and III meetings, that an additional staff member be hired at each tuna RFMO to deal with bycatch issues;
    - the increasing workload of the IOTC Secretariat regarding bycatch issues, including through the direct requests of the Commission;
    - that the workload of the WPEB has increased exponentially in recent years and yet there appears to be limited resources being given to issues of bycatch, despite the range of IOTC Conservation and Management Measures and other international agreements addressing bycatch in fisheries for tuna and tuna-like species;

    The SC strongly **RECOMMENDED** that an additional Fishery Officer (P3 or P4) be hired to handle a range of issues related to bycatch, including those from the Commission relating to ecosystems and bycatch issues.

110. Noting the need to provide advice to the Commission concerning the status of the most commonly caught species of sharks in the Indian Ocean, the SC **AGREED** on the need to explore the shark data presently available at the IOTC Secretariat, and to determine if that data can be used to derive total estimates of shark catches for each species.

Chairs and Vice-Chairs of the Working Party's

111. The SC **NOTED** and welcomed the re-elected and new Chairs and Vice-Chairs for each of the IOTC Working Party's, as listed in Appendix VII.

Recommendations from the Working Parties on data collection and reporting deficiencies

112. Noting the wide range of recommendations from the IOTC Working Party's in 2011, which included requests to address the deficiencies in data collection, monitoring and reporting by CPCs, as well as recommendations to improve research, the SC **ENDORSED** the consolidated list of recommendations of the WP's on these matters as those of the SC (provided at Appendix VIII). The SC requested that the IOTC Secretariat communicate these recommendations to relevant parties so that they may address these matters in 2012 and provide progress updates to the IOTC Working Party's at their next meetings.

Recommendations from the Working Parties to the IOTC Secretariat, Chairs and NGOs

113. The SC **ADOPTED** the recommendations from the WPs to the IOTC Secretariat, Chairs and other groups (Appendix IX).

8. UPDATE ON THE KOBE PROCESS

114. The SC **NOTED** paper IOTC–2011–SC14–06 which provided a report on the first meeting of the bycatch joint technical working group. The BJTWG developed recommendations on data collection and harmonization, sharks, collaboration and research, and a provisional list of research priorities was proposed covering bycatch mitigation measures, their impacts in a multi-taxa context, depredation, life history parameters, electronic monitoring systems and the development of Ecological Risk Assessments. The SC **NOTED** that the current activities undertaken by the WPEB cover most of the priority topics, and thus, **ENCOURAGED** that WPEB scientists get involved in the BJTWG workplan.

115. The SC **NOTED** paper IOTC–2011–SC14–07 which provided the recommendations arising from the KOBE III meeting. The SC expressed its disappointment at the very limited scope of the recommendations arising from the meeting, in comparison to the list of research priorities agreed by the Chairs of the tRFMO's scientific committees and presented at the meeting. The SC **NOTED** that the Kobe process continues, but allow some time for implementation of agreed recommendations before convening another joint meeting.

9. EXAMINATION OF THE EFFECT OF PIRACY ON FLEET OPERATIONS AND SUBSEQUENT CATCH AND EFFORT TRENDS

116. 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).*

117. 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.

118. 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 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. 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 vessels in 2011. Overall, the piracy situation did not the catch and the catch rates of the EU purse seine fleet.

119. The SC **NOTED** that piracy was also reported to be playing a role in the behaviour of some small-scale fishing vessels for which the number have declined in the region.

120. The SC **NOTED** that for skipjack tuna, the large declines of catches observed in the Maldives are unlikely to be linked to the impacts of piracy, but rather by other factors which require further investigation to be elucidated.

121. The SC **NOTED** that a workshop will be held in the Seychelles in early 2012 that will explore the impacts of piracy on fisheries at national, regional and international levels. The workshop is being convened by the governments of Seychelles and Norway and the South West Indian Ocean Fisheries Project, with support from the European Bureau for Conservation and Development. The SC

AGREED that it is preferable for consolidated information from the various working parties to be presented at the workshop, focusing on current knowledge of pirate impacts on fisheries managed by the IOTC.

122. In response to the request of the Commission (para. 40 of the S15 report), 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.

10. STATUS OF TUNA AND TUNA-LIKE RESOURCES IN THE INDIAN OCEAN

123. 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.

10.1 Tuna – Highly migratory species

124. 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 X
    - Bigeye tuna (*Thunnus obesus*) – Appendix XI
    - Skipjack tuna (*Katsuwonus pelamis*) – Appendix XII
    - Yellowfin tuna (*Thunnus albacares*) – Appendix XIII

125. The SC **AGREED** that the Chairs of the IOTC Working Party's should ensure that where possible, all KOBE plots should be presented in a standardized format for the consideration of the SC.

126. The SC **NOTED** paper IOTC–2011–SC14–12 which provided an overview of the biology, stock status and management of southern bluefin tuna (*Thunnus maccoyii*), and thanked CCSBT for providing it.

10.2 Tuna and mackerel – Neritic species

127. The SC **RECOMMENDED** that the Commission note the management advice developed for each neritic tuna species as provided in the Executive Summary for each species:
    - Longtail tuna (*Thunnus tonggol*) – Appendix XIV
    - Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix XV
    - Bullet tuna (*Auxis rochei*) – Appendix XVI
    - Frigate tuna (*Auxis thazard*) – Appendix XVII
    - Kawakawa (*Euthynnus affinis*) – Appendix XVIII
    - Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XIX

10.3 Billfish

128. 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 XX
    - Black marlin (*Makaira indica*) – Appendix XXI
    - Indo-Pacific blue marlin (*Makaira mazara*) – Appendix XXII
    - Striped marlin (*Tetrapturus audax*) – Appendix XXIII
    - Indo-Pacific sailfish (*Istiophorus platypterus*) – Appendix XXIV

11. STATUS OF MARINE TURTLES, SEABIRDS AND SHARKS IN THE INDIAN OCEAN

11.1 Marine turtles

129. 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 XXV

11.2 Seabirds

130. 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 XXVI

11.3 Sharks

131. 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 XXVII
    - Oceanic whitetip sharks (*Carcharhinus longimanus*) – Appendix XXVIII
    - Scalloped hammerhead sharks (*Sphyrna lewini*) – Appendix XXIX
    - Shortfin mako sharks (*Isurus oxyrinchus*) – Appendix XXX
    - Silky sharks (*Carcharhinus falciformis*) – Appendix XXXI
    - Bigeye thresher sharks (*Alopias superciliosus*) – Appendix XXXII
    - Pelagic thresher sharks (*Alopias pelagicus*) – Appendix XXXIII

12. IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME

132. The SC **NOTED** paper IOTC–2011–SC14–34 which provided an update on the national implementation of the regional observer scheme by CPCs, noting that the IOTC Regional Observer Scheme (ROS) started on July 1st, 2010 (Resolution 10/04 – superseded by Resolution 11/04).

133. The SC **NOTED** the update on the implementation of the Regional Observer Scheme set out in Resolution 11/06 *on a Regional Observer Scheme* and **EXPRESSED** its concerns regarding the low level of implementation and 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 (8 CPCs provided a list of accredited observers and 11 reports were submitted from 4 CPCs).

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

135. The SC **NOTED** that the implementation of the ROS is not a simple task and CPCs should continue to work towards full implementation of the scheme as prescribed in Resolution 11/04. Difficulties experienced in the training of observers and deployment, would benefit from collaborative arrangements among CPCs.

136. The SC **NOTED** the work being undertaken by the SWIOFP to accredit observers in the region (40 observers trained so far) and the development of a database for observer data. SWIOFP indicated that it has also been proving field sampling equipment for CPCs in the region to carry out the necessary observer tasks onboard vessels.

137. The SC **NOTED** the indication by some CPCs present at the SC14 meeting (Rep. of Korea, Thailand, Mauritius), that they do have the necessary information available but due to domestic administrative difficulties, the information has not yet been provided to the IOTC Secretariat. The SC **NOTED** the commitment by these CPCs to provide the information early in 2012.

138. The SC **AGREED** that such a low level of implementation and reporting is detrimental to its work, in particular regarding the estimation of incidental catches of non-targeted species, as requested by the Commission and **RECOMMENDED** the Commission to consider how to address the lack of implementation of observer programmes by CPCs for their fleets and reporting to the IOTC Secretariat

as per the provision of Resolution 11/04 *on a Regional Observer Scheme*, noting the update provided in Appendix XXXIV

139. The SC **RECOGNISED** the difficulties that some CPCs have in developing and implementing a national observer programme, in particular due to the piracy activities in the western Indian Ocean, the lack of trained observers and the lack of resources and expertise in observer training and management of such programmes.

13. IMPLEMENTATION OF THE PRECAUTIONARY APPROACH AND MANAGEMENT STRATEGY EVALUATION

140. The SC **NOTED** that the Commission, at its 15th Session *endorsed the development of a Management Strategy Evaluation (MSE) in the framework of IOTC and **requests** that this process be continued in 2011 (para. 43 of the S15 report).*

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

142. The SC **NOTED** paper IOTC–2011–SC14–35 which provided a proposal for the implementation of the precautionary approach by the IOTC, responding to the recommendations from the Performance Review Panel, and in line with recommended best practices from international legal instruments and eco-certification guidelines.

143. The SC **NOTED** that the proposed implementation includes the formulation of interim or provisional target and reference points for the major tuna stocks. These provisional reference points will be replaced by updated reference points and harvest control rules, that will be recommended based on their performance in the management strategy evaluation process.

144. The SC **NOTED** that the proposal further includes provisions for the SC to be mandated to conduct a full management strategy evaluation and report on its results by the year 2014. The SC considered a workplan to advance this process through the Working Party on Methods, refocusing its efforts to give priority to the conduct of the evaluation, and taking advantage of existing national initiatives to develop the analytical tools needed.

145. The SC, with the exception of India, **SUPPORTED** the initiative to implement the precautionary approach as described, and supported the plan to advance the management strategy evaluation process as proposed.

146. The SC **NOTED** paper IOTC–2011–SC14–36 which provided a proposal for a Management Strategy Evaluation process for the IOTC.

147. The SC **NOTED** that the adoption of management plans requires careful and detailed work that attempts, to the best capacity of the IOTC scientific community, to acknowledge all sources of error and variability, explore possible measures robust to those uncertainties, and present this in a clear and direct manner to managers and stakeholders.

148. The SC **NOTED** that the use of Management Strategy Evaluation (MSE), also termed Management Procedure approach, was first proposed as a way of developing management plans for IOTC stocks in 2002. MSE has been widely used in the years since, in various stocks and management settings, from EU waters to Southern Bluefin Tuna, whaling, and for marine mammals.

149. The SC **NOTED** that:

- the impact on management of a MSE procedure is likely to depend on several factors. The political will to better manage the fisheries, and even the support of fishery stakeholders for doing so, is a necessary although not sufficient condition for achieving success. The first element in which stakeholder and manager input is required relates to the objectives for the fishery, both in terms of stock status and economic or yield expectations.
- deciding on precise objectives for management is an essential component for the development of HCRs. Discussion on this issue could be best carried out in some multi-lateral meeting, where scientists, managers, industry and other stakeholders,

can be introduced into the precise ways in which IOTC finally decides to conduct the development of management plans, feedback can be obtained on the issues of interest to various parties, and agreement could be attempted on the exact objectives that the plans should attempt to provide for.

- given the likely diversity of the audience, an extra effort needs to be made to make the presentation of model and results as clear and attractive as possible. The issue of communication of scientific results, always difficult, is likely to be of major impact for the acceptance of modelling exercise on great complexity.
- some kind of external review process is probably appropriate, both in terms of internal quality assurance, and for external accreditation of results and methods.

150. The SC **RECALLED** the necessity that all CPCs be fully participative in this process, but that training activities would be necessary especially on the quantitative aspect of the approach. Opportunities for funding such training should be sort and ISSF announced they could contribute to this kind of financial support.

151. The SC **ENDORSED** the roadmap presented for the implementation of MSE in the Indian Ocean in IOTC–2011–SC14–36 and **RECOMMENDED** the Commission agree to the organization of a joint meeting between managers, stakeholder and scientist during 2012 to begin discussions about the implementation of MSE in IOTC.

152. The SC **AGREED** that Dr. Iago Mosqueira (European Union) and Dr. Toshihide Kitakado (Japan) would act in the roles of co-ordinators for the MSE process until the Working Party on Methods can consider candidates for Chair and Vice-Chair at its meeting in 2012.

14. EVALUATION OF DATA COLLECTION AND REPORTING SYSTEMS

153. The SC **NOTED** paper IOTC–2011–SC14–38 which provided an evaluation of data collection and reporting systems for artisanal fisheries in the Indian Ocean.

154. 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.

155. 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.

156. 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.

157. Noting that in the case of purse seine fleets the catches recorded in the logbooks are corrected for species composition at the end of each quarter, the SC **RECOMMENDED** that CPCs having purse seine vessels 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.

158. The SC **NOTED** the comments from various participants who indicated that their reporting abilities are highly variable, from near real time to many months. It was agreed that data collection and reporting systems need to be continuously updated and improved.

15. DATA PROVISION NEEDS – BY GEAR

159. The SC **NOTED** that the Commission, at its 15th Session *requested that the Scientific Committee in its 2011 Session, to evaluate the data provision needs for longline, purse seine, gillnet and pole-and-line gear types, notably regarding information relating to the vessel characteristics and the definition of the pole-and-line 'fishing event'. The evaluation is requested in order to ensure that consistent and uniform information is collected to assist the IOTC to fulfil its mandate. The Scientific Committee should make appropriate recommendations to the 2012 Commission meeting* (para. 45 of the S15 report).

160. Noting the Commission's request to evaluate the data provision needs for longline, purse seine, gillnet and pole and line gear types, notably regarding information relating to the vessel characteristics and the definition of the pole and line 'fishing event', which was requested in order to ensure that consistent and uniform information is collected to assist the IOTC to fulfil its mandate, the SC **CONSIDERED** the recommendations issued by the WPDCS and WPEB in 2011, including a revised draft of minimum data requirements for trip and operational data, and bycatch species to be recorded, by gear, respectively. In addition, the SC considered a proposal from the WPDCS to incorporate requirements for two more gear types (trolling and handline) into the text of a revised proposal for a Resolution.

161. The SC **NOTED** the extended list of shark species (including rays) proposed by the WPEB for each gear, provided at Table 4 below for information, agreeing on the need to collect catch data for all the species proposed by the WPEB. However, the SC acknowledged the difficulties that some CPCs may have to add more shark species into their existing logbooks, as identification of some species may be difficult by the crew. In this regard, the SC **NOTED** that the IOTC Secretariat has put together identification cards for shark species, which will be available early in 2012 and will be forwarded to interested parties.

Table 4. Proposed list of shark species to be recorded in logbooks for all gears.

For longline:	**For gillnet:**
Blue Shark (*Prionace glauca*)	Blue Shark (*Prionace glauca*)
Mako Sharks (*Isurus* spp.)	Mako Sharks (*Isurus* spp.)
Porbeagle Shark (*Lamna nasus*)	Other requiem sharks (*Carcharhinus spp.*)
Other requiem sharks (*Carcharhinus spp.*)	Oceanic Whitetip Shark (*Carcharhinus longimanus*)
Oceanic Whitetip Shark (*Carcharhinus longimanus*)	Hammerhead Sharks (Sphyrnidae)
Hammerhead Sharks (Sphyrnidae)	Thresher Sharks (*Alopias* spp.)
Thresher Sharks (*Alopias* spp.)	Tiger shark (*Galeocerdo cuvier)*
Other sharks	Mantas and devils rays (Mobulidae)
	Other sharks
	Other rays

For purse seine:

Oceanic Whitetip Shark (*Carcharhinus longimanus*)
Silky sharks (*Carcharhinus falciformis*)
Mantas and devils rays (Mobulidae)
Other sharks
Other rays

162. Noting the concerns expressed by some CPCs, the SC **AGREED** that the logbook recording requirements for shark species are not extended at this time. The SC further **AGREED** that recording of shark species other than those in recommendation 11/06, as proposed by the WPEB, be made optional, but to be collected through observer programmes.

163. The SC **RECOMMENDED** that the minimum recording requirements for handline and trolling provided in Appendix XXXV be incorporated into the revised proposal for minimum recording requirements as detailed in para. 162.

164. The SC **RECOMMENDED** that IOTC Recommendation 11/06 be modified to include the elements as provided in Appendix XXXV, noting that the lists of species to be recorded, as detailed in section 2.3 of Annex II, and makes collection of these data mandatory.

16. OUTLOOK ON TIME-AREA CLOSURES

165. The SC **NOTED** that the Commission, at its 15th Session *reiterated the request that the Scientific Committee should evaluate the time-area closure established in Resolution 10/01 for the conservation and management of tropical tunas stocks in the IOTC area of competence, in terms of its impacts on the stocks of tuna and tuna-like species* (para. 47 of the S15 report).

166. 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.

167. Noting the lack of research examining time-area closures in the Indian Ocean by the WPTT in 2011, as well as the slow progress made in addressing the Commission request, the SC **RECOMMENDED** 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.

168. Seychelles presented information to the SC on the planned activities in the Indian Ocean by the Convention on Biological Diversity (CBD) with respect to Ecologically or Biologically Significant marine Areas (EBSAs), noting that this CBD process links to the FAO recommendations for incorporating vulnerable marine ecosystems (VMEs) in fisheries management. The SC recognised the importance of active contribution by IOTC and its member scientists to this process.

Evaluation of the IOTC time-area closure

169. The SC **NOTED** paper IOTC–2011–SC14–39 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.

170. 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.

171. 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.

172. 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.

MPA effects on yellowfin tuna

173. The SC **NOTED** paper IOTC–2011–SC14–40 which provided a preliminary investigation into the effects of the network of Indian Ocean MPAs on yellowfin tuna, *Thunnus albacares*, with particular emphasis on the IOTC closed area.

174. 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

175. 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.

176. 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).

17. ALTERNATIVE MANAGEMENT MEASURES; IMPACTS OF THE PURSE-SEINE FISHERY; JUVENILE TUNA CATCHES

177. The SC **NOTED** that the Commission, at its 15th Session *requested that the Scientific Committee provide clear advice outlining alternative management approaches which would provide effective protection of a possible southwest Indian Ocean swordfish stock* (para. 46 of the S15 report).

178. The SC **NOTED** that advice provided by the WPB that the stock structure of the Indian Ocean swordfish resource is 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.

179. The SC **RECOMMENDED** that the Commission note that:
    - most of the evidence provided to date has 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}), however recent declines in catch and effort have brought fishing mortality rates to levels below F_{MSY}. There is a risk of reversing the rebuilding trend if there is any increase in catch in this region. Thus, catches in the southwest Indian Ocean should be maintained at levels at or below those observed in 2009 (6,600 t), until there is clear evidence of recovery and biomass exceeds B_{MSY}.
    - the southwest region should continue to be analysed as a special resource, as it appears to be highly depleted compared to the Indian Ocean as a whole. However the difference in depletion does not appear to be as extreme as analyses in previous years have suggested. A review of the spatial assumptions should be conducted following the final results of the Indian Ocean Swordfish Stock Structure (IOSSS) project and the analysis of tagging experiments undertaken by SWIOFP.
    - that there is no current need to apply additional management measures to the southwest Indian Ocean, although the resource in the area should be carefully monitored.that the Working Party on Methods will be progressing Management Strategy Evaluation over the coming year that will aid in addressing the Commission's request, which was considered as the appropriate mechanism for this work.

180. The SC **NOTED** that the Commission, at its 15th Session *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).

181. 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 5 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 **AGREED** that the WPTT should provide the SC with multi-gear yield-per-recruit estimates for all stocks assessed in 2012, as this is another useful indicator of the impact of each gear on potential yields.

Table 5. 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

182. 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 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.

183. 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. 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.

184. 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.

185. The SC **RECOMMENDS** that the Commission note the research of the Western and Central Pacific Fisheries Commission, which has shown that the use of FAD closures can be very effective in reducing the take of juvenile yellowfin and bigeye tuna.

186. The SC **AGREED** that the SC Chair present the response to the Commission on this request, at the Technical Committee on Allocation Criteria, to be held in the Maldives from 4–6 March, 2012.

18. PROGRESS IN IMPLEMENTATION OF THE RECOMMENDATIONS OF THE PERFORMANCE REVIEW PANEL

187. The SC **NOTED** paper IOTC–2011–SC14–37 which provided an update on progress regarding resolution 09/01 – on the performance review follow–up. The SC **NOTED** that the Commission, at its 15th Session *agreed that the Secretariat and Chair of each of the three Committee's should further develop the status table by including a work plan with proposed timelines and priorities. The Secretariat was tasked with ensuring the revised table is provided to the respective Committee's in advance of their next Sessions, in accordance with the rules of procedure* (para. 125 of the S15 report).

188. 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 XXXVI.

19. SCHEDULE AND PRIORITIES OF WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS FOR 2012 AND TENTATIVELY FOR 2013

189. The SC **NOTED** paper IOTC–2011–SC14–42 which outlined the proposed schedule and list of priorities for IOTC Working Party and Scientific Committee meetings in 2012 and tentatively for 2013.

190. The SC **RECOMMENDED** that the Commission endorse the schedule of Working Party and Scientific Committee meetings for 2012, and tentatively for 2013 (Table 6).

Table 6. Schedule of Working Party and Scientific Committee meetings for 2012, and tentatively for 2013.

Meeting	2012		2013 (tentative)	
	Date	Location	Date	Location
Working Party on Temperate Tunas	3–5 July (3d)	TBD (China?)	Early Aug (3d)	TBD (ICCAT SAA)
Working Party on Ecosystems and Bycatch	17–19 Sept (3d)	Cape town, South Africa – TBD	16–18 Sept (5d)	Bali, Indonesia
Working Party on Billfish	11–15 Sept (5d)	Cape town, South Africa – TBD	10–14 Sept (5d)	Bali, Indonesia
Working Party on Methods	22–23 Oct (2d)	Port Louis, Mauritius	18–19 Oct (2d)	TBD
Working Party on Tropical Tunas	24–29 Oct (6d)	Port Louis, Mauritius	21–26 Oct (6d)	TBD
Working Party on Neritic Tunas	Pending (3d)	Penang, Malaysia	Pending (3d)	TBD
Working Party on Data Collection and Statistics	nil	nil	5–6 Dec	TBD
Scientific Committee	10–15 Dec (6d)	Victoria, Seychelles	9–14 Dec (6d)	TBD

191. The SC **NOTED** the proposed workplans and priorities of each of the Working Parties and **AGREED** to the following:

192. The SC **AGREED** that the SC Chair should develop a draft workplan for the IOTC Scientific Process prior to the SC each year, taking into account the research priorities identified by the Commission and the Working Party's, for the consideration and potential endorsement of the SC.

Working Party on Billfish (WPB) – Research Recommendations and Priorities

193. The SC **RECOMMENDED** that marlins and sailfish undergo CPUE analysis in 2012, with striped marlin taking priority over other species.

194. The SC **RECOMMENDED** that as a matter of priority, striped marlin be the subject of CPUE analysis in 2011, and that CPUE series be compared among fleets where possible.

195. The SC **AGREED** that there was no urgent need to carry out stock assessments for the swordfish resources in the Indian Ocean in 2012, and **RECOMMENDED** that efforts over the coming year be focused on the other billfish species, in particular on striped marlin.

196. The SC **RECOMMENDED** the following core areas as priorities for research over the coming year;

- Swordfish stock structure and migratory range – using genetics
- Swordfish stock structure and movement rates – using tagging techniques

- Billfish species growth rates
- Size data analyses
- Stock status indicators – exploration of indicators from available data
- CPUE standardization – swordfish, marlins and sailfish
- Stock assessment – Istiophorids
- Depredation – focus on the southwest

Working Party on Temperate Tunas (WPTmT) – Research Recommendations and Priorities

CPUE standardisation

197. The SC **AGREED** that there was an urgent need to investigate the CPUE issues as outlined in paragraph 61 and for this to be a high priority research activity for the albacore resource in the Indian Ocean in 2012.

Stock assessment

198. The SC **AGREED** that there was an urgent need to carry out revised stock assessments for the albacore resource in the Indian Ocean in 2012, and **RECOMMENDED** that the Commission consider approving funds for this purpose.

Stock structure

199. Noting that at present very little is known about the population structure and migratory range of albacore in the Indian Ocean, other than the possible connectivity with the southern Atlantic, the SC **RECOMMENDED** that a research project addressing the albacore stock structure, migratory range and movement rates in the Indian Ocean be considered at its 2012 annual meeting as this project is assigned a high priority.

Additional core topics for research

200. The SC **RECOMMENDED** that the following core topic areas as priorities for research over the coming year:
    - Size data analyses
    - Growth rates and ageing studies
    - Stock status indicators – exploration of indicators from available data
    - Collaborate with SPC-OFP to examine their current simulation approach to determine priority research areas.

Working Party on Tropical Tunas (WPTT) – Research Recommendations and Priorities

CPUE standardisation

201. Noting the importance of the various CPUE indices for stock assessment of the tuna tropical species, the SC **AGREED** that there was an urgent need to investigate the CPUE issues as outlined in sections 8–10, for bigeye tuna, skipjack tuna and yellowfin tuna, and for these to be a high priority research activity for the tropical tuna resources in the Indian Ocean in 2012.

202. The SC **NOTED** that there are various levels of needs for each fleet. For example, while for pole-and-line and purse seine fleets, the data and methodological approach are considered key issues to be resolved before any attempt of CPUE standardization; longline CPUE standardization constraints (differences between fleets, spatial structure, materials, etc.) can be resolved and reviewed in a dedicated workshop with the presence of other tRFMO CPUE experts.

203. The SC **RECOMMENDED** that the Secretariat and Maldivian scientists continue the joint effort to standardize the Maldivian pole-and-line CPUE in preparation for assessment in 2012.

204. The SC **RECOMMENDED** that standardization of purse seine CPUE be made where possible using the operational data on the fishery, and that participants working on CPUE for the main fleets, attend the CPUE standardization workshop being organized by ISSF in Honolulu, Hawaii in 2012.

Stock assessment

205. Noting the difficulty of carrying out stock assessments for three tropical tuna species in a single year, the SC **RECOMMENDED** to a revised assessment schedule on a two- or three-year cycle for the three tropical tuna species as outlined in Table 7. Following the uncertainty remaining in the yellowfin tuna assessment the SC **AGREED** that priories for stock assessments in 2012 would be yellowfin tuna (Multifan-CL and SS3, Yield per recruit and possibly others) with an update of fishery indicators for the other two species.

Table 7. New schedule proposed for tropical tuna species stock assessment to be recommended to the SC:

Species/Assessment year	2012	2013	2014	2015	2016	2017
Yellowfin tuna	Full	Update	Update	Full	Update	Update
Skipjack tuna	Update	Full	Update	Update	Full	Update
Bigeye tuna	Update	Update	Full	Update	Update	Full

Note: the schedule may be change depending on the situation of the stock from various sources such as fishery indicators, Commission requests, etc.

Additional topics for research

206. The SC **RECOMMENDED** the following core topic areas as priorities for research over the coming year in order of priority:
    - An update of the Brownie-Peterson method for the 3 tropical tuna species (possible issue for the 2012 IO Tuna Tagging Symposium).
    - An update YFT growth curve (work in progress to be presented to 2012 Tuna Tagging Symposium).

Working Party on Ecosystems and Bycatch (WPEB) – Research Recommendations and Priorities

207. The SC **RECOMMENDED** that marlins and sailfish undergo CPUE analysis in 2012, with striped marlin taking priority over other species.

208. The SC **AGREED** that sharks should be the priority for the next meeting of the WPEB in 2012, and seabirds, marine turtle, marine mammals and other bycatch should be reassessed as priorities at the next session of the SC. Thus, the SC **RECOMMENDED** the following core topic areas as priorities for research over the coming year.
    - ***Ecological Risk Assessment***
        i. All sharks
    - ***CPUE analyses***
        i. Oceanic whitetip shark
        ii. Other sharks
    - ***Stock status analyses***
        i. Oceanic whitetip shark
        ii. Other sharks
    - ***Capacity building***
        i. Scientific assistance to CPCs and specific fleets considered to have the highest risk to bycatch species (e.g. gillnet fleets and longline fleets).

Working Party on Neritic Tunas (WPNT) – Research Recommendations and Priorities

Stock structure

209. Noting that at present very little is known about the population structure and migratory range of most neritic tunas in the Indian Ocean, the SC **RECOMMENDED** a research plan that includes two separate research lines; i) genetic research to determine the connectivity of neritic tunas throughout their distributions, and ii) tagging research to better understand the movement dynamics, possible

spawning locations, and post-release mortality of neritic tunas from various fisheries in the Indian Ocean. These should be considered high priority research projects for 2012 and 2013.

Biological information

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

CPUE standardisation

211. The SC **AGREED** that there was an urgent need to develop standardised CPUE series for each neritic tuna species for the Indian Ocean as a whole or by sub-region as appropriate, once stock structure and management units have been determined.

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

213. The SC **ENCOURAGED** CPCs catching neritic tunas to participate in the CPUE standardisation workshop that will be organized by the IOTC Secretariat in 2013.

Stock assessment

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

Requests from the Commission

215. Noting that each year the Commission makes a number of requests to the SC without clearly identifying the task to be undertaken, its priority against other tasks previously or simultaneously assigned to the SC and without assigning a budget to fund the request made, the SC **RECOMMENDED** that these matters be addressed by the Commission at its next session.

20. OTHER BUSINESS

20.1 Rules for the appointment of an invited expert

216. The SC **NOTED** paper IOTC–2011–SC14–43 which provided a proposed set of rules for the appointment of invited experts to attend IOTC Working Party meetings. The SC **AGREED** to a revised set of "*Rules for the appointment of an Invited Expert*" as provided at Appendix XXVII.

20.2 Guidelines for the appointment of a consultant

217. The SC did not add to the previously agreed positions at SC13 and WPTT13.

20.3 Peer review process for IOTC stock assessments

218. The SC **NOTED** paper IOTC–2011–SC14–44 which provided an overview of how peer review of how other tRFMO's undertake peer review of their stock assessments. The SC **AGREED** that at this time it did not feel that there was a need to undertake a peer review of IOTC stock assessments and deferred this discussion to its next meeting in 2013.

20.4 IOTC Regional Tuna Tagging Programme – Tagging Symposium

219. The SC **NOTED** the development on the International Tagging Symposium, funded by the EU (300,000€), the IOTC (50,000€) and the IRD (25,000€), that will be organized in Mauritius in November 2012. Part of the funds will be used to undertake analyses of the large datasets from the Indian Ocean Tuna Tagging Programme (IOTTP), in particular from the Regional Tuna Tagging Programme in the Indian Ocean (RTTP-IO), during which more than 200,000 tropical tunas were tagged and released, and more than 31,000 were recaptured and reported. These studies will include analyses of the growth of the three tropical tuna species (based on the tagging data and otolith readings), updates of the estimation of the reporting and shedding rates, estimation of exploitation rates and natural mortalities and the improved use of tagging data in the Indian Ocean stock assessments for tuna and tuna-like species.

220. The SC **RECALLED** that the IOTTP and its main phase, the RTTP-IO, were a great success, tagging large numbers of yellowfin tuna, bigeye tuna and skipjack tuna. However, much of the data collected remains largely under-analysed and that this symposium will be the perfect opportunity i) to undertake these essentials analyses and ii) to present the results of the IOTTP to all interested stakeholders in the region.

20.5 Translation of SC documents into English and French

221. The SC **AGREED** that documents should continue to be provided in both English and French for SC meetings.

21. ELECTION OF A CHAIRPERSON AND VICE-CHAIRPERSON FOR THE NEXT BIENNIUM

222. The SC participants were unanimous in **THANKING** the outgoing Chair Dr. Francis Marsac for his outstanding Chairpersonship over the past six years, including his dedication to the IOTC scientific process. It was noted that he has tirelessly attended most of the working party meetings over the five year period and has contributed greatly to almost the full range of activities undertaken by the IOTC.

223. Noting the rules of procedure of the IOTC: Rule X.6: The Scientific Committee shall elect, preferably by consensus, a Chairperson and a Vice-Chairperson from among its members for two years, the SC **CALLED** for nominations for the newly vacated positions of Chair and Vice-Chair for the next biennium. Dr. Tom Nishida (Japan) was nominated and elected as Chair, and Mr. Jan Robinson (Seychelles) was nominated and elected as Vice-Chair of the SC for the next biennium, following a vote by the 13 CPCs present.

224. The SC **RECOMMENDED** that the Commission note the new Chair, Dr. Tom Nishida (Japan) and Vice-Chair, Mr. Jan Robinson (Seychelles), of the SC for the next biennium, as well as the Chairs and Vice-Chairs of each of the Working Party's as provided in Appendix VII

22. REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE FOURTEENTH SESSION OF THE SCIENTIFIC COMMITTEE

225. The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC14, provided at Appendix XXXVIII.

226. The report of the Fourteenth Session of the Scientific Committee (IOTC–2011–SC14–R) was **ADOPTED** on 17 December 2011.

APPENDIX I
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Thanks to the support team from the Seychelles Fishing Authority
Slim Dogley

APPENDIX II
AGENDA FOR THE FOURTEENTH SESSION OF THE SCIENTIFIC COMMITTEE

Date: 12–17 December, 2011
Location: International Conference Centre, Victoria
Mahé, Seychelles
Time: 09:00 – 17:00 daily
Chair: Dr. Francis Marsac

1. **OPENING OF THE SESSION** (Chair)
2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Chair)
3. **ADMISSION OF OBSERVERS** (Chair)
4. **ACTIVITIES OF THE COMMISSION** (Secretariat)
5. **ACTIVITES OF THE IOTC SECRETARIAT IN 2011** (Secretariat)
6. **NATIONAL REPORTS FROM CPCs** (CPCs)
7. **REPORTS OF THE 2011 IOTC WORKING PARTY MEETINGS**
   - 7.1. IOTC–2011–WPB09–R: Report of the Ninth Session of the Working Party on Billfish
   - 7.2. IOTC–2011–WPTmT03–R: Report of the Third Session of the Working Party on Temperate Tunas
   - 7.3. IOTC–2011–WPTT13–R: Report of the Thirteenth Session of the Working Party on Tropical Tunas
   - 7.4. IOTC–2011–WPEB07–R: Report of the Seventh Session of the Working Party on Ecosystems and Bycatch
   - 7.5. IOTC–2011–WPNT01–R: Report of the First Session of the Working Party on Neritic Tunas
   - 7.6. IOTC–2011–WPDCS08–R: Report of the Eighth Session of the Working Party on Data Collection and Statistics
8. **UPDATE ON THE KOBE PROCESS** (Chair)
9. **EXAMINATION OF THE EFFECTS OF PIRACY ON FLEET OPERATIONS AND SUBSEQUENT CATCH AND EFFORT TRENDS** (Chair)
10. **STATUS OF TUNA AND TUNA-LIKE RESOURCES IN THE INDIAN OCEAN** (Chair)
    - 10.1 Tuna – Highly migratory species
    - 10.2 Tuna and mackerel – Neritic species
    - 10.3 Billfish
11. **STATUS OF MARINE TURTLES, SEABIRDS AND SHARKS IN THE INDIAN OCEAN** (Chair)
    - 11.1 Marine turtles
    - 11.2 Seabirds
    - 11.3 Sharks
12. **IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME** (Secretariat)
13. **IMPLEMENTATION OF THE PRECAUTIONARY APPROACH AND MANAGEMENT STRATEGY EVALUATION** (Chair & Secretariat)
14. **EVALUATION OF DATA COLLECTION AND REPORTING SYSTEMS** (Secretariat)
15. **DATA PROVISION NEEDS – BY GEAR** (Chair WPDCS)
16. **OUTLOOK ON TIME-AREA CLOSURES** (Chair)
17. **ALTERNATIVE MANAGEMENT MEASURES; IMPACTS OF THE PURSE SEINE FISHERY; JUVENILE TUNA CATCHES** (Chair)
18. **PROGRESS IN IMPLEMENTATION OF THE RECOMMENDATIONS OF THE PERFORMANCE REVIEW PANEL** (Secretariat)

19. SCHEDULE AND PRIORITIES OF WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS FOR 2012 AND TENTATIVELY FOR 2013 (Secretariat)

20. OTHER BUSINESS (Chair)

20.1 Rules for the appointment of an invited expert

20.2 Guidelines for the appointment of a consultant

20.3 Peer review process for IOTC stock assessments

20.4 IOTC Regional Tuna Tagging Programme – Tagging Symposium

20.5 Translation of SC documents into English and French

21. ELECTION OF A CHAIRPERSON AND VICE-CHAIRPERSON FOR THE NEXT BIENNIUM (Chair & Secretariat)

22. REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE FOURTEENTH SESSION OF THE SCIENTIFIC COMMITTEE (Chair)

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC–2011–SC14–01a	Draft agenda of the Fourteenth Session of the Scientific Committee	✓ (19 August)
IOTC–2011–SC14–01b	Draft annotated agenda of the Fourteenth Session of the Scientific Committee	✓ (12 November)
IOTC–2011–SC14–02	Draft list of documents	✓ (12 November)
IOTC–2011–SC14–03	Outcomes of the Fifteenth Session of the Commission	✓ (11 August)
IOTC–2011–SC14–04	Previous decisions of the Commission	✓ (7 November)
IOTC–2011–SC14–05	Report of the secretariat – Activities in support of the IOTC science process in 2011	✓ (24 November)
IOTC–2011–SC14–06	Report of the First Meeting of the Bycatch Joint Technical Working Group	✓ (22 August)
IOTC–2011–SC14–07	Recommendations arising from the KOBE III meeting	✓ (12 August)
IOTC–2011–SC14–08	Status of the albacore resource	✓ (8 November)
IOTC–2011–SC14–09	Status of the bigeye tuna resource	✓ (23 November)
IOTC–2011–SC14–10	Status of the skipjack tuna resource	✓ (22 November)
IOTC–2011–SC14–11	Status of the yellowfin tuna resource	✓ (23 November)
IOTC–2011–SC14–12	Status and management of southern bluefin tuna (from CCSBT)	✓ (21 November)
IOTC–2011–SC14–13	Status of the bullet tuna resource	✓ (23 November)
IOTC–2011–SC14–14	Status of the frigate tuna resource	✓ (23 November)
IOTC–2011–SC14–15	Status of the longtail tuna resource	✓ (23 November)
IOTC–2011–SC14–16	Status of the Indo-Pacific king mackerel resource	✓ (23 November)
IOTC–2011–SC14–17	Status of the kawakawa resource	✓ (23 November)
IOTC–2011–SC14–18	Status of the narrow-barred Spanish mackerel resource	✓ (23 November)
IOTC–2011–SC14–19	Status of the swordfish resource	✓ (17 November)
IOTC–2011–SC14–20	Status of the black marlin resource	✓ (17 November)
IOTC–2011–SC14–21	Status of the Indo-Pacific blue marlin resource	✓ (17 November)
IOTC–2011–SC14–22	Status of the striped marlin resource	✓ (17 November)
IOTC–2011–SC14–23	Status of the Indo-Pacific sailfish resource	✓ (17 November)
IOTC–2011–SC14–24	Status of marine turtles	✓ (24 November)
IOTC–2011–SC14–25	Status of seabirds	✓ (25 November)
IOTC–2011–SC14–26	Status of blue sharks	✓ (25 November)
IOTC–2011–SC14–27	Status of silky sharks	✓ (25 November)
IOTC–2011–SC14–28	Status of oceanic whitetip sharks	✓ (25 November)
IOTC–2011–SC14–29	Status of scalloped hammerhead sharks	✓ (25 November)
IOTC–2011–SC14–30	Status of shortfin mako sharks	✓ (25 November)
IOTC–2011–SC14–31	Status of bigeye thresher sharks	✓ (25 November)
IOTC–2011–SC14–32	Status of pelagic thresher sharks	✓ (25 November)
IOTC–2011–SC14–33	Status of development and implementation of National Plans Of Action for seabirds and sharks (Secretariat)	✓ (7 November)
IOTC–2011–SC14–34	National Implementation of the regional observer scheme by CPCs (Secretariat)	✓ (23 November)
IOTC–2011–SC14–35	On the implementation of the precautionary approach (Secretariat)	✓ (25 November)
IOTC–2011–SC14–36	Development of a Management Strategy Evaluation process for the IOTC (SC Chair, in the absence of a Chair WPM)	✓ (30 November)
IOTC–2011–SC14–37	Update on progress regarding Resolution 09/01 – on the performance review follow–up (Secretariat and Chair)	✓ (12 August)

Document	Title	Availability
IOTC–2011–SC14–38	Evaluating the ability of IOTC CPCs and other fishing parties in the Indian Ocean to produce close-to-real time estimates of catches of yellowfin tuna and bigeye tuna (Secretariat)	✓ (28 November)
IOTC–2011–SC14–39	Evaluation of current and alternative time/area closures by catch reductions scenarios (H. Murua, M. Herrera, A. Fonteneau and F. Marsac)	✓ (2 December)
IOTC–2011–SC14–40	A preliminary investigation into the effects of Indian Ocean MPAs on yellowfin tuna, *Thunnus albacares*, with particular emphasis on the IOTC closed area (S. Martin, C. Mees, C. Edwards, and L. Nelson)	✓ (25 November)
IOTC–2011–SC14–41	A preliminary investigation into the potential effects of limiting size at first capture of yellowfin tuna, *Thunnus albacares*, in the Indian Ocean (S. Martin , C. Edwards and C. Mees)	WITHDRAWN
IOTC–2011–SC14–42	Proposed schedule and priorities of Working Party and Scientific Committee meetings for 2012 and 2013 (Secretariat)	✓ (25 November)
IOTC–2011–SC14–43	Rules for the appointment of an invited expert (Chair SC and Secretariat)	✓ (25 November)
IOTC–2011–SC14–44	Peer review of IOTC stock assessments (Secretariat)	✓ (25 November)
IOTC–2011–SC14–45	Review of IOTC discussions and recommendations for shark conservation in the Indian Ocean (Australia)	✓ (17 November)
IOTC–2011–SC14–46	A comparison between stocks and between 2011 stock assessment results of yellowfin in the Indian and Eastern Pacific oceans (European Union)	✓ (19 November)
Working Party Reports		
IOTC–2011–WPB09–R	Report of the Ninth Session of the Working Party on Billfish	✓ (2 August)
IOTC–2011–WPTmT03–R	Report of the Third Session of the Working Party on Temperate Tunas	✓ (29 September)
IOTC–2011–WPTT13–R	Report of the Thirteenth Session of the Working Party on Tropical Tunas	✓ (9 November)
IOTC–2011–WPEB07–R	Report of the Seventh Session of the Working Party on Ecosystems and Bycatch	✓ (7 November)
IOTC–2011–WPNT01–R	Report of the First Session of the Working Party on Neritic Tunas	✓ (18 November)
IOTC–2011–WPDCS08–R	Report of the Eighth Session of the Working Party on Data Collection and Statistics	✓ (10December)
National Reports – Members		
IOTC–2011–SC14–NR01	Australia	✓ (10 November)
IOTC–2011–SC14–NR02	Belize	✓ (26 October)
IOTC–2011–SC14–NR03 Rev_1	China	✓ (25 November) ✓ (16 December)
IOTC–2011–SC14–NR04 Rev_1	Comoros	✓ (25 November) ✓ (4 December)
IOTC–2011–SC14–NR05	Eritrea	Not provided
IOTC–2011–SC14–NR06	European Union	✓ (2 December)
IOTC–2011–SC14–NR07	France	✓ (9 December)
IOTC–2011–SC14–NR08	Guinea	Not provided
IOTC–2011–SC14–NR09	India	✓ (25 November)
IOTC–2011–SC14–NR10	Indonesia	✓ (10 December)
IOTC–2011–SC14–NR11	Iran, Islamic Republic of	✓ (26 November)
IOTC–2011–SC14–NR12 Rev_1	Japan	✓ (30 November) ✓ (4 December)
IOTC–2011–SC14–NR13	Kenya	✓ (25 November)

Document	Title	Availability
IOTC–2011–SC14–NR14	Korea, Republic of	✓ (26 November)
IOTC–2011–SC14–NR15	Madagascar	✓ (26 November)
IOTC–2011–SC14–NR16	Malaysia	✓ (28 November)
IOTC–2011–SC14–NR17	Maldives, Republic of	✓ (9 December)
IOTC–2011–SC14–NR18	Mauritius	✓ (3 December)
IOTC–2011–SC14–NR19	Oman, Sultanate of	Not provided
IOTC–2011–SC14–NR20	Pakistan	Not provided
IOTC–2011–SC14–NR21	Philippines	Not provided
IOTC–2011–SC14–NR22	Seychelles, Republic of	✓ (30 November)
IOTC–2011–SC14–NR23	Sierra Leone	Not provided
IOTC–2011–SC14–NR24	Sri Lanka	✓ (23 November)
IOTC–2011–SC14–NR25	Sudan	Not provided
IOTC–2011–SC14–NR26 Rev_1	Tanzania	✓ (29 November) ✓ (3 December)
IOTC–2011–SC14–NR27	Thailand	✓ (10 December)
IOTC–2011–SC14–NR28	United Kingdom	✓ (25 November)
IOTC–2011–SC14–NR29	Vanuatu	✓ (8 December)
National Reports – Cooperating non-Contracting Parties		
IOTC–2011–SC14–NR30	Mozambique	✓ (2 December)
IOTC–2011–SC14–NR31	Senegal	✓ (25 November)
IOTC–2011–SC14–NR32	South Africa, Republic of	✓ (29 November)
Information Papers		
IOTC–2011–SC14–INF01	Guidelines for the Presentation of Stock Assessment Models	✓ (3 Aug 2011)
IOTC–2011–SC14–INF02	Kobe Strategy Matrix (Secretariat)	✓ (25 November)
IOTC–2011–SC14–INF03	Protection of leatherback turtles (*Dermochelys coriacea*) from fishing impacts in the Indian Ocean (Australia)	✓ (17 November)
IOTC–2011–SC14–INF04 Rev_1	Report of the 10th OFCF tuna statistics and management training course (Japan)	✓ (4 December) ✓ (9 December)
IOTC–2011–SC14–INF05	Recording and reporting of catch and effort by fishing vessels in the IOTC area of competence (Australia)	✓(30 November)
IOTC–2011–SC14–INF06	Toward improvement of IUCN Red List (Japan)	✓ (4 December)
IOTC–2011–SC14–INF07	Summary of the 2nd symposium on "Tuna Fisheries and FAD" Tahiti, November 28th-December 2nd, 2011 (European Union)	✓ (10 December)
IOTC–2011–SC14–INF08	Effects of wire leader use and species-specific distributions on shark catch rates off the southeastern United States (W.B. Driggers, J.K. Carlson, E. Cortés & G.W Ingram)	✓ (10 December)

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) Convention Area. In 2010, four Australian longliners (three from the Western Tuna and Billfish Fishery and one from the Eastern Tuna and Billfish Fishery) operated in the IOTC Convention Area. Together they caught 18.7 t of albacore tuna (*Thunnus alalunga*), 65.3 t of bigeye tuna (*Thunnus obesus*), 21.9 t of yellowfin tuna (*Thunnus albacares*), 349.4 t of swordfish (*Xiphius gladius*) and 0.5 t of striped marlin (*Tetrapturus audax*). These catches represent less than 15 per cent of the peak catches taken by Australian vessels fishing in the IOTC Convention Area in 2001, for these five species combined. 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 4039 t in 2010. There was no purse seine catch of skipjack tuna (*Katsuwonus pelamis*) in 2010. The peak skipjack catch taken by Australian vessels fishing in the IOTC Convention Area was 1039 t in 2001. In 2010, approximately 5 t of shark was landed by the Australian longline fleet operating in the IOTC Convention Area and approximately 14 000 sharks were discarded/released.

Belize

Long line is the main fishing method used by Belize flagged vessels to target tuna and tuna like species in the Indian Ocean Tuna Commission (IOTC) Convention area. In 2010 our fleet consisted of 7 long line vessels. Together they caught 141.125 m/t of Albacore tuna (*Thunnus alalunga*), 14.362 m/t of yellowfin tuna (*Thunnus albacares*), 31.456 m/t of bigeye tuna (*Thunnus obesus*), 6.689 m/t of swordfish (*Xiphius gladius*), 1.663 m/t of black marlin (*Makaria indica*) and 6.317 of Wahoo (*Acanthocybium solandri*). There has been an 88% reductions in our overall catches from 1257 m/t in 2007 to 201 m/t in 2010. Albacore has always been the main target species for our vessels from 2007 to 2010 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 2010 have fluctuated over the years from 162 gt in 2007 to 241 gt in 2008, 88 gt in 2009 and 179 gt in 2010. There has also been a reduction in the number of vessels operating in this area from 10 vessels in 2007, 9 in 2008, 6 in 2009 and 7 in 2010.

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 32 in 2009 to 20 in 2010 due to piracy, with the main fishing area shifting to the central and eastern Indian Ocean (60 ºE ~ 85ºE , 5ºN ~20ºS). Chinese fishing fleet caught 1894 MT of main tunas (BET, YFT) in 2010 (39 % lower than the catch of 3114 MT in 2009). The bigeye tuna and yellowfin tuna catches both from deep freezing longliners and ice fresh longliners have been declined dramatically since 2006. There was a remarkable increase in albacore catch for deep freezing longliner since 2009 and for ice fresh longliners since 2008. The logbook and observer programs are going on for the Chinese longline fleets in the Indian Ocean, for which catch and effort data collection of bycatch species are being improved. The observer trip report for 2010 has been submitted to the secretariat.

Comoros

La pêche aux Comores est exclusivement artisanale, pratiquée sur des embarcations non ponté en

bois ou en fibre de verre, motorisé ou non motorisé d'une longueur de 3 m à 9 m. Elle exploite essentiellement les espèces pélagiques (*Thunnus albacares, Katsuwonus pelamis, Thunnus alalunga Istiophorus platypterus, Thunnus obesus, Euthynnus affinis*) et contribue pour sa totalité à l'alimentation de la population comorienne, tout en fournissant 55% de l'emploi total du secteur agricole soit environ 8000 pêcheurs. Selon le dernier statistique de 1994 la production était estimée 9822 tonnes Les techniques de pêche utilisées sont essentiellement la ligne de traine, la palangrotte et peu de filet pour les petits pélagiques. La duré de la marée est d'une journée à 7 jours. Pour de raison technique et financière depuis 1995 nous n'avons pas pu continuer la collecte et le traitement des données. Depuis février 2011 les Comores ont mis en place un système de collecte des données sur les lieux de débarquement Grace à l'appui technique et financière de la CTOI et l'OFCF.

Eritrea

Conformément à la Résolution 10/02 de la CTOI, les données scientifiques concernant toutes les flottes ont été soumises à la CTOI. La flotte de l'UE qui est composée des différentes flottes des Etats membres de l'Union européenne (Espagne, France, Portugal et Royaume Uni) a soumis les respectives données scientifiques en moments distincts. La globalité des données nécessaires pour les travaux du comité scientifique, conformément à la législation en vigueur, a été transmise à la CTOI. Pour des raisons liées à des réajustements internes de certains instituts de recherche et/ou des organismes responsables pour la gestion des données scientifiques quelques informations ont été transmises avec un certain retard et certaines données qui seront validées bientôt et disponibles pour mi 2012. Par ailleurs, pour des raisons de sécurité liées au développement des actes de piraterie dans l'ouest de l'Océan Indien, les programmes d'observation ont été affectés, et dans certains cas arrêtés, ce qui a forcement diminué la fréquence de données et affecté leur qualité. Toutefois, les scientifiques européens ayant participé aux groupes de travail de la CTOI ont également transmis, au fur et à mesure de leur participation, une partie des données nécessaires à l'accomplissement des travaux de ces groupes de travail. En outre, les experts communautaires participant au Comité scientifique pourront également apporter des informations ajournées ou complémentaires aux données déjà transmises. L'Union européenne poursuit ses efforts en vue de l'harmonisation de la gestion, de la collecte et de la transmission de données scientifiques.

European Union

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France (territories)

Les territoires français de l'Océan indien incluent Mayotte, collectivité d'outre-mer, et les îles Eparses qui sont rattachées administrativement aux Terres australes et antarctiques françaises (TAAF). La zone économique exclusive (ZEE) de Mayotte est depuis janvier 2010 un parc naturel

marin (PNM) doté d'un conseil de gestion. La ZEE des Glorieuses, qui fait partie des îles Eparses et jouxte la ZEE de Mayotte, va devenir un parc naturel marin probablement dès décembre 2012. Les captures totales dans l'océan Indien des senneurs français immatriculés à Mayotte se sont élevées en 2010 à 18 350 tonnes, soit un niveau sensiblement supérieur à celui de 2009 (13 700 t) du à une augmentation de l'effort de pêche. Le programme observateur mis en place en 2005 puis interrompu en 2009 pour raison de sécurité face au développement de la piraterie somalienne, a repris en 2011 en particulier sur les plus grands senneurs de la flottille, grâce à une collaboration mise en place avec les TAAF. La flotte de pêche côtière artisanale de Mayotte, composée d'un grand nombre de pirogues et de barques pratiquant essentiellement la pêche à la palangrotte, à la traîne et au filet, et de quatre petits palangriers (palangre pélagique dérivante) ciblant les thons et espadons essentiellement. Les captures réalisées par cette flotte dans les eaux de Mayotte sont en augmentation par rapport à 2009. Le dispositif de recherche thonière actuel de la France (IRD & Ifremer principalement) couvre des activités de type observatoire, l'étude des comportements migratoires des grands pélagiques, des études génétiques pour la délimitation des stocks, des études sur la biologie de la reproduction, la mise au point de mesures d'atténuations des prises accessoires et l'étude de la dynamique de l'écosystème tropical. La plupart des projets sont financés sur appel d'offre international, européen ou national. On trouvera dans le rapport la liste des différents projets qui se sont poursuivis ou ont débuté en 2010-2011.

Guinea
National Report not provided.

India
India's tuna fishing fleet includes coastal multipurpose boats operating a number of traditional gears, oceanic 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 2010 was 127616 tonnes, against a total production of 135262 tonnes during the year 2009. There was a reduction in production by the coastal fishery and increase in the tuna landings by oceanic sector during the year under report. There was considerable reduction in the quantity of tuna exports during the financial year 2010-11 compared to the year 2009-10. Survey conducted by the Fishery Survey of India in the EEZ revealed that sharks constitute 19.49% by number and 28.33% 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).

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 line contribute a bigger proportion (44 %) of tuna catch com pare to other gears and the number of active long liners registered and operated on the two FMAs is 1118**.** The national catch of four main tuna species in 2009 is estimated 101,292 while the total catch for all species by all gears type tend to increase to just above 600,000 mt in 2010. Benoa fishing port has demonstrated a long history of both port sampling and scientific observer programs. Although observer data set is currently the most detailed and most reliable data available from the fishery expanding the coverage of scientific observer is substantially required. Indonesia since 10 October 2010 already has a National Plan of Action of the Shark (NPOA-Shark). 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
Tuna and tuna-like species fisheries is one of the most important activities in the Persian Gulf & Oman Sea. In 2010 a total of 5 industrial purse- seiners and 5920 Gillnetters operated in the area. GRT of purse seiners is >1000 t and GRT of Gillnetters ranges from less than 3 t to more than 100 t. Iranian Annual catch Tuna and tuna-like species in 2010 were estimated as follows: Yellowfin tuna: 31485 t; Skipjack tuna: 22285 t; Longtail tuna: 64450 t; Kawakawa: 16336 t; Frigate tuna: 6172 t; Billfish*: 9209 t; Indo-pacific king mackerel: 3170 t; Narrow- barred Spanish mackerel: 10884 t; Total catch: 163991 tons. *contain Sailfish and Marlin. The amount of catch for purse-seiners showed an ascending trend in 2010 comparing to 2009. The amount of catch for different fishing methods of purse seine, Gillnet and trolling was estimated 3377 t, 159320 t and 1294, respectively.

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
Tuna fisheries in Kenya continue to play an important role in the socio-economic development of the country. Artisanal landings of 180 tons of tuna were realised in 2010 while a local longliner landed 137 tons. Recreational big- game fishing for tuna and billfishes landed 60 tons. The artisanal fleet structure remains multi-gear fleet of locally made crafts of varied capacities. Regarding tuna fisheries governance, Kenya is implementing port sampling, improving artisanal fisheries data collection system and playing an active part in implementing the national sea turtle conservation strategy.

Korea, Republic of
Longline is the only type of fishing gear for Korea fishing for tuna species in the Indian Ocean. Korean longline fishery in the Indian Ocean commenced in 1957. 13 longliners were operated in 2010, which were the lowest in number of vessels as it ranged from 31 to 21 during previous 5 years. With this fishing capacity, Korean longloners caught 2,723 mt in 2010, which was 8.6% decreasing of the catch in 2009. In 2010, fishing efforts were 5,079 thousand hooks and distributed higher in the western and eastern areas around 20-40 ^{o}S, while the fishing efforts averaged for 2005-2009 were 9,214 thousand hooks and distributed higher in the western areas around 20 ^{o}N -20 ^{o}S, as well as in the western and eastern areas around 20-40 ^{o}S. It was noted that fishing efforts had not been deployed in the western Indian Ocean around 20 ^{o}N -20 ^{o}S in recent years. As results, the catch of bigeye tuna and yellowfin tuna significantly decreased and albacore became important in catch. In 2010, 2 scientific observers were dispatched for monitoring compliance and scientific data collection and, as results, carried out 7.5 % of observer coverage in terms of the number of hooks.

Madagascar
L'année 2010 a été marquée par l'essai de reconversion de plusieurs chalutiers crevettiers artisanaux dans la pêche aux poissons. Il s'agit des navires de moins de 12 m de LHT. Par ailleurs, il faut noter l'entrée en activité de nouveaux navires ligneurs dans la côte Est de Madagascar. En tout, 41 navires ont obtenu des licences de pêche pour cette année développant 3 398 KW de puissance pour 1012 TJB. Il s'agit de navire multi-engin et multi espèces cibles en général. Au niveau activités de recherche, collecte et traitement des données, Madagascar, par l'intermédiaire de l'Unité Statistique Thonière d'Antsiranana projette de mettre en œuvre des projets qui ont trait à l'évaluation des faux

poissons débarqués à Antsiranana, à la mise en place d'une base de données nationale sur la pêche sportive.

Malaysia

Malaysia is considered as a new country in tuna fisheries in the Indian Ocean. And has experienced a drastic growth in tuna longline fleet from 15 vessels in 2003, the year when it started fishing to 58 in 2010. The highest catch was recorded in 2005 at 2885 tonnes. However, the tuna catch (*Thunnus albacares* and *Thunnus obesus*) from the past two years showed a significant dropped from 2,532 tonnes in 2008 to 1,138 tonnes in 2010. Similar pattern were observed in total effort (number of berthing) which decreased from 79 to 30 during the same period. The highest number of berthing was recorded in 2005 with 110 berthings. The catch of neritic tuna from the Malacca Straits (under IOTC areas of Competence) showed a steady increased in catch from 8,978 tonnes in 2001 to the record highest at 20,147 tonnes in 2010. The fishing areas only confined within the EEZ of Malaysian continental shelf with *Thunnus tonggol*, *Euthynnus affinis* and *Auxis thazard* formed the only known neritic tuna species found from these areas. Purse seine nets contributed over 90% of the neritic tuna landings from the Malacca Straits followed by trawl nets, gill/drift nets and hook & lines.

Maldives, Republic of

Maldives has a tuna fishery dating back hundreds of years. Fishing is conducted from pole-and-line vessels using livebait. Tuna catches increased to an all time record of 167,000 t in 2006 but have been steadily declining since then. The catch of 2010 was about 60,000 t, more than 50% lower than catches reported in 2006. The pole-and-line method contributes 75-80% of all tuna landings. A handline fishery targeting surface dwelling large yellowfin fishery started in later 1990s. Current catches from landline fishery are estimated to be 10,000 - 12,000 t exported fresh to lucrative markets of EU. Longline fishing is restricted to a licensed foreign fleet of round 25-30 vessels operating in outer EEZ of 75 miles and beyond. Licensing was suspended in 2010. A domestic fleet is now being developed with 4 vessels licensed to fish outside 100 miles range. Maldives used to have an important troll fishery targeting kawakawa and frigate tuna in the coastal areas and atoll basins. The fishery no longer exists and so trolling is now a very minor component of the tuna fishery. The national data collection is based on an enumeration system and requires use of conversion factors to estimate total catch. The conversion factors in use are inadequate both in magnitude and its coverage leading to potential bias in the estimate of total catches. Use of conversion factors however, is now getting less important as catches are also been recorded in weights and being reported through logbook system introduced in January 2010. Reporting from both methods will continue until fishermen have accustomed to reporting through logbooks. 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. The two main component of the tuna fishery (PL and HL) are extremely selective in their targets and therefore have almost zero bycatch and nothing is discarded. Sharks and other non-target species do occur in the longline fishery and their reporting is mandatory under the new rules on longline fishing.

Mauritius

Though Mauritius is not presently classified as a fishing nation for tuna species, however the tuna fishery forms the basis for the local fish processing industries. Tuna transhipment at Port Louis is another fish related activity. In 2010, a total of 592 calls of fishing vessels was registered and transhipped 43 723 tonnes of fish. The local longliner unloaded 306 tonnes of tuna and related species. Mauritius issued 225 licenses to foreign vessels to operate in its waters during 2010. Licences are issued to foreign longliners (mostly Asian) and purse seiners to operate in the Mauritian waters under a set of conditions which include the compliance of the vessels to

international conservation and management measures, listing of the vessel in the Positive or Active lists of IOTC and mandatory VMS reporting. The sport fishery also lands about 330 tonnes of pelagic fishes mostly for the local market. An artisanal tuna fishery has also been developed around fish aggregating devices. Mauritius is implementing all the recommendations of the Scientific Committee. All tuna statistics collected are processed and are transmitted to the IOTC regularly. It has also developed its NPOA-IUU. A Standard Operating Procedure (SOP) is under preparation for the implementation of the NPOA-IUU as well as the IOTC Regulation 10/11on Port State Measures (PSM) to prevent, deter and eliminate IUU fishing. The implementation of an effective PSM would help control the harvest of fish caught in the IOTC Area and thereby would ensure the long-term conservation and sustainable use of these resources and the marine ecosystems.

Oman, Sultanate of
National Report not provided.

Pakistan
National Report not provided.

Philippines
National Report not provided.

Seychelles, Republic of
The Seychelles national report summarizes activities of the purse seine, longline and semi-industrial fishery for the past 5 years. The total catch for the whole Purse Seine fleet in 2010 is estimated at 279,244 MT, representing increase of 6% over the catches reported for 2009. The mean catch rate stands at 28.243 MT/ fishing day for 2010. CPUE has been on an increasing trend from 15.69 MT /fishing day in 2007. For the Seychelles fleet the total catch for 2010 is estimated at 75,787 MT, representing an increase of 11% and the mean catch rate stand at 29.26 MT/ fishing days. Skipjack remained the dominant species accounting for 55% of the total catch and 58% for the Seychelles catch. Similar to 2009, the year 2010 saw increasing effort on FADs associated schools whereas effort on free swimming schools dropped. For the longline fishery, a decrease of 39% was recorded in licensed issued and a remarkable increase to 83% in logbook return to SFA. The total catch for the Seychelles fleet in 2010 is estimated at 6,659 MT obtained from a fishing effort of 18 million hooks, representing a 16% drop in catch and 12% drop in fishing effort when compared to 2009. The total catch for the local semi industrial vessel targeting tuna and swordfish stands at 295MT representing a decrease of 10%. The fishing effort increase slightly by 4% from 484,597 hooks to 506,334 hooks. This fishery has been experiencing declining CPUE trends since 2007. The decline has been more significant over the past 2 years. Reported shark catches in the semi-industrial fishery has also decreased significantly since 2008. 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, and swordfish (stock structure/ movement).

Sierra Leone
National Report not provided.

Sri Lanka
Sri Lanka is one of the oldest and most important tuna producing island in the Indian Ocean. Longline and the Gillnet are the main fishing gears used for harvesting of tuna and tuna like species. operation of the longlines has become more popular among fishermen, due to the provision of better

quality fish than the gillnets. A recent survey indicated that around 20% of the local fishing fleet, used only longline with greater number of hooks per set, as the principal fishing gear, by mechanizing the gear operation, with line-haulers.Two boat types, OFRP and IMUL, which catogorised based on the size/length and the duration of the fishing trip are being operated in Neritic and Oceanic provinces around Sri Lanaka. According to this categorization, six boat types are being operated with the length of 6-7M, OFRPs (one day operating) and 9-10M, 10-12M, 12-15M, 15-18M length IMUL (operating oneday and >1day). Around 3700 boats are actively operated during the period of 2009 – 2010, for large pelagic fishery. About 1% of them are <15M in length.

The catches of tuna fishery resources are mainly, Yellowfin tuna (*Thunnus albacares),* Bigeye tuna (*Thunnus obsesus*), Skipjack tuna (*Katsuwonus pelamis*), Kawakawa (*Enthynnus affinis*), Frigate tuna (*Auxis thazard*) and Bullet tuna (*Auxis rochei*). The estimated total production of large pelagic species in 2010 was 136,626Mt. which is an increment of 28% to the production in 2009. Major portion of the catches of large pelagic varities, in 2010, consisted of tunas; 91,903mt. (66% of the total). Among tunas, skipjack tuna dominated the production, with 55,438Mt., followed by yellow fin tuna with 26,959Mt. Yellowfin tuna production has shown and increase of about 10%. Export of Chilled- yellowfin tuna has become a lucrative venture in recent times. Hence attention is being paid to the production maintanance of the quality of the tuna catch in terms of handling, storage and transport. Shashimi tuna and tuna-loins, etc. Of the yellowfin tuna are exported mainly to Japan and EU markets.

Sudan
National Report not provided.

Tanzania, United Republic of
Presently the national fleet of Tanzania is all artisanal that is involved in multi-species, multi-gear and multi-cultural fisheries. Most of the fishing takes place within 6nm from shore predominantly on reef areas. However a small number of boats are involved in the fisheries of tuna, bill fish and sharks, using manually handled drift gill nets and long lines. The catch data is collected in terms of weight of fish group and is not based on gear type, vessel size and duration of fishing operations. Statistics from the Fisheries Departments (of Zanzibar and the United Republic of Tanzania) show 1643 tonnes of Tuna species were fished in 2010 and information from Zanzibar alone shows catches of 1334 tonnes and 1418 tonnes of bill fish and shark-and-rays species respectively. There is no available data from the recreational fisheries, and because the artisanal fleet does not operate with any kind of a geographic positioning system there is no data on the distribution of fishing effort and fishing catch. Initial discussions on NPOAs for sharks, seabirds and marine turtles have commenced while terms and conditions related to the protection of these species are contained within the EEZ fishing licenses. Logsheet data started to be collected in 2002 from all licensed EEZ fishing vessels and a Vessel Monitoring System has been monitoring the Tanzania EEZ since 2009. There have been no Observer and Port sampling programmes as well as unloading and transhipment because Tanzanian Ports have no facilities for handling commercial deep sea fishing vessels. Current research programmes are focusing on the potential of establishing a national fleet for small pelagics and tuna and tuna like species in the Exclusive Economic Zone with the aim of reducing the rapidly increasing fishing pressure within the inshore waters.

Thailand
Neritic tuna and king mackerel species in the Andaman Sea Coast, Thailand comprise 6 species (*Thunnus tonggol*, *Euthynnus affinis*, *Auxis thazard*, *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 metric tons in 1999. The production was quite stable around

17,000 tons during 1999 to 2008. These neritic tuna species are more or less have its production trend similarity. Three Thai tuna longliners were operated in the Indian Ocean in 2007 and in 2008-2009 only two Thai tuna longliners kept on fishing there. Fishing grounds were mainly in the western coast of Indian Ocean. The total catches were 1,026.15 tons with 1,429 days of fishing effort. The average catch rate of total catch was the highest at 27.24 number/1,000 hooks in 2007 followed by 16.46 and 14.46 number/ 1,000 hooks in 2008 and 2009. Albacore was the dominant species in 2007 followed by yellowfin tuna and bigeye tuna in 2008 and 2009. While, tuna purse seine fishery operated by four Thai purse seiners, 227-670 fishing operations was conducted in the Indian Ocean during 2007-2010. Fishing ground was mainly in the western Indian Ocean. Tuna purse seine fishery can be operated throughout the year in both the eastern and western parts of the Indian Ocean with the peak from February - May and September - October. Total catch was 28,688.50 tonnes. It was found that skipjack tuna comprised the highest proportion (64.94%) followed by bigeye tuna (18.83%), yellowfin tuna (13.78%) and bonito (2.44%). The average size of skipjack, yellowfin and bigeye tuna were 50.34±9.87, 63.32±23.09 and 63.24±16.94 cm., respectively.

United Kingdom (BIOT)

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. BIOT does not operate a flag registry and has no commercial tuna fleet or fishing port. 28.4t of tuna and tuna like species were landed by recreational fishers on Diego Garcia in 2010. Length frequency data were recorded for a sample of 738 yellowfin tuna from this fishery. The mean length was 74cm. Sharks caught in the recreational fishery are released alive. There was no BIOT observer programme during 2010 on the licensed foreign fishery. IUU fishing remains the greatest threat 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

There was only longline fishery operated by Vanuatu in 2010 in the Indian Ocean. Four longliners targeted oilfishes with bycatch of yellowfin, bigeye and albacore tunas in the southwestern region of the Ocean. Total catch of 2010 was estimated to be 622.2 mt, with 383.0 mt for oilfishes, 93.9 mt for yellowfin tuna, 87.4 mt for bigeye tuna, 53.5 mt for albacore and 4.4 mt for swordfish (data is still preliminary). These data were compiled from the logsheets that submitted by the vessels. All the four vessels have now removed registration from Vanuatu.

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 10º 32’ and 20º south. The purse seine fleet is composed of vessels from France, Spain and Seychelles. Long line fishing occurs between 20º and 26º 52’ south, with particular intensity below parallel 25º 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 ranges from 948 to 17.470 tonnes per year. For the period 2005 / 2010, 264 licenses and 486 licenses were issued respectively to purse seine vessels and longline vessels, giving an average of 125 tuna licenses issued per year. The number of longline vessels operating in Mozambique EEZ has declined substantially since 2007. In 2010, a total of 31 fishing companies were authorized to fish large pelagic species.

Senegal

En 2010, la flottille thonière industrielle sénégalaise est composée de 06 canneurs qui exploitent essentiellemnt Yellowfin (*Thunnus albacares*), Bigeye tuna (*Thunnus obesus*) et Skipjack (*Katsuwonus pelamis*) et 01 palangrier qui cible l'espadon. Par ailleurs, certaines pêcheries artisanales (la ligne à la main, la ligne de traine et la senne tournante) et la pêche sportive capturent les poissons porte épée (marlins, espadon et voilier) et les petits thonidés (thonine, maquereau bonite, auxide etc.). En 2010, les prises totales des canneurs sénégalais sont estimées à 4606 tonnes (1168 tonnes d'albacore, 2412 tonnes de listao, 844 tonnes de patudo). Les captures ont connu une baisse par rapport à 2009 (6720 tonnes). Cette réduction est due à la diminution de l'effort de pêche qui est passé de 1574 jours de pêche en 2009 à 1220 en 2010. Les prises de la pêche palangrière en 2010 sont estimées à 312 tonnes (590 tonnes en 2009). Les captures sont constituées essentiellement de l'espadon, requins, marlins. Quant aux pêcheries artisanales, les prises de petits thonidés et espèces apparentées s'élèvent à 8719 tonnes. Les captures ont connu une hausse par rapport à 2009 (5315 tonnes). Concernant la pêche sportive, les prises sont estimées à 288 tonnes en 2010 pour un effort de pêche de 682 sorties. Le suivi régulier des activités de pêche des thoniers est toujours assuré par l'équipe mise en place au port de Dakar par le CRODT. Le travail consiste à la collecte des statistiques de captures et d'effort de pêche. Ce travail est complété par des informations de diverses sources (usines, armements, Direction des pêches maritimes etc.). Des échantillonnages multispécifiques sont également réalisés en pêche industrielle et pêche artisanale. Grâce au fond du Programme de Recherche Intensive des Istiophoridés (EPBR), l'échantillonnage des captures, efforts et tailles des istiophoridés est intensifié dans les principaux centres de débarquement de la pêche artisanale.

South Africa, Republic of

South Africa has three 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, pole and line/ rod and reel, and shark longline. 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 due to be released by end of 2011. Seabirds: Threat Abatement Plan (longline fishery only) in review. No Plan for purse seine or other gears.
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		–	Sharks: Approved on 05-Feb-2009 and it is currently being implemented. Seabirds: Currently being finalised for adoption in the last quarter of 2011.
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 report submitted to COFI in Jan. 2011 Seabirds: NPOA–Seabird implementation report submitted to COFI in Jan. 2011.

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 but not yet 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: No update received by the Secretariat. Seabirds: No information received by the Secretariat.
Maldives, Republic of					Sharks: NPOA has been formulated and will be discussed with stakeholders in November 2011. Shark fishing was banned on 15th March 2010 based on scientific advice. The Government has spent ~US$5 million on a gear buyback scheme from Maldivian fishers. Seabirds: Development has not begun.
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.
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: No revision currently planned.

					Seabirds: Development has not begun.
United Kingdom		–		–	Chagos waters are a MPA closed to fishing except recreational fishing around Diego Garcia. Section 7 (10) (e) of the Fisheries (Conservation and Management) Ordinance refers to recreational fishing and requires sharks to be released alive.
Vanuatu					Sharks: No information received by the Secretariat. Seabirds: No information received by the Secretariat.
COOPERATING NON-CONTRACTING PARTIES					
Mozambique		–		–	Sharks: Development has not begun. Seabirds: Development has not begun.
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: Currently being drafted. Seabirds: Not currently under review.

Colour key	
NPOA Completed	
Drafting being finalised	
Drafting commenced	
Not begun	

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

a. Longline and gillnet fisheries

Availability of catch data for 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

b. Purse seine and pole-and-line* fisheries

*** Note that catch rates of sharks on pole-and-line fisheries are thought to be nil or negligible**

Availability of catch data for 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

c. Handline, trolling (Line) and other fisheries operated in coastal waters (Other)

APPENDIX VII
LIST OF CHAIRS, VICE-CHAIRS AND THEIR RESPECTIVE TERMS FOR ALL IOTC SCIENCE BODIES

Group	Chair/Vice-Chair	Chair	CPC/Affiliation	Term commencement date	Term expiration date (End date is until replacement is elected)	Comments
SC	Chair	Dr. Tsutomu Nishida	Japan	17 December 2011	End of SC in 2013	1st term
	Vice-Chair	Mr. Jan Robinson	Seychelles	17 December 2011	End of SC in 2013	1st term
WPB	Chair	Mr. Jerome Bourjea	La Reunion/France	08 July 2011	End of WPB in 2013	1st term
	Vice-Chair	Mr Miguel Santos	EU,Portugal	08 July 2011	End of WPB in 2013	1st term
WPTmT	Chair	Dr. Zang Geun Kim	Korea, Rep. of	22 September 2011	End of WPTmT in 2013	1st term
	Vice-Chair	Dr. Tsutomu Nishida	Japan	22 September 2011	End of WPTmT in 2013	1st term
WPTT	Chair	Dr. Hilario Murua	EU,Spain	25 October 2010	End of WPTT in 2012	1st term
	Vice-Chair	Dr. Shiham Adam	Maldives, Rep. of	23 October 2011	End of WPTT in 2013	1st term
WPEB	Chair	Dr. Charles Anderson	UK/Independent	14 October 2010	End of WPEB in 2013	2nd term
	Vice-Chair	Dr. Evgeny Romanov	La Reunion/France	27 October 2011	End of WPEB in 2013	1st term
WPNT	Chair	Dr. Prathibha Rohit	India	27 November 2011	End of WPNT in 2013	1st term
	Vice-Chair	Mr. Farhad Kaymaram	I.R. Iran	27 November 2011	End of WPNT in 2013	1st term
WPDCS	Chair	Mr. Miguel Herrera	Secretariat	04 December 2010	End of WPDCS 2012	2nd term
	Vice-Chair	Dr. Pierre Chavance	European Union	10 December 2011	End of WPDCS 2013	1st term
WPM	Chair (Coordinator)	Dr. Iago Mosqueira	European Union	18 December 2011	Start of WPM 2012	Interim
	Vice-Chair (Co-Coordinator)	Dr. Toshihide Kitakado	Japan	18 December 2011	Start of WPM 2012	Interim
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 VIII
CONSOLIDATED RECOMMENDATIONS TO CPCS ON IMPROVED DATA COLLECTION, MONITORING, REPORTING AND RESEARCH

Working Party on Billfish

Data collection and reporting systems

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 gillnet fisheries, as soon as possible, noting that this is already a mandatory reporting requirement.

Species identification

The SC **RECOMMENDED** that marlin and sailfish identification material, currently being used by the La Réunion fleets, be provided to the IOTC Secretariat in the coming months to aid in the development of the identification cards.

Sampling coverage

The SC **RECOMMENDED** that Japan increase sampling coverage to attain the minimum recommended by the Commission (1 fish by metric ton of catch by type of gear and species).

Size data

NOTING that the EU,Portugal had recently reported size data for swordfish from its longline fleets; The SC **RECOMMENDED** that the EU,Portugal report size data for marlin and sailfish species for its longline fleets, noting that this is already a mandatory reporting requirement.

NOTING that eleven longliners from the EU,United Kingdom, Kenya, Guinea, and Tanzania have operated in the Indian Ocean in recent years; The SC **RECOMMENDED** that the EU,United Kingdom, Kenya, Guinea, and Tanzania make every possible effort to collect and report size data for billfish species for their longline fleets, noting that this is already a mandatory reporting requirement.

The SC **RECOMMENDED** that Japan and Taiwan,China analyse the size samples collected from their longline fisheries for swordfish and marlins in order to verify if the length frequencies derived from such samples are representative of their fisheries. In particular Japan to compare length frequency distributions derived from samples collected:

- by fishermen on commercial vessels
- by observers on commercial vessels
- by scientists on research and training vessels.

The SC **RECOMMENDED** that Taiwan,China collect and provide the IOTC Secretariat with size data for billfish caught by its fresh tuna longliners, noting that this is already a mandatory requirement.

The SC **RECOMMENDED** 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.

Sports fisheries

The SC **RECOMMENDED** that the African Billfish Foundation continue its important work, particularly in the areas of collaborative research aimed at obtaining more information on movements of billfishes, via both conventional and archival tagging programs that will allow the collection of information on both horizontal and vertical movements.

Mozambique billfish landings

The SC **RECOMMENDED** that sports fishery and other recreational fishery catches taken from Mozambique waters should be reported to the WPB in 2012.

India longline fishery: Indo-Pacific sailfish

The SC **RECOMMENDED** that Indian scientists continue to carry out new and innovative research on billfish species, and to report findings to each WPB meeting.

Sri Lankan billfish fisheries

The SC **RECOMMENDED** that as a matter of priority, Sri Lanka increase sampling coverage to attain at least the coverage levels recommended by the Commission, including:

- catches sampled 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.

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

The SC **RECOMMENDED** that billfish catches by Sri Lankan vessels, by gear and location, as per IOTC requirements, be presented at the next WPB meeting.

Portuguese longline fishery

The SC **RECOMMENDED** that EU,Portugal scientists undertake a CPUE analysis for the EU,Portugal longline fleet,

and to consider combining the analysis with catch-and-effort data from the EU,Spain longline fleet for the next WPB meeting.

Logbook coverage

The SC **RECOMMENDED** that Japan and Taiwan,China analyse the size samples collected from their longline fisheries for swordfish and marlins in order to verify if the length frequencies derived from such samples are representative of their fisheries. In particular Japan to compare length frequency distributions derived from samples collected:

- by fishermen on commercial vessels
- by observers on commercial vessels
- by scientists on research and training vessels.

Working Party on Temperate Tunas

Review of the data available for temperate tuna species

The SC **NOTED** the main albacore data issues that are considered to negatively affect the quality of the statistics available at the IOTC, by type of dataset and fishery, which are provided in Appendix V [Report of the WPTmT03], 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.

Logbook coverage

The SC **RECOMMENDED** that the main fleets catching albacore (Japan, Taiwan,China and Indonesia) collect biological information on albacore caught in their fisheries, preferably through observer programmes, and provide this information (including the raw data) to the Secretariat in 2012.

Catch-and-effort and Size data

The SC **RECOMMENDED** that as a matter of priority, India provide catch-and-effort data and size data for temperate tuna, in particular from its commercial longline fleet, as soon as possible, noting that this is already a mandatory reporting requirement.

The SC **RECOMMENDED** that as a matter of priority, Indonesia and Malaysia provide catch-and-effort data and size data for temperate tuna, in particular for their fresh tuna and/or deep-freezing longline fleets, as soon as possible, noting that this is already a mandatory reporting requirement. Reporting should also include data from their vessels operating from other CPCs.

The SC **RECOMMENDED** that size data for albacore from the Japanese longline fleet are collected and reported to the IOTC Secretariat in 2012, with a summary to be provided to the WPTmT.

The SC **RECOMMENDED** that Japan and Taiwan,China analyse the size samples collected from their longline fisheries for albacore in order to verify if the length frequencies derived from such samples are representative of their fisheries. In particular Japan to compare length frequency distributions derived from samples collected:

- by fishermen on commercial vessels
- by observers on commercial vessels
- by scientists on research and training vessels.

The SC **RECOMMENDED** that as a matter of priority, the Philippines provide size data for temperate tuna, noting that this is already a mandatory reporting requirement.

Observer data from China

Noting that the current information available on albacore biology from the Indian Ocean is limited, the SC **RECOMMENDED** that China provide further updates on research carried out as part of its national observer program, at the next session of the SC and **ENCOURAGED** other CPCs to provide similar research reports on albacore biology, either from data collected through observer programs or other research programs, at the next WPTmT meeting.

Noting that there are difficulties faced by some CPCs in collecting gonad samples from albacore – albacore is generally frozen whole and not gutted, the SC **RECOMMENDED** that CPCs, in particular Japan, collect gonad samples from albacore to confirm the spawning time and location of the spawning area that are presently hypothesized for albacore, over the coming year and to report findings at the next WPTmT.

Korean catch and effort for albacore

Noting that the nominal catch (NC) data provided at the WPTmT03 meeting was found to conflict with the NC data history provided by the Republic of Korea for all years prior to 1994, and for catch-and-effort data for most of the history of the longline fleet, the SC **RECOMMENDED** that the Rep. of Korea liaise with the Secretariat to provide a fully justified revised catch history which will replace the data currently held by the Secretariat before the end of 2011.

Indonesian longline fishery

Noting that Indonesian catches represent more than 40% of the total albacore catches in the Indian Ocean, determined from the revised catch history developed by the Secretariat, the SC **RECOMMENDED** that Indonesia further strengthen sampling efforts on its coastal and off-shore fisheries in early 2012, where required, and liaise with the Secretariat in order to better determine the catches of albacore by the Indonesian longline fleet.

The SC **RECOMMENDED** 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.

Piracy in the Indian Ocean

The SC **RECOMMENDED** that given the potential impacts of piracy on the albacore fishery through the relocation of longliners into traditional albacore fishing grounds, specific analysis should be carried out and presented at the next WPTmT meeting by CPCs most affected by these activities, including Japan, Republic of Korea and Taiwan,China.

CPUE discussion summary

The SC **RECOMMENDED** that the following matters be taken into account when undertaking CPUE standardisation analysis:

- The SC **AGREED** that changes in species targeting is the most important issue to address in CPUE standardisations, and that the following points should be taken into consideration:
  i. While hooks between floats (HBF) provides some indication of setting depth, it is generally considered not to be a sufficient indicator of species targeting. HBF is just one aspect of the setting technique, which can vary by species, area, set-time, and other factors.
  ii. Highly aggregated (e.g. 5x5 degrees) data can make it difficult to observe the factors driving CPUE in a fishery, in particular the targeting effects. Operational data provides additional information that may allow effort to be classified according to fishing strategy (e.g. using cluster analyses or regression trees to estimate species targeting as a function of spatial areas, bait type, catch species composition, set-time, vessel-identity, skipper, etc.). Operational data also permits vessel effects to be included in analyses.
  iii. The inclusion of other species as factors in a Generalized Linear Model (GLM) standardization may be misleading, because the abundance of all species changes over time. Including these factors may also fail to resolve problems due to changes in targeting, particularly when modeling aggregated data. However, comparing models with and without the other species factors can be useful to identify whether there is likely to be a targeting problem.
- The SC **AGREED** that appropriate spatial structure needs to be considered carefully as fish density (and targeting practices) can be highly variable on a fine spatial scale, and it can be misleading to assume that large areas are homogenous when there are large shifts in the spatial distribution of effort. The following points should also be taken into consideration:
  i. Addition of finer scale (e.g. 5x5 degrees) fixed spatial effects in the model can help to account for heterogeneity within sub-regions.
  ii. Efforts should be made to identify spatial units that are relatively homogeneous in terms of the population and fishery to the extent possible (e.g. uniform catch size composition and targeting practices).
  iii. There may be advantages in conducting separate analyses for different sub-regions. The error distribution may differ by sub-region (e.g. proportion of zero sets), and there may be very different interactions among explanatory variables.
  iv. If the selectivity differs among regions (e.g. due to spatial variability in the age composition of the population, it may not be appropriate to pool sub-regional indices into a regional index (e.g. albacore populations seem to be partitioned with spawners caught predominantly in the equatorial/tropical regions and juveniles caught predominantly in the temperate waters and the two age categories could have somewhat different CPUE trends).
  v. The possibility of defining a representative 'space-time' window: if this leads to the identification of a fishery with homogeneous targeting practices, it is probably worthwhile. However, it may not be possible to identify an appropriate window, or the window may be so small that it is not representative of the larger population (or has a high variance).
- The SC **AGREED** that if there are many observations with positive effort and zero catch, it is worth considering models which explicitly model the processes that lead to the zero observations (e.g. negative binomial, zero-inflated or delta models). Adding a small constant to the lognormal model

may be okay if there are few zeroes, but may not be appropriate for areas with many zero catches (e.g. north of 10°S). Sensitivity to the choice of constant should be tested.

- The SC **NOTED** that the appropriate inclusion of environmental variables in CPUE standardization is an ongoing research topic. The SC **AGREED** that often these variables do not have as much explanatory power as, or may be confounded with, fixed spatial effects. This may indicate that model-derived environmental fields are not accurate enough at this time, or there may need to be careful consideration of the mechanisms of interaction to include the variable in the most informative way.
- The SC **AGREED** that it is difficult to prescribe analyses in advance, and model building should be undertaken as an iterative process to investigate the processes in the fishery that affect the relationship between CPUE and abundance. Specifically:
  i. Model building should proceed with a stepwise introduction of explanatory terms, in which the net effect of each level of complexity is presented. Parameter estimates should be presented and examined to see if the mechanism makes sense and the contribution has a practical influence.
  ii. Simulations have shown that model selection using Akaike Information Criterion (AIC) tends to recommend over-parameterized models.

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.

Stock assessment

Noting that the only stock assessment for albacore was not made available by the authors until the 19th September, 2011 which did not allow the other participants of the meeting to adequately review the methodology, the SC reminded working party participants of the 2010 Scientific Committee **RECOMMENDATION** that stock assessment papers need to be provided to the Secretariat for posting to the IOTC website no later than 15 days before the commencement of the relevant meeting.

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.

Working Party on Tropical Tunas

Review of the data available for tropical tuna species

The SC **NOTED** the main tropical tuna data issues that are considered to negatively affect the quality of the statistics available at the IOTC, by type of dataset and fishery, which are provided in Appendix V [Report of the WPTT13], and **RECOMMENDED** that the CPCs listed in Appendix V [Report of the WPTT13] make efforts to remedy the data issues identified and to report back to the WPTT at its next meeting.

Review of the data available for tropical tuna species

The SC **RECOMMENDED** that as a matter of priority, Pakistan provide catch-and-effort data and size data for tropical tunas, in particular from their gillnet fisheries, noting that this is already a mandatory reporting requirement.

The SC welcomed the efforts of Sri Lanka to improve data collection and management for its fisheries and **RECOMMENDED** that the IOTC-OFCF project and Sri Lanka continue their cooperation towards improving the collection and reporting of fisheries statistics and to report back to the WPTT at its 2012 Session.

The SC **RECOMMENDED** that Maldives report catch and effort data as per the IOTC standards for 2010 and that for earlier statistics (2002 to 2009), and that they are reported by atoll, month, gear and species, as it was done in the past.

The SC urged Madagascar and Yemen to collect and report statistics on their coastal fisheries and **RECOMMENDED** that these countries request assistance from the IOTC Secretariat where required.

The SC **RECOMMENDED** that Philippines investigate the reasons for the differences between bigeye tuna export data and reported catch data from their longline fishery, and to report findings to the next WPTT meeting.

The SC **RECOMMENDED** that Iran and Pakistan report size data for tropical tuna species, as per the IOTC requirements, for their gillnet fleets, noting that this is already a mandatory reporting requirement, and that the Secretariat assist Iran and Pakistan to facilitate reporting of this information where required.

The SC **RECOMMENDED** that India, Malaysia, Oman and Philippines make every possible effort to collect and report size data for tropical tuna species for their longline fleets, noting that this is already a mandatory reporting requirement.

The SC **RECOMMENDED** that Indonesia report size data for tropical tuna species for its longline vessels as soon as

possible as per IOTC standards, noting that this is already a mandatory reporting requirement.

The SC **RECOMMENDED** that Japan increase sampling coverage to attain at least the minimum required by the IOTC Resolution 10/02 *on mandatory statistical requirements* (1 fish by metric ton of catch by type of gear and species), and for the IOTC Secretariat to assess levels of reporting for Japan upon receiving size data for 2010 and to report back to the WPTT at its next meeting

The SC **RECOMMENDED** that biological data is gathered and reported to the IOTC Secretariat in order to develop specific length-age, length-weight and processed weight-live keys for the Indian Ocean tropical tuna species, in particular by the main longline fisheries (Taiwan,China, Indonesia, Japan, EU and China).

Noting the importance of biological information to be considered in the stock assessment models, the SC **RECOMMENDED** that gonad collection and calculation of the gonadosomatic index for yellowfin tuna be carried out prior to the next WPTT meeting.

The SC **RECOMMENDED** that Japan and Taiwan,China review catch, effort and size frequency datasets in order 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 and research and training vessels.

The SC **RECOMMENDED** that all CPCs catching small yellowfin tuna should undertake scientific sampling of their yellowfin tuna catches in order to identify potential bigeye tuna catches (in particular for those CPCs identified in previous paragraphs) and to report findings at the next WPTT meeting.

Mozambique catch data

Noting the difficulties Mozambique has experienced in receiving the logbooks of fishing vessels licensed to fish in its EEZ, the SC **RECOMMENDED** that the CPCs concerned send the logbook data to Mozambique, noting that this is already a mandatory requirement under IOTC Resolution 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area* and Resolution 10/03 *concerning the recording of catch by fishing vessels in the IOTC area*.

Noting that to date, Mozambique has not reported data for its coastal fisheries to the IOTC Secretariat the SC **RECOMMENDED** that data are collected and reported as soon as possible.

Comoros artisanal fisheries

The SC welcomed the implementation of a frame survey and of a new sampling programme in the Comoros and strongly **RECOMMENDED** that Comoros maintain this activity after the end of the programme to be able to report annual data as per IOTC requirements.

Malaysian fisheries

Noting that to date, vessels flagged to Malaysia are not using logbooks to record their activities, as required by IOTC Resolution 08/04, which includes minimum requirements for collecting and reporting operational data, the SC **RECOMMENDED** that Malaysia implement the requirements under Resolution 08/04 as a matter of priority.

Indian fisheries

Noting that India has a large data set collected on the research longline vessels operated by the Fishery Survey of India during the last 30 years, the SC **RECOMMENDED** that Indian scientists participate in the CPUE standardization workshop in order to assess the value of using this information.

Thailand fisheries

Noting that both the total catches and species composition presented for purse seine vessels flagged to Thailand were substantially different from those reported for other purse seine fleets operating in the Indian Ocean, and that the difference may originate from Thai and EU purse seiners operating in different areas, the SC **RECOMMENED** that the EU and Thailand further investigate the reasons for this difference and to report findings to the next WPTT meeting.

Republic of Korea longline fishery

Noting that the nominal catch (NC) and the catch-and-effort (CE) data provided at the WPTT13 meeting was found to conflict with the historical data for the longline fleet previously provided by the Rep. of Korea to the IOTC Secretariat, and that the differences were due to the ongoing internal data review by the Rep. of Korea, the SC **RECOMMENDED** that the Rep. of Korea liaise with the Secretariat to provide a fully justified revised catch history which will replace the data currently held by the Secretariat before the end of 2011.

I.R. Iran fisheries

The SC **RECOMMENDED** that the I.R. Iran strengthen its port sampling so that bigeye tuna can be properly identified and its catches estimated routinely by field samplers.

Maldives tuna length sampling

Noting that to date no bigeye tuna have been reported as being caught by the Maldives pole-and-line fleet, despite independent verification of substantial numbers of bigeye tuna being caught by these vessels, the SC **RECOMMENDED** that the Maldives rapidly improve species identification in logbooks and in their sampling programme.

Maldives yellowfin tuna fishery

The SC commended the authors for the efforts devoted to reviewing the time-series of catch and length data for the fisheries in the Maldives and the results presented to the meeting. In this regard, the SC **RECOMMENDED** that

the revised dataset be reported to the IOTC Secretariat by the end of 2011, so that the IOTC databases can be updated to include the latest estimates produced by the Maldives.

Noting that an ad-hoc procedure had been used to separate length frequency samples of yellowfin tuna not recorded by gear, in particular those combining specimens of yellowfin tuna caught by pole-and-line and handline gears during the same trip, the SC **RECOMMENDED** that the Maldives validate the procedure using samples collected for each individual gear, in port or, where not possible, through observers onboard baitboats, and to report progress to the next WPTT meeting.

Maldives skipjack tuna fishery

Noting that the Maldivian skipjack tuna catch is not separated for FAD and free schools, and therefore the proportion of skipjack tuna caught under the FADs anchored around the Maldives is unknown, the SC **RECOMMENDED** that the Maldivian data collection system is improved in order to account for the association of the reported catch, as this could improve the standardization of the pole-and-line CPUE.

Review of new information on the status of skipjack tuna

Noting that catch rates by free and associated school sets for purse seine have showed analogous absolute levels on yearly fluctuations over the time-series, the SC **RECOMMENDED** that EU scientists explore the reasons for this, and to report findings at the next session of the WPTT.

The SC **RECOMMENDED** further investigation of the existing data irregularities, and expansion of the logbook programme to improve CPUE analyses for skipjack tuna in the Indian Ocean, and for information on these matters to be presented to the next meeting of the WPTT.

Review of new information on the status of yellowfin tuna

The SC **NOTED** that the change in gear appears to have had the effect of increasing the ratio of yellowfin tuna in the Japanese longline catch when compared to bigeye tuna. The SC also **NOTED** that 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 standardization and, thus, the SC **RECOMMENDED** to further examine those issues in the future.

Review of new information on the status of bigeye tuna

The SC **RECOMMENDED** that the following matters be taken into account when undertaking CPUE standardisation analysis for bigeye tuna as well as yellowfin tuna in 2012:

- The SC **AGREED** that changes in species targeting is the most important issue to address in CPUE standardisations, and that the following points should be taken into consideration:
  i. While hooks between floats (HBF) provides some indication of setting depth, it is generally considered not to be a sufficient indicator of species targeting. HBF is just one aspect of the setting technique, which can vary by species, area, set-time, and other factors.
  ii. Highly aggregated (e.g. 5x5 degrees) data can make it difficult to observe the factors driving CPUE in a fishery, in particular the targeting effects. Operational data provides additional information that may allow effort to be classified according to fishing strategy (e.g. using cluster analyses or regression trees to estimate species targeting as a function of spatial areas, bait type, catch species composition, set-time, vessel-identity, skipper, etc.). Operational data also permits vessel effects to be included in analyses.
  iii. The inclusion of other species as factors in a Generalized Linear Model (GLM) standardization may be misleading, because the abundance of all species changes over time. Including these factors may also fail to resolve problems due to changes in targeting, particularly when modeling aggregated data. However, comparing models with and without the other species factors can be useful to identify whether there is likely to be a targeting problem.
- The SC **AGREED** that appropriate spatial structure needs to be considered carefully as fish density (and targeting practices) can be highly variable on a fine spatial scale, and it can be misleading to assume that large areas are homogenous when there are large shifts in the spatial distribution of effort. The following points should also be taken into consideration:
  vi. Addition of finer scale (e.g. 1x1 degrees or latitude/longitude) fixed spatial effects in the model can help to account for heterogeneity within sub-regions.
  vii. Efforts should be made to identify spatial units that are relatively homogeneous in terms of the population and fishery to the extent possible (e.g. uniform catch size composition and targeting practices).

viii. There may be advantages in conducting separate analyses for different sub-regions. The error distribution may differ by sub-region (e.g. proportion of zero sets), and there may be very different interactions among explanatory variables.

ix. If the selectivity differs among regions (e.g. due to spatial variability in the age composition of the population), it may not be appropriate to pool sub-regional indices into a regional index.

x. The possibility of defining a representative 'space-time' window: if this leads to the identification of a fishery with homogeneous targeting practices, it is probably worthwhile. However, it may not be possible to identify an appropriate window, or the window may be so small that it is not representative of the larger population (or has a high variance).

- The SC **NOTED** that the appropriate inclusion of environmental variables in CPUE standardization is an ongoing research topic. The SC **AGREED** that often these variables do not have as much explanatory power as, or may be confounded with, fixed spatial effects. This may indicate that model-derived environmental fields are not accurate enough at this time, or there may need to be careful consideration of the mechanisms of interaction to include the variable in the most informative way.

Analysis of Tagging Data

The SC **NOTED** that the sex of most large tagged yellowfin tuna and bigeye tuna recovered in Seychelles on the European purse seine fleet have been identified since July 2009. This program offers a unique potential to evaluate if adult yellowfin tuna and bigeye tuna male and female show a differential growth. The results already obtained tend to confirm the existence of such sex differential growth. Worldwide, this is the first time that tagged yellowfin tuna and bigeye tuna have been sexed by scientists. The SC **RECOMMENDED** that this sampling programme should be maintained as long as these tunas are recovered, in order to ideally sex 100% of the future recoveries.

The SC **RECOMMENDED** that more analyses on the tagging data should be undertaken in 2011 and 2012, and should include the estimation of mixing rates and tag induced mortality (in particular for the small-scale projects). These analyses should be done in advance of the next Session of the WPTT in order to be included in future analyses and stock assessments.

The SC **RECOMMENDED** that analysis of the tagging data carried out in preparation for the Tagging Symposium and presented at the next WPTT meeting.

Effect of Piracy on Tropical Tuna Catches

The SC **RECOMMENDED** 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 meeting by CPCs most affected by these activities, including Japan, Republic of Korea and Taiwan,China.

Methods

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 by CPCs be made available not less than 30 days before each meeting.

Working Party on Ecosystems and Bycatch

Data available

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

The SC **RECOMMENDED** that data on marine mammal interactions with IOTC fisheries are collected and reported by CPCs to the IOTC Secretariat.

The SC **NOTED** the main bycatch 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 [Report of the WPEB07]AppendixV, and **RECOMMENDED** that the CPCs listed in Appendix VI, make efforts to remedy the data issues identified and to report back to the WPEB at its next meeting.

The SC **RECOMMENDED** that the actions outlined in Appendix VII [Report of the WPEB07] should be undertaken by each CPC to improve the standing of the data on sharks, seabirds, marine turtles and marine mammals currently available at the IOTC Secretariat. In general, these recommendations are made over and above the existing obligations and technical specifications relating to the reporting of data.

The SC **RECOMMENDED** that, in addition to the implementation of the Regional Observer Scheme, the collection of scientific data by all other means available including auto-sampling (collection of data by trained crew) and electronic monitoring (sensors and video cameras) be encouraged and developed, and for CPCs to report on progress at the next WPEB meeting.

The SC further **NOTED** that this could be estimated through the deployment of video monitoring system on the upper deck, however, the SC **RECOMMENDED** that intensive sampling with two observers are conducted, whenever possible, in order to better evaluate this potential bias and to report progress and findings to the next WPEB meeting.

The SC **RECOMMENDED** that further research into the effectiveness of circle hooks adopt a multi-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.

The SC **RECOMMENDED** that IOTC CPCs eventually translate, print and disseminate the IOTC identifications cards for marine turtles, seabirds and sharks as a priority to their observers accredited for the Regional Observer Scheme and field samplers (Resolution 11/04), and to a larger extent to their fishing fleets targeting tuna, tuna-like and shark species. This would allow accurate observer, sampling and logbook data on marine turtles, seabirds and sharks to be recorded and reported as per IOTC requirements.

The SC **RECOMMENDED** that scientists from all CPCs having fleets using driftnets in the Indian Ocean shall provide at the next session of the WPEB a report summarizing the known information on bycatch in driftnet fisheries, including sharks and marine mammals, with estimates of their likely order of magnitude where more detailed data are not available.

The SC **RECOMMENDED** that CPCs explore means to undertake research cruises using driftnet vessels in the Indian Ocean aimed at documenting and quantifying the nature and extent of bycatch in these fisheries and for results to be presented at the next Session of the WPEB.

Noting the lack of data on bycatch of these fleets, the SC **REMINDED** coastal countries with gillnet fisheries of their responsibilities to monitor catches and bycatch of these fisheries and **RECOMMENDED** them to improve sampling of landings, to develop and implement their observer schemes, to seek support from the IOTC to develop such activities if necessary and report on progress at the next Session of the WPEB.

Sharks and rays

The SC **NOTED** the absence of information on shark catches from artisanal fisheries in Mozambique and **RECOMMENDED** that information on bycatch from artisanal fisheries is provided at the next Session of the WPEB.

Noting the absence of data on fishing effort, numbers and species of sharks caught, the SC **RECOMMENDED** that the data collection system in Madagascar is strengthened in order to provide catch and effort reports that are consistent with IOTC standards and **ENCOURAGED** Madagascar to work with the IRD of La Réunion to develop a specific logbook for their new longline fleet.

The SC **RECOMMENDED** that all available data and/or indicators on oceanic whitetip shark abundance and population trends are compiled in order to assess current stock status and the level of decline for discussion at the next WPEB and SC.

The SC **RECOMMENDED** further research on silky sharks, including the possible construction of a data series of silky shark abundance from purse seine associated school fisheries.

The WPEB **NOTED** that it is important to collect data from all major gears catching silky sharks, including but not restricted to purse seines, longlines and gillnets and the SC **RECOMMENDED** that indicators of the relative abundance of silky sharks are developing to better quantify changes in abundance.

The SC **NOTED** that a protocol of 'best practices' for shark handling and release onboard purse seiners will be developed by the MADE project and ISSF to minimize the risk of injury of vessel crew and will increase shark survival opportunities and **RECOMMENDED** that these guidelines are presented at the next session of the WPEB.

The SC **RECOMMENDED** that more research is conducted on other mitigation methods to be used prior to the sharks being brought onboard, as well as on post-release mortality of sharks.

The SC **RECOMMENDED** that the recommendations from the KOBE bycatch technical working group are considered to encourage research and development of best practice with regard to setting nets on whale sharks to determine the impacts of the practice. It was noted that these practices are generally recorded in logbooks for the purse seine fleet and the whale sharks are also extracted from the net by fishers, however, it was agreed it would be useful to have information on the extent of the practice and to develop best practice methods through direct collaboration with WCPFC.

Noting the summary of available information on the oceanic whitetip shark (Appendix XI) [Report of the WPEB07] indicating a decline in abundance over the last past two decades, the SC **RECOMMENDED** an urgent need for a more quantitative approach to the assessment of this species.

The SC **RECOMMENDED** research and development of mitigation measures to minimize 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) to make these available to the next meeting in

2012 when the SC **AGREED** to revisit the status of oceanic whitetip sharks and management options be proposed if appropriate.

Noting that the data holdings of the IOTC Secretariat for sharks are limited and would not facilitate stock assessments, the SC **RECOMMENDED** that historic datasets held by CPCs be provided to the IOTC Secretariat as a matter of urgency, in disaggregated forms.

Seabirds

The SC **RECOMMENDED** that targeted observer effort be deployed in specific fisheries where high seabird bycatch is known or suspected.

The meeting **NOTED** that the development of the mitigation measures outlined in the papers presented [at the WPEB07] was the result of excellent collaboration between fishers, seabird experts and mitigation technologists with specialist expertise. Many IOTC members will lack capacity to collect such data, but it is imperative that this be done if further progress is to be made. The SC **RECOMMENDED** that CPCs look to establish collaborative relationships with other CPCs, NGOs and IGOs with the relevant skill set to provide the necessary training and build capacity.

Marine turtles

The SC further **RECOMMENDED** that data on incidental catches of marine turtles should be better recorded in the artisanal and coastal fisheries of the Indian Ocean.

The SC **NOTED** that no new information regarding the development and implementation of any national management plans for the reduction of marine turtle bycatch in tuna fisheries was presented and **RECOMMENDED** that CPCs develop such a plan and that the scientists participating in the WPEB report on progress at the next session of the WPEB.

The SC **RECOMMENDED** that all fleets, including longline, purse seine and gillnet fleets, shall report on interactions between marine turtles and fisheries for tuna and tuna-like species, at the next session of the WPEB.

The SC **RECOMMENDED** that the development and adoption of improved FAD designs to reduce the incidence of entanglement of marine turtles and sharks, including the use of biodegradable materials, be undertaken by the main fleets using FADs, noting that the use of these FADs could become mandatory in the future.

Other bycatch and byproduct species

Noting the potential negative impacts of fish aggregation devices (FADs) on bycatch in fisheries for tuna and tuna-like species in the Indian Ocean, the SC **RECOMMENDED** that CPCs utilizing anchored FADs undertake research aimed as assessing the effect of anchored FADs on bycatch, and for the results to be reported to the next session of the WPEB.

Depredation

Noting that there is currently no mandatory requirement to report incidences of depredation, the SC **RECOMMENDED** that data collection capacity be strengthened, with regard to depredation, in longlines and other major fisheries (i.e. drift gillnets and purse seines). In addition, the use of other data collection methods, such as questionnaires and interviews (which are an important, inexpensive and rapid method for highlighting problems), should be encouraged.

Noting that depredation has been reported to be high in some areas of the Indian Ocean (e.g. 19% in the Seychelles longline fishery: IOTC–2011–WPB09–R), which is much higher than in other regions of the Indian Ocean and would lead to bias in the CPUE series, the SC **RECOMMENDED** that the main longline fleets in the Indian Ocean (Taiwan,China, Japan, Indonesia, EU,Spain, EU,Portugal) carry out research and monitoring programs aimed at determining the level of depredation in a range of areas and under different fishing conditions, and for the results to be presented at the next session of the WPEB.

The SC **RECOMMENDED** that research be carried out by EU scientists to analyse the incidental encirclement of whales, through logbooks and observer data from EU flagged vessels, specifically when setting on whales prior to the mid-1990s and in association with whales after the mid-1990s. These results should be presented to the next session of the WPEB.

Depredation

The SC **NOTED** the development of handling guidelines for cetacean by the WCPFC and **RECOMMENDED** that these be presented and discussed at the session of the WPEB.

Noting that the IOTC Secretariat has received limited information to date on marine mammal interactions with driftnet fisheries in the Indian Ocean, the SC **RECOMMENDED** that all CPCs using drift gillnets to report all interactions between marine mammals and drift gillnet fisheries in the Indian Ocean.

Noting that there is no mandatory requirement to record and report incidental catches of marine mammals, the SC **RECOMMENDED** all CPCs to collect and report marine mammal incidental catches through their observer programmes and **ENCOURAGED** that these interactions are recorded in the logbook of fleets catching species under the IOTC Agreement and reported to the IOTC Secretariat.

Ecosystem approaches

Noting with concern the high levels of shark byproduct and bycatch reported in many National Reports to the Scientific Committee, and considering that future management decisions would benefit from collated bycatch data in an attempt to quantify cumulative bycatch impacts, the SC **RECOMMENDED** that research be

undertaken as a high priority to assess the cumulative impacts of IOTC fishing operations on bycatch species, with a particular emphasis on shark species, noting that the data required to do this is already present in the National Reports of CPCs.

Working Party on Neritic Tunas

Review of data available for neritic tuna species

The SC **NOTED** the main neritic tuna data issues that are considered to negatively affect the quality of the statistics available at the IOTC, by type of dataset and fishery, which are provided in Appendix V [Report of the WPNT01], 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.

Noting that the nominal catch (NC) data provided at the WPNT01 meeting was found to conflict with the NC data history provided by Malaysia to the IOTC Secretariat, the SC **RECOMMENDED** that Malaysia liaise with the IOTC Secretariat in order to verify and provide a revised catch history which will replace the data currently held by the IOTC Secretariat before the next WPNT meeting in 2012.

Noting that substantial data sets, i.e. catch and length frequencies, have been collected in India and that several studies analysing these data sets have already been undertaken, the SC **RECOMMENDED** that this data be reported to the IOTC Secretariat as per the requirements adopted by all IOTC Members through Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties*.

Noting that the paper presented by Indian scientists did not contain information on narrow-barred Spanish mackerel (*Scomberomorus* commerson) and Indo-Pacific king mackerel (*S. guttatus*) which are covered under the mandate of the WPNT, the SC **RECOMMENDED** that fishery information on these mackerel species caught in Indian fisheries be presented at the next meeting of the WPNT.

The SC **AGREED** that there appears to be large datasets available on neritic tuna species caught by fleets of the coastal countries, in particular from India, Indonesia, Malaysia and Thailand, however most of this information has not been provided to the IOTC Secretariat. As such, the SC **RECOMMENDED** that these countries, as well as other CPCs, provide these data sets for neritic tunas, noting that this is already a mandatory requirement as per the IOTC Resolution 10/02 adopted by the IOTC Members, as this would allow a better assessment of the status of these stocks.

Review of information on the status of longtail tuna

Noting that some countries have collected large data sets over long time periods, the SC **RECOMMENDED** that this data, as well as data from other countries, be submitted to the IOTC Secretariat as per the requirements adopted by its members in Resolution 10/02. This would allow the WPNT to develop stock status indicators or a more comprehensive stock assessment of longtail tuna in the future.

Review of information on the status of narrow-barred Spanish mackerel

Noting that some countries have collected large data sets over long time periods, the SC **RECOMMENDED** that this data, as well as data from other CPCs, be submitted to the IOTC Secretariat as per the requirements adopted by its members in Resolution 10/02. This would allow the WPNT to develop stock status indicators or a more comprehensive stock assessment for narrow-barred Spanish mackerel in the future.

Review of information on the status of other neritic tuna species

Noting that some countries have collected large data sets 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 its members in Resolution 10/02. This would allow the WPNT to develop stock status indicators or a more comprehensive stock assessments of other neritic tuna species in the future.

Working Party on Data Collection and Statistics

Discrepancy in the size frequency data available from Japan and Taiwan,China for major IOTC species (yellowfin tuna, bigeye tuna, albacore, swordfish)

Noting the information presented by the IOTC Secretariat on the conflicting estimates of average weight derived from operational catch and size frequency datasets for the longline fisheries of Japan and Taiwan,China over their time series, and the concerning effect that the problems identified may have on the assessments of tuna and billfish species, the SC **RECOMMENDED** that Japan and Taiwan,China work with the IOTC Secretariat in order to clarify these issues, and report on their findings at the next meeting of the WPDCS and any other relevant working party meetings (e.g. WPB, WPTmT and the WPTT).

Update on national Statistics Systems

Noting that while the data collection systems in the Maldives are considered to be appropriately designed, the system continues to rely on summary reports from Island/Atoll Offices until such time the logbook reporting is fully established. Given that quality of the reports from Island/Atoll Offices are deteriorating, the SC **RECOMMENDED** that the Maldives considers implementing a sampling program in order to validate these reports, including the recent logbook data.

The SC **RECOMMENDED** that the Maldives estimate the quantity of bigeye tuna being caught by its fisheries, in particular those operating around anchored FADs.

Recommendations to Improve the Quality of the Statistics at the IOTC

The SC recalled its **RECOMMENDATION** that as resources become available, the IOTC Secretariat commence the process to develop a scoring system to assess the quality of data being reported to the Secretariat, noting that the allocation of scores to all data items in the IOTC databases will require a substantial investment of resources by Secretariat. The process shall be implemented gradually, with yellowfin tuna, bigeye tuna and swordfish data as priorities.

The SC **RECOMMENDED** that countries having sampling schemes or planning to implement such schemes, assess the precision of estimates of catches from those schemes considering different levels of coverage and report the results to the WPDCS.

Noting that paragraph 9 of Resolution 10/04 contains provisions for the reporting of numbers of fishing vessels monitored and the coverage achieved by gear type, by year to both, the Executive Secretary and the Scientific Committee, the SC **RECOMMENDED** that this information is also provided along with the statistics reported to the IOTC (IOTC Resolution 10/02).

The SC recalled its **RECOMMENDATION** for scientists from the EU and Thailand to explore the use of size data collected on EU vessels for the same areas and periods to adjust the species composition from logbooks reported by Thai purse seiners, and to report progress to the next WPDCS meeting.

The SC recalled its **RECOMMENDATION** that Indonesia reported size frequency data for its longline fleet for 2009 and 2010.

APPENDIX IX
CONSOLIDATED RECOMMENDATIONS TO THE IOTC SECRETARIAT, CHAIRS AND NGO'S

Working Party on Billfish

Data inconsistencies for the Japanese and Taiwan,China swordfish catches

The SC **RECOMMENDED** that the IOTC Secretariat finalize 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 Japan, Taiwan,China, Seychelles and EU,Spain and to report final results at the next WPB meeting.

Data collection and reporting systems

The SC **RECOMMENDED** that the IOTC Secretariat travel to India and Pakistan in order to assess the status of data collection and reporting systems in those countries, and to report back to the WPB at its 2012 session.

The SC **RECOMMENDED** that the IOTC Secretariat further assist India and Pakistan in the strengthening of data collection and reporting systems, where required, so as to facilitate reporting of statistics for billfish species as per IOTC standards.

Species identification

The SC **RECOMMENDED** that the IOTC Secretariat, in collaboration with relevant experts, develop species identification cards for marlins and sailfish by the next meeting of the WPB.

Length-age keys and other information

The SC **RECOMMENDED** that as a matter of priority, the IOTC Secretariat formally request, and provide assistance where necessary, CPCs that have important fisheries for billfish (EU, Taiwan,China, Japan, Indonesia and Sri Lanka) to collect and provide the basic data that would be used to establish length-age keys and non-standard measurements to standard measurements keys for billfish species, and sex ratio data, by sex and area.

The SC **RECOMMENDED** that the IOTC Secretariat develop a priority list of measurements to be collected for the purposes of developing length-age keys and other measurement keys, and to communicate this to CPCs before the end of the year.

Sampling coverage

The SC **RECOMMENDED** that the IOTC Secretariat assess levels of reporting for Japan upon receiving size data for 2010 and report back to the next meeting of the WPB.

Logbook coverage

The SC **RECOMMENDED** that the IOTC Secretariat request countries include levels of precision in their reports of catch-and-effort for billfish species.

The SC **RECOMMENDED** that the IOTC Secretariat follow-up on the results of the study with Japan and Taiwan,China and to report to the next WPB meeting.

The SC **RECOMMENDED** that the IOTC Secretariat liaise with the EU,Spain in order to assess the status of catch-and-effort data for marlins and sailfish.

Other data matters

The SC **RECOMMENDED** that the IOTC Secretariat liaise with the Republic of Korea to inform them about the new nominal catches estimated for its longline fishery.

NOTING that Japanese scientists are assisting the Republic of Korea in the review of catch-and-effort data series for longline vessels under the flag of Korea; The SC **RECOMMENDED** that the IOTC Secretariat follow-up with Japan and the Republic of Korea in order to obtain a new catch-and-effort data series from the Republic of Korea as soon as possible.

Sports fisheries

The SC **RECOMMENDED** that the IOTC Secretariat develop a project aimed at enhancing data recovery from sports and other recreational fisheries in the region, in collaboration with Kenya and other interested parties, and to report progress at the next WPB meeting.

The SC **RECOMMENDED** that as a matter of priority, the Chair of the WPB, in collaboration with the IOTC Secretariat, participating billfish foundations and other interested parties, facilitate the acquisition of catch-and-effort and size data from sport fisheries, by developing and disseminating reporting forms to Sport Fishing Centres in the region and to report back to the WPB at its meeting in 2012.

The SC **RECOMMENDED** that the IOTC Secretariat provide contact details for purse seine and longline fleets obtained during the Regional Tuna Tagging Project-Indian Ocean (RTTP-IO), to participating billfish foundations so that they may improve their own outreach and awareness campaigns.

The SC **RECOMMENDED** that the African Billfish Foundation (ABF) work with the IOTC Secretariat to facilitate engagement between the ABF and IOTC scientists on issues from data analysis to the collection and dissemination of biological information on billfish species.

India longline fishery: Indo-Pacific sailfish

The SC **RECOMMENDED** that as a matter of priority, the IOTC Secretariat liaise with India, Oman, Indonesia, Philippines and Malaysia in order to improve the quality of the data reported from their longline fleets, by species, and to report back to the WPB at its next meeting.

Indonesian longline fishery

The SC **RECOMMENDED** that the IOTC Secretariat send a mission to Indonesia to assist in the reporting of catch-and-effort data and to report progress to the WPB at its next meeting.

Sri Lankan billfish fisheries

The SC **RECOMMENDED** that the IOTC-OFCF Project assist Sri Lanka to strengthen sampling efforts on its coastal and off-shore fisheries in late 2011, where required.

Working Party on Tropical Tunas

Review of the data available for tropical tuna species

Noting that an IOTC mission to Pakistan was scheduled but had to be postponed due to the situation in the country, the SC **RECOMMENDED** that the IOTC Secretariat travel to Pakistan once the situation improves, in order to assess the status of data collection and reporting systems in this country and to report back to the WPTT at its 2012 session.

The SC **NOTED** the plans from the IOTC-OFCF Project to hold a Catch Estimation Workshop in Indonesia in March 2012, in order to assess data collection and reporting systems for Indonesia's coastal and longline fisheries. The WPTT thanked the IOTC-OFCF Project for this initiative and **RECOMMENDED** that the outcomes of the Workshop be reported to the next Session of the WPTT.

The SC **RECOMMENDED** that as a matter of priority, the IOTC Secretariat liaise with India, Oman, Indonesia, Philippines and Malaysia to implement the minimum requirements of IOTC Resolution 08/04 *concerning the recording of catch by longline vessels in the IOTC area*, in order to improve the quality of the data reported from their longline fleets, by species, and to report back to the WPTT at its next meeting.

The SC **RECOMMENDED** that the IOTC Secretariat continue working with the Iranian authorities towards improving reporting from their purse seine fleet, and to report progress to the WPTT at its next meeting.

Noting the difficulties that the IOTC Secretariat has experienced in completing the review of datasets for tropical tunas, including the implementation of a scoring system and further use of those scores to derive alternative series of catches for tropical tuna species, the SC **RECOMMENDED** that the Secretariat makes every possible effort to finalize this work before the next meeting of the WPTT in 2012.

Noting the preliminary results of a study conducted by the IOTC Secretariat comparing average weights, as derived from the length frequency, and time area catches in number and weight available for the longline fleets of Japan and Taiwan,China, the SC **RECOMMENDED** that the IOTC Secretariat complete this study and present results to the next meeting of the WPDCS.

Review of new information on the status of yellowfin tuna

The SC thanked Dr. Adam Langley (consultant) for his contributions and expertise on integrated stock assessment models, and **RECOMMENDED** that his engagement be renewed for the coming year.

The SC **RECOMMENDED** that the IOTC stock assessment scientist and consultant work in collaboration with Japanese scientists and other interested participants to produce an SS3 assessment for yellowfin tuna in 2012 for presentation to the WPTT.

Working Party on Ecosystems and Bycatch

KOBE process

The SC **RECOMMENDED** that the Secretariat maintain its involvement in the KOBE process and to lead and/or facilitate the IOTCs involvement with the Bycatch Joint Technical Working Group.

Noting paragraph 14 of Resolution 11/04 *on a Regional Observer Scheme* which states that "*The funds available from the IOTC balance of funds may be used to support the implementation of this programme in developing States, notably the training of observers and field samplers*", and that the IOTC Secretariat has hired a consultant to carry out an evaluation of the data collection and reporting capabilities of a number of developing coastal state CPCs, the SC **RECOMMENDED** that the IOTC Secretariat facilitate the training of observers and field samplers according to the IOTC Regional Observer Scheme Manual and Observer Trip Report Template.

The SC **RECOMMENDED** that all CPCs comply with the requirements of Resolution 09/06 *on Marine Turtles* which states that "*CPCs with longline vessels that fish for species covered by the IOTC Agreement shall: Ensure that the operators of all longline vessels carry line cutters and de-hookers in order to facilitate the appropriate handling and prompt release of marine turtles caught or entangled, and that they do so in accordance with IOTC Guidelines to be developed. CPCs shall also ensure that operators of such vessels are required to carry and use, where appropriate, dip-nets, in accordance with guidelines to be adopted by the IOTC.*", and that the IOTC Secretariat develop guidelines for handling and de-hooking marine turtles caught on longliners, and for these to be distributed to all CPCs before the next WPEB meeting.

The SC **RECOMMENDED** that the IOTC Secretariat develop an identification guide for hooks used in IOTC fisheries, and to distribute the guide to all CPCs once completed.

The SC **RECOMMENDED** that the IOTC Secretariat print and disseminate the IOTC identifications cards for marine turtles, seabirds and sharks using the remaining funds allocated to the task and to distribute these to developing coastal states as a priority, for use by observers accredited for the Regional Observer Scheme and field samplers (Resolution 11/04), and to a larger extent to their fishing fleets targeting tuna, tuna-like and shark species. This would allow accurate observer, sampling and logbook data on marine turtles, seabirds and sharks to be recorded and reported as per IOTC requirements.

The SC **REITERATED** that CPCs should fulfill their FAO obligation to assess the need for an NPOA-Sharks and develop plans if appropriate. The SC **RECOMMENDED** that to assist in this, the IOTC Secretariat should revise annually the table summarising progress towards the development of NPOA-Sharks by CPCs for the consideration as each WPEB and the Scientific Committee meeting.

The SC **RECOMMENDED** a databank of geo-referenced photographs of sharks (and other species groups) caught in the Indian Ocean be established at the IOTC Secretariat with contributions by scientists and observers from the region. The SC **NOTED** that this would be a useful tool for verification of species identifications.

Marine turtles

The SC **RECOMMENDED** that the comprehensive 'Assessment of the conservation status of the leatherback turtle in the Indian Ocean and South-East Asia', prepared by IOSEA in 2006, be reviewed, especially with regard to its recommended follow-up.

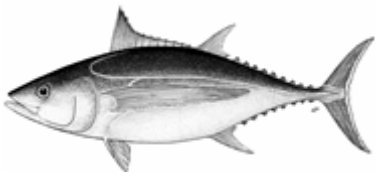
Working Party on Data Collection and Statistics

The SC **RECOMMENDED** that the IOTC Secretariat makes an evaluation of the costs associated with data management of the observer data (e.g. development and maintenance of a database, data entry etc.).

IOTC Data Summary and Field Manual

Noting that the IOTC Secretariat has not resumed the publication of the IOTC Data Summary due to a lack of resources, the SC **RECOMMENDED** that the IOTC Secretariat design a new Data Summary and present an example at the next meeting of the WPDCS and for publication on the new IOTC website once completed.

APPENDIX X
EXECUTIVE SUMMARY: ALBACORE TUNA



STATUS OF THE INDIAN OCEAN ALBACORE TUNA RESOURCE
(*THUNNUS ALALUNGA*)

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

Area[1]	**Indicators – 2011 assessment**		**2011 stock status determination**
			2010[2]
Indian Ocean	Catch 2010:	43,711 t	
	Average catch 2006–2010:	41,074 t	
	MSY (1 model):	29,900 t (21,500–33,100 t)	
	F_{2010}/F_{MSY} (1 model):	1.61 (1.19–2.22)	
	B_{2010}/B_{MSY} (1 model):	0.89 (0.65–1.12)	
	B_{2010}/B_{1980} (1 model):	0.39 (n.a.)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]The stock status refers to the most recent years' data used for the assessment.

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

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

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

Outlook. Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE. The impacts of piracy in the western Indian Ocean has resulted in the displacement of a substantial portion of longline fishing effort into the traditional albacore fishing areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on albacore will decline in the near future.

The SC **RECOMMENDED** the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- Current catches (average ~41,000 t over the last five years, ~44,000 t in 2010) likely exceed MSY (29,900 t, range: 21,500–33,100 t). Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.
- A Kobe 2 Strategy matrix was calculated to quantify the risk of different future catch scenarios. However, a number of inconsistencies between the model and data were noted for future investigation (matrix not presented here as a result).

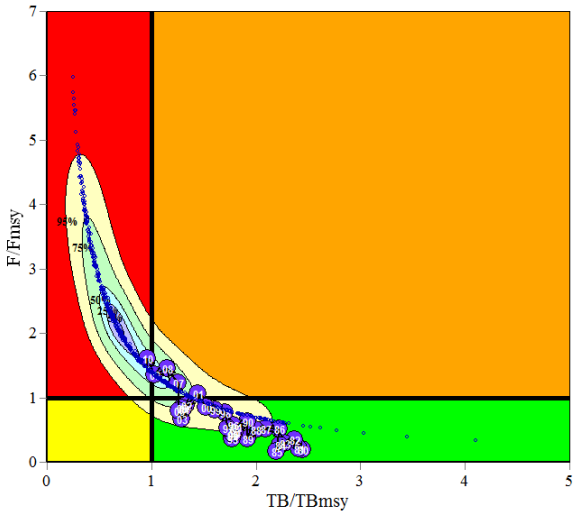


Fig. 1. ASPIC Aggregated Indian Ocean assessment Kobe plot (95% Confidence surfaces shown around 2010 estimate). Fixed B/K=0.9. Blue circles indicate the trajectory of the point estimates for the TB ratio and F ratio for each year 1980–2010 (Note: at this time the WPTmT had limited confidence in the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

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 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area*.
- Resolution 09/02 *On the implementation of a limitation of fishing capacity of contracting parties and cooperating non-contracting parties*.
- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*.
- Resolution 10/03 *concerning the recording of catch by fishing vessels in the IOTC area.*
- Resolution 10/07 *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 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence*.

FISHERIES INDICATORS

General

Overall, the biology of albacore stock in the Indian Ocean is not well known and there is relatively little new information on albacore stocks. Albacore (*Thunnus alalunga*) life history characteristics, including a relatively late maturity, long life and sexual dimorphism, make the species vulnerable to over exploitation. Table 2 outlines some of the key life history traits of albacore specific to the Indian Ocean.

Catch trends

Albacore are currently caught almost exclusively using drifting longlines (98%), and between 20°S and 40°S, with remaining catches recorded using purse seines and other gears (Fig. 2). Between 1983 and 1992, a large portion of albacore catches were taken by the Taiwan,China fleet using drifting gillnets (Fig. 2; Table 3) which 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.

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, with total catches in excess of 30,000 t. Following the removal of the drifting gillnet fleet, catches dropped to less than 20,000 t by

1993. However, catches more than doubled over the period from 1993 (less than 20,000 t) to 2001 (44,000 t). Record catches of albacore were reported in 2007, at around 45,000 t, and again in 2008, at 48,000 t. Catches for 2009 are estimated to be approximately 40,000 t, while preliminary catches for 2010 amount to 43,711 t (Table 3).

TABLE 2. Biology of Indian Ocean albacore (*Thunnus alalunga*)

Parameter	Description
Range and stock structure	A temperate tuna living mainly in the mid oceanic gyres of the Pacific, Indian and Atlantic oceans. In the Pacific and Atlantic oceans there is a clear separation of southern and northern stocks associated with the oceanic gyres that are typical of these areas. In the Indian Ocean, there is probably only one southern stock, distributed from 5°N to 40°S, because there is no northern gyre. Albacore is a highly migratory species and individuals swim large distances during their lifetime. It can do this because it is capable of thermoregulation, has a high metabolic rate, and advanced cardiovascular and blood/gas exchange systems. Pre-adults (2-5 year old albacore) appear to be more migratory than adults. In the Pacific Ocean, the migration, distribution availability, and vulnerability of albacore are strongly influenced by oceanographic conditions, especially oceanic fronts. It has been observed on all albacore stocks that juveniles concentrate in cold temperate areas (for instance in a range of sea-surface temperatures between 15 and 18°C), and this has been confirmed in the Indian Ocean where albacore tuna are more abundant north of the subtropical convergence (an area where these juvenile were heavily fished by driftnet fisheries during the late 1980's). It appears that juvenile albacore show a continuous geographical distribution in the Atlantic and Indian oceans in the north edge of the subtropical convergence. Albacore may move across the jurisdictional boundary between ICCAT and IOTC. It is likely that the adult Indian Ocean albacore tunas do yearly circular counter-clockwise migrations following the surface currents of the south tropical gyre between their tropical spawning and southern feeding zones. In the Atlantic Ocean, large numbers of juvenile albacore are caught by the South African pole-and-line fishery (catching about 10,000 t yearly) and it has been hypothesized that these juveniles may be taken from a mixture of fish born in the Atlantic (north east of Brazil) and from the Indian Ocean. For the purposes of stock assessments, one pan-ocean stock has been assumed.
Longevity	8 years (reported to 10 years in the Pacific)
Maturity (50%)	Age: females 5–6 years; males n.a. Size: females n.a.; males n.a.
Spawning season	Little is known about the reproductive biology of albacore in the Indian Ocean but it appears, based on biological studies and on fishery data, that the main spawning grounds are located east of Madagascar between 15° and 25°S during the 4th and 1st quarters of each year. Like other tunas, adult albacore spawn in warm waters (SST>25°C).
Size (length and weight)	n.a.

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

Catches of albacore in recent years have come almost exclusively from vessels flagged in Indonesia and Taiwan,China, although the catches of albacore reported for the fresh tuna longline fishery of Indonesia have increased considerably since 2003 to around 17,000 t (Fig. 3), which represents approximately 40% of the total catches of albacore in the Indian Ocean.

Longliners from Japan and Taiwan,China have been operating in the Indian Ocean since the early 1950s (Fig. 3). While 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.

In contrast to the Japanese longliners, catches by Taiwan,China longliners increased steadily from the 1950's to average around 10,000 t by the mid-1970s. Between 1998 and 2002 catches ranged between 21,500 t to 26,900 t, equating to just over 60% of the total Indian Ocean albacore catch. Between 2003 and 2010 the albacore catches by Taiwan,China longliners have been between 10,000 and 18,000 t, with catches appearing to be on the increase in recent years. There has been a shift in the proportion of catches of albacore by deep-freezing and fresh-tuna longliners in recent years, with increasing catches of fresh-tuna (68% of the total catches for 2008–2010) as opposed to deep-freezing longliners (Fig. 2; Table 3).

While most of the catches of albacore have traditionally come from the western Indian Ocean, in recent years a larger proportion of the catch has come from the southern and eastern Indian Ocean (Fig. 4; Table 4). The relative increase in catches in the eastern Indian Ocean since the early 2000's is mostly due to increased activity of fresh-tuna longliners from Taiwan,China and Indonesia (Indonesia not represented in Fig. 4 as spatial catch-and-effort data is not available or

highly uncertain for these fleets). In the western Indian Ocean, the catches of albacore mostly result from the activities of deep-freezing longliners and purse seiners.

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

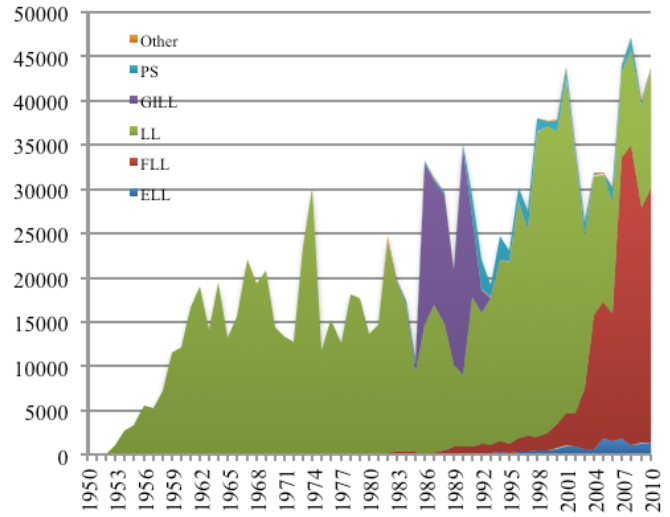


Fig. 2. Annual catches of albacore by gear recorded in the IOTC Database (1961–2010) (Data as of August 2011). Other gears nei (Other); Purse seine (PS); Freezing-longline (LL); Fresh-tuna longline (FLL); Swordfish-longline (ELL)

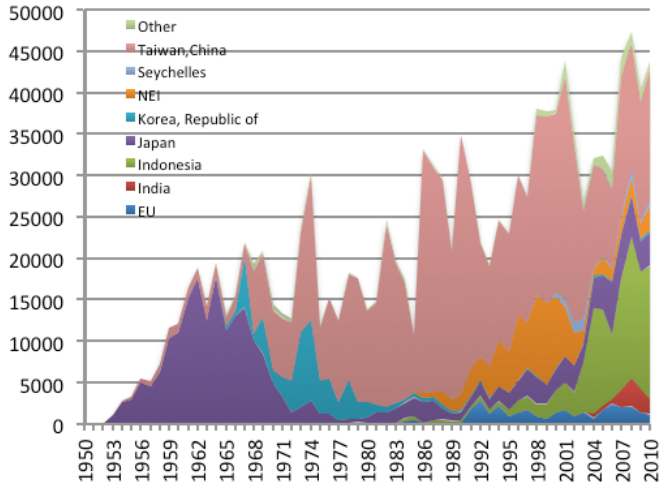


Fig. 3. Annual catches of albacore by fleet recorded in the IOTC Database (1961–2010) (Data as of August 2011).

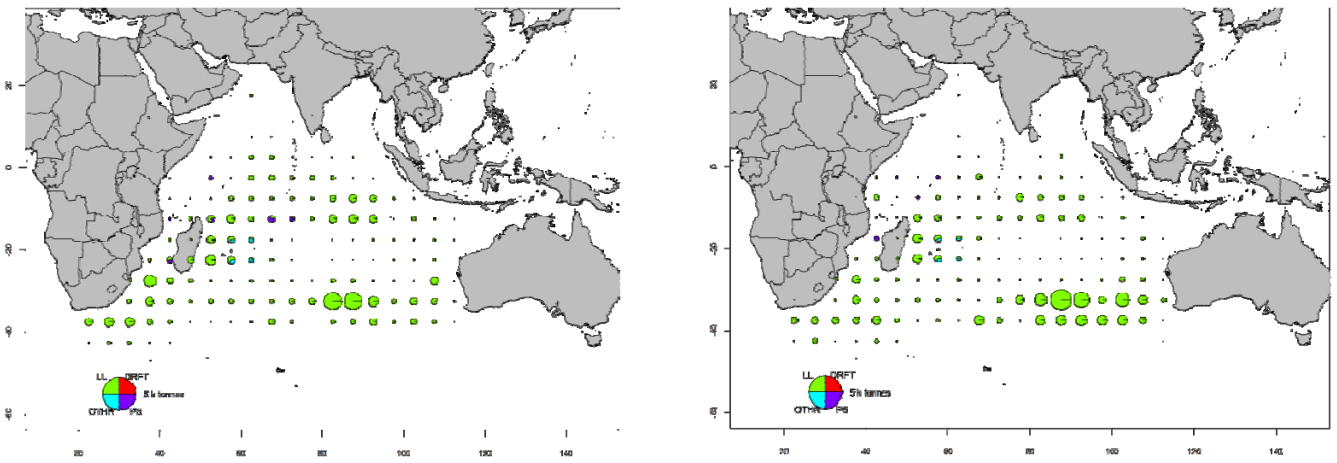


Fig. 4a–b. Time-area catches (total combined in tonnes) of albacore estimated for 2009 (left) and 2010 (right) by type of gear: Longline (LL, green), Driftnet (DFRT, red), Purse seine (PS, purple), Other fleets (OTHER, blue). Time-area catches are not available for all fleets; catches for those were assigned by 5x5 square and month using information from other fleets. Catches of fresh-tuna longliners are not represented (Data as of August 2011).

TABLE 3. Best scientific estimates of the catches of albacore (*Thunnus alalunga*) by gear and main fleets [or type of fishery] by decade (1950–2000) and year (2001–2010), in tonnes. Data as of October 2011. Catches by decade represent the average annual catch, noting that some gears were not used for all years (refer to Fig. 2).

	By decade (average)						By year (last ten years)									
Fishery	**1950s**	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
DN				5,823	3,735											
LL	3,715	17,231	16,900	15,212	21,876	20,283	38,664	29,998	17,818	16,283	16,149	14,123	11,468	11,704	12,874	14,498
FLL			80	314	1,329	15,493	3,728	3,920	6,910	15,242	15,524	14,455	31,759	33,969	26,619	28,752
FS				195	1,578	855	1,030	755	1,493	230	149	1,388	705	1,391	366	166
LS				8	105	65	251	17	3	2	15	160	21	33	26	42
OT	5	9	24	67	61	148	172	139	131	150	143	108	107	91	293	254
Total	**3,721**	**17,240**	**17,005**	**21,620**	**28,684**	**36,844**	**43,845**	**34,829**	**26,355**	**31,906**	**31,979**	**30,234**	**44,059**	**47,189**	**40,178**	**43,711**

Fisheries: Driftnet (**DN**; Taiwan,China); Freezing-longline (**LL**); Fresh-tuna longline (**FLL**); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Other gears nei (**OT**). Note: LL includes the ELL catches shown in Fig. 2.

TABLE 4. Best scientific estimates of the catches of albacore (*Thunnus alalunga*) by fishing area for the period 1950–2009 (in metric tons). Data as of October 2011.

	By decade (average)						By year (last ten years)									
Area	**1950s**	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
N	3,369	8,275	7,659	5,486	8,525	21,597	20,526	13,867	14,049	19,538	19,809	18,625	34,248	30,189	29,827	23,257
S	351	8,965	9,346	16,134	20,158	15,247	23,319	20,962	12,306	12,368	12,170	11,609	9,811	17,000	10,351	20,454
Total	**3,721**	**17,240**	**17,005**	**21,620**	**28,684**	**36,844**	**43,845**	**34,829**	**26,355**	**31,906**	**31,979**	**30,234**	**44,059**	**47,189**	**40,178**	**43,711**

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

Uncertainty of catches

Retained catches are fairly well known (Fig. 5); however catches are uncertain for:

- Longliners of Indonesia, India and Malaysia operating in Southern waters: To date, Indonesian, Indian and Malaysian longline vessels operating in Southern waters have not reported catches of albacore, noting that the Secretariat has estimated these catches at around 3000 t annually.
- Fleets using gillnets on the high seas, in particular Iran, Pakistan and Sri Lanka: Catches are likely to be less than 1000 t.
- Non-reporting industrial longliners (NEI): Refers to catches from longliners operating under flags of non-reporting countries. Historically high catches, however thought to be between 1000 and 2000 t in recent years.

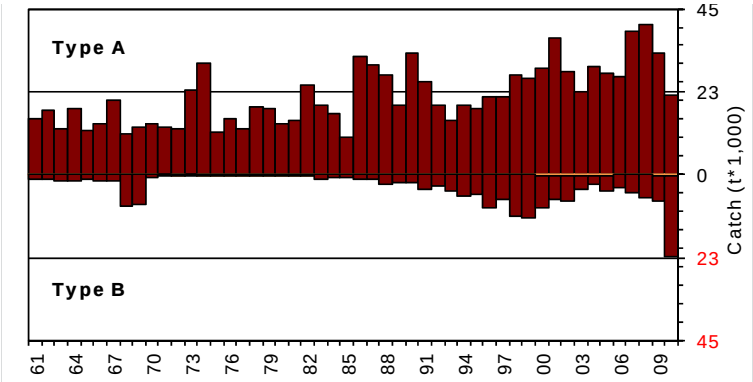


Fig. 5. Uncertainty of annual catch estimates for albacore (1950–2010) (Data as of August 2011).

*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.*

- The catch series for albacore in recent years has changed substantially, especially since 2003. This change was due to a review of the data series for Indonesian longliners (Fig. 6).
- Levels of discards are believed to be low although they are unknown for industrial fisheries other than European (EU) purse seiners.
- 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 and Philippines.
    - non-reporting by industrial purse seiners and longliners (NEI).

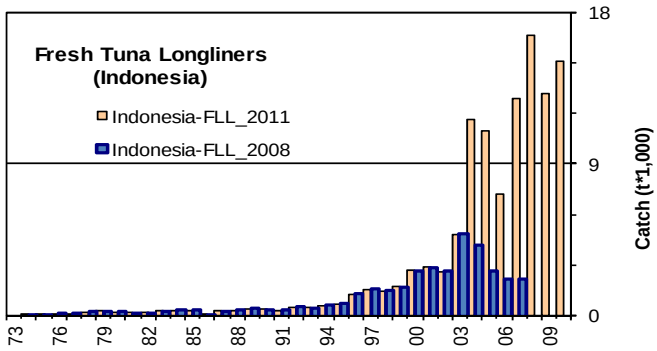


Fig. 6. Catches of fresh-tuna longline vessels based in Indonesia (domestic and foreign) estimated in 2011 (1973–2010) versus catches estimated in 2008 (1973–2006). The revised Indonesian nominal catch series data was estimated by the IOTC Secretariat.

Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid from 2007 to 2010 are provided in Fig. 7, and total effort from purse seine vessles flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2007 to 2010 are provided in Fig. 8.

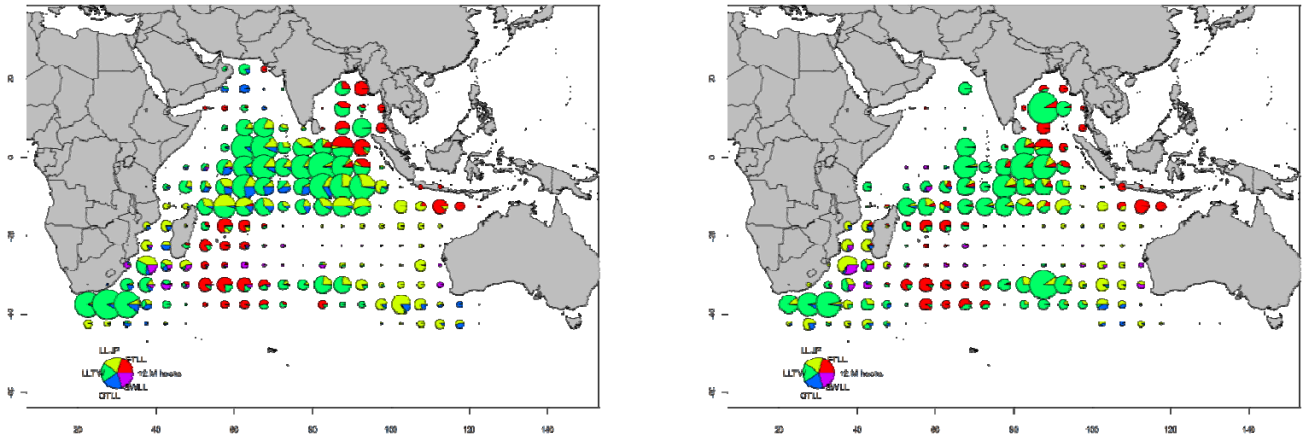


Fig. 7. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

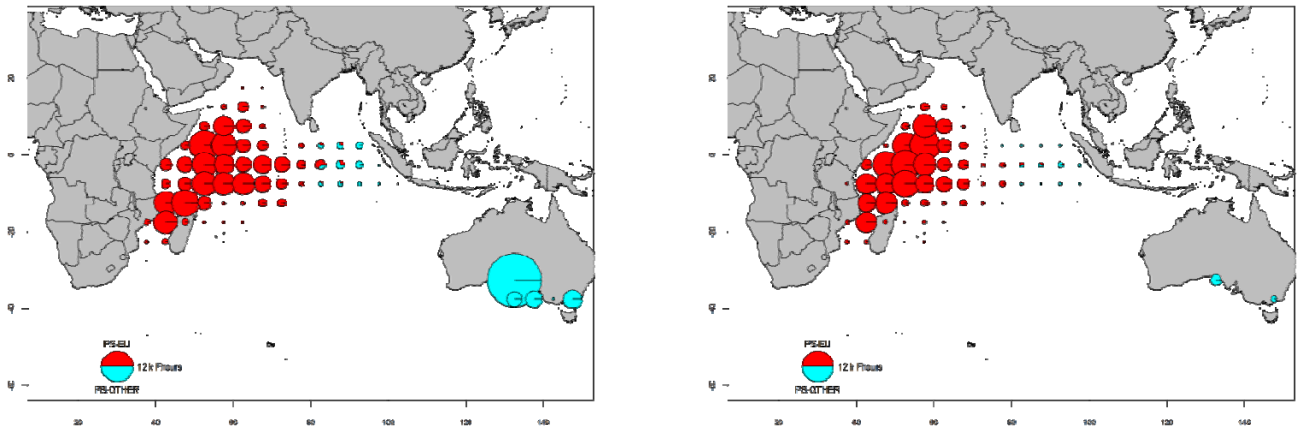


Fig. 8. Number of hours of fishing(Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

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

The CPUE series available for assessment purposes are shown in Fig. 9, although only the Taiwan,China series was used in the stock assessment model for 2011 for the reasons discussed in IOTC–2011–WPTmT03–R.

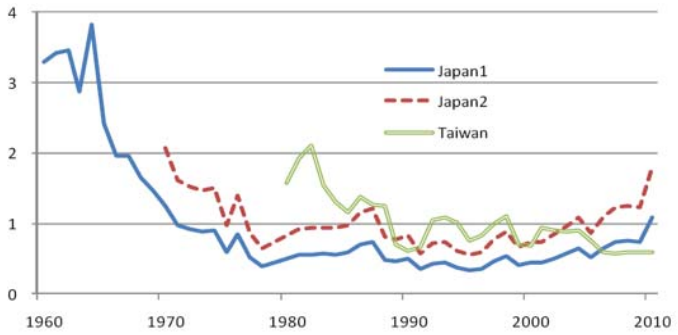


Fig. 9. Comparison of the three CPUE series for Indian Ocean albacore. Series have been rescaled relative to their respective means from 1960–2010.

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

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

- Trends in average weight can be assessed for several industrial fisheries although they are incomplete or of poor quality for most fisheries before 1980, between 1986 and 1991, and in recent years, for the fleets referred to above (Fig. 10).
- Catch-at-Size(Age) tables are available but the estimates are highly uncertain for some periods and fisheries including:
    - all industrial longline fleets before the mid-60s, from the early-1970s up to the early-1980s and most fleets in recent years, in particular fresh-tuna longliners.
    - the paucity of catch by area data available for some industrial fleets (Taiwan,China, NEI, India and Indonesia).

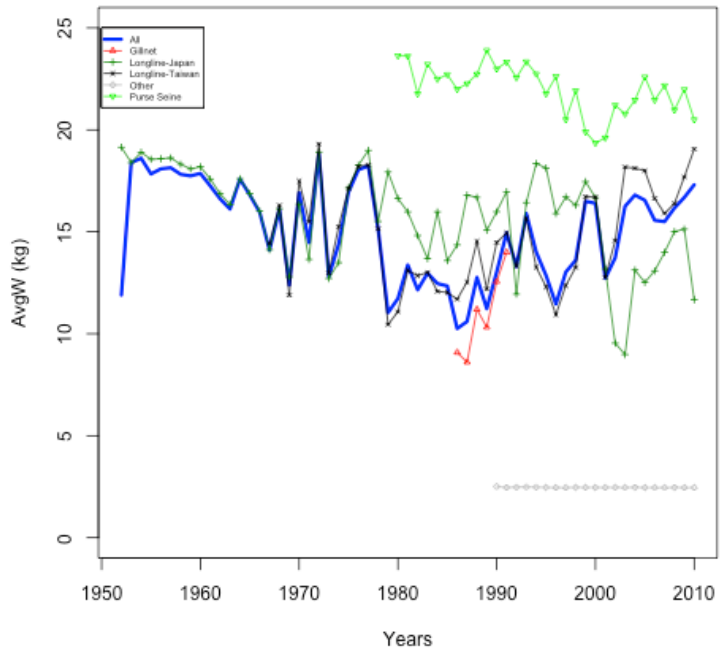


Fig. 10. Average weight in kg of the catches of all fleets (blue), gillnet (red), LL-JPN (dark green), LL-TWN (black), Purseine (green) and other gears (grey) from 1950 to 2010.

STOCK ASSESSMENT

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

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

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

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

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

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

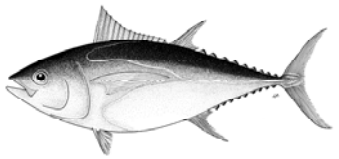
Management Quantity	Aggregate Indian Ocean
2010 catch estimate (1000 t)	43.7
Mean catch from 2006–2010 (1000 t)	41.1
MSY (1000 t) (80% CI)	29.9 (21.5–33.1)
Data period used in assessment	1980–2010
F_{2010}/F_{MSY} (80% CI)	1.61 (1.19–2.22)
B_{2010}/B_{MSY} (80% CI)	0.89 (0.65–1.12)
SB_{2010}/SB_{MSY}	–
B_{2010}/B_{1980} (80% CI)	0.39 (n.a.)
SB_{2010}/SB_{1980}	–
$B_{2010}/B_{1980, F=0}$	–
$SB_{2010}/SB_{1980, F=0}$	–

LITERATURE CITED

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

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

APPENDIX XI
EXECUTIVE SUMMARY: BIGEYE TUNA



STATUS OF THE INDIAN OCEAN BIGEYE TUNA RESOURCE
(*THUNNUS OBESUS*)

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

Area[1]	Indicators – 2011 assessment			2011 stock status determination
				2009[2]
		SS3[3]	ASPM[4]	
Indian Ocean	Catch (1000 t):	102.0 t	71.5 t	
	Average catch last 5 years:	104.7 t	104.7 t	
	MSY (1000 t):	114 (95–183 t)	102.9 t (86.6–119.3 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	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]The stock status refers to the most recent years' data used for the assessment.
[3]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.
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

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 $F_{2019}>$FMSY) (Table 1).

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.

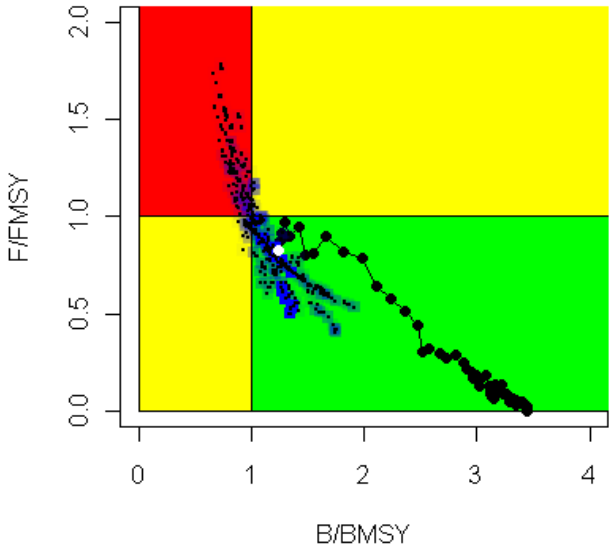


Fig. 1. SS3 Aggregated Indian Ocean assessment Kobe plot. Black circles represent the time series of annual median values from the weighted stock status grid (white circle is 2009). Blue squares indicate the MPD estimates for 2009 corresponding to each individual grid C model, with colour density proportional 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, ± 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 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% (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[2]				
	60% (42,900t)	**80%** (57,200t)	**100%** (71,500t)	**120%** (85,800t)	**140%** (100,100t)
$SB_{2013} < SB_{MSY}$	4	8	15	24	35

[2] Projections were undertaken with a steepness value at 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).

$F_{2013} > F_{MSY}$	<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*.

FISHERIES INDICATORS

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. 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 and weight)	Maximum length: 200 cm FL; Maximum weight: 210 kg. 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)

Catch trends

Bigeye tuna are mainly caught by industrial purse seine and longline fisheries and appears only occasionally in the catches of other fisheries (Fig. 2). However, in recent years the amounts of bigeye tuna caught by gillnet fisheries are likely to be considerably higher than what is reported, due to the major changes experienced in some of these fleets, notably changes in boat size, fishing techniques and fishing grounds.

Total annual bigeye tuna 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). Total annual catches averaged 130,849 t over the period 2001–2005 and 104,635 t over the period 2006–2010 (Table 4). In 2010, preliminary catches of bigeye tuna have been estimated to be at around 71,489 t, representing a large decrease in catches with respect to those estimated for 2009 and previous years (Figs. 2, 3).

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 (Figs. 4a, b).

Bigeye tuna has been caught by industrial longline fleets since the early 1950's, but before the mid-1970's they only represented an incidental component of the total catch. With the introduction of fishing practices that improved the access to the bigeye tuna resource and the emergence of a sashimi market in the mid-1970's, bigeye tuna became an important target species for the main industrial longline fleets (Figs. 2, 3). The catches estimated for 2010 are at around 46,000 t, representing less than half the longline catches of bigeye tuna recorded before the onset of piracy in the Indian Ocean.

The total catch of bigeye tuna by purse seiners in the Indian Ocean reached 40,700 t in 1999, but the average annual catch for the period 2006–2010 was 26,000 t (25,000 t for 2001–2005) (Fig. 2). Purse seiners mainly take small juvenile bigeye tuna (averaging around 5–6 kg) whereas longliners catch much larger and heavier fish; and therefore while purse seiners take much lower tonnages of bigeye tuna compared to longliners, they take larger numbers of individual fish.

Although the activities of purse seiners have been affected by piracy in the Indian Ocean, the effects have not been as marked as with longliners. The main reason for this is the presence of security personnel onboard purse seine vessels since the mid-2009, which has made it possible for purse seiners to operate in the northwest Indian Ocean without a reduction in fishing effort (Fig. 4). However, in the IOTC area an approximate 30% reduction of the number of purse seiner has been observed since 2006.

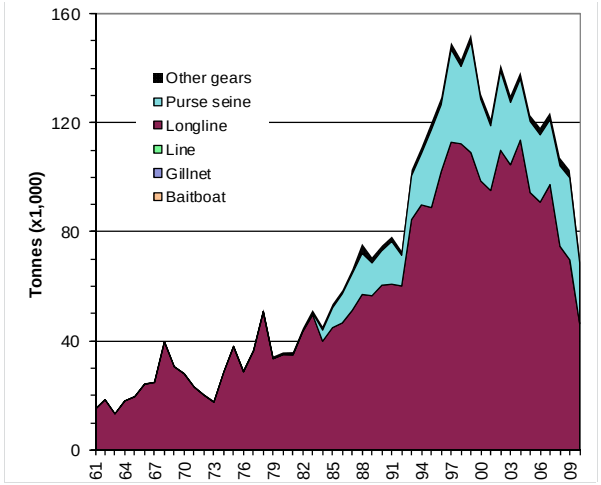


Fig. 2. Annual catches of bigeye tuna by gear recorded in the IOTC Database (1961–2010) (Data as of September 2011).

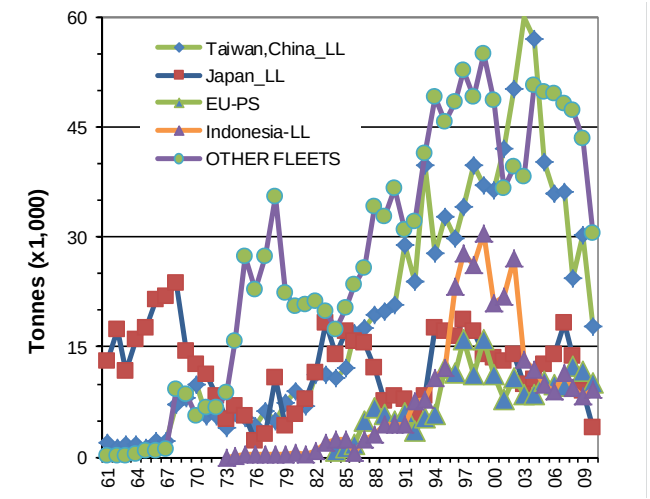


Fig. 3. Annual catches of bigeye tuna by fleet recorded in the IOTC Database (1961–2010) (Data as of September 2011).

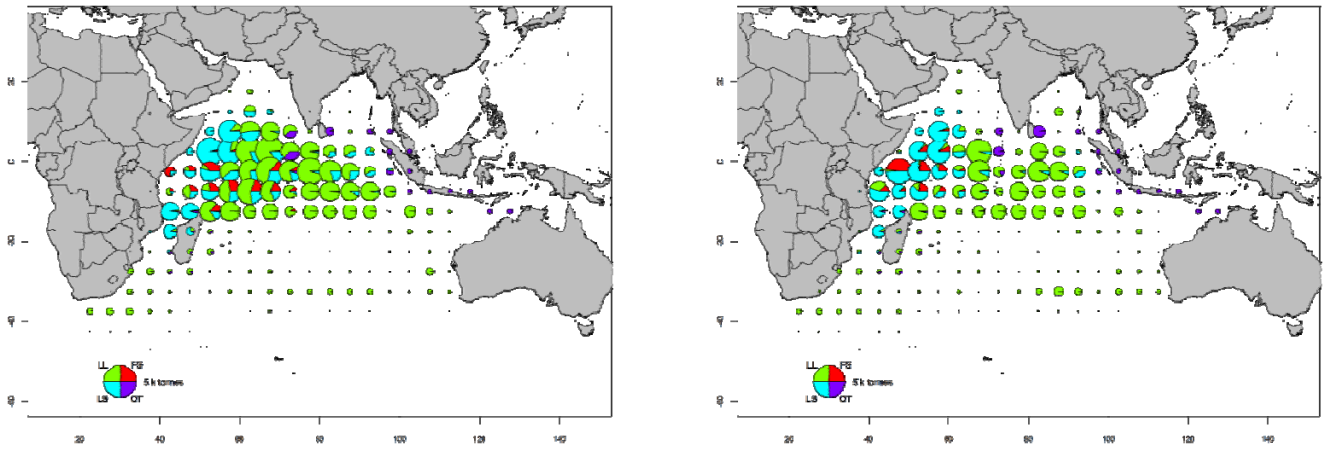


Fig. 4a–b. Time-area catches (total combined in tonnes) of bigeye tuna estimated for 2009 and 2010 by type of gear: Longline (LL), Purse seine free-schools (FS), Purse seine associated-schools (LS), and other fleets (OT), including pole-and-line, drifting gillnets, and various coastal fisheries (Data as of September 2011).

TABLE 4. Best scientific estimates of the catches of bigeye tuna (*Thunnus obesus*) by gear and main fleets [or type of fishery] by decade (1950–2000) and year (2001–2010), in tonnes. Data as of October 2011. 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	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
LL-TW	6,008	18,684	23,647	28,226	19,759	14,699	14,693	14,091	11,217	13,288	15,299	17,261	19,630	14,336	9,812	4,490
LL-JP	481	3,288	6,820	17,716	68,347	80,201	80,472	95,807	93,398	100,341	79,064	73,632	77,695	60,417	59,917	41,875
FS	0	0	0	2,067	4,808	6,042	4,260	4,099	7,172	3,658	8,501	6,406	5,670	9,648	5,317	3,827
LS	0	0	0	4,234	18,224	20,147	19,457	24,944	15,662	18,749	17,568	18,249	18,066	19,831	24,773	18,438
OT	154	279	575	1,544	2,298	2,577	2,564	2,504	2,573	2,549	2,315	2,616	2,667	2,897	2,846	2,859
Total	**6,642**	**22,252**	**31,043**	**53,787**	**113,437**	**123,666**	**121,447**	**141,445**	**130,023**	**138,584**	**122,748**	**118,164**	**123,728**	**107,129**	**102,664**	**71,489**

Fisheries: Longline Taiwan,China and assimilated fleets (LL-TW); Longline Japan and assimilated fleets (LL-JP); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Other gears nei (**OT**).

Uncertainty of catches

Retained catches are thought to be well known for the major fleets (Fig. 5); but are uncertain for the fleets listed below, noting that catches for these fleets are considered to represent a small proportion of total catches:

- Non-reporting industrial purse seiners and longliners (NEI) and for other industrial fisheries (longliners of India and Philippines).
- Some artisanal fisheries including the pole-and-line fishery in the Maldives.
- The gillnet fisheries of Iran and Pakistan.
- The gillnet/longline fishery in Sri Lanka.
- The artisanal fisheries in Indonesia, Comoros and Madagascar.

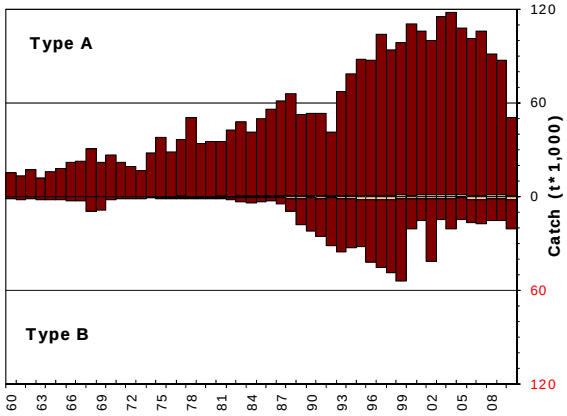


Fig. 5. Uncertainty of annual catch estimates for bigeye tuna (Data as of September 2011).

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.

- The catch series for bigeye tuna has not been significantly revised since the WPTT12 in 2010.
- Levels of discards are believed to be low although they are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–2007.
- Catch-and-effort series 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 very little data available for the fresh-tuna longline fishery of Taiwan,China.
    - uncertain data from significant fleets of industrial purse seiners from Iran and longliners from India, Indonesia, Malaysia, Oman, Philippines, and Taiwan,China (fresh tuna up to 2006).
    - no data available for the highseas gillnet fisheries of Iran and Pakistan and the gillnet/longline fishery of Sri Lanka, especially in recent years.

Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid from 2007 to 2010 are provided in Fig. 6, and total effort from purse seine vessles flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2007 to 2010 are provided in Fig. 7. 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.

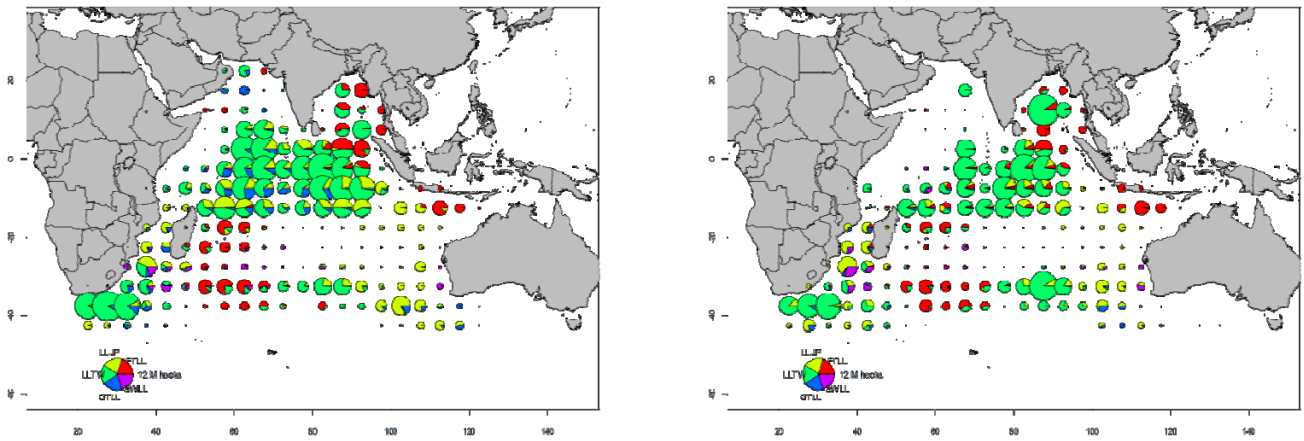


Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

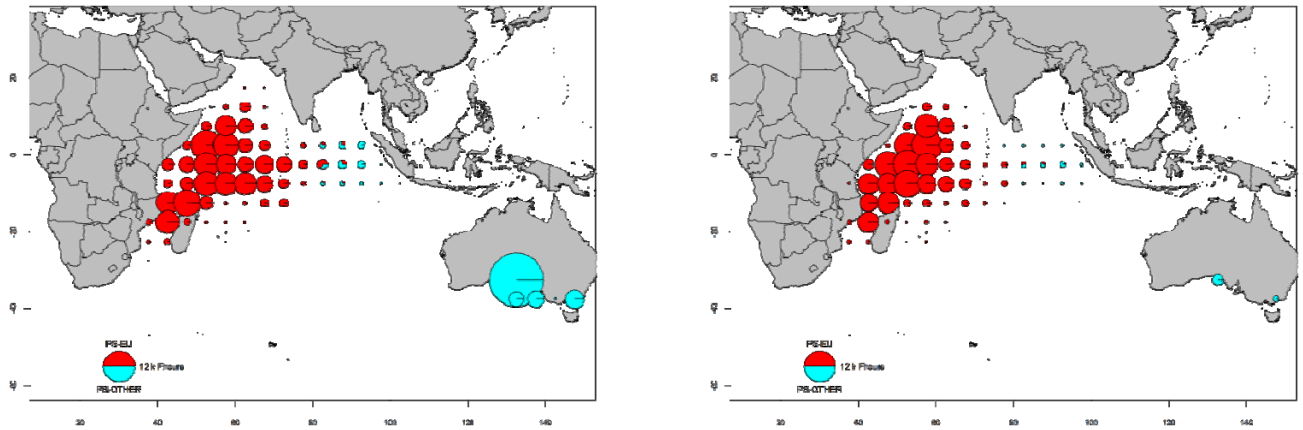


Fig. 7. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

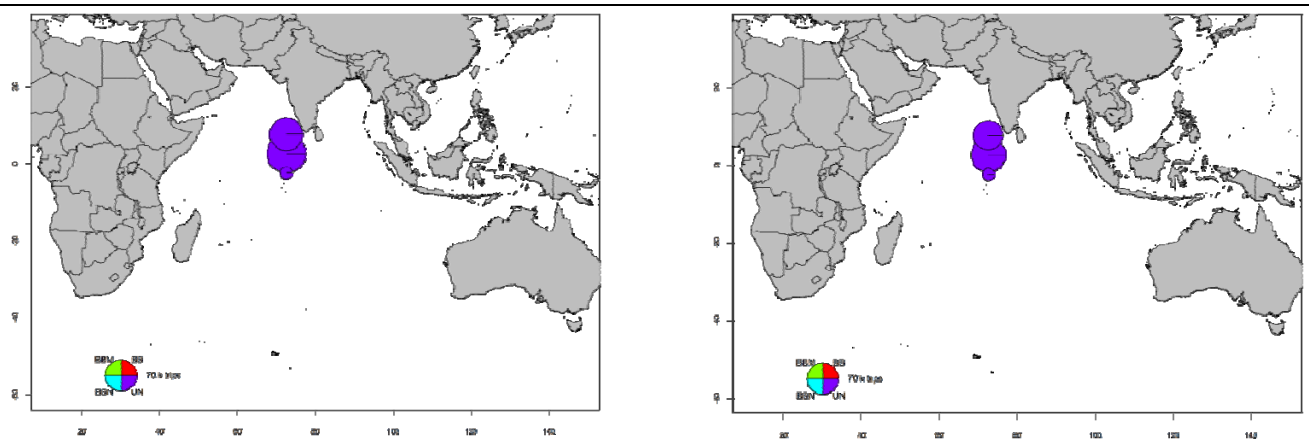


Fig. 8. Number of fishing trips by vessels flagged to the Maldives by 5 degree square grid, type of boat and gear, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
BBN (blue): Baitboat non-mechanized; BBM (Green): Baitboat mechanized; BB (Red): Baitboat unspecified; UN (Purple): Unclassified 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.

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

Of the CPUE series available for assessment purposes, listed below, only the Japanese series from the tropical areas of the Indian Ocean was used in the stock assessment model for 2011 (shown in Fig. 10).

- Taiwan,China data (1980–2010): Series from document IOTC–2011–WPTT13–39 (Fig. 9).
- Japan data (1960–2010): Series 2 from document IOTC–2011–WPTT13–52. Whole Indian Ocean (Figs. 9 and 10).
- Rep. of Korean data (1977–2009): Series from document IOTC–2011–WPTT13–38 (Fig. 9).
- Japan data (1960–2010): Series1 from document IOTC–2011–WPTT13–52. Tropical area of Indian Ocean (Fig. 10).

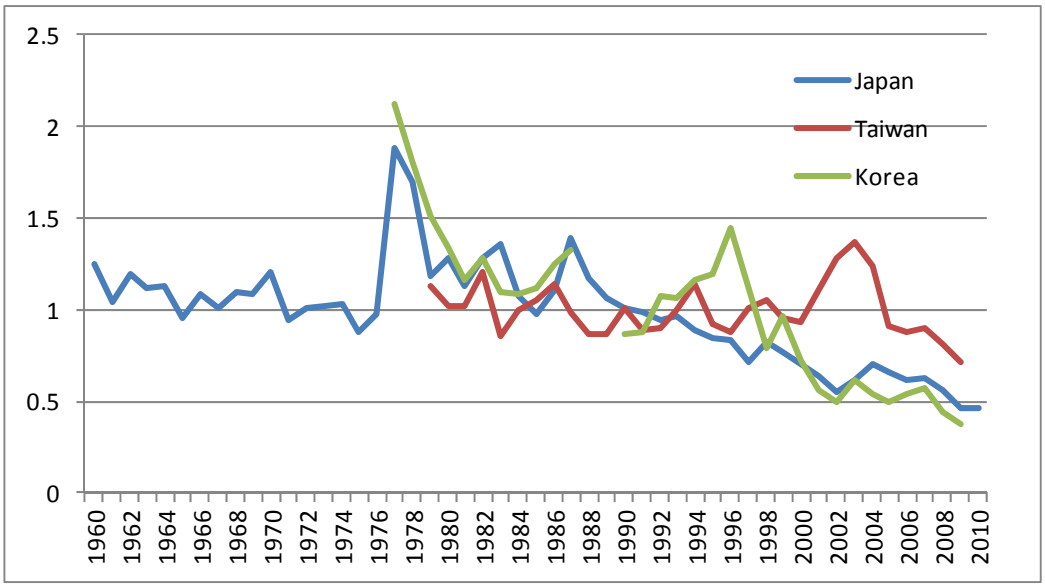


Fig. 9. Comparison of the three standardised CPUE series for Indian Ocean bigeye tuna. Series have been rescaled relative to their respective means from 1960–2010.

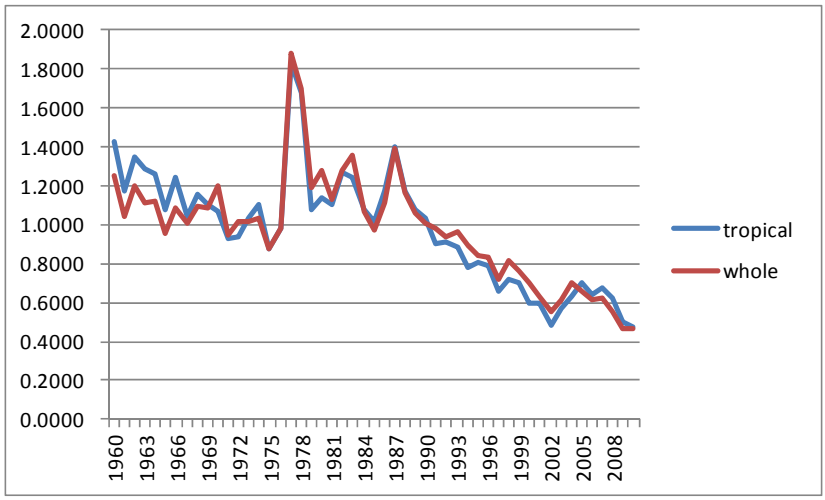


Fig. 10. Comparison of two Japanese standardised CPUE series for Indian Ocean bigeye tuna, one for the whole Indian Ocean and one for the tropical area only. Series have been rescaled relative to their respective means from 1960–2010.

The large increase in both the nominal and standardized bigeye tuna CPUEs for longline fleets in the Indian Ocean (as well as in the Atlantic) (Figs. 9 and 10). The increase in CPUEs may be due (1) to a large increase in the adult stock biomass, or (2) more probably to the introduction of deep longline in 1977. The fishery data does not allow to estimate a fully realistic trend of adult BET biomass during the seventies.

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

Trends in average weight (Fig. 11) 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) (see paper

IOTC–2011–WPTT13–08).

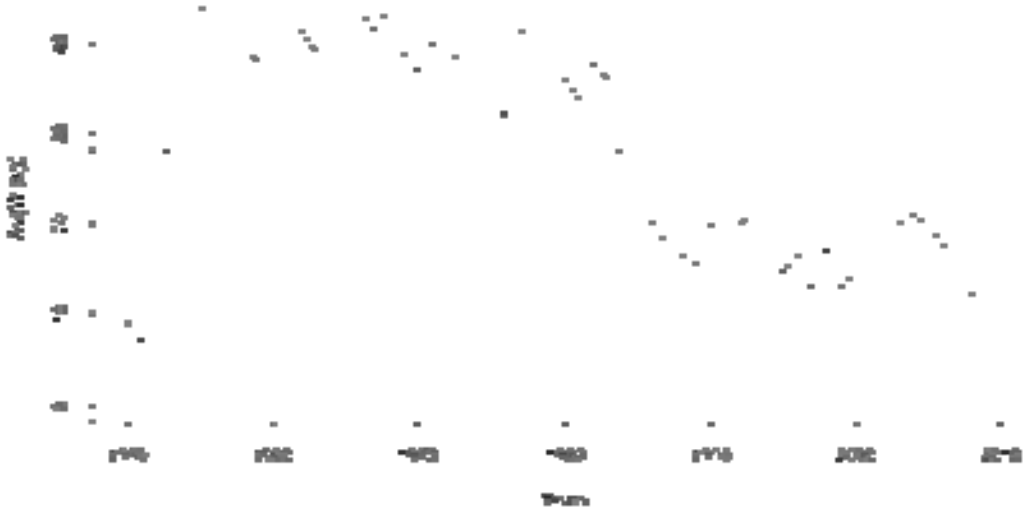


Fig. 11. Changes in average weight (kg) of bigeye tuna from 1950 to 2010 – all fisheries combined (Data as of September 2011).

- Catch-at-Size and Age tables are available but the estimates are highly uncertain for some periods and fisheries including:
  - 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).
  - the paucity of catch by area data available for some industrial fleets (NEI, India, Indonesia, Iran, Sri Lanka).

Tagging data

The WPTT **NOTED** that a total of 35,971 bigeye tuna were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP) which represented a 17.8% of the total number of fish tagged. Most of the bigeye tuna tagged (96.1%) were tagged during the main EU-funded Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and were primarily released off the coast of Tanzania (Fig. 12) between May 2005 and September 2007. The remaining were tagged during small-scale projects around the Maldives, India and the southwest and eastern Indian Ocean by institutions with the support of IOTC. To date 5,563 (15.7%) of tagged fish have been recovered and reported to the IOTC Secretariat.

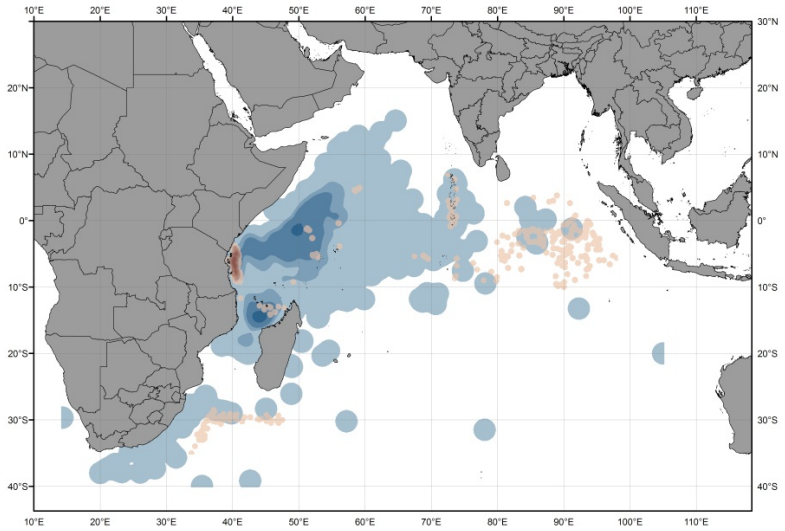


Fig. 12. Densities of releases (in red) and recoveries (in blue) of bigeye tuna. Data as of September 2011.

STOCK ASSESSMENT

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

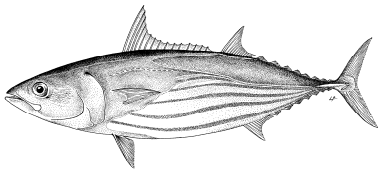
Management Quantity	2010 SS3	2011 ASPM
2009 (SS3) and 2010 (ASPM) catch estimate (1000 t)	102	71.5
Mean catch from 2006–2010 (1000 t)	104.7	104.7
MSY (1000 t)	114 (95–183)	102.9 (86.6–119.3) [2]
Data period used in assessment	1952–2009	1950–2010
F_{curr}/F_{MSY} [3]	0.79 [1] Range[1]: 0.50 – 1.22	0.67 (0.48–0.86) [2]
B_{curr}/B_{MSY} [3]	–	–
SB_{curr}/SB_{MSY} [3]	1.20 [1] Range[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] Range[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.

LITERATURE CITED

Froese R, & Pauly DE, 2009. *FishBase,* version 02/2009, FishBase Consortium, <www.fishbase.org>.
Nootmorn, P., 2004. Reproductive biology of bigeye tuna in the eastern Indian Ocean. IOTC–2004–WPTT04–05.

APPENDIX XII
EXECUTIVE SUMMARY: SKIPJACK TUNA



STATUS OF THE INDIAN OCEAN SKIPJACK TUNA RESOURCE
(*KATSUWONUS PELAMIS*)

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

Area[1]	Indicators – 2011 assessment		2011 stock status determination
			2009[2]
Indian Ocean	Catch 2010:	428,719 t	
	Average catch 2006–2010:	489,385 t	
	MSY (1 model):	564,000 t (395,000–843,000 t)	
	C_{2009}/MSY (1 model)[3]:	0.81 (0.54–1.16)	
	SB_{2009}/SB_{MSY} (1 model):	2.56 (1.09–5.83)	
	SB_{2009}/SB_0 (1 model):	0.53 (0.29–0.70)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]The stock status refers to the most recent years' data used for the assessment.
[3]Due to numerical problems in the F_{MSY} calculations for this population, the proxy reference point C/MSY is reported instead of F/FMSY, which should be interpreted with caution for the following reasons: it may incorrectly suggest $F>F_{MSY}$ when there is a large biomass (early development of the fishery or large recruitment event); it may incorrectly suggest that $F<F_{MSY}$ when the stock is highly depleted; due to a flat yield curve, C could be near MSY even if $F << F_{MSY}$.

Colour key	Stock overfished($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
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 weighted results suggest that the stock is not overfished ($B>B_{MSY}$) and that overfishing is not occurring (C<MSY, used as a proxy for $F<F_{MSY}$) (Table 1 and Fig. 1). Spawning stock biomass was estimated to have declined by approximately 47 % in 2009 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. However, 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 fisheries and environmental factors affecting recruitment or catchability. Catches in 2009 (455,999 t) and 2010 (428,719 t) as well as the average level of catches of 2006–2010 (489,385 t) were lower than median value of MSY.

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, there is a low risk of exceeding MSY-based reference points by 2020 if catches are maintained at the current levels (< 20 % risk that B2019 < BMSY and 30 % risk that C2019>MSY as proxy of F > FMSY) and even if catches are maintained below the 2006–2010 average (489,385 t).

The SC **RECOMMENDED** the following:

- The median estimates of the Maximum Sustainable Yield for the skipjack tuna Indian Ocean stock is 564,000 t (Table 1) and considering the average catch level from 2005–2009 was 512,305 t, catches of skipjack tuna should not exceed the average of 2005–2009.
- 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) illustrates the levels of risk associated with varying catch levels over time and could be used to inform management actions.

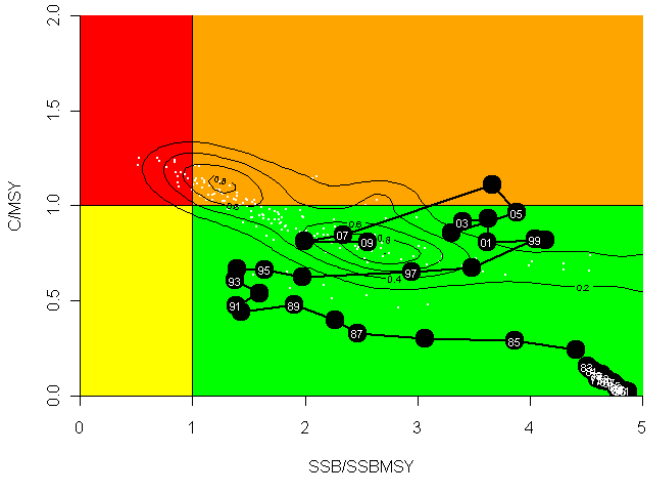


Fig. 1. SS3 Aggregated Indian Ocean assessment Kobe plot. Black circles indicate the trajectory of the weighted median of point estimates for the SB ratio and C/MSY ratio for each year 1950–2009. Probability distribution contours are provided only as a rough visual guide of the uncertainty (e.g. the 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. 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.

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 are 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 10/02 *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*.

FISHERIES INDICATORS

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. 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). NOAA (http://www.nmfs.noaa.gov/fishwatch/species/atl_skipjack.htm, 14/12/2011).

Catch trends

Catches of skipjack tuna increased slowly from the 1950s, reaching around 50,000 t during the mid-1970s, mainly due to the activities of pole-and-lines and gillnets (Fig. 2 and 3). The catches increased rapidly with the arrival of purse seiners in the early 1980s, and skipjack tuna became one of the most important tuna species in the Indian Ocean.

The increase in purse seine caught skipjack tuna post 1984 (Figs. 2 and 3) was due to the development of a fishery in association with Fish Aggregating Devices (FADs). Since the 1990's, 85% of the skipjack tuna caught by purse seine vessels was taken in association with FADs. Following the peak catches taken in 2002 (240,000 t) and 2006 (247,000 t), catches dropped markedly, probably as a consequence of exceptional purse seine catch rates on free schools of yellowfin tuna. In 2007 purse seine catches dropped by around 100,000 t (145,000 t), with similar catches recorded in 2008 and have remained low (150,000–160,000 t).

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 used in the fishery. The sharp decline in purse seine catches shown since 2007 (resulting partially from an approximate 30% decline of effort) coincided with a similar decline in the catches of Maldivian pole-and-line vessels (Fig. 3). The Maldivian fishery effectively increased its fishing effort with the mechanisation of its pole-and-line fishery from 1974, including an increase in boat size and power and the use of anchored FADs (AFADs) since 1981. The decrease in catches of both fisheries may also be the result of a sharp decrease in the mean skipjack tuna weight during this period, from 3 kg in 2006 to 2.3 kg in 2010. It should be noted that during the period 2006–2010, the gillnet fishery was catching over 100,000 tons of large skipjack tuna (~4.3 kg).

Several fisheries using gillnets have reported large catches of skipjack tuna in the Indian Ocean (Fig. 3), 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 20–30% of the total catches of skipjack tuna in the Indian Ocean. Although it is known that vessels from Iran and Sri Lanka 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. Although the drop in catches could be partially explained by a drop in catch rates and fishing effort by the purse seine fishery, due to the effects of piracy in the western Indian Ocean region, drops in the catches of other fisheries, in particular for the Maldives, are not fully understood.

The absolute price of skipjack tuna in the world tuna market, as well as its relative value compared to yellowfin tuna prices, has been greatly increased during recent years: 80% increase of average landing values between the 2000–2006 (758 USD/t) and 2007–2011 (1355 USD/t) periods. It was considered that the high value had contributed to an increase in the fishing pressure and targeting on skipjack tuna during recent years.

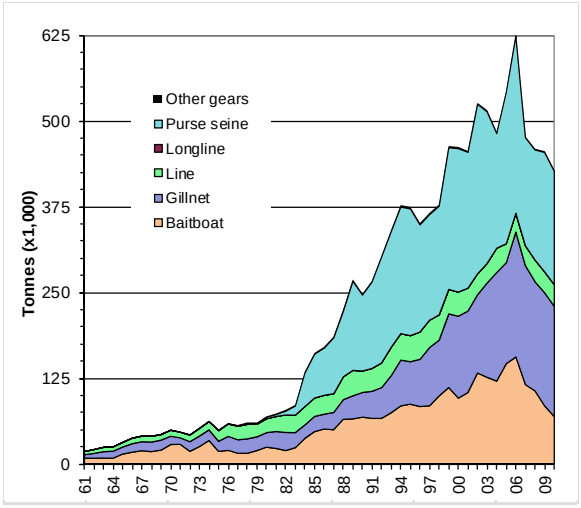


Fig. 2. Annual catches of skipjack tuna by gear recorded in the IOTC Database (1961–2010) (Data as of September 2011).

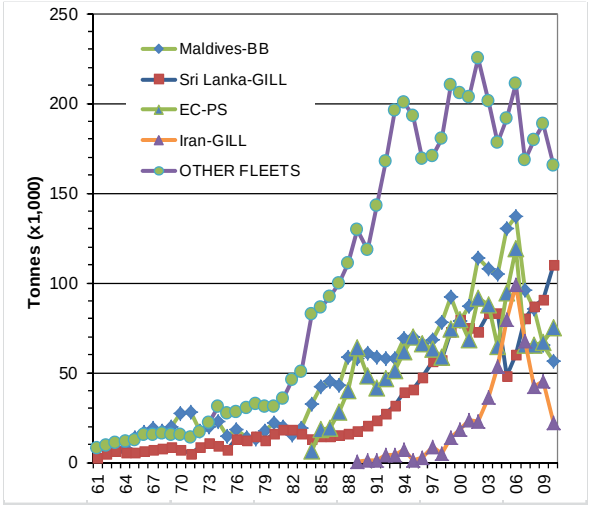
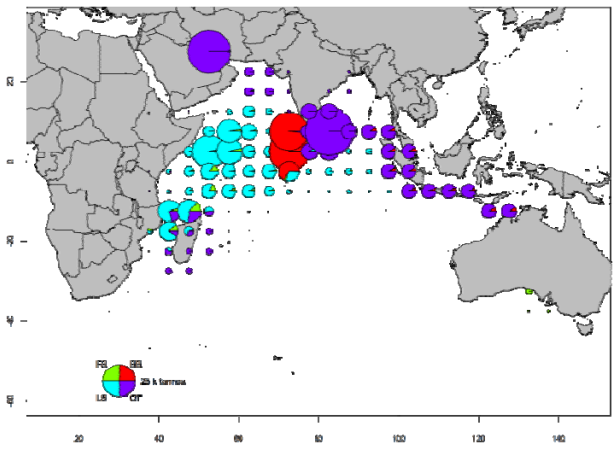


Fig. 3. Annual catches of skipjack tuna by fleet recorded in the IOTC Database (1961–2010) (Data as of September 2011).



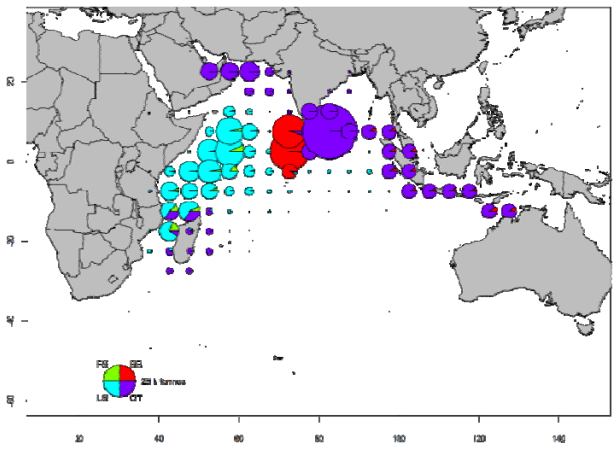


Fig. 4a–b. Time-area catches (total combined in tonnes) of skipjack tuna estimated for 2009 and 2010 by type of gear: Purse seine free-schools (FS), Purse seine associated-schools (LS), pole-and-line (BB), and other fleets (OT), including longline, drifting gillnets, and various coastal fisheries (Data as of September 2011).

TABLE 4. Best scientific estimates of the catches of skipjack tuna (*Katsuwonus pelamis*) by gear and main fleets [or type of fishery] by decade (1950–2000) and year (2001–2010), in tonnes. Data as of October 2011. 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	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
BB	9,292	13,176	22,305	40,579	82,592	118,783	104,130	132,426	126,131	120,718	146,133	155,841	115,599	106,388	84,532	69,032
FS			41	15,551	30,651	25,922	28,919	22,801	30,992	18,565	43,123	34,954	24,198	16,277	10,458	8,826
LS			125	33,570	124,096	164,300	159,646	215,781	180,556	137,882	168,012	211,940	120,925	128,596	148,717	141,797
OT	7,054	17,546	31,665	55,763	109,775	191,540	163,586	155,170	178,094	206,559	186,447	222,339	216,498	208,254	212,292	209,064
Total	**16,346**	**30,721**	**54,136**	**145,464**	**347,115**	**500,545**	**456,281**	**526,179**	**515,774**	**483,724**	**543,715**	**625,074**	**477,220**	**459,515**	**455,999**	**428,719**

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

TABLE 5. Best scientific estimates of the catches of skipjack tuna (*Katsuwonus pelamis*) in the Western and Eastern Indian Ocean areas for the period 1950–2010 (in metric tons). Data as of October 2011.

Area	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
W	10,846	17,569	28,595	96,868	249,919	322,664	326,695	407,328	387,233	349,945	451,617	516,652	342,066	307,021	299,140	258,257
E	5,499	13,153	25,541	48,596	97,196	139,308	129,586	118,851	128,541	133,780	92,098	108,422	135,155	152,494	156,859	170,462

Uncertainty of catches

Retained catches are 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 important fleets including the Sri Lankan coastal fisheries, and the coastal fisheries of Comoros and Madagascar.
- Approximately 10–12 % of the reported catches from some coastal fisheries are uncertain.
- the catch series for skipjack tuna has not been substantially revised since the WPTT12 in 2010.
- levels of discards are believed to be low although they are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–2007.

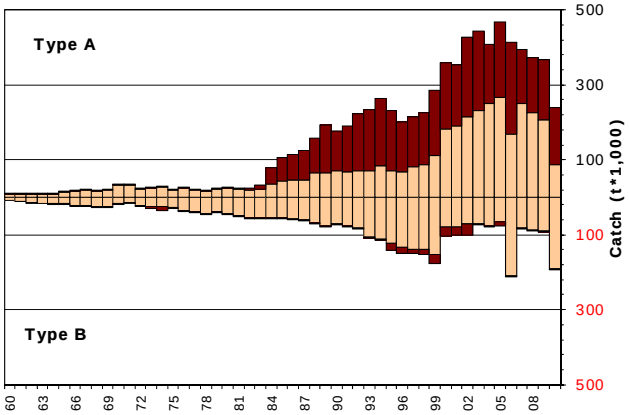


Fig. 5. Uncertainty of annual catch estimates for skipjack tuna (Data as of September 2011).

*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.*

- catch-and-effort series 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 fishery of Pakistan.
  - although Iran has provided catch and effort data, it is not reported as per the IOTC standards.

- 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 Indonesia, Madagascar and Comoros.

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 2007 to 2010 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 2009 and 2010 are provided in Fig. 7.

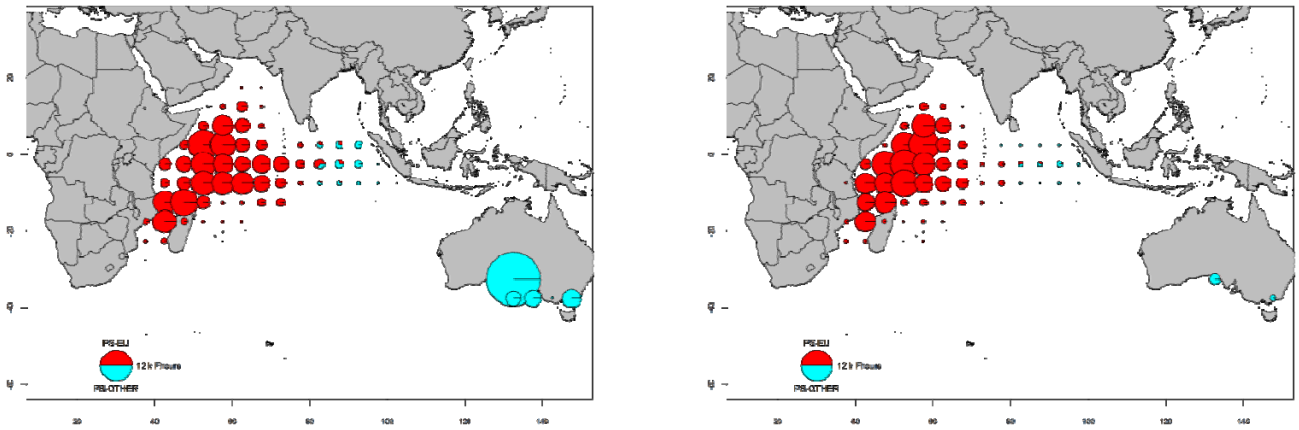


Fig. 6. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

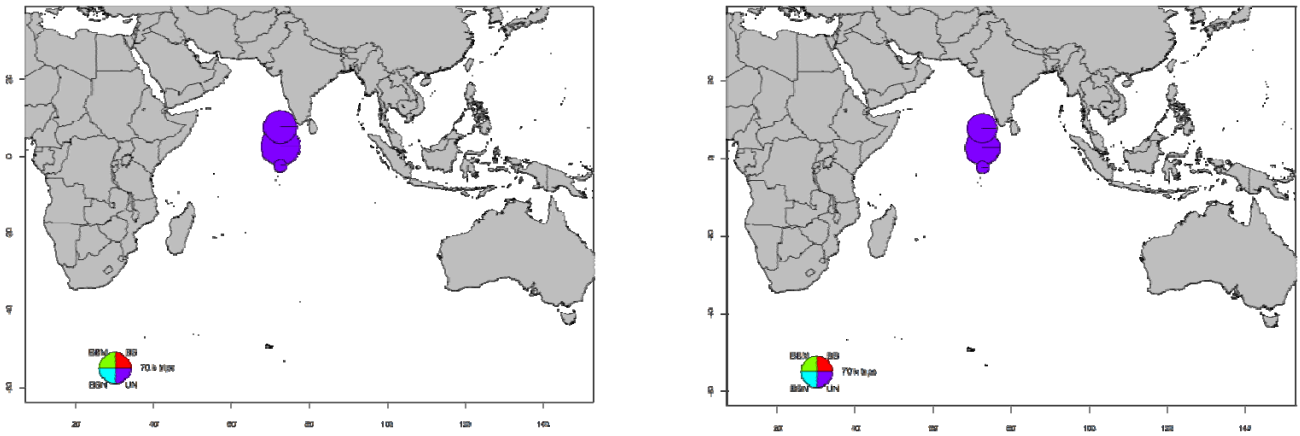


Fig. 7. Number of fishing trips by vessels flagged to the Maldives by 5 degree square grid, type of boat and gear, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
BBN (blue): Baitboat non-mechanized; BBM (Green): Baitboat mechanized; BB (Red): Baitboat unspecified; UN (Purple): Unclassified 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.

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

The CPUE series available for assessment purposes are shown in Fig. 8 and 9, although only the 'Pole-and-line series (Fig.8)–was used in the stock assessment model for 2011.

- Maldives data (2004–2010): Series1 from document IOTC–2011–WPTT13–29 and 31.
- EU purse seine free and log school data (1991–2010) (Fig.9): Series from document IOTC–2011–WPTT13–27. These series were not used in the assessment because they were not standardized and likely subject to problems as noted in paragraphs 133 and 141 of the WPTT13 report (IOTC–2011–WPTT13–R).

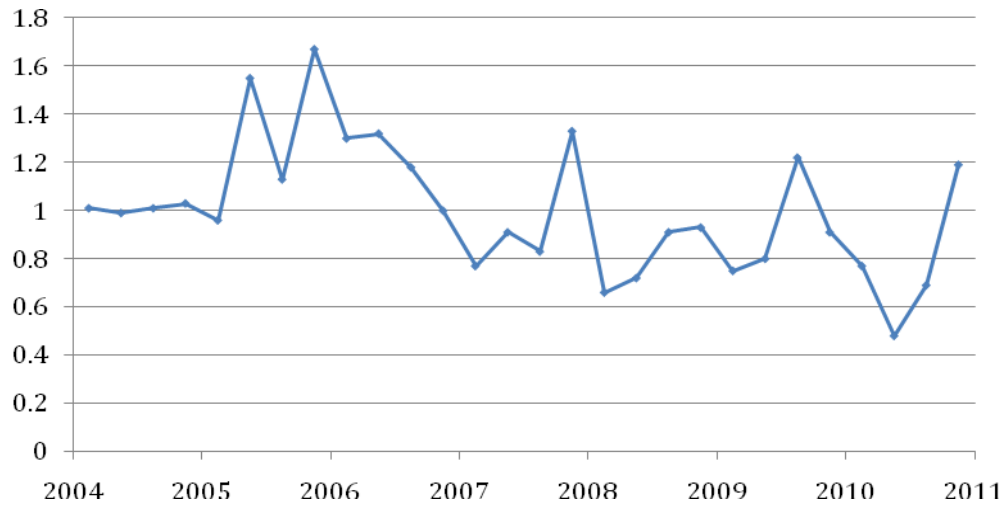


Fig. 8. Standardised Maldivian pole-and-line CPUE series for Indian Ocean skipjack tuna from 2004 to 2011 The series have been rescaled relative to their respective means from 2004–2010

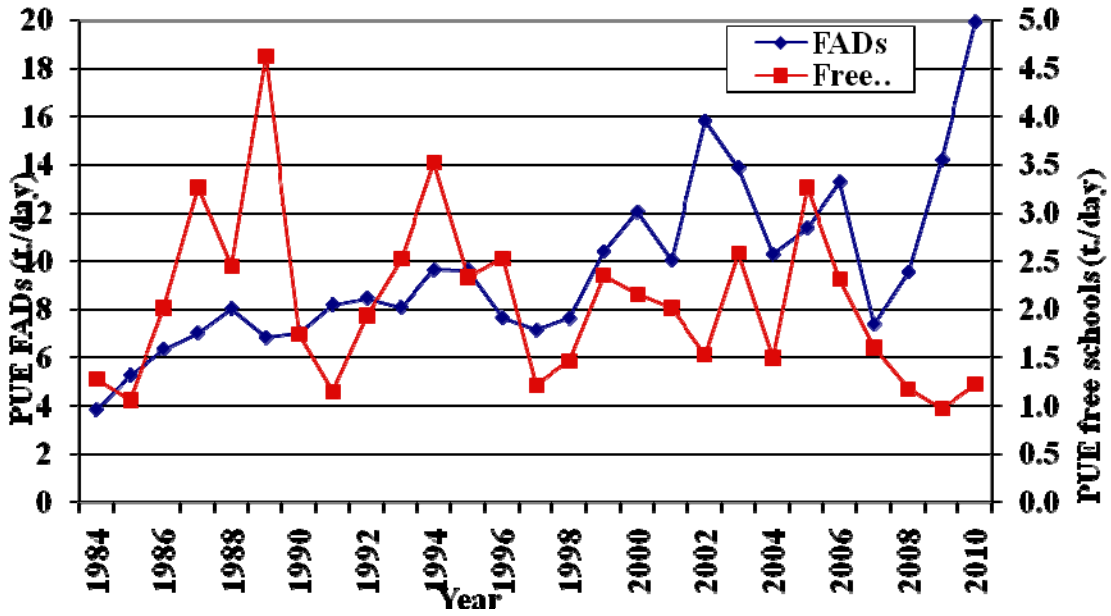


Fig. 9. Comparison of the European purse seine CPUE series for Indian Ocean skipjack caught on free and FAD associated school from 1984 to 2010.

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

Trends in average weight (Fig. 10) cannot be accurately assessed before the mid-1980s and are incomplete for most artisanal fisheries post-1980, namely hand lines, troll lines and many gillnet fisheries (Indonesia) (see paper IOTC–2011–WPTT13–08). While the average weight seems to be stable for all fisheries combined, baitboat and purse seiner are showing a decreasing trends during the last 5 years.

Catch-at-Size and Age tables 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).

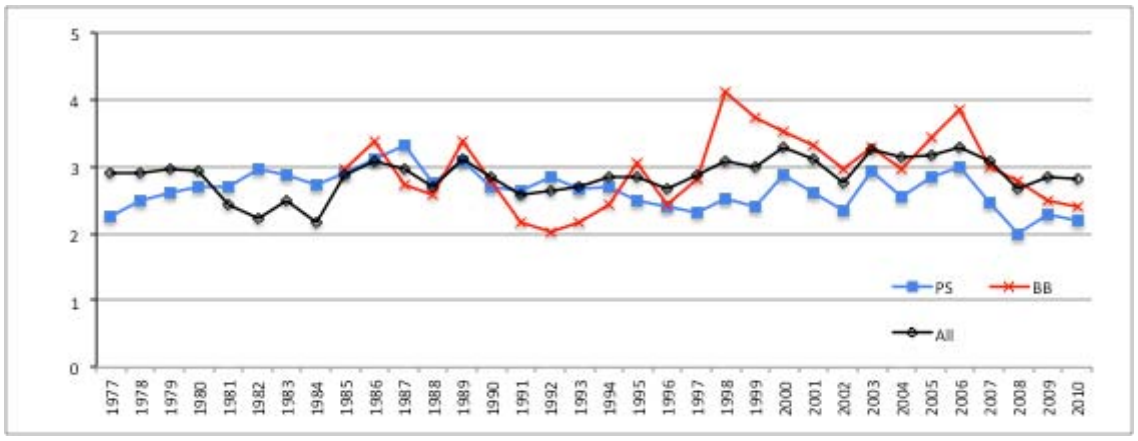


Fig. 10. Changes in average weight (kg) of skipjack tuna from 1977 to 2010 for Maldivian baitboat (BB) and purse seine (PS) as well as all fisheries combined (ALL) –(Data as of September 2011).

Skipjack tuna – tagging data

A total of 100,620 skipjack tuna were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP) which represented 49.8% of the total number of fish tagged. Most of the skipjack tuna tagged (77.8%) were tagged during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and were primarily released off the coasts of the Seychelles and Tanzania and in the Mozambique Channel (Fig. 11) between May 2005 and September 2007. The remaining were tagged during small-scale projects around the Maldives, India and the southwest and eastern Indian Ocean by institutions with the support of IOTC. To date 15,270 (15.2%) of the tagged fish have been recovered and reported to the IOTC Secretariat.

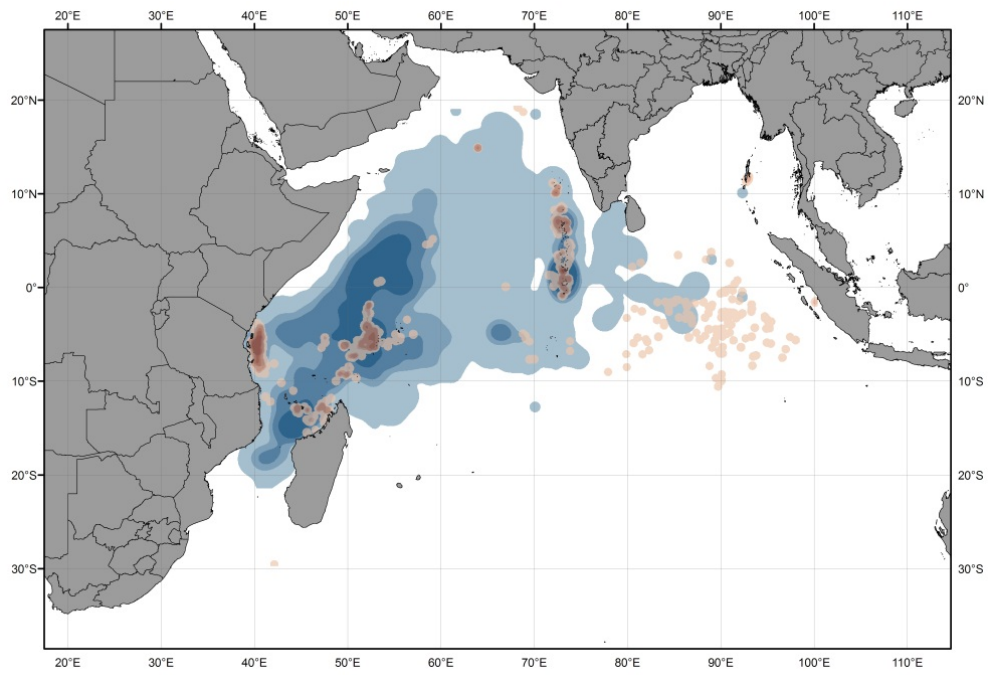


Fig. 11. Densities of releases (in red) and recoveries (in blue) of skipjack tuna. Data as of September 2011.

STOCK ASSESSMENT

A single quantitative modelling method, a "Stock Synthesis III" (SS3), was applied to the skipjack tuna assessment in 2011, using data from 1950–2009. The model was age-structured, iterated on a quarterly time-step, spatially aggregated, with four fishing fleets and Beverton-Holt recruitment dynamics. Model parameters (virgin recruitment, selectivity by fleet, recruitment deviations, and M in some cases) were estimated by fitting predictions and observations of Maldivian pole-and-line CPUE (2004–2010), length frequency data for all fleets, and tag recoveries (for the purse seine fleets, and in some cases, the Maldivian pole-and-line fleet). The uncertainties and interactions among a range of assumptions was examined (including a range of fixed values for parameters that are known to be difficult to estimate). The stock status estimates represented a synthesis from 180 models (balanced factorial design of 5 assumptions, including i) 3 M options (estimated internally, fixed at point estimates from the preliminary Brownie analysis (IOTC–2011–WPTT13–30), or fixed at ICCAT values), ii) 5 stock recruit steepness options (h = 0.55–0.95), iii) 2 tagging program release/recovery options (RTTP or combined RTTP and small-scale), iv) 2 growth curve options and v) 3 tag recovery overdispersion options.

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

- The models estimate a steep biomass decline between 1980 and 1990 followed by a steep biomass increase. At this stage, there are no CPUE series during this period to inform the model. The catch increased in this period due to the onset of purse seine fishing and industrialization of the Maldivian pole and line fishery and thus, trends in recruitment are required to explain the biomass patterns. The biomass/recruitment trends were supported only by the length frequency data, and it is not likely that these data are sufficiently informative to estimate this trend. Furthermore, the trend is not evident in the nominal CPUE series from either the pole and line or purse seine fisheries.
- 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 following reasons:
  - it may incorrectly suggest $F>F_{MSY}$ when there is a large biomass (early development of the fishery or large recruitment event)
  - it may incorrectly suggest that $F<F_{MSY}$ when the stock is highly depleted
  - due to a flat yield curve, C could be near MSY even if $F << F_{MSY}$.
- Although CPUE from the EU,France fleet targeting free school was only reliable for yellowfin tuna and bigeye tuna after 1991, due to species misidentification, for skipjack tuna this series could be extended back to 1983, as misidentification would not have occurred between this species and the others. It was noted, however, that this nominal series would not take into account changes in fishing/gear efficiency and so could still be unsuitable as an index of abundance for the earlier years. These restrictions also apply to the post–1991 series. However, it should be taken into account that the free school catch of purse seiners is relatively small in comparison to FAD-associated fishing (less than 10%) and the fishery is seasonal, located mainly in the Mozambique Channel during the first quarter of the year.
- Most of the natural mortality assumptions included in the assessment were lower than those assumed in other oceans. The values estimated within the model only using the WPTT tagging data were unrealistically low for ages 0–1. The values estimated within the model appeared plausible when the small-scale tagging data was included with the RTTP data. The values adopted from the independent Brownie analysis using only RTTP data showed a similar pattern of M(age) to the SS3 RTTP+small-scale estimates, but were substantially lower. It was noted that there were some differences in the way that the SS3 model and Brownie analysis estimated M, but it was not obvious why either of the approaches would be biased.

TABLE 6. Key management quantities from the SS3 assessment, for the aggregate Indian Ocean. Estimates represent 50^{th} (5^{th}–95^{th}) percentiles from the weighted distribution of MPD results. 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 in Table 1.

Management Quantity	Aggregate Indian Ocean
2009 catch estimate (1000 t)	456
Mean catch from 2005–2009 (1000 t)	512
MSY (1000 t) (90% CI)	564 (395–843)
Data period used in assessment	1950–2009

$C_{2009}/_{MSY}$ (90% CI) (proxy for F_{2009}/F_{MSY})	0.81 (0.54–1.16)
B_{2009}/B_{MSY}	–
SB_{2009}/SB_{MSY} (90% CI)	2.56 (1.09–5.83)
B_{2009}/B_0	–
SB_{2009}/SB_0 (90% CI)	0.53 (0.29–0.70)
$B_{2009}/B_{1950, F=0}$	–
$SB_{2009}/SB_{1950, F=0}$	0.53 (0.29–0.70)

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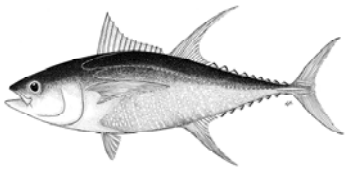
Grande M, Murua H, Zudaire I and Korta M. 2010. Spawning activity and batch fecundity of skipjack, *Katsuwonus pelamis*, in the Western Indian Ocean. Working paper presented to the 12th session of the IOTC Working Party on Tropical Tunas. IOTC–2010–WPTT12–47.

APPENDIX XIII
EXECUTIVE SUMMARY: YELLOWFIN TUNA



STATUS OF THE INDIAN OCEAN YELLOWFIN TUNA RESOURCE (*THUNNUS ALBACARES*)

TABLE 1. Status of yellowfin tuna (*Thunnusalbacares*) 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)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]The stock status refers to the most recent years' data used for the assessment.

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. 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.

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.

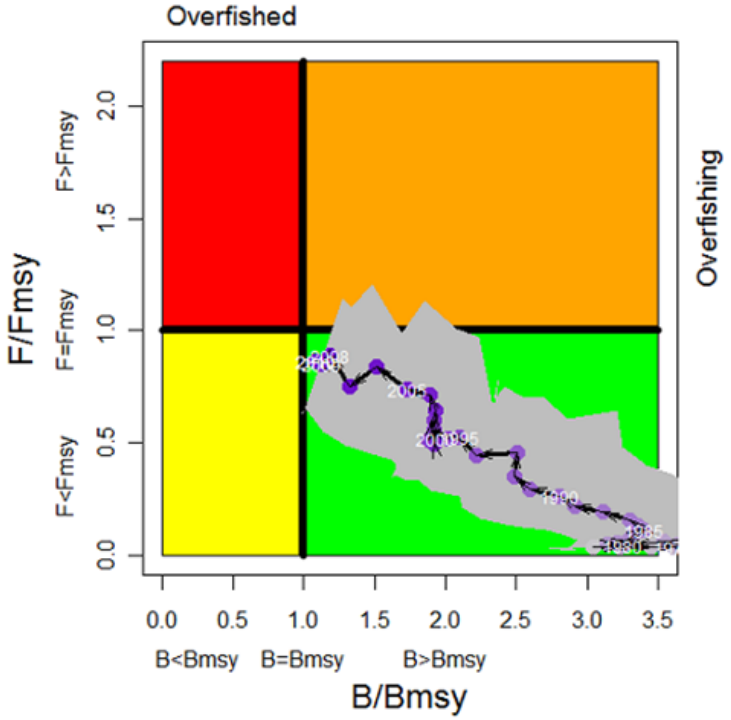


Fig. 1. MULTIFAN-CL Indian Ocean yellowfin tuna stock assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year 1972–2009. The equal weighted mean trajectory of the scenarios investigated in the assessment. The range is given by the different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

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*.

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. Biology of Indian Ocean yellowfin tuna (*Thunnusalbacares*)

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)

Catch trends

Contrary to the situation in other oceans, the artisanal fishery (*i.e.* vessels less than 24m fishing inside their EEZ) component of yellowfin tuna catches in the Indian Ocean is substantial, taking approximately 20–25% of the total catch landed. 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 (Fig. 2).

Catches of yellowfin tuna increased rapidly with the arrival of the purse seine fleets in the early 1980s (Figs. 2 and 3), along with increased activity by longline vessels, with more than 400,000 t landed in 1993. Purse seiners typically take fish ranging from 40–140 cm fork length and smaller fish are more common in the catches taken north of the equator.

The purse seine fishery is characterized by the use of two different fishing modes: a fishery on drifting objects (FADs), which catches large numbers of small yellowfin 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 took 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 2003–2006 (64%) was much higher than in previous (49% for 1999–2002) or following years (55% for 2007–2009).

The longline fishery primarily catches large fish, from 80–160 cm fork length, although smaller fish in the size range 60–100 cm have been taken and reported 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, Rep. of Korea and Taiwan,China) and a fresh-tuna longline component (small to medium scale fresh tuna longliners from Indonesia and Taiwan,China). As was the case with purse seine fisheries, since 2005 longline catches have decreased substantially with current catches estimated to be at around 41,000 t, representing a more than three-fold decrease over the catches in 2005 (Fig. 2).

Total yellowfin tuna catches dropped markedly from the peak catches taken in 2006, with the lowest catches recorded since the early 1990's reported in 2009, at around 275,955 t. Preliminary catch levels in 2010 are estimated to be around 299,074 t (Tables 4, 5).

The recent drop in catches of yellowfin tuna could be related, at least in part, 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 (Figs. 4a, b) as well as to the decline in the number of purse seiners in the Indian Ocean (~30% reduction).

Catches by other gears, i.e. pole-and-line, gillnet, troll, hand line and other minor gears, have increased steadily since the 1980s (Fig. 2). In recent years the total artisanal yellowfin tuna catch has been between 140,000–160,000 t, with the catch by gillnets (the dominant artisanal gear) at around 80,000 t.

Most yellowfin tuna are caught in the Indian Ocean, north of 12°S, and in the north of the Mozambique Channel (Figs. 4a, b). 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 2008 and 2010. The drop in catches is the consequence of a generalised drop in fishing effort due to the effect of piracy in the western Indian Ocean region.

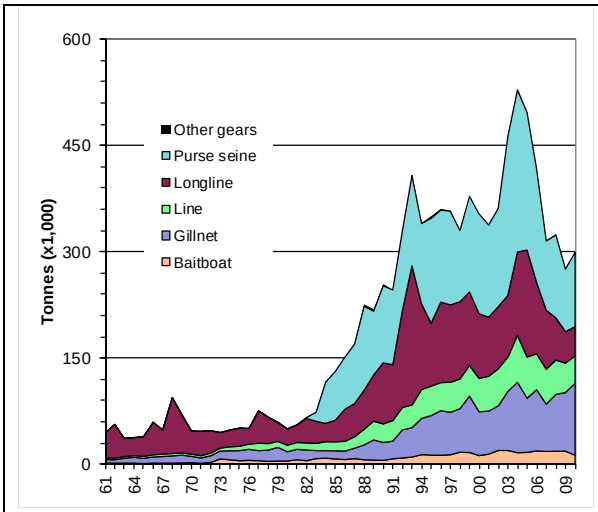


Fig. 2. Annual catches of yellowfin tuna by gear recorded in the IOTC Database (1961–2010) (Data as of September 2011).

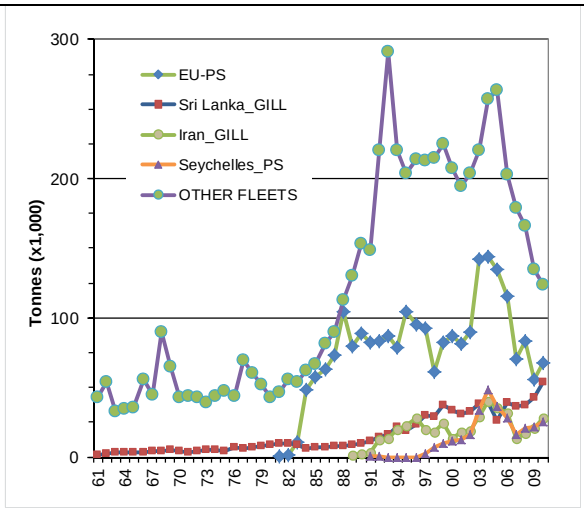


Fig. 3. Annual catches of yellowfin tuna by fleet recorded in the IOTC Database (1961–2010) (Data as of September 2011).

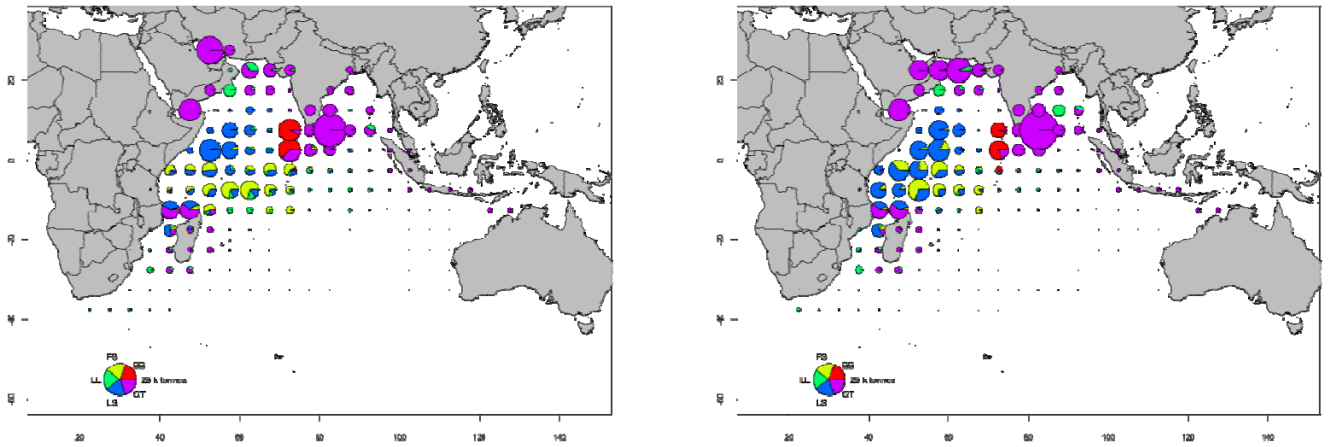


Fig. 4a–b. Time-area catches (total combined in tonnes) of yellowfin tuna estimated for 2009 and 2010 by type of gear: Longline (LL), Purse seine free-schools (FS), Purse seine associated-schools (LS), pole-and-line (BB), and other fleets (OT), including drifting gillnets, and various coastal fisheries (Data as of September 2011).

TABLE 4. Best scientific estimates of the catches of yellowfin tuna (*Thunnus albacares*)by gear and main fleets [or type of fishery] by decade (1950–2000) and year (2001–2010), in tonnes. Data as of October 2011. 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	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
FS	0	0	18	32,590	64,942	89,761	78,969	77,059	137,492	168,799	124,024	85,021	53,529	74,990	36,263	31,951
LS	0	0	17	18,090	56,304	61,909	50,997	61,933	86,585	59,597	69,873	74,454	43,843	41,453	51,565	72,199
LL	21,990	41,256	29,512	33,889	66,689	57,668	43,932	53,132	55,741	86,415	116,847	69,831	54,414	29,128	21,242	17,130
LF	0	0	615	4,286	47,570	32,827	39,323	34,429	31,292	31,125	33,991	30,475	28,752	30,424	23,157	24,089
BB	1,754	1,452	4,380	6,621	11,765	17,162	14,233	19,393	19,451	16,177	16,607	18,644	18,133	18,351	18,463	12,755
GI	2,604	7,569	12,861	15,261	50,192	76,053	60,748	62,982	83,283	99,254	76,660	86,286	66,693	80,086	82,695	101,418
HD	679	1,175	2,615	6,990	20,002	31,762	29,790	34,093	31,105	40,820	38,993	31,789	30,274	28,895	23,952	20,472
TR	832	1,514	3,502	7,193	16,825	19,479	19,453	18,288	17,270	25,798	19,136	19,160	19,061	19,770	17,682	18,177
OT	118	130	497	1,275	1,344	1,107	543	463	1,396	1,734	1,123	1,436	1,290	1,567	936	883
Total	**27,978**	**53,096**	**54,017**	**126,193**	**335,634**	**387,728**	**337,988**	**361,772**	**463,615**	**529,719**	**497,254**	**417,096**	**315,989**	**324,664**	**275,955**	**299,074**

Fisheries: 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**).

TABLE 5. Best scientific estimates of the catches of yellowfin tuna (*Thunnus albacares*)in the Western and Eastern Indian Ocean areas for the period 1950–2010 (in metric tons). Data as of October 2011.

Area*	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
R1	2,164	5,430	9,376	18,462	73,169	83,578	65,544	73,160	82,854	119,183	129,226	92,860	74,179	72,600	62,861	65,123
R2	11,899	23,101	20,921	72,400	143,122	183,679	156,045	164,369	265,456	278,103	248,113	204,035	126,450	135,499	100,973	111,041
R3	919	7,857	4,483	9,646	28,681	33,100	32,009	34,377	31,004	36,490	33,887	33,480	35,123	30,867	28,990	27,545
R4	918	1,799	1,370	1,075	3,314	2,122	3,376	3,328	2,387	3,802	2,904	1,363	540	507	427	498
R5	12,079	14,909	17,869	24,611	87,347	85,250	81,014	86,538	81,914	92,141	83,124	85,358	79,697	85,191	82,704	94,867
Total	**27,978**	**53,096**	**54,017**	**126,193**	**335,634**	**387,728**	**337,988**	**361,772**	**463,615**	**529,719**	**497,254**	**417,096**	**315,989**	**324,664**	**275,955**	**299,074**

*See Fig. 9 for a description of the areas

Uncertainty of catches

Retained catches are generally well known for the major fleets (Fig. 5); but 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 commercial longliners from India.

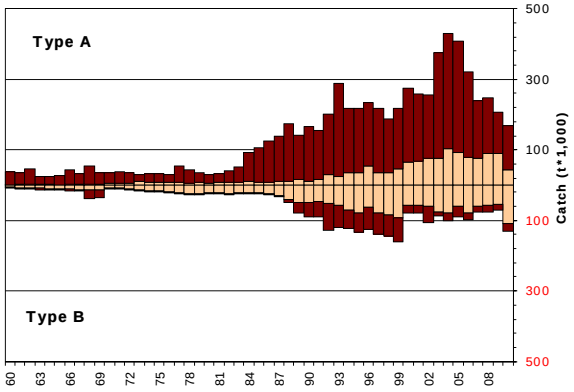


Fig. 5.Uncertainty of annual catch estimates for yellowfin tuna (Data as of September 2011).
Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species 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.

- the catch series for yellowfin tuna has not been significantly revised since the WPTT12 in 2010, although there has been some revision to the time series of catch from the fisheries of India leading to changes in catches by gear.
- levels of discards are believed to be low although they are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–2007.
- catch-and-effort series are available from the major industrial and artisanal fisheries. However, these data are not available for some important artisanal 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 very little data available for the fresh-tuna longline fishery of Taiwan,China.
    - no data are available for the gillnet fisheries of Pakistan.
    - although Iran has provided catch and effort data, it is not reported as per the IOTC standards.
    - 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.

Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid from 2007 to 2010 are provided in Fig. 6, and total effort from purse seine vessles flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2007 to 2010 are provided in Fig. 7. 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.

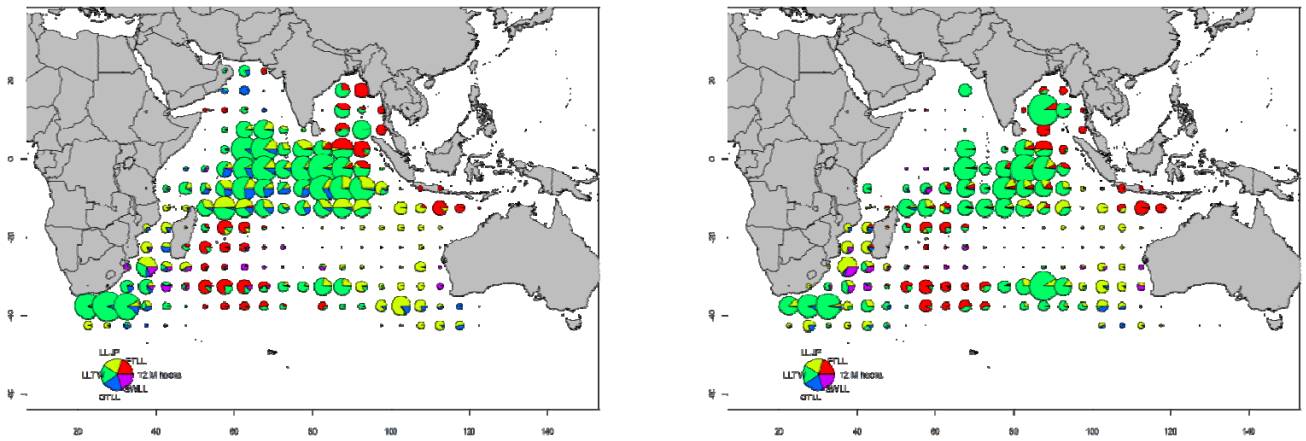


Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

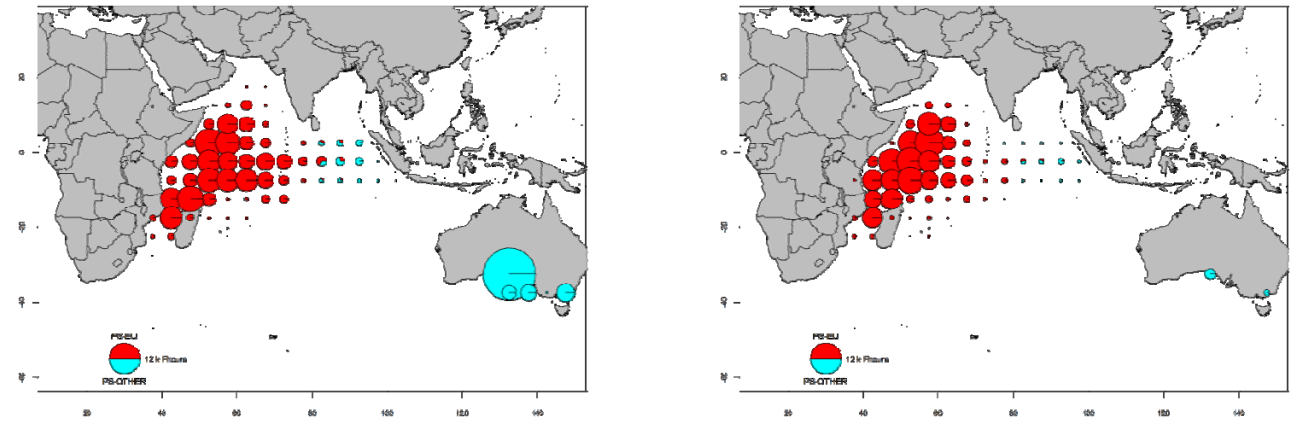


Fig. 7. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

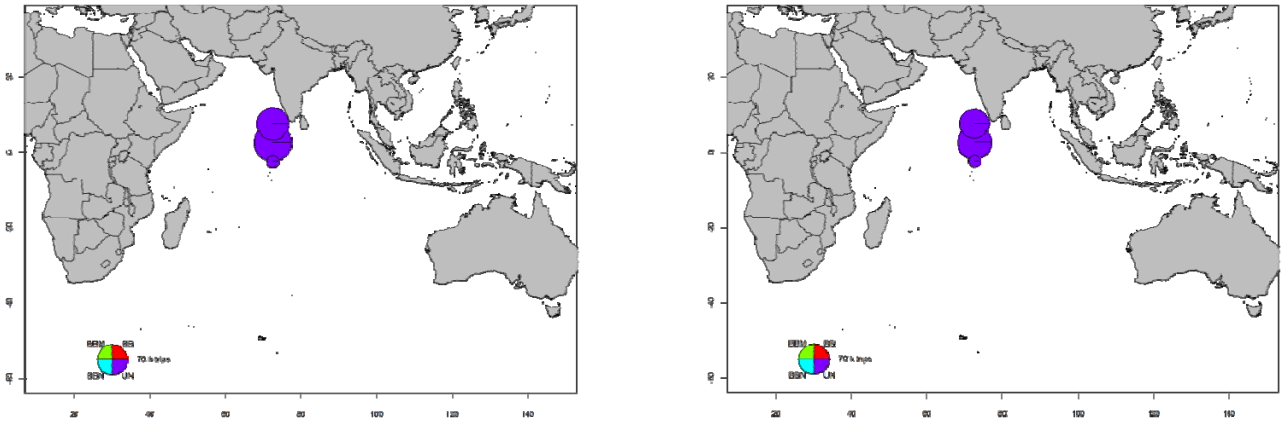


Fig. 8. Number of fishing tripsby vessels flagged to the Maldives by 5 degree square grid,type of boat and gear, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
BBN (blue): Baitboat non-mechanized; BBM (Green): Baitboat mechanized; BB (Red): Baitboat unspecified; UN (Purple): Unclassified 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.

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

For the longline fisheries (LL fisheries in regions 1–5; Fig. 9), CPUE indices were derived using generalized 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 assessment 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 2011 assessment (Fig. 10). 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.

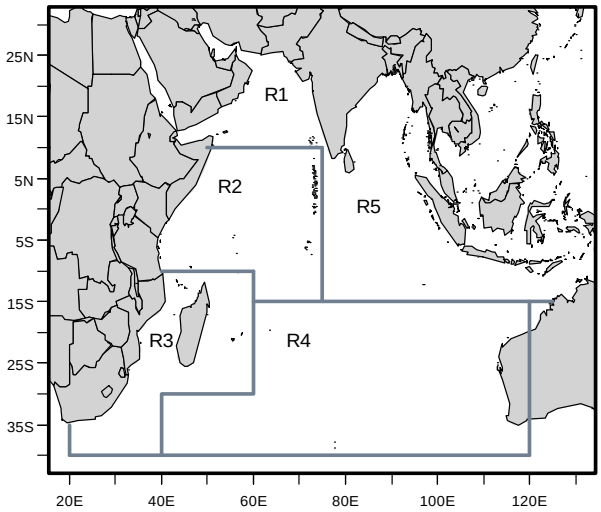


Fig. 9. Spatial stratification of the Indian Ocean for the MFCL assessment model.

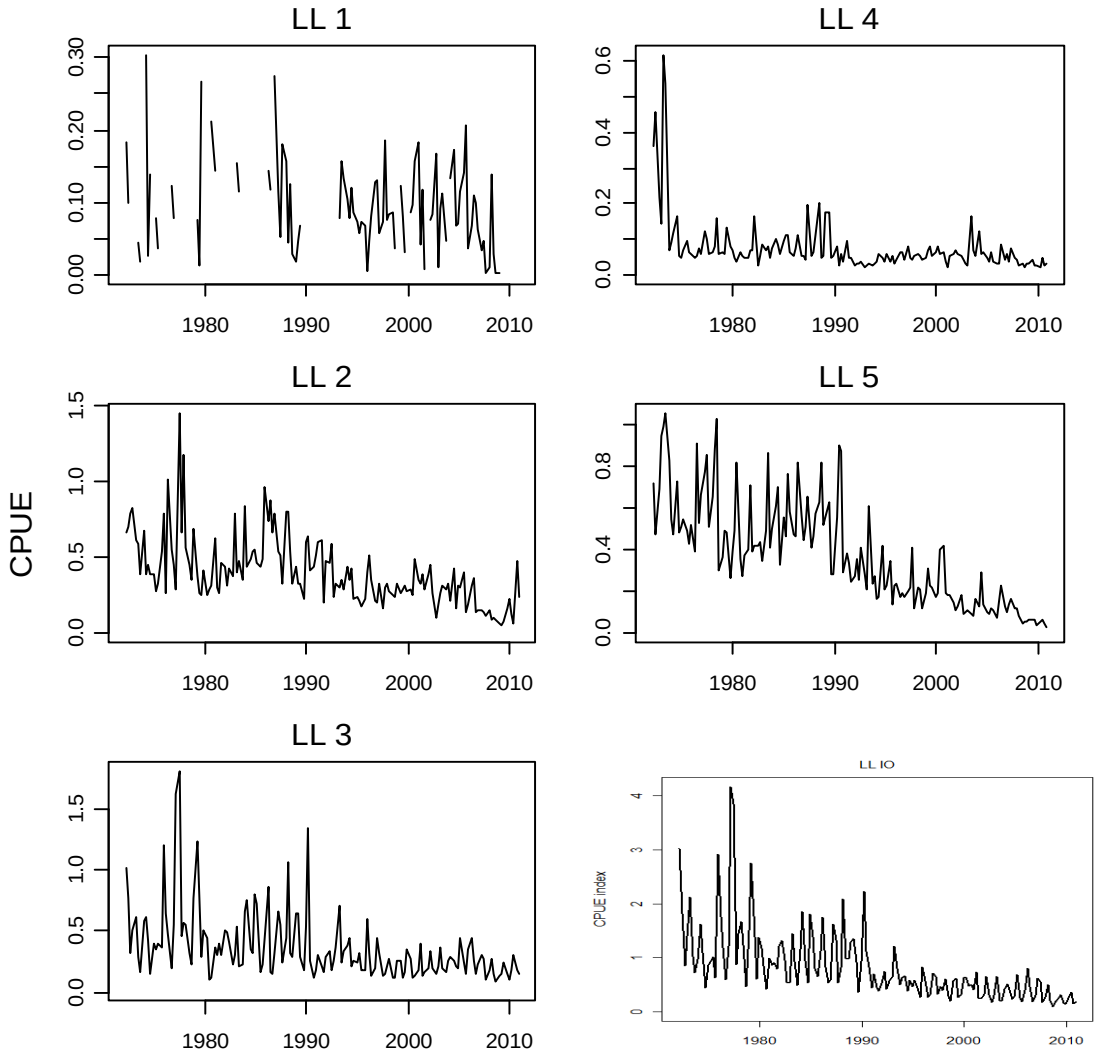


Fig. 10. Annualised GLM standardised catch-per-unit-effort (CPUE) for the principal longline fisheries (longline region 1: Taiwan,China and longline regions 2–5: Japan) and the whole Indian Ocean (IO), scaled by the respective region scalars.

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

- trends in average weight (Fig. 11) 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 (see paper IOTC–2011–WPTT13–08).

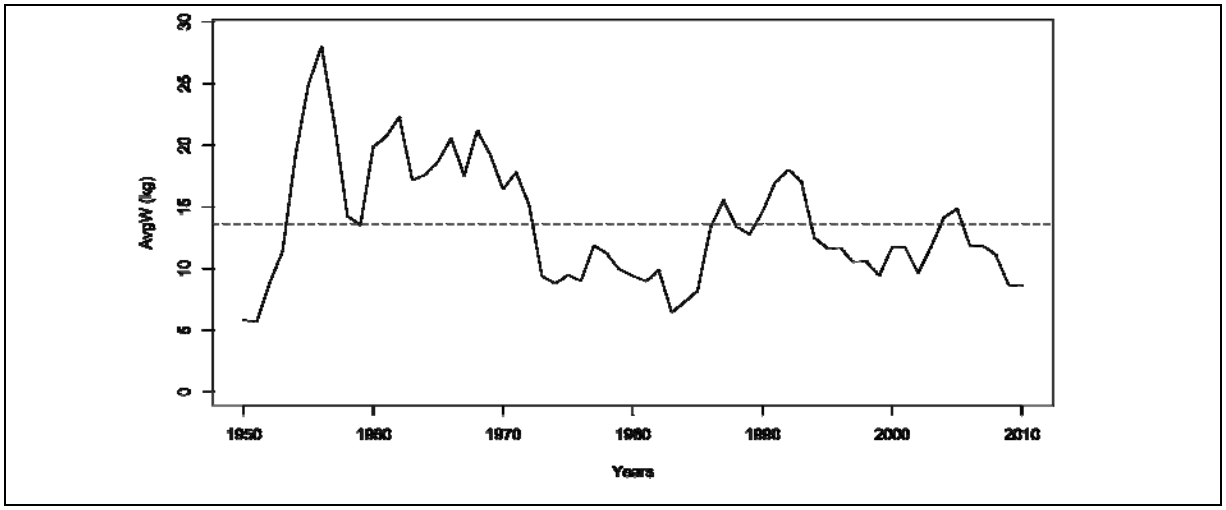


Fig. 11.Changes in average weight (kg) of yellowfin tuna from 1950 to 2010 – all fisheries combined (Data as of September 2011).

- catch-at-Size and Age tables are 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.
    - the paucity of catch by area data available for some industrial fleets (NEI, Iran, India, Indonesia, Malaysia).

Tagging data

A total of 63,310 yellowfin tuna were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP) which represented 31.4% of the total number of fish tagged. Most of the yellowfin tuna tagged (86.4%) were tagged during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and were primarily released off the coasts of the Seychelles, in the Mozambique Channel, along the coast of Oman and off the coast of Tanzania (Fig. 12) between May 2005 and September 2007. The remaining were tagged during small-scale projects around the Maldives, India and the southwest and eastern Indian Ocean by institutions with the support of IOTC. To date 10,560 (16.7%) tagged fish have been recovered and reported to the IOTC Secretariat.

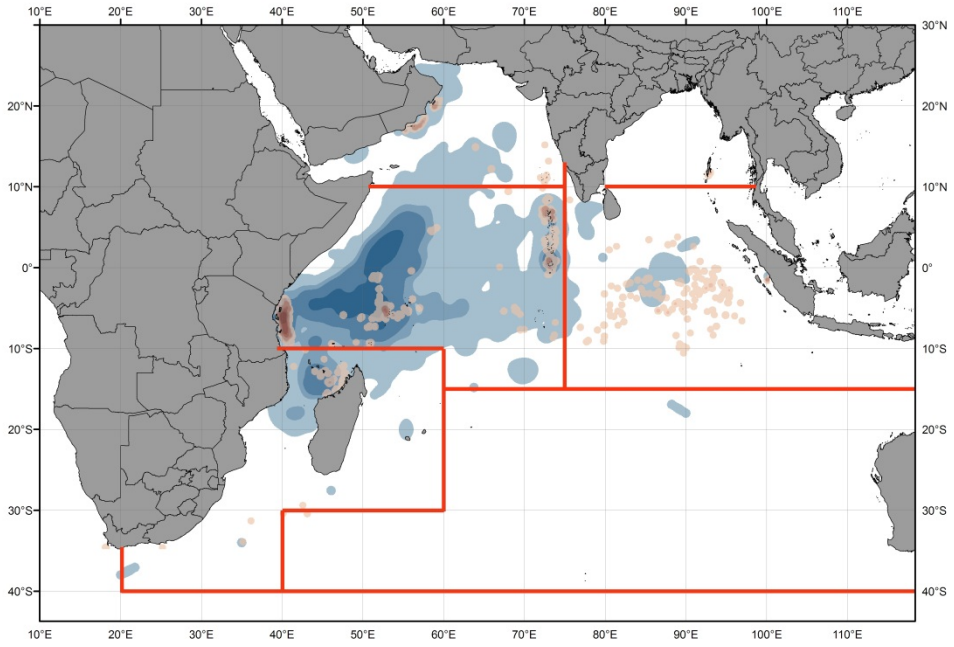


Fig. 12.Densities of releases (in red) and recoveries (in blue) of yellowfin tuna. Data as of September 2011.

STOCK ASSESSMENT

A single quantitative modelling method (MULTIFAN-CL) was applied to the yellowfin tuna assessment in 2011, using data from 1972–2010.The following is worth noting with respect to the modelling approach used:

- The main features of the model in the 2010 assessment included a fixed growth curve (with variance) with an inflection, an age-specific natural mortality rate profile (M), the modelling of 24 fisheries including the separation of two purse seine fisheries into three time blocks, using a cubic spline method to estimate longline selectivities in the place of a logistic curve, the down-weighting of length frequency data in the fitting, separation of the analysis into five regions of the Indian Ocean and the specification of four steepness parameters for the stock recruitment relationship (h=0.6, 0.7, 0.8 and 0.9).
- In addition to another year of data, the 2011 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 and the Taiwan,China index was revised for region 1); major historical catch revisions for fisheries in Region 5,

splitting the longline fleet in Region 5 into distant water and fresh tuna logline fleets leaving 25 total fleets in the model; and the range of steepness evaluated was expanded to h=0.55-0.95.

While the biomass trends were very similar between the 2010 and 2011 assessments, the estimates of stock productivity and thus, the status, differed. There were several reasons for this: there was poor convergence in the 2010 assessment, thus the fits were suboptimal and alternative solutions were near optimal. Refitting the 2010 assessment is now more optimistic. Also, fitting the 2010 model to 2011 data was more optimistic. Thus, revisiting of key parameters and the inclusion of the latest year of data in the 2011 assessment appeared to be important. These issues are difficult to explore in the MFCL framework. The WPTT reviewed several alternative model structures and parameter formulations for the model that were presented in the assessment. These included: the new longline model structure for Region 5; alternative Japanese CPUE indices; a single region model where all 5 Regions were collapsed into one; a Region 2 model estimated separately from other Regions; the 5 values of steepness and alternative tag mixing periods (1–4 quarters). Additionally, an attempt was made to estimate age-specific M's. In regards to the latter, this parameter was not well estimated and the WPTT adopted the low M profile as the most appropriate way to proceed.

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 available tagging data has provided the WPTT with relevant information on various biological parameters, such as natural mortality and growth. Further use of these data should better support the analyses conducted by the WPTT.

In the previous assessment purse seine selectivity in the period 2003–2007 was separated into three blocks of time surrounding 2005 to accommodate the unusually large catches in the middle of that time period. This was continued in the current assessment. However, the WPTT questioned whether this was the most appropriate way to do this. An alternative was suggested in which the time blocks of PS fleet were removed and the same selectivity was applied throughout the period. This was explored in new model runs. Results were not demonstrably different.

Longline selectivity will be revisited in 2012 as it was suggested that this selectivity might still be best described by a logistic (flat-topped) model instead of a cubic spline approach, whereby the resulting selectivity was dome-shaped. This option reinvigorated a long standing debate that has yet to be resolved. A run whereby logistic selectivities were imposed was evaluated.

Generally, the runs with alternative parameter and model structures did not suggest large differences in the approach and resulted in qualitatively predictable outcomes. The WPTT felt that the alternative outcomes were an expression of uncertainties in the model, data and assessment. Therefore, the WPTT focused on following basic alternatives for characterizing the uncertainty: logistic versus cubic spline longline selectivity; using the low M profile; alternative steepness of the stock-recruitment relationship of 0.7, 0.8 and 0.9, and estimation of MSY based reference points using the average recruitment for the whole time series. It was determined that with current knowledge outcomes using these alternatives are equally likely and a combined evaluated was generated based upon this.

The final range of model options adopted by the WPTT included the 2 alternative parametrization of longline selectivity (cubic spline and logisitic) and three steepness options (0.7, 0.8 and 0.9). For the cubic spline model option, there is a strong temporal trend in recruitment and recent recruitments (average of the last 15 years) is estimated to be lower (80%) than the long term recruitment level. On that basis, it was agreed to also derived alternative MSY estimates based on the recent levels of recruitment for comparative purposes.Key assessment results for the MFCL stock assessment areshown in Tables 1, 2 and 6; Fig. 1.

It was noted that some of the results of the Multifan-CL model selected were not intuitive and have been discussed extensively by the WPTT and the SC. The SC **NOTED** the following points:

- the movements of yellowfin tuna, between the five regions used in the stock assessment, estimated by the model show insignificant mixing between some regions which may infer three nearly independent different stocks in the Arabian sea (area 1), the South-East Indian Ocean (area 5) and the rest of the Indian Ocean. However, this result seems to be in contradiction with the biological knowledge of the stock and with the recent tagging results suggesting wide and fast movements between all areas.
- the levels and trends of biomass estimated by the model in each of the 5 areas seem unrealistic:
    - the very high initial biomass in the South-East area (area 5) and its major decline during recent years
    - the biomass in the South-West Indian Ocean (area 3) being larger than that of the Western equatorial Indian Ocean (area 2), which is recognized as the main yellowfin fishing area and consequently, where biomass should be at a much higher level.

Table 6. Key management quantities from the MFCL assessment, for the agreed scenarios of yellowfin tuna in the Indian Ocean.Values represent an equal weighting mean of the scenarios investigated. The range is described by the

range values between those scenarios.

Management Quantity	Indian Ocean
2010 catch estimate (1000 t)	299.1
Mean catch from 2006–2010 (1000 t)	326.6
MSY (1000 t)	357 (290–435)
Data period used in assessment	1972–2010
F_{2009}/F_{MSY}	0.84 (0.63–1.10)
B_{2009}/B_{MSY}	1.46 (1.35–1.59)
SB_{2009}/SB_{MSY}	1.61 (1.47–1.78)
B_{2009}/B_0	0.49
SB_{2009}/SB_0	0.35 (0.31–0.38)
$B_{2009}/B_{0,\ F=0}$	0.58
$SB_{2009}/SB_{0,\ F=0}$	–

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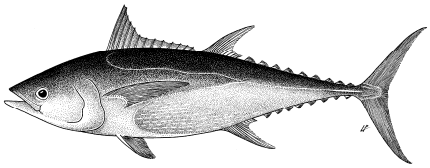
APPENDIX XIV
EXECUTIVE SUMMARY: LONGTAIL TUNA



STATUS OF THE INDIAN OCEAN LONGTAIL TUNA RESOURCE
(*THUNNUS TONGGOL*)

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

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

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]The stock status refers to the most recent years' data used for the assessment.
[3]Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

The SC **RECOMMENDED** the following management advice for longtail tuna in the Indian Ocean, noting that there remains considerable uncertainty about stock structure and about the total catches.

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

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

The SC **RECOMMENDED** the following:

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

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

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

- Resolution 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area*.
- Resolution 09/02 *On the implementation of a limitation of fishing capacity of contracting parties and cooperating non-contracting parties*.
- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*.
- Resolution 10/03 *concerning the recording of catch by fishing vessels in the IOTC area*.
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence*.

FISHERIES INDICATORS

General

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

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

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

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

Longtail tuna – Catch trends

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

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

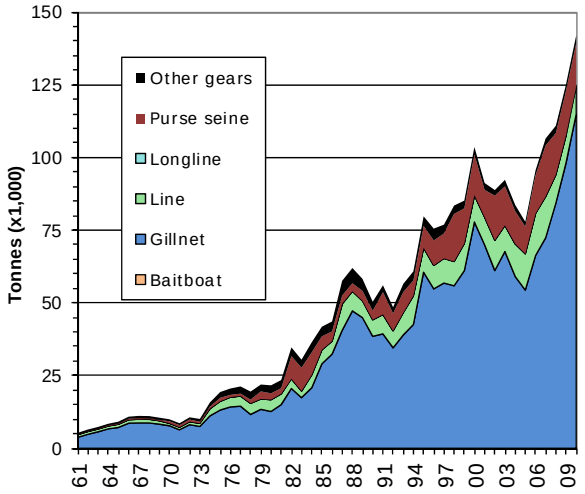


Fig. 1. Longtail tuna: Catches by gear recorded in the IOTC Database (1961–2010).

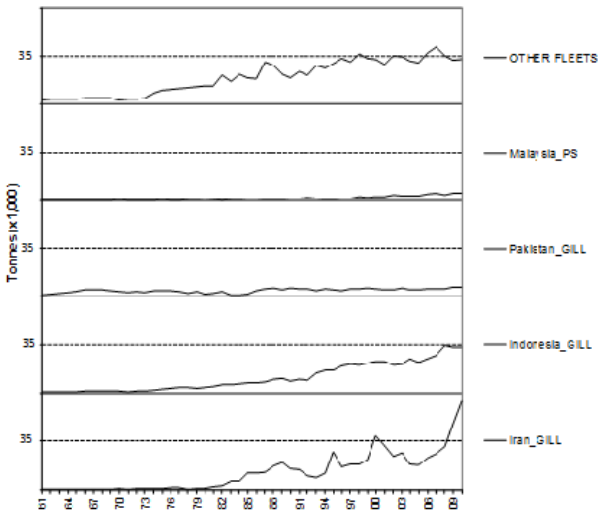


Fig. 2. Longtail tuna: Catches recorded in the IOTC Database for main fishing fleets (1961–2010).

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

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

Longtail tuna – Uncertainty of catches

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

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

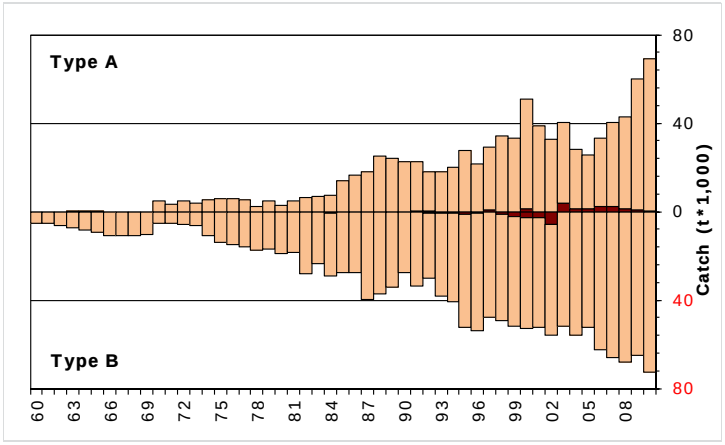


Fig. 3. Longtail tuna: Uncertainty of annual catch estimates (1961–2010) (Data as of October 2011).
*Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear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

Longtail tuna – Effort trends

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

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

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

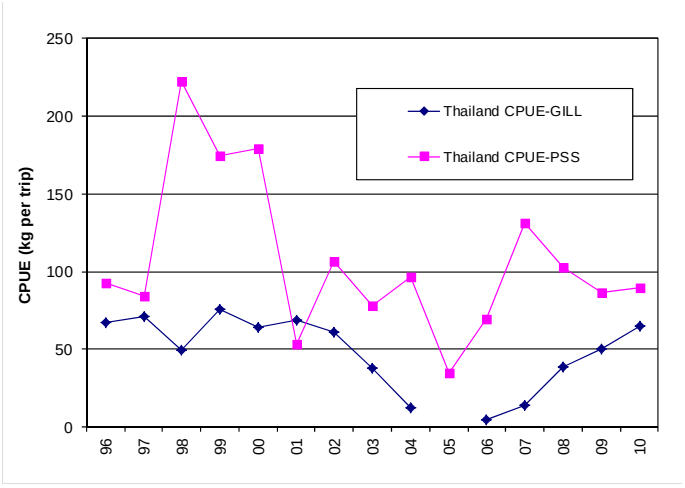


Fig. 4. Longtail tuna: Nominal CPUE series for the gillnet (GILL) and coastal purse seine (PSS) fisheries of Thailand derived from the available catches and effort data (1996–2010).

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

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

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

STOCK ASSESSMENT

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

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

Management Quantity	Aggregate Indian Ocean
2010 catch estimate (1000 t)	114.9
Mean catch from 2006–2010 (1000 t)	116.0
MSY (1000 t) (80% CI)	unknown
Data period used in assessment	–
F_{2010}/F_{MSY} (80% CI)	–
B_{2010}/B_{MSY} (80% CI)	–
SB_{2010}/SB_{MSY}	–
B_{2010}/B_0 (80% CI)	–
SB_{2010}/SB_0	–
$B_{2010}/B_{0,\ F=0}$	–
$SB_{2010}/SB_{0,\ F=0}$	–

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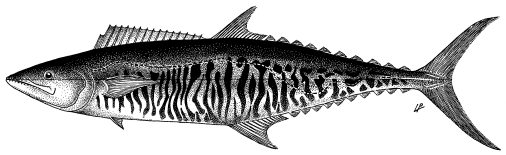
APPENDIX XV
EXECUTIVE SUMMARY: NARROW-BARRED SPANISH MACKEREL



STATUS OF THE INDIAN OCEAN NARROW-BARRED SPANISH MACKEREL RESOURCE (*SCOMBEROMORUS COMMERSON*)

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

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

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]The stock status refers to the most recent years' data used for the assessment.
[3]Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

The SC **RECOMMENDED** the following management advice for narrow-barred Spanish mackerel in the Indian Ocean noting that there remains considerable uncertainty about stock structure and about the total catches.

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

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

The SC **RECOMMENDED** the following:

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

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

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

- Resolution 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area*.
- Resolution 09/02 *On the implementation of a limitation of fishing capacity of contracting parties and cooperating non-contracting parties*.
- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*.
- Resolution 10/03 *concerning the recording of catch by fishing vessels in the IOTC area*.
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence*.

FISHERIES INDICATORS

General

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

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

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

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

Narrow-barred Spanish mackerel – Catch trends

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

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

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

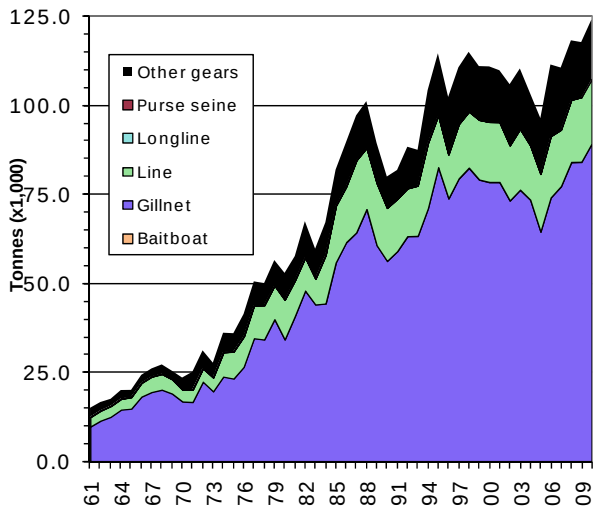


Fig. 1. Narrow-barred Spanish mackerel: Catches by gear recorded in the IOTC Database (1961–2010).

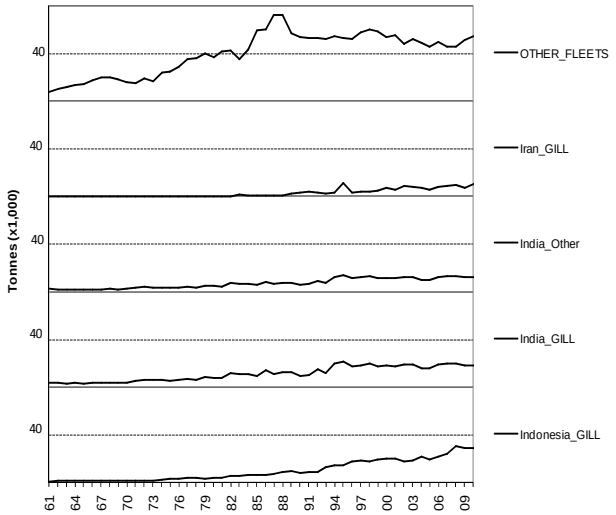


Fig. 2. Narrow-barred Spanish mackerel: Catches recorded in the IOTC Database for main fishing fleets (1961–2010).

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

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

Narrow-barred Spanish mackerel – uncertainty of catches

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

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

- Changes to the catch series: The catch series of narrow-barred Spanish mackerel has changed since those estimated in 2010, following reviews of catches for the coastal fisheries in Indonesia and India, involving marked changes in catches by species. Overall, the new catches estimated represent the 98% of those recorded in the past.

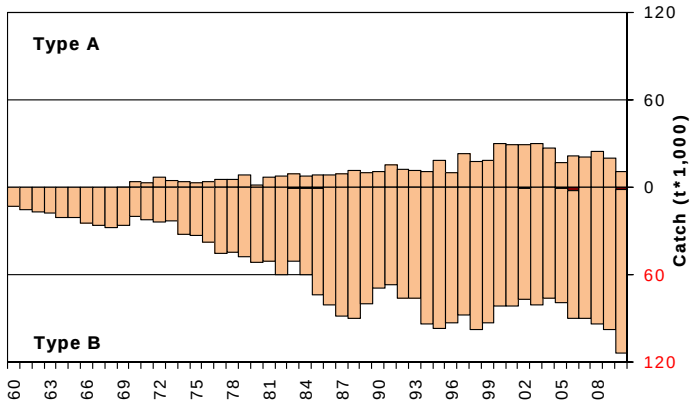


Fig. 3. Narrow-barred Spanish mackerel: Uncertainty of annual catch estimates (1960–2010) (Data as of November 2011).
Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken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

Narrow-barred Spanish mackerel – Effort trends

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

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

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

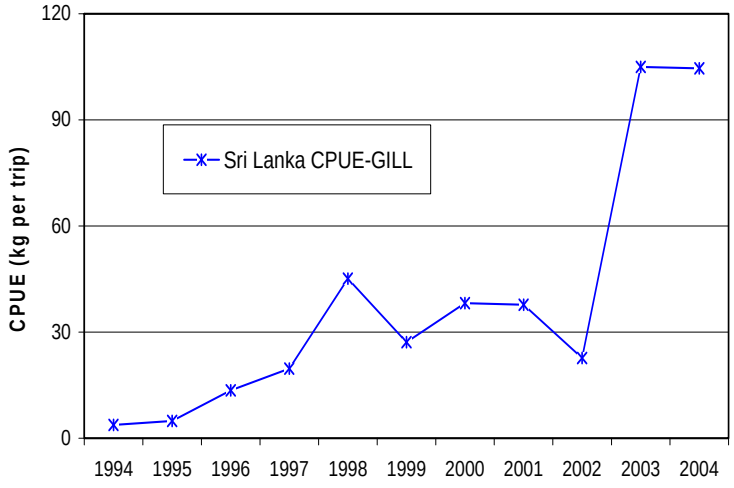


Fig. 4. Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004).

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

- The size of narrow-barred Spanish mackerel taken by the Indian Ocean fisheries typically ranges between 30–140 cm depending on the type of gear used, season and location. The size of narrow-barred Spanish mackerel taken varies by location with 32–119 cm fish taken in the Eastern

Peninsular Malaysia area, 17–39 cm fish taken in the East Malaysia area and 50–90 cm fish taken in the Gulf of Thailand. Similarly, Spanish mackerel caught in the Oman Sea are typically larger than those caught in the Persian Gulf.

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

STOCK ASSESSMENT

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

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

Management Quantity	Aggregate Indian Ocean
2010 catch estimate (1000 t)	124.1
Mean catch from 2006–2010 (1000 t)	116.4
MSY (1000 t) (80% CI)	unknown
Data period used in assessment	–
F_{2010}/F_{MSY} (80% CI)	–
B_{2010}/B_{MSY} (80% CI)	–
SB_{2010}/SB_{MSY}	–
B_{2010}/B_0 (80% CI)	–
SB_{2010}/SB_0	–
$B_{2010}/B_{0,\ F=0}$	–
$SB_{2010}/SB_{0,\ F=0}$	–

LITERATURE CITED

Darvishi M, Kaymaram F, Salarpouri A, Behzadi S and Daghooghi B, 2011. Population dynamic and biological aspects of *Scombermorus commerson* in the Persian Gulf and Oman Sea (Iranian coastal). IOTC–2011–WPNT01–23. Working paper.

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

Grandcourt EM, Al Abdessalaam TZ, Francis F and Al Shamsi AT, 2005. Preliminary assessment of the biology and fishery for the narrow-barred Spanish mackerel, *Scomberomorus commerson* (Lac´ep`ede, 1800), in the southern Arabian Gulf. Fish. Res.76:277–290.

APPENDIX XVI
EXECUTIVE SUMMARY: BULLET TUNA

STATUS OF THE INDIAN OCEAN BULLET TUNA RESOURCE
(*XXXXXXXXX*)

APPENDIX XVII
EXECUTIVE SUMMARY: FRIGATE TUNA

STATUS OF THE INDIAN OCEAN FRIGATE TUNA RESOURCE
(*XXXXXXXXXXXXXX*)

APPENDIX XVIII
EXECUTIVE SUMMARY: KAWAKAWA

STATUS OF THE INDIAN OCEAN KAWAKAWA TUNA RESOURCE
(*XXXXXXXXXXXXXXXX*)

APPENDIX XIX
EXECUTIVE SUMMARY: INDO-PACIFIC KING MACKEREL

STATUS OF THE INDIAN OCEAN INDO-PACIFIC KING MACKEREL RESOURCE
(*XXXXXXXXXXXXXX*)

APPENDIX XX
EXECUTIVE SUMMARY: SWORDFISH

STATUS OF THE INDIAN OCEAN SWORDFISH RESOURCE
(*xxxxxxxxxxxx*)

APPENDIX XXI
EXECUTIVE SUMMARY: BLACK MARLIN

STATUS OF THE INDIAN OCEAN BLACK MARLIN RESOURCE
(*xxxxxxxxxxxxx*)

APPENDIX XXII
EXECUTIVE SUMMARY: INDO-PACIFIC BLUE MARLIN

STATUS OF THE INDIAN OCEAN INDO-PACIFIC BLUE MARLIN RESOURCE
(*xxxxxxxxxxxxx*)

APPENDIX XXIII
EXECUTIVE SUMMARY: STRIPED MARLIN

STATUS OF THE INDIAN OCEAN STRIPED MARLIN RESOURCE
(*xxxxxxxxxxxxxx*)

APPENDIX XXIV
EXECUTIVE SUMMARY: INDO-PACIFIC SAILFISH

STATUS OF THE INDIAN OCEAN INDO-PACIFIC SAILFISH RESOURCE
(*xxxxxxxxxxxxx*)

APPENDIX XXV
EXECUTIVE SUMMARY: MARINE TURTLES

STATUS OF INDIAN OCEAN MARINE TURTLES

APPENDIX XXVI
EXECUTIVE SUMMARY: SEABIRDS

STATUS OF INDIAN OCEAN SEABIRDS

APPENDIX XXVII
EXECUTIVE SUMMARY: BLUE SHARK

STATUS OF THE INDIAN OCEAN BLUE SHARK
(*xxxxxxxxxxxxx*)

APPENDIX XXVIII
EXECUTIVE SUMMARY: OCEANIC WHITETIP SHARK

STATUS OF THE INDIAN OCEAN OCEANIC WHITETIP SHARK
(*xxxxxxxxxxxxx*)

APPENDIX XXIX
EXECUTIVE SUMMARY: SCALLOPED HAMMERHEAD SHARK

STATUS OF THE INDIAN OCEAN SCALLOPED HAMMERHEAD SHARK
(*xxxxxxxxxxxxx*)

APPENDIX XXX
EXECUTIVE SUMMARY: SHORTFIN MAKO SHARK

STATUS OF THE INDIAN OCEAN SHORTFIN MAKO SHARK
(*xxxxxxxxxxxxx*)

APPENDIX XXXI
EXECUTIVE SUMMARY: SILKY SHARK

STATUS OF THE INDIAN OCEAN SILKY SHARK
(*xxxxxxxxxxxxx*)

APPENDIX XXXII
EXECUTIVE SUMMARY: BIGEYE THRESHER SHARK

STATUS OF THE INDIAN OCEAN BIGEYE THRESHER SHARK
(*xxxxxxxxxxxxx*)

APPENDIX XXXIII
EXECUTIVE SUMMARY: PELAGIC THRESHER SHARK

STATUS OF THE INDIAN OCEAN PELAGIC THRESHER SHARK
(*xxxxxxxxxxxxx*)

APPENDIX XXXIV
UPDATE ON THE IMPLEMENTATION OF THE IOTC REGIONAL OBSERVER SCHEME

CPCs	Active Vessels LOA≥24m or High Seas vessels[3]				Progress	List of accredited observers submitted	Observer Trip Reports submitted
	LL	PS	GN	BB			
MEMBERS							
Australia	4	9			Australia has implemented an observer programme that complies with the IOTC Regional Observer Scheme.	**YES: 21**	**YES: 3**
Belize	5				No information received by the Secretariat.	**No**	**No**
China –Taiwan,China	20 562				China has an observer programme. No information received by the Secretariat.	**No** **YES: 54**	**YES: 1** **No**
Comoros					Comoros does not have vessel more than 24m on which observer should be placed. 2 observers were trained under the IOC Regional Monitoring Project, and 5 by SWIOFP.	**YES: 7**	N/A
Eritrea					No information received by the Secretariat.	**No**	**No**
European Union	47	21			EU has an observer programme on-board its purse-seine fleets, however the programme is limited due to the piracy activity in the western Indian Ocean. EU has or is developing observer programmes on-board its longline fleets, i.e. La Réunion, Spanish and Portuguese fleets.	Partial: EU,France: 7 EU,Portugal: 3	**YES: 1**
France (OT)		5			No information received by the Secretariat.	**YES: 15**	**No**
Guinea	3				No information received by the Secretariat.	**No**	**No**
India	53				India has not developed any observer programme so far.	**No**	**No**
Indonesia	996				Indonesia has an observer programme based in Benoa, Bali with 5 trained observers. The number of observers should double in 2012.	**No**	**No**
Iran, Isl. Rep. of		8	863		No information received by the Secretariat.	**No**	**No**
Japan	83	1			Japan has started its observer programme on the 1st of July 2010, and 14 observers are currently being deployed in the Indian Ocean.	**YES: 14**	**YES: 6**
Kenya	1				Kenya is developing an observer programme and 5 observers have been trained under the SWIOFP training.	**No**	**No**
Korea, Rep. of	13				Korea has an observer programme since 2002 with 3 observers being deployed in the Indian Ocean giving a14.5% coverage of the fishing operation in 2009.	**No**	**No**
Madagascar	3				Madagascar is developing an observer programme. Five and three observers have been trained respectively under the SWIOFP and the IOC projects.	**YES: 8**	**No**
Malaysia	41	1			No information received by the Secretariat.	**No**	**No**
Maldives, Rep. of				459	Maldives vessels are monitored by field samplers at landing sites. Have in excess of 250 vessels larger than 24m.	**No**	**No**
Mauritius	4				Mauritius is developing an observer programme, and, 5 and 3	**No**	**No**

[3] The number of active vessels is given for 2010.

					observers have been trained respectively under the SWIOFP and the IOC projects.		
Oman, Sul. of	48				No information received by the Secretariat.	**No**	**No**
Pakistan			10		No information received by the Secretariat.	**No**	**No**
Philippines	7				No information received by the Secretariat.	**No**	**No**
Seychelles, Republic of	35	9			Seychelles is developing an observer programme. Four and three observers have been trained respectively under the SWIOFP and the IOC projects.	**YES: 7**	**No**
Sierra Leone					No information received by the Secretariat.	**No**	**No**
Sri Lanka			3346		Sri Lanka has not started the implementation of an observer programme.	**No**	**No**
Sudan					No information received by the Secretariat.	**No**	**No**
Tanzania, United Rep.of	3				No information received by the Secretariat.	**No**	**No**
Thailand	2	4			Thailand has not developed an observer programme so far.	**No**	**No**
United Kingdom					UK does not have any active vessels in the Indian Ocean.	N/A	N/A
Vanuatu	4				No information received by the Secretariat.	**No**	**No**
COOPERATING NON-CONTRACTING PARTIES							
Mozambique					No information received by the Secretariat.	**No**	**No**
Senegal	3				No information received by the Secretariat.	**No**	**No**
South Africa, Republic of	23				No information received by the Secretariat.	**No**	**No**

APPENDIX XXXV
DRAFT PROPOSAL FOR MINIMUM REQUIREMENTS FOR CATCH AND EFFORT DATA

Record once per trip (or month for daily operation), unless gear configuration changes

1.1 REPORT INFORMATION

1) Date of the submission of logbook
2) Name of reporting person

1.2 VESSEL INFORMATION

1) Vessel name and/or registration number
2) IOTC number, where available
3) Call sign: if call sign is not available, other unique identifying code such as registration or fishing license number should be used
4) Vessel size: gross tonnage and/or overall length (meters)

1.3 CRUISE INFORMATION

For multiday fishing operations record the

1) Departure date and port
2) Arrival date and port

1.4 OTHER REQUIRED INFORMATION

Longline (Gear Configuration):

1) Average branch line length (meters): straight length in meters between snap and hook (Figure 1)
2) Average float line length (meters): straight length in meters from the float to the snap
3) Average length between branch (meters): straight length of main line in meters between successive branch lines
4) Main line material classified into four categories:
    a. Thick rope (Cremona rope)
    b. Thin rope (PE or other materials)
    c. Nylon braided
    d. Nylon monofilament

Purse Seine
Gear configuration:

1) Length and height of the purse seine net
2) Stretched mesh size

Search information:

1) Days searched
2) Spotter plane used (Yes/No)
3) Supply vessel (Yes/No)

Gillnet (Gear Configuration):

1) Minimum and maximum fishing depth of assembled net (meters): record the maximum and minimum of the depth range fished
2) Mesh size of net (millimetres): record the mesh size used during the trip
3) Height of assembled net (meters): height on assembled net in meters
4) Netting material: e.g. nylon braid, nylon monofilament, etc.
5) Total length of net lost and not recovered (meters): record the total length lost during the trip

Pole and line (Gear configuration)

1) Number of poles onboard
2) Number of fishermen

Record once per set/shot/operation

2.1 OPERATION

For longline:

1) Date of set (YYYY/MM/DD)
2) Position in latitude and longitude: either at noon (GMT) position or position of start of gear, area code of operation (e.g. Seychelles EEZ, High seas, etc.) may be optionally used
3) GMT (24 hr) of starting setting the gear
4) Sea surface temperature at noon with one decimal point, if available (XX.X^{o}C)
5) Number of hooks between floats: if there are different hooks counts between floats in a single set then record the most representative (average) number
6) Total number of hooks used in the set
7) Number of light-sticks used in the set
8) Type of bait used in the set

For purse seine:

1) Date of event (YYYY/MM/DD)
2) Type of event: **fishing set** or **deployment of a new FAD**
3) Position in latitude and longitude and time of event, or if no event during the day, at noon (GMT)
4) If fishing set: specify if the set was successful, nil, well, type of school (FAD association, specify the type (e.g. object, beacon, whale shark, whale, etc.) and/or free swimming

school)

5) Sea surface temperature at noon with one decimal point, if available (XX.X^{o}C)

For gillnet:

1) Date of set (YYYY/MM/DD): record the date for each set of day at sea (for days without sets)
2) Total length of net (meters): length floatline used for each set in meters
3) Start fishing time: record the UCT time (24 hr) when starting each set
4) Start and end position in latitude and longitude: record start and end latitude and longitude that represent the area that your gear is set between. Record the latitude and longitude at noon for days with no set.
5) Depth at which net is set (meters): approximate depth at which the gillnet is set

For Pole and Line:

1) Date of activity: record the day. Each day should be recorded separately.
2) Position: record the latitude and longitude at noon
3) Number of fishing gears used: Record the number of fishing poles used during the day
4) Start fishing time (record the UTC time (24 hr) immediately after bait fishing is complete and the vessel heads to the ocean for fishing. For multiple days, the time at which search starts should be recorded) and end fishing time (record the UTC time (24 hr) immediately after fishing is complete from the last school. On multiple days this is the time fishing stopped from the last school.
5) Type of school: FAD associated and/or free school

2.2 CATCH

1) Catch weight (kg) or number by species per set/shot/fishing event for each of the species and form of processing in section 2.3:
    a. For longline by number and weight;
    b. For purse seine by weight;
    c. For gillnet by weight;
    d. For pole and line by weight or number

2.3 SPECIES

TABLE 1. List of elasmobranchs species to be recorded in the logbook for longline, purse seine and gillnet fishing vessels.

For longline:	
IOTC species	***Optional species to be recorded***
Southern bluefin tuna (*Thunnus maccoyii*)	Thresher Sharks (*Alopias* spp.)
Albacore (*Thunnus alalunga*)	Tiger shark (*Galeocerdo cuvier)*
Bigeye tuna (*Thunnus obesus*)	Crocodile shark (*Pseudocarcharias kamoharai*)
Yellowfin tuna (*Thunnus albacares*)	Great white shark (*Carcharodon carcharias*)
Skipjack tuna (*Katsuwonus pelamis*)	Mantas and devils rays (Mobulidae)
Swordfish (*Xiphias gladius*)	Pelagic stingray (*Pteroplatytrygon violacea*)
Striped marlin (*Tetrapturus audax*)	

Blue marlin (*Makaira indica*)
Black marlin (*Makaira mazara*)
Indo-Pacific sailfish (*Istiophorus platypterus*)

Other species

Shortbill spearfish (*Tetrapturus angustirostris*)
Blue Shark (*Prionace glauca*)
Mako Sharks (*Isurus* spp.)
Porbeagle (Lamna nasus)
Oceanic Whitetip Shark (*Carcharhinus longimanus*)
Hammerhead Sharks (Sphyrnidae)
Other bony fish
Other sharks
Other requiem sharks (*Carcharhinus spp.*)
Other sharks
Other rays

For purse seine:

IOTC species

Albacore (*Thunnus alalunga*)
Bigeye tuna (*Thunnus obesus*)
Yellowfin tuna (*Thunnus albacares*)
Skipjack tuna (*Katsuwonus pelamis*)
Other IOTC species

Optional species to be recorded

Oceanic whitetip shark (*Carcharhinus longimanus*)
Silky shark (*Carcharhinus falciformis*)
Whale shark (*Rhincodon typus*)
Mantas and devils rays (Mobulidae)
Other sharks
Other rays
Other bony fish

For gillnet:

IOTC species	***Other species***
Albacore (*Thunnus alalunga*)	Shortbill spearfish (*Tetrapturus angustirostris*)
Bigeye tuna (*Thunnus obesus*)	Blue Shark (*Prionace glauca*)
Yellowfin tuna (*Thunnus albacares*)	Mako Sharks (*Isurus* spp.)
Skipjack tuna (*Katsuwonus pelamis*)	Porbeagle (Lamna nasus)
Longtail tuna (Thunnus tonggol)	Oceanic Whitetip Shark (*Carcharhinus longimanus*)
Frigate and bullet tuna (*Auxis spp.*)	Hammerhead Sharks (Sphyrnidae)
Kawakawa (*Euthynnus affinis*)	Other bony fish
Narrow-barred Spanish mackerel (*Scomberomorus commerson*)	Other sharks
Indo-Pacific king mackerel (*Scomberomorus guttatus*)	***Optional species to be recorded***
Swordfish (*Xiphias gladius*)	Thresher Sharks (*Alopias* spp.)
Indo-Pacific sailfish (*Istiophorus platypterus*)	Tiger shark (*Galeocerdo cuvier)*
Marlins (*Tetrapturus* spp.; *Makaira* spp.)	Crocodile shark (*Pseudocarcharias kamoharai*)
Other IOTC species	Great white shark (*Carcharodon carcharias*)
	Mantas and devils rays (Mobulidae)
	Pelagic stingray (*Pteroplatytrygon violacea*)
	Other requiem sharks (*Carcharhinus spp.*)
	Other sharks
	Other rays

For pole-and-line:

IOTC species	***Optional species to be recorded***
Albacore (*Thunnus alalunga*)	Other bony fish
Bigeye tuna (*Thunnus obesus*)	Sharks
Yellowfin tuna (*Thunnus albacares*)	Rays
Skipjack tuna (*Katsuwonus pelamis*)	
Frigate and bullet tuna (*Auxis spp.*)	
Kawakawa (*Euthynnus affinis*)	
Longtail tuna (Thunnus tonggol)	
Narrow-barred Spanish mackerel (*Scomberomorus commerson*)	
Other IOTC species	

2.4 REMARKS

1) Discard of tuna, tuna-like fish and sharks to be recorded by species in weight (kg) or number for all gears should be recorded in the remarks[4]
2) Any interactions with whale sharks (*Rhincodon typus*), marine mammals, marine

[4] Recall the 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*

turtles and seabirds should be recorded in the remarks

3) Other information is also written in the remarks

Note: The species included in the logbooks are regarded as minimum requirement. Optionally other frequently caught shark and/or fish species should be added as required across different areas and fisheries.

HANDLINE

All logbook information shall be recorded by day; where more than one fishing event is recorded for the same day, it is advisable to record each fishing event separately

Record once in one cruise, or month where daily operation

1-1 INFORMATION OF REPORT

1) Fishing day (or Date of submission of the logbook, where multiple fishing days).
2) Name of reporting person

1-2 VESSEL INFORMATION

3) Vessel name and registration number
4) IOTC number, where available
5) Fishing License number
6) Licensed gears and species
7) Vessel size: Gross tonnage (in MT) and/or length overall (in m)

1-3 CRUISE INFORMATION

1) Departure date and port
2) Arrival date and port

HANDLINE

2-1 OPERATION

1) Date of fishing

Record the date of fishing. Each fishing day should be recorded separately.

2) Number of fishermen

Record the number of fishermen on the boat by fishing day (fishing event)

3) Number of Fishing Gear

Record the number of fishing gear used during the day (fishing event). If the exact number is not available a range may be used i) less than 5 lines, ii) 6-10 lines; iii) more than 11 lines.

4) Start Fishing Time

Record the UCT time (24 hr) corresponding to the time the boat heads to ocean for fishing. Where fishing occurs on multiple days the time at which searching starts should be recorded.

5) End Fishing Time

Record the UCT time (24 hr) immediately after fishing is complete. This is the time in which the captain decides to head home. On multiple days this is the time fishing stopped.

6) Type of school (Anchored or drifting FAD, marine mammal, free, other)

Record the type of school, i.e. anchored FAD, drifting FAD, marine mammal associated, other.

7) Position of the catch

Record the latitude and longitude at the start of each fishing event; record the latitude and longitude at noon for non-fishing days, where not in port.

Where information is recorded by day, record the 1° x 1° area(s) where fishing took place.

8) Bait

Record the type of bait used (e.g. fish, squid), where applicable

2-2 CATCH

Catch in number and weight (kg) by species

1) Catch number and Weight

For each species shown in section 2-3 caught and retained, record the number and estimated live weight (kg), per fishing day (fishing event).

2) Discard number and Weight

For each species shown in section 2-3 caught and not retained record the number and estimated live weight (kg) discarded, per fishing day (fishing event).

2-3 SPECIES

Common name	**Scientific name**
Yellowfin tuna	*Thunnus albacares*
Bigeye tuna	*Thunnus obesus*
Skipjack tuna	*Katsuwonus pelamis*
Indo-Pacific sailfish	*Istiophorus platypterus*
Black marlin	*Makaira indica*
Other billfish	
Longtail tuna	*Thunnus tonggol*
Kawakawa	*Euthynnus affinis*
Frigate tuna/Bullet tuna	*Auxis spp.*
Narrow-barred Spanish mackerel	*Scomberomorus commerson*
Indo-Pacific king mackerel	*Scomberomorus guttatus*
Sharks	
Other fishes	

2-4 REMARKS

1) Discard of tuna, tuna-like fish should be recorded in the remarks, to species level where possible.

2) Other relevant information is also written in the remarks.

Note: These species included in the logbook are regarded as minimum requirement. Optionally other species should be added as species may differ depending on the area fished and type of fishery.

TROLLING VESSELS

All logbook information shall be recorded by day; where more than one fishing event is recorded for the same day, it is advisable to record each fishing event separately

Record once in one cruise

1-1 INFORMATION OF REPORT

8) Date of the submission of logbook.
9) Name of reporting person

1-2 VESSEL INFORMATION

10) Vessel name and registration number
11) IOTC number, where available
12) Fishing License number
13) Licensed gears and species
14) Vessel size: Gross tonnage (in MT) and/or length overall (in m)

1-3 CRUISE INFORMATION

3) Departure date and port
4) Arrival date and port

TROLLING VESSELS

2-1 OPERATION

1) Date of fishing

Record the date of fishing. Each fishing day should be recorded separately.

2) Number of fishermen

Record the number of fishermen on the boat by fishing day (fishing event)

3) Number of Fishing Gear

Record the number of lines and hooks used during the day (fishing event). If the exact number is not available a range may be used i) less than 5 lines, ii) 6-10 lines; iii) more than 11 lines.

4) Time Fishing

Record the total number of hours fishing during the day (fishing event).

5) Number and type of school (Anchored or drifting FAD, marine mammal, free, other) fished

Record the number and type of school fished (i.e. anchored FAD, drifting FAD, marine mammal associated or free) fished during the day.

6) Position of the catch

Record the latitude and longitude when fishing starts; record the latitude and longitude at noon for non-fishing days, where not in port.

Where information is recorded by day, record the 1° x 1° area(s) where fishing took place.

7) Bait

Record the type of bait/lures used, where applicable

2-2 CATCH

Catch in number or weight (kg) by species

1) Number or Weight of fish retained

For each species shown in section 2-3 caught and retained, record the number or estimated live weight (kg), per fishing day (fishing event).

2-3 SPECIES

Common name	**Scientific name**
Yellowfin tuna	*Thunnus albacares*
Bigeye tuna	*Thunnus obesus*
Skipjack tuna	*Katsuwonus pelamis*
Albacore	*Thunnus alalunga*
Swordfish	*Xiphias gladius*
Indo-Pacific blue marlin	*Makaira mazara*
Black marlin	*Makaira indica*
Striped marlin	*Tetrapturus audax*
Indo-Pacific sailfish	*Istiophorus platypterus*
Other billfish	
Longtail tuna	*Thunnus tonggol*
Kawakawa	*Euthynnus affinis*
Frigate tuna/Bullet tuna	*Auxis spp.*
Narrow-barred Spanish mackerel	*Scomberomorus commerson*
Indo-Pacific king mackerel	*Scomberomorus guttatus*
Sharks	
Other fishes	

2-4 REMARKS

1) Discard of tuna, tuna-like fish should be recorded in the remarks, to species level where possible in number or live weight.

2) Other relevant information is also written in the remarks.

Note: These species included in the logbook are regarded as minimum requirement. Optionally other species should be added as species may differ depending on the area fished and type of fishery.

APPENDIX XXXVI
UPDATE ON PROGRESS REGARDING RESOLUTION 09/01 – ON THE PERFORMANCE REVIEW FOLLOW–UP

(NOTE: NUMBERING AND RECOMMENDATIONS AS PER APPENDIX I OF RESOLUTION 09/01)

ON CONSERVATION AND MANAGEMENT	RESPONSIBILITY	UPDATE/STATUS	WORKPLAN/TIMELINE	PRIORITY
Data collection and sharing				
The Panel identified a poor level of compliance by many IOTC Members. with their obligations, notably those related to the statistical requirements on artisanal fisheries and sharks, and recommends that:				
3. The timing of data reporting be modified to ensure that the most recent data are available to the working parties and the Scientific Committee.	*Scientific Committee*	**Completed**: Currently CPCs are required to submit information on their flag vessels by 30th June every year. The timeline for coastal CPCs who license foreign vessels has been brought forward to 15th February every year.The timing of the Working Party will be reviewed annually to ensure that assessments can be completed and results reported to the Scientific Committee each year.	Review annually at IOTC WP and SC meetings.	Medium.
5. The scheduling of meetings of the working parties and Scientific Committee be investigated based on the experience of other RFMOs. This should bear in mind the optimal delivery of scientific advice to the Commission.	*Scientific Committee*	**Completed**: Given the large number of meetings of other RFMOs, it is becoming increasingly difficult to find a schedule of meetings that would be better than the one currently in practice. However, the Working Parties and the Scientific Committee will annually review the timing of the Working Parties.	Review annually at IOTC WP and SC meetings.	Low.
6. The Commission task the Scientific Committee with exploring alternative means of communicating data to improve timeliness of data provision.	*Scientific Committee*	**Partially completed**: The Secretariat encourages members to utilise electronic means to expedite reporting. A study was commissioned for 2011 to determine the feasibility of reporting near real–time for various fleets. Outcome: Real time reporting not currently possible for most CPCs	Review annually at IOTC WP and SC meetings. Within the best delays	Medium.

10. There is a need to improve the quality and quantity of the data collected and reported by the Members, including the information necessary for implementing the ecosystem approach. The most immediate emphasis should be placed on catch, effort and size frequency. The Panel also recommends that:	*Scientific Committee*	**Ongoing**: See below recommendation 11.		
12. A regional scientific observer programme to enhance data collection (also for non–target species) and ensure a unified approach be established, building on the experience of other RFMOs, Regional standards on data collection, data exchanged and training should be developed.	*Scientific Committee*	**Completed**: Resolution 11/04 (superseding Res.09/04 and Res. 10/04) provides CPCs with the necessary framework for putting in place national scientific observer programmes. The Regional Observers Scheme commenced July 1st 2010, and is based on national implementation. The Secretariat coordinated the preparation of standards for data requirements, training and forms.	Review annually at IOTC WP and SC meetings.	High.
15. The Secretariat's capacity for data dissemination and quality assurance be enhanced, including through the employment of a fisheries statistician.	*Standing Committee on Administration and Finance via Scientific Committee* *Commission*	**Partially completed**: The existing post of Data Analyst was converted to a Fisheries Statistician to join the Data Section of the Secretariat. A new Fisheries Officer (data/stats) has been selected and will join the Secretariat in early 2012.	Staffing needs to be assessed annually at IOTC meetings.	Medium.
16. A statistical working party be established to provide a more efficient way to identify and solve the technical statistical questions.	*Scientific Committee*	**Completed**: The Working Party on Data Collection and Statistics resumed its annual meeting in 2009.	Annual meeting.	High.
21. Innovative or alternative means of data collection (e.g. port sampling) should be explored and, as appropriate, implemented.	*Scientific Committee*	**Ongoing**: The Secretariat has been implementing sampling programmes since 1999. The IOTC–OFCF Programme has supported sampling programmes and other means of data collection since 2002. The SC recommended the continuation of the IOTC-OFCF project.	Review annually at IOTC WP and SC meetings.	Medium.

Quality and provision of scientific advice				
23. For species with little data available, the Scientific Committee should be tasked with making use of more qualitative scientific methods that are less data intensive.	*Scientific Committee*	**In progress**: The species Working Parties have been using informal analyses of stock status indicators when data are considered insufficient to conduct full assessments for some time. However, a formal system that reviews those qualitative indicators and provides a recommendation on the current status, based on the weight–of–evidence has yet to be developed.	To be considered at the WPM and others. Review annually at IOTC WP and SC meetings.	High.
25. Confidentiality provisions and issues of accessibility to data by the scientists concerned needs to be clearly delineated, and/or amended, so that analysis can be replicated.	*Scientific Committee*	**Ongoing**: Input, output and executable files for the assessment of major stocks are archived with the Secretariat to allow replication of analyses. Access to operational data under cooperative arrangements, and those subject to confidentiality rules is still limited. In some cases the Secretariat is bound by the domestic data confidentiality rules of Members and Cooperating non–Contracting Parties. The SC recommended to include observer data under the confidentiality policy of IOTC.	Review annually at IOTC WP and SC meetings.	Medium.
27. To enhance the quality of scientific advice and the technical soundness of the papers being considered by the Scientific Committee and its working parties, and to encourage publication of IOTC scientific papers in relevant journals, future consideration should be given to the establishment of a scientific editorial board within the Scientific Committee	*Scientific Committee*	**Partially completed**: Guidelines for the presentation of stock assessment papers were revised and agreed to by the Scientific Committee in 2010. An editorial board should select working party papers to be submitted for publication to a Peer Reviewed journal.	Review annually at IOTC WP and SC meetings. Creation of an Editorial board and prior arrangement with an International Journal by 2013.	Medium.
29. Ongoing peer review by external experts should be incorporated as standard business practice of working parties and the Scientific Committee.	*Scientific Committee*	**Pending**: External experts (Invited Experts) are regularly invited to provide additional expertise at Working Party meetings, although this does not constitute a formal process of peer review. The Scientific Committee in 2010, agreed that once stock assessment models were considered robust, that peer review would be advantageous and funds will be requested to undertake peer reviews of stock assessments. The Scientific Committee will review the processes for Invited Experts, Consultants and Peer review at its 14th Session in 2011.	Review annually at IOTC WP and SC meetings.	Medium.

30. New guidelines for the presentation of more user friendly scientific reports in terms of stock assessments should be developed. In this respect, Kobe plots are considered to be the most desirable method of graphical presentation, especially to non–technical audience.	*Scientific Committee*	**Ongoing**: All recent stock assessment results have been presented using the Kobe plot, and the species Working Parties are progressing in presenting the Kobe matrix. The 2010 and 2011Scientific Committee report includes Kobe Matrices for all stock assessments. The format of the Working Party reports and the resultant Executive Summaries has been revised to improve readability and content.	Review annually at IOTC WP and SC meetings.	Medium.
Adoption of conservation and management measures				
35. IOTC should consider developing a framework to take action in the face of uncertainty in scientific advice.	*Scientific Committee and Commission*	**In progress**: The Scientific Committee has agreed that the development of a Management Strategy Evaluation process be initiated to provide better advice that would incorporate explicit consideration of uncertainty. The 2012 meeting of the Working Party on Methods will focus on this process.	Intersessional start of the MSE process by correspondence, as of Jan.2012 Progress at 2012 WPM annual meeting.	High.
Capacity management				
42. IOTC should establish a stronger policy on fishing capacity to prevent or eliminate excess fishing capacity.	*Working Party on Fishing Capacity* *Scientific Committee* *Commission*	**Ongoing**: The Commission has since 2003 adopted a series of Resolutions (03/01, 06/05, 07/05 and 09/02) with the objective of addressing the issue of fishing capacity. However, to date these resolutions have not resulted in a strong control on fishing capacity, and the concern remains that overcapacity might result from this lack of control. The Secretariat is actively involved in developing the global vessels record for vessels fishing for tuna and tuna–like species that would contribute to the assessment of existing fishing capacity.	See Recommendation 33, which has been agreed as the priority path in this regard.	Medium.

APPENDIX XXXVII
RULES OF PROCEDURE FOR THE SELECTION OF INVITED EXPERTS TO ATTEND IOTC WORKING PARTY MEETINGS

Definition of an Invited expert

The role of an Invited Expert and the guiding principles for their selection are as follows (noting that Invited Experts are **NOT** consultants, as they are **unpaid**, other than for return **economy** airfares and DSA to attend a meeting):

Duties: (i) if possible/willing, to carry out tasks identified by the Working Party (WP) (to be identified separately for each meeting); (ii) as applicable, attend and contribute to discussions at any preparatory sessions (e.g. any pre-assessment workshops, noting that ideally, these may need to be carried out several months in advance of a WP meeting), and at the WP meeting;

Capacity: The invited expert must have recognized experience and skill in the subjects for which they are tasked;

Independence: The invited expert's advice on matters relating to tasks defined by the WP should be based on the principles of independence, impartiality and transparency. Therefore, the invited expert shall be invited in their personal capacity without representing any CPCs and/or stakeholder. Participation of experts based in IOTC developing coastal states shall be encouraged. Invited Experts should not be:

- directly involved with current IOTC stock assessments or CPUE standardisations.
- from a CPC where a scientist is presenting a stock assessment or CPUE standardization.

Confidentiality: Invited Experts shall not divulge any information, including data considered confidential by the Commission, as defined in IOTC Resolution 98/02.

Process for Selection

Process and timeline for the selection of an Invited Expert.

STEP	Action Item	Responsibility	Due date
1	Chair of the Working Party (WP) (Vice-Chair if Chair not available) to distribute an email to the IOTC Science contact list (consisting of the combined WP and SC mailing list/s), calling for Invited Expert nominations. The call for nomination will include a summary of the priority areas for contribution (identified during the previous WP meeting, in combination with requests from the SC and Commission), specific details to be provided by potential candidates (e.g. one page CV), and the selection timeline.	Chair of the WP (or Vice-Chair)	No later than 90 days prior to the commencement of the WP meeting or any other preparatory sessions as identified by the WP.
2	Deadline for nominations: two weeks from the call for nominations. Nominations should be made via return email to the IOTC Science contact list.	IOTC Science contact list	14 days after the call for nominations by the Chair (Step 1 above)
3	Selection panel, **consisting of the Chair and Vice-Chair of the Working Party, in consultation with the Chair of the Scientific Committee** to determine the most appropriate Invited Expert/s for the meeting, taking into consideration budgetary constraints, as advised by the Executive Secretary or his/her delegate. Potential Invited Expert to be contacted by the Chair to confirm availability.	Selection panel	Within 5 days of the deadline for comments on candidates from participants
4	Chair of the Working Party (or Vice-Chair) to advise the IOTC Science contact list of the successful Invited Expert/s, and request the Secretariat to commence the travel process. The IOTC Secretariat will also inform the IOTC Commissioner's contact list of the selected Invited Expert/s for each meeting.	Chair of WP or alternate & Secretariat	Within 2 days of the selection meeting.
5	Working Party meeting.	Participants	–

APPENDIX XXXVII
CONSOLIDATED SET OF RECOMMENDATIONS OF THE FOURTEENTH SESSION OF THE SCIENTIFIC COMMITTEE (12–17 DECEMBER, 2011)

SC14.01 (para. xx): The SC …….