Commission for the Conservation of
Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of the Seventeenth Meeting of the Scientific Committee

27-31 August 2012

Tokyo, Japan

Report of the Seventeenth Meeting of the Scientific Committee

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Agenda Item 1. Opening meeting

1. The independent Chair, Dr Annala, welcomed participants and opened the meeting.
2. The list of participants is at **Appendix 1**.

Agenda Item 2. Approval of decisions taken by the Extended Scientific Committee

3. The Scientific Committee endorsed all the recommendations made by the Extended Scientific Committee for the Seventeenth Meeting of the Scientific Committee, which is at **Appendix 2**.

Agenda Item 3. Other business

4. There was no other business.

Agenda Item 4. Adoption of report of meeting

5. The report of the Scientific Committee was adopted.

Agenda Item 5. Closure of meeting

6. The meeting was closed at 2:55 pm, on 31 August 2012.

List of Appendices

Appendix

1 List of Participants

2 Report of the Extended Scientific Committee for the Seventeenth Meeting of the Scientific Committee

Appendix 1

List of Participants
Seventeenth Meeting of the Scientific Committee

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Commission for the Conservation of
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みなみまぐろ保存委員会

Appendix 2

Report of the Extended Scientific Committee for the Seventeenth Meeting of the Scientific Committee

27-31 August 2012

Tokyo, Japan

Report of the Extended Scientific Committee for

the Seventeenth Meeting of the Scientific Committee

27-31 August 2012

Tokyo, Japan

Agenda Item 1. Opening

1. The independent Chair, Dr Annala, welcomed participants and opened the meeting.

1.1 Introduction of Participants

2. Each delegation introduced its participants. The list of meeting participants is at **Attachment 1**.

1.2 Administrative Arrangements

3. The Executive Secretary announced the administrative arrangements for the meeting.

Agenda Item 2. Appointment of Rapporteurs

4. Australia and Japan assigned rapporteurs to produce and review the text of the substantive agenda items.

Agenda Item 3. Adoption of Agenda and Document List

5. The agreed agenda is shown in **Attachment 2**.
6. The agreed document list is shown in **Attachment 3**.

Agenda Item 4. Review of SBT Fisheries

4.1 Presentation of National Reports

7. Members provided brief presentations of their National Reports.
8. New Zealand presented paper CCSBT-ESC/1208/SBT Fisheries – New Zealand that describes the New Zealand SBT fishery for 2011 and the 2010/11 fishing year. Commercial landings were 547t for the period 1 October 2010 to 30 September 2011. From scaled observer data, it is estimated that 84 dead SBT were discarded from the domestic fleet and none from the charter fleet during the 2010/11. CPUE in 2010/11 increased for the domestic fishery but decreased slightly for the charter fleet, which largely fishes the west coast of the South Island (CCSBT Area 6). All four charter vessels were covered by observers in 2010/11. Coverage by the observers was 82% of catch (numbers) and 74% of effort (hooks). For the domestic fishery in 2010/11 coverage was 9% and 8% of

catch and effort. A comparison of length frequency data from the CDS forms and the observer programme showed a close match of size distribution.

9. Japan presented paper CCSBT-ESC/1208/SBT Fisheries-Japan. The number of Japanese longline vessels targeting the SBT has decreased yearly. In the 2011 fishing year, 82 longline vessels caught 2585t SBT. In the calendar year, 83 vessels caught 2519t. Nominal CPUE in 2011 represented higher levels in the major CCSBT statistical area after 2008. Japanese longline vessels mainly caught small or middle sized fish (120-150 cm Fork Length) in areas 4 and 7. In CCSBT statistical area 8, larger fish were also caught. Smaller fish were caught in CCSBT statistical area 9. Japanese fishermen reported the release and discard of SBT from longline vessels using RTMP reports; in total 3988 individuals were released in 2011 calendar year. Based on the visual size estimation by the fishermen, 79% of released SBT were <20 kg fish. Details of release activities are summarised in CCSBT-ESC/1208/40. Japan sent 16 scientific observers to Japanese authorised longline vessels for SBT fishing in 2011. 12 vessels operated in the SBT fishing ground while observers were onboard. Observer coverage was 14.8% in terms of the number of vessels, 11.8% in terms of the number of hooks used and14.8% in terms of the number of SBT caught. Observer activity is detailed in CCSBT-ESC/1208/27. Observers reported the recapture of 4 conventional tags from 4 individuals. In total, 43 individuals with conventional tags were reported from Japanese longline vessels. Activity related to tag recapture is detailed in CCSBT-ESC/1208/28.

10. Australia presented paper CCSBT-ESC/1208/SBT Fisheries – Australia. The paper summarises catches and fishing activities in the Australian SBT Fishery up to and including Year 2 of the 2009-11 season (December 2010 – November 2011) and some preliminary results for the 2011-12 fishing season (December 2011-November 2012). A total of 18 commercial fishing vessels landed SBT in Australian waters in Year 2 of the 2009-11 season for a total catch of 3958 t, 97.8% of the catch was taken by purse seine with the remainder taken by longline and trolling. Five purse seiners fished off South Australia for farm operations during Year 2 of the 2009-11 fishing season. Most of the purse seine fishing commenced in mid December 2010 and finished in late March 2011. In the 2011-12 fishing season observers monitored 11.1% of purse seine sets where fish were retained and 13.8% of the estimated SBT catch.

11. Korea presented paper CCSBT-ESC/1208/SBT Fisheries – Korea, reporting that in the 2011 fishing year, 7 Korean longline vessels were engaged in fishing for SBT and their total catch was 737t (705t in the 2011 calendar year). The nominal CPUE was at almost the same level as in recent years with a slight increase from 3.23 fish/1000 hooks in 2010, to 3.38 fish/1000 hooks in 2011. The size composition of SBT collected from CDS documents ranged from 60-205 cm (fork length) with a mean length of 119.3 cm. No observers were deployed in 2011, but 3 observers were dispatched for the Korean SBT fishery during the 1st and 2nd quarters of 2012. Korea advised that the Distant-water Fisheries Development Act was revised and put into effect from 1 July 2012. This was a measure to promote the data collection and submission requirements most recently adopted by the CCSBT and other Tuna RFMOs for target, non-target species and ecologically related species. NFRDI improved fisheries database systems to enable data cross-checking. Operational protocols for the Korean observer program are being drafted for inclusion in the Act to secure the observer

coverage design, fishery and biological data collection, and ERS data collection and handling, recently required by the RFMOs.

12. Indonesia presented paper CCSBT-ESC/1208/SBT Fisheries – Indonesia, reporting that the number of registered tuna longliners in the port of Benoa (Bali) that mainly target tuna was 757. Indonesian longliners registered with CCSBT numbered 187. Those fishing boats vary in size from 23-594 GT. About 85% of Indonesia's catch of SBT is landed in the port of Benoa. CDS Reports from Bali and Jakarta showed that the catch of SBT in 2011 was 672t. The results of estimation on the basis of data from Benoa catch monitoring SBT was 432t. Monitoring of fish size landed in Benoa revealed that the size distribution of SBT was in the range from 160cm to 180cm (fork length) with a mean length of about 169cm. There was no significant change in the mean length of SBT in 2010-2012 compared to the length of SBT in 2002/03; this has fluctuated between 168 and 171 cm FL. The nominal CPUE for 2005-2012 showed higher catch rates in the temperate regions. The average catch rate was 0.1 per 1000 hooks. A higher catch rate of SBT in 2011 occurred in October and November with 0.1-0.3 per 1000 hooks. Lower catch rates occurred from April to August (0-0.01 per 1000 hooks). Indonesia and Australia (CSIRO) are continuing to work together to provide age composition data (based on direct ageing using otoliths) and close kin genetic analysis. Scientific observer program activities in 2011 covered 210 days at sea, and up to July 2012 the observer coverage was up to 283 days with an average of 56 days at sea per trip.

13. Taiwan presented paper CCSBT-ESC/1208/SBT Fisheries – Taiwan, reporting that in 2011, Taiwan's annual catch of SBT was 518t for the quota year and 556t for the calendar year with 56 active vessels. Taiwan's SBT permitted quota for fishers in the 2011 quota year was set at 578 ton. The catch was well below this permitted quota. Taiwan advised that the fishing grounds have not changed; one is in the southern central Indian Ocean around 50°E-105°E, 20°S-40°S, and the other is located in the south eastern waters off Africa around 20°E-50°E, 25°S-45°S. These two fishing grounds have been labelled Area 1 and Area 2 respectively. The nominal CPUE (number of SBT caught per 1000 hooks) in Area 1 and Area 2 all increased slightly in 2011. Further, in 2011, because of the increasing threat of piracy, and in consideration of the safety of observers, Taiwan stopped dispatching observers on board in Indian Ocean until the end of December. For the 2011 fishing season, 2 observers were deployed on 2 seasonal target vessels. The observer coverage rate was about 3.56% by hooks. No tagged SBT were recaptured during the observed periods in 2011.

14. In response to questions from participants, the following information was provided in addition to that included in the reports:-

- New Zealand advised that it had included lengths from both the Catch Documentation Scheme (CDS) and Observer Logbooks, as an example to show the representativeness of the Observer Data. New Zealand recommended that other Members/Cooperating Non-Members (CNM's) do the same in future reports to CCSBT meetings.
- Australia advised that:
    - It was in the process of working with its State departments in developing methodologies to provide estimates of total recreational catch, and that it will provide further information on this project to next year's ESC meeting.

- The Stereo Video commercial trial was completed during the last season; however the data from the trial was not necessarily representative of the catch for that year.

- New Zealand commented that the scale of the Australian recreational catch was such that it should be considered in the SBT stock assessment.
- The importance of the Benoa research centre was noted as was the importance of continued genetic and length frequency sampling in the spawning ground.
- Indonesia advised the ESC of its intention to continue the catch and biological monitoring at Benoa as part of the regular activities of the Tuna Research Institute at Benoa, Bali.
- Taiwan reported that the number of released SBT in the last fishing season was 50.

4.2 Secretariat Review of Catches

15. The Secretariat presented paper CCSBT-ESC/1208/04. The reported catch for the 2011 calendar year was 9,309t, excluding the unreported catch scenarios. The global SBT reported catch by flag is shown at **Attachment 4**. The Secretariat advised that Attachment A of CCSBT-ESC/1208/04 should remain confidential due to the unreported catch and surface fishery bias scenarios contained in that Attachment.

Agenda Item 5. Evaluation of Fisheries Indicators

16. Paper CCSBT-ESC/1208/15 provided an update of the commercial spotting index (surface abundance per unit effort or SAPUE) for the Australian surface fishery in the 2011-12 fishing season. Data on SBT sightings have now been collected by experienced tuna spotters for 11 fishing seasons (2001-02 to 2011-12). In 2012, data were again collected by only two spotters between December 2011 and March 2012. Only data from these two spotters were included in the standardisation analyses for the whole time series as they are the only spotters that have operated in all years. The same modelling approach used in previous years was updated with the 2012 data. The standardised index for 2-4 year olds was highest in 2010-11; the 2011-12 value is similar to the second lowest value seen in 2003.
17. Paper CCSBT-ESC/1208/16 provides an update of the analysis methods and results for the scientific aerial survey. The estimate of relative juvenile abundance in the Great Australian Bight for 2012 shows a substantial decrease from 2011, and the point estimate is second lowest, next to 1999, of all survey years. Taking confidence intervals into account, the 2012 estimate is similar to estimates obtained in 1999 and several years during the period 2005-2009. The methods of analysis were the same as last year except for the addition of sea shadow as an environmental covariate in the sightings model. The environmental conditions during the 2012 survey (i.e., during search time) were unusual in that the wind speed and sea surface temperature (SST) were slightly favourable when taken over all months of the survey, but the level of sea shadow and haze were both notably higher than average. Similar to the past few years, a high proportion

of schools were comprised of small fish (<8 kg; estimated to be 1-year-olds). Thus, as was done last year, schools of small (<8 kg) fish were omitted from all years in the analysis. This makes the index comparable across years and provides consistency with the CCSBT operating model and management procedure (which assume the scientific aerial survey provides an index of age 2-4 abundance).

18. Discussion on both the SAPUE and AS indices focused on whether the low point for both indices in 2012 was an indication of low recruitment. This was further investigated through comparison against the other indicators. This comparison is described further below (paragraph 33). No conclusion on the magnitude of recent recruitment could be made at this time.

19. Sea-shadow and haze were higher than the average for the other years and sea-shadow was an additional environmental covariate in the AS analysis. An analysis of environmental data in 2012 will be examined for information on whether or not this was an anomalous year in terms of the environmental conditions for SBT in the Great Australian Bight (GAB).

20. It was noted that in November 2011 – April 2012 there was a seismic survey associated with oil and gas exploration activities in the GAB and there is no information on what effect these activities might have had on the AS and SAPUE indices.

21. Paper CCSBT-ESC/1208/18 provides an update on otolith collection, direct ageing and length at age keys for the Australian surface fishery. Australia continued to collect and archive otoliths from SBT caught by the Australian surface fishery during the 2011-12 fishing season. Age was also estimated for 100 SBT caught by the surface fishery in the previous fishing season (2010-11), and the proportions-at-age of SBT caught in the fishery were estimated using three methods: the standard age-length-key (ALK), the Morton and Bravington (M&B) method (Morton and Bravington, 2003) with known growth, and the M&B method with unknown growth. For many seasons there is reasonably good agreement between the three methods but for others, including the 2010-11 season, the estimated proportions at ages 2-4 differ considerably. The CVs of the estimates for the 2010-11 season are higher than for previous seasons, which is most likely due to a contrast between the direct age-length data and the length-frequency data, with the former suggesting larger average lengths for fish of ages 2 and 3 than the latter. The reason for this discrepancy is unclear. The work highlights the need for further discussion within the CCSBT regarding the technical details of how the direct age data will be incorporated into the operating model (see CCSBT/ESC/1208/22).

22. The sample representativeness of the otolith collection activities was queried, and it was explained that the otoliths and lengths of these fish were collected from fish that died in the grow-out pens.

23. Paper CCSBT-ESC/1208/25 updated previous analyses of SBT length and age data from the Indonesian longline fishery operating out of the port of Benoa, Bali. Length-frequency data up to the 2011–12 season, and age-frequency data to the 2010–11 spawning seasons are available for the fishery. The age frequency for the last two seasons (2009-10 and 2010-11) were updated this year, after otoliths were provided by Indonesia for these two seasons, and the direct ageing was completed in time for the ESC meeting. As noted previously, considerable

change has occurred in the size and age distribution of SBT caught on the spawning ground since monitoring began in 1992-93. Both the mean length and age of SBT landed declined from the mid-1990s to the early-2000s. The mean size decreased from around 188 cm to 168-171 cm, and the mean age from 20 to 14-17 years. The size and age distribution of the Indonesian catch has remained relatively stable since the early-2000s. In the latest season, the mean age was 16.8 years.

24. Indonesia noted that current otolith sampling at Benoa was reliant on one or two experienced staff and that additional staff needed to be trained to ensure long-term continuity of the monitoring of the spawning ground catches in Indonesia.

25. Japan presented paper CCSBT-ESC/1208/33, detailing that in January and February 2012, the trolling research survey has been carried out in the southern Western Australia in similar manner since 2006. The trolling index (the number of age-1 SBT school per 100 km searched on the pre-determined straight line) was 1.6 with a 90% confidence range of 0.8-2.4, which was lower than that of 2011. The paper noted length frequency distributions were quite different to those in previous years.

26. CCSBT-ESC/1208/39 was presented regarding the size of SBT in southern Western Australia where the trolling survey was conducted. It was observed that SBT around 50 cm FL had formed a large part in 14 years from 1996 to 2010, while many SBT around 60-70 cm FL were also observed in 2011 and 2012. These two modes in size were considered to be sub-cohorts resulting from successful spawning at different times of the spawning season; SBT around 50 cm FL probably resulted from February spawning and would be approximately age-1.0 while SBT around 60-70 cm FL were probably spawned earlier (in October) and would be approximately age-1.3.

27. There were some very small fish (30-35 cm) caught in 2012, and it was noted that fish of this size were also seen in 2008. It was suggested that there may have also been other occurrences in the past, but not noted in the research area in January-February during which the survey was undertaken. The very small fish have been found during other research programs such as the collaborative Australian and Japanese recruitment monitoring program research on the Western Australian coast, but this was much further north. Past work (e.g. Serventy, 1956) also examined multiple modes in these young fish. Japan asked Australia to check whether data analysed in these past papers are available to further examine the small fish distribution.

28. CCSBT-ESC/1208/41 checked whether exceptional circumstances existed at this time and examined the need to invoke meta-rules by comparing projection results that were obtained from operating models last year to the latest observations for the scientific aerial survey index, longline CPUE and catch-at-age compositions of longline and purse seine fisheries. The value of the aerial survey index in 2012 is outside the 95% probability interval predicted using the base case operating model and is therefore considered to be an unexpected event. However, the severity of this occurrence in the context of resource conservation was considered relatively low because some of the robustness trials considered have projections whose 95% probability intervals cover the 2012 observation and the Bali procedure was confirmed to be robust to the associated uncertainties. In addition, observed LL1 CPUE and catch-at-age compositions fell within the

projection ranges. Therefore, the authors consider that there is no need to invoke a meta-rule and suggested that the ESC monitor and review the scientific aerial survey results carefully over the next few years.

29. The ESC considered whether or not the low scientific Aerial Survey (AS) point for 2012 triggered exceptional circumstances according to the meta-rules process. The calculations in CCSBT-ESC/1208/41 were repeated with the data files from the MP runs that formed the basis of the work looked at by the Commission when adopting the MP, and the AS point was reported to be on the boundary, but not outside the 95% confidence intervals. As noted in CCSBT-ESC/1208/41, the MP has been shown to be robust to low recruitment trials and the high CV AS scenario ,so even though the 2012 point is low, it is not outside the range of the historical series and the MP should be robust to this value. The ESC agreed that, on this basis, exceptional circumstances had not been triggered this year and that further consideration would be given to this issue at ESC18 when more detailed analysis of the environmental and fishery data were available.

30. The ESC agreed that examination of whether the MP input data series and relevant indicators would trigger exceptional circumstances under the meta-rule process should be a standard agenda item under the Evaluation of Fisheries Indicators for future ESC meetings. This should include reporting of results against a standard set of analyses similar to those provided in CCSBT-ESC/1208/41 to be agreed at ESC18. A summary of these results will be reported under Management Advice.

31. Paper CCSBT-ESC/1208/32 was presented by Japan. Various fisheries indicators were examined to provide an overview of the current status of southern bluefin tuna stock. Recent longline standardised CPUE for age 4 to 7 showed increasing trends (especially, age 5 to 7) and the CPUE levels were higher than the past 5-year mean (similar to those observed in the early 1980s). The CPUE levels for age 8 and older in recent years were still very low and there appeared to be slow and gradual decreases in trends. Recent recruitment indices from trolling (age 1) and aerial (age 2 to 4) surveys showed increasing trends. However, both indices in 2012 greatly dropped to a level similar to the mid-2000s.

32. Australia presented paper CCSBT-ESC/1208/14 on fishery indicators. The three indices of juvenile (age 1 to 4) abundance in the Great Australian Bight—the scientific aerial survey (AS) index, SAPUE index and trolling index—exhibited decreases over the past 12 months from values observed in the 2010–11 fishing season (austral summer). The AS index in particular exhibited a substantial decrease, compared to 2011 and is at its second lowest level since the survey began in 1993. However, 2012 is similar to estimates obtained in 1999 and several years during the period 2005–09. Indicators of age 4+ SBT exhibited some upward trends, such as the New Zealand domestic CPUE, the Japanese longline nominal CPUE for ages 4-7 and Korean nominal CPUE. The New Zealand joint venture CPUE decreased slightly in 2011 but was well above the 10 year mean. Juvenile fish comprised a smaller proportion of the NZ charter catch in 2011. The Japanese longline nominal CPUE for ages 4+ also decreased slightly in 2011, as did the Taiwanese nominal CPUE. The mean age of 20+ fish on the Indonesian spawning grounds decreased again in 2010-11 while the mean age of all SBT on the spawning grounds increased.

33. Discussion focused on the comparison of indicators for information on year class strength. Comparisons of AS, SAPUE and the trolling survey did not show consistent information on cohort strength across the time series. It was noted that fig 5-1 in CCSBT-ESC/1208/32 may give the impression that there is a drop in recruitment, and therefore it was suggested that in future a moving average of 2,3 and 4 year olds from the trolling survey be calculated to compare against the AS data. Japan noted that the acoustic index after 2003 lacked reliability because of the small school sizes seen, and difficulties for the sonar specialist to estimate the species of small (<10t) schools.

Agenda Item 6. Report on intersessional scientific activities

34. CCSBT-ESC/1208/30 was presented. In the paper, size measurements at harvest for farmed SBT in Australia and imported to Japan between 2007 and 2010 were analysed in two ways; applying mixed normal distribution to length frequency and age-slicing method in assumed growth. The result showed that age-3 fish or age-4 fish dominated, but there were few age-2 fish in all the years. It was quite different to the Australian claim that age-2 fish dominated with few age-4 fish. Estimated total catch was similar between the two methods. The estimated total catches in the age-slicing, based on growth rate derived from of tag recapture data were 8,273 t (5,342 t in Australian report) in 2007, 6,659 t (5,211 t) in 2008, 6,675 t (5,022 t) in 2009 and 5,689 t (3,935 t) in 2010. To match the reported catch from Australia would require the fish to grow at a rate equivalent to a VB growth parameter (K) of 0.51 to 0.81. It is highly unlikely that farmed SBT attains VB-K several times as high as that of wild SBT (VB-K=0.22) and even higher than that of fast growth tuna, such as yellowfin tuna. The paper concluded that there was a large bias in the 40 fish sampling for farmed fish and it affected the age composition and total catch amount of the Australian purse seine fishery.

35. Australia reiterated the concerns it had raised at previous ESC meetings, that the approach in paper CCSBT-ESC/1208/30 has inherent bias. A fundamental issue was the lack of a detailed sampling design or information on the basis for data exclusions; the data was not shown to be representative and Australia does not regard the results as valid. Australia reiterated the request that Japan provide the raw shipment data used in its analysis so that they could better understand the results presented. Australia noted its concerns over the analytical approach and the assumed growth rates.

36. Australia further reiterated its concerns that the approach has an inherent bias because the final harvest weights (and lengths) at the individual pontoon and fish level are affected by a range of factors, including different farming, feeding and holding practices, as well as differential growth rates at different ages, different grow-out periods, and the variable size of fish going into the farms. Australia encouraged Japan to provide the ESC with the input data and sample design in order for the ESC to judge the representativeness of the data.

37. Japan noted that while the data did not cover every fish harvested, the coverage for most years was quite high. Japan also noted that the cohort slicing method was used for the current SBT stock assessment and that the mixture of normal distributions and cohort slicing methods often produced similar results. Japan advised that while it would not be possible to provide the raw input data due to

confidentiality issues, a solution to this would be that Australia analysed Catch Documentation Scheme length and weight data, which covered 100% of the individuals harvested, as provided to the CCSBT Secretariat. Australia responded that this would not be a valid approach because of the potential biases noted above.

38. In response to a question from Japan regarding the use of the 40 fish sample method in the 2011/12 fishing year, Australia noted, that as reported in their National Report, this was still being used. Australia also noted that the commercial trial of stereo video was conducted in 2011 and reported to the 6th meeting of the Compliance Committee. In response to a further question, Australia noted that when stereo video was implemented the 40 fish sample method would be discontinued.

39. Japan pointed out that Australia had not reported representative data regarding size and age-composition from the stereo video commercial trial at the 6th Compliance Committee. Australia advised that a comprehensive report on the outcomes of the commercial trial had been provided to the 6th meeting of the Compliance Committee, however due to confidentiality issues the size and age-composition data could not be provided

40. The Chair referred to the 2011 ESC report where the following comments were made:

"In response to a request by Japan for other members to comment, the Advisory Panel advised their frustration at this issue not yet being resolved and noted their general support of the methodology used by Japan in the past. They also advised they had not yet examined the new method put forward by Japan at this meeting in detail. Similarly, New Zealand stated that they also found it frustrating that this issue was not yet resolved. They also noted their previous support for the mixture distribution approach the Japanese have taken in past years, as this method produced good fits to previous years data. The method used in 2011 may not be as robust."

41. The panel reiterated their continuing frustration at the timeframe taken to implement stereo video monitoring technology. The panel also recommended that the age composition analysis is continued so that it may be compared with the results of the stereo video monitoring results when these become available.

42. In CCSBT-ESC/1208/28, Japan reported their tag and recapture activity in the 2011 season. A total of 91 SBT (Averaging 57.7 cm FL) were tagged using CCSBT conventional tags and an archival tag for each individual during the trolling survey during January and February 2012. In addition, Pop-up archival tags were deployed on 10 individuals (Ave. 70.7 cm FL) during the survey. From Japanese longline vessels, a total of 32 individuals with conventional tags were recaptured between June 2011 and July 2012 (42 CCSBT tags from 31 individuals, and one CSIRO tag from one individual). Over the past 11 years, Japan has released 401 archival tags on large SBT from offshore regions by Japanese longline vessels, and 359 archival tags on juvenile SBT from south coast of Western Australia. To date, 22 archival tags from offshore releases have been recaptured.

43. Japan presented CCSBT-ESC/1208/31, providing an update of the Japanese domestic market monitoring. This monitoring has been conducted to validate the

reported SBT catch by the Japanese longline fisheries. The calculation methods are almost the same as the Independent Review of Japanese SBT Market Anomalies Report (JMR) in 2006. The ratio of wild/farmed frozen fish at Tsukiji market, domestic/imported ratio of auctioned fish, and time-lag information between catch and sale were all updated. Based on the above information, domestic SBT catch amounts in 2004-2011 were estimated under the same assumptions and parameters for Japanese market behaviour as with previous Japanese Market Review (e.g. double-counting, off-market selling rate, market share). Estimated catch amounts were compared to the official catch amounts reported from fishermen. In 2011, estimated catch was much smaller than official catch, thus there was no evidence for under-reporting of catch by fishermen. There are some possibilities that recent years market behaviour was changed according to the TAC reduction. Therefore, Japan concluded that the market assumptions and parameters should be updated.

44. In CCSBT-ESC/1208/40, Japan reported the release and discard of small-sized SBT. Based on the RTMP data, Japanese longline vessels released and discarded 3,988 SBT in the 2011 calendar year. There was no discrepancy between the release and discard rate reported by the scientific observer and that reported by the fishermen during the RTMP. According to the visual size measurement by the fishermen, 79% were <20 kg (corresponding to age ≤4). If fish in a ‘Vigorous Condition” when they were captured, could survive after release, then it was considered that the 84% of the released and discarded small-sized SBT (age ≤4) would be still alive.

45. In response to a question raised by Australia, Japan noted that the release and discard numbers were based on scientific observer reports and reports from vessel skippers. New Zealand commented that they would like to determine the survivability of fish in the 20-40kg weight range. Japan noted that survival estimates for this range are not specifically referenced in the paper however these fish were likely to be 4-7 year olds and data on the condition of all fish at capture was available in Figure 2. In response to a question from Australia, Japan confirmed that the 84% figure was a straight average of all year classes (1-4) and noted that Australia has previous experience in its own fisheries with choosing live and vigorous fish when undertaking tagging and Japan believes that post release mortality of vigorous fish is low. Australia suggested an average, weighted by the proportion of released fish in each age class (based on observer coverage), may be more representative. Japan reiterated the importance of grasping all SBT mortalities in SBT stock assessments and requested other Members cooperation in submitting release and discard data.

46. CCSBT-ESC/1208/29 was presented, providing an update on Otolith collection. Japan collected otoliths from 422 SBT individuals in 2011. Ages were estimated from 152 SBT individuals that were caught between 2006 and 2009. The data were submitted to the CCSBT Secretariat during the 2012 data exchange.

47. Australia noted that a comparison of otolith reading between countries had not been undertaken since 2002 and that it was a valuable exercise that should be considered in the Scientific Research Plan discussion. Japan agreed and noted that the Japanese age estimation has been undertaken by the same company for a number of years. In response to a question from Australia regarding the amount of otoliths collected by the Japanese longline fleet Japan noted that it was very

important for the observers to gain the trust of the skipper and the crew of the vessel in order to gain access to samples. It also noted that since the introduction of individual quotas it was difficult to determine when vessels would be targeting SBT and therefore difficult to have observers on board at appropriate times. Japan noted that the 200 otoliths collected were the result of extensive work under difficult circumstances.

Agenda Item 7. Report from the CPUE modelling group

48. The Chair of the CPUE working group presented a summary of the working group's inter-sessional activities, including a description of the outcomes of the webinar (CCSBT-ESC/1208/11). Topics discussed at the webinar included:

- a potential decline in catchability (q) in the early years of the longline fishery
- the potential for a change in q for LL1 after 2006 (following the changes in the TAC),
- exploration of alternative explanations for changes in CPUE that are unrelated to changes in abundance (e.g. environment)
- a review of the current alternative monitoring series, ST Windows and the Laslett core areas index
- the development of concentration indices for effort and catch from LL1, addressed in more detail in papers CCSBT-ESC/1208/17 and CCSBT-ESC/1208/42.

49. Australia presented paper CCSBT-ESC/1208/17, Exploration of the Laslett Core Area (LCA) CPUE index. This paper presented analyses aimed at examining recently observed differences between two monitoring CPUE series, the LCA index and the ST-Windows (ST-Win) index. CPUE was modelled using the spline model of Laslett (CCSBT-SC/0103/06) and similar generalised additive models (GAMs). The fitted models were used to predict CPUE in the ST-Win domain and derive indices of abundance. Relative abundance indices calculated in this way were compared with the Laslett Core Area CPUE index and the ST-Windows index. The analysis suggests that recently observed differences between the LCA and ST-Win indices are due to CPUE in recent years being lower in CCSBT Area 8 and CCSBT Area 9, relative to other areas as well a reduction in the number of cells fished in the ST-Win domain. These two factors are estimated to contribute in approximately equal measure to recently observed differences between the LCA and ST-Win indices. The merit of calculating relative abundance indices for SBT based on temporal smoothing of modelled CPUE, described by Laslett (CCSBT-SC/0103/06), is examined. It is important the data inputs for the recently accepted management procedure are not changed. However smoothed CPUE indices as an input to the OM would be expected to provide more consistency in projected spawning stock biomass between years.

50. Regarding the temporal smoothing of CPUE indices, the Advisory Panel asked if it might be appropriate to alternatively smooth the annual index within the CPUE model. It was also suggested that the different variances of individual annual CPUE indices be taken into account in fitting of the smoothing spline.

51. The Advisory Panel also suggested the maps of temporal/spatial effects on CPUE shown in Figure 14 and Figure 15 might be used to aid the choice of factors to include in future CPUE models.

52. CCSBT-ESC/1208/42 examined differences in trends between the STwindows and standardised CPUE indices (w0.5/w0.8) based on the core vessels data. The trends in the w0.5/w0.8 within the STwindows Areas/months was more similar to that of the STwindows than trends of the w0.5/w0.8 outside the STwindows Areas/months. The trend of the w0.5 within the STwindows Areas/months appeared to be more similar to that of the STwindows than the trend of the w0.8 within the STwindows Areas/months, suggesting that the STwindows index behaves more like the Variable Square than like the Constant Square. A difference of trends between the STwindows and the overall w0.5 and w0.8 indices for Areas 4 to 9/April to September observed in recent years is caused by an upturn of the w0.5 and w0.8 indices for Areas 4 to 7/April to September. In Area 8/September and October, the fished area has continued to decline since the mid 2000s, especially in 2010 and 2011. These decreases in the fished area raise a serious concern about whether the STwindows index is appropriately capturing the stock dynamics in a region where fishing is no longer consistent.

53. The ESC noted that, due to changes in the operation of the LL1 fleet and the vessels in the core fleet, the original month/area strata used in the ST-Windows were potentially were no longer appropriate. Given this the ESC agreed that while the STwindows CPUE series had been a useful “extreme” series for contrast with the base series in the development and evaluation of the MP, there was now a need to replace the ST Windows series.

54. Taiwan presented CCSBT-ESC/1208/12, which provided a CPUE analysis for SBT caught by the Taiwanese longline fleet. Due to change in the Taiwanese SBT statistics system, Taiwan had not provided standardised CPUE series after 2006. This year Taiwan performed CPUE standardisation, since SBT catch and effort data have been accumulated using the new SBT statistics system for more than 10 years. This paper attempts to select Taiwanese longline vessels which deployed more effort for catching southern bluefin tuna. The results of vessel selections can exclude about 13.5-39.4% of the effort and keep about 78.1-96.1% of the SBT catches. This implies that some Taiwanese vessels did not deploy effort for catching SBT even though these vessels were active longline vessels authorised to seasonally target SBT. Nominal and standardised CPUE trends are generally similar among different vessel selection cases for the fishing area from 20°S-40°S and east of 50°E (Area 1), while the CPUE trend for all SBT vessels is obviously distinct from that for the selected vessels for fishing area from 20°S-45°S and 20°E-50°E (Area 2). The standardised CPUE in Area 1 increased continuously before 2007 and obviously decreased thereafter, while the standardised CPUE trend in Area 2 is relatively stable.

55. The ESC welcomed the new analysis of CPUE for the Taiwanese longline fleet and encouraged continued exploration of standardisation approaches. It was noted that current area stratification may be appropriate for the Taiwanese data, but that if the spatial strata chosen had been the CCSBT statistical areas then comparisons could be made with the other longline CPUE indices. It was also suggested that exploration of alternative forms for including by-catch effect

effects in the standardisation would be useful. The ESC noted that Indonesia and Korea intend to prepare additional CPUE series and it welcomed this initiative.

56. CCSBT-ESC/1208/34 was presented, which updated results of investigation of the Japanese longline operation pattern resulting from the introduction of an IQ system in 2006. In 2011, the numbers decreased to 36% in terms of vessel number, 25% in terms of hooks used and 51% in terms of SBT caught in comparison to the average from 2001-2005. However, this decreasing trend stopped for the number of SBT caught in 2008 and for the number of hooks used in 2010. It appears that longline fishermen have fully adjusted to the new management system as six years has already passed. Such an investigation of the Japanese longline operational pattern is nevertheless important for monitoring the input data for MP and there is now a need to interpret these changes, particularly the changes in concentration index.

57. CCSBT-ESC/1208/35 was presented, which summarised the core vessel CPUE which is an abundance index for SBT utilised in the MP. It described data preparation, CPUE standardisation using GLM and area weighting. The data were updated up to 2011. The index values in 2011, w0.8 and w0.5 for the base GLM model, are higher than the average over the last 10 years, though have decreased since 2010.

58. The ESC noted the value of the continuing work to provide these important data exploration papers for monitoring the CPUE series required for MP implementation. The ESC noted the decreasing trend in the number of vessels included in the core fleet for the standardisation, and that the individual vessels included in the core fleet change over time (the criteria for inclusion is that a vessel must have been in the top 56 vessels in the past 3 years).

59. The Advisory Panel commented that when interpreting the catch and effort concentration profiles that the level of concentration had changed over time in some areas. In some areas there has been a further concentration of effort over time and there may be value in further consideration of these profiles. These could be related to trends in fleet dynamics for instance.

60. The ESC agreed that the immediate work program of the CPUE WG include:

- Monitoring and review of the core CPUE series used in the MP;
- Monitoring of the operation of the LL1 fleet, in particular the concentration indices presented in paper CCSBT-ESC/1208/34;
- Renewed exploration of the potential value of other longline CPUE series (e.g. Taiwanese CPUE as described in CCSBT-ESC/1208/12) for particular areas (e.g. CCSBT Indian ocean statistical areas) as contrast to the wider LL1 series; and
- Exploration and potential development of alternative CPUE series as a basis for new "monitoring series" for the base series used in the MP.
- Feasibility studies for the use of longline research sets as a basis for providing consistent time/area distribution of longline CPUE.
- Examination of the effect of the bigeye and yellowfin bycatch covariates in the w0.5 and w0.8 indices by deriving indices from corresponding models without these by-catch covariates.

61. The Chair of the CPUE Modelling Group (CPUE Chair) proposed an inter-sessional webinar, April 2013, to assist in progressing the work program. The ESC endorsed this proposal and the work program and thanked the CPUE Chair and working group participants for their contributions.

7.1. Investigation of CPUE data from the early years of the fishery to evaluate whether catchability (q) decreased during the "fishing down" phase

62. This item had been discussed at the April web meeting (CCSBT-ESC/1208/11). Consequently this item was not considered further at this meeting.

7.2. Further analyses on whether there has been a recent increase in catchability and operational changes in the longline fleet

63. The ESC recalled that the potential for a change in catchability as a result of changes in operational of longline fleet due to changes in TAC had been considered at ESC16. The results of these analyses are reported in Attachment 7 of the Report of ESC16 in 2011. In light of these analyses, an additional robustness trial (Up q2008, q equals a step increase of 0.35) was specified and included in the MP evaluations at that meeting. The MP has been tested and found to be robust to this form of change in catchability.

64. CCSBT-ESC/1208/43 describes analysis of CPUE by age, year and area. The data are interpreted by ANOVA to give age*area, year-class and changes after 2005. Basic results were presented to the April 2012 CPUE Web meeting. Additional analyses were made to address questions asked at that meeting. These suggest that, 1) the high 2005 year-class estimate was not an artefact of the method, 2) the error structure used needs further attention, 3) the apparent increase in catchability in years after 2005 might plausibly be interpreted as resulting from a reduction in the total mortality rate after 2005, 4) this method and other analyses suggested what were important factors to include in future improved CPUE series. The method was seen as a useful addition tool for studies of CPUE quality.

Agenda Item 8. Evaluation of new data sources and models

8.1. Results from close-kin genetics analysis

65. Paper CCSBT-ESC/1208/19 details how it is in principle possible to estimate the absolute abundance of adult SBT without using catch or CPUE data, via a variant of mark-recapture applied to parents and offspring identified by genotyping large numbers of adults and juveniles. The method was first described in CCSBT-ESC/0709/18, and since 2006 a large project has been undertaken to implement the approach. The project is now coming to a successful end, and this paper describes the main outcomes. Over 13,000 SBT, caught between 2006 and 2010 in the GAB (juveniles) and off Indonesia (mature adults), were genotyped and 45 Parent-Offspring Pairs (POPs) were detected. Combining data from these POPs (the number found, plus their age, size, sex, and date of capture) with fecundity-at-size studies and Indonesian length, sex, and age-frequency data, a self-contained assessment of absolute adult abundance was constructed that does not require any catch or CPUE data. As well as abundance, estimates of adult

survival, the selectivity-size relationship, and the effective female reproductive contribution as a function of length were also obtained. The paper explains the method, and presents an example of results for a steady-state scenario. These results, plus those from a limited number of other scenarios explored to date, indicated that adult abundance is considerably higher than current OM estimates. A small amount of work remains to finalise the self-contained assessment and explore the model uncertainties more fully, which is expected to be completed in the coming months as part of final project reporting. Options for the integration of the new data into the OM are considered in CCSBT ESC 1208/21.

66. Paper CCSBT-ESC/1208/21 details an initial exploration of options for including the close-kin data into the SBT operating model. While the close-kin project produced its own estimation method (using reproductive data, Indonesian catch-at-age and length, and the close-kin data) we cannot directly include these estimates within the SBT OM. By maintaining the core ideas behind the independent estimator it was demonstrated how we can transform and incorporate the close-kin data and a more realistic definition for the effective spawning population into the SBT operating model. With these potential refinements to the definition of the spawning population and the inclusion of the close-kin data in this form, the OM results indicate higher levels of adult abundance and survival probabilities. An in-depth exploration of the true statistical information content in the data in relation to key grid parameters suggests a need to rethink both the most recent grid and how to weight grid elements in future. In summary, the close-kin data are generally well fitted by the OM and do suggest a more optimistic level of spawning population depletion, but more work is required to effectively handle the age/length structured nature of the reproductive dynamics of the population as well as the issue of sexual dimorphism.

67. Discussion of these two papers was focused on 3 areas:

- Technical issues,
- Potential implications for management advice, and
- How to incorporate the close-kin results into the OM.

Technical Issues

68. The ESC acknowledged that it did not have the genetics expertise to review the details of the genetics analyses. However, given that the international steering committee for the project had that expertise and had strongly endorsed the rigour and quality control of this component of the project, it was the view of the ESC that these data, i.e. the estimated number of Parent-offspring-Pairs and associated information, should be used in the assessment of SBT

69. The close-kin data were incorporated into two different models in the two papers to estimate the annual spawning potential of the SBT stock: a self contained-assessment in the close-kin report (CCSBT-ESC/1208/19), and incorporated into the OM in paper CCSBT-ESC/1208/21. A number of assumptions had to be made in doing so, and in some cases these assumptions differed between the two approaches. The ESC identified a number of these and issues associated with them that require further evaluation for ESC18 and before the ESC will have the

confidence required to provide management advice based on the outcomes. These include: selectivity and residence time (on the spawning ground) assumptions, definition of effective reproductive potential of the population, use of age and size based assumptions, and alternative recruitment and adult survival hypotheses.

70. While both approaches indicate similar qualitative results, i.e. that there appear to be more reproductively active adults than in the current reference OM, the absolute abundance estimates differ between the two. Given that, at a fundamental level, both approaches use the same underlying POP data, the ESC suggested a number of issues that both approaches might explore to better understand the different estimates in absolute abundance.

71. In both cases, a more rigorous evaluation of both model specification uncertainty and estimation uncertainty is required. In the absence of this, it is not possible to reliably judge the statistical significance (or otherwise) of the differences between the two approaches. For the self contained-assessment, explore the impact of making similar assumptions to the OM in relation to recruitment trend and variability, effective reproductive capacity, selectivity and survival. For the OM approach, explore the impact of making similar assumptions to the self contained-assessment on issues such as directly incorporating sex, length and age-based processes simultaneously, in contrast to externally, as done in CCSBT-ESC/1208/21.

72. In addition to these model sensitivity analyses, additional exploratory data analyses could be conducted to inform possible departures from the assumptions made regarding the main input data. These mainly relate to the potential for over-dispersion within the POP data, the likely sources of which are non-independence within the data and process error in the reproductive process in addition to that included within the models. In relation to non-independence, the ESC was reminded that, within the observed POPs, no siblings or half-siblings were observed, although it was noted that this alone does not provide a definitive answer to the question of independent samples and additional work is planned to address this. The second issue, process error, was considered to be plausible but not, at present, quantifiable. It was considered that specification of suitable robustness tests for exploring the impact of candidate levels of process error may be a reasonable way to proceed.

73. The ESC noted the following data sources had the potential to address some of these assumptions:

- Detailed examination of the spatial and temporal variation in catch, effort and species composition of the Indonesian fishery on the spawning ground to inform sensitivity analyses for selectivity changes during the 2000s;
- Analysis of catch and temperature-depth logger data from the spawning ground to inform selectivity by size and sex;
- Review of previous studies of reproductive biology and additional analyses of historical reproductive material.

Potential Implications for Management Advice

74. It was agreed that, given the preliminary nature of the results and the issues identified above, the ESC would not be in a position to provide quantitative

advice on the implications of the Close-kin results until this work was complete (2013 ESC meeting). The ESC was, however, prepared to provide qualitative interpretation of these results and these were used to formulate the stock status and management advice provided under agenda item 9.

Methods for including close-kin results in the OM

75. The ESC agreed that the Close-kin data should be incorporated into the OM, following the general approach presented in CCSBT-ESC/1208/21, and with the intention that the version of the OM will be used for the future stock assessment scenario modeling in 2014. It is anticipated that this will involve a substantial amount of preparatory work and technical consideration. Hence a technical working group, to be convened in 2013 at some point prior to the next ESC, has been proposed to advance the process.

8.2. Direct ageing data

76. Paper CCSBT-ESC/1208/22 provides information on inclusion of direct ageing data in the operating models as requested in the 2012 ESC workplan. The paper provides background information on the direct ageing data available and issues related to inclusion of those data in place of cohort-sliced catch at age (CAA) and catch at length data currently used in the OM, noting that direct ageing data are used for the Indonesian fishery in the OM already. Several ageing procedures have been discussed in previous papers to the ESC. Implementation of the direct ageing data in place of the age frequency data currently used for the Australian surface fishery appears to be relatively straightforward. An ageing procedure has been proposed, and effective samples sizes have been calculated. The effective sample sizes have been scaled in the same manner as the “reduced sample sizes” (Anon, 2004: CCSBTESC/0409/42) currently being used in the OM.

77. Use of direct ageing data in place of the longline 1 fishery (LL1) length frequency data in the OM will be slightly more complicated. The appropriate ageing method has not yet been defined, direct age data are not available for all components of this fishery and effective sample sizes would need to be calculated. The OM code would need to work around the change from historical length data to recent age data for this fishery.

78. It was suggested that there be a review of the “reduced sample sizes” referred to in CCSBT-ESC/1208/22 that were defined in 2004. The process for doing this was discussed, and some members of the ESC noted that in previous OM meetings a process was developed that might form a basis for the future. The observed and predicted values for the age and length frequencies from the OM would need to be reviewed by the ESC to determine appropriate scaling of effective sample sizes.

79. Inter-laboratory comparison of direct ageing methods to avoid a drift in ageing over a long period was suggested for further discussion under the SRP.

8.3. Results from global spatial dynamics project

80. Paper CCSBT-ESC/1208/Info1 provides the non-technical summary from the recently completed final report for the project titled "Spatial interactions among juvenile southern bluefin tuna at the global scale: a large scale archival tag experiment". The full report can be found at http://www.frdc.com.au/research/final-reports. This project has led to substantial improvement in understanding of juvenile SBT movements, spatial dynamics and habitat use. Project results have relevance to the scientific aerial survey index of abundance, the interpretation of longline CPUE (for juveniles in particular), and approaches to analyses of conventional tag data. For instance, data on the arrival and departure times of juveniles to the GAB indicate that the timing and duration of the aerial survey is appropriate. The data also indicate that the majority of juvenile SBT spend each summer (or part thereof) in the GAB; however, we cannot rule out the possibility that some juveniles never visit the GAB in summer (as they would be unlikely to be tagged or recaptured). With regard to CPUE, the report considers that the high variability in migration paths and timing among individuals and years mean that low spatial and temporal coverage of fishing effort continues to be a problem for getting a reliable index of abundance from catch and effort data in a non-spatial modelling framework. Finally, results indicate the potential information gains from developing spatial operating models, relative to a non-spatial model.

81. Questions were asked about the available information on the area 9 fishery off South Africa; whether this was a sub-stock, and how to get information on this aspect of the stock. The tag releases from South Africa were small in number (27) because of operational difficulties, and none had been returned. With average tag return rates of 13% this was not a problem of reporting rates, but of insufficient tags being deployed in the area. The global spatial dynamics project did observe fish tagged in the GAB that went to South Africa and then returned to the GAB. Tag deployment from South Africa would help answer the question.

82. Otolith micro-chemistry was also a possible way to answer this question. Current generation otolith micro-chemistry is able to detect seasonal signals. A collection of otoliths from the GAB, Indian Ocean, NZ/Tasman Sea and Indonesian spawning ground have been analysed in a pilot study, and results will be presented to ESC18. CSIRO holds a collection of otoliths from fish that also had archival tags, which can be used to cross-validate the micro-chemistry results with the archival tag data.

83. The question was asked whether there was information on the level of migration between areas. It was noted that SBT have a wide migratory range and that migration patterns can alter from year to year and by individual.

84. Questions on movement patterns towards the spawning ground, and frequency of return to the spawning grounds were asked. The global spatial dynamics project tagged mainly 2-5 year old fish, which are unlikely to be seen on the spawning grounds while the archival tag is still active. Pop-up satellite tags have been deployed on older fish and the results recently published. Two fish almost made it to the spawning ground before their tag popped-off. A proposal for further discussion under the SRP is that archival tags be deployed on older fish, to examine behaviour of these fish on the spawning grounds and their frequency of return to the spawning grounds. The new generation archival tags can last for

longer deployments. The frequency of return of mature fish to the spawning grounds is also discussed under agenda item 8.1.

8.4. Possibility of using scientific aerial survey data to develop an index for 1 year old SBT

85. Paper CCSBT-ESC/1208/20 was presented. Part of the 2011 ESC future work-plan was to explore the potential utility of the SAPUE index as an additional index of juvenile abundance in the SBT operating model. The series has shown good qualitative agreement with the scientific aerial survey for common years (2005-2012) and holds information on the key weak cohorts of the 1999-2002 period. The major issue relating to the potential inclusion of this index within the OM is the relationship between the SAPUE and aerial survey indices, and how potentially complex - and as yet unknown - correlation effects between the two indices make it too difficult at present to include the SAPUE index in the operating model. The issue raised at the 2011 ESC on development of an index of 1 year olds is also addressed in this paper. Given the only quite recent appearance of significant numbers of apparently 1 year old fish within the survey, yet no evidence that they were missing in any of the other data, it seems apparent that there is a non-stationary and strongly trending catchability time-series for 1 year olds. This makes the generation of a usable index of 1 year olds from the survey highly unlikely and not to be advised at present.
86. There was general agreement with the paper. Japan suggested that fish less than 8kg which are excluded from the aerial survey analysis may be a mix of 1 and 2 year olds, leading to the conclusion that identification of 1 year olds was an additional issue making it difficult to derive a sensible index.

8.5. Evaluation of use of commercial spotting data and the feasibility of conducting scientific aerial surveys less frequently to minimise the financial burden of the surveys

87. This item was also addressed in CCSBT-ESC/1208/20. Further explanation was sought on why it was difficult to combine the AS and SAPUE indices in the OM. Even with some simplifying assumptions, it would be difficult to combine these indices in the OM because of the covariance matrix structure of the AS index, and it’s inclusion in the OM. There were additional problems with differing degrees of freedom and different general precision in the CV estimates. This matter was referred to the intersessional Technical Workshop (TWS).

8.6 Other

88. Australia presented paper CCSBT-ESC/1208/23 which discussed complexities with including the Scientific Research Program (SRP) tagging data in the operating model for SBT. These include the unusually low returns from age 1 fish released off Western Australia, the lack of data for estimating reporting rates from certain fleets, and the potential need for a spatial model. With regard to the latter, results from previous analyses indicated that incomplete mixing of tagged and untagged fish may be greater issues for the 2000s SRP tagging data than for the 1990s tagging data; therefore, the most appropriate method for including the

SRP data in the OM would be through a spatial model. The current OM is not spatially structured, so to include a spatial likelihood for the SRP data would ideally involve restructuring the OM. The movement towards a spatial OM is something currently being considered for other reasons as well, such as interpretation of CPUE data. In the meantime, however, a possible alternative is to include a spatial likelihood (i.e., that involves region-specific parameters) for the SRP data in the OM, but then also within the OM calculate aggregated ("non-spatial") parameters from the region-specific parameters. Even this approach would take a fair amount of time and effort to implement for reasons discussed, so guidance is sought from the SC as to whether it should be pursued.

89. It was queried whether these data could be included in a spatial model which operated outside of the OM, and the external estimates linked back into the OM. The problems that might occur with this option are mainly related to different structural and parametric assumptions made by the external spatial mark-recapture model and the current OM. The ESC considered that, at present, the most appropriate treatment of the SRP tagging data is in a spatially resolved operating model. The development of spatial operating models has been highlighted as a future priority, but is not part of the immediate work plan, and so the inclusion of these data would be reconsidered at a later stage and when feasible.

Agenda Item 9. SBT Assessment, Stock Status and Management

9.1. Status of the SBT Stock

90. The ESC did not conduct a model based assessment at its 2012 meeting, so the information presented here is from the 2011 stock assessment and information from indicators presented to the 2012 ESC. The 2011 assessment suggested that the SBT spawning biomass is at a very low fraction of its original biomass as well as below the level that could produce maximum sustainable yield. Rebuilding the spawning stock biomass would almost certainly increase sustainable yield and provide security against unforeseen environmental events. The current TAC has been set using the management procedure adopted in 2011, which has a 70% probability of rebuilding to the interim target biomass level by 2035.

Stock prognosis

There is a positive outlook for the SBT stock based on the 2011 assessment:

- Continued reduction in the total reported global catch
- Current fishing mortality reduced below Fmsy
- Stock is expected to increase at current catch levels, and future catch levels determined by the MP.

Summary of indicators

There have been mixed signals from the indicators in 2012 (**Attachment 5**):

- Longline CPUE has an increasing trend since 2007
- A decrease in the aerial survey index in 2012 to a low level (also seen in the SAPUE and troll survey results). The ESC has identified the need to further examine the factors that may have impacted on the Aerial survey at its 2013 meeting.

SOUTHERN BLUEFIN TUNA SUMMARY from 2011 ESC (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, 10449t in 2012, and 10949t in 2013.

91. Preliminary results of the close-kin study give us valuable new insight into the size of the spawning population of SBT, an area of the stock status that has been previously uninformed by specific data. While the preliminary results suggest that the current spawning biomass may be appreciably higher than was previously estimated, associated initial population modeling indicates that the estimates of the proportional productivity of the stock is lower. When these two elements are considered in combination, the indications are that the estimated recent productivity of the resource (upon which TAC advice is based) differs only slightly from previous estimates.

9.2. SBT Management Recommendations

92. At its Eighteenth annual meeting in 2011, the CCSBT agreed that a Management Procedure (MP) would be used to guide the setting of the SBT global total allowable catch (TAC) to ensure that the SBT spawning stock biomass achieves the interim rebuilding target of 20% of the original spawning stock biomass. The CCSBT will set the TAC from 2012 and beyond based on the outcome of the MP, unless the CCSBT decides otherwise based on information that is not otherwise incorporated into the MP.

93. The CCSBT also adopted the meta-rule process described in Attachment 10 of the Report of the 15th Meeting of the Scientific Committee as the method for dealing with exceptional circumstances in the SBT fishery. The meta-rule

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

process describes: (1) the process to determine whether exceptional circumstances exist; (2) the process for action; and (3) the principles for action.

94. In adopting the MP, the CCSBT emphasised the need to take a precautionary approach to increase the likelihood of the spawning stock rebuilding in the short term and to provide industry with more stability in the TAC (i.e. to reduce the probability of future TAC decreases).

Current TAC

95. For the first three-year TAC setting period (2012-2014), the TAC will be as follows:

Year	2012	2013	2014
TAC (t)	10,449	10,949	12,449[2]

Review of MP implementation

96. The ESC considered whether or not the low 2012 scientific aerial survey index triggered exceptional circumstances according to the meta-rules process. The ESC agreed that exceptional circumstances had not been triggered this year, as discussed under Agenda Item 5.

97. The results of the close-kin genetics and the preliminary estimate of spawning abundance developed were also examined. The ESC noted the preliminary nature of the results and the need for a full range of sensitivity tests of model assumptions to be conducted for discussion at ESC18 in 2013.

Management Recommendations

98. Consistent with the MP, the ESC recommended, based on the Review of indicators, the 2011 stock assessment, MP inputs and the preliminary outcomes of the close kin analysis, that there is no need to revise the Commission’s 2011 TAC decision.

99. The ESC updated the annual report on biology, stock status and management of SBT that it prepares for provision to FAO and the other tuna RFMOs. The updated report is at **Attachment 6.**

Agenda Item 10. Update of MP and OM codes

10.1. Discuss issues related to the update of the MP and OM codes

100. CCSBT-ESC/1208/41 raised a question about whether or not the Bali procedure needed to be re-tuned before applying the rule to calculate the TACs for 2015-2017. The reason was that the TACs set by the Commission for the years 2012 and 2013 were not as specified by the MP. Because the Commission did not specify which MP rule was to be adopted, the ESC regarded that the MP rule adopted by the Commission most closely corresponded to the version based on:

[2] The 2014 TAC shall be either 12,449t or the output of the MP for 2015 – 2017 (whichever is less).

- - Tuning year = 2035
- - Max TAC change from year to year = 3000 t
- - Allow 3000 t TAC increment during first period

101. Parameters for that version were obtained by tuning the MP so that the spawning biomass achieved 20% of SSB0 with a 70% probability in 2035. Under this tuning, the TAC calculated for 2012-2014 was 12449 t. The commission opted for a more precautionary path as specified in paragraph 92.

102. Because the chosen TACs for 2012-2013 are more conservative than those dictated by the tuned MP, the rebuilding probabilities would not be compromised by that departure from the tested MP. In view of this, the ESC did not see the need to retune the MP.

103. In terms of the specifics of how the rule will be applied to calculate the TAC 2015-2017, the ESC recommended using the value of 12449 t as the prior TAC as used in the MP calculation.

104. The ESC agreed that for the CPUE and AS data inputs to the MP, the standardisation procedures would continue to be updated each year, though careful consideration would be needed if the inclusion of further covariates was proposed.

105. The Secretariat has set up version control for tracking of future changes to the operating model code. The ESC has agreed to use version control for all future updates to code.

10.2. Review of compiled MP Specifications

106. The Secretariat introduced paper CCSBT-ESC/1208/06, which provided draft specifications for the CCSBT Management Procedure. The compiled draft specifications were developed using specifications provided in attachments to the reports of the 2010 and 2011 ESC meetings and by having these specifications edited and revised by those most familiar with the relevant components of the Management Procedure.

107. The technical specifications of the MP were further revised during the meeting. The agreed specifications are provided at **Attachment 7**.

Agenda Item 11. Initial consideration of an updated scientific research program with the aim of finalising the plan at the 2013 ESC meeting

108. CCSBT-ESC/1208/36 was presented relating to catch characteristics and CPUE. The paper noted the importance of combining various fishery and research indices which are complementary to each other because SBT are distributed widely and the distribution varies with age and season. It stressed that detailed and correct descriptions of the fishery and for research are necessary in the first step.

109. CCSBT-ESC/1208/24 provided details on the CCSBT Scientific Research Program (SRP) initiated in in 2002 to address priority monitoring and research

requirements for the assessment of the stock and management of the fishery. Progress of the SRP was reviewed at the 2007 meeting of the Extended Scientific Committee (ESC): a number of new components were added to the program and the SRP conventional tagging program was discontinued. In this paper Australia briefly reviewed progress since 2007 as a basis for initial discussions at this year's ESC on the future directions, priorities and collaborative opportunities for the future SRP. It is intended that this discussion will provide the opportunity for the ESC and member scientists to develop more detailed proposals for consideration by the ESC and the Extended Commission in 2013.

110. The ESC had initial discussion of priorities and items for a future Scientific Research Program (SRP), to facilitate domestic discussions, development of proposals and consideration of feasibility aspects. The items listed in the 2007 set of priorities in addition to OM development work were discussed, updated and re-prioritised. A table of the new SRP items, their relative priority and information that they provide is in **Attachment 8**.

111. Japan suggested that the relationship and links between indices should also be explored and documented, to provide a more holistic, model independent overview. Each of the components of the SRP was discussed.

112. Catch Characterisation: It was suggested that it was essential to collect information on the total removals from the stock, and the CDS data may be able to be used in the future as well as providing a comprehensive sample of the size structure of removals. The catch amount, and representative samples of the size and age data by area were needed. Recreational catches, releases, discards and discard mortality should also be accounted for.

113. The primary CPUE data requirements have been discussed under the CPUE modeling agenda item. In addition to these items for future work, it was suggested that catch rate indices of routinely reported data to the Extended Commission could be collated and exploratory analyses completed.

114. The spawning biomass index summary of research work undertaken in the SRP (Table 2 of CCSBT-ESC/1208/24) should have included the Fisheries High School observer data analyses undertaken in 2007 (e.g. CCSBT-ESC/0709/15). An index has not been developed from these data, but further explorations of these data could form part of a future SRP. The close-kin estimates of abundance research work can potentially provide information on trends in abundance over time in addition to a "one off" estimate.

115. Indonesia suggested there was a range of research that could be completed to examine some of the key assumptions underpinning the close-kin analyses. They suggested otolith samples could be analysed for information on the spawning period using current generation microchemistry. They asked Australia for assistance with expertise and facilities. Indonesia also suggested that to obtain additional information on size correlations with depth, a project that involved deployment of mini-loggers on hooks by Indonesian observers could be re-established, building on the results and capacity building from an earlier ACIAR funded collaborative project. Indonesia suggested that to extend and improve the information on length at first maturity and spawning output, collaborative initiatives to collect and analyse gonads from on and off the spawning grounds

could be considered – these could be examined relative to historical data to look for changes in size that may be a result of the selective effects of fishing.

116. Under the observer program, observer coverage has generally been below 10% (Anon, 2007). It was noted that observer coverage needed to be representative and that links with collection of ERSWG related data requirements should be established. Sufficient coverage was required to make estimates of ERS and other items of interest.

117. Under the SBT tagging item, it was noted that conventional tagging had been discontinued because of the low reporting rates from some fisheries. As noted previously, PIT tagging is not considered feasible (Anon, 2008). Gene-tagging involves mark recapture tagging using DNA profiling technology to match "release" and "recapture" tissue samples of individual fish (this is quite separate from, but complementary to, the close-kin type abundance estimation) which is now potentially feasible, and the development of the microsatellite libraries required for the DNA profiling has already been undertaken as part of the close-kin project. This means that the considerable upfront costs associated with marker development would not be required to initiate this form of mark-recapture program.

118. There has been some discussion of archival (or other forms of electronic) tagging to provide information on spawning behaviour, such as residence times and skip spawning. It was noted that skip spawning could potentially be addressed more cheaply through otolith micro-chemistry work. Feasibility studies for this approach are underway (Clear and McDonald 2011). Otolith micro-chemistry would not provide information on within spawning season behaviour, such as depth preferences, daily behaviour patterns, residence times, or vulnerability by size and sex. Obtaining this information would require some form of electronic tagging. Archival tagging or pop-up tagging would require multi-lateral co-operation to release sub-adult and/or adult fish close to the spawning grounds.

119. The recruitment monitoring programs are ongoing. In addition to this work, examination of environmental interactions with these surveys could be undertaken as a matter of priority as described under Agenda item 5.

120. Collection of otoliths and direct ageing should continue and best efforts be made to increase the space-time coverage and representativeness of the samples across areas and fleets. Incorporation of these data into the OM was discussed. The advisory panel noted that there was little point including the surface fishery direct ageing data into the OM until the issue of any 40 fish sample bias had been resolved or stereo video system implemented. For the longline fisheries the Secretariat will document the data source used to create the length frequency used in the OM. A cross-laboratory recalibration of ageing techniques was suggested to avoid drift, since it was 10 years since the 2002 direct ageing workshop.

121. MP development: it was noted that the next scheduled calculation of the TAC using the MP is in 2013, but that no further development is required at this time.

122. OM development: development of a spatial model was identified for consideration (see paragraph 89)

123. The SRP will be further discussed intersessionally and a 5 year work plan agreed at ESC18.

Agenda Item 12. Requirements for Data Exchange in 2013

124. The requirements for the 2013 data exchange were discussed and agreed in the margins of the meeting. These requirements were endorsed by the ESC and are provided in **Attachment 9**.

125. A High-Level Code of Practice for Scientific data verification was also discussed and agreed during the margins of the meeting. The recommended code is at **Attachment 10**.

Agenda Item 13. Research Mortality Allowance

126. Paper CCSBT-ESC/1208/26 is an update to Australia's request in the previous year for a total of 5 tonnes of research mortality allowance (RMA). The allowance requested is to continue research focused on investigating the spatial dynamics and mortality rates of SBT utilising electronic tagging techniques. The proposal extends the RMA request granted in 2011, to cover SBT tagging over the years 2012-13 to 2013-14, noting that none of the RMA requested in 2011 has yet been used.

127. CCSBT-ESC/1208/38 was presented. Japan reported that 324.9 kg of the 1t RMA was used for the 2011/2012 research program. Japan requested 1t of RMA for 2012/2013 research.

128. The ESC endorsed Australia's request for a Research Mortality Allowance (RMA) of 5t and Japan's request for an RMA of 1t for the purposes specified.

Agenda Item 14. Report of the Ecologically Related Species Working Group

129. The Secretariat presented the recommendations from the Report of the Ninth Meeting of the Ecologically Related Species Working Group (CCSBT-ESC/1208/09). The ESC had no comments or advice to provide to the Extended Commission in relation to the report.

130. Japan commented that the ERSWG's recommendation to hold its next meeting back to back with the 2013 ESC meeting would cause difficulties due to similar timing of other related meetings. To overcome the difficulty, Japan proposed that the next ERSWG meeting be held in April 2013. Japan also offered to host that meeting.

Agenda Item 15. Use of Trade Figures for Analysing Market Trends

131. The Secretariat presented paper CCSBT-ESC/1208/15 on exploratory analyses of SBT trade data. The paper provided import and export tonnages and price per kilo of both fresh and frozen SBT (excluding fillets) from 2009 to 2011, and for the first quarter of 2012. A general inspection of the Global Trade Atlas (GTA) and Catch Documentation Scheme (CDS) data suggested that the main markets

outside the current CDS coverage included USA, Singapore, Hong Kong and, more recently, China. Inspection of the GTA data identified 26 Non Cooperating Non Members (NCNMs) as SBT importers, with one additional NCNM being identified from the CDS data. However, many of these only imported SBT in small quantities. A total of 11 exporting NCNMs were identified from the two data sources. However, some low unit price figures and some unlikely trade (particularly with fresh product) suggested that miscoding of commodity codes may be present within the data.

132. The ESC expressed appreciation for the Secretariat's work in examining the GTA data and comparisons with the CCSBT CDS data (CCSBT-ESC/1208/10). The ESC noted the Commission's adoption of the Sixth Meeting of the Compliance Committee's recommendation to conduct market analyses and the request to the ESC to develop a method for using these trade figures for analysing market trends.

133. The ESC nevertheless noted the limitations in the trade data presented in the Secretariat's paper. In addition, the ESC noted the substantial issue of potential accidental or intentional miscoding and that there is uncertainty in the robustness of the price and origin data. The ESC was not aware of the validation processes for these data; the Compliance Committee is probably better placed to evaluate this. The GTA data also do not distinguish trade of SBT product that is on-sold, that is imported to one country and then exported on to another country.

134. The ESC regarded the lack of information for SBT fillets in the subscription to the GTA database as being a substantial issue, given the potential scale of SBT fillet trade. The Secretariat's paper noted that there is not a standardised global code for SBT fillets, but that the subscription could be expanded to include country specific codes in cases where they are available.

135. The ESC agreed that the Secretariat's analysis was of value in identifying broad market trends and particularly expansion of new markets and trade by NCNMs. Australia noted it will continue to provide the Secretariat with information that becomes available on SBT trade.

136. Given the data limitations, the ESC did not recommend more detailed analyses at this stage, but reiterated the value of continuing the Secretariat's approach.

<u>Agenda Item 16. Workplan, Timetable and Research Budget for 2013</u>

16.1. Overview, time schedule and budgetary implications of proposed 2013 research activities

137. The Secretariat introduced paper CCSBT-ESC/1208/07, which provided an update of the surface fishery tagging program, including a proposed budget for tag recoveries in 2012.

138. Japan presented CCSBT-ESC/1208/37. The paper proposed the plan of the piston-line trolling survey off the south coasts of Western Australia in 2012/2013. The ESC endorsed the proposed survey. In addition, Australia noted that the survey provided a potential opportunity for increased deployment of tags and hoped to discuss the opportunities for collaboration with Japan in relation to this.

139. The ESC developed the following workplan for 2013.

Activity	Approximate Period	Resources or approximate budgetary implications
Continuation of tag recovery efforts.	Tag recovery is continuous.	$3,000 for tag recovery as per draft budget in Attachment C of CCSBT-ESC/1208/07.
Provide SBT Stock Status report to the other tuna RFMOs.	Aug-Nov 12	N/A
MP Code made available using Version Control software	Jan	Australia
CPUE Webinar to review progress of the intersessional CPUE work[3]	Apr	Intersessional work by Japan, Australia, New Zealand, Taiwan and possibly Korea and Indonesia. Three panel days.
Standard Scientific Data Exchange.	Apr – Jul	N/A
Update Operating Model with close-kin results	Sep 12 – Aug 13	Led by Australia using version control software.
Small technical meeting in relation to the Operating Model in advance of ESC meeting. See **Attachment 11** for details.	4 days, July (*most likely USA, in Seattle or Portland, Maine*)	3 panel members, MP consultant, 1 interpreter.
Calculation of TAC using MP	Mid-Aug	Everyone
Extended Scientific Committee for the 18th meeting of the Scientific Committee. The meeting will focus on finalising the SRP, running the MP to produce a recommended TAC for 2015-2017, review of indicators and finalising the work program for the 2014 stock assessment.	6 days, first half of September (*Canberra*)	ESC Chair, 3 panel members, full interpretation and 3 Secretariat staff. For the full assessment in 2014 it is likely that 4 panel members will be required.

16.2. Timing, length and structure of next meeting

140. The next ESC meeting is proposed to be during the first half of September 2013, in Canberra, Australia.

Agenda Item 17. Other Matters

141. There were no other matters.

Agenda Item 18. Adoption of Meeting Report

142. The report was adopted.

[3] Including: continued investigations of implication of changes of LL fleet behaviour on catchability; development of new/revised CPUE trends by statistical area by Indonesia, Taiwan and Korea; specification and development of improved CPUE series to be used as monitoring series for the base series in the short-term (2-3 years) and as potential replacements in the long-term (5-10 years); and feasibility studies of the utility of LL research sets.

Agenda Item 19. Close of Meeting

143. The meeting closed at 2:53pm on 31 August 2012.

List of Attachments

Attachment

1. List of Participants
2. Agenda
3. List of Documents
4. Global Reported Catch By Flag
5. Trends in selected indicators of the SBT stock
6. Report on Biology, Stock Status and Management of Southern Bluefin Tuna: 2012
7. Specifications of the CCSBT Management Procedure
8. Table of Proposed activities under the SRP
9. Data Exchange Requirements for 2013
10. High-level Code of practice for Scientific Data Verification
11. Technical Elements of the 2013 Workplan

Attachment 1

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Extended Scientific Committee Meeting
of the Seventeenth Meeting of the Scientific Committee

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Attachment 2

Agenda
Extended Scientific Committee for the Seventeenth Meeting of the Scientific Committee
Tokyo, Japan
27 – 31 August, 2012

1. **Opening**
    - 1.1. Introduction of Participants
    - 1.2. Administrative Arrangements

2. **Appointment of Rapporteurs**

3. **Adoption of Agenda and Document List**

4. **Review of SBT Fisheries**
    - 4.1. Presentation of National Reports
    - 4.2. Secretariat Review of Catches

5. **Evaluation of Fisheries Indicators**

6. **Report on intersessional scientific activities**

7. **Report from the CPUE modelling group**
    - 7.1. Investigation of CPUE data from the early years of the fishery to evaluate whether catchability (q) decreased during the “fishing down” phase
    - 7.2. Further analyses on whether there has been a recent increase in catchability and operational changes in the longline fleet

8. **Evaluation of new data sources and models**
    - 8.1. Results from close-kin genetics analysis
    - 8.2. Direct ageing data
    - 8.3. Results from global spatial dynamics project
    - 8.4. Possibility of using scientific aerial survey data to develop an index for 1 year old SBT
    - 8.5. Evaluation of use of commercial spotting data and the feasibility of conducting scientific aerial surveys less frequently to minimize the financial burden of the surveys

9. **SBT Assessment, Stock Status and Management**
    - 9.1. Status of the SBT Stock
    - 9.2. SBT Management Recommendations

10. Update of MP and OM codes

10.1. Discuss issues related to the update of the MP and OM codes

10.2. Review of compiled MP Specifications

11. Initial consideration of an updated scientific research program with the aim of finalizing the plan at the 2013 ESC meeting

12. Requirements for Data Exchange in 2013

13. Research Mortality Allowance

14. Report of the Ecologically Related Species Working Group

15. Use of Trade Figures for Analysing Market Trends

16. Workplan, Timetable and Research Budget for 2013

16.1. Overview, time schedule and budgetary implications of proposed 2013 research activities

16.2. Timing, length and structure of next meeting

17. Other Matters

18. Adoption of Meeting Report

19. Close of Meeting

Attachment 3

List of Documents
Extended Scientific Committee
for the Seventeenth Meeting of the Scientific Committee

(CCSBT-ESC/1208/)

1. Draft Agenda
2. List of Participants
3. List of Documents
4. (Secretariat) Secretariat review of catches (ESC agenda item 4.2)
5. (Secretariat) High-level Code of Practice for Scientific Data Verification
6. (Secretariat) Specifications of the CCSBT Management Procedure
7. (Secretariat) Surface fishery tagging program – an update
8. (Secretariat) Data Exchange (ESC agenda item 12)
9. (Secretariat) Report from the Ninth Meeting of the Ecologically Related Species Working Group (Secretariat)
10. (Secretariat) Southern bluefin tuna trade data: Exploratory analyses
11. (Chair – CPUE Modelling Group) Report of the CCSBT CPUE Modelling Group Webinar (April 2012)
12. (Taiwan) CPUE analysis for southern bluefin tuna caught by Taiwanese longline fleet
13. (Australia) Preparation of Australia's southern bluefin tuna catch and effort data submission for 2012
14. (Australia) Fishery indicators for the southern bluefin tuna stock 2011-12
15. (Australia) Commercial spotting in the Australian surface fishery, updated to include the 2011/12 fishing season
16. (Australia) The aerial survey index of abundance: updated analysis methods and results for the 2011/12 fishing season
17. (Australia) Exploration of the Laslett Core Area CPUE Index
18. (Australia) An update on Australian otolith collection activities, direct ageing and length at age keys for the Australian surface fishery
19. (Australia) Report of close-kin project
20. (Australia) Potential inclusion of SAPUE index into the SBT operating model
21. (Australia) Initial exploration of options for inclusion of close-kin data into the SBT operating model

22. (Australia) Potential Inclusion of direct ageing data in the SBT operating model
23. (Australia) Incorporation of SRP tagging data into the SBT operating model: discussion and recommendations
24. (Australia) Strategic Research Plan: summary of review recommendations and potential directions based on recent research
25. (Australia) Update on the length and age distribution of SBT in the Indonesian longline catch
26. (Australia) Proposed use of CCSBT Research Mortality Allowance to facilitate electronic tagging of SBT as part of Australia's contributions to SBT research in 2012/13 and 2013/14
27. (Japan) Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2011
28. (Japan) Report of activities for conventional and archival tagging and recapture forsouthern bluefin tuna by Japan in 2011/2012
29. (Japan) Activities of southern bluefin tuna otolith collection and age estimation and analysis of the age data by Japan in 2011
30. (Japan) Analyses on age composition, growth and catch amount of southern bluefin tuna used for farming in 2007-2010
31. (Japan) Monitoring of Southern Bluefin Tuna tradingin the Japanese domesticmarkets: 2012 update
32. (Japan) Summary of fisheries indicators of southern bluefin tuna stock in 2012
33. (Japan) Report of the piston-line trolling monitoring survey for the age-1southernbluefin tuna recruitment index in 2011/2012
34. (Japan) Change in operation pattern of Japanese SBT longliners in 2011 resulting from the introduction of the individual quota system in 2006
35. (Japan) Description of CPUE calculation from the core vessel data for southern bluefin tuna in 2012
36. (Japan) A consideration for the update of scientific research plan in CCSBT toward the 2013 ESC meeting
37. (Japan) Proposal for the recruitment monitoring survey in 2012/2013
38. (Japan) Report of the 2011/2012 RMA utilization and application for the 2012/2013 RMA
39. (Japan) Sub-cohort structure of southern bluefin tuna in the recruitment monitoring trolling survey in 2012
40. (Japan) Releases and discards of small-sized Southern Bluefin Tuna by the Japanese longline fishery in 2011

41. (Japan) A check of operating model predictions from the viewpoint of metarule invocation and technical details for computing future TACs
42. (Japan) Comparison between “ST windows” index and Core vessels CPUE indices by different Area/month combinations
43. (Panel) Using General Linear Models of SBT CPUE-at-age data to investigate changes in catchability with age and time (John Pope)

(CCSBT- ESC/1208/BGD)

(CCSBT-ESC/1208/SBT Fisheries -)

Australia	Australia's 2010-11 Southern Bluefin Tuna Fishing Season
Indonesia	Indonesia Southern Bluefin Tuna Fisheries - A National Report Year 2011
Japan	Review of Japanese SBT Fisheries in 2011
Korea	Review of Korean SBT Fishery for 2011 fishing year
New Zealand	Annual Review of National SBT Fisheries for the Scientific Committee – New Zealand (2012)
Taiwan	Review of Taiwan SBT Fishery of 2010/2011 (National Report)

(CCSBT-ESC/1208/Info)

1. (Australia) Report of the global spatial dynamics project Non - Technical Summary

(CCSBT-ESC/1208/Rep)

1. Report of the Ninth Meeting of the Ecologically Related Species Working Group (March 2012)
2. Report of the Eighteenth Annual Meeting of the Commission (October 2011)
3. Report of the Sixth Meeting of the Compliance Committee (October 2011)
4. Report of the Special Meeting of the Commission (August 2011)
5. Report of the Sixteenth Meeting of the Scientific Committee (July 2011)
6. Report of the Seventeenth Annual Meeting of the Commission (October 2010)
7. Report of the Fifteenth Meeting of the Scientific Committee (September 2010)
8. Report of the Third Operating Model and Management Procedure Technical Meeting (June 2010)
9. Report of the Second meeting of the Strategy and Fisheries Management Working Group Meeting (April 2010)

Attachment 4

Global Reported Catch By Flag

Reviews of southern bluefin tuna data presented to a special meeting of the Commission in 2006 suggested that the catches may have been substantially under-reported over the previous 10 to 20 years. The data presented here do not include estimates for this unreported catch.

Catches are presented as whole weights in tonnes. Numbers in **bold** font differ from those in Attachment 4 of the SC16 report.
All shaded figures are subject to change as they are either preliminary figures or they have yet to be finalised.
Blank cells are unknown catch (many would be zero).

	Australia			New Zealand									
Calendar Year	Commercial	Amateur	Japan	Commercial	Amateur	Korea	Taiwan	Philippines	Indonesia	South Africa	European Commission	Miscellaneous	Research & Other
1952	264	0	565	0	0	0	0	0	0	0	0	0	0
1953	509	0	3,890	0	0	0	0	0	0	0	0	0	0
1954	424	0	2,447	0	0	0	0	0	0	0	0	0	0
1955	322	0	1,964	0	0	0	0	0	0	0	0	0	0
1956	964	0	9,603	0	0	0	0	0	0	0	0	0	0
1957	1,264	0	22,908	0	0	0	0	0	0	0	0	0	0
1958	2,322	0	12,462	0	0	0	0	0	0	0	0	0	0
1959	2,486	0	61,892	0	0	0	0	0	0	0	0	0	0
1960	3,545	0	75,826	0	0	0	0	0	0	0	0	0	0
1961	3,678	0	77,927	0	0	0	0	0	0	145	0	0	0
1962	4,636	0	40,397	0	0	0	0	0	0	724	0	0	0
1963	6,199	0	59,724	0	0	0	0	0	0	398	0	0	0
1964	6,832	0	42,838	0	0	0	0	0	0	197	0	0	0
1965	6,876	0	40,689	0	0	0	0	0	0	2	0	0	0
1966	8,008	0	39,644	0	0	0	0	0	0	4	0	0	0
1967	6,357	0	59,281	0	0	0	0	0	0	5	0	0	0
1968	8,737	0	49,657	0	0	0	0	0	0	0	0	0	0
1969	8,679	0	49,769	0	0	0	80	0	0	0	0	0	0
1970	7,097	0	40,929	0	0	0	130	0	0	0	0	0	0
1971	6,969	0	38,149	0	0	0	30	0	0	0	0	0	0
1972	12,397	0	39,458	0	0	0	70	0	0	0	0	0	0
1973	9,890	0	31,225	0	0	0	90	0	0	0	0	0	0
1974	12,672	0	34,005	0	0	0	100	0	0	0	0	0	0
1975	8,833	0	24,134	0	0	0	15	0	0	0	0	0	0
1976	8,383	0	34,099	0	0	0	15	0	12	0	0	0	0
1977	12,569	0	29,600	0	0	0	5	0	4	0	0	0	0
1978	12,190	0	23,632	0	0	0	80	0	6	0	0	0	0
1979	10,783	0	27,828	0	0	0	53	0	5	0	0	4	0
1980	11,195	0	33,653	130	0	0	64	0	5	0	0	7	0
1981	16,843	0	27,981	173	0	0	92	0	1	0	0	14	0
1982	21,501	0	20,789	305	0	0	182	0	2	0	0	9	0
1983	17,695	0	24,881	132	0	0	161	0	5	0	0	7	0
1984	13,411	0	23,328	93	0	0	244	0	11	0	0	3	0
1985	12,589	0	20,396	94	0	0	241	0	3	0	0	2	0
1986	12,531	0	15,182	82	0	0	514	0	7	0	0	3	0
1987	10,821	0	13,964	59	0	0	710	0	14	0	0	7	0
1988	10,591	0	11,422	94	0	0	856	0	180	0	0	2	0
1989	6,118	0	9,222	437	0	0	1,395	0	568	0	0	103	0
1990	4,586	0	7,056	529	0	0	1,177	0	517	0	0	4	0
1991	4,489	0	6,477	164	0	246	1,460	0	759	0	0	97	0
1992	5,248	0	6,121	279	0	41	1,222	0	1,232	0	0	73	0
1993	5,373	0	6,318	217	0	92	958	0	1,370	0	0	15	0
1994	4,700	0	6,063	277	0	137	1,020	0	904	0	0	54	0
1995	4,508	0	5,867	436	0	365	1,431	0	829	0	0	201	296
1996	5,128	0	6,392	139	0	1,320	1,467	0	1,614	0	0	295	290
1997	5,316	0	5,588	334	0	1,424	872	0	2,210	0	0	333	0
1998	4,897	0	7,500	337	0	1,796	1,446	5	1,324	1	0	471	0
1999	5,552	0	7,554	461	0	1,462	1,513	80	2,504	1	0	403	0
2000	5,257	0	6,000	380	0	1,135	1,448	17	1,203	4	0	31	0
2001	4,853	0	6,674	358	0	845	1,580	43	1,632	1	0	41	4
2002	4,711	0	6,192	450	0	746	1,137	82	1,701	18	0	203	17
2003	5,827	0	5,770	390	0	254	1,128	68	565	15	3	40	17
2004	5,062	0	5,846	393	0	131	1,298	80	633	19	23	2	17
2005	5,244	0	7,855	264	0	38	941	53	1,726	24	0	0	5
2006	5,635	0	4,207	238	0	150	846	50	598	9	3	0	5
2007	4,813	0	2,840	379	4	521	841	46	1,077	41	18	0	3
2008	5,033	0	2,952	319	0	1,134	913	45	926	45	14	4	10
2009	5,108	0	2,659	419	0	1,117	921	47	641	32	2	0	0
2010	4,200	0	2,223	501	0	867	1,208	43	**471**	34	**11**	0	0
2011	4,206	0	2,518	547	0	705	556	45	673	49	10	0	1

Indonesia: **The figure for 2010 is still being investigated by Indonesia and may change as a result of that investigation**

European Commission: From 2006, estimates are from EC reports to the CCSBT. Earlier catches were reported by Spain and the IOTC.

Miscellaneous: Before 2004, these were from Japanese import statistics (JIS). From 2004, the higher value of JIS and CCSBT TIS was used combined with available information from flags in this category.

Reseach and other: Mortality of SBT from CCSBT research and other sources such as discarding practices in 1995/96.

Trends in selected indicators of the SBT stock

Indicator	Period	Min.	Max.	2008	2009	2010	2011	2012	12 month trend 2010 to 2011	12 month trend 2011 to 2012
Scientific aerial survey	1993–2000 2005–12	0.38 (1999)	1.86 (2011)	0.94	0.55	1.05	1.86	0.54	↑	↓
SAPUE index	2002–12	0.55 (2004)	1.70 (2011)	1.29	0.87	1.51	1.79	0.59	↑	↓
Trolling index	1996–2003 2005–06 2006–12	2.817 (2006)	5.653 (2011)	5.43	3.58	2.92	5.65	1.55	↑	↓
NZ charter nominal CPUE (Areas 5+6)	1989–2011	1.339 (1991)	7.825 (2010)	4.88	4.53	7.83	6.42		↓	
NZ domestic nominal CPUE	1989–2011	0.000 (1989)	1.904 (2010)	0.87	1.26	1.90	2.23		↑	
NZ charter age/size composition (proportion age 0–5 SBT)*	1989–2011	0.001 (2005)	0.414 (1993)	0.24	0.33	0.25	0.11		↓	
NZ domestic age/size composition (proportion age 0–5 SBT)*	1980–2011	0.001 (1985)	0.404 (1995)	0.11	0.09	0.19	0.15		↓	
Indonesian age composition: mean age on spawning ground, all SBT	1994–95 to 2010–11	14 (2005–06)	21 (1994–95)	16.7	15.6	15.3	16.8		↑	
Indonesian age composition: median age on spawning ground	1994–95 to 2010–11	13 (2001–03)	21 (1994–97, 1998–99)	17	15	15	17		↑	

Indicator	Period	Area weighting	Min.	Max.	2008	2009	2010	2011	2012	12 month trend	
										2010 to 2011	**2011 to 2012**
Standardised JP LL CPUE (age 3)	1969-2011	W0.5 W0.8	0.196(2003) 0.224((2003)	2.842(1972) 2.658(1972)	0.685 0.939	0.576 0.697	0.265 0.315	0.450 0.524		↑	
Standardised JP LL CPUE (age 4)	1969-2011	W0.5 W0.8	0.258(2006) 0.287(2006)	2.936(1974) 2.694(1974)	0.537 0.730	0.864 1.119	0.684 0.846	0.745 0.923		↑	
Standardised JP LL CPUE (age 5)	1969-2011	W0.5 W0.8	0.231(2006) 0.261(2006)	2.620(1972) 2.467(1972)	0.409 0.526	0.776 1.037	1.324 1.790	1.147 1.466		↓	
Standardised JP LL CPUE (age 6+7)	1969-2011	W0.5 W0.8	0.204(2007) 0.243(2007)	2.581(1976) 2.459(1976)	0.354 0.444	0.458 0.603	0.863 1.208	1.085 1.466		↑	
Standardised JP LL CPUE (age 8-11)	1969-2011	W0.5 W0.8	0.269(2007) 0.294(1992)	3.539(1969) 3.257(1969)	0.424 0.516	0.367 0.472	0.320 0.439	0.312 0.431		↓	
Standardised JP LL CPUE (age 12+)	1969-2011	W0.5 W0.8	0.478(2010) 0.601(1978)	3.083(1970) 2.782(1970)	0.687 0.863	0.623 0.785	0.478 0.628	0.503 0.684		↑	

Attachment 6

Report on Biology, Stock Status and Management of Southern Bluefin Tuna: 2012

The CCSBT Extended Scientific Committee (ESC) conducted a review of fisheries indicators in 2012 to provide updated information on the status of the stock. This report updates description of fisheries and the state of stock, and provides fishery and catch information.

1. Biology

Southern bluefin tuna (*Thunnus maccoyii*) are found in the southern hemisphere, mainly in waters between 30° and 50° S, but only rarely in the eastern Pacific. The only known spawning area is in the Indian Ocean, south-east of Java, Indonesia. Spawning takes place from September to April in warm waters south of Java and juvenile SBT migrate south down the west coast of Australia. During the summer months (December-April), they tend to congregate near the surface in the coastal waters off the southern coast of Australia and spend their winters in deeper, temperate oceanic waters. Results from recaptured conventional and archival tags show that young SBT migrate seasonally between the south coast of Australia and the central Indian Ocean. After age 5 SBT are seldom found in nearshore surface waters, and their distribution extends over the southern circumpolar area throughout the Pacific, Indian and Atlantic Oceans.

SBT can attain a length of over 2m and a weight of over 200kg. Direct ageing using otoliths indicates that a significant number of fish larger than 160cm are older than 25 years, and the maximum age obtained from otolith readings has been 42 years. Analysis of tag returns and otoliths indicate that, in comparison with the 1960s, growth rate has increased since about 1980 as the stock has been reduced. There is some uncertainty about the size and age when SBT mature, but available data indicate that SBT do not mature younger than 8 years (155cm fork length), and perhaps as old as 15 years. SBT exhibit age-specific natural mortality, with M being higher for young fish and lower for old fish, increasing again prior to senescence.

Given that SBT have only one known spawning ground, and that no morphological differences have been found between fish from different areas, SBT are considered to constitute a single stock for management purposes.

2. Description of Fisheries

Reported catches of SBT up to the end of 2011 are shown in Figures 1 - 3. However, a 2006 review of SBT data indicated that there may have been substantial under-reporting of SBT catches and surface fishery bias in the previous 10 - 20 year period and there is currently substantial uncertainty regarding the true levels of total SBT catch over this period. Historically, the SBT stock has been exploited for more than 50 years, with total catches peaking at 81,750t in 1961 (Figures 1 - 3). Over the period 1952 - 2011, 78% of the reported catch was taken by longline and 22% using surface gears, primarily purse-seine and pole&line (Figure 1). The proportion of reported catch made by surface fishery peaked at 50% in 1982, dropped to 11-12 % in 1992 and 1993 and increased again to average 35% since 1996 (Figure 1). The Japanese longline fishery (taking a wide age range of fish) recorded its peak catch of

77,927t in 1961 and the Australian surface fishery catches of young fish peaked at 21,501t in 1982 (Figure 3). New Zealand, the Fishing Entity of Taiwan and Indonesia have also exploited southern bluefin tuna since the 1970s - 1980s, and Korea started a fishery in 1991.

On average 79% of the SBT catch has been made in the Indian Ocean, 17% in the Pacific Ocean and 4% in the Atlantic Ocean (Figure 2). The reported Atlantic Ocean catch has varied widely between about 18t and 8,200t since 1968 (Figure 2), averaging about 817t over the past two decades. This variation in catch reflecting shifts in longline effort between the Atlantic and Indian Oceans. Fishing in the Atlantic occurs primarily off the southern tip of South Africa (Figure 4). Since 1968, the reported Indian Ocean catch has declined from about 45,000t to 8000t, averaging about 20,000t, and the reported Pacific Ocean catch has ranged from about 800t to 19,000t, averaging about 5500t, over the same periods (although SBT data analyses indicate that these catches may be under-estimated).

3. Summary of Stock Status

The 2011 assessment suggested that the SBT spawning biomass is at a very low fraction of its original biomass as well as below the level that could produce maximum sustainable yield. Rebuilding the spawning stock biomass would almost certainly increase sustainable yield and provide security against unforeseen environmental events. The current TAC has been set using the management procedure adopted in 2011, which has a 70% probability of rebuilding to the interim target biomass level by 2035.

Stock prognosis

There is a positive outlook for the SBT stock based on the 2011 assessment, including:

- a continued reduction in the total reported global catch;
- the current fishing mortality has reduced to below F_{msy}; and
- Stock is expected to increase at current catch levels, and future catch levels determined by the MP

Summary of indicators

There have been mixed signals from the indicators in 2012, including:

- longline CPUE has an increasing trend since 2007 and;
- a decrease in the aerial survey index in 2012 to a low level (also seen in the SAPUE and troll survey results). In relation to this, the ESC has identified the need to further examine the factors that may have impacted on the Aerial survey at its 2013 meeting.

4. Current Management Measures

At its Eighteenth annual meeting, the CCSBT agreed that a Management Procedure (MP) would be used to guide the setting of the SBT global total allowable catch (TAC) to ensure that the SBT spawning stock biomass achieves the interim rebuilding target of 20% of the original spawning stock biomass. The CCSBT will set the TAC from 2012 and beyond based on the outcome of the MP, unless the CCSBT decides otherwise based on information that is not otherwise incorporated into the MP. The adopted MP has the following management parameters:

- The MP is tuned to a 70% probability of rebuilding the stock to the interim rebuilding target reference point of 20% of the original spawning stock biomass by 2035;
- The minimum TAC change (increase or decrease) is 100 tonnes;
- The maximum TAC change (increase or decrease) is 3,000 tonnes;
- The TAC will be set for three-year periods, subject to paragraph 7 of CCSBT's Resolution on Adoption of a Management Procedure; and
- The national allocation of the TAC within each three-year period will be apportioned according to CCSBT's Resolution on the Allocation of the Global Total Allowable Catch.

The CCSBT also adopted the meta-rule process described in Attachment 10 of the Report of the 15th Meeting of the Scientific Committee as the method for dealing with exceptional circumstances in the SBT fishery. The meta-rule process describes: (1) the process to determine whether exceptional circumstances exist; (2) the process for action; and (3) the principles for action.

Catch Limits for future Seasons

In adopting the MP, the CCSBT emphasised the need to take a precautionary approach to increase the likelihood of the spawning stock rebuilding in the short term and to provide industry with more stability in the TAC (i.e. to reduce the probability of future TAC decreases). For the first three-year TAC setting period (2012-2014), the TAC and allocation of the TAC will be as follows:

	2012	**2013**	**2014**[1]
Japan	2,519	2,689	3,366
Australia	4,528	4,698	5,147
Republic of Korea	911	945	1,036
Fishing Entity of Taiwan	911	945	1,036
New Zealand	800	830	909
Indonesia	685	707	750
Philippines	45	45	45
South Africa	40	80[2]	150[2]
European Union	10	10	10
TAC	**10,449**	**10,949**	**12,449**

In addition, some flexibility is provided to Members for limited carry-forward of unfished allocations within the three year period. This flexibility is described in CCSBT's Resolution on Limited Carry-forward of Unfished Annual Total Allowable Catch of Southern Bluefin Tuna within Three Year Quota Blocks.

[1] The allocations shown for 2014 and the proportional allocation shown for Japan are dependent on the TAC for 2014 (these figures assume a TAC of 12,449t) and a compliance review at CCSBT 20 (2013) as described in the Resolution on the Allocation of the Global Total Allowable Catch.

[2] The increased allocation to South Africa in 2013 and 2014 is subject to its accession to the Convention for the Conservation of Southern Bluefin Tuna.

Monitoring, Control and Surveillance Measures

On 1 June 2000, the CCSBT implemented a Trade Information Scheme (TIS) for SBT, in which a CCSBT TIS document must be issued for all exports of SBT. The scheme also requires all Members of the CCSBT to ensure that all imports of SBT are to be accompanied by a completed CCSBT TIS Document, endorsed by an authorised competent authority in the exporting country, and including details of the name of fishing vessel, gear type, area of catch, dates, etc. Shipments not accompanied by this form must be denied entry by Members and Cooperating Non-Members. Completed forms are lodged with the CCSBT Secretariat where they are used to maintain a database for monitoring catches and trade and for conducting reconciliations between exports and imports of SBT.

On 1 July 2004, the CCSBT established a list of fishing vessels over 24 metres in length which were approved to fish for SBT. The list was extended to include all vessels, regardless of size, from 1 July 2005.

On 31 December 2008, the CCSBT established a list of authorised farms that are approved to operate for farming SBT and on 1 April 2009, the CCSBT established a list of carrier vessels that are authorised to receive SBT at sea from large scale fishing vessels. Members and Cooperating Non-Members will not allow the trade of SBT caught by fishing vessels and farms, or transhipped to carrier vessels that are not on these lists.

The CCSBT Vessel Monitoring System (VMS) came into effect immediately after the Fifteenth Annual Meeting of the Commission, on 17 October 2008. It requires CCSBT Members and Cooperating Non-Members to adopt and implement satellite-linked VMS for vessels fishing for SBT that complies with the IOTC, WCPFC, CCAMLR, or ICCAT VMS requirements according to the respective convention area in which the SBT fishing is being conducted. For fishing outside of these areas, the IOTC VMS requirements must be followed.

The CCSBT Transhipment monitoring program came into effect on 1 April 2009. The program applies to transhipments at sea from tuna longline fishing vessels with freezing capacity (referred to as “LSTLVs”). It requires, amongst other things, for carrier vessels that receive SBT transhipments at sea from LSTLVs to be authorised to receive such transhipments and for a CCSBT observer to be on board the carrier vessel during the transhipment. The CCSBT transhipment program is harmonized and operated in conjunction with those of ICCAT and IOTC to avoid duplication of the same measures. ICCAT or IOTC observers on a transhipment vessel that is authorised to receive SBT are deemed to be CCSBT observers provided that the CCSBT standards are met.

The CCSBT Catch Documentation Scheme (CDS) came into effect on 1 January 2010 and replaces the existing TIS system. The CDS provides for tracking and validation of legitimate SBT product flow from catch to the point of first sale on domestic or export markets. As part of the CDS, all transhipments, landings of domestic product, exports, imports and re-exports of SBT must be accompanied by the appropriate CCSBT CDS Document(s), which will include a Catch Monitoring Form and possibly a Re-

Export/Export After Landing of Domestic Product Form. Similarly, transfers of SBT into and between farms must be documented on either a Farm Stocking Form or a Farm Transfer Form as appropriate. In addition, each whole SBT that is transhipped, landed as domestic product, exported, imported or re-exported must have a uniquely numbered tag attached to it and the tag numbers of all SBT (together with other details) will be recorded on a Catch Tagging Form. Copies of all documents issued and received will be provided to the CCSBT Secretariat on a quarterly basis for compiling to an electronic database, analysis, identification of discrepancies, reconciliation and reporting.

5. Scientific Advice

Consistent with the MP, the ESC recommended, based on the Review of indicators, the 2011 stock assessment, MP inputs and the preliminary outcomes of the close kin analysis, that there is no need to revise the Commission’s 2011 TAC decision.

6. Biological State and Trends

The ESC did not conduct a model based assessment at its 2012 meeting, so the information presented here is from the 2011 meeting of the ESC. Analyses suggest the SBT spawning biomass is at a very low fraction of its original biomass as well as below the level that could produce maximum sustainable yield. Rebuilding the spawning stock biomass would almost certainly increase sustainable yield and provide security against unforeseen environmental events. Catches at the current TAC are expected to achieve rebuilding.

Exploitation rate: Moderate (Below F_{MSY})
Exploitation state: Overexploited
Abundance level: Low abundance

SOUTHERN BLUEFIN TUNA SUMMARY FROM ESC in 2011 (global stock)	
Maximum Sustainable Yield	34,500 t (31,100-36,500t)[13]
Reported (2010) Catch	9547t
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 9449t annually over 2010-2011, 10449t in 2012, and 10949t in 2013.

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

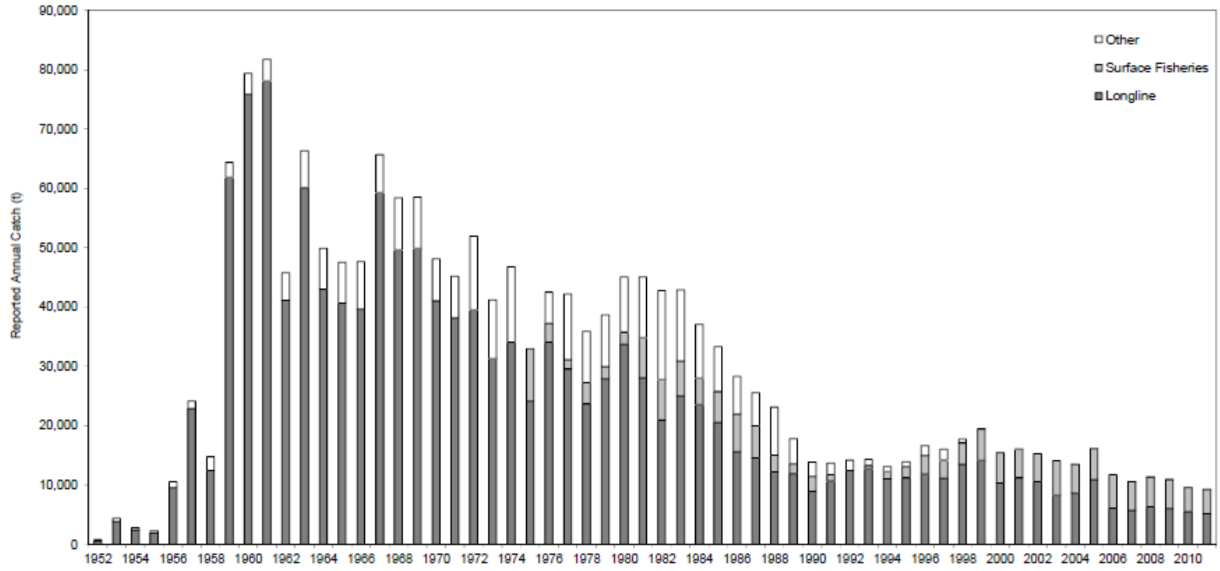

Figure 1: Reported southern bluefin tuna catches by fishing gear, 1952 to 2011. Note: a 2006 review of SBT data indicated that catches over the past 10 to 20 years may have been substantially under-reported.

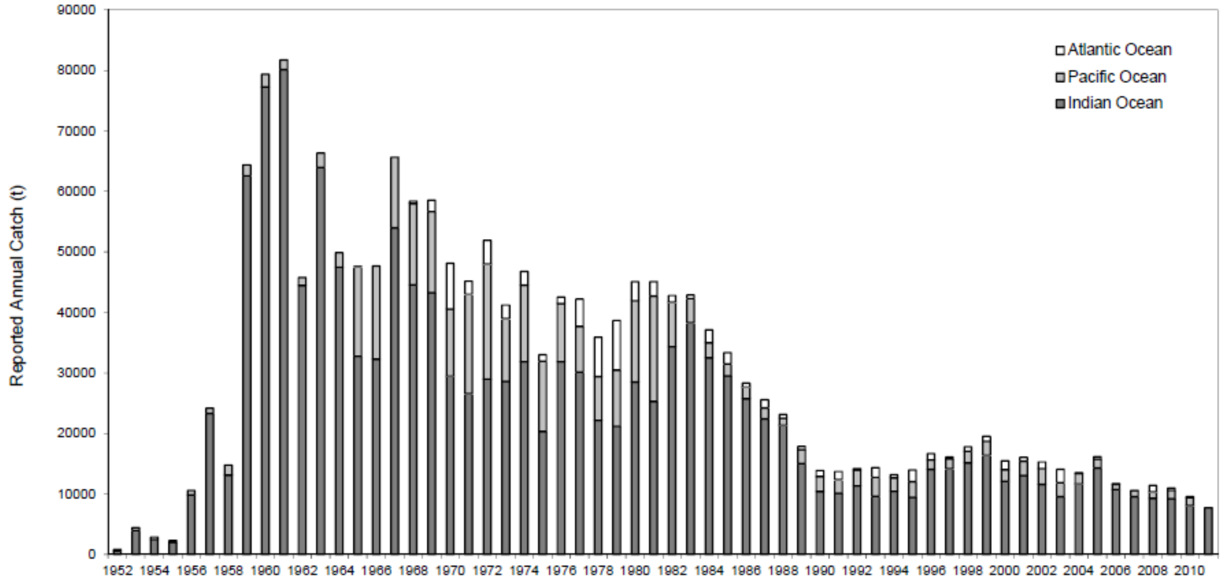

Figure 2: Reported southern bluefin tuna catches by ocean, 1952 to 2011. Note: a 2006 review of SBT data indicated that catches over the past 10 to 20 years may have been substantially under-reported.

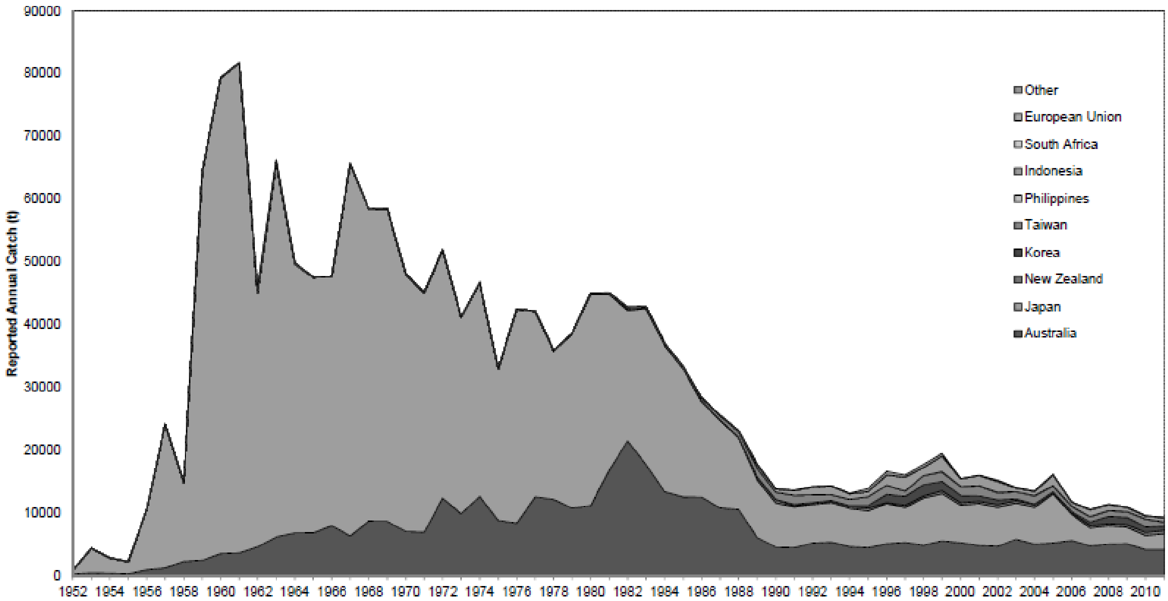

Figure 3: Reported southern bluefin tuna catches by flag, 1952 to 2011. Note: a 2006 review of SBT data indicated that catches over the past 10 to 20 years may have been substantially under-reported.

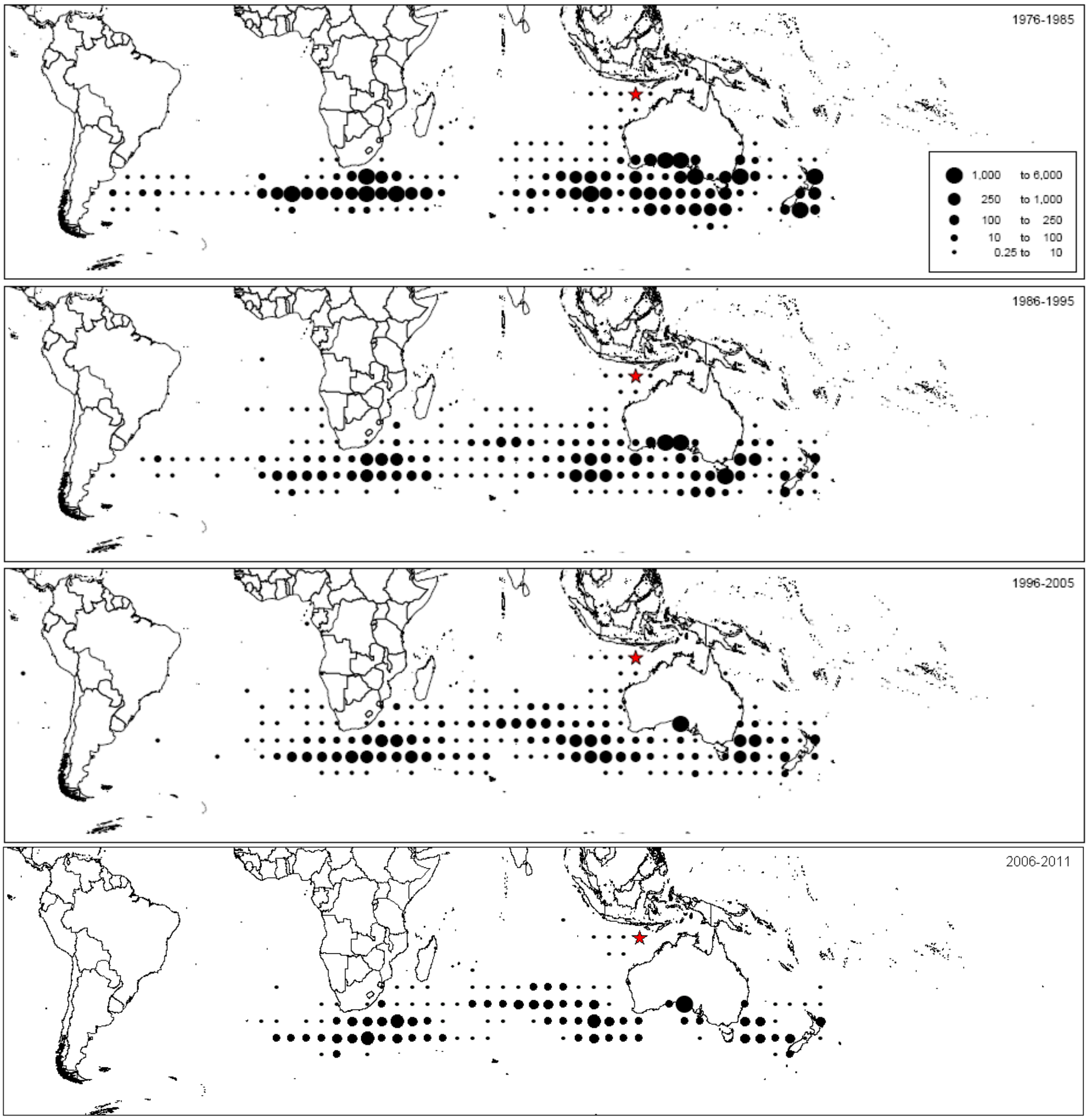

Figure 4: Geographical distribution of average annual southern bluefin tuna catches (t) by CCSBT members and cooperating non-members over the periods 1976-1985, 1986-1995, 1996-2005 and 2006-2011 per 5° block by oceanic region. The area marked with a star is an area of significant catch in the breeding ground. Block catches averaging less than 0.25 tons per year are not shown. Note: This figure may be affected by past anomalies in catch.

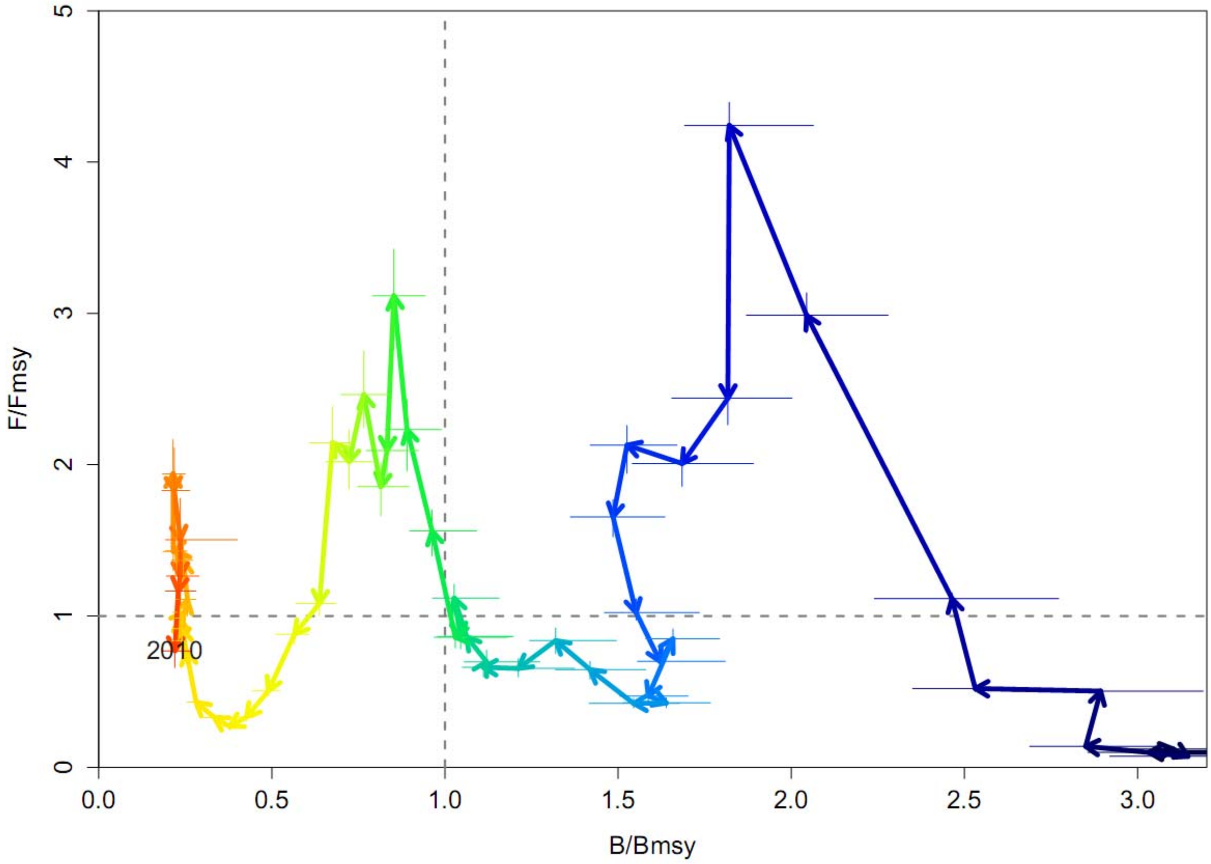

Figure 5. Time trajectory from 1952 to 2010 of median fishing mortality over the F_{msy} (for ages 2-15) versus spawning biomass (B) over B_{msy}. The fishing mortality rates are based on biomass-weighted values and the relative fishery catch composition and mean SBT body weights in each year. Vertical and horizontal lines represent 25^{th}-75^{th} percentiles from the operating model grid.

Attachment 7

Specifications of the CCSBT Management Procedure

Introduction

From 2002 to 2011, the CCSBT conducted extensive work to develop a Management Procedure (MP) to guide its global TAC setting process for southern bluefin tuna. The final MP, known as the "Bali Procedure", was recommended by the CCSBT's Extended Scientific Committee (ESC) in July 2011. Management parameters of the Bali Procedure could be adjusted to set different time horizons for rebuilding, and to constrain the maximum TAC changes allowed every time the TAC is updated. Simulation tests results for a range of parameter options were presented to CCSBT's Extended Commission for its consideration.

The Extended Commission adopted the Bali Procedure together with the following associated management parameters as its MP at the CCSBT's eighteenth annual meeting in October 2011:

- The MP is to be tuned to a 70% probability[1] of rebuilding the stock to the interim rebuilding target reference point of 20% of the original spawning stock biomass by 2035;
- The minimum TAC change (increase or decrease) will be 100 tonnes;
- The maximum TAC change (increase or decrease) will be 3,000 tonnes;
- The TAC will be set for three-year periods, subject to paragraph 7 of CCSBT's Resolution on the Adoption of a Management Procedure[2]; and
- The national allocation of the TAC within each three-year period will be apportioned according to CCSBT's Resolution on the Allocation of the Global Total Allowable Catch[2].

The CCSBT used the MP to compute the TAC for 2012 to 2014 inclusive and decided that MP will be used to guide the setting of the global SBT TAC for 2012 and beyond[3]. For the second (2015-2017) and subsequent three-year TAC setting periods, there will be a one year lag between the TAC calculation by the MP and implementation of that TAC (i.e. the 2015-2017 TAC will be calculated in 2013).

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[1] Probabilities were computed across a weighted set of operating models defined as the "Reference Set", which represented the most important uncertainties in the model structure, parameters, and data. These included alternative values for natural mortality and steepness parameters (model weights proportional to their maximum posterior density), alternative CPUE series (given equal weights), and two different age ranges used to normalize selectivity for CPUE predictions (given pre-determined weights). Specifications about the reference set used for the final tuning of MPs are provided at paragraph 92 of Appendix 2 of the Report of the Sixteenth Meeting of the Scientific Committee.

[2] Report of the Eighteenth Annual Meeting of the Commission (10-13 October 2011, Bali, Indonesia).

[3] The TAC for 2012 and 2013 was set at the value computed using the MP in 2011. The Extended Commission decided that the TAC for 2014 will either be the value computed in 2011 or the value of the MP outcomes for 2015 – 2017 (whichever is the less), unless the Extended Commission decides otherwise based on the assessment of the Compliance Committee.

Technical details of the MP, together with specifications of how the CPUE and Aerial Survey indices that are to be provided as input to the MP are to be calculated, and the Metarule process that the Extended Commission has adopted for dealing with exceptional circumstances in the SBT fishery, are provided in the following sections of this document.

1. Background and Technical details of the Bali Procedure 3
2. Specification of Standardised CPUE for the MP 6
3. Data and Model Specifications for the Aerial Survey Index used in the MP 9
4. Metarule Process 12

1. Background and Technical details of the Bali Procedure

Concept

The ESC experienced difficulty in choosing between the two preferred MPs that it had identified (MP1 and MP2) and it subsequently decided to recommend an alternative which was a combination of MP1 and MP2. There were features of each of MP1 and MP2 that appealed to the ESC, and an integrated combination of those features was considered to be a suitable approach for providing a single MP (the Bali Procedure) that is a genuine representation of all the work Member scientists had conducted.

Details

There were several key features that differed between MP1 and MP2:

- Empirical versus model based;
- CPUE target versus CPUE trend; and
- Use of historical aerial survey data

Empirical MPs have the virtue of being (usually) simpler to understand and compute, but their output recommendations can often be over-strongly influenced by noise in the data. Model-based MPs can "filter" the signal (and key parameters) from the noise in the MP data, but if that process is too complex or over-parameterised, it can sometimes behave strangely in the testing phase, as a result of non-convergence or hitting boundaries due to complex likelihood surfaces. The simple Biomass Random Effect Model (BREM) part of MP1 did not exhibit any of these properties: it always converged and without any apparently strange parameter estimates. Given that in both rounds of MP testing it demonstrated an ability to reduce variance in both catch and spawning stock biomass (SSB), this suggested that it would form a sensible base point for an MP.

CPUE

MPs that act (primarily) on trends in CPUE have the advantage of acting "locally", in that they do not depend on the absolute level of the abundance index, unlike target-based MPs where target mis-specification can be a problem. However, trend-based MPs can get "lost" by failing to recognise a spuriously positive trend at very low stock biomass levels and thus potentially fail to secure resource recovery. Both MP1 and MP2 are target and trend driven (in relation to CPUE), so a combination of the two should have a mix of both trend and target driven behaviour at their core.

Aerial survey

The historical aerial survey data points (1993-2000, 2005-2011) cover the years for which estimated recruitments were the lowest on record. As such, they represent levels of the aerial survey index to preferably stay above and ideally, never be below. In MP2 the tuning parameter was effectively a target level of the future aerial survey which was a multiple of the average historical level of the survey given real data. From paper CCSBTESC/1107/34 in Table 1 it was seen that the tuned level of this multiplier was always less than 1 and mostly between 0.6-0.8. This meant, in effect, that the target level of aerial survey was actually less than that observed in the historical data. This is perhaps not ideal, as it is not desirable for the recruitment level to decrease below the levels seen in the last two decades, so it was suggested that the average historical level of the aerial survey should form a kind of limit reference point, and that below this point any MP (including MP2) should act strongly to ensure that the stock is brought above this level as was done in MP1.

Form of the new HCR

To combine the features of both MP1 and MP2 two candidate TACs are calculated, based on the key aspects of each of MP1 and MP2, and the (arithmetic) mean of the two TACs are taken. The key MP variables are not the raw CPUE and aerial survey, but their "filtered" counterparts the adult (B_y) and juvenile (R_y) relative biomass, respectively, that come from the BREM estimation framework of MP1. The first candidate TAC is based upon the trend in adult relative biomass:

$$TAC^1_{y+1} = TAC_y \times \begin{cases} 1 - k_1 |\lambda|^\gamma & \lambda < 0 \\ 1 + k_2 \lambda & \lambda \geq 0 \end{cases} \tag{1}$$

where λ is the slope in the regression of $\ln B_y$ against year (from years $y-\tau_B+1$ to year y). The second TAC is defined as follows:

$$TAC^2_{y+1} = 0.5 \times \left(TAC_y + C^{t\arg}_y \Delta^R_y \right), \tag{2}$$

where

$$C^{t\arg}_y = \begin{cases} \delta \left[B_y / B^* \right]^{1-\varepsilon_b} & B_Y \geq B^* \\ \delta \left[B_y / B^* \right]^{1+\varepsilon_b} & B_y < B^* \end{cases} \tag{3}$$

where $\varepsilon_b \in [0,1]$ represents the degree to which the response to a biomass level above or below the target level B^* is asymmetric. The recruitment adjustment Δ^R_y is defined as follows:

$$\Delta^R_y = \begin{cases} \left[\overline{R} / \Phi \right]^{1-\varepsilon_r} & \overline{R} \geq \Phi \\ \left[\overline{R} / \Phi \right]^{1+\varepsilon_r} & \overline{R} < \Phi \end{cases} \tag{4}$$

and $\varepsilon_r \in [0,1]$ is the level of asymmetry in response to the current moving (arithmetic) average - and this has been changed to include up to year y - recruitment levels, $\overline{R}$:

$$\overline{R} = \frac{1}{\tau_R} \sum_{i=y-\tau_R+1}^{y} R_i \ , \tag{5}$$

of length τ_R relative to the average, Φ, calculated over the years for which the estimates are based on the most up to date observed data (1993-2000 and 2005-2011). Most of the fixed parameters of this MP are kept at their respective levels as used in MP1 and MP2 with the single tuning parameter δ. However, the parameter k_2 is reduced to a value of 3 to reduce reactivity to positive CPUE trends, but to ensure tuning is possible for the most difficult tuning settings requested by the Extended Commission, the parameter ε_b is reduced from 0.5 to 0.25. Table 1 details the fixed parameter values in the combined Bali Procedure and their values in the individual procedures. Finally, the Bali Procedure TAC is defined as:

$$TAC_{y+1} = 0.5 \times \left(TAC^{1}_{y+1} + TAC^{2}_{y+1}\right). \qquad (6)$$

Table 1: Fixed values and tuning parameter for the combined Bali Procedure and their respective values for the two original MPs.

Parameter	Bali Procedure	MP1/MP2
Δ	Tuned	Tuned (MP1)
k_1	1.5	1.5 (MP2)
k_2	3	5 (MP2)
Γ	1	1 (MP2)
τ_B	7	7 (MP2)
B^*	1.2	1.2 (MP1)
ε_b	0.25	0.5 (MP1)
ε_r	0.75	0.75 (MP1)
τ_R	5	5 (MP1)

2. Specification of Standardised CPUE for the MP

Data to be used

The CPUE dataset to be used in the MP is based on the longline catch and effort data of Japanese, Australian (Real-Time Monitoring Program in the 1990s) and New Zealand (NZ) charter vessels at the shot-by shot resolution. Southern bluefin tuna (SBT) aged 4 years or older are used in the CPUE dataset. In the most recent year of the dataset, CPUE (number of SBT individuals per 1000 hooks) is calculated from Japanese data available at the time which are mainly from RTMP and New Zealand data. From this dataset, a set of core vessels are selected which meet certain conditions. These conditions are: CCSBT statistical areas (Area) 4-9, Month 4-9, x (top rank of SBT catch in a year) = 52, and y (number of years in the top ranks) = 3.

The dataset each year is further adjusted by:

- Deleting records from operations south of 50^0S;
- Combining operations from Area 5 and Area 6 into one area (Area 56); and
- Deleting operations with extremely high CPUE values (>120).

The shot-by-shot data are then aggregated into 5x5 degree cells by month before standardization. Aggregated data cells with little effort (<10,000 hooks) are deleted.

CPUE standardization

Unweighted CPUE

The aggregated CPUE dataset is standardized using the following Generalised Linear Model (GLM)[4]:

$$\begin{aligned} log(CPUE+const) = {} & Intercept + Year + Month + Area + Lat5 + BET\_CPUE + \\ & YFT\_CPUE + (Month*Area) + (Year*Lat5) + (Year*Area) + \\ & Error \end{aligned} \qquad (1)$$

where

Area	is the CCSBT statistical area
Lat5	is the latitude in 5 degree
BET_CPUE	is the bigeye tuna CPUE
YFT_CPUE	is the yellowfin tuna CPUE
const	is the constant as 0.2 derived as 10% of the mean nominal CPUE in Nishida and Tsuji (1998)

Area weights

To obtain the area weighted CPUE indices described below, the area of SBT distribution was calculated based on a 1x1 degree square resolution. The area was calculated in the form of an area index such that an area size of 1x1 degree square along the equator was defined as 1, and the area size for other 1x1 degree squares of different latitudes was determined as the proportion of the square area along the equator. The area index for the Constant Square (CS)[5] was simply a union of fished 1x1 degree squares through all years (1969-present) and was calculated for each

[4] Currently, there is no specification of the procedure to be followed for the GLMs here and below that have fixed interaction effects if in a future year one of the associated cells is empty of data.

[5] For explanation of Constant Square and Variable Square CPUE interpretations, see Anonymous (2001b).

quarter, month, statistical area, and latitude (5 degree) combination. The area index for the Variable Square (VS) was the sum of fished 1x1 degree square areas and was calculated for each year, quarter, month, statistical area, and latitude combination. For VS, a square counts as fished only for the month in which fishing occurred. More details of the area index calculation are described in Nishida (1996).

Area weighted CPUE
With the estimated parameters obtained from the CPUE standardization above (1), the Constant Square (CS) and Variable Square (VS) CPUE abundance indices are computed by the following equations:

$$CS_{4+,y} = \sum_m \sum_a \sum_l (AI_{CS})_{(yy\text{-}present)}[\exp(Intercept + Year + Month + Area + Lat5 + BET\_CPUE + YFT\_CPUE + (Month*Area) + (Year*Lat5) + (Year*Area) + \sigma^2/2) - 0.2] \quad (2)$$

$$VS_{4+,y} = \sum_m \sum_a \sum_l (AI_{VS})_{ymal}[\exp(Intercept + Year + Month + Area + Lat5 + BET\_CPUE + YFT\_CPUE + (Month*Area) + (Year*Lat5) + (Year*Area) + \sigma^2/2) - 0.2] \quad (3)$$

where

$CS_{4+,y}$	is the CS abundance index for age 4+ and *y*-th year,
$VS_{4+,y}$	is the VS abundance index for age 4+ and *y*-th year,
$(AI_{CS})_{(yy\text{-}present)}$	is the area index of the CS model for the period *yy*-present (*yy*=1969 or 1986 depending on the period of standardization,
$(AI_{VS})_{ymal}$	is the area index of the VS model for *y*-th year, *m*-th month, *a*-th SBT statistical area, and *l*-th latitude,
σ	is the mean square error in the GLM analyses.

The w0.5 and w0.8 (B-ratio and geostat proxies) CPUE abundance indices are then calculated using the following equation (Anonymous 2001a):

$$I_{y,a} = wCS_{y,a} + (1-w)VS_{y,a} \qquad \text{where } w = 0.5 \text{ or } 0.8 \quad (4)$$

The final CPUE input series is the arithmetic average of the w0.5 and w0.8 series.

Data calibration
The estimated CPUE value in the most recent year, which is mainly derived from RTMP data, is corrected using the average of the "Logbook based CPUE / RTMP based CPUE" ratio for the most recent three years of logbook data.

The area weighted CPUE series between 1986 and the most recent year are then calibrated to the historical CPUE series between 1969 and 2008 using the following GLM (equation 5), described in Nishida and Tsuji (1998) for 5x5 degree cells by month data for all vessels (i.e. both core and other vessels) in Areas 4-9 and Months 4-9:

$$\log(CPUE+const) = Intercept + Year + Quarter + Month + Area + Lat5 + (Quarter*Area) + (Year*Quarter) + (Year*Area) + Error \quad (5)$$

where
const is 10% of the mean nominal CPUE.

CPUE series for monitoring

Two additional CPUE series will be used for monitoring purposes of the status of the stock and MP implementation. These include:

(1) Same procedure as specified above, but at the shot-by-shot level rather than the aggregated 5x5 level.
(2) Same procedure as specified above, but using the simpler GLM given by:

$$log(CPUE+0.2) = Intercept + Year + Month + Area + Lat5 + (Month*Area) + Error \quad (6)$$

Reference

Anonymous. 2001a. Report of the Fifth Meeting of the Commission for the Conservation of Southern Bluefin Tuna, Scientific Committee. 19-14 March 2001, Tokyo, Japan.

Anonymous. 2001b. Report of the SC to CCSBT on the Scientific Research Program. Attachment D in Report of the Fifth Meeting of the Commission for the Conservation of Southern Bluefin Tuna, Scientific Committee. 19-14 March 2001, Tokyo, Japan.

Nishida, T. 1996. Estimation of abundance indices for southern bluefin tuna (Thunnus maccoyii) based on the coarse scale Japanese longline fisheries data. Paper submitted to the Commission for the Conservation of Southern Bluefin Tuna, Scientific Meeting. CCSBT/SC/96/12. 26 pp.

Nishida, T. and S. Tsuji. 1998. Estimation of abundance indices of southern bluefin tuna (*Thunnus maccoyii*) based on the coarse scale Japanese longline fisheries data (1969-97). Paper submitted to the Commission for the Conservation of Southern Bluefin Tuna, Scientific Meeting. CCSBT/SC/9807/13.27 pp.

3. Data and Model Specifications for the Aerial Survey Index used in the MP

Data

The scientific aerial survey data are estimates of the biomass of SBT patches in the Great Australian Bight (GAB) as observed by experienced spotters. The aerial survey is conducted in January through March of each year, and consists of an aircraft flying along 15 north-south transect lines running from the coast to continental shelf (from 128E to 134E degrees longitude). Trained tuna spotters (historically, one dedicated spotter and one spotter-pilot) search for surface schools of SBT. When a school or group of schools is spotted (termed 'a sighting'), the plane flies out to the sighting and each spotter independently estimates the biomass of each school. The plane then returns to the transect line to continue the survey. The survey data consists of distance flown, location of sightings, biomass estimates of each school in a sighting, and environmental observations that might affect the number and size of sightings, such as sea surface temperature (SST), swell, haze, wind speed, and sea shadow. The aim is to complete four to six replicates of the survey region, but this is not always possible because planes can only fly when minimal environmental conditions are met.

From 2011 there were no spotter-pilots in the survey, only dedicated spotters and a non-spotting pilot. Calibration experiments were carried out in 2008 and 2009 to assess the impact of this change on the standardised index (Eveson et al. 2008, 2009). Based on data from these calibration experiments, a method for accounting for the fact that a plane with one spotter makes fewer sightings than a plane with two spotters was developed and subsequently refined (Eveson et al. 2011). Unless further data comes available regarding the one spotter calibration issue, the approach detailed in Eveson et al. (2011) will be used in the aerial survey standardisation.

Standardisation model

The raw survey data are standardised in two stages, in terms of biomass-per-sighting (BpS) and sightings-per-mile (SpM), and then combined together to produce a single standardised abundance index with accompanying CV-by-year (see Eveson et al.(2011) for the details of this combination process). Since environmental conditions affect what proportion of tuna are available at the surface to be seen, as well as how visible those tuna are, and since different observers can vary both in their estimation of school size and in their ability to see tuna patches, the models include 'corrections' for environmental and observer effects in order to produce standardized indices that can be meaningfully compared across years. The coefficients of the GLM model used are updated each year by making use of the data from the most recent survey.

Biomass-per-sighting (BpS) model

For the biomass-per-sighting (BpS) standardisation, the spatio-temporal and environmental covariates which are most statistically appropriate have been explored, and the following model determined:

$$\log(BpS) \sim Year*Month*Area + SST + WindSpeed \qquad (1)$$

The model is fitted using a GLMM with a log link and a Gamma error structure. The Year, Month and Area effects are treated as factors, with the term Year*Month*Area covering all 1-, 2- and 3-way interactions. The main (1-way) effects are treated as fixed effects, and the 2- and 3-way interactions are treated as random effects to deal with sometimes sparse data coverage.

Given the changing nature of the environmental information in each year, and the shortness of the time series, the environmental covariates determined as most appropriate can change with time. Thus, there may be minor variations in the model structure (the same applies to the SpM model); however, the standardisation routine will always use the same set of covariates for all years in the analysis (i.e., each year, the BpS and SpM models are fit to the data from all survey years to produce a time-series of relative abundance indices). This is in line with the primary goal of the derivation of an unbiased index of the juvenile biomass in the GAB as assumed in the operating model and for the MP testing.

Sightings-per-mile (SpM) model

For the sightings-per-mile (SpM) model, as with the biomass-per-sighting model the spatio-temporal and environmental covariates which are most statistically appropriate have been explored, and the following model determined[6]:

$$\log(N\_sightings) \sim offset(\log(Distance)) + Year*Month*Area + \log(ObsEffect) + SST + WindSpeed + Swell + Haze + MoonPhase \qquad (2)$$

The SpM model is fitted using a GLMM with the number of sightings (N_sightings) as the response variable, as opposed to the sightings rate. The model can then be fitted assuming an overdispersed Poisson error structure[7] with a log link and including the distance flown (Distance) as an offset term to the model (i.e. as a linear predictor with a known coefficient of one), given SpM = N_sightings/Distance. As with the BpS model, the main spatio-temporal effects (Year, Month and Area) are fitted as fixed effects, and the 2- and 3-way spatio-temporal effects are fitted as random effects.

Generating the standardised index

The specific details of the combination of the two standardised indices into one index can be found in Eveson et al. (2011). Combining the index to obtain a mean index is straightforward, with a weighted average of the biomass in each stratum being summed to obtain the total index. The calculations to obtain the CV-by-year for the index are more complex, involving the delta method, given the lack of independence of both the SpM and BpS estimates across strata.

Issue of inter-annual scale changes

Unlike CPUE, the overall scale of the standardised aerial survey can change from year to year, and sometimes substantially. This is because it is a weighted sum of the abundance in the various survey strata not some kind of weighted average. In an OM context there is no issue as the estimation of the catchability coefficient takes care of the any scale changes. This scale change

[6] These were the environmental covariates used in the 2011 analysis. Note that, as for the BpS model, the covariates included in the SpM model and the functional nature of their inclusion (linear/polynomial) can change over time as new data are recorded and future analyses are undertaken.

[7] Note that the standard Poisson distribution has a very strict variance structure in which the variance is equal to the mean, and it would almost certainly underestimate the amount of variance in the sightings data, hence the use of an overdispersed Poisson distribution to describe the error structure.

does have to be taken into account when either running the MP or when attempting to ascertain whether the new aerial survey data point is inside or outside of the bounds of what we have tested for in the MP evaluation work. This can very easily be dealt with using robust but simple statistical bootstrap techniques and, when required, this process and any required scale changes in the MP will be detailed.

Reference

Eveson, P., Bravington, M. and Farley, J. 2008. The aerial survey index of abundance: updated analysis methods and results. CCSBT-ESC/0809/24.

Eveson, P., Farley, J., and Bravington, M. 2009. The aerial survey index of abundance: updated analysis methods and results. CCSBT-ESC/0909/12.

Eveson, P., Farley, J., and Bravington, M. 2010. The aerial survey index of abundance: updated analysis methods and results for the 2009/10 fishing season. CCSBT-ESC/1009/14.

Eveson, P., Farley, J., and Bravington, M. 2011. The aerial survey index of abundance: updated analysis methods and results for the 2010/11 fishing season. CCSBT-ESC/1107/15.

4. Metarule Process

Preamble

Metarules can be thought of as "rules" which prespecify what should happen in unlikely, exceptional circumstances when application of the total allowable catch (TAC) generated by the management procedure (MP) is considered to be highly risky or highly inappropriate. Metarules are not a mechanism for making small adjustments, or 'tinkering' with the TAC from the MP. It is difficult to provide firm definitions of, and be sure of including all possible, exceptional circumstances. Instead, a process for determining whether exceptional circumstances exist is described below. The need for invoking a metarule should only be evaluated at the ESC based on information presented and reviewed at the ESC.

All examples given in this document are meant to be illustrative, and NOT meant as complete or exhaustive lists.

Process to determine whether exceptional circumstances exist

Every year the ESC will:

- Review stock and fishery indicators, and any other relevant data or information on the stock and fishery; and
- On the basis of this, determine whether there is evidence for exceptional circumstances.

Examples of what might constitute an exceptional circumstance include, but are not limited to:

- Recruitment, or a series of recruitment values outside the range[8] for which the MP was tested;
- A scientific aerial survey or CPUE result outside the range[8] for which the MP was tested;
- Substantial improvements in knowledge, or new knowledge, concerning the dynamics of the population which would have an appreciable effect on the operating models used to test the existing MP; and
- Missing input data for the MP, resulting in an inability to calculate a TAC from the MP.

Every three years (not coinciding with years when a new TAC is calculated from the MP) the ESC will:

- Conduct an in depth stock assessment; and
- On the basis of the assessment, indicators and any other relevant information, determine whether there is evidence for exceptional circumstances (an example of exceptional circumstances would be if the stock assessment was substantially outside the range of simulated stock trajectories considered in MP evaluations, calculated under the reference set of operating models).

Every six years (not coinciding with years when a new TAC is calculated from the MP) the ESC will:

- Review the performance of the MP; and
- On the basis of the review determine whether the MP is on track or a new MP is required.

[8] The "range" refers to 95% probability intervals for projections for the index in question made using the reference set of the operating models during the testing of the MP.

If the ESC concludes that there is no or insufficient evidence for exceptional circumstances, the ESC will:

- Report to the Extended Commission that exceptional circumstances do not exist.

If the ESC has agreed that exceptional circumstances exist, the ESC will:

- Determine the severity of the exceptional circumstances; and
- Follow the "Process for Action".

Process for Action

Having determined that there is evidence of exceptional circumstances, the ESC will in the same year:

- Consider the severity of the exceptional circumstances (for example, how severely "out of bounds" is the CPUE or recruitment);
- Follow the Principles for Action (see below);
- Formulate advice on the action required (for example, there may be occasions, if there appears to be 'exceptional circumstances', but the severity is deemed to be low, when the advice is not for an immediate change in TAC, but rather a trigger for a review of the MP or collection of ancillary data to be reviewed at the next ESC); and
- Report to the Extended Commission that exceptional circumstances exist and provide advice on the action to take.

The Extended Commission will:

- Consider the advice from the ESC; and
- Decide on the action to take.

Principles for Action

If the risk is to the stock, principles may be:

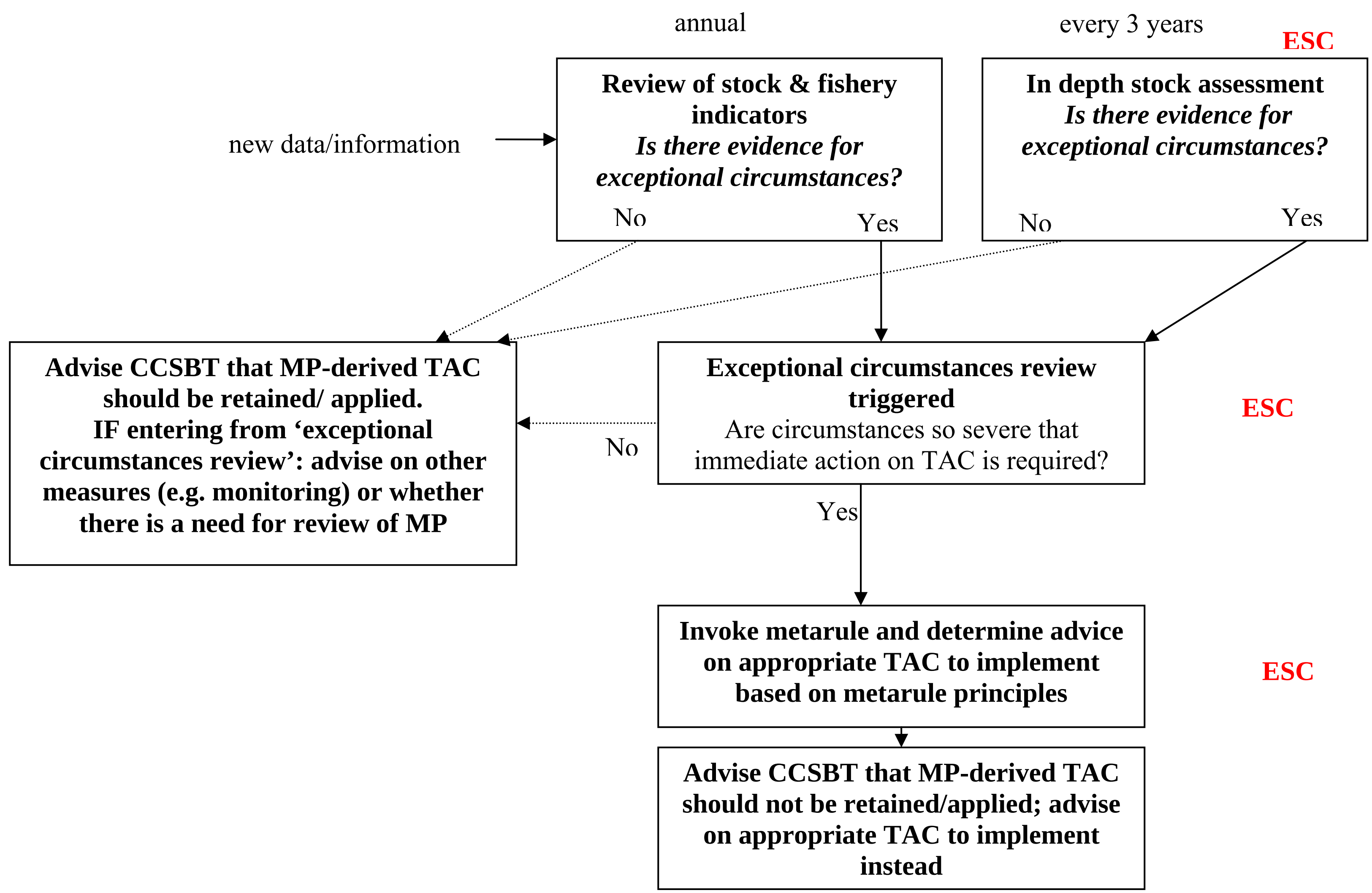
a) The MP-derived TAC should be an upper bound;
b) Action should be at least an x% change to the TAC, depending on severity.

If the risk is to the fishery, principles may be:

a) The MP-derived TAC could be a minimum;
b) Action should be at least an x% change to the TAC, depending on severity.

An urgent updated assessment and review of indicators will take place, with projections from that assessment providing the basis to select the value of the x% referred to above.

Figure 1: Flowchart for Metarules process



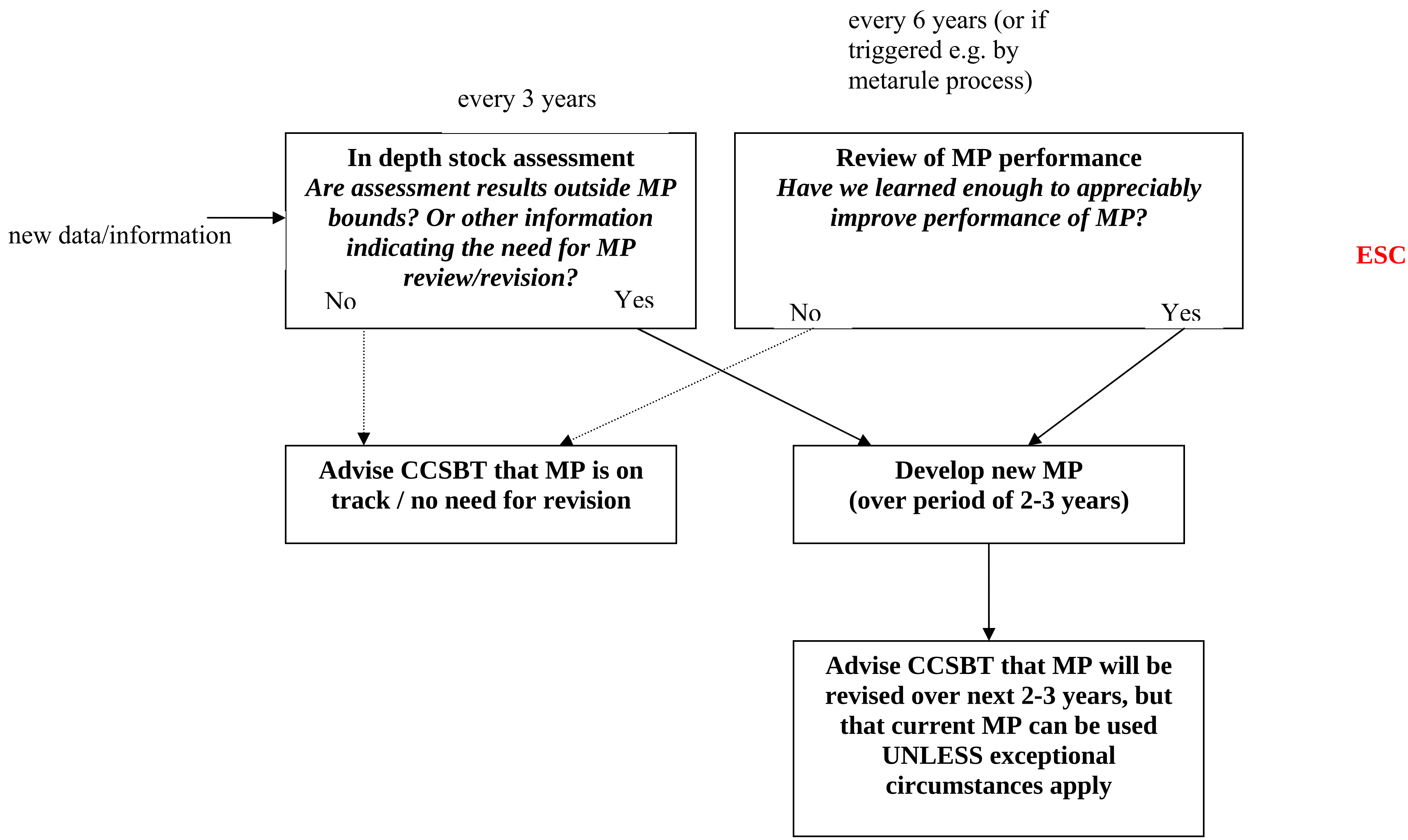

every 3 years
every 6 years (or if triggered e.g. by metarule process)
new data/information
In depth stock assessment
Are assessment results outside MP bounds? Or other information indicating the need for MP review/revision?
No
Yes
Review of MP performance
Have we learned enough to appreciably improve performance of MP?
No
Yes
ESC
Advise CCSBT that MP is on track / no need for revision
Develop new MP (over period of 2-3 years)
Advise CCSBT that MP will be revised over next 2-3 years, but that current MP can be used UNLESS exceptional circumstances apply

Table of Proposed activities under the SRP

Item	Preliminary ESC Priority	Informs
Characterization of catch		
Future		
Catch amount	Essential	H, SSB
Size structure	Essential	H, SSB, R
Age	High	H, SSB, R
Australian SV	High	H,, R
CPUE interpretation		
SAPUE	Medium	SSB, R
Monitoring/Research sets - longline surveys	Medium	SSB, R
Commercial gear- all fleets	High	SSB, R
CPUE other longline fleets	Med	SSB, R
Spawning biomass index		
Indonesian C&E	High	SSB, M, F
Close kin	High	SSB, M, F
Otolith microchemistry	High	Assumptions for close kin; stock structure
Scientific observer program		
	High	SSB, R, F
SBT tagging		
Conventional tagging	Low	F, M, R, SSB
Genetic tagging	High	F, M, R, SSB
Electronic tagging	Medium	Movement, stock structure, assumptions for close kin
Recruitment monitoring		
Scientific Aerial survey	Essential	R
Piston line	Medium	R
Direct ageing		
Sample collection/ageing	High	SSB
Analysis for stock assessment	High	SSB
MP implementation		
	High	H
OM development		
New data in OM (2013)	High	SSB, R, F, M, H
Reconditioning of OM (2014)	High	SSB, R, F, M, H

SSB= Spawning stock biomass

R=Recruitment

F=Fishing mortality

M=Natural mortality

H=harvestable amount/rate

Attachment 9

Data Exchange Requirements for 2013

Introduction

Data exchange requirements for 2013 are provided in Annex A. The Annex shows the data that are to be provided during 2013 and the dates and responsibilities for the data provision.

Catch effort and size data should be provided in the identical format as were provided in 2012. If the format of the data provided by a member is changed, then the new format and some test data in that format should be provided to the Secretariat by 31 January 2013 to allow development of the necessary data loading routines.

Data listed in Annex A should be provided for the complete 2012 calendar year plus any other year for which the data have changed. If changes to historic data are more than a routine update of the 2011 data or very minor corrections to older data, then the changed data will not be used until discussed at the next SAG/ESC meeting (unless there was specific agreement to the contrary). Changes to past data (apart from a routine update of 2011 data) must be accompanied by a detailed description of the changes.

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
CCSBT Data CD	Secretariat	31 Jan 13	An update of the data (catch effort, catch at size, raised catch and tag-recapture) on the data CD to incorporate data provided in the 2012 data exchange and any additional data received since that time, including: • Tag/recapture data (*The Secretariat will provided additional updates of the tag-recapture data during 2012 on request from individual members*); • Update the unreported catch estimates using the revised scenario (S1L1) produced at SAG9,
New Zealand joint venture summary of observed trips	New Zealand	23Apr 13	New Zealand to provide the secretariat with a summary of observed trips, by vesselID, for New Zealand joint venture vessels. *<u>Secretariat Comment</u>: These data are required so that the Secretariat can provide NZ with a summary of Observed catch and effort data , which is required for NZ preparation of joint venture shot by shot data.*
Total catch by Fleet	all Members and Cooperating Non-Members (excluding Indonesia – which is specified later)	30 Apr 13	Raised total catch (weight and number) and number of boats fishing by fleet and gear. These data need to be provided for both the calendar year and the quota year.
Recreational catch	all Members and Cooperating Non-Members that have recreational catches	30 April 13	Raised total catch (weight and number) of any recreationally caught SBT if data are available. A complete historic time series of recreation catch estimates should be provided (unless this has previously been provided). Where there is uncertainty in the recreational catch estimates, a description or estimate of the uncertainty should be provided.
SBT import statistics	Japan	30 Apr 13	Weight of SBT imported into Japan by country, fresh/frozen and month. These import statistics are used in estimating the catches of non-member countries.
Mortality allowance (RMA and SRP) usage	all Members (& Secretariat)	30 Apr 13	The mortality allowance (kilograms) that was used in the 2012 calendar year. Data is to be separated by RMA and SRP mortality allowance. If possible, data should also be separated by month and location.
Catch and Effort	all Members (& Secretariat)	23 Apr 13 (New Zealand)[2] 30 Apr 13 (other members, South Africa & Secretariat) 31 July 13 (Indonesia)	Catch (in numbers and weight) and effort data is to be provided as either shot by shot or as aggregated data (New Zealand provides fine scale shot by shot data which is aggregated and distributed by the Secretariat). The maximum level of aggregation is by year, month, fleet, gear, and 5x5 degree (longline fishery) or 1x1 degree for surface fishery. Indonesia will provide estimates based on either shot by shot or as aggregated data from the trial Scientific Observer Program.

[1] The text "**<u>For MP/OM</u>**" means that this data is used for both the Management Procedure and the Operating Model. If only one of these items appears (e.g. **<u>For OM</u>**), then the data is only required for the specified item.

[2] The earlier date specified for New Zealand is so that the Secretariat will be able to process the fine scale New Zealand data in time to provide aggregated and raised data to members by 30 April.

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
Non-retained catches	All Members	30 Apr 13 (most Members) 31 July 13 (Indonesia)	The following data concerning non retained catches will be provided by year, month, and 5*5 degree for each fishery: • Number of SBT reported (or observed) as being non-retained; • Raised number of non-retained SBT taking into consideration vessels and periods in which there was no reporting of non-retained SBT; • Estimated size frequency of non-retained SBT after raising; • Details of the fate and/or life status of non-retained fish. Indonesia will provide estimates based on either shot by shot or as aggregated data from the trial Scientific Observer Program.
RTMP catch and effort data	Japan	30 Apr 13	The catch and effort data from the real time monitoring program should be provided in the same format as the standard logbook data is provided.
NZ joint venture catch and effort data at 1*1 spatial resolution	Secretariat	30 Apr 13	Aggregated New Zealand catch and effort data, to 1*1 degrees of resolution instead of 5*5 degrees. The Secretariat will produce and provide these data to Japan only for use in the $W_{0.5}$ and $W_{0.8}$ CPUE indices produced by Japan. *Other members may request approval from New Zealand to be provided with access to these data for necessary analyses.*
NZ joint venture catch and effort with Observers	Secretariat	27 Apr 13	A summary of NZ joint venture catch and effort data, to be provided to New Zealand only, specifying which shots had an observer on board. Secretariat Comment: *These data are required so that New Zealand can provide shot by shot data for the NZ joint venture to Japan.*
New Zealand joint venture shot by shot data	New Zealand	30 Apr 13	Shot by shot data for New Zealand joint venture vessels in statistical areas 5 and 6 for 2012. These data should specify which shots had an observer on board. These data are only being provided to Japan and are for use in the new CPUE index.
Raised catch data for AU, NZ and KR catches	Australia, Secretariat	30 Apr 13	Aggregated raised catch data should be provided at a similar resolution as the catch and effort data. Japan and Taiwan do not need to provide anything here because they provide raised catch and effort data. New Zealand does not need to provide anything here because the Secretariat produces New Zealand's raised catch data from the fine scale data provided by New Zealand. Similarly, the Secretariat will be calculating and providing the raised catch data for Korea (based on raising Korea's catch effort data to its total catch).

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
Observer length frequency data	New Zealand	30 Apr 13	Raw observer length frequency data as provided in previous years.
Raised Length Data	Australia, Taiwan, Japan, New Zealand	30 Apr 13 (Australia, Taiwan, Japan) 7 May 13 (New Zealand)[3]	Raised length composition data should be provided[4] at an aggregation of year, month, fleet, gear, and 5x5 degree for longline and 1x1 degree for other fisheries. Data should be provided in the finest possible size classes (1 cm). A template showing the required information is provided in Attachment C of CCSBT-ESC/0609/08.
Raw Length Frequencies	South Africa	30 Apr 13	Raw Length Frequency data from the South African Observer Program.
RTMP Length data	Japan	30 Apr 13	The length data from the real time monitoring program should be provided in the same format as the standard length data is provided.
Raw Size Data	Korea	30 Apr 13	Raw length/weight measurement data should be provided by Korea instead of raised length data because Korea does not yet have a suitable sample size to produce raised length data. *However, Korea is encouraged to improve its sample sizes of length frequency data in the future.*
Indonesian LL SBT age and size composition	Australia Indonesia	30 Apr 13	Estimates of both the age and size composition (in percent) is to be generated for the spawning season July 2011 to June 2012. Length frequency for the 2011 calendar year and age frequency for the 2011 calendar year is also to be provided. Indonesia will provide size composition in length and weight based on the Port-based Tuna Monitoring Program. Australia and Indonesia in collaboration, will provide age composition data according to current data exchange protocols.
Direct ageing data	All Members	30 Apr 13	Updated direct age estimates (and in some cases revised series due to a need to re-interpret the otoliths) from otolith collections. Data must be provided for at least the 2006 calendar year (see paragraph 95 of the 2003 ESC report). Members will provide more recent data if these are available. The format for each otolith is: Flag, Year, Month, Gear Code, Lat, Long, Location Resolution Code[5], Stat Area, Length, Otolith ID, Age estimate, Age Readability Code[6], Sex Code, Comments.
Trolling survey index	Japan	30 Apr 13	Estimates of the different trolling indices for the 2012/13 season (ending 2013), including any estimates of uncertainty (e.g. CV).
Tag return summary data	Secretariat	30 Apr 13	Updated summary of the number tagged and recaptured per month and season.
Catch at age data	Australia, Taiwan, Japan, Secretariat	14 May 13	Catch at age (from catch at size) data by fleet, 5*5 degree, and month to be provided by each member for their longline fisheries. The Secretariat will produce the catch at age for New Zealand using the same routines it uses for the CPUE input data and the catch at age for the MP.

[3] The additional week provided for New Zealand is because New Zealand requires the raised catch data that the Secretariat is scheduled to provide on 30 April.
[4] The data should be prepared using the agreed CCSBT substitution principles where practicable. It is important that the complete method used for preparing the raised length data be fully documented.
[5] M1=1 minute, D1=1 degree, D5=5 degree.
[6] Scales (0-5) of readability and confidence for otolith sections as defined in the CCSBT age determination manual.

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
Total Indonesian catch by month and % of Indonesian LL catch that is SBT	Indonesia	15 May 13	The 2012 catch of SBT in numbers and weight and the number of vessels fishing for SBT for each port and month. Also the 2012 total catch by weight of each species.
Global SBT catch by flag and by gear	Secretariat	22 May 13	Global SBT catch by flag and gear as provided in recent reports of the Scientific Committee.
Raised catch-at-age for the Australia surface fishery **For OM**	Australia	24 May 13[7]	These data will be provided for July 2011 to June 2012 in the same format as previously provided.
Raised catch-at-age for Indonesia spawning ground fisheries. **For OM**	Secretariat	24 May 13	These data will be provided for July 2011 to June 2012 in the same format as on the CCSBT Data CD.
Total catch per fishery each year from 1952 to 2012. **For MP/OM**	Secretariat	31 May 13	The Secretariat will use the various data sets provided above together with previously agreed calculation methods to produce the necessary total catch by fishery data required by both the Management Procedure and the Operating Model.
Catch-at-length (2 cm bins) and catch-at-age proportions **for OM**	Secretariat	31 May 13	The Secretariat will use the various catch at length and catch at age data sets provided above to produce the necessary length and age proportion data required by the operating model (for LL1, LL2, LL3, LL4 – separated by Japan and Indonesia, and the surface fishery). The Secretariat will also provide these catch at length data subdivided by sub fishery (e.g. the fisheries within LL1).
Catch at Age **for MP**	Secretariat	31 May 13	Cohort slicing by month of the 5*5 raised length data provided by members. The data used is the data for LL1 fisheries only. For LL1 fisheries where raised length data are not available (i.e. Korea, Philippines, Miscellaneous), the Secretariat will use Japanese length frequency data as a substitute in the same manner as conducted when producing the length frequency inputs for the operating model.
Global catch at age	Secretariat	31 May 13	Calculate the total catch-at-age in 2012 according to Attachment 7 of the MPWS4 report except that catch-at-age for Japan in areas 1 & 2 (LL4 and LL3) is to be prepared by fishing season instead of calendar year to better match the inputs to the operating model.
CPUE input data	Secretariat	31 May 13	Catch (number of SBT and number of SBT in each age class from 0-20+ using proportional aging) and effort (sets and hooks) data[8] by year, month, and 5*5 lat/long for use in CPUE analysis.
Tag releases / recoveries and reporting rates. **For OM**	Australia	31 May 13	The RMP tag/recapture data for the period 1991-1997 will be updated for any changed/new data in the database.

[7] The date is set 1 week before 31 May to provide sufficient time for the Secretariat to incorporate these data in the data set it provides for the OM on 31 May.
[8] Data restricted to months April to September, SBT statistical areas 4-9, and the Japanese, Australian joint venture and New Zealand joint venture fleets.

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
CPUE series.	Australia / Japan	15 Jun 13 (earlier if possible)[9]	5 CPUE series are to be provided for ages 4+, as specified below: • Nominal (Australia) • Laslett Core Area (Australia) • B-Ratio proxy (W0.5) (Japan) • Geostat proxy (W0.8) (Japan) • ST Windows (Japan) • The number of 1*1 degree fished squares in each 5*5 degree square. These data will be accessed only by the Secretariat[10]. (Japan) The operating model uses the median of these series.
Core Vessel CPUE Series **For OM**	Japan	15 Jun 13	Provide the Core Vessel CPUE series for use in the OM and MP
Aerial survey index	Australia	31 Jul 13 (every attempt will be made to provide this at least 4 weeks earlier)	Estimate of the aerial survey index from the 2012/13 fishing season, including any estimates of uncertainty (e.g. CV).
Commercial spotting index	Australia	31 Jul 13	Estimate of the commercial spotting index from the 2012/13 season, including any estimates of uncertainty (e.g. CV).

[9] When there are no complications, it is possible to calculate the CPUE series less than two weeks after the CPUE input data is provided. Therefore, if there are no complications, Members should attempt to provide the CPUE series earlier than 15 June.

[10] These data will be temporarily accessed, under Japan's supervision, by the Secretariat to allow the Secretariat to verify calculation of the ST Windows CPUE series.

Attachment 10

High-level Code of practice for Scientific Data Verification

Introduction

The code of practice is intended to function as both a target and a guide to Members and Cooperating Non-Members (CNMs) on the procedures that should be in place for the verification of data. It is not intended to specify the types of data collection and monitoring systems that should be in place; instead, it provides information on the type of data management systems, and the types of verification/cross checking that are expected.

REPORTING ON SCIENTIFIC DATA VERIFICATION

To provide greatest understanding of the data, together with transparency and confidence in the data, all Members and CNMs are encouraged to report annually to the Extended Scientific Committee on the data verification conducted in accordance with this code of practice, together with the results of comparisons and the outcomes of any investigations into the data.

DATA MANAGEMENT SYSTEMS

It is expected that all scientific datasets maintained for CCSBT purposes would be managed using a robust database management system (e.g. SQL Server, Oracle), and preferably using a relational model. The database(s) should be professionally designed and implemented, and be accompanied by up-to-date documentation. Where a Member’s datasets reside on different physical databases, systems should be in place to allow easy cross-checking and verification between the physically separated datasets.

Automatic checking should be conducted at the time of data entry/loading to prevent erroneous data being stored on the database(s). Automatic checks should include:

- Validity checks: These are checks or constraints on individual fields to ensure that the data is valid. They include checks on the format of the data (e.g. that a valid date is provided); the validity of codes (e.g. that a valid species code or statistical area is provided); the magnitude of a value (e.g. that a weight is within an acceptable range, and a date is not in the future etc.). A variety of validity checks should exist on nearly all fields within the database.
- Plausibility checks: These are checks to identify items that are unlikely, but not impossible. These checks will often be range checks such as: very small or large weights/numbers/hooks; small or large average weights for a species etc. As a minimum, when these checks reveal an unlikely item, the operator should check the data to ensure that a data entry error has not been made. Checks of this nature should be implemented for all relevant fields (most numeric and date fields) and the checks should be finetuned for the specific data (e.g. the actual species and gear) involved.

Checks of these types, when implemented at the database level as specified, significantly reduce the risk of erroneous data being stored.

CROSS-VERIFICATION OF DATASETS

The main data that Members and CNMs currently provide to the CCSBT for scientific purposes comprise: Total SBT catches, Catch and Effort, and Catch at Size/Age data. The CCSBT has also adopted a Catch Documentation Scheme to confirm catches of Members and CNMs, as well as Scientific Observer Program Standards with a target observer coverage of 10% for catch and effort monitoring for each fishery. Furthermore, different Members/CNMs have additional programs (such as real-time monitoring, landing inspections, and quota monitoring systems) in place to monitor and manage their catches.

An important component of this code of practice is that each scientific dataset be cross-verified against other, independent data sets wherever possible and that this cross-verification be conducted for each scientific dataset on an annual basis. The cross-checking recommended for each scientific dataset is as follows:

Total Annual SBT Catches

Members/CNMs report total annual SBT catches to the CCSBT as part of the "Total Catch by Fleet" data provided for the annual Scientific Data Exchange, in national reports to the Extended Scientific Committee and Extended Commission, and as part of the Final Catch by Vessel/Client reporting requirements. All these reports should be cross checked to ensure that the figures are the same. In addition, the following verification(s) should be conducted:

- The nationally reported annual SBT catches should be compared on a gear by gear basis with the annual catch estimated from CCSBT CDS documents for the same years[1]. It is expected that the nationally reported catch should closely match the CDS figures. Discrepancies of greater than +/- 5% should be explained. If a clear explanation is not readily available, discrepancies of greater than +/- 5% should be investigated[2].
- The nationally reported annual SBT catches should be verified against any other independent nationally available total catch data sets such as quota monitoring system or landing inspections.

Commercial Catch and Effort data

Catch and Effort data is provided to the CCSBT Secretariat annually as a part of the Scientific Data Exchange. These figures should be verified where possible in the following ways:

- Commercial Catch and Effort data for observed trips should be crossed-checked against the observer's data for the same parts of the same trips. Any discrepancies should be investigated.
- Commercial Catch and Effort data for non-observed shots should be compared with data for observed shots. Any substantial inconsistencies in the temporal or spatial CPUE

[1] The Secretariat can provide Members with CDS figures for their documents on request. However, there is a time lag in provision of CDS data such that figures for the most recent year may not always be complete.

[2] A technical working group at CCSBT 12 recommended that the principles for a CCSBT CDS should include a performance measure that the CDS be capable of accounting for at least 95% of all sources of fishing mortality of southern bluefin tuna (paragraph 90 of the CCSBT 12 report)

estimates or trends, or relative proportions of bycatch for the two datasets should be investigated.

- The weights of SBT from the unraised[3] Catch and Effort data should be compared with:
    - Total Annual SBT Catches: Any substantial discrepancies[4] (including differing trends in total catches between the two data sources between years) should be investigated.
    - CDS harvest data, stratified by statistical area and month[1]: Again, any substantial discrepancies should be investigated.

Catch at Size data

Catch at Size data are provided to the CCSBT Secretariat annually as a part of the Scientific Data Exchange. For those Members/CNMs whose Catch at Size data is collected independently of CDS Catch Tagging Forms, a spatio-temporally stratified comparison should be made of the catch at size distributions of the two data sets[5]. Any substantial inconsistencies should be investigated.

[3] Some Members raise their catch and effort data to match that of the total catch before providing that data to the CCSBT.
[4] After adjusting for the Catch Effort reporting rate (e.g. log books not being provided for a certain percentage of fishing).
[5] This is not possible for farmed product as the CDS length data is for grown out SBT.

Attachment 11

Technical Elements of the 2013 Workplan

A small working group met during ESC 17 to discuss developments leading to OM and assessment model revisions (for the full stock assessment anticipated to be conducted in 2014).

They focused on work that could be classified as pertaining to data and to model development/analysis in preparation for next year's technical workshop and ESC.

The group developed a list of issues that need to be addressed and noted if they could be handled at the technical workshop (TWS) and/or the 2013 ESC:

- Updates on data already in OM (prior to TWS)
- Close-kin data—to use SVN (version control software) (prior to TWS)
  - Evaluate uncertainty with respect to OM specification as a term of reference (over grid cells)
- Direct ageing (TWS)
  - Surface: work has been completed; include it but critical to evaluate with respect to 40 fish sample (TWS)
  - Longline: extent of data and coverage may be insufficient
- Length frequency data (substitution methods etc.)
  - Secretariat to provide definition. (Future)
- SAPUE
  - Possible with appropriate process-error specifications within OM *Issue for years when scientific survey was unavailable* (TWS/SC)
- Alternative CPUE indices
  - Indonesian (ESC)
  - Additional (ESC)
- Recent tagging data
  - Would require spatial considerations (Future)
- Catch estimates including:
  - Discard mortality (survival from released fish) (Future)
  - Recreational component (Future)

Based on these discussions, the group established the following terms of reference for the TWS:

1) Evaluate alternative approaches of for applying close-kin (CK) data for stock assessment purposes
   a. Include sensitivity to assumptions of models (for those outside of OM).
2) Examine the impact of using the CK data within the OM to evaluate consistency with other information and model assumptions.
3) Evaluate grid structure and associated uncertainty given new CK information
   a. E.g., the impact of spawning stock definitions, selectivity, etc. and influence on MPD, and evaluate the within-grid cell uncertainty (perhaps using Hessian approximations).
   b. Weighting schemes for key parameters (i.e., grid axes).
4) Refine version control and MP code for ESC implementation.