Commission for the Conservation of
Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of the Sixteenth Meeting of the Scientific Committee

19 – 28 July 2011
Bali, Indonesia

Provisional Agenda

Sixteenth Meeting of the Scientific Committee

19 – 28 July 2011

Bali, Indonesia

Agenda Item 1. Opening of meeting

1. The independent Chair, Dr Annala, declared the Scientific Committee meeting open and welcomed all participants.
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 Sixteenth 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 5:42 pm, on 28 July 2011.

List of Appendices

Appendix

1 List of Participants

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

Appendix 1

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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 Sixteenth Meeting of the Scientific Committee

19 – 28 July 2011

Bali, Indonesia

Report of the Extended Scientific Committee for

the Sixteenth Meeting of the Scientific Committee

19 – 28 July 2011

Bali, Indonesia

Agenda Item 1. Opening

1. Dr John Annala opened the meeting and welcomed participants. He extended his appreciation to Indonesia for hosting the meeting and for Indonesia's assistance with meeting preparations.

1.1 Introduction of Participants

2. Participants introduced themselves. The list of participants is shown in **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 relating to agenda items 5 to 11 inclusive.

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. Australia presented paper CCSBT-ESC/1107/SBT Fisheries-Australia. The paper summarises catches and fishing activities in the Australian SBT Fishery up to and including Year 1 of the 2009–11 season (December 2009 – November 2010) and some preliminary results for Year 2 of the 2009–11 season (December 2010 – November 2011). A total of 23 commercial fishing vessels landed SBT in Australian waters in the first year of the 2009–11 season for a total catch of 4199 t; 96.0% of the catch was taken by purse seine with the remainder taken by longline. Seven purse seiners fished off South Australia for farm operations. Purse seine fishing commenced in early December 2009 and finished in late

February 2010. In the second year of the 2009–11 fishing season observers monitored 20.2% of purse seine sets where fish were retained and 12.4% of the estimated SBT catch.

9. Taiwan presented paper CCSBT-ESC/1107/SBT Fisheries-Taiwan. In 2010, Taiwan's annual catch of SBT was 1,140 t for the quota year and 1,208 t for the calendar year according to reported landed weights. Taiwan's SBT quota for the 2010 and 2011 fishing season was set at 1,718 t, therefore, the remaining quota is 578 t for the 2011 fishing season. There were 82 vessels fishing for SBT, with 65 seasonal target, and 17 by-catch vessels in 2010 fishing season. The number of vessels increased by 15 vessels from 2009. Because of the impact of Somalian piracy, some vessels operating in the tropical Indian Ocean shifted to the Southern Indian Ocean to fish for temperate tuna and tuna-like species. In 2010, 7 observers were deployed on 11 seasonal target vessels. The observer coverage by vessels was about 16.67%, 11.95% by hooks and 8.35% by catch in 2010.

10. Indonesia presented paper CCSBT–ESC/1107/SBT Fisheries – Indonesia. The number of registered tuna longliners in the port of Benoa (Bali) that mainly target tuna was 737. The longline fishing boats vary in size from 30-200 GT. More than 90% of Indonesia's catch of SBT is landed in the port of Benoa. The report based on CDS Reports and 2 fishing ports, i.e: Pelabuhan and Cilacap shows that the catch in 2010 from this SBT fishery was 468 t. The result of estimation on the basis of data from catch monitoring, however, shows that the national SBT catch could be up to 566 t. Monitoring of fish size landed in Benoa revealed that the mean size of SBT landed steadily decreased from 182 cm FL in the 1990's to 168 cm FL in 2010. The nominal CPUE shows higher catch rates in the temperate regions. The maximum SBT hook rates (1-2 fish per 1000 hooks) occurred within 2 squares between 25°-35°S and 100°-105°E. The highest landings of SBT generally occurred during the months of December to February. The average hook rate was 0.1 per 1000 hooks with a decreasing trend through the year. Higher hook rates of SBT occurred during October, November, February and March (0.1-0.3 per 1000 hooks), lower hook rates occurred during May, June and July (0-0.005 per 1000 hooks). In 2011 a new research institute for tuna fisheries was formally established in Benoa, called the Research Institute for Tuna Fisheries (RITF).

11. Japan presented paper CCSBT-ESC/1107/SBT Fisheries/Japan. The number of Japanese longline vessels targeting SBT has decreased yearly. In the 2010 fishing year, 84 longline vessels caught 2083 t SBT (86 vessels caught 2223 t in the calendar year). Nominal CPUEs in 2010 were at higher levels than in the recent past especially in the major CCSBT statistical Areas (Areas 4, 7, 8, and 9). Japanese longline vessels caught small and middle sized SBT (110-130 cm FL) in Areas 4, 7, and 9, while smaller fish (mode of around 120 cm FL) and larger fish (140-180 cm FL) were caught in CCSBT Area 8. Japanese fishers reported the release and discard of SBT from longline vessels in the Real Time Monitoring Program (RTMP); 9811 individuals in 2009 fishing season, and 4244 individuals in 2010 fishing season. Details of release activity were summarised in CCSBT-ESC/1107/32. Japan sent scientific observers to 11 authorised Japanese longline vessels in 2010. However, only eight of them operated in the SBT fishing grounds while the observer was onboard. Observer coverage was 9.6% in terms of the number of vessels, 6.5% in terms of the number of SBT caught, and 7.2% in terms of the number of hooks used. Observer activity is detailed in

CCSBT-ESC/1107/23. Observers retrieved four conventional tags (from four individuals).

12. New Zealand presented paper CCSBT-ESC/1107/SBT Fisheries-New Zealand, which describes the New Zealand SBT fishery for 2010 and the 2009/10 fishing year. The total available catch to the New Zealand commercial fishery in the 2009/10 fishing year, which runs from 1 October to 30 September, was 558 t; landings were 500 t for this period. In addition, New Zealand made allowances for non-commercial fishers (9 t) and other sources of fishing-related mortality (3 t) as part of its allocation. The estimate of non-commercial SBT catch as bycatch from the Pacific bluefin tuna game fishery was less than 1 t in 2010. From scaled observer data, it is estimated that 25 dead SBT were discarded from the domestic fleet and three from the charter fleet during the 2009/10 season, for an estimated weight of 2 t. CPUE in 2009/10 was similar to that observed in 2008/09 for the domestic fishery but increased markedly for the charter fleet, which largely fishes the west coast of the South Island (CCSBT Area 6). The catch rate data reflect the increased abundance of small fish, particularly ages 4, 5, and 6. All four charter vessels were covered by observers in 2009/10. Coverage by the observers was 84% of catch (numbers) and 80% of effort (hooks). For the domestic fishery in 2009/10 coverage was 7% of both catch and effort.

13. Korea presented paper CCSBT-ESC/1107/SBT Fisheries-Korea and SBT fishery information for 2010 and earlier years. In the 2010 fishing year, nine large longliners caught 869.1 t (867.4 t in calendar year) of its national catch limit of 876.4 t. It noted that the active vessel numbers reduced from 19 in 2009 to 9 in 2010 so as to be matched with the reduced national TAC. The CPUE was 3.23 /1000 hooks in 2010, which is stable at a higher level than the average of the last 10 years, except for 2004 and 2005 when the CPUE was affected by economic or operational causes. It was shown in the map of CPUEs that there were low or no distribution of CPUEs at those times in Areas 9, 8 and 2, despite national catch limits from Korea's accession to the CCSBT and the normal fishing pattern of Korean longline vessels having operated in Area 9 from April to July or August and in Areas 8 and 2 from August to December. The size of SBT caught by Korean longliners ranged 86-196 cm (FL) with a main mode of 110-132 cm (FL) and a secondary mode of 150-180 cm (FL). Finally, Korea reported the results of its scientific observer program conducted in 2010. The observer coverage was 12.7 % in hook numbers. Two scientific observers carried out collection of fisheries data, biological data and samples for target and non target, including ERS, in conformity with the CCSBT's measures.

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

- Japan advised that:
  - There was a reduction in the number of discards of approximately 50% in 2010 compared to 2009, and that this might be due in part to the reduction in the number of smaller fish being caught, along with an increase in price for smaller fish.
  - It is currently working with industry to revise the Observer program, so that observers can be deployed to Area 7 where there has been an appreciable increase in CPUE, but with minimal Observer coverage.

- Australia advised that:
  - Responsibility for management and monitoring of recreational catch was with the individual Australian States, and that it was currently working on development of methodologies to collect this information. Australia further advised that this would be an ongoing process and would take some time due to the complexities involved.
  - It is reasonable to consider that SBT from 11 aborted purse seine sets survived after release, as they were released in their natural habitats and no mortalities were observed.

15. Australia noted that there were discrepancies between observed and reported Japanese longline release/discard rates (CCSBT-ESC/1107/32) and emphasized the need to continue to improve observer coverage to be representative of fishing activities.

16. Japan responded that the proportion of fish released varies not only with season and area, but also as a result of large differences in release strategies from vessel to vessel. Even if observer coverage is increased the discrepancies noted by Australia would continue to occur for these reasons.

17. Some Members expressed concern that discards were still not being reported by certain Members, and requested that these be included in future National Reports.

18. Some Members requested Australia to report all tagging information and to submit the data for their domestic recreational fishing. The data would be useful for SBT stock assessment and CCSBT Members should ensure that the Secretariat is informed of all tagging programs to improve tag reporting processes.

4.2 Secretariat Review of Catches

19. The Secretariat presented paper CCSBT-ESC/1107/04. The 2010 catch of Taiwan was revised, after it advised that the actual catch was slightly lower than initially reported due to the differences between weight measured on board the vessel and landed weight. Indonesia also provided a revision of its 2010 catch, to include data from artisanal fisheries. With the revisions, the reported SBT catch for the 2010 calendar year was 9,547 t, excluding the unreported catch scenarios. The global SBT reported catch by flag is shown at **Attachment 4**. The unreported catch and surface fishery bias estimate scenarios have not been included in **Attachment 4**, and the Secretariat advised that Attachment A of CCSBT-ESC/1107/04 should remain confidential due to the unreported catch and surface fishery bias scenarios contained in that Attachment.

Agenda Item 5. Report on intersessional scientific activities

20. Australia presented paper CCSBT-ESC/1107/22 outlining a new approach to analyse market data. At its annual meeting in October 2010, the Compliance Committee noted that the expansion of markets for SBT posed a risk to CCSBT management measures, including decisions on the global total allowable catch (TAC) and the effectiveness of the catch documentation scheme (CDS). It was

agreed that members, particularly Japan and Australia, would work intersessionally to develop methods of market analyses based on CDS data, trade data and public data from the markets. The overarching objective of this proposal is to provide an indication of whether significant breaches of national allocations are occurring, and whether trade by non-members is indicative of fishing by non-members. This paper outlines an approach to achieving this objective and the information for the analyses currently available, as well as the advantages and disadvantages of each data source. Australia will be seeking endorsement of this proposal and the associated analyses at the 2011 meeting of the Compliance Committee.

21. Japan presented paper CCSBT-ESC/1107/24. This paper summarised Japanese tag and recapture activity in the 2010 season. A total of 34 SBT (mainly age-1 fish) were tagged with two CCSBT conventional tags and an archival tag for each individual during the trolling survey in January-February 2011. In addition, 12 pop-up archival tags were deployed on immature SBT from longline vessels by the scientific observers. Recaptures for conventional tags have decreased due to the end of the CCSBT tagging program. 19 individuals with conventional tags were recovered between August 2010 and May 2011 (26 CCSBT tags from 17 individuals, and two CSIRO tags from two individual). Over the past 10 years, Japan has released 401 archival tags on large SBT from offshore regions by Japanese longline vessels and 268 archival tags on juvenile SBT from the south coast of Western Australia. To date, 21 tags from offshore releases have been recaptured.

22. Australia asked Japan about their experience using the new ‘mini PAT’ tags. Japan responded that the mini PATs and the ‘x-tags’ also used were the same size, which suited the study. However, in terms of reliability of the tags there was room for improvement. Japan also commented they are planning to analyse the tracks of the tags but had not yet had the opportunity to do so.

23. In CCSBT-ESC/1107/25, Japan reported that otoliths were collected from 315 individual SBT in 2010. Ages were estimated in 2010 for 369 individual SBT which were caught between 2006 and 2009 with an age range of 2 to 28, and the data were submitted to the Secretariat in the CCSBT data exchange process.

24. Following this paper, it was noted that considerable effort had been expressed in the collection and ageing of fish from otoliths by a number of Members. Now that a useful time series had been established, the use of direct ageing in the OM should be considered. It was further noted that methods had been developed to formally combine size at age data with length data (CCSBT-ESC/0309/32).

25. Japan presented paper CCSBT-ESC/1107/26 on the age composition of Australian farmed SBT in 2010, which were estimated based on data on size at harvest. The paper presented age decompositions based on length frequencies estimated independently for each month and product type. The age composition was estimated as 3% for age 2, 28% for age 3, 48% for age 4 and 18% for age 5. The total catch of the Australian purse seine fisheries in the 2010 fishing season was estimated to be 5,663 t, assuming the growth rate during farming was the same as the SRP tag-recapture data. This figure is 44% larger than the reported Australian purse seine catch (3,931t). The paper noted that these differences relate to age composition, catch weight and growth rate analysis of wild stock so they have a large effect on stock assessment of SBT as well as the OM/MP. The

paper recommended urgent examination of the bias in the 40 fish sampling, which is used by Australia to calculate its reported purse seine catch, as well as analysis of the growth rate during the farming period. The paper also recommended analysis of the tag seeding data for growth during farming and CDS data for weight at harvest of all individuals to resolve this issue.

26. Australia reiterated the concerns it had raised at the 2010 ESC meeting that the approach has an inherent bias because 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 requested Japan provide the raw shipment data used in its analysis, including dates and sources of shipments, so they could better understand the results produced.

27. Australia has been working to improve their data reporting by conducting the commercial trial of stereo video in the farm sector. The outcomes of this trial will be reported at the 6th meeting of the Compliance Committee (October 2011).

28. Japan considered that sampling bias in their analysis was unlikely given the high level of sampling they had across individual farms and pontoons which would have captured variation in farming practices. They also commented that if there was an issue with confidentiality of the tag seeding data and CDS data, then Australia should undertake the analysis. Japan remarked that while it might be possible for a fish that is farmed to be twice the weight of a wild fish, it seemed unlikely that feeding practices would cause farmed fish to have twice the length increment. Finally, Japan noted that while they had high expectations of the stereo video trial, the implementation of stereo video would not resolve the issue for past years data. They advised they were unable to provide the raw data requested by Australia due to issues with confidentiality.

29. 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.

30. Japan presented CCSBT-ESC/1107/27, 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. Recent discrepancies between reported catch and estimated catch were small; therefore Japan concluded that, although there were some uncertainties in the results, there was no evidence for under/over-catch reporting by Japanese longline vessels.

31. Australia agreed that there were many uncertainties in this approach and flagged the potential of the new market analysis approach Australia is proposing. Australia also requested the raw data used in the analysis, including the non-auction data. Finally, Australia noted an over or under catch of 500 t was not insignificant as it was approximately 20% of Japan's quota.

32. Japan noted that its market monitoring is undertaken to confirm that its fisheries management system is effective, with the aim of eliminating the possibility of illegal catches being landed by its fleet. Japan considered the level of accuracy of its market monitoring was sufficient. Japan also noted that there were difficulties in provision of the raw data, as they include commercially confidential data, while also commenting that some of the Members had participated in the monitoring activities.

33. Japan advised that it was interested in the new market analysis Australia is proposing, but expressed concerns about statistics from sources outside of Japan where it may be difficult to have confidence in the data, for example if the fish were actually SBT, and noted that data quality would need to be monitored. Japan considered that its monitoring program could contribute to the new analysis proposed and advised that it intended to continue this program.

Agenda Item 6. Inputs to the assessment model and MP and indicator of stock-status

6.1 CPUE

34. Japan presented CCSBT-ESC/1107/31 which concerned changes in the operating pattern of Japanese SBT longliners in 2010 resulting from the introduction of the individual quota system in 2006. Compared to the 2001-2005 average, in 2010, there were decreases of 38% in vessel numbers, 23% in hooks used and 41% in SBT caught. There were changes in time and area fished, length/age composition of catch, number of five degree square areas fished and number of operations per five degree square areas. However, the introduction of the individual quota system was not considered to have caused a major change in the operating pattern.

35. In response to a question of whether the decrease in total hook number was due to a decrease in the number of hooks per operation, Japan commented that there was no change in the number of hooks per operation.

36. Australia asked for a clarification on the restrictions of fishing season that were in place previously in Japan and the rationale behind those restrictions. Japan responded that the fishing season had been restricted, after consultation with industry and fisheries managers, in order to maximize economic gain under the limited catch allocation.

37. Australia asked about the change in CPUE in Area 7 and if this was the result of fishers going to this area because they had done well there the previous year. Japan noted that Areas 4 and 7 were normally areas where many small sized SBT are caught. However, the CPUE and the number of vessels fishing in these areas are changing corresponding to the strength of recruitment in the areas.

38. Australia asked if fishers in Area 7 were coming from fishing tuna in the western and central Pacific Ocean or the Indian Ocean. Japan responded that the main

fishing ground in Area 7 was the Tasman Sea and the fishers there were likely coming from the Pacific Ocean.

39. The Advisory Panel asked if the results of compositions by area noted in CCSBT-ESC/1107/31 would be the same if only the core fleet data were analysed. Japan advised that the data were all RTMP data which included all vessels fishing for SBT, but they did not have information for when only the core fleet data are used. Further, in response to a question from Australia on the decline in the number of operations noted for Area 8, Japan commented that in 2010 all fishing operations in this area concluded in August, when there were many smaller fish around, and the quota was quickly filled.

40. The meeting also briefly discussed two possible scenarios on what could cause a systematic change in catchability. First, the consolidation of vessels in the Japanese longline fleet may have left only the more efficient vessels active, which could increase the catchability coefficient. However, with fewer vessels, the ability to search fishing grounds and share information would be reduced, which could decrease the catchability coefficient. Japan agreed that these scenarios could both impact CPUE but reiterated that the effect of these factors on CPUE was difficult to detect quantitatively from the catch data available.

41. Australia asked whether fishers targeted valuable large fish in the IQ system. Japan responded that while some vessels may pursue larger SBT, some may target smaller fish in order to use their IQ efficiently and as soon as possible in order to move on to other areas to fish for other tuna species.

42. Japan presented CCSBT-ESC/1107/30 which provides a summary of standardized CPUE for the SBT longline fishery that is used as input to the MP. The paper describes data preparation processes, model specifications and results from the base model and other models using GLM.

43. Noting the previous discussion about the two types of behaviour by fishers, Australia asked if it was appropriate to use aggregated data and suggested analyses using finer-scale shot-by-shot data may be more useful than the current analysis.

44. Japan responded that the current method of CPUE standardization had been developed at the CPUE workshop that examined shot-by-shot data, and the workshop confirmed that there was no substantial difference in the trend in the CPUE between the results using the aggregated data and those from the shot-by-shot data.

45. Paper CCSBT-ESC/1107/28 presents a summary of the fisheries indicators. Various indicators examined generally support a view that the current stock levels for the 3, 4, 5, 6 & 7 age groups are above those observed in the late 1980s, which are the historically lowest levels. When looking at recent years, CPUE indices for these age classes show increasing trends. Age classes 8-11 and 12+ tend to be stable after 2003 with some variability. Current levels for these age groups, however, are still low and similar to those observed in the recent past. Many indices indicate low recruitment of 1999, 2000, 2001, and 2002 cohorts. The indices for past acoustic survey suggested sequential low recruitments for these four years. The longline CPUE indices for age 3 in 2007, for age 4 in 2009, and for age 5 in 2009 and 2010 show large upturns. Whether these large positive

upturns reflected increased stock abundance and/or change of catchability is still unknown.

46. Paper CCSBT-ESC/1107/10 compares CPUE based abundance indices derived from the base model (SAG9) with indices based on a simpler model that excludes interaction terms involving Year. Compared with the base model, indices based on the simpler model exhibit considerably less increase over the past three years. A number of uncertainties in the current CPUE indices exist including the unknown effects of changes in Japanese longline (LL1) fisher behaviour following the introduction of individual quotas, release/discarding practices and the broad spatial and temporal level of aggregation of the data currently used. Uncertainty in CPUE as suggested by the recent divergence of alternative CPUE indices requires continued scrutiny as CPUE is a key input into the operating model. Further examination of finer scale shot-by-shot data is required to better understand CPUE trends.

47. The Advisory Panel asked why the Bayesian Information Criterion (BIC) and Akaike's Information Criterion (AIC) models yielded different results. Australia responded that AIC tends to select more complex models than BIC and that the discrepancy between the two models might be the result of modeling aggregated data.

48. In response to the question, whether the constant added to the CPUE had been tested to measure sensitivity to alternate values, Australia responded that alternate values for the constant were not tested, but it is generally accepted that a value that is too small can affect the CPUE model.

49. Australia thanked Japan for providing the aggregated CPUE data that was used in this paper, and noted they looked forward to continued cooperation. Japan agreed, noting it was a good opportunity for them to have others analyse the data and invited other members to participate as well.

50. The CPUE modelling group met in the margins of the ESC. A report of the discussions is attached in **Attachment 5.**

6.2 Aerial survey

51. Paper CCSBT-ESC/1107/15 provides an update on the scientific aerial survey of juvenile SBT in the Great Australian Bight (GAB). The estimate of relative juvenile abundance from the 2011 scientific aerial survey shows a substantial increase from 2010 and is similar to the 1993 estimate, which was the highest estimate of all survey years. The confidence interval on the 2011 estimate is quite wide, but taking this into account, it is still significantly higher than other estimates in the 2000s. The 2011 survey was the first in which all flights had only one spotter (i.e. no flights had a spotter-pilot). A method for dealing with this was developed in 2010 based on calibration experiments conducted in 2008 and 2009. The presence of a high proportion of large schools in the 2011 survey led to further investigation of the calibration factor estimated previously, since a plane with one spotter is less likely to miss very large schools relative to smaller ones. Re-analysing the calibration data leaving out very small sightings (<2 t) led to a revised calibration factor estimate of 0.7 instead of 0.5 (i.e. a plane with only one spotter makes approximately 70% as many sightings as a plane with two spotters). Methods to incorporate uncertainty in the calibration factor estimate were also

developed and applied this year. Further complicating the analysis this year was the high proportion of schools comprised of small fish less than 8 kg (estimated to be 1-year-olds). Such small fish were far less common in past survey years. In the OM and MP, the aerial survey index is assumed to provide a relative time series of age 2-4 abundance in the GAB. Thus, for consistency with the OM and MP as well as in interpretation of the index across years, schools of small fish were omitted from the analysis.

52. Given the increased abundance of 1 year old fish observed in the scientific aerial survey the question was raised whether these small fish could either be used as an additional index of recruitment or incorporated into the existing index, noting that they have been excluded from the current index. Australia noted that the proportion of 1 year old SBT has been quite variable over the full time series; typically less than 10% and frequently less than 5% or absent. However, it was noted that the proportion of 1 year olds in the survey has increased consistently over the last three years and, should this trend continue, including the 1 year old fish in the current aerial survey index would warrant further consideration.

53. It was noted that the proportion of 1 year olds observed in the survey did not appear to correlate directly with the total biomass observed. For example, the highest unstandardised biomass was recorded in 1995 and was only slightly higher than the most recent survey, yet the proportion of 1 year olds was only 8.8% in 1995 compared with 30.8% in 2011. Australia commented that this was most likely due to the different age structure at that time and provided a time series of the distribution of 1 year olds in the GAB by year from the survey. This figure showed that the 1 year old fish tend to enter the GAB in the earlier period of the survey (January and February) and are largely distributed inshore in association with inshore and mid-shelf reefs and "lumps".

54. Japan thanked Australia for continuing to undertake the scientific aerial survey. While noting there were some challenges with the survey, they commended Australia for carrying it out. Japan asked about the timing and distribution of the larger schools (> 50 t) reported for 2011, as well as the smaller fish (<8 kg). They also asked how the spotter estimated the size of fish in the schools.

55. Australia responded that the location of the sightings is provided in Figure 3 of the paper and that the size of the "bubbles" in the figure are proportional to the size of the schools, although the overlap in the sightings made it difficult to distinguish between the size of some sightings. The figure includes all fish observed in the survey (i.e. it is the raw observations), including the small fish (less than 8 kg) that are excluded from the index. The 8 kg cut off is based on the current growth curve and allows for the time of year that the cohorts are in the GAB. The spotters used in the scientific aerial survey are experienced commercial spotters and, as such, have considerable experience with estimating weights for commercial operations. Further, unlike some years in the mid-2000s when many schools of mixed size classes were present, the schools observed in 2011 generally consisted of fish of similar size classes, which made it easier for the spotter to estimate the average weight of fish in the school.

56. An Australian Industry representative commented that the sizes of schools seen in 2011 were much larger than those observed by many operators since commencement of operations in the GAB. Japan observed that it was important

to get this perspective from Industry as 1 year olds are not targeted and therefore there is little catch information on them.

57. New Zealand commented on the spatial coverage of the survey, the environmental factors that also determine the index and the correction factor applied, which had a dampening effect on the 2011 index. Australia responded that the scientific aerial survey covers the entire GAB, including the western side, and there is no concern over the correction factor, based on the data shown in Figure 5.

58. Indonesia asked if, given the increase in the index, the survey could be interpreted as a recovery of the spawning stock. In response, it was pointed out that the scientific aerial survey provides an index of recruitment of predominantly 2-4 year olds to the stock and, as such, is not an index of the spawning stock. The levels of recruitment observed in 2011 are similar to the 1994/95 levels, and significantly higher than those estimated for the 2000s. However, this does not necessarily translate into later recovery of the spawning stock, which will depend also on catch and natural mortality on these cohorts before they become mature.

59. In response to a question about verification of the estimates of average weight of SBT in schools, the Australian Industry advised that commercial spotters obtain regular feedback on the estimated weight of fish in schools from the purse-seine vessels during commercial fishing operations. This provides the spotters with direct verification on the accuracy of their estimated average weight which assists in improving their estimate over time. This type of verification was not available to spotters during the scientific aerial survey as there is no means to obtain a direct estimate of average weight of fish in the schools observed.

6.3 Other indicators

60. Australia presented paper CCSBT-ESC/1107/08 on fishery indicators. Overall, there were positive signals in the indicators in 2010. The general increase in many of the indicators may be reflective of improvements in the status of the stock, as well as the reduction in global catches. The three indicators of juvenile (age 1–4) SBT abundance in the GAB exhibited increases over the past 12 months (scientific aerial survey index, surface abundance per unit effort (SAPUE) and trolling index). Similarly, indicators of age 4+ SBT such as the New Zealand domestic CPUE and the New Zealand joint venture CPUE exhibited some upward trends. However, the mean age of 20+ fish on the Indonesian spawning grounds decreased in 2010 while the mean age of all SBT on the spawning grounds remained the same.

61. Paper CCSBT-ESC/1107/16 provided an update of the commercial spotting index (surface abundance per unit effort or SAPUE) for the Australian surface fishery in the 2010/11 fishing season. Data on SBT sightings have now been collected by experienced tuna spotters for 10 fishing seasons (2001-02 to 2010 11). In 2011, data were collected by only two spotters between December 2010 and March 2011. Only data from these two spotters were included in the standardisation analyses for the 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 2011 data. As seen previously, the standardised index for 2-4

year olds was lowest in 2003 and 2004, and the estimate for 2011 is the highest seen so far in the time series.

62. Japan suggested that it is preferable that information on the stock status of fish distributed in the GAB is obtained from multiple sources and that the commercial spotting activities may provide a wider range of information than the contained in the current SAPUE Index alone, as commercial spotting activities occur over a wider range of months (Dec-Apr) than the scientific aerial survey (Jan-Mar). Japan commented on the importance of the estimates of fish size from commercial spotters, as these were verified by the vessels, and this information could be used as an additional means of interpreting the results from the scientific aerial survey. They also noted that the commercial spotting activities had identified a higher abundance of smaller fish, although, overall, the SAPUE and scientific aerial survey indices showed similar trends. They considered that it would be useful to compare information, such as the school size and distribution, obtained from the scientific aerial survey and commercial spotting activities.

63. Australia welcomed the suggestion that more use could be made of the information collected from the commercial spotting activities. It was clarified, however, that the scientific aerial survey covered a larger area than the commercial spotting activities. As the SAPUE index is derived from a subset of the commercial spotting activity, it is focused on the main fishing grounds as illustrated in figure 1 of paper CCSBT-ESC/1107/16. The scientific aerial survey is designed to provide an index of 2-4 year old relative abundance for the entire GAB, and includes large areas in the western GAB in which there was very limited or no commercial fishing activity in recent years (figure 1, paper CCSBT-ESC/1107/15). Furthermore, the scientific aerial survey runs from January to March each year with specific protocols about the distribution of survey effort among months. In contrast the temporal coverage of the SAPUE index varies among years and months depending on the activities and range of operation of the commercial fishery, with the majority of effort generally taking place between mid December and the end of February (Table 1 and 2, paper CCSBT-ESC/1107/16).

64. It was noted that while the estimates from spotters cannot be verified as part of the scientific aerial survey, a range of measures had been undertaken to limit variability in the ability of the spotters and provide a basis for estimating spotter effects. These included using experienced commercial spotters (to the greatest extent possible), using the same spotters over time and conducting calibration experiments for the change from two spotters per plane to one spotter per plane. Given the targeted nature of the SAPUE it would be difficult to directly integrate this and the scientific aerial survey into a single index.

65. It was noted that, while not equivalent to the scientific aerial survey, the trend in the time series from the SAPUE generally followed that of the scientific aerial survey and was now of sufficient duration that it may be informative if included in the operating model (OM). This was raised in the context of ongoing development of the OM, including the spawning biomass estimate from the close-kin project, when available, and the financial cost of the scientific aerial survey and relative information content of the different data series used in the OM. Australia noted that given the substantial cost of running the scientific aerial survey it was important to explore links with the SAPUE index so that the

available resources for research and monitoring can be directed most appropriately. Exploratory work to investigate approaches to include the SAPUE index in the OM could therefore be of value. It was noted that this work would need to account for the differences in the spatial and temporal coverage of the SAPUE and scientific aerial survey, and the distribution of different size classes of SBT in the GAB.

66. Australia commented that work with MP1 including both the SAPUE and the scientific aerial survey showed good consistency between the two indices, assuming they both observe relative abundance of juvenile SBT in the GAB (CCSBT-ESC/1107/12). The inclusion of the SAPUE index, particularly for the years not covered by the scientific aerial survey, added further evidence as to the weakness of the late 1990s and early 2000s cohorts and the high exploitation rates they experienced as they moved through the surface and longline fisheries.

67. Paper CCSBT-ESC/1107/17 provided an update on otolith sampling and ageing of SBT in Australia. Otoliths were sampled from 180 SBT caught by the Australian SBT surface fishery during 2010–11. Additional otoliths were collected during CSIRO tagging operation and from the recreational sector. Age was estimated for 100 SBT caught by the surface fishery in 2009–10 from otoliths collected and archived last year. As in previous years, the proportions at age of SBT in the surface fishery were estimated using three methods – the standard Age-Length Key, the Morton and Bravington method with known growth, and the Morton and Bravington method with unknown growth. There was reasonably good agreement between the various methods, but the work highlights the need for further discussion within the ESC regarding the technical details of how the direct age data will be incorporated into the OM.

68. Paper CCSBT-ESC/1107/18 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 2010–11 season, and age-frequency data to the 2009–10 spawning seasons are available for the fishery. However, as ageing of 500 otoliths collected in the 2009–10 season was not undertaken this year, it was not possible to build a direct age-length-key (ALK) for the season. The 2009–10 age distribution presented in the paper was based on an ALK developed using the direct age data for the 2007–08 and 2008–09 seasons. The length frequency data for 2009–10 was then applied to that key. As noted previously, considerable change has occurred in the size and age distribution of SBT caught on the spawning ground since monitoring began. 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 14-16 years.

69. Paper CCSBT-ESC/1107/19 provides an update on the close-kin spawning biomass estimation project. The project uses parent-offspring-pairs (POPs) identified using microsatellite comparisons (i.e. “DNA fingerprinting”) to estimate the absolute spawning abundance of SBT (CCSBT-ESC/0709/18). Since reporting to the 2010 meeting of the ESC, DNA has been extracted and 25 loci scored for 8,880 fish (Table 1, CCSBT-ESC/1107/19). Extensive quality control is being undertaken to ensure a clean data set is available for analysis. In response to fewer POPs from the analysis of the first 4,000 samples (ESC CCSBT-ESC/1009/Info 2), additional funding has been secured to increase the total number of samples to be processed for the project to 14,000. This is

expected to result in sufficient POPs to develop an appropriate statistical estimator with a CV on the estimate of spawning stock similar to that originally proposed (i.e. 0.2). Sample processing and genotyping are scheduled for completion in September 2011, with a preliminary estimate and draft final report in December 2011. The final report is due in mid 2012 and will be made available to the next meeting of the ESC.

70. Japan noted it was important to consider what will happen when the results of the close-kin project are available. The results could improve the precision of the OM which could impact the MP. However, the results might also show that the assessment is not correct. Although these possibilities are covered in a generic sense by the meta-rules for the MP, the ESC considered that a more detailed discussion was required. It was agreed that this would be further discussed at the 2012 ESC meeting.

71. Paper CCSBT-ESC/1107/20 provides an update on some aspects of the "Global Spatial Dynamics project" which Australia initiated in 2003 as part of the CCSBT Scientific Research Program. The project is close to completion and the final report should become available towards the end of 2011. Of the 568 releases, a total of 75 tags had been recaptured as of May 2011, including first-ever recoveries of archival tags from releases in the Indian Ocean and Tasman Sea (New Zealand). Movement tracks show large variability between animals in the timing of arrival into or departure from the GAB, and the westerly extent of the tracks. There is a large degree of mixing of the tagged fish over the winter grounds. Data from archival tag returns in the 1990s and the 2000s lend some support for a contraction in eastward movement after 2001; there is less support for a contraction in westward movement. A framework for combining archival and conventional tag data in a spatial mark-recapture model was developed and applied to the SBT data. Results show that the inclusion of archival tag data has substantial effects on many of the parameter estimates, and particularly on the movement rates.

72. In response to a question from Japan on the accuracy of the global positioning of the tags, Australia noted that CSIRO developed their own software due to problems with positioning, particularly latitude. The new methodology will impose the correct spatial boundaries and avoid such obvious positional inconsistencies.

73. In response to questions about the distribution of juvenile SBT, Australia advised that 2-5 year old SBT do not extend into cooler western waters as much as larger fish do. It was also noted that the longest deployment duration was 3.5 years on a fish tagged at 2 years of age. This fish spent the first two winters it was tracked in the Indian Ocean, but spent the third summer in the Tasman Sea.

74. The Advisory Panel noted that it would be interesting to know if the range of the population is contracting or expanding. Australia responded that there was strong evidence indicating that there is a reduction in eastward movement and some evidence for a reduction in westward movement.

75. In response to a question from Indonesia, Australia confirmed that the global spatial tagging project was designed around understanding juvenile spatial dynamics and how that information could inform CPUE. Previous work had focussed on mature SBT in the Tasman Sea to investigate residency in wintering

grounds and frequency of return to the spawning grounds. Tag retention in these large fish was quite poor, with only two fish retaining the tags halfway up the eastern coast of Australia. However, new tags are much smaller than the ones used in this study and so should be retained by the fish for much longer. There is a need to discuss the potential for another large scale project using tags to answer some of these questions.

76. Paper CCSBT-ESC/1107/21 provides preliminary results of a project designed to address the question of what proportion of the global population of juvenile SBT spend time in the GAB in summer. Tuna otoliths can provide such information about movements and residency because they act as a natural tag and contain a permanent record of the life history of fish. An initial pilot project had been conducted to determine if it was possible to identify otolith chemical fingerprints from different areas within the SBT range. The elements Ca, Mg, Sr, Li, Mn, Cu, Ba and Pb in 26 SBT otoliths collected from juveniles and adults (45-166 cm FL) at three locations (the spawning grounds, the west coast of Australia and the GAB) were measured by laser ablation inductively coupled spectrometry (LA-ICP-MS). Elements were measured continuously along the otolith growth axis from the earliest-formed primordial area to the margin, to provide a life history of elemental levels. Cyclical variation in all elements was observed. This pilot project has confirmed the feasibility of using LA-ICP-MS on a near continuous scale on SBT as small as the pre-recruits. The project is still underway and, in the next phase, univariate and multivariate statistical analyses will be used to test for significant differences between areas and between years, in order to differentiate spatial and temporal otolith chemical fingerprints in SBT.

77. Japan reported the results of the trolling survey carried out in January 2011 in CCSBT-ESC/1107/29. The survey was carried out in south-western Australia for 18 days including six days for the piston-line survey. The trolling index of recruitment, the number of schools of age-1 SBT per 100 km searched, was higher for the 2005-2010 year classes than the 1995-1998 year classes when taking into account both the trolling survey and the trolling catch data in the acoustic survey.

78. Australia noted that caution needs to be applied when examining multiple data series, as the trolling survey and the scientific aerial survey do not always align. Japan agreed, although they noted that qualitatively the two surveys were similar for some years.

79. There was discussion of the possibility of using the information from the trolling survey in the assessment in the future, noting that differences in error structure and other factors would need to be considered. However, New Zealand commented that the trolling survey has only been going for six years; three of the indices are above the mean level and three are below. Given the short time frame it would not be appropriate to consider incorporating these data into the reference set of the OM until it was clear that the trolling index reflected year class strength. Australia agreed, noting that while the survey has improved since its inception, there are still some issues including that the series at present remains short.

80. Australia also asked Japan about the bimodal length distribution of age-1 fish in their data. Japan responded that it could be the result of two peaks in the spawning season (October and January-February). However, the data needed to be examined further to answer this question conclusively.

81. Trends in selected indicators of the SBT stock are shown in **Attachment 6.**

Agenda Item 7. Update of Operating Model

7.1 Update operating model using most current data

82. The Chair of the technical working group gave a report on the intersessional work that had been done since the last ESC meeting:

- The underlying growth model has been changed based on research on SBT growth conducted in 2001-02 (technical details are in paper CCSBT-ESC/1107/9). The members updated all historical data using the new growth model, evaluated the effects of the change in growth intersessionally, and agreed that the new growth schedule would be used for the data exchange from 2011 onwards. This growth update affects the following items: input mean length at age for the two periods (seasons 1 and 2 in the OM), input variance of length at age to replace the ad-hoc formula, age composition of surface fishery, and longline CPUE (only a minor effect due to the truncation at age 4).
- The OM has been updated with two years of additional data since the last update in 2009.

83. Japan presented CCSBT-ESC/1107/33. This document provides the results of conditioning and constant catch projection using the OM. To evaluate the influence of the recent update, conditioning results under the previous and present version of OM were compared. The fits of the OM using the new growth schedule indicate that higher values of steepness are more likely compared to previous growth schedule version. This higher steepness preference seems to arise as a result of the fit to the LL3 catch composition data. Moreover, inclusion of the most recent two years' data also sees the conditioning results prefer somewhat higher steepness. To evaluate the cause of higher steepness preference by the recent two years' data, retrospective analyses for the stock index (LL1 CPUE and aerial survey index) were conducted. The removal of the most recent two CPUE values and the aerial survey index reduced the preference for higher steepness, thus the update of the stock indices is one of the causes of the preference for higher steepness. Under the condition of "basehup" scenario, the present OM indicates that the current spawning stock biomass remains at a very low level; typically about 5% or less of SSB_0. However, historical trajectories for recruitment over the last decade are higher than the previous result calculated for the 2010 OMMP meeting, and the constant catch projection result indicates that the future Spawning Stock Biomass (SSB) will decline to a minimum in 2012 and then recover rapidly after the mid-2010s. These results show clearly that the present OM provides more optimistic projections compared to the previous OM.

84. Australia presented CCSBT-ESC/1107/11 which details a summary (diagnostics, stock status, parameter estimates) of the reconditioning of the CCSBT operating model for the most recent data. Current SSB depletion is very low (about 5% of SSB_0) but recent recruitments (2005-2011) are all estimated to be higher than the very low recruitments estimated in the late 1990s/early 2000s. There has also been a notable increase in the levels of steepness being sampled from the grid. Primary information on steepness comes from the catch composition data (in

particular LL1 and LL3) and this information is contradictory across these data sets, with often clear dependence on the M10 (natural mortality at age 10) grid element. Recent increases in the Japanese longline CPUE and scientific aerial survey indices of abundance also contributed to the increases in steepness levels. These increases, in conjunction with the higher estimates of recent recruitment, contribute to a more optimistic view of the future recovery rate of the SSB, for zero and current catch levels.

85. Discussion was focused on the recent trends in CPUE and the scientific aerial survey, and on further identifying the sources within the data that resulted in the preference for higher levels of steepness in the updated OM. The work was referred to a technical working group (**Attachment 7**).

86. There was some discussion of the fit to the scientific aerial survey data in the OM, and whether there was a lack of fit to the year class strengths estimated by the OM in the last five years. However, it was noted that CPUE is the more dominant factor compared with the scientific aerial survey in determining year class strength in the OM. There is also more uncertainty in the estimates of the younger ages in the OM.

87. Discussion also focused on the CPUE data. In particular, there were some concerns about the implications of possible increases in catchability in some years across age classes which did not relate to increased abundance (Figure 1of CCSBT-ESC/1107/11). It was agreed that these concerns could be addressed in the robustness trials. Several different robustness trials were specified, which are intended to test the MPs to ensure that they are robust to alternative scenarios related to uncertainty in the CPUE. The ESC agreed with recommendations made in previous years that the “base” model in the CPUE standardization would be used unless there was an exception or major concerns. It was also suggested that the base CPUE series should stay within the bounds of the other CPUE series (currently bounded by Laslett Core CPUE and the STwin model). It was noted that these two series had crossed over each other in the past and that this should be further investigated. No further investigation of the CPUE and input data was attempted, and the existing base CPUE series was used in the OM.

88. Catch composition data for some years in the LL3 fishery had a large impact on the estimates of steepness in the OM, which was incompatible with their relative scale to the other fisheries e.g. LL1. The ESC considered that this was giving undue weight to these data in the OM. After further investigation in the OM Technical Working Group, more flexible assumptions regarding the LL3 selectivity were incorporated, which resulted in a shift in the posteriors for steepness to slightly lower values (**Attachment 7**and section 7.4).

7.2 Evaluate sensitivity to updated size-at age data based on new growth estimates

89. Paper CCSBT-ESC/1107/33 evaluated the impact on the OM conditioning of using the updated growth estimates. As noted above the new growth schedule favored an increased value for steepness in the OM as shown in **Attachment 7 Figure 4.** The mode of the posterior increased from 0.64 to 0.73.

7.3 Approaches for incorporating new information into the assessment

90. No new data other than the updates described in 7.1 were incorporated into the OM. Potential new sources of data (eg. Close kin genetics) that may become available in future years were discussed further in the future work plan section (Section 14.1).

7.4 Possible changes in the structure/parameterization of conditioning and projection model to be used for assessment

91. Several changes were made to the OM. For the LL3 fishery, where catches are now very small, length frequency data are not fitted in the model when catches are below 200t (paragraph 50 in CCSBT-ESC14, 2009). In addition, increased frequency of selectivity changes have been incorporated to allow for increased flexibility in the estimated selectivity for the LL3 fishery. This specification is documented in **Attachment 7**. Steepness and M10 (natural mortality at age 10) values in the reference set were also changed (described below in section 7.5). No changes were made to the projection model.

7.5 Selection of reference set and sensitivity trials.

92. A new reference set was agreed during the meeting, which incorporated the changes described in section 7.4. The reference set includes five values for steepness including a higher value than those used in 2009. The increased flexibility on selectivity in the LL3 component shows that M10 is also sampled for higher values, and therefore an additional M10 value of 0.16 was included in the reference set (**Attachment 7 Figure 5**). All other values used in the reference set are the same as in previous years. The new reference set is described in Table 1.

Table 1. Specification of the axes of reference set grid.

	Levels	Cumul N	Values	Prior	Simulation Weights
Steepness (*h*)	5	5	0.55 0.64 0.73 0.82 0.9	Uniform	Likelihood
M_1	4	20	0.30 0.35 0.40 0.45	Uniform	Likelihood
M_{10}	4	80	0.07 0.1 0.13 0.16	Uniform	Likelihood
Omega	1	80	1	NA	NA
CPUE series	2	160	w.5 w.8	Uniform	Prior
q age-range	2	320	4-18 8-12	0.67, 0.33	Prior
Sample Size	1	320	Sqrt	NA	NA

93. The previously agreed base model for CPUE is used in the reference set. To evaluate the robustness of the MP to uncertainties in CPUE, a new robustness trial called upq2008 was agreed. The new robustness test has an increase in catchability of 0.35, using a step function, from 2008 onwards. The updownq robustness trial is also included and has an increase in catchability (0.5) in 2009 and then returns to normal levels after five years. It was agreed that the pessimistic set of robustness trials would be run to compare MP performance

(these include upq2008, lowR, STwin, Omega75 and updownq). These robustness tests are documented in **Attachment 7**.

94. The status of the SBT stock in 2011 is based on the reconditioned CCSBT Operating Model (OM), incorporating revised growth schedules and the most recent data (i.e. 2010 catch, CPUE, length and age data; 2011 scientific aerial survey data). The reference set (base case) OM and 4 plausible pessimistic scenarios (upq2008, omega75, updownq, STwin) all indicated that the SSB remained at a very low level; typically about 5% (Base case: median 0.05 (0.03-0.07 80% C.I.); Plausible scenarios: median 0.04-0.05 (0.02-0.06 80% C.I.)) of unexploited biomass (SSB_0); similar to the 2009 OM conditioning (see Figure 1).

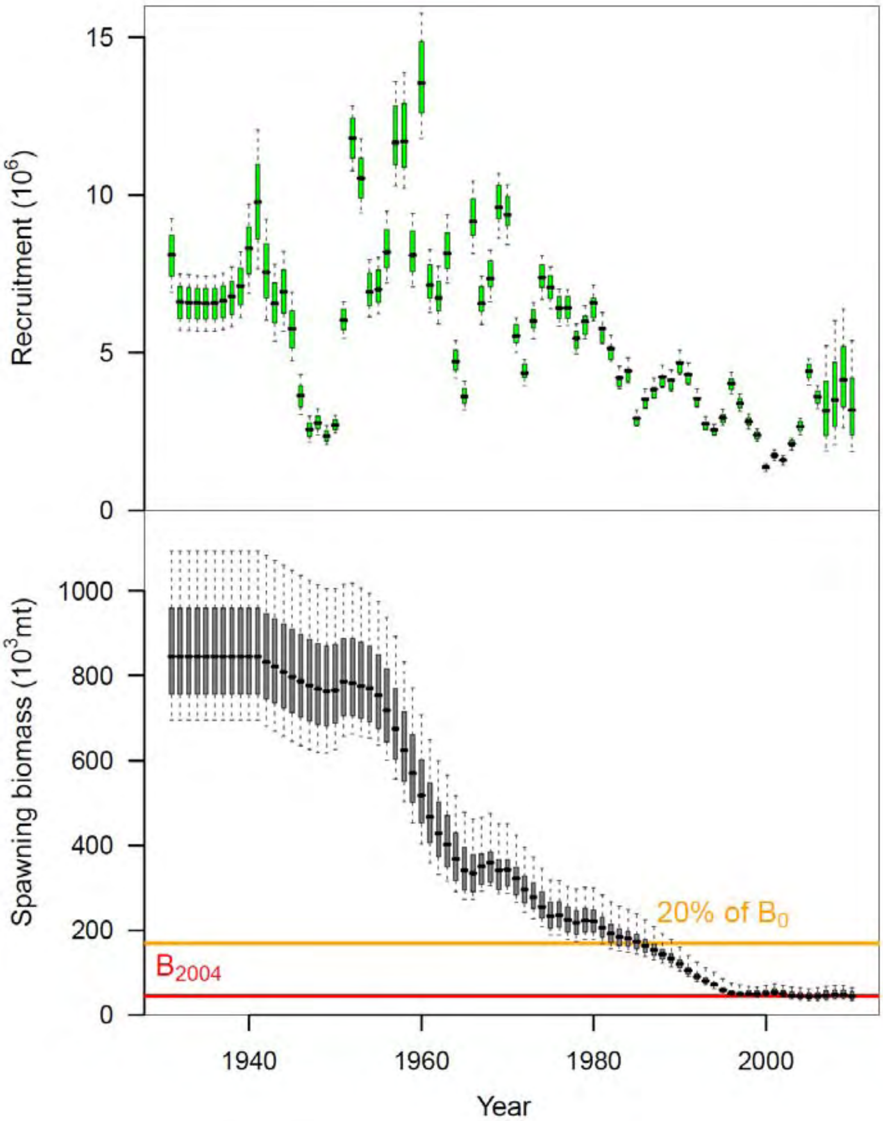

Figure 1. Recruitment and spawning stock biomass for the base case, showing the medians, quartiles and 90th percentiles, together with reference points of 20% of pre-exploitation spawning stock biomass (SSB_0) and the spawning stock biomass in 2004 (SSB_{2004}).

Agenda Item 8. Evaluation of stock status with respect to reference points

8.1. Sensitivity of MSY calculations to input parameters and estimation methods

95. Paper CCSBT-ESC/1107/14 details estimates of reference points for the stock of SBT as requested by the Extended Commission. Spawning biomass-per-recruit reference points based on a target reduction ratio, relative to unfished conditions, of 35% were estimated. For ages 2-15 (the default age range used when reporting age-aggregated exploitation rates for SBT) the current estimates of exploitation rate were found to be very similar, at the median level, as to those expected for a 35% target reduction ratio. The concept of MCY (Maximum Constant Yield) was used to estimate both replacement yield at 20% of SSB_0 (with a 70% probability) and a proxy for stochastic MSY (i.e. one which includes recruitment variability and grid uncertainty simultaneously). Estimates of MCY were in the order of 29,000t, with an expected SSB depletion of 0.3 at MSY, in comparison to the deterministic estimates of MSY which had an expected yield of around 35,000t and associated SSB depletion of 0.22 at MSY. A simple comparison with the stochastic and deterministic estimates from the previous OM showed how the change in steepness and mortality when updating the previous OM for the last two years of data changed estimates of MSY by more than 20% and expected depletion levels by over 10%. It was noted that unambiguous information on steepness (and by correlation many other parameters) will not appear until a sustained and data-validated recovery in the SSB occurs, and by the current projection levels this will not be likely to occur until the later part of the current decade. As a result, any estimates of MSY (deterministic or stochastic) are likely to be prone to such instability, making it difficult to provide a robust estimate of MSY at the present, even if factors such as selectivity and other key variables remain constant.

96. The ESC noted that there were a number of factors that need to be taken into account when estimating the long-term sustainable yield that can be taken from a stock. These include:
    - the assumed relationship between spawning stock size and average recruitment
    - the level of inter-annual recruitment variability
    - changes in growth over time (possibly reflecting density dependence)
    - changes in selectivity over time related to the distribution of catch among fleets, or changes in selectivity due to shifts in fishing practices within fleets
    - changes in other biological parameters over time, e.g. mass-at-age, fecundity-at-age

97. As noted in ESC-CCSBT 14, these factors are incorporated to different degrees in the methods for estimating long-term sustainable yield (e.g. MSY, MCY).

98. The ESC recalled that the primary reason for reporting on the expected levels of long-term yield from the SBT stock was to inform the Extended Commission's consideration of likely long-term yield from the stock. In addition, the ESC has previously recognized the utility of being able to estimate long-term yield for the stock in a way that is consistent with the structure and assumptions of the CCSBT OM.

99. To investigate the impacts of changes in selectivity and growth on historical estimates of MSY, F_{MSY} and surplus production, five scenarios were explored that account for the extremes in the changes in growth and the proportion of total catch taken by the surface and longline fisheries (Table 2). Both changes in selectivity (fishing pattern) and growth had roughly equal influence on these estimates of MSY.

Table 2: Configuration of model scenarios for explorations of factors affecting MSY

Scenario	MSY	Weight at age vector	Catch composition
1	31,500	1956	85% LL1, 8% Australia (1994)
2	35,600	2010	85% LL1, 8% Australia (1994)
3	25,000	1956	29% LL1, 52% Australia (2007)
4	29,100	2010	29% LL1, 52% Australia (2007)
5	29,500	2010	37% LL1, 46% Australia (Current)

The estimates of MSY by year vary substantially between the earlier and later periods of the fishery (Figure 2).

100. Given this the ESC noted:

- The current estimates of expected long-term sustainable yield are in the order of 31,100t to 36,500t (Figure 2).
- These estimates are substantially higher than those estimated prior to the most recent update of the OM.
- This difference in estimates between OM updates results from updated growth estimates and data inputs (Aerial Survey, CPUE, catch composition) and the related impacts on the OM preference for steepness and natural mortality in the grid.
- This underlying uncertainty in the productivity of the stock is likely to remain until there is empirical evidence of sustained recovery in the spawning stock. On the basis of the current projections this is not expected to occur for 5-10 years.

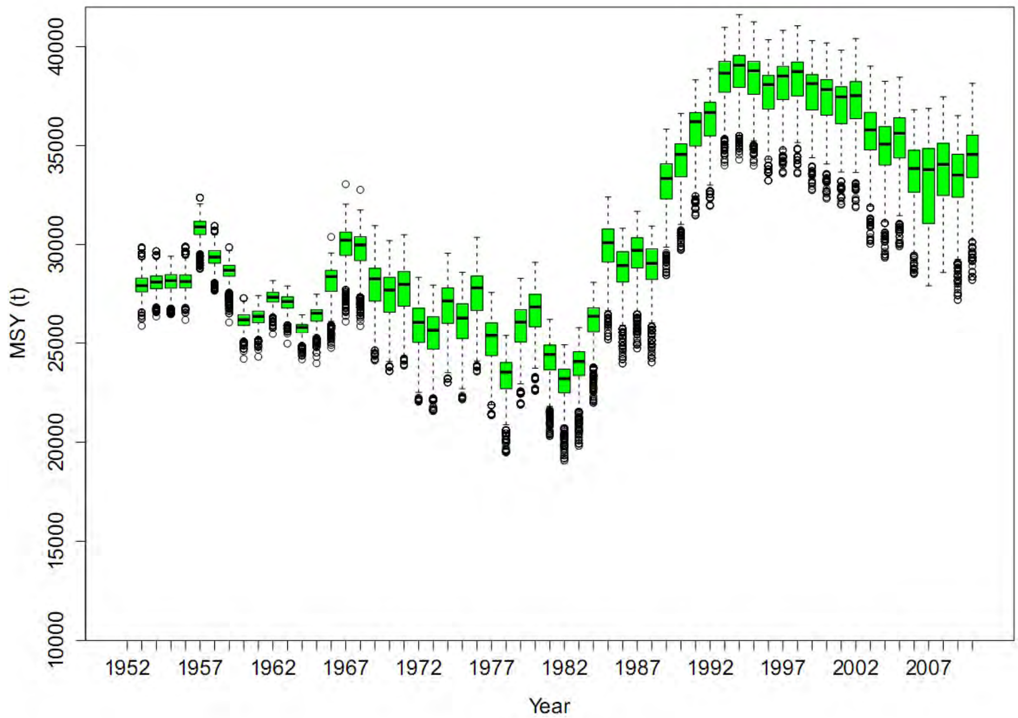

Figure 2. Estimated MSY based on annual age-specific mean weight and selectivity estimates as computed over the base grid of the operating model. Note that the catch composition from each fishery in each year affects the values of MSY. Boxplot representations are as follows: horizontal lines within the box is the median, the box delineates the inter-quartile range, and "whiskers" extend 1.5 times the interquartile range.

101. The time series of average fishing mortality rates for the reference set integrated over the grid relative to annually calculated F_{msy} values is shown in Figure 3 (**Attachment 8 Figure 2** contains fleet and age specific fishing mortality rates). The F_t/F_{msy} has declined from approximately 2.0 in 2005 to approximately 0.7 in 2010. This decrease in fishing mortality corresponds to reductions in reported global catches and the two reductions in the global TAC in 2006 and 2009 and higher recruitment than the early 2000's for the past 4-5 years. The median F_t/F_{msy} for the most recent year, 2010, is less than one (~0.70) and indicates that overfishing is no longer occurring, although the stock is still at a low level. Maintaining the ratio F_t/F_{msy} at or below 1 is a prerequisite for rebuilding the stock to B_{msy}.

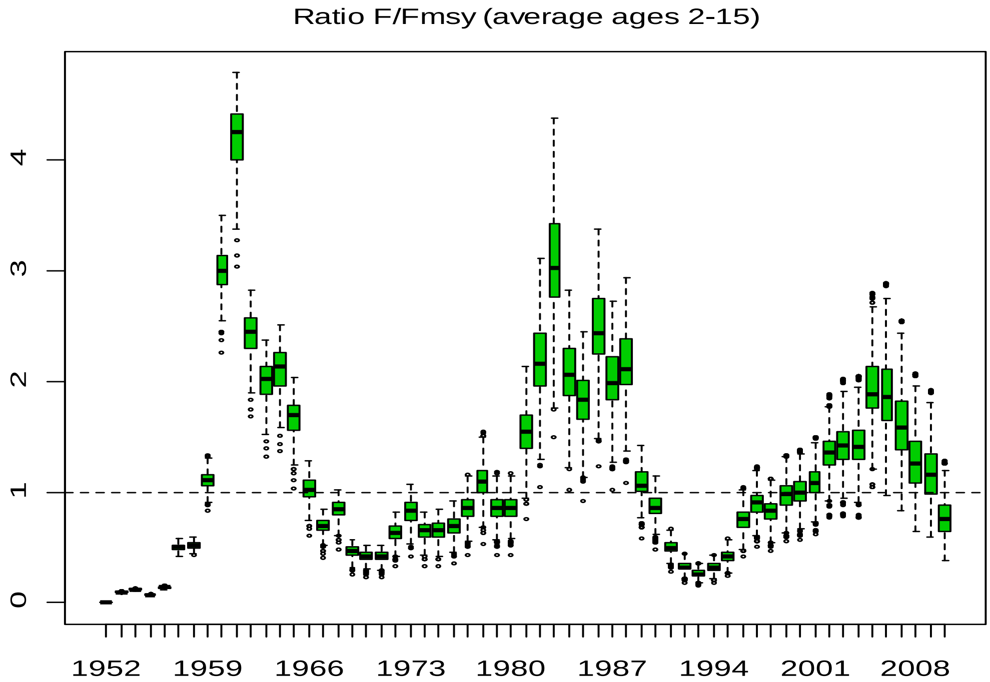

Figure 3. Boxplots of average fishing mortality over the F_{msy} (for ages 2-15). In both cases, the averages are weighted by the posterior likelihood from the OM grid (computed based on grid-cell parameter values, annual mean weights at age, catch composition and selectivity estimates by year for ages 2-15). For each year and sample of the grid, the equilibrium biomass and F_{msy} estimates were computed. Boxplot representations are as follows: horizontal lines within the box is the median, the box delineates the inter-quartile range, and "whiskers) extend 1.5 times the interquartile range.

8.2. Calculation of replacement yield at 20% SSB_0

102. CCSBT-ESC/1107/14 evaluated the constant catch that meets the criteria that the SSB stays above 20% SSB_0 with 70% probability for projections conducted using the original reference set. Under the new reference set this same calculation results in an average constant catch of 28,400t. The analogous estimate in median terms, i.e., the constant catch value that keeps the median SSB at 20% of SSB_0 is 29,600t. This compares with MSY = 34,500t which corresponds to a B_{msy} of 24% of SSB_0.

8.3. Trends in annual surplus production and spawning biomass per recruit

103. Previous analyses (ESC report of 2009) revealed an apparent discrepancy between estimates of historical surplus production, and estimates of MSY. However, updated calculations (Figure 4) show surplus production levels that are consistent with estimates of both MSY and replacement yield seen in the previous section. The current surplus production is 27,200t.

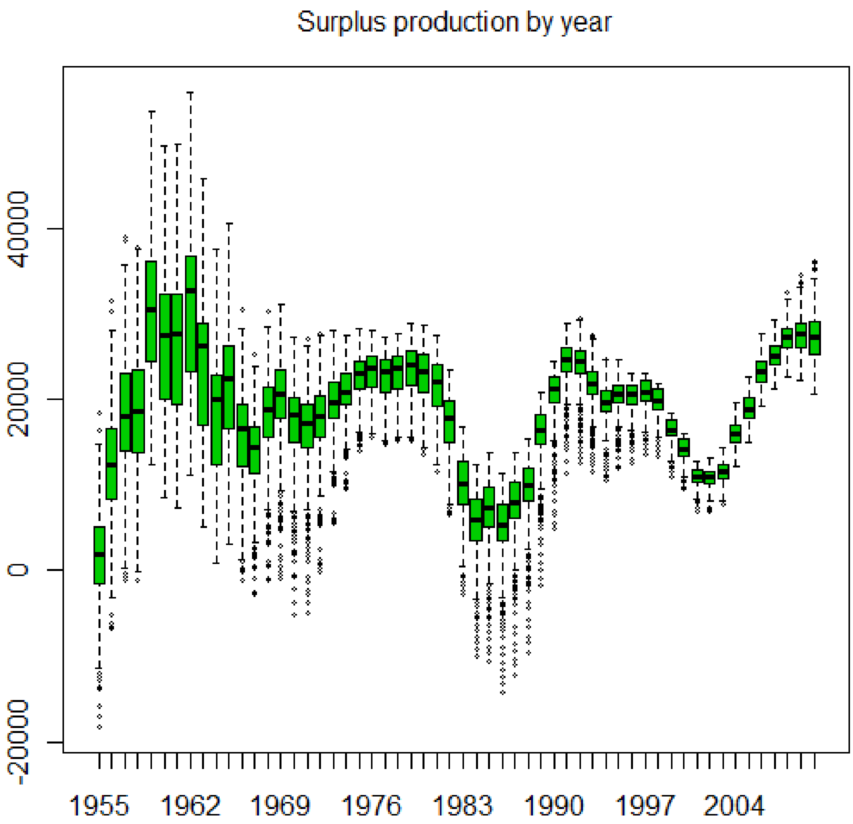

Figure 4. Estimated surplus production (catch in year *t* + biomass difference in year *t* from year *t-1*) as computed over the base grid of the operating model. Boxplot representations are as follows: horizontal line within the box is the median, the box delineates the inter-quartile range, and "whiskers" extend 1.5 times the interquartile range.

Conclusion

104. For the purposes of considering levels of long-term yields that might be expected if the stock is rebuilt to MSY the ESC advise the Extended Commission that the estimated current 5%-95% range is 31,100t to 36,500t, noting that this range does not take into account potential density dependent effects that may reduce somatic growth rates as the stock rebuilds.

Agenda Item 9. MP implementation

9.1 Performance of MP in projections

105. The two MPs evaluated at the 2010 ESC meeting were re-evaluated against the updated OM, using the "basehup" reference set that was agreed prior to the meeting. Results are provided in papers CCSBT-ESC/1107/34 and CCSBT-ESC/1107/13. Technical changes to MP1 made since 2010 are described in paper CCSBT-ESC/1107/12.

106. Japan presented CCSBT-ESC/1107/34. This document evaluated the performance of the empirical management procedure (MP2) using the updated operating model. The authors reported that in order to meet management targets,

TACs needed to be increased steadily and substantially under the updated reference set, and the MP behavior is different from that under the previous reference set used at the 2010 ESC meeting. This is because the updated operating model estimates a more productive stock at present than previously, due to higher steepness and recent good recruitments. They also found that tuning for some runs was very difficult within the realistic range of parameter values used for this analysis, when using this more optimistic operating model. Therefore, they considered that tuning options might need to be reconsidered to better compare different MPs. Results for robustness trials showed that MP2 generally deals well with pessimistic scenarios such as lowR, STwin, Omega75, upq, and updownq. MP2 would be quite robust to different model assumptions and input data under the updated operating model.

107. Paper CCSBT-ESC/1107/12 detailed the performance of the estimation scheme at the core of MP1. Given the most recent CPUE and scientific aerial survey data, the model and estimation scheme that form the basis for MP1 were assessed. The underlying biomass random effect model of MP1 explained both the CPUE and scientific aerial survey data well. To assess the consistency of the recruitment estimates in the model, the SAPUE index was also integrated into the estimation scheme (though not into the actual MP) and showed strong consistency between the scientific aerial survey and the SAPUE data when they overlap. It also confirmed the low recruitments and high exploitation rates from the early 2000s seen in other data. A minor change to the harvest control rule in MP1 was suggested, to include as much of the scientific aerial survey data as possible, and a comparison with the old structure of MP1 on the updated OM was provided.

108. Paper CCSBT-ESC/1107/13 summarises the performance of MP1 for the reference OM (prior to the ESC meeting) and several key robustness trials. The management procedure was tuned to three of the priority tuning targets agreed by the OM and Management Procedure Working Group (Runs 1-3) but could not be tuned to the initial reduction period (IRP) scenario (Run 4). The strict constraint on initial TACs for the IRP scenario, in conjunction with a more optimistic OM and projected faster recovery of the stock was the cause of the tuning problem (the MP over-shot the tuning target). In general, and contrary to the previous MP evaluation work, no initial reductions in TAC were required to meet any of the tuning targets. In terms of robustness trials, the MP was found to be robust to the more important pessimistic trials (lowR, omega75) but did not perform as well for the trials relating to bias in CPUE (upq, updownq). For the most pessimistic trial (STWindows) there was a notable decrease in rebuilding performance relative to 20% SSB_0 but not relative to current SSB levels. As with previous work, there was little significant impact on performance (relative to the reference OM) for trials relating to overcatch (c1s1l2, c2s1l1, c3s1l1), alternative CPUE (run3, run6, Laslett), or structural OM scenarios (mixtag, regime, aerflat).

109. The ESC noted that the results of the MP evaluations were similar for MP1 and MP2. MP1 was slightly more reactive to positive signals and therefore did not perform as well on the upq and updownq robustness trials, which are used to evaluate performance of the MP for alternative CPUE scenarios. MP1 performed better on STwin and Omega75 robustness trials. MP2 performed better under the upq and updownq. However, MP2 was unable to tune to the 2035 year with a maximum TAC change of 3000 t, unless a very reactive variant was used. MP2 showed more variation in the SSB and catch trajectories, with a small number of

trajectories going to zero, though the probability was extremely low. There were two variants for MP2 using the k_2 values of 5 and 10, which represent increasing reaction to the trend in the CPUE. There was some concern that the high values used may result in the MP being too aggressive in increasing catches, but these were necessary to reach the tuning targets. In later evaluations, only the k_2=5 version of MP2 was evaluated.

110. Both MPs were re-tuned to the new reference set agreed at the meeting, and re-run for the pessimistic robustness trials. An additional variant of the tuning criteria was the inclusion of a cap on TAC increases at the first TAC decision year (i.e. for the no increase scenarios (with lag 1), TAC is capped at 9449 t for the years 2013-15). MP2 was still unable to tune to the year 2035 with a maximum TAC change of 3000 t using the new reference set, with or without an increase in the first TAC decision year, and therefore for the purpose of comparing the behavior of the MPs, the MPs were also tuned to the year 2030 with a maximum TAC change of 3000 t. Results are presented in **Attachment 9.**

111. The meeting agreed that both MPs performed well, and that there was little difference between the performance of the two MPs for the reference set. For the robustness trials, the ESC members noted that the performance was mixed, with better or worse performance of one MP relative to the other depending on the tuning year and whether or not a TAC increase was allowed in the first TAC setting year. It was noted that neither of the MPs failed the robustness tests i.e. exhibited unacceptable behaviour. In general, it was noted that for the 5000t maximum TAC change there was a much higher probability of a decrease in TAC following an initial increase, and this may be an undesirable behaviour.

112. Given that MP2 could not tune to all the tuning years except 2035 with 3000 t maximum TAC change, and that each MPs performed better than the other for different robustness trials, a joint MP was developed that combines the best features of MP1 and MP2 into a single tuned MP (the "Bali Procedure", which is sometimes referred to in figures as "MP3"). The key features of the Bali Procedure are described in Attachment 10. The Bali Procedure was re-tuned to the new reference set agreed at the meeting and tested against the pessimistic robustness trials. Performance of the Bali Procedure was compared with performance of MP1 and MP2. These figures are in **Attachment 9**.

113. For nearly all the robustness tests, the Bali Procedure performance was better than MP1 for the worst performance tests of MP1 and better than MP2 in the worst performance tests for MP2, although it was noted that the probability of SSB rebuilding was lower for the Bali Procedure compared with MP1 and MP2 under the lowR robustness trial. The ESC agreed to recommend the Bali Procedure for consideration by the Extended Commission, and that results should be provided for the various combinations of tuning year, choice of maximum TAC change, increase or no increase in first TAC decision period (**Attachment 9 Table 2a**). A summary of performance is presented below. It was noted at SC15 and again in intersessional work that results for a lag in implementation of the MP are similar to no-lag, and therefore the MP had only been tuned for the 1 year implementation lag option at this meeting.

114. A summary of the trade-offs between stock rebuilding and catch performance for the Bali Procedure against alternative rebuilding years and operational TAC constraints (maximum TAC increase and whether, or not, a TAC increase is

allowed in the first TAC decision year) is provided in Table 3 below. This summary is based on consideration of the detailed performance statistics (**Attachment 9 Table 2a**) and examination of **Attachment 9, Figures 1 to 10**. Further details are provided in **Attachment 9**.

Table 3: Summary of main trade-offs in stock rebuilding and catch performance for the Bali Procedure against rebuilding year and TAC constraints.

Rebuilding year/TAC constraint	Stock rebuilding performance	Catch performance
Tuning year (2030, 2035, 2040)	• 2030 leads to more rapid rebuilding than 2035 or 2040*. *Note there was no difference evident between 2035 and 2040	• Earlier tuning means greater likelihood of lower average catches. • Earlier tuning increases up/down TAC behaviour.
Maximum TAC change (3000, 5000t)	• 3000t max change leads to more rapid rebuilding by 2025.	• 5000t max change leads to greater inter-annual variation in catch. • 5000t max change leads to higher likelihood of TAC increase followed by decrease in the first two and the first four TAC decisions. • 5000t max change leads to higher average catch between 2013-2025.
TAC increase allowed in first year of MP implementation (i.e. 2012) (Yes/No)	• Allowing TAC increase in first year does not prevent MP meeting rebuilding target. • Allowing increase slows rate of biomass rebuilding in initial period (2011-2025).	• No TAC increase reduces up/down TAC behavior between 2015-2021. • No increase reduces catch variation 2013-2025. • Allowing TAC increase in first year leads to higher maximum TAC decrease remainder of evaluation period. • Allowing increase leads to, on average, a 0.15 probability of a decrease in TAC in the 2015 decision year. • No TAC increase generally leads to lower catches between 2013-2025.

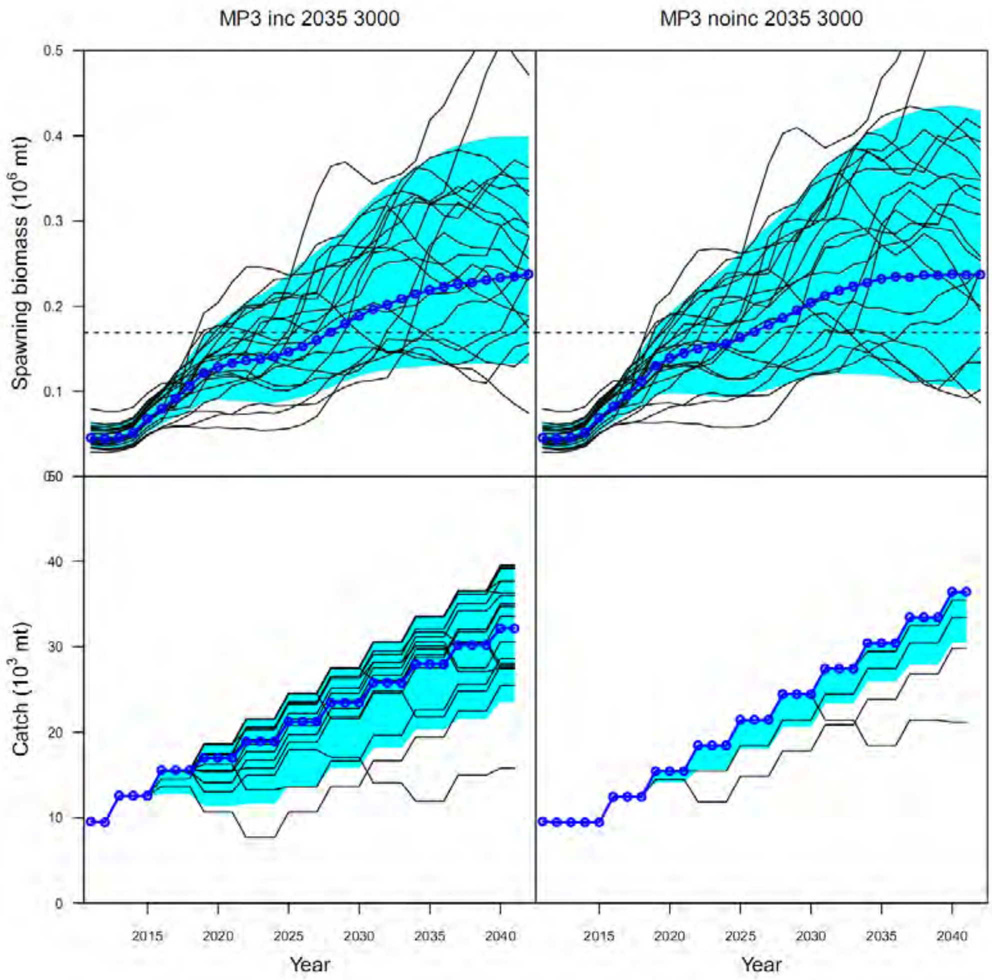

Figure 5 Projected spawning biomass (top row) and catch (bottom row) by the Bali Procedure (referred to in this figure as MP3) tuned to achieve a 70% probability of rebuilding to 0.2 SSB_0 by 2035 under the reference set. For the plots on the left a TAC increase is allowed in the first TAC implementation year (2013) for the MP; the plots on the right allow for a TAC increase in second TAC implementation year (2016), but not in 2013. In both cases, the constraint on the maximum TAC change from year to year is 3000 t. The shaded regions represent range between the 10th and 90th percentile of the 2000 simulations and the individual lines represent a sample (10) of the different realizations. The thick bulleted line represents the median from all 2000 simulations. The dashed line reflects the median estimate of 0.2 SSB_0 from the reference set of the OM.

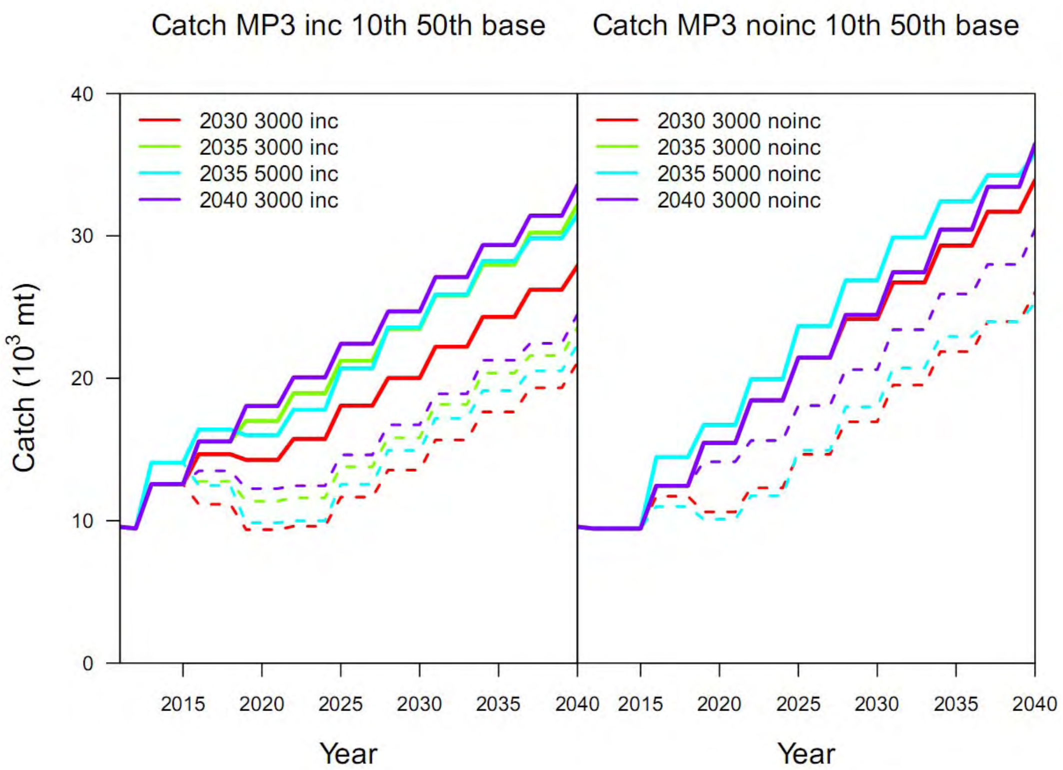

Figure 6. Projected catch by Bali Procedure (referred to in this figure as MP3) for four different variants involving tuning years 2035, 2040 and 2030 and maximum TAC changes of 3000 t and 5000 t (assuming a 1 year lag). The solid lines represent the median values from the 2000 simulations and the dashed lines are the 10th percentiles. For the plots on the left a TAC increase is allowed in the first TAC implementation year (2013) for the MP; the plots on the right allow for a TAC increase in second TAC implementation year (2016), but not in 2013. In the right hand panel the catch increments for the "2035 3000 noinc" and "2040 3000 noinc" are identical.

Summary of the Bali Procedure's performance for robustness tests

115. Performance of the Bali Procedure against the five robustness tests is illustrated in **Attachment 9 Figure 9** and is summarized below.

116. For the *lowR* trial, which is designed to test the response of the MP to a consecutive series of low recruitments not predicted by the OM, the Bali Procedure is close to achieving the SSB rebuilding objective for all combinations of tuning year and TAC constraints. For the *Upq*, *STwindows* and *Updownq*, rebuilding is substantially less than the 0.2 level, with performance being worst against the STwindows robustness test (~20% probability of rebuilding to 0.2 SSB_0). The Bali Procedure succeeded to increase stock biomass substantially with very low probability of decline of stock biomass.

117. General observations on performance specific to each robustness trials include:

- LowR - No increase in TAC in the first decision year results in better rebuilding than when an increase is allowed.
- Omega75 - intermediate performance between LowR and STwindows.
- Upq - 5000t maximum TAC change leads to higher catches and lower SSB rebuilding.
- STwindows – generally the most pessimistic robustness trial for stock rebuilding performance statistics.
- Updownq - 5000t maximum change leads to higher catches and lower rebuilding.

TAC calculations using the Bali Procedure

118. The TAC settings that result from the application of the Bali Procedure under each combination of rebuilding year, maximum TAC constraint and increase/no increase in the first decision TAC year are provided in Table 4 below.

Table 4: TAC results for the Bali Procedure under each combination of rebuilding year, maximum TAC constraint and increase/no increase in first TAC decision year.

Tuning Year	Max change	TAC inc	TAC
2030	3000	Yes	12449
2030	3000	No	9449
2035	3000	Yes	12449
2035	3000	No	9449
2035	5000	Yes	13983
2035	5000	No	9449
2040	3000	Yes	12449
2040	3000	No	9449

9.2 Other

119. CCSBT17 requested candidate MPs be tested for a range of scenarios, including an initial reduction period (IRP) of 2, 3, or 4 years to a TAC of 3,000t or 5,000t (Report of CCSBT17 Attachment 13). Given the more optimistic stock trajectories in the new OM produced using more recent (higher) CPUE and aerial survey indices, neither MP1 nor MP2 could be successfully tuned for the IRP scenarios. Because of these initial results, no further analyses for the IRP scenarios were run at the meeting, and no IRP scenarios were examined for the Bali Procedure. Similarly, additional analysis was not undertaken on requests to present results of MP1 and MP2 runs under the condition that there is no limit on the TAC reduction in the first TAC period; or to present the period required to reach a SSB 20% larger than SSB2009 for the IRP scenarios.

Specification of input data and methods used to calculate indices for MP implementation

120. The recommended MP uses the scientific aerial survey index of abundance and the longline CPUE data.

121. The CPUE modelling group agreed that the base CPUE series used for MP testing should be used for MP implementation. A full specification is provided in Attachment 7 of the report for CCSBT-ESC, 2010.

122. The standardization of the scientific aerial survey is described in Paper CCSBT-ESC/1107/15.

Agenda Item 10. Update of MP and OM codes

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

123. **Attachment 10** details the rationale and technical details behind the Bali Procedure. In particular, it details the relevant parts of each MP that were included, why they were included and why certain elements were excluded, what the fixed MP parameters are and what the tuning parameter will be.

Agenda Item 11. SBT Assessment, Stock Status and Management

11.1 Status of the SBT Stock

124. The ESC advises that the current spawning stock biomass (SSB) remains very low (0.03-0.07 SSB_0); however, the outlook for the stock is positive.

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

Stock

- Reduction in the total reported global catch
- Current fishing mortality reduced and now below F_{MSY} (see Figure 2 and Attachment 11, Figure 5)
- Confirmation of increases in longline CPUE since 2007.

Recruitment

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

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

127. Increases in a number of CPUE indices in the most recent years, such as the New Zealand domestic fishery and Japanese longline fishery for age classes 4 and 5, suggest stronger year classes in recent years. Caution should nevertheless continue to be exercised in interpreting the longline CPUE data, where there is underlying uncertainty in the past data and potential changes in fishing operation patterns since 2006, which remain to be resolved.

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

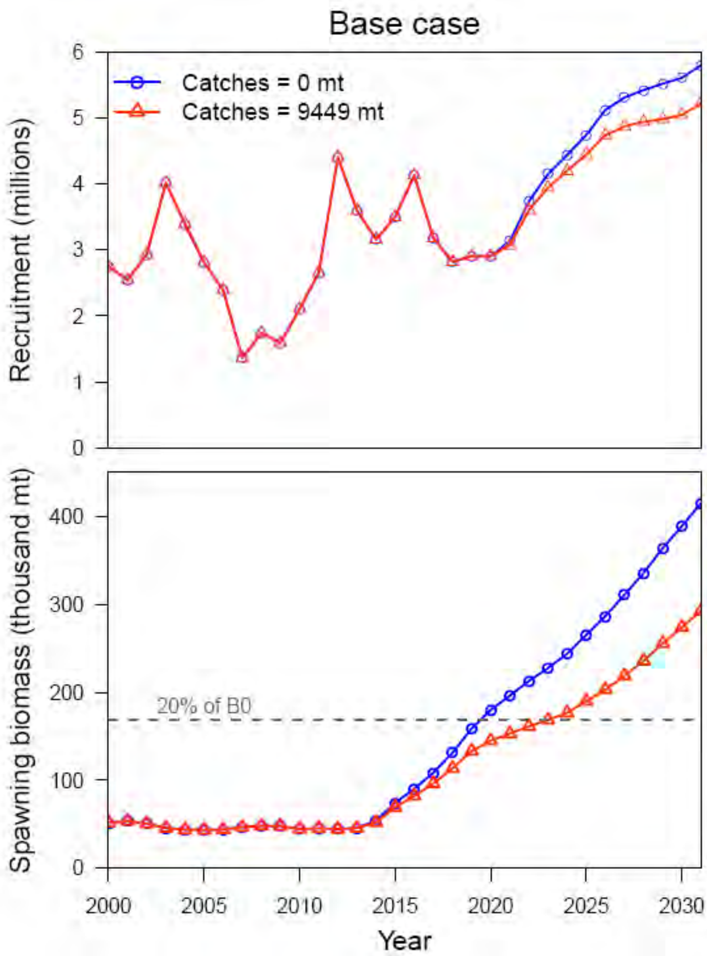

Figure 7. Median recruitment and spawning stock biomass projections under a constant catch equal to the current TAC (9449 t) and zero TAC. Median recruitments beyond 2010 are estimated using the model stock - recruitment relationship and assume that this relationship holds for future levels of spawning stock biomass. Consequently, estimates of the future recruitment are more uncertain.

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

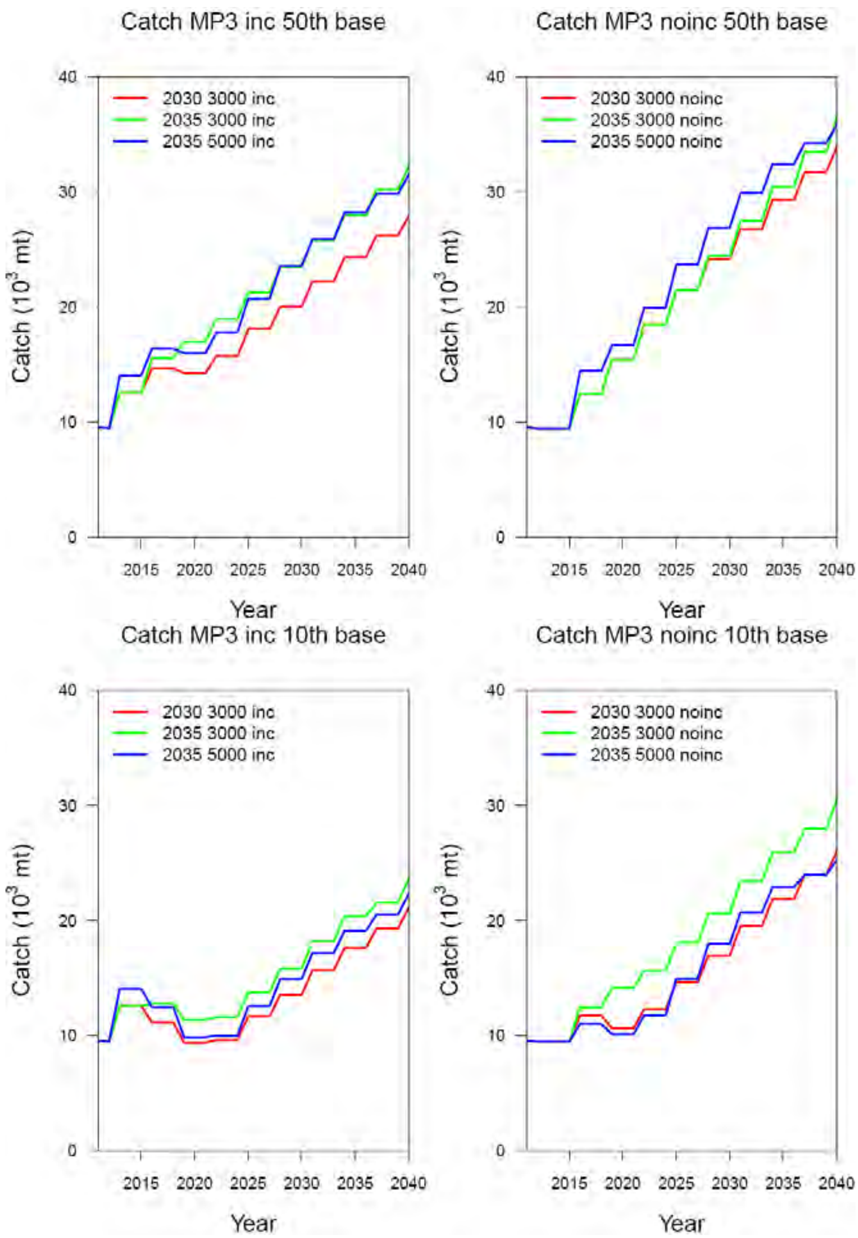

Figure 8. Projected median catch (top row) and 10th percentile of catch (bottom row) for the reference set and a tuning 70% probability of 0.2 SSB_0 by 2030 and 2035 and a maximum TAC change of 3000 and 5000t, with (left column) and without (right column) an increase in TAC in the first implementation year.

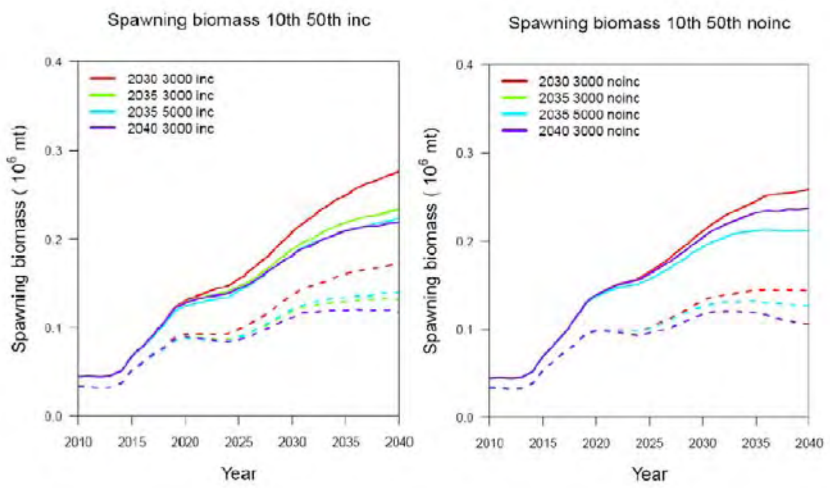

Figure 9. Median recruitment and spawning stock biomass for the base case together with reference level of 20% of pre-exploitation spawning stock biomass (*SSB0*). Projections of future spawning stock biomass and recruitments commence in 2010 for a constant catch equal to the current TAC (9,449t).

130. 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 11.**

11.2 SBT Management Recommendations

131. The ESC recommends the Management Procedure (MP) be adopted.

132. The Extended Commission is referred to Agenda Item 9 of the report to differentiate MP behaviour under alternate MP criteria (tuning year, maximum TAC change and an increase in the initial TAC setting).

133. Based on the MP selected by the Extended Commission the following TACs are recommended (assuming a 1-year lag):

Tuning year	Maximum TAC change (t)	Increase in initial TAC setting	Recommended TAC (t) (2013-2015)
2035	3000	Yes	12449
2035	3000	No	9449
2035	5000	Yes	13983
2035	5000	No	9449
2040	3000	Yes	12449
2040	3000	No	9449
2030	3000	Yes	12449
2030	3000	No	9449

134. The ESC strongly advises that any future TAC changes are considered in the context of an adaptive MP that reacts to the data inputs.

135. If a zero-lag is selected, the MP should be retuned, though differences in biomass and catch performance will be minor.

136. If the MP is implemented in 2011 with a 1-year lag, the ESC recommends that the current TAC of 9449 t remains for 2012 prior to implementation.

137. Under the MP options above there are only three possible TAC changes at the first implementation (0;+3000t;+4534t). The ESC advises the Extended Commission that it could have additional flexibility in the context of an MP by considering a smaller maximum TAC change for the first implementation only. This could be incorporated together with any of the TAC increase options listed in paragraph 133. This would require retuning of the MP prior to the Extended Commission meeting.

138. Noting the importance of accurate data inputs for the performance of the MP, the ESC recommends that the Extended Commission continue to take steps to ensure accurate future catch and effort reporting.

Agenda Item 12. Requirements for Data Exchange in 2012

139. The requirements for the 2012 data exchange were discussed and agreed in the margins of the meeting. These requirements were endorsed by the ESC and are provided in **Attachment 12.**

Agenda Item 13. Research Mortality Allowance

140. Japan advised that its Research Mortality Allowance (RMA) utilisation in the 2010/2011 season was 844.4 kg as reported in CCSBT-ESC/1107/36. Japan also presented an application for 1.0 t of RMA for the 2011/2012 season for the trolling surveys.

141. Australia presented paper CCSBT-ESC/1107/37 which outlined a request for an RMA of 5 t to continue deployment of archival and pop-up satellite tags. The request for 5 t is to allow for the possibility of large inadvertent longline catches. While all efforts would be made to avoid this scenario, the additional RMA was requested as a contingency. It further advised that the specific details for the project were still being finalised but would be provided to Members of the ESC intersessionally.

142. The ESC endorsed Japan’s request for an RMA of 1t and Australia’s request for an RMA of 5t for the purposes specified.

Agenda Item 14. Workplan, Timetable and Research Budget for 2012

14.1. Overview, time schedule and budgetary implications of proposed 2012 research activities.

143. The Secretariat presented paper CCSBT-ESC/1107/05, which provided an update of the surface fishery tagging program, including a proposed budget for tag recoveries in 2012. The Secretariat noted that the actual tag recovery rate for 2011 was unknown since no tags had yet been recovered, and that this was due to the early timing of this meeting.

144. Japan provided details on plans for conducting a troll survey in 2012 in the same format as the 2011 survey (CCSBT-ESC/1107/35). It advised that the survey would be funded by Japan, and would use CCSBT conventional tags. Japan further advised that no new tags would be required as it held sufficient CCSBT tags from previous surveys that would be used.

145. The ESC noted that the Special Meeting of the Extended Commission could request that additional projections be conducted for different MP options between the Special Meeting (ending 27 August 2011) and the annual meeting of the Extended Commission (commencing 10 October 2011). It was agreed that if such a request was made, the Member scientists would conduct the work, coordinated by Dr Parma.

146. The meeting recognised that the workplan for 2012 would be dependent on whether the Extended Commission adopts a management procedure. It was not yet possible to predict the nature of scientific work required if a management procedure was not adopted, so discussion of the workplan was on the assumption that a management procedure is adopted.

147. It was agreed that the 2012 ESC meeting should consider the following priority issues:

- Evaluation of fishery indicators
- Consider the inclusion of new data sources and models with particular reference to:
  - results from close-kin analysis;
  - direct ageing data;
  - results from the global spatial dynamics project;
  - data from the recent SRP tagging program.
- The ESC also encouraged Members to give consideration to the following issues:
  - Investigation of CPUE data from the early days of the fishery to evaluate whether catchability (*q*) decreased during the “fishing down” phase.
  - Further analyses on whether there has been a recent increase in catchability and operational changes in the longline fleet.
  - The possibility of using scientific aerial survey data to develop an index for 1 year old SBT.
  - Evaluation of the use of commercial spotting data and the feasibility of conducting scientific aerial surveys less frequently to minimise the financial burden of the surveys.
- Initial consideration of an updated scientific research plan with the aim of finalising the plan at the 2013 ESC meeting.

148. It was noted that the code for the operating model has yet to be “cleaned” in the manner proposed in 2010 and that cleaning of the code would be beneficial. This involves a substantial amount of programming effort and suitable resources have yet to be identified for this task. One approach is to implement a version control system for the code and have Members conduct incremental clean-up of the code as time permits.

Summary workplan

149. The ESC developed the following workplan for 2012 on the assumption that the Extended Commission adopts an MP by its 2011 annual meeting. This workplan will require revision if an MP is not adopted.

Activity	Approximate Period	Resources or approximate budgetary implications
Continuation of tag recovery efforts.	Tag recovery is continuous.	$10,550 for tag recovery as per draft budget in Attachment B of CCSBT-ESC/1107/05.
Provide SBT Stock Status report to the other tuna RFMOs.	Aug-Nov 11	N/A
Implement a version control system for the operating model code and Members "clean-up" the code as time permits.	Commencing from Nov 11 as time permits	Secretariat to implement version control system (VCS) with advice and assistance from Members. Cost of VCS to be determined. Allocate 5 days by MP coordinator to provide advice on OM code.
CPUE Webinar to review progress of the intersessional work specified in **Attachment 5**	Apr	Intersessional work by Japan, Australia and New Zealand. Three panel days.
Standard Scientific Data Exchange.	Apr – Jul	N/A
Provision of core vessel catch and effort data aggregated by 5x5 and month	Jun – Jul	Provision by Japan to requesting Member(s)
Update OM with Close-kin results	July - August	Australia
Compile existing MP Specifications for review by SC17	August	Secretariat
Extended Scientific Committee for the 17th meeting of the Scientific Committee meeting.	5-6 days, first half of September (depending on venue availability), Tokyo.	ESC Chair, 2-3 panel members, full interpretation and 2-3 Secretariat staff.

14.2. Timing, length and structure of next meeting

150. The ESC considered the Extended Commission's request for advice in relation to the number of panel members required for future ESC meetings and the necessary duration of future meetings. The ESC noted that this is dependent on the workplan, such that when a full stock assessment and an update of the MP is required, a longer meeting and the presence of the full panel is desirable. However, for the current 2012 workplan, which assumes that an MP has been adopted, the ESC considered that 2-3 panel members and a 5-6 day meeting would be sufficient.

151. The next ESC meeting is proposed to be during the first half of September 2012 (subject to venue availability), in Tokyo, Japan.

Agenda Item 15. Other Matters

152. In response to a question from Japan, Australia advised that there were no artificially hatched SBT remaining alive from this year's spawning.

Agenda Item 16. Adoption of Meeting Report

153. The report was adopted.

Agenda Item 17. Close of meeting

154. The meeting closed at 5:40pm on 28 July 2011.

List of Attachments

Attachment

1. List of Participants
2. Agenda
3. List of Documents
4. Global Reported Catch by Flag
5. The report of the CPUE modelling group (Agenda item 6.1)
6. Trends in selected indicators of the SBT stock (Agenda item 6.3)
7. Report of the OM Technical Working Group (Agenda item 7)
8. MSY calculation (Agenda item 8)
9. MP Evaluations (Agenda item 9.1)
10. The rationale and technical details behind the combined MP (Agenda item 10)
11. Stock Status Report (Agenda item 11.1)
12. Data exchange (Agenda item 12)

Attachment 1

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Attachment 2

Agenda

Extended Scientific Committee for the Sixteenth Meeting of the Scientific Committee

Bali, Indonesia

19 – 28 July 2011

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. **Report on intersessional scientific activities**

6. **Inputs to the assessment model and MP and indicators of stock-status**
    - 6.1. CPUE
    - 6.2. Aerial survey
    - 6.3. Other indicators

7. **Update of Operating Model**
    - 7.1. Update operating model using most current data
    - 7.2. Evaluate sensitivity to updated size-at-age data based on new growth estimates
    - 7.3. Approaches for incorporating new information into the assessment
    - 7.4. Possible changes in the structure/parameterization of conditioning and projection model to be used for assessment
    - 7.5. Selection of reference set and sensitivity trials

8. Evaluation of stock status with respect to reference points

8.1. Sensitivity of MSY calculations to input parameters and estimation methods

8.2. Calculation of replacement yield at 20%SSB_0

8.3. Trends in annual surplus production and spawning biomass per recruit

9. MP implementation

9.1. Performance of MP in projections

9.2. Other

10. Update of MP and OM codes

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

11. SBT Assessment, Stock Status and Management

11.1. Status of the SBT Stock

11.2. SBT Management Recommendations

12. Requirements for Data Exchange in 2012

13. Research Mortality Allowance

14. Workplan, Timetable and Research Budget for 2012

14.1. Overview, time schedule and budgetary implications of proposed 2012 research activities

14.2. Timing, length and structure of next meeting

15. Other Matters

16. Adoption of Meeting Report

17. Close of Meeting

Attachment 3

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

(CCSBT-ESC/1107/)

1. Draft Agenda
2. List of Participants
3. List of Documents
4. (Secretariat) Secretariat Review of Catches (ESC agenda item 4.2)
5. (Secretariat) Surface Fishery Tagging Program – an update
6. (Secretariat) Data Exchange (ESC agenda item 12)
7. (Australia) Preparation of Australia's southern bluefin tuna catch and effort data submission for 2011 (Sahlqvist, Hobsbawn)
8. (Australia) Fishery indicators for the southern bluefin tuna stock 2010-11 (Patterson, Preece, Hartog)
9. (Australia) Updated growth estimates for the 1990s and 2000s, and new age-length cut-points for the operating model and management procedures (Eveson)
10. (Australia) Examination of CPUE indices for southern bluefin tuna (Chambers)
11. (Australia) Reconditioning of the southern bluefin tuna operating model: exploratory data analysis, fitting performance, and current stock status (Hillary, Preece, Barnes, Davies, Begg, Chambers, Tennant)
12. (Australia) Updated technical specifications and performance analyses for MP1 (Hillary, Preece)
13. (Australia) Results of the performance of MP1 (Barnes, Hillary, Tennant, Chambers, Preece, Davies, Begg)
14. (Australia) Reference point estimation for southern bluefin tuna (Hillary, Preece, Davies)
15. (Australia) The aerial survey index of abundance: updated analysis, methods and results for 2010/11 fishing season (Eveson, Farley, Bravington)
16. (Australia) Commercial spotting in the Australian surface fishery, updated to include the 2010/11 fishing season (Farley, Basson)
17. (Australia) An update on Australian otolith collection activities, direct ageing and length at age keys for the Australian surface fishery (Farley, Eveson, Clear)

18. (Australia/Indonesia) Update on the length and age distribution of SBT in the Indonesian longline catch (Farley, Eveson, Nugraha, Proctor)
19. (Australia) Update on the close-kin genetics project for estimating the absolute spawning stock size of SBT (Bravington, Grewe, Davies)
20. (Australia) Update on the global spatial dynamics archival tagging project – 2011 (Basson, Eveson, Hobday, Lansdell, Patterson)
21. (Australia) Identifying spatial structure of juvenile southern bluefin tuna using otolith microchemistry: initial results from a pilot project (Clear, Macdonald)
22. (Australia) Global markets for southern bluefin tuna: Principles for an analysis of established, expanding and emerging markets (Phillips)
23. (Japan) Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2010/2011 (Osamu Sakai, Daisuke Tokuda, Tomoyuki Itoh, Yuujirou Akatsuka and Osamu Abe)
24. (Japan) Report of activities for conventional and archival tagging and recapture for southern bluefin tuna by Japan in 2010/2011 (Osamu Sakai, Daisuke Tokuda and Tomoyuki Itoh)
25. (Japan) Activities of otolith collection and age estimation and analysis of the age data by Japan in 2010 (Tomoyuki Itoh, Osamu Sakai, Akio Hirai and Kenichiro Omote)
26. (Japan) Analysis of age composition and catch amount of southern bluefin tuna used for farming in 2010 (Tomoyuki Itoh, Tetsuya Kawashima and Mari Mishima)
27. (Japan) Monitoring of Southern Bluefin Tuna tradingin the Japanese domestic markets: 2011 update (Osamu Sakai, Tomoyuki Itoh, Mari Mishima, and Tetsuya Kawashima)
28. (Japan) Summary of fisheries indicators of southern bluefin tuna stock in 2011 (Norio Takahashi and Tomoyuki Itoh)
29. (Japan) Report of the piston-line trolling monitoring survey for the age-1southern bluefin tuna recruitment index in 2010/2011 (Tomoyuki Itoh, Ko Fujioka and Osamu Sakai)
30. (Japan) Standardized CPUE for Management Procedure in 2011 (Tomoyuki Itoh, Osamu Sakai and Norio Takahashi)
31. (Japan) Change in operation pattern of Japanese SBT longliners in 2010 resulting from the introduction of the individual quota system in 2006 (Tomoyuki Itoh)
32. (Japan) Releases and discards of small Southern Bluefin Tuna in the Japanese longline fishery (Osamu Sakai and Tomoyuki Itoh)
33. (Japan) Conditioning of the SBT operating model to inform projection

specifications (Osamu Sakai, Hiroyuki Kurota, Norio Takahashi, and Doug S Butterworth)

34. (Japan) Performance of the empirical management procedure (MP2) under the updated operating models (Hiroyuki Kurota, Norio Takahashi, Osamu Sakai, and Doug S Butterworth)
35. (Japan) Proposal for the recruitment monitoring survey in 2011/2012 (Tomoyuki Itoh and Osamu Sakai)
36. (Japan) Report of the 2010/2011 RMA utilization and application for the 2011/2012 RMA (Fisheries Agency of Japan)
37. (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 (Evans, Patterson, Davies)

(CCSBT- ESC/1107/BGD)

(CCSBT-ESC/1107/SBT Fisheries -)

Australia	Australia's 2009-10 southern bluefin tuna fishing season
New Zealand	Annual Review of National SBT Fisheries for the Scientific Committee – New Zealand (2011)
Japan	Review of Japanese SBT Fisheries in 2010
Taiwan	Review of Taiwan SBT Fisheries of 2009/2010
Indonesia	Indonesia Southern Bluefin Tuna Fishery
Korea	Review of Korean SBT Fishery for 2010 fishing year
South Africa	
Philippines	
European Union	

(CCSBT-ESC/1107/Info)

(CCSBT-ESC/1107/Rep)

1. Report of the Seventeenth Annual Meeting of the Commission (October 2010)
2. Report of the Fifteenth Meeting of the Scientific Committee (September 2010)
3. Report of the Third Operating Model and Management Procedure Technical Meeting (June 2010)
4. Report of the Second meeting of the Strategy and Fisheries Management Working Group Meeting (April 2010)

5. Report of the Sixteenth Annual Meeting of the Commission (October 2009)
6. Report of the Fourteenth Meeting of the Scientific Committee (September 2009)
7. Report of the Operating Model and Management Procedure Technical Meeting (July 2009)
8. Report of the Strategy and Fisheries Management Working Group Meeting (April 2009)

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 5 of the SC15 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		565	0		0	0	0	0	0	0	0	
1953	509		3,890	0		0	0	0	0	0	0	0	
1954	424		2,447	0		0	0	0	0	0	0	0	
1955	322		1,964	0		0	0	0	0	0	0	0	
1956	964		9,603	0		0	0	0	0	0	0	0	
1957	1,264		22,908	0		0	0	0	0	0	0	0	
1958	2,322		12,462	0		0	0	0	0	0	0	0	
1959	2,486		61,892	0		0	0	0	0	0	0	0	
1960	3,545		75,826	0		0	0	0	0	0	0	0	
1961	3,678		77,927	0		0	0	0	0	145	0	0	
1962	4,636		40,397	0		0	0	0	0	724	0	0	
1963	6,199		59,724	0		0	0	0	0	398	0	0	
1964	6,832		42,838	0		0	0	0	0	197	0	0	
1965	6,876		40,689	0		0	0	0	0	2	0	0	
1966	8,008		39,644	0		0	0	0	0	4	0	0	
1967	6,357		59,281	0		0	0	0	0	5	0	0	
1968	8,737		49,657	0		0	0	0	0	0	0	0	
1969	8,679		49,769	0		0	80	0	0	0	0	0	
1970	7,097		40,929	0		0	130	0	0	0	0	0	
1971	6,969		38,149	0		0	30	0	0	0	0	0	
1972	12,397		39,458	0		0	70	0	0	0	0	0	
1973	9,890		31,225	0		0	90	0	0	0	0	0	
1974	12,672		34,005	0		0	100	0	0	0	0	0	
1975	8,833		24,134	0		0	15	0	0	0	0	0	
1976	8,383		34,099	0		0	15	0	12	0	0	0	
1977	12,569		29,600	0		0	5	0	4	0	0	0	
1978	12,190		23,632	0		0	80	0	6	0	0	0	
1979	10,783		27,828	0		0	53	0	5	0	0	4	
1980	11,195		33,653	130		0	64	0	5	0	0	7	
1981	16,843		27,981	173		0	92	0	1	0	0	14	
1982	21,501		20,789	305		0	182	0	2	0	0	9	
1983	17,695		24,881	132		0	161	0	5	0	0	7	
1984	13,411		23,328	93		0	244	0	11	0	0	3	
1985	12,589		20,396	94		0	241	0	3	0	0	2	
1986	12,531		15,182	82		0	514	0	7	0	0	3	
1987	10,821		13,964	59		0	710	0	14	0	0	7	
1988	10,591		11,422	94		0	856	0	180	0	0	2	
1989	6,118		9,222	437		0	1,395	0	568	0	0	103	
1990	4,586		7,056	529		0	1,177	0	517	0	0	4	
1991	4,489		6,477	164		246	1,460	0	759	0	0	97	
1992	5,248		6,121	279		41	1,222	0	1,232	0	0	73	
1993	5,373		6,318	217		92	958	0	1,370	0	0	15	
1994	4,700		6,063	277		137	1,020	0	904	0	0	54	
1995	4,508		5,867	436		365	1,431	0	829	0	0	201	296
1996	5,128		6,392	139		1,320	1,467	0	1,614	0	0	295	290
1997	5,316		5,588	334		1,424	872	0	2,210	0	0	333	
1998	4,897		7,500	337		1,796	1,446	5	1,324	1	0	471	
1999	5,552		7,554	461		1,462	1,513	80	2,504	1	0	403	
2000	5,257		6,000	380		1,135	1,448	17	1,203	4	0	31	
2001	4,853		6,674	358		845	1,580	43	1,632	1	0	41	4
2002	4,711		6,192	450		746	1,137	82	1,701	18	0	203	17
2003	5,827		5,770	390		254	1,128	68	565	15	3	40	17
2004	5,062		5,846	393		131	1,298	80	633	19	23	2	17
2005	5,244		7,855	264		38	941	53	1,726	24	0		5
2006	5,635		4,207	238		150	846	50	598	9	3		5
2007	4,813		2,840	379	4	521	841	46	1,077	41	18		3
2008	5,033		2,952	319	0	1,134	913	45	926	45	14	4	10
2009	5,108		2,659	419	0	1,117	**921**	47	641	32	2		0
2010	4,199		2,223	501	0	867	1,208	43	468	34	3		1

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.

Attachment 5

Meeting of the CPUE Modelling WG

The Chair (John Pope) opened the meeting and reminded members of ongoing tasks - particularly those CPUE issues outlined in the ESC report under Agenda 14.1.

These concern possible changes in catchability in the early days of the fishery and in the most recent years 5 years in particular. An additional question might be the investigation of the sensitivity of the OM to technical creep in vessel efficiency (presently set at 0.5% in the operation model) and hence in catchability.

The Chair updated the meeting on work he had conducted before and during the meeting on recent changes in catchability. These involved linear models of CPUE at age data and also some thoughts on approximating concentration indices by

1. Using the ratio of the variable square (VS) CPUE index to the constant squares index, which may reflect concentration of area fished
2. Considering the ratio of the Nominal CPUE series to VS which may approximate to a concentration index senso Gulland 1956. Prof Hillborn put this paper on the server for the benefit of members.

There was a lively discussion of the issues. With respect to early changes in catchability it was noted that these did not seem to strongly impact the MP operating model but they could well become an urgent issue in respect of any "listing" process for SBT. The early decline in CPUE is possibly misleading but might be central to any decline criteria used by certain IGO's. Suggestions for work included investigation of the quality of early catch size distributions (action KS to talk to Talbot Murray) that may be an important contributor to the perceived decline.. Investigating vessel effects might also be a valuable tool.

With respect to both past and recent problems there was a need to develop ways to investigate catchability. It was agreed that Dr Itoh should be encouraged to provide updates of his paper (CCSBT-ESC/1107/31) on trends in the SBT fishery for future years. The Chairman's suggestion of using analysis of CPUE at age by area data was thought useful and he would provide members with an update of the working paper he had provided to the meeting (Action JP). The Chairman's suggestion of investigations of concentration indices was also thought useful and he would liaise with Dr Itoh with a view to including these in an update of CCSBT-ESC/1107/31 (action JP, TI).

Discussion of concentration indices reminded the group that considerable work had been conducted on this problem before most members were involved with SBT. A review of past work and some clarification of measures such as VS (including consideration of alternative definitions) and the Laslett core area and ST windows measures would be helpful (action NT, MC) for more recent group members. More generally we should draw on the collective memory of present and past members.

Understanding fleet movements could be useful in understanding effort concentration. How fleets behaved with respect to changes in abundance by size also seemed to be a poorly understood aspect of catchability. There was also an issue with how selection should be normalized by age since this may affect the perceived catchability of the LL fleet. (action all group members to think of and propose analyses).

The possibility of standardized research sets by commercial vessels was raised. Various approaches were discussed. (Action DB to form a small discussion group to explore the practicality and possible design of such a survey). CD offered to provide an example from the east coast tuna fishery on the design of a similar idea.

The possible inclusion of other countries CPUE was discussed. In particular developing a CPUE series from the Indonesian by-catch fishery of spawning SBT could be useful. However, Indonesia has limited resources for such data collection which would require extension of current trial observer and logbook programmes. The utility of this might thus need to be weighed against that of the close kin studies of SBT spawning stock abundance, due for completion in the coming year, that if successful could provide an ongoing time-series of SSB abundance of SBT.

Lastly it was noted that there was mounting evidence on changes in the short and long term distribution and movement of SBT and that these are likely to be partly the result of environmental influences. The group re-iterated it's earlier request to investigate the use of environmental correlates in the analysis of CPUE and that this would be best pursued by an active collaboration between Japan TI and Australia (CD).
The Chair mentioned it was possible his role might be less in future years and the group may need to find a new chair in due course. He suggested that to encourage intersessional work it may be useful to arrange a web meeting possibly in April 2012.

Action Initials
JP= John POPE
KS=Dr Kevin SULLIVAN
TI= Dr Tomoyuki ITOH
MC =Mr Mark CHAMBERS
DB =Prof Doug. BUTTERWORTH
NT =Dr Norio TAKAHASHI
CD+ Dr Campbell DAVIS

Attachment 6

Trends in selected indicators of the SBT stock

Indicator	Period	Min.	Max.	2007	2008	2009	2010	2011	12 month trend 2009 to 2010	12 month trend 2010 to 2011
Scientific aerial survey	1993–2000 2005–11	0.581 (2007)	1.813 (1993)	0.881	0.919	0.592	1.129	1.776	↑	↑
SAPUE index	2002–11	0.51 (2004)	1.70 (2011)	0.91	1.26	0.83	1.40	1.70	↑	↑
Trolling index	1996–2003 2005–06 2006–11	2.817 (2006)	5.653 (2011)	4.723	5.426	3.578	2.918	5.653	↓	↑
NZ charter nominal CPUE (Areas 5+6)	1989–2010	1.339 (1991)	7.825 (2010)	1.746	4.881	4.326	7.825		↑	
NZ domestic nominal CPUE	1989–2010	0.000 (1989)	1.904 (2010)	0.715	0.870	1.256	1.904		↑	
NZ charter age/size composition (proportion age 0–5 SBT)	1989–2010	0.001 (2005)	0.414 (1993)	0.082	0.237	0.333	0.254		↓	
NZ domestic age/size composition (proportion age 0–5 SBT)	1980–2010	0.001 (1985)	0.404 (1995)	0.004	0.114	0.092	0.194		↑	
Indonesian age composition: mean age on spawning ground, all SBT	1993–94 to 2008–10	14 (2005–06)	24 (1995–96)	15.1	16.7	15.6	15.6		–	
Indonesian age composition: median age on spawning ground	1994–95 to 2008–10	13 (2001–03)	21 (1994–97, 1998–99)	15	17	15	16		↑	

Indicator	Period	Aerial Weighting	Min.	Max.	2007	2008	2009	2010	2011	12 month trend	
										2009 to 2010	2010 to 2011
Standardised JP LL CPUE (age 3)	1969–2010	W0.5	0.249 (2003)	2.633 (1972)	0.528	0.691	0.587	0.294		↓	
		W0.8	0.287 (2003)	2.470 (1972)	0.616	0.931	0.710	0.354			
Standardised JP LL CPUE (age 4)	1969–2010	W0.5	0.314 (2006)	2.739 (1974)	0.427	0.559	0.849	0.718		↓	
		W0.8	0.349 (2006)	2.523 (1974)	0.494	0.746	1.095	0.897			
Standardised JP LL CPUE (age 5)	1969–2010	W0.5	0.292(2006)	2.478 (1972)	0.301	0.448	0.780	1.334		↑	
		W0.8	0.328(2006)	2.350 (1972)	0.358	0.568	1.036	1.805			
Standardised JP LL CPUE (age 6+7)	1969–2010	W0.5	0.260 (2007)	2.447 (1976)	0.260	0.397	0.489	0.887		↑	
		W0.8	0.310 (2007)	2.349 (1976)	0.310	0.494	0.639	1.236			
Standardised JP LL CPUE (age 8-11)	1969–2010	W0.5	0.315 (2007)	3.256 (1969)	0.315	0.454	0.400	0.380		↓	
		W0.8	0.362 (1992)	2.994 (1969)	0.379	0.549	0.509	0.515		↑	
Standardised JP LL CPUE (age 12+)	1969–2010	W0.5	0.526 (2010)	2.873 (1970)	0.537	0.689	0.630	0.526		↓	
		W0.8	0.632 (1978)	2.598 (1970)	0.648	0.860	0.792	0.692			

Attachment 7

Report of the OM Technical Working Group

The OM technical working group met to discuss the updated OM.

The group examined the SSB and recruitment estimates from the OM reference set, partitioned by steepness values (Figure 1), in an attempt to identify causes for the change in the recovery trajectories for SSB in the updated OM compared with the 2009 update of the OM. It was noted from these figures that the change in the recovery rate was informed by steepness and not just recent higher recruitment.

The discussion focused next on identifying the sources within the data that resulted in the preference for higher levels of steepness in the OM. The likelihood profiles, partitioned by steepness and M10 (natural mortality at age 10), for the basehup reference set agreed upon before the ESC meeting show the impacts of the different components of the objective function in the OM on the steepness estimates, and which components are dominant and/or conflicting (Figure 2). The LL3 component of the OM prefers higher steepness values. The LL3 fishery is the Area 2 fishery, where catches became very small after 1971 when Japan closed this area to targeted SBT fishing. It was agreed at the ESC14 meeting (2009), that when catches are very small (< 200 t) the length frequency data would not be fitted (paragraph 50 and Attachment 9 in the ESC14 report).

The technical working group examined the impact of recent and early LL3 data on the steepness posteriors. With the most recent 3 years of data excluded, the likelihood profiles for the various components are the same. These data were not informing steepness. Most of the catch and information for the model is from the early part of the LL3 time series. To improve the fit to the catch composition data, selectivity was made more flexible, through increasing the frequency of selectivity changes, over certain periods of the fishery, and excluding LL3 data for the low catch years. The increased flexibility on selectivity in the LL3 component shows that M10 (natural mortality at age 10) is also sampled for higher values, and therefore an additional M10 value of 0.16 was included in the OM reference set and the 0.14 value was changed to 0.13.

For LL3 selectivity the following changes were made: early years selectivity changes in blocks of 4 years (1961 to 1968); then in 1 year blocks (1969 to 1971); years 1972-2004 were not fitted; selectivity for 2005-2007 was fitted each year; and data after 2007 were not fitted.

After these changes were implemented, profiles on the likelihood of different components showed that LL3 did not appear to strongly favour higher steepness values (Figure 3). It was agreed that this new flexibility in the selectivities for LL3 be included in the OM. The technical group also determined that the MPs were re-tuned using this new reference set.

The technical working group also discussed the recent CPUE trends and changes in operational behaviours and catchability that could change the relationship between CPUE and abundance. This included discussion of the recent change in the distribution of operations in the Japanese longline fishery. The ratio of variable squares to constant squares had declined since 2006, highlighting the concentration of operations in recent years. It was noted that this decline since 2006 corresponds with the changes in management in the Japanese fishery, but that other factors may be contributing to the continued concentration. It is unknown how these factors may have changed the relationship between CPUE and SBT abundance.

Trends of increased CPUE in all year classes in a year have been observed in the Japanese LL fishery (Figure 1 in CCSBT-ESC/1107/11). The group discussed possible causes for these year effects in the CPUE (e.g. increased catchability, increased recruitment, changes in selectivity and mortality), but there was no evidence to conclude that it is caused by a single factor. There were some concerns about the implications of possible increases in catchability in some years across age classes, which did not relate to increased abundance. It was decided that these concerns could be addressed in the robustness trials, some of which are intended to test the MPs to ensure that they are robust to alternative scenarios related to uncertainty in the CPUE. The likelihood of the size of a potential catchability increase for use in a robustness trial was examined. From likelihood profiles of the change in catchability in 2008, a step function increase of 0.35 in 2008 was agreed for use in a new robustness trial called upq2008.

The OM technical Working Group agreed with recommendations made in previous years that the “base” model in the CPUE standardization would be used unless there was an exception or major concerns. It was also suggested that the base CPUE series should stay within the bounds of the other CPUE series (currently bounded by Laslett Core CPUE and the STwin model). It was noted that these two series had crossed over each other in the past. No further investigation of the CPUE and inputs data was attempted at the meeting, and the existing base CPUE series was used in the OM.

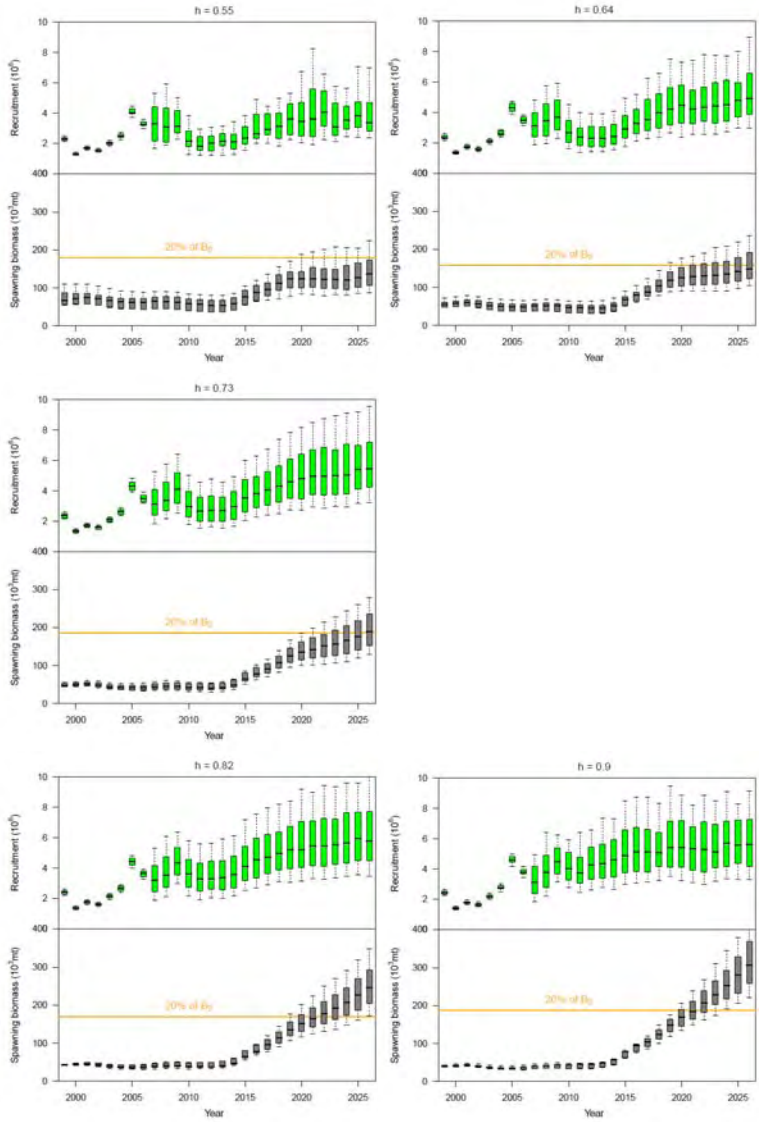

Figure 1: projections of spawning stock biomass and recruitment under constant current catch, partitioned by steepness level (h) ranging from least productive (h=0.55) to most productive (h=0.9).

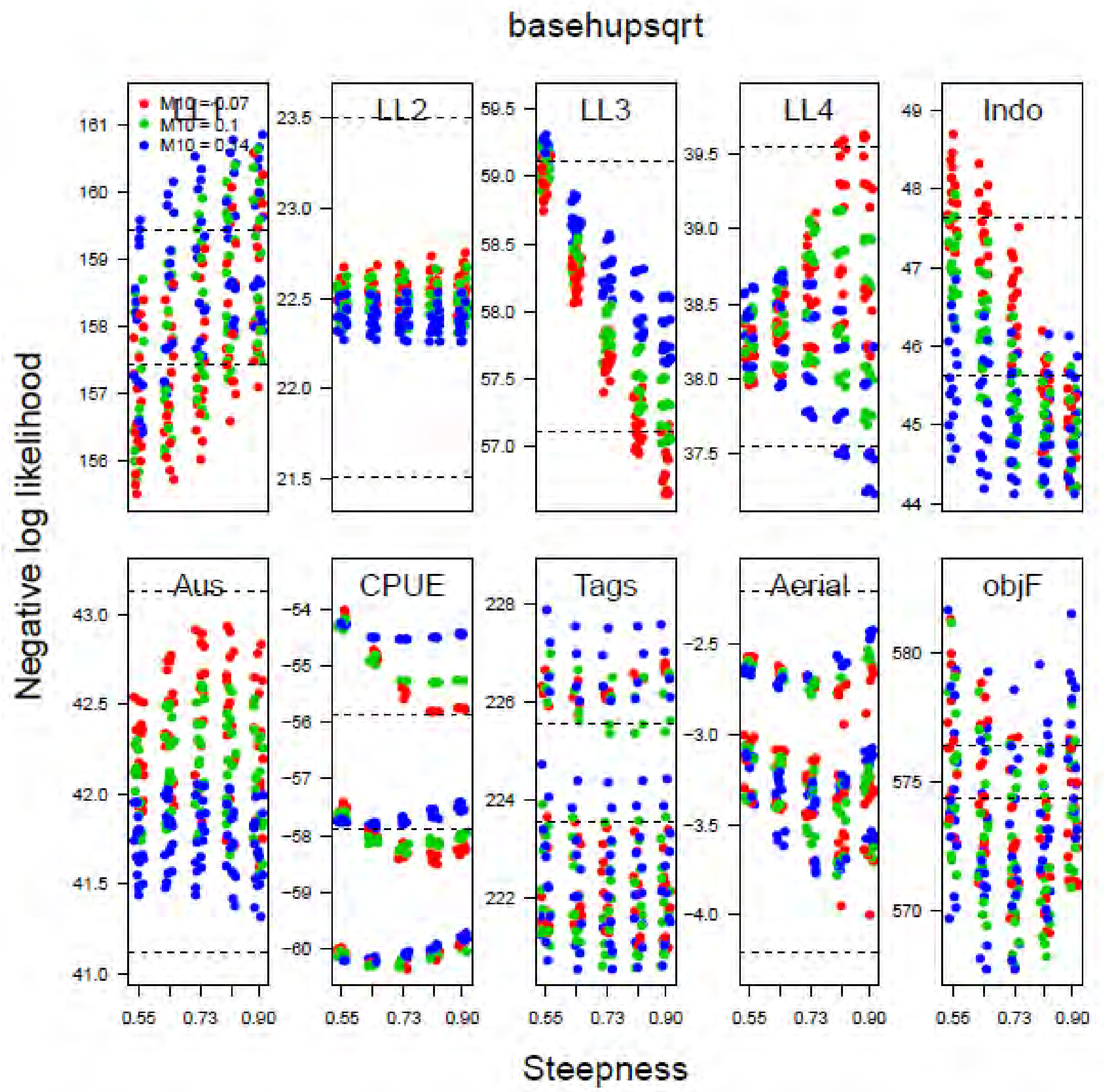

Figure 2. Components of the likelihood for the operating model, for the basehup reference set agreed on before the ESC meeting.

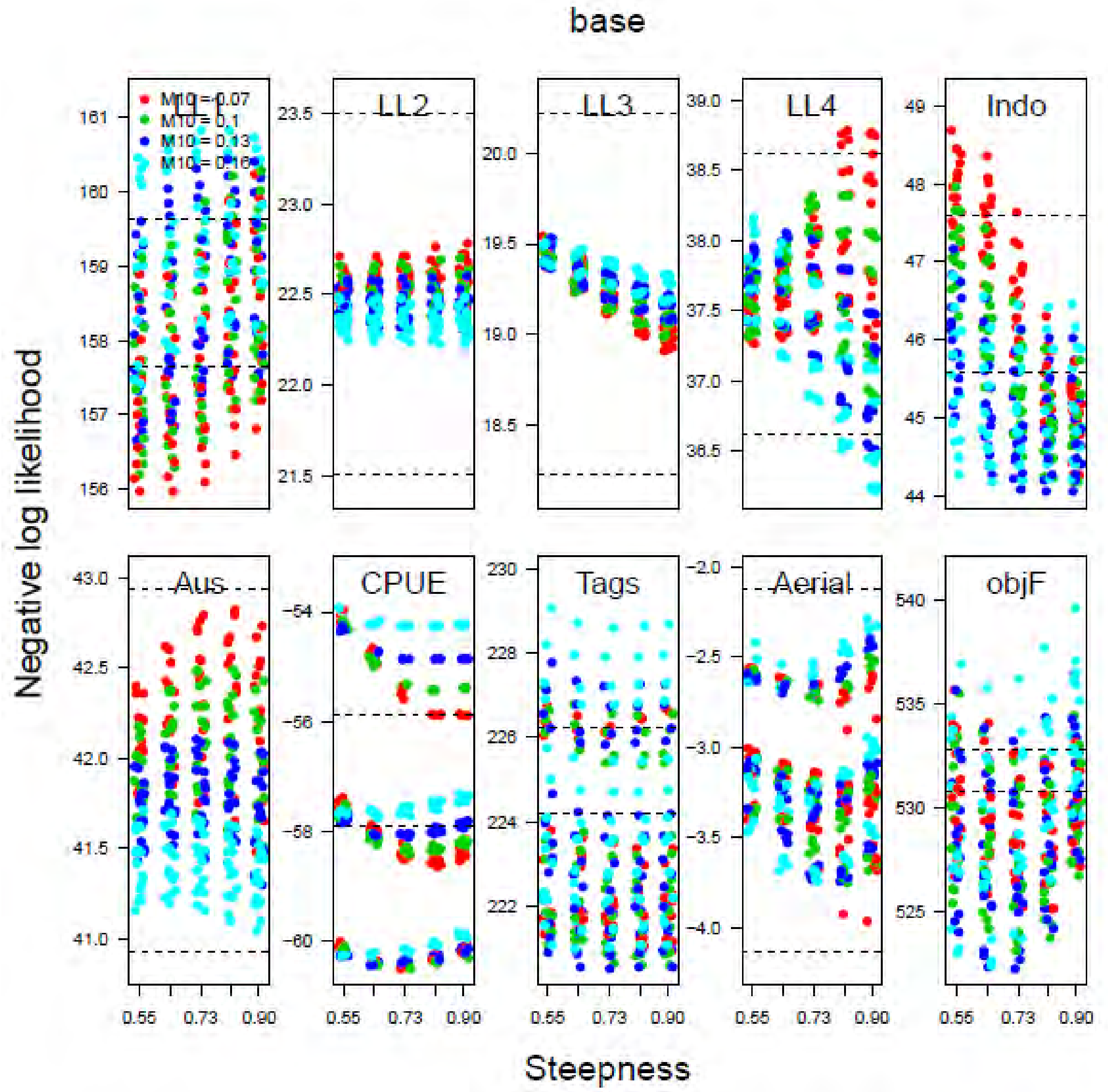

Figure 3. Components of the likelihood for the operating model, for the basehup reference set agreed on before the ESC meeting.

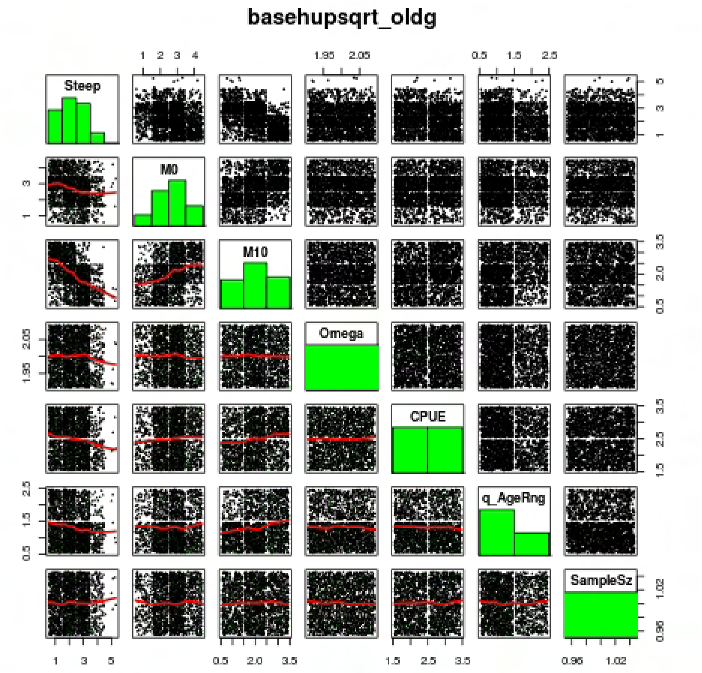

Figure 4a) Sampling of different model parameter values under the old growth schedule.

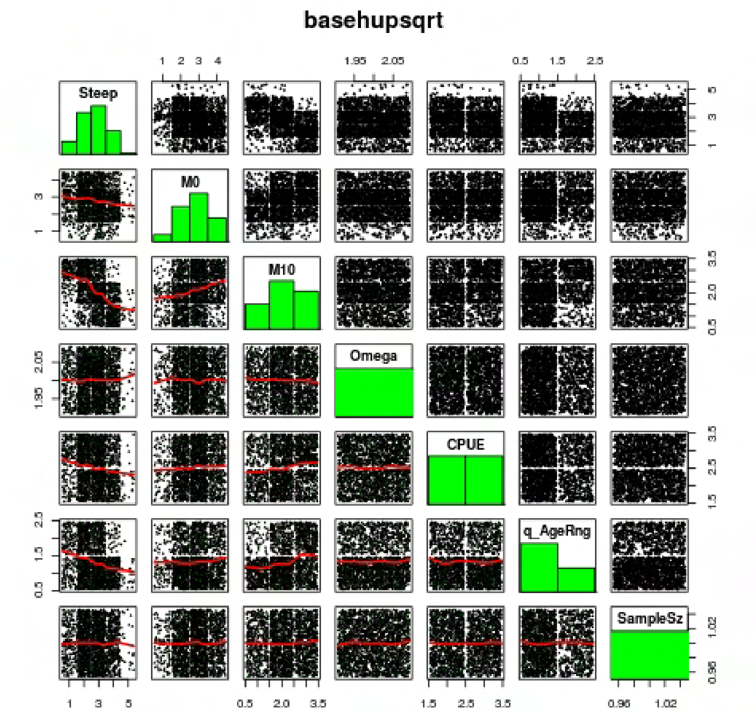

Figure 4b. Impact on Figure 1a of updating the growth schedule.

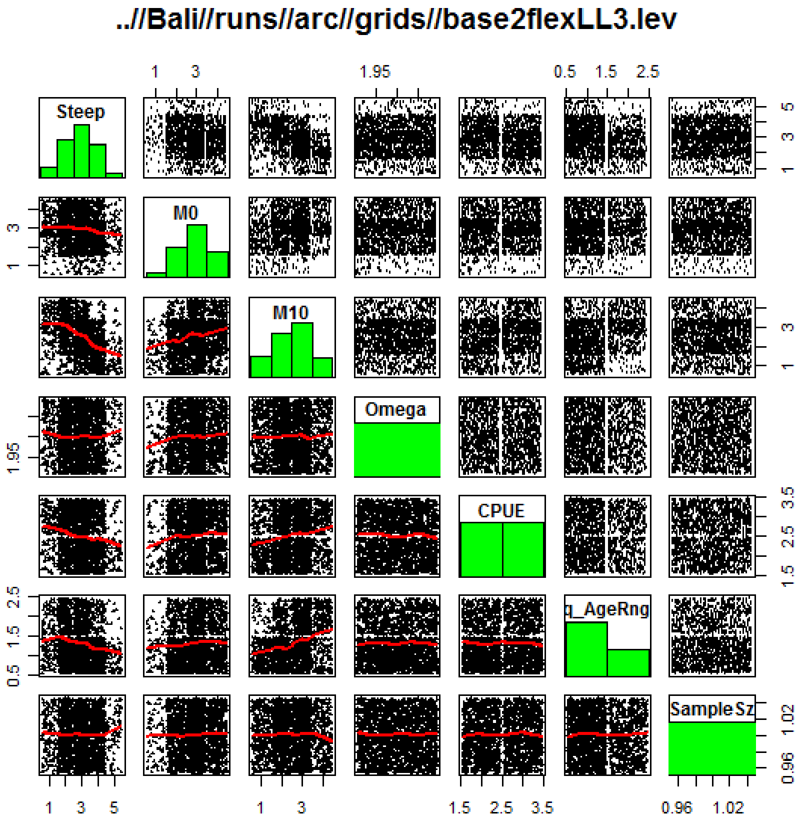

Figure 5. Shadow plots of the likelihood distribution for the new reference set.

Attachment 8

MSY calculation

Equilibrium maximum sustainable yield is calculated based on the same equations used for conditioning the operating model. For each year, the equilibrium yield is maximized numerically using the year-specific weight and selectivities at age, and subject to a constraint that the allocation between the six fisheries is maintained at the observed values in each year. The numerical maximization is conducted using a stand-alone ADMB code which solves for the values of F_f, one for each fishery, that maximize total yield while minimizing (essentially setting to zero) the sum of squares of the difference between the catch in weight proportions by fishery and the year allocation.

To calculate the overall F^{msy} the harvest rates at age within each season are first summed to calculate the total mortality at age as:

$$F_a^{msy} = -\log\left(1 - \sum_{f \in f^1} H_{f,a}^{msy}\right)\left(1 - \sum_{f \in f^2} H_{f,a}^{msy}\right)$$

Then the average F^{msy} is calculated as the average of the age-specific F_a^{msy} for ages 2 to 15, weighted by the equilibrium total biomass at age B_a^{msy} (biomass calculated using weights for season 1).

$$F_{2-15}^{msy} = \frac{\sum_{a=2}^{a=15} F_a^{msy} B_a^{msy}}{\sum_{a=2}^{a=15} B_a^{msy}}$$

The actual proportions of catch attributed to the different fisheries is shown in Figure 1.

A comparison of annual fleet and age specific fishing mortality rates is shown in Figure 2. Spawning biomass per recruit values over the reference grid is shown in Figure 3.

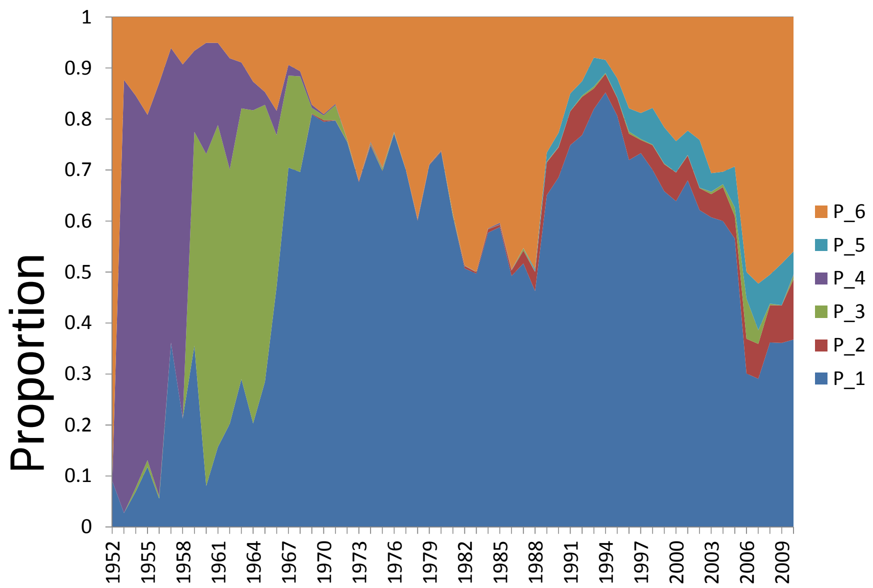

Figure 1. Proportion of total catch by "fishery" as defined in the operating model, 1952-2010. P_1 represents the catch attributed to "longline 1"), P_5 is the Indonesian fishery, and P_6

represents catch in the surface fishery. The other fisheries form the balance of catches.

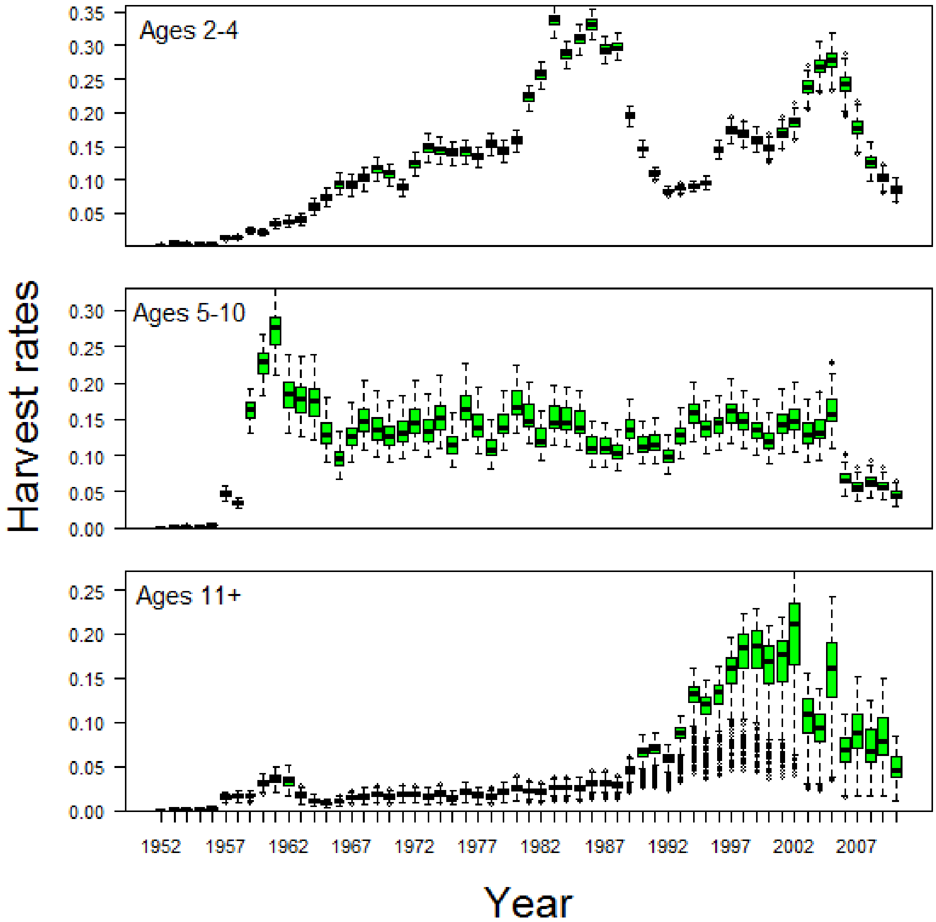

Figure 2. Harvest rate by age groups for SBT from 1952-2010. Boxplot representations are as follows: horizontal lines within the box is the median, the box delineates the inter-quartile range, and “whiskers” extend 1.5 times the interquartile range.

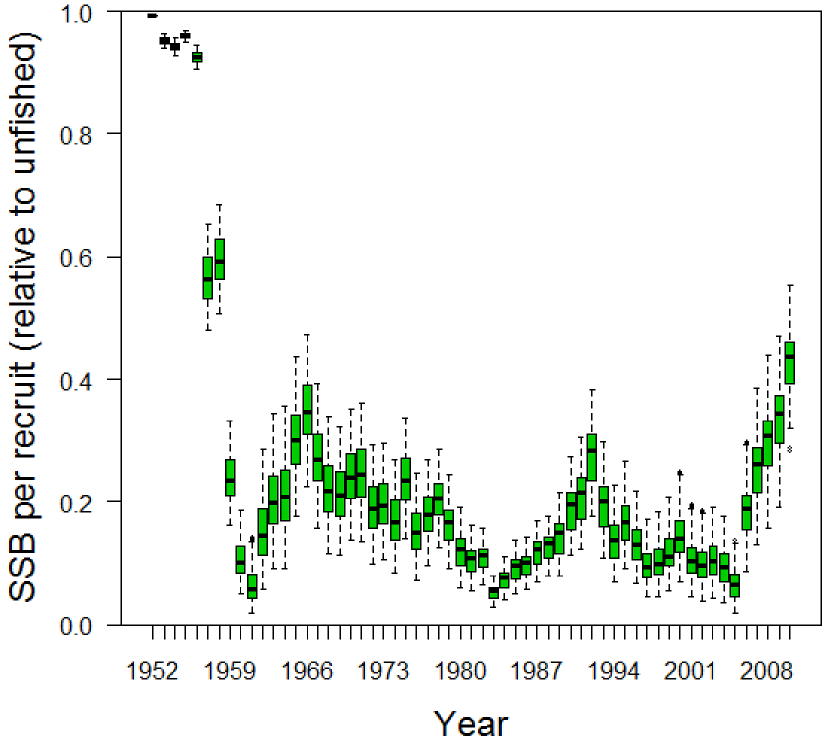

Figure 3. Trends in equilibrium spawning biomass per recruit relative to unfished calculated based on the current reference set. Note that lower values indicate higher fishing rates (the calculation is the reduction in spawning biomass per recruit due to fishing). Boxplot representations are as follows: horizontal lines within the box is the median, the box delineates the inter-quartile range, and "whiskers) extend 1.5 times the interquartile range.

Attachment 9

MP Evaluations.

MPs were evaluated for the reference set and against robustness trials for a set of alternative tuning years and operational constraints on the TAC changes. These were: tuning year 2035 or 2040, maximum TAC change of 3000t or 5000t, and increase or no increase in the first TAC decision year. The lag between TAC decision and implementation year was set to 1 as a default for all the evaluations conducted for and at the meeting, noting that earlier evaluations had demonstrated that the "lag" did not have a substantial impact on MP performance behaviour. The Commission agreed in 2010 that all MPs would be tuned to a 70% probability of reaching the target of 20% SSB_0 by the tuning year, and that TAC changes would be every three years. An additional tuning year, 2030, was used for evaluation of the performance of MPs because MP2 was unable to tune to all the combinations requested, and in light of the increased productivity estimated in the updated OM.

The set of robustness trials examined during the meeting were:

Name	Description
lowR	4 years (from 2011) where recruitment is 50% lower than predicted, uncorrelated with subsequent recruitments.
omega75	Omega value of 0.75 (CPUE non-linearity factor) or a higher value that is more supported by data (note that the value of that 0.75 has little support relative to the linear relationship).
STwin	Substitute alternative CPUE series by ST-windows (the most pessimistic trend) to represent alternatives for changes in spatio-temporal distribution of fishing effort.
updownq	Catchability goes up by 50% in 2009 and returns to normal in 5 years as fishermen adjust to new management regime. Uncorrelated with subsequent CPUE observations
upq	Step function change in catchability 35% up between 2007 and 2008 unknown to the MP.

Figures 1- 4 provide a comparison of MP1 and MP2 trajectories for SSB and recruitment, for various combinations of tuning year and maximum TAC change.

Figure 5 provides a comparison of the MP1 performance tuned to 2035 and 3000t combination, with and without an increase in the first TAC tuning year.

Figure 6 provides the statistics comparing the performance of MP1 and MP2 for procedures tuned to 2030 and 3000 t maximum change in TAC, allowing either an increase (inc) or no increase (noinc) in 2013.

Figure 7 provides statistics comparing the performance of MP1, MP2 and the Bali Procedure for procedures tuned to 2030 and 3000 t maximum change in TAC, under the base case and four robustness trials.

Figure 8 provides statistics comparing the performance of MP1 and the Bali Procedure for procedures tuned to 2035 and 3000 t maximum change.

Figure 9 provides statistics comparing the performance of the Bali Procedure under eight combinations of tuning year, maximum TAC change, and allowing an increase or not in the first decision year, and for the base case and five robustness scenarios.

Figure 10 provides statistics comparing the performance of the Bali Procedure under tuning year, maximum TAC change, and allowing an increase or not in the first decision year, and for the base case; grouped by robustness scenarios.

Table 1 provides a summary of MP1 and MP2 performance for the updated OM for a range of exploratory tuning criteria for the reference set and the robustness trials.

Table 2 provides a summary of the Bali Procedure's performance for the reference set and the robustness trials.

The ESC noted that, should the Commission adopt the recommended MP and decide the combination of rebuilding period (tuning year) and operational constraints on TAC changes for the MP (including consideration of the options outlined in paragraph 137 of the ESC Report) this would fully specify the final MP for implementation. This fully specified MP would be retuned to the agreed specification between the Special Meeting of the Extended Commission in August and CCSBT 18 to provide the TAC for implementation to CCSBT 18.

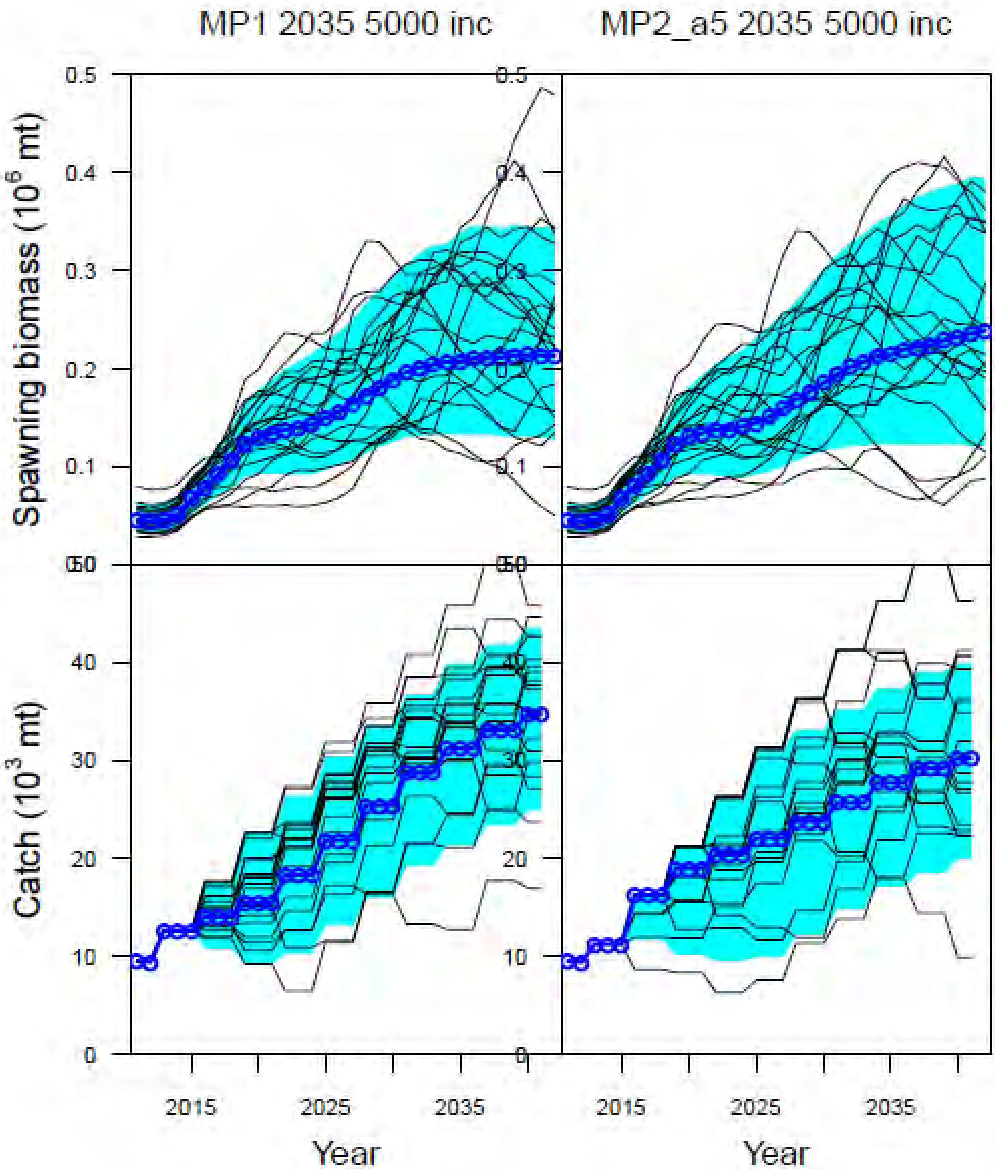

Figure 1. Spawning biomass (10^6 tons) and catch (10^3 tons) for projections under the two initial management procedures, MP1 (left column) and MP2 (right column). In each plot, the dark blue circles represent the median, the light blue shading the 10th to 90th percentiles, and the 10 black lines a random sample of 10 trajectories. The tuning level (2035 5000 inc) means that the MPs are tuned to ensure that spawning biomass in 2035 has a 70% probability of being above 20% of pre-exploitation spawning biomass, while not allowing more than a 5000t increase or decrease in TAC in any year, and furthermore allowing an increase (as opposed to no increase) in TAC in the first decision year (2013).

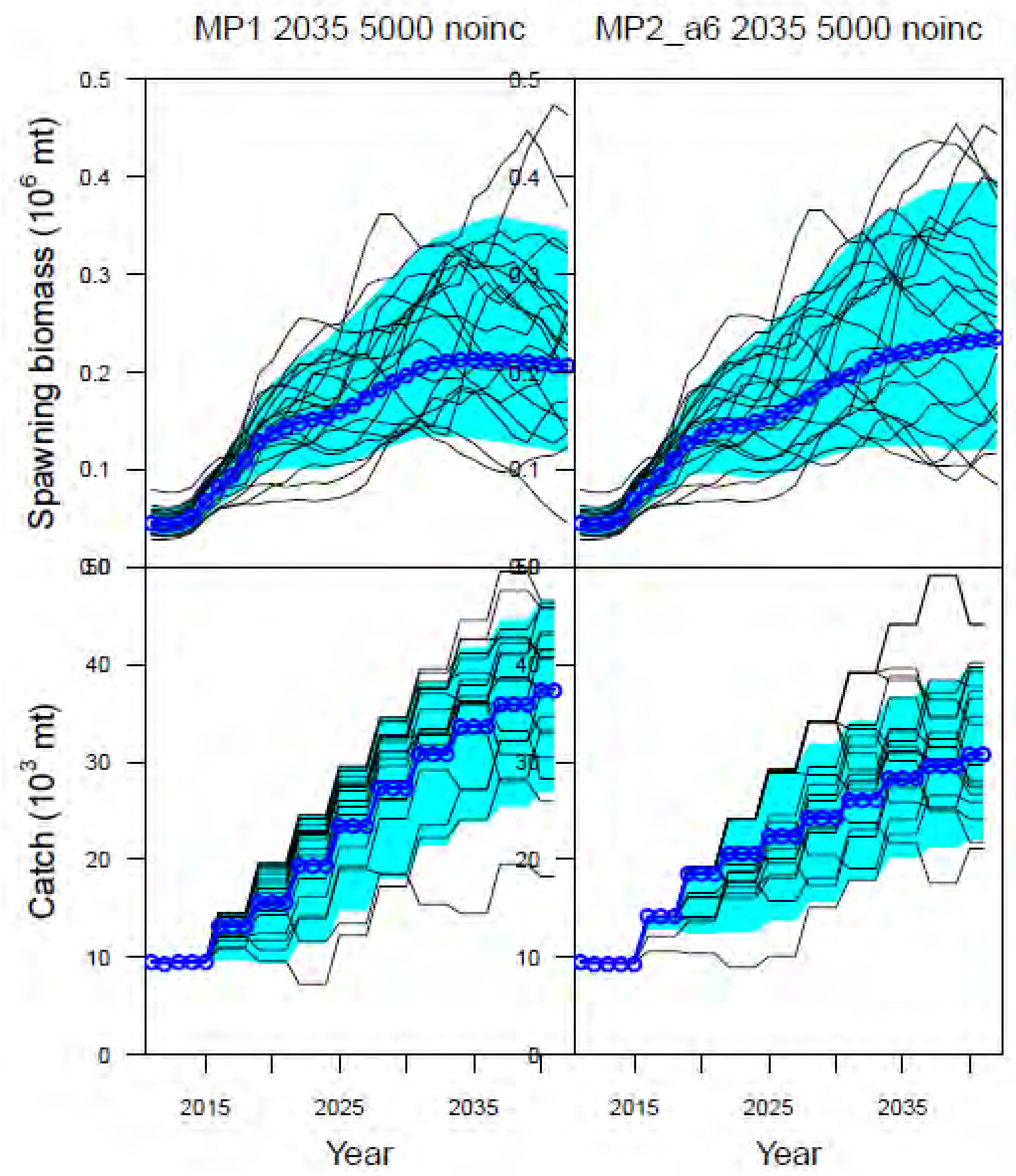

Figure 2. As for Figure 1, except with the MP1 and MP2 tuned to meet the objective in 2035 allowing for a 5000 t TAC increase or decrease in any year, but no increase allowed in 2013 (noinc).

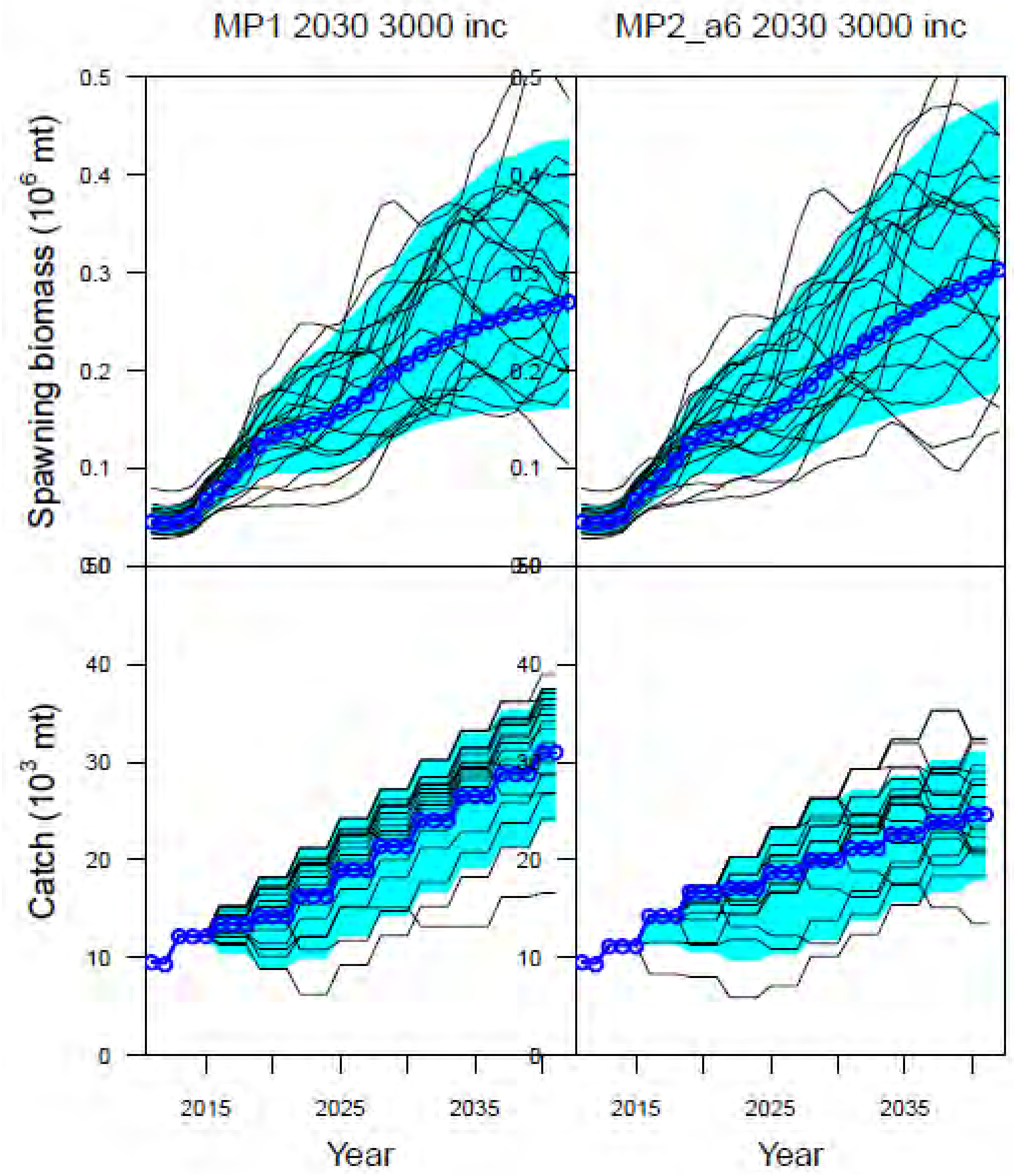

Figure 3. As for Figure 1, except with MP1 and MP2 tuned to meet the objective in <u>2030</u> allowing for a <u>3000</u> t TAC increase or decrease in any year, and with an increase allowed in 2013 (inc).

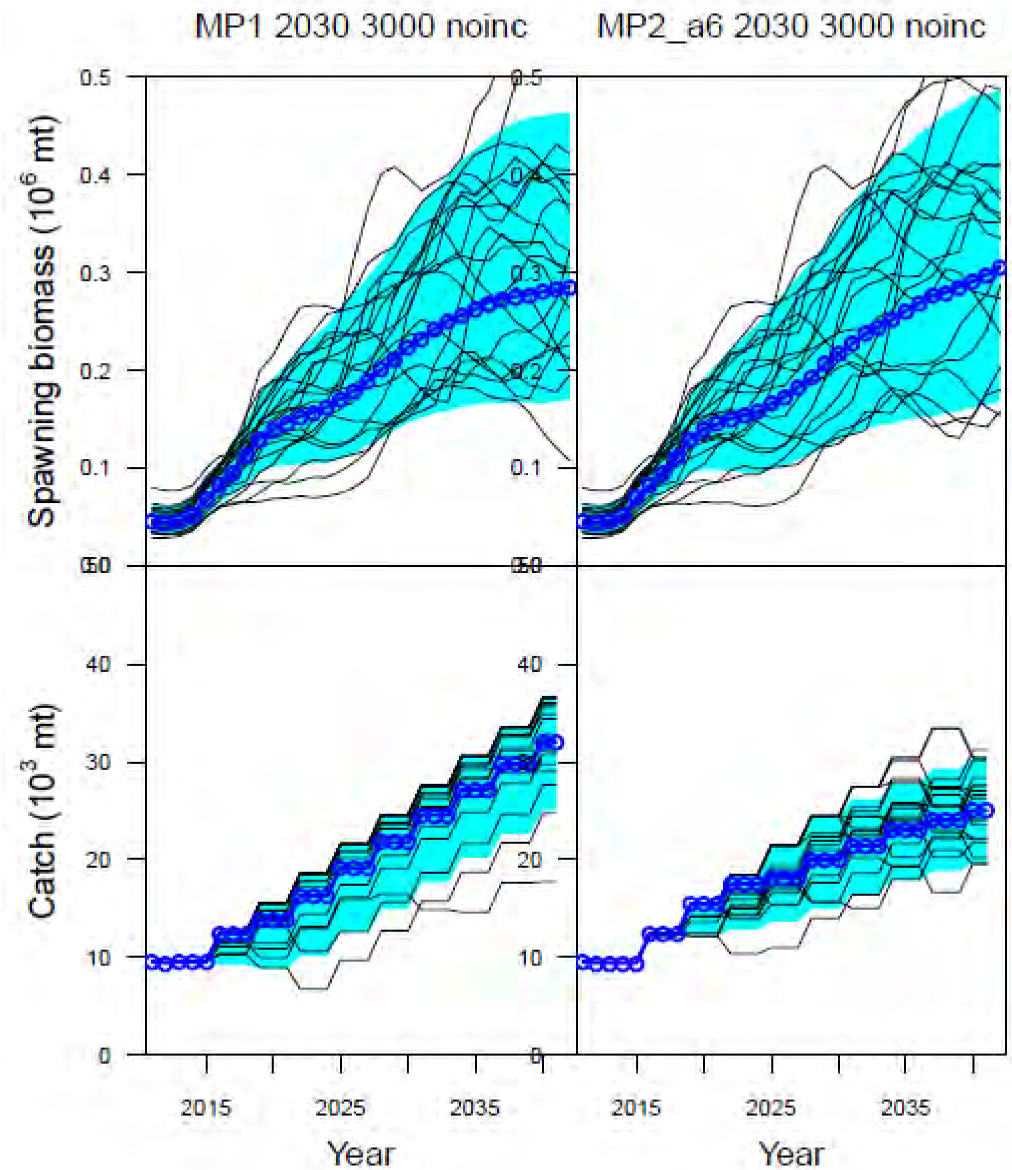

Figure 4. As for Figure 1, except with MP1 and MP2 tuned to meet the objective in <u>2030</u> allowing for a <u>3000</u> t TAC increase or decrease in any year, but no increase allowed in 2013 (noinc).

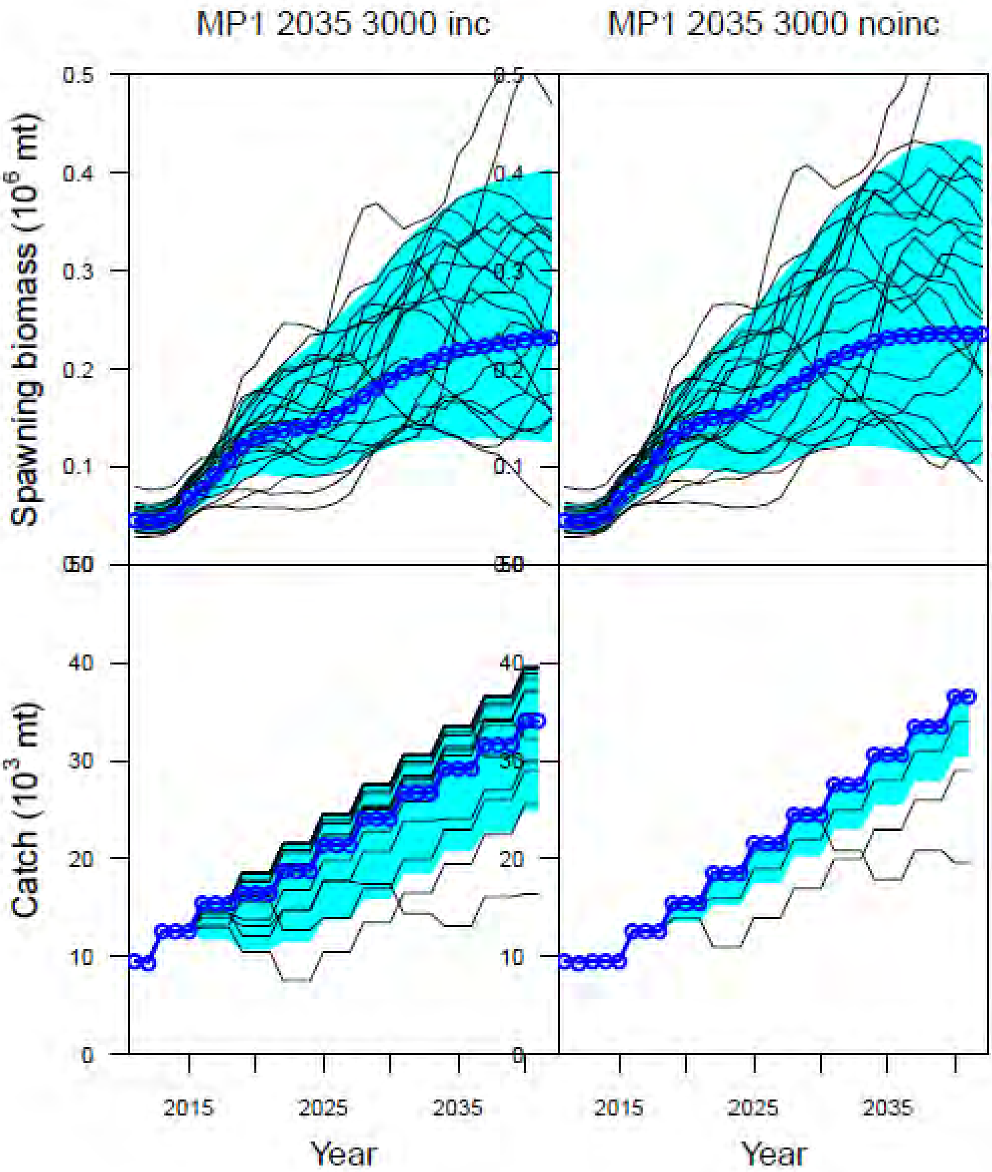

Figure 5. As for Figure 1, except showing only MP1 tuned to meet the objective in 2035 allowing for a 3000 t TAC increase or decrease in any year, comparing the effect of inc and noinc in 2013.

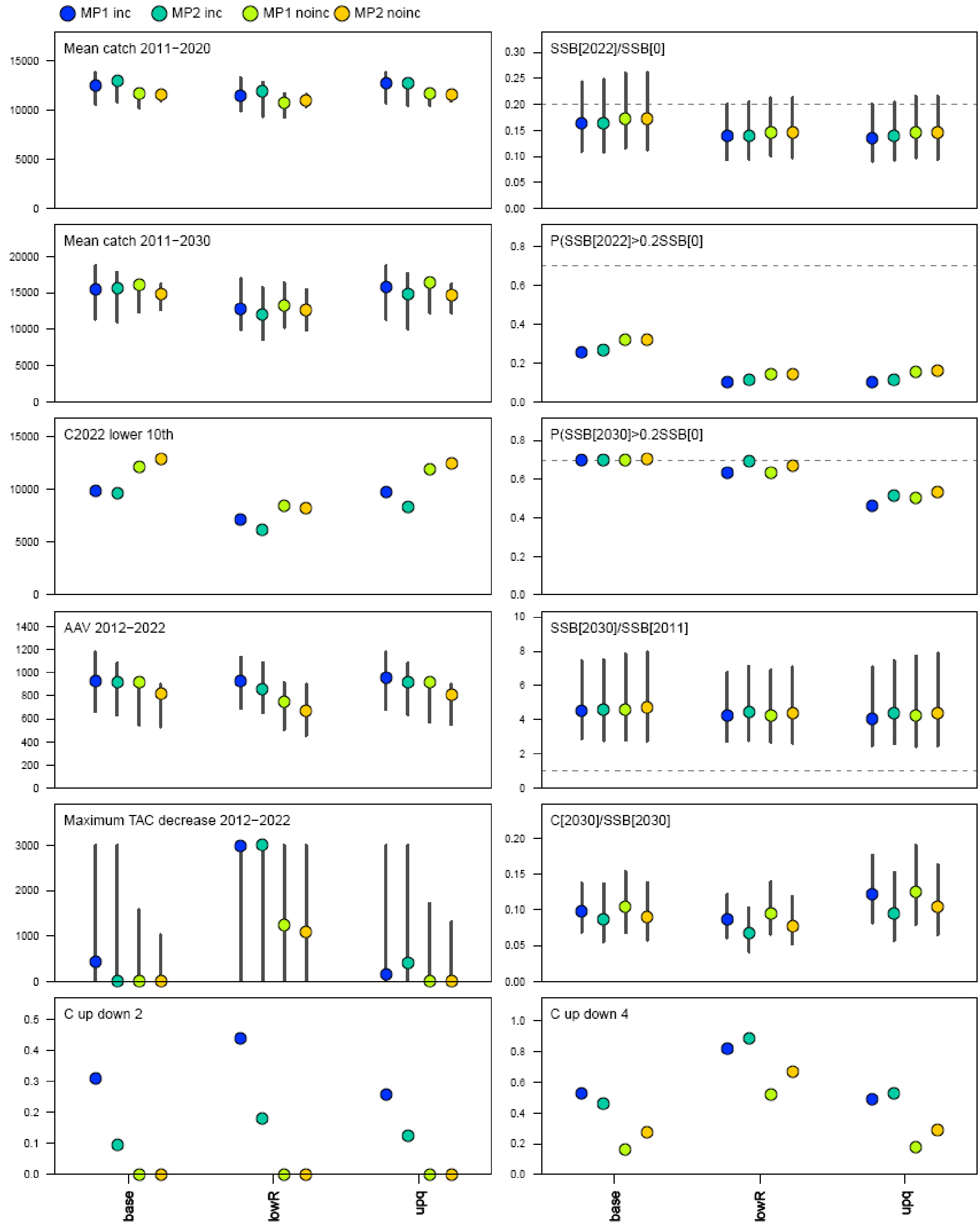

Figure 6. Statistics comparing the performance of MP1 and MP2 for procedures tuned to 2030 and 3000 t maximum change in TAC, allowing either an increase (inc) or no increase (noinc) in 2013. AAV is average annual catch. “C up down 2” is the probability that the TAC goes up and then down in the first two MP decision years (2013, 2016); “C up down 4” is the probability that the TAC goes up then down in any of the first four MP decision years (2013, 2016, 2019, 2022).

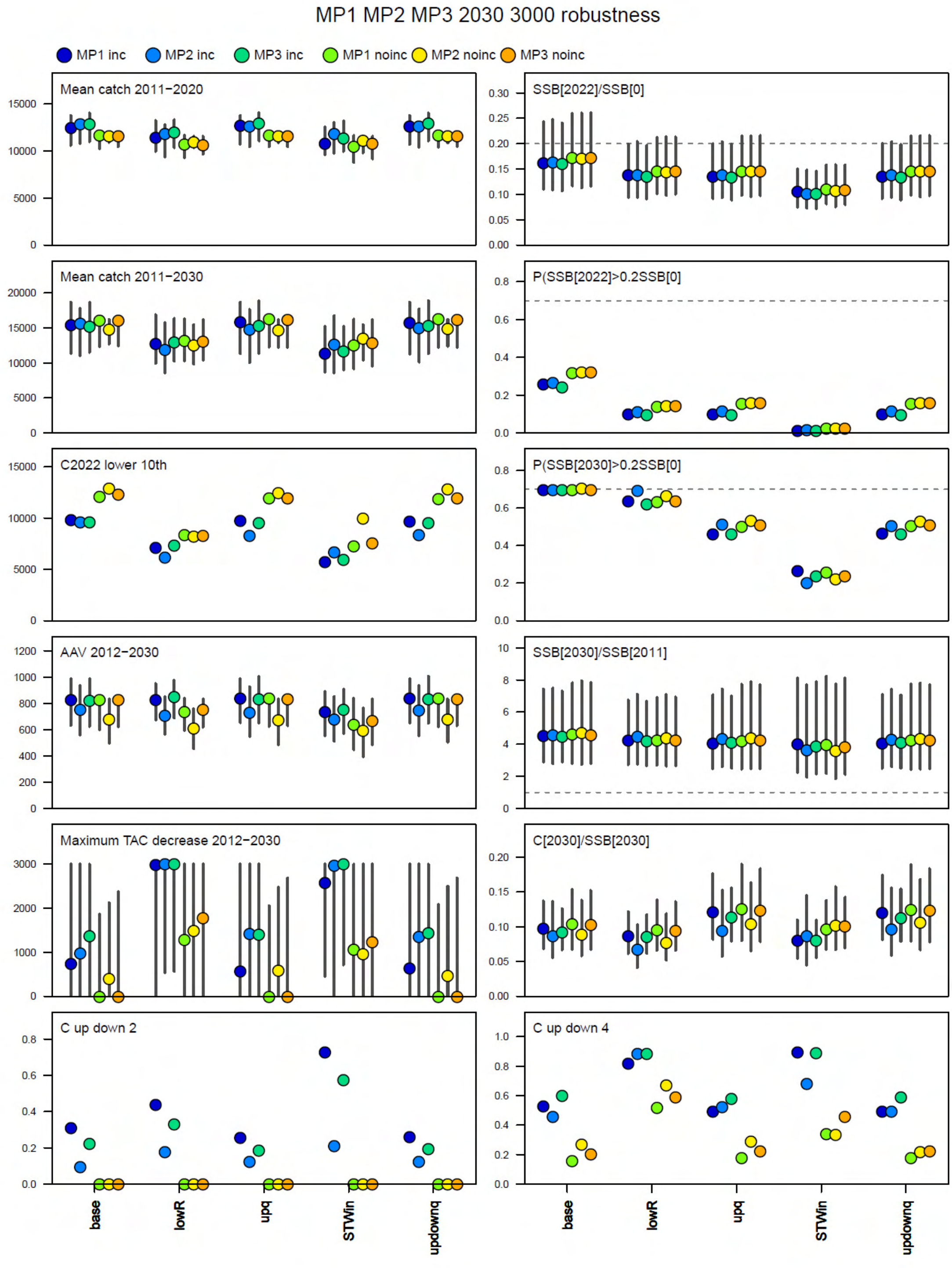

Figure 7. Statistics comparing the performance of MP1, MP2 and the Bali Procedure (referred to in this figure as MP3) for procedures tuned to 2030 and 3000 t maximum change in TAC, under the base case and four robustness trials (low recruitment, qup=catchability increase, using the ST windows CPUE time series, and qupdown=catchability increase then decrease).

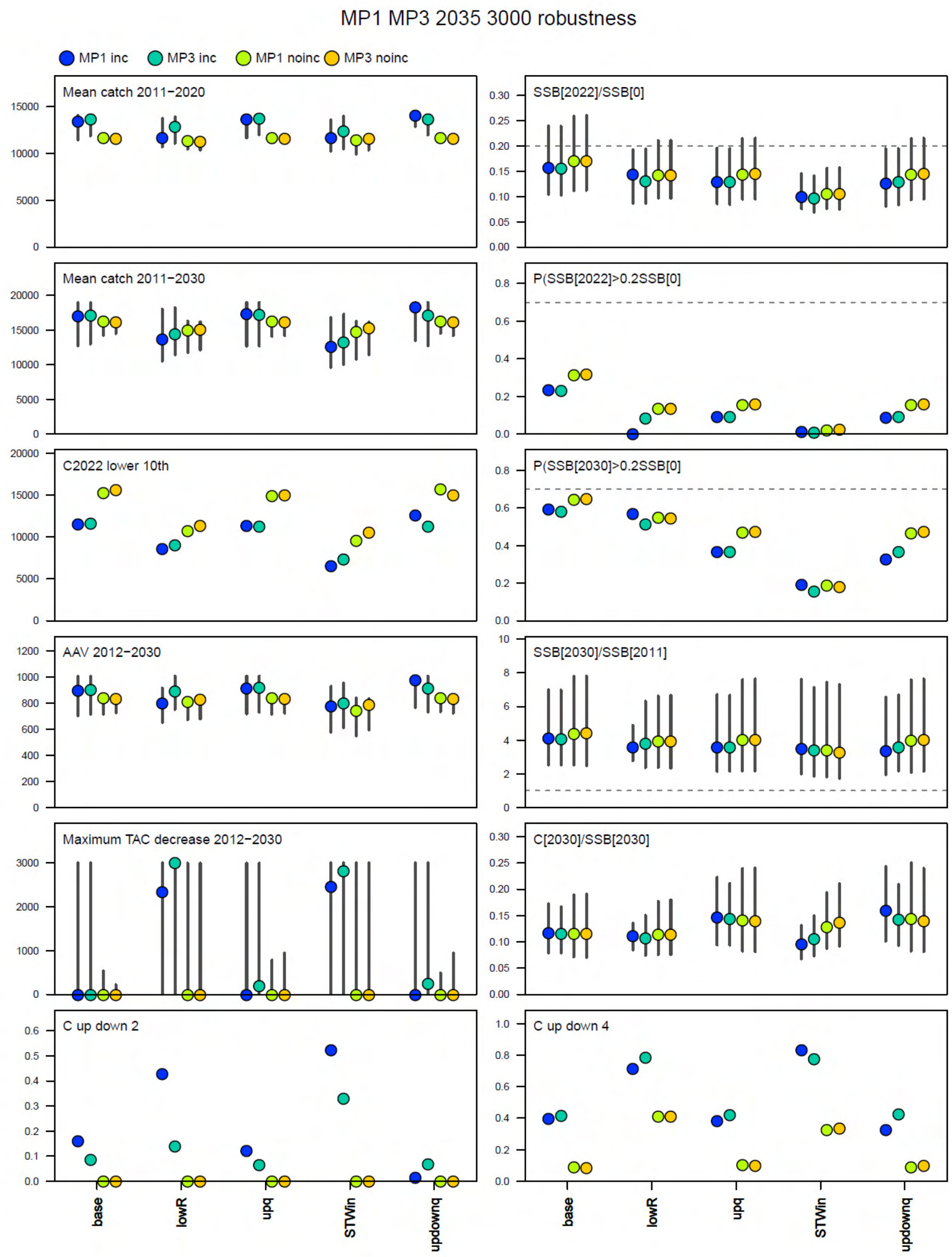

Figure 8. Statistics comparing the performance of MP1 and the Bali Procedure (referred to in this figure as MP3) for procedures tuned to 2035 and 3000 t maximum change in TAC.

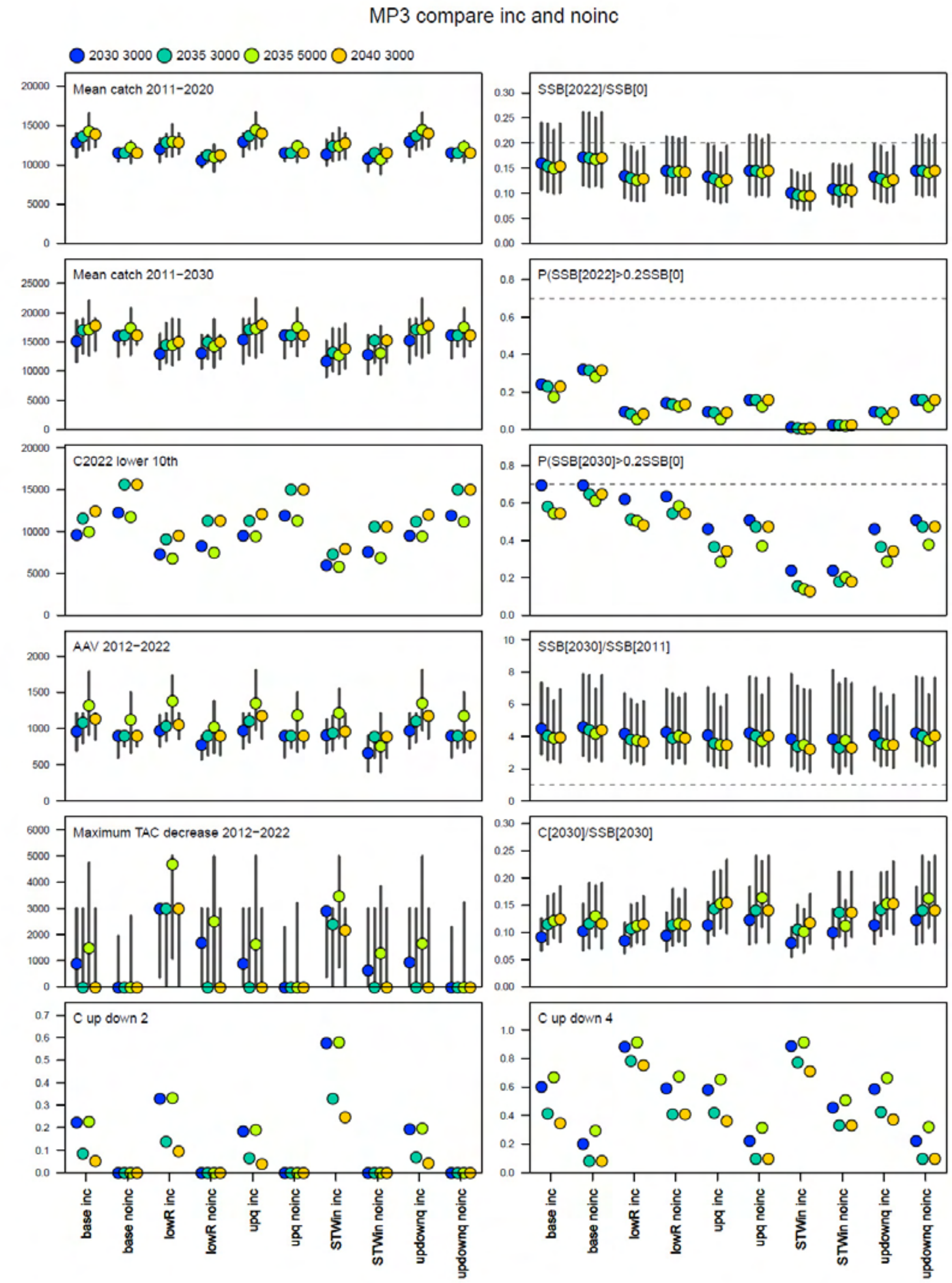

Figure 9. Statistics comparing the performance of <u>the Bali Procedure</u> (referred to in this figure as MP3) under eight combinations of tuning year, maximum TAC change, and allowing an increase or not in the first decision year, and for the base case and five robustness scenarios.

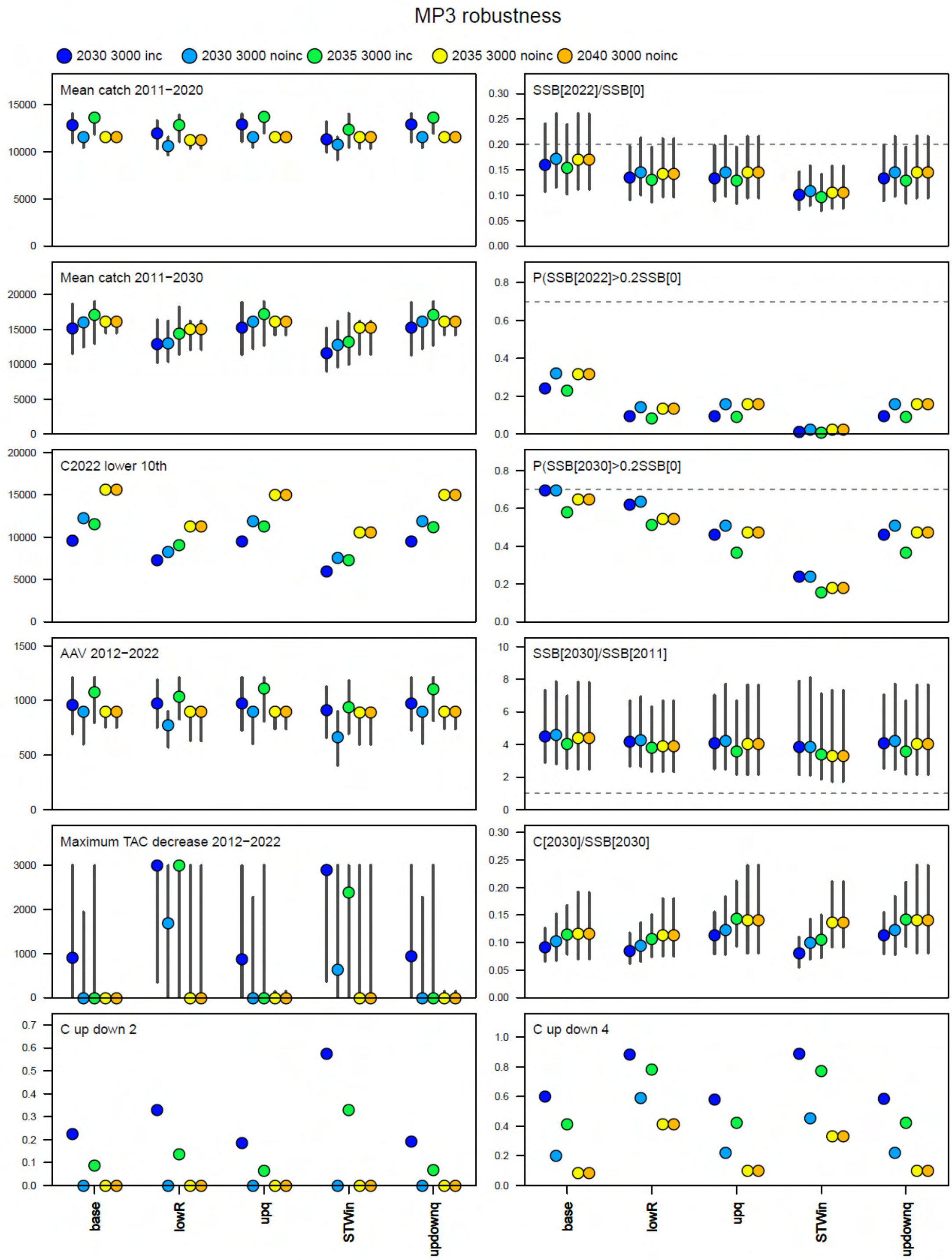

Figure 10. Statistics comparing the performance of the Bali Procedure (referred to in this figure as MP3) under tuning year, maximum TAC change, and allowing an increase or not in the first decision year, and for the base case; grouped by robustness scenarios.

Figure 11: Spawning biomass (10^6) and catch (10^3 tonnes) for projections under the Bali Procedure (referred to in these figures as MP3). In each plot, the dark blue circles represent the median, the light blue shading the 10^{th} to 90^{th} percentiles, and the 10 black lines a random sample of 10 trajectories. The plots on the left are tuned to allow an <u>increase</u> in the initial implementation period while those on the right do not allow an increase in this period. All plots are tuned to achieve a 70% probability of being above 20% of pre-exploitation spawning biomass by the specified tuning year and maximum TAC change:

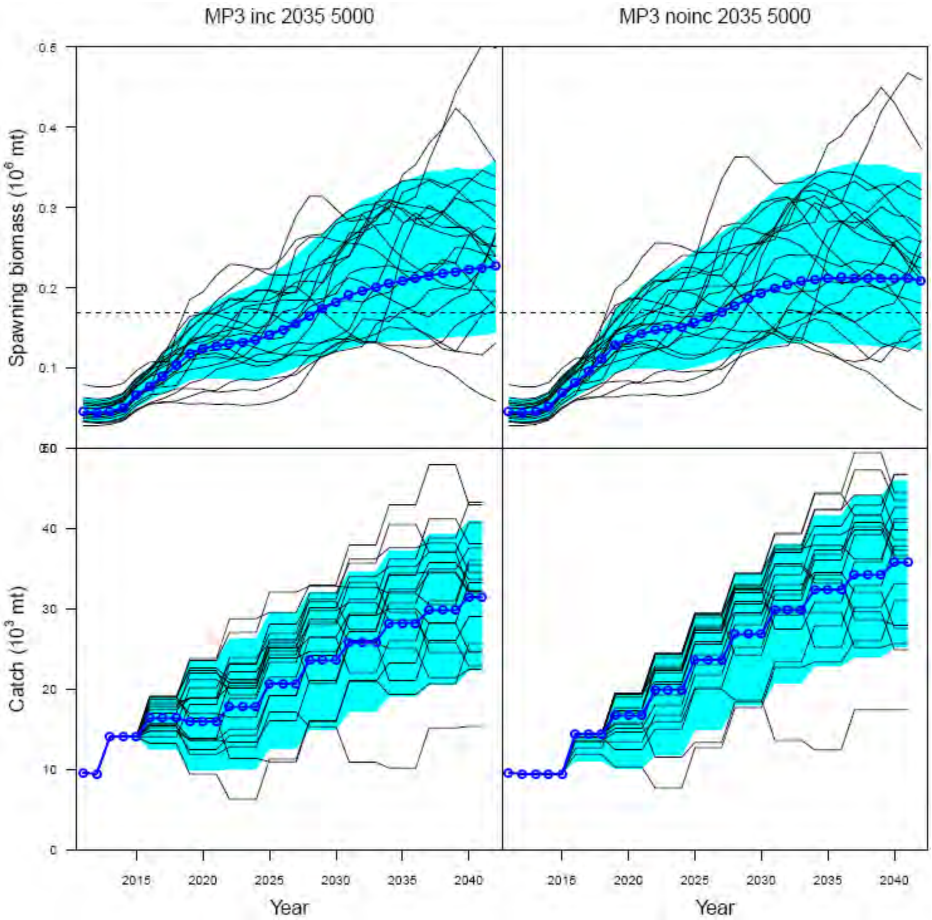

Fig 11a: tuning year 2035 and maximum TAC change of 5000t

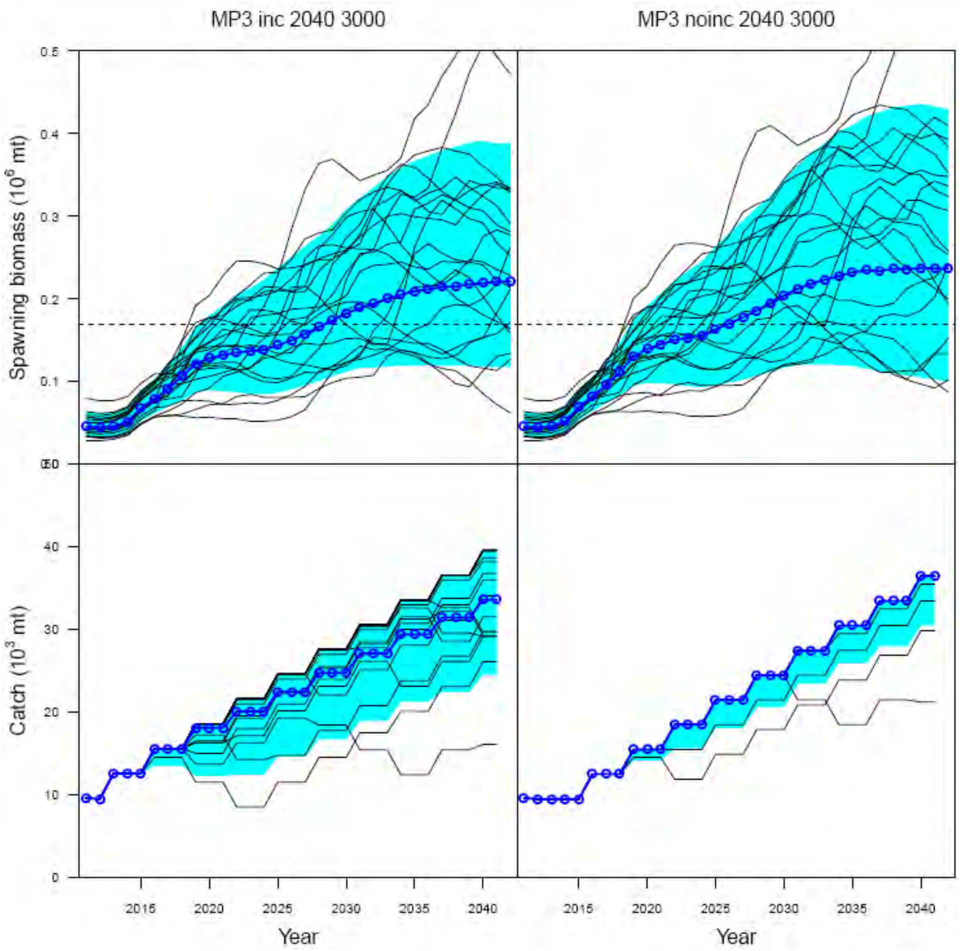

Figure 11b: tuning year 2035 and maximum TAC change of 3000t

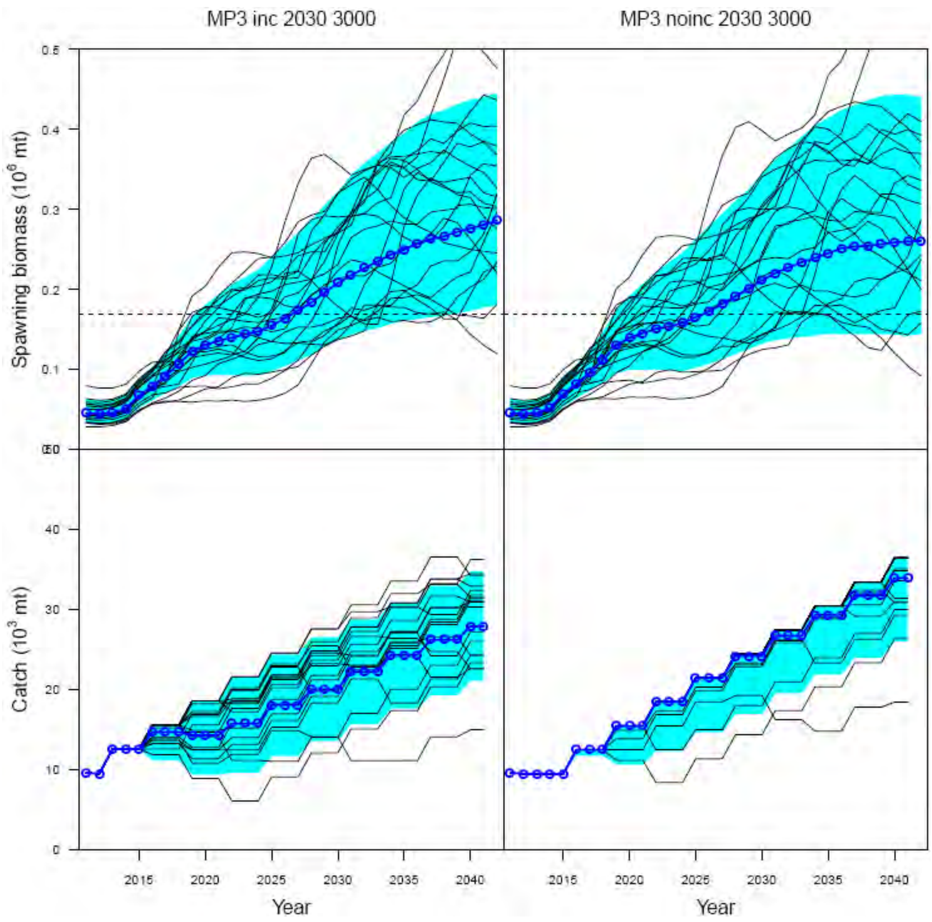

Figure 11c: tuning year 2040 and maximum TAC change of 3000t

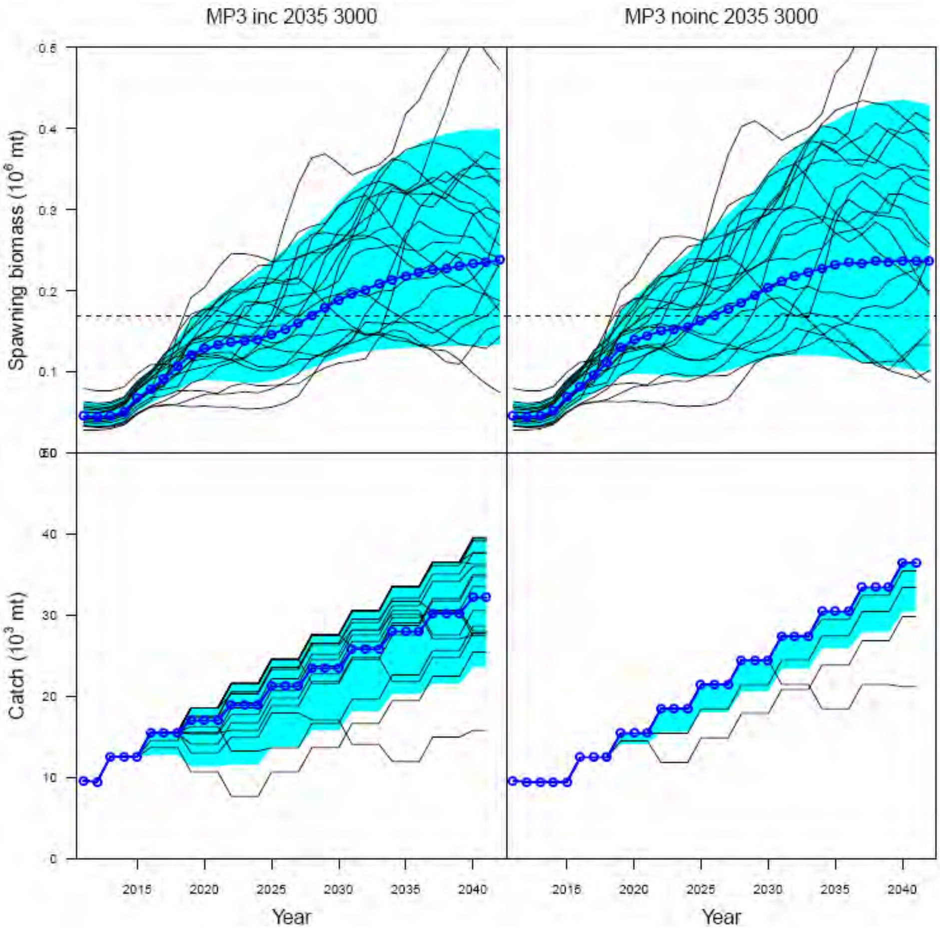

Figure 11d: tuning year 2030 and maximum TAC change of 3000t

Table 1: Summary of candidate MP1 and MP2 performance to updated OM and range of exploratory tuning criteria

Legend

$B_{10th\%}$ Lower 10th SSB percentile in year t, i.e. 2020, 2022 or 2025 depending on the tuning level
$C_{10th\%}$ Lower 10th catch percentile in year t, i.e. 2020, 2022 or 2025 depending on the tuning level

Catch:

1) Proportion of occurrence that initial 2 changes up then down TAC (irrelevant for no increase)
2) Proportion of occurrence that initial 4 changes up then down TAC
3) Measure of TAC smoothness (through to tuning year)
4) Proportion of runs above the current catch at the tuning year

SSB:

5) Proportion of runs above the current biomass at the tuning year
6) Appearance that catch continues to increase while SSB stays low
   should be avoided (ratio of catch / SSB in 2030) a) lower 10th, b) median, c) upper 90th
7) SSB lower (10th) percentile continuing to increase
   (no drop in period 2013-2035)

Base

Tuning Year	Max Incr	Incr	MP #	Year B_t	$P[B_t> 0.2B_0]$	$P[B_{2035}> 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$B_{10^{th}\%}$	$C_{10^{th}\%}$	Up then down 2x 1)	4x 2)	TAC Smth 3)	P[C_t> C_{2011}] 4)	P[B_t> B_{2011}] 5)	C_t/B_t 10^{th} 6a)	50^{th} 6b)	90^{th} 6c)	P[B.↓] 7)
2035	3000	Yes	1	2022	23%	70%	92%	91%	3.13	16,100	90,300	11,500	16%	40%	0.25	100%	100%	0.08	0.12	0.17	0.23
2035	3000	No	1	2022	32%	70%	95%	94%	3.39	14,600	96,600	15,300	0%	9%	0.33	100%	100%	0.07	0.12	0.19	0.27
2040	3000	Yes	1	2025	32%	67%	92%	91%	3.08	16,400	90,300	14,200	13%	36%	0.25	100%	100%	0.08	0.12	0.18	0.23
2035	5000	Yes	1	2022	22%	70%	94%	92%	3.18	15,700	92,300	10,300	30%	55%	0.44	100%	100%	0.09	0.13	0.18	0.14
2035	5000	Yes	2	2022	23%	70%	93%	92%	3.07	17,100	91,200	9,500	8%	46%	0.47	98%	100%	0.07	0.12	0.20	0.18
2035	5000	No	1	2022	29%	71%	98%	96%	3.42	15,000	101,600	11,500	0%	24%	0.52	100%	100%	0.09	0.13	0.18	0.23
2035	5000	No	2	2022	28%	70%	95%	94%	3.23	16,000	94,800	12,600	0%	31%	0.51	100%	100%	0.08	0.12	0.19	0.23
2030	3000	Yes	1	2020	16%	83%	95%	94%	3.36	14,400	94,700	9,000	31%	53%	0.28	99%	100%	0.07	0.10	0.14	0.05
2030	3000	Yes	2	2020	18%	84%	95%	94%	3.29	15,100	94,600	10,500	10%	46%	0.28	96%	100%	0.06	0.09	0.14	0.09
2030	3000	No	1	2020	21%	87%	98%	97%	3.62	13,300	101,300	8,800	0%	21%	0.33	100%	100%	0.06	0.09	0.13	0.00
2030	3000	No	2	2020	21%	83%	96%	95%	3.48	14,000	98,400	12,300	0%	27%	0.32	100%	100%	0.06	0.09	0.14	0.18

Upq

Tuning Year	Max Incr	Incr	MP #	Year B_t	$P[B_t> 0.2B_0]$	$P[B_{2035}> 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$B_{10^{th}\%}$	$C_{10^{th}\%}$	Up then down 2x 1)	4x 2)	TAC Smth 3)	P[C_t> C_{2011}] 4)	P[B_t> B_{2011}] 5)	C_t/B_t 10^{th} 6a)	50^{th} 6b)	90^{th} 6c)	P[B.↓] 7)
2035	3000	Yes	1	2022	9%	46%	79%	85%	2.80	16,300	74,900	11,400	12%	38%	0.25	100%	100%	0.09	0.15	0.22	0.27
2035	3000	No	1	2022	15%	55%	86%	91%	3.14	14,600	81,800	14,900	0%	10%	0.33	100%	100%	0.08	0.14	0.24	0.36
2040	3000	Yes	1	2025	16%	44%	77%	82%	2.76	16,700	70,700	13,900	10%	36%	0.25	100%	99%	0.10	0.15	0.23	0.32
2035	5000	Yes	1	2022	8%	39%	81%	87%	2.82	16,200	77,400	10,100	24%	52%	0.44	100%	100%	0.11	0.16	0.23	0.32
2035	5000	Yes	2	2022	9%	55%	83%	89%	2.86	16,400	78,800	7,800	11%	53%	0.51	96%	100%	0.06	0.13	0.23	0.23
2035	5000	No	1	2022	12%	43%	89%	93%	3.08	15,500	86,700	11,300	0%	25%	0.51	100%	100%	0.11	0.16	0.24	0.27
2035	5000	No	2	2022	13%	54%	85%	91%	2.98	15,900	81,200	10,600	0%	34%	0.53	99%	100%	0.08	0.14	0.22	0.23
2030	3000	Yes	1	2020	5%	59%	85%	90%	3.01	14,800	81,300	9,200	26%	49%	0.27	98%	100%	0.08	0.12	0.18	0.18
2030	3000	Yes	2	2020	6%	73%	86%	91%	3.09	14,500	82,800	9,300	12%	52%	0.30	91%	100%	0.06	0.09	0.15	0.18
2030	3000	No	1	2020	8%	68%	91%	95%	3.33	13,600	88,200	9,000	0%	22%	0.33	99%	100%	0.07	0.11	0.16	0.14
2030	3000	No	2	2020	8%	68%	88%	93%	3.21	14,000	85,700	12,200	0%	29%	0.33	99%	100%	0.07	0.10	0.16	0.18

LowR

Tuning Year	Max Incr	Incr	MP #	Year B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$B_{10^{th}\%}$	$C_{10^{th}\%}$	Up then down 2x 1)	Up then down 4x 2)	TAC Smth 3)	$P[C_t > C_{2011}]$ 4)	$P[B_t > B_{2011}]$ 5)	C_t/B_t 10th 6a)	C_t/B_t 50th 6b)	C_t/B_t 90th 6c)	P[B.↓] 7)
2035	3000	Yes	1	2022	0%	71%	86%	71%	2.35	12,700	82,300	8,600	43%	71%	0.39	100%	100%	0.08	0.11	0.14	0.36
2035	3000	No	1	2022	14%	65%	88%	85%	2.57	13,600	82,800	10,700	0%	41%	0.34	100%	100%	0.08	0.11	0.18	0.23
2040	3000	Yes	1	2025	10%	66%	75%	71%	2.38	13,800	68,700	11,300	21%	73%	0.37	100%	100%	0.08	0.11	0.16	0.23
2035	5000	Yes	1	2022	8%	69%	84%	81%	2.51	12,700	78,800	6,700	42%	84%	0.72	100%	100%	0.08	0.11	0.16	0.27
2035	5000	Yes	2	2022	10%	84%	86%	83%	2.53	12,200	79,900	4,700	16%	89%	0.97	93%	100%	0.04	0.07	0.13	0.18
2035	5000	No	1	2022	13%	72%	93%	90%	2.73	12,000	88,300	7,400	0%	56%	0.75	100%	100%	0.08	0.11	0.16	0.32
2035	5000	No	2	2022	12%	82%	89%	86%	2.66	11,500	83,800	6,700	0%	73%	0.86	98%	100%	0.05	0.08	0.14	0.18
2030	3000	Yes	1	2020	14%	81%	94%	92%	2.60	12,000	92,500	7,000	44%	82%	0.43	97%	100%	0.06	0.09	0.12	0.18
2030	3000	Yes	2	2020	15%	87%	94%	93%	2.60	11,800	92,200	6,500	18%	89%	0.48	86%	100%	0.04	0.07	0.10	0.18
2030	3000	No	1	2020	20%	86%	97%	96%	2.85	10,900	100,100	6,200	0%	49%	0.48	99%	100%	0.06	0.08	0.12	0.18
2030	3000	No	2	2020	19%	83%	95%	94%	2.69	11,900	95,700	9,400	0%	67%	0.39	96%	100%	0.05	0.08	0.12	0.18

UpDownQ

Tuning Year	Max Incr	Incr	MP #	Year B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$B_{10^{th}\%}$	$C_{10^{th}\%}$	Up then down 2x 1)	Up then down 4x 2)	TAC Smth 3)	$P[C_t > C_{2011}]$ 4)	$P[B_t > B_{2011}]$ 5)	C_t/B_t 10^{th} 6a)	C_t/B_t 50^{th} 6b)	C_t/B_t 90^{th} 6c)	P[B.↓] 7)
2035	3000	Yes	1	2022	9%	41%	76%	81%	2.66	17,400	70,400	12,600	1%	33%	0.25	99%	100%	0.10	0.16	0.24	0.36
2035	3000	No	1	2022	15%	54%	86%	90%	3.13	14,600	81,100	15,700	0%	9%	0.33	100%	99%	0.08	0.14	0.25	0.32
2040	3000	Yes	1	2025	15%	40%	71%	77%	2.65	17,600	65,200	14,500	1%	30%	0.25	100%	99%	0.10	0.17	0.26	0.36
2035	5000	Yes	1	2022	7%	31%	75%	80%	2.54	17,800	70,400	10,900	5%	49%	0.41	99%	100%	0.12	0.18	0.26	0.32
2035	5000	Yes	2	2022	9%	66%	83%	88%	2.92	15,600	78,700	7,000	11%	82%	0.57	95%	100%	0.05	0.10	0.18	0.18
2035	5000	No	1	2022	12%	37%	85%	90%	2.89	16,800	80,800	12,300	0%	29%	0.51	100%	100%	0.12	0.18	0.26	0.36
2035	5000	No	2	2022	13%	66%	85%	91%	3.06	15,000	81,200	9,000	0%	73%	0.59	99%	100%	0.07	0.11	0.18	0.18
2030	3000	Yes	1	2020	5%	60%	85%	90%	3.02	14,700	81,400	9,100	26%	50%	0.27	98%	100%	0.08	0.12	0.17	0.14
2030	3000	Yes	2	2020	6%	72%	86%	91%	3.08	14,600	82,800	9,300	12%	49%	0.29	92%	100%	0.06	0.10	0.16	0.18
2030	3000	No	1	2020	8%	69%	91%	95%	3.34	13,600	88,300	8,900	0%	23%	0.33	99%	100%	0.07	0.11	0.16	0.18
2030	3000	No	2	2020	8%	67%	88%	93%	3.21	14,200	85,700	12,100	0%	22%	0.33	99%	100%	0.07	0.11	0.17	0.18

Omega75

Tuning Year	Max Incr	Incr	MP #	Year B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$B_{10^{th}\%}$	$C_{10^{th}\%}$	Up then down 2x 1)	Up then down 4x 2)	TAC Smth 3)	$P[C_t > C_{2011}]$ 4)	$P[B_t > B_{2011}]$ 5)	C_t/B_t 10^{th} 6a)	C_t/B_t 50^{th} 6b)	C_t/B_t 90^{th} 6c)	P[B.↓] 7)
2035	3000	Yes	1	2022	7%	52%	70%	88%	2.93	13,600	67,700	8,400	33%	67%	0.31	99%	100%	0.09	0.12	0.17	0.18
2035	3000	No	1	2022	11%	48%	76%	93%	3.09	14,600	72,500	11,300	0%	28%	0.33	100%	100%	0.09	0.14	0.22	0.32
2040	3000	Yes	1	2025	12%	52%	73%	87%	2.93	13,600	67,300	10,300	33%	67%	0.31	100%	100%	0.09	0.12	0.17	0.18
2035	5000	Yes	1	2022	7%	55%	73%	91%	3.08	12,800	70,300	6,900	52%	80%	0.57	99%	100%	0.09	0.12	0.16	0.14
2035	5000	Yes	2	2022	7%	56%	71%	91%	2.87	14,200	69,300	5,900	16%	68%	0.55	90%	100%	0.05	0.12	0.20	0.23
2035	5000	No	1	2022	10%	57%	83%	96%	3.32	12,200	79,100	7,600	0%	38%	0.62	100%	100%	0.09	0.12	0.17	0.18
2035	5000	No	2	2022	9%	53%	76%	93%	3.00	14,200	72,900	8,600	0%	50%	0.54	97%	100%	0.07	0.13	0.20	0.23
2030	3000	Yes	1	2020	4%	67%	76%	94%	3.21	12,000	74,600	7,100	54%	79%	0.37	94%	100%	0.07	0.10	0.13	0.14
2030	3000	Yes	2	2020	5%	66%	76%	95%	3.04	13,100	74,200	7,600	18%	69%	0.33	85%	100%	0.06	0.09	0.15	0.18
2030	3000	No	1	2020	7%	72%	85%	98%	3.47	11,200	81,300	6,500	0%	33%	0.40	96%	100%	0.07	0.09	0.13	0.09
2030	3000	No	2	2020	6%	61%	80%	96%	3.17	13,100	76,600	10,500	0%	46%	0.33	97%	100%	0.07	0.11	0.16	0.18

STWindow

Tuning Year	Max Incr	Incr	MP #	Year B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$B_{10^{th}\%}$	$C_{10^{th}\%}$	Up then down 2x 1)	Up then down 4x 2)	TAC Smth 3)	$P[C_t > C_{2011}]$ 4)	$P[B_t > B_{2011}]$ 5)	C_t/B_t 10^{th} 6a)	C_t/B_t 50^{th} 6b)	C_t/B_t 90^{th} 6c)	P[B.↓] 7)
2035	3000	Yes	1	2022	1%	42%	49%	71%	2.67	12,300	70,900	6,500	52%	83%	0.39	96%	100%	0.07	0.10	0.13	0.09
2035	3000	No	1	2022	2%	33%	59%	75%	2.69	13,600	74,000	9,600	0%	33%	0.33	99%	100%	0.09	0.13	0.19	0.23
2040	3000	Yes	1	2025	3%	36%	57%	72%	2.57	12,700	72,800	8,400	48%	77%	0.37	100%	100%	0.07	0.11	0.15	0.09
2035	5000	Yes	1	2022	1%	41%	55%	71%	2.75	11,500	71,800	5,700	71%	90%	0.72	98%	100%	0.06	0.10	0.14	0.00
2035	5000	Yes	2	2022	1%	38%	48%	69%	2.50	13,300	70,200	5,300	20%	67%	0.67	87%	100%	0.04	0.10	0.20	0.09
2035	5000	No	1	2022	2%	45%	70%	80%	3.00	11,000	82,300	6,300	0%	32%	0.73	99%	100%	0.07	0.10	0.15	0.00
2035	5000	No	2	2022	2%	35%	58%	75%	2.66	13,600	74,800	7,800	0%	40%	0.60	96%	100%	0.06	0.12	0.19	0.09
2030	3000	Yes	1	2020	0%	53%	49%	70%	2.83	10,900	72,000	6,500	73%	90%	0.46	85%	100%	0.05	0.08	0.11	0.00
2030	3000	Yes	2	2020	0%	46%	47%	68%	2.59	12,600	71,000	7,700	21%	68%	0.39	78%	100%	0.04	0.09	0.15	0.09
2030	3000	No	1	2020	1%	61%	62%	76%	3.12	10,200	79,700	5,800	0%	27%	0.46	90%	100%	0.05	0.08	0.11	0.00
2030	3000	No	2	2020	1%	42%	56%	73%	2.71	13,000	74,800	9,500	0%	33%	0.35	95%	100%	0.07	0.10	0.16	0.14

Table 2: Summary of the Bali Procedure’s performance to updated OM and range of exploratory tuning criteria

Base

Table 2a. Table of MP performance configured for different tuning year, maximum allowable increase, allowance of a TAC increase in 2013, and MP form (first 4 columns) for the **Base run** model set. Note that B_t represents spawning biomass where t is the year presented in 5th column. B_0 is the unfished spawning stock biomass. The last two columns are the proportion of runs that the TAC increases then decreases in the first 2 (2013 and 2016) and the first 4 opportunities (2013, 2016, 2019, and 2022).

Tuning Year	Max Incr	Increase In 1st yr	MP	Year of B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$\bar{C}_{2013-2035}$	Lower 10th SSB %ile in yr t	Lower 10th catch %ile in yr t	Up then down 2x	Up then down 4x
2030	3000	No	Bali	2020	21%	79%	97%	96%	3.47	14,500	19,000	99,500	10,600	0%	20%
2035	3000	No	Bali	2022	32%	70%	95%	94%	3.41	14,500	19,500	96,700	15,600	0%	9%
2035	5000	No	Bali	2022	28%	70%	97%	95%	3.34	15,600	21,000	99,400	11,700	0%	30%
2040	3000	No	Bali	2025	42%	70%	94%	93%	3.41	14,500	19,500	95,900	18,100	0%	9%
2030	3000	Yes	Bali	2020	15%	85%	94%	93%	3.29	14,500	17,400	92,700	9,400	22%	60%
2035	3000	Yes	Bali	2022	23%	70%	91%	90%	3.08	16,200	19,800	88,600	11,600	9%	42%
2035	5000	Yes	Bali	2022	18%	70%	89%	88%	2.98	16,400	19,900	86,400	10,000	23%	67%
2040	3000	Yes	Bali	2025	31%	65%	90%	88%	3.02	16,800	20,600	86,600	14,600	5%	35%

Upq

Table 2b. Table of MP performance configured for different tuning year, maximum allowable increase, allowance of a TAC increase in 2013, and MP form (first 4 columns) for the stepwise increase in CPUE catchability of 35% in 2008 robustness set. Note that B_t represents spawning biomass where t is the year presented in 5th column. B_0 is the unfished spawning stock biomass. The last two columns are the proportion of runs that the TAC increases then decreases in the first 2 (2013 and 2016) and the first 4 opportunities (2013, 2016, 2019, and 2022).

Tuning Year	Max Incr	Increase In 1st yr	MP	Year of B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$\bar{C}_{2013-2035}$	Lower 10th SSB %ile in yr t	Lower 10th catch %ile in yr t	Up then down 2x	Up then down 4x
2030	3000	No	Bali	2020	8%	61%	89%	93%	3.23	14,500	19,200	86,700	10,600	0%	22%
2035	3000	No	Bali	2022	16%	55%	87%	91%	3.15	14,500	19,500	82,200	15,000	0%	10%
2035	5000	No	Bali	2022	12%	43%	88%	92%	3.02	15,800	21,200	84,600	11,300	0%	32%
2040	3000	No	Bali	2025	24%	55%	85%	87%	3.15	14,500	19,500	77,500	17,400	0%	10%
2030	3000	Yes	Bali	2020	5%	63%	83%	89%	2.97	14,700	17,600	79,900	9,600	19%	58%
2035	3000	Yes	Bali	2022	9%	47%	78%	84%	2.77	16,400	19,900	73,700	11,300	7%	42%
2035	5000	Yes	Bali	2022	6%	40%	75%	80%	2.64	16,600	19,900	71,000	9,500	19%	65%
2040	3000	Yes	Bali	2025	15%	43%	75%	80%	2.72	17,000	20,700	69,600	13,900	4%	36%

LowR

Table 2c. Table of MP performance configured for different tuning year, maximum allowable increase, allowance of a TAC increase in 2013, and MP form (first 4 columns) for the **low recruitment** robustness set. Note that B_t represents spawning biomass where t is the year presented in 5th column. B_0 is the unfished spawning stock biomass. The last two columns are the proportion of runs that the TAC increases then decreases in the first 2 (2013 and 2016) and the first 4 opportunities (2013, 2016, 2019, and 2022).

Tuning Year	Max Incr	Increase In 1st yr	MP	Year of B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$\bar{C}_{2013-2035}$	Lower 10th SSB %ile in yr t	Lower 10th catch %ile in yr t	Up then down 2x	Up then down 4x
2030	3000	No	Bali	2020	19%	77%	96%	95%	2.71	11,800	15,500	97,300	8,200	0%	59%
2035	3000	No	Bali	2022	14%	65%	88%	85%	2.58	13,600	18,000	82,900	11,300	0%	41%
2035	5000	No	Bali	2022	12%	70%	91%	88%	2.67	12,400	17,600	86,600	7,500	0%	68%
2040	3000	No	Bali	2025	16%	65%	82%	77%	2.58	13,600	18,000	74,300	14,200	0%	41%
2030	3000	Yes	Bali	2020	13%	80%	93%	91%	2.52	12,500	14,800	90,200	7,600	33%	89%
2035	3000	Yes	Bali	2022	8%	67%	79%	75%	2.36	13,700	16,700	74,300	9,100	14%	78%
2035	5000	Yes	Bali	2022	6%	67%	77%	72%	2.31	13,600	17,100	72,400	6,800	33%	92%
2040	3000	Yes	Bali	2025	9%	62%	72%	67%	2.31	14,300	17,400	65,000	12,100	10%	75%

STwin

Table 2d. Table of MP performance configured for different tuning year, maximum allowable increase, allowance of a TAC increase in 2013, and MP form (first 4 columns) for the **STWindows (a CPUE series)** robustness set. Note that B_t represents spawning biomass where t is the year presented in 5th column. B_0 is the unfished spawning stock biomass. The last two columns are the proportion of runs that the TAC increases then decreases in the first 2 (2013 and 2016) and the first 4 opportunities (2013, 2016, 2019, and 2022).

Tuning Year	Max Incr	Increase In 1st yr	MP	Year of B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$\bar{C}_{2013-2035}$	Lower 10th SSB %ile in yr t	Lower 10th catch %ile in yr t	Up then down 2x	Up then down 4x
2030	3000	No	Bali	2020	1%	44%	57%	74%	2.86	12,000	14,900	76,500	7,600	0%	46%
2035	3000	No	Bali	2022	2%	31%	58%	74%	2.63	14,100	17,800	72,100	10,600	0%	33%
2035	5000	No	Bali	2022	2%	38%	66%	78%	2.86	11,900	15,400	79,500	6,900	0%	51%
2040	3000	No	Bali	2025	5%	31%	58%	73%	2.63	14,100	17,800	70,700	12,200	0%	33%
2030	3000	Yes	Bali	2020	0%	51%	45%	68%	2.72	11,500	13,000	70,200	6,900	58%	89%
2035	3000	Yes	Bali	2022	1%	35%	46%	66%	2.49	13,000	14,800	66,800	7,300	33%	77%
2035	5000	Yes	Bali	2022	1%	35%	41%	64%	2.48	12,500	14,400	65,000	5,800	58%	92%
2040	3000	Yes	Bali	2025	3%	30%	48%	67%	2.41	13,600	15,600	66,100	9,200	25%	71%

Omega75

Table 2e. Table of MP performance configured for different tuning year, maximum allowable increase, allowance of a TAC increase in 2013, and MP form (first 4 columns) for the **Omega75 (a non-linear relationship between CPUE and abundance)** robustness set. Note that B_t represents spawning biomass where t is the year presented in 5th column. B_0 is the unfished spawning stock biomass. The last two columns are the proportion of runs that the TAC increases then decreases in the first 2 (2013 and 2016) and the first 4 opportunities (2013, 2016, 2019, and 2022).

Tuning Year	Max Incr	Increase In 1st yr	MP	Year of B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$\bar{C}_{2013-2035}$	Lower 10th SSB %ile in yr t	Lower 10th catch %ile in yr t	Up then down 2x	Up then down 4x
2030	3000	No	Bali	2020	6%	59%	82%	97%	3.24	12,800	16,400	78,800	8,500	0%	42%
2035	3000	No	Bali	2022	11%	47%	76%	92%	3.08	14,500	19,200	71,900	12,300	0%	26%
2035	5000	No	Bali	2022	9%	52%	81%	96%	3.19	13,000	17,300	77,100	8,000	0%	50%
2040	3000	No	Bali	2025	17%	47%	74%	88%	3.08	14,500	19,200	67,800	14,600	0%	26%
2030	3000	Yes	Bali	2020	4%	67%	74%	94%	3.10	12,400	14,400	72,800	7,500	42%	82%
2035	3000	Yes	Bali	2022	7%	50%	67%	86%	2.86	14,100	16,600	65,200	8,800	20%	67%
2035	5000	Yes	Bali	2022	5%	51%	64%	84%	2.82	13,700	16,300	63,900	6,800	42%	86%
2040	3000	Yes	Bali	2025	11%	45%	65%	83%	2.77	14,500	17,400	61,500	11,300	14%	61%

UpDownq

Table 2f. Table of MP performance configured for different tuning year, maximum allowable increase, allowance of a TAC increase in 2013, and MP form (first 4 columns) for the **UpDownq** robustness set. Note that B_t represents spawning biomass where t is the year presented in 5th column. B_0 is the unfished spawning stock biomass. The last two columns are the proportion of runs that the TAC increases then decreases in the first 2 (2013 and 2016) and the first 4 opportunities (2013, 2016, 2019, and 2022).

Tuning Year	Max Incr	Increase In 1st yr	MP	Year of B_t	$P[B_t > 0.2B_0]$	$P[B_{2035} > 0.2B_0]$	$P[B_t > 0.1B_0]$	$P[B_t > 2B_{2011}]$	$\frac{B_{2025}}{B_{2011}}$	$\bar{C}_{2013-2025}$	$\bar{C}_{2013-2035}$	Lower 10th SSB %ile in yr t	Lower 10th catch %ile in yr t	Up then down 2x	Up then down 4x
2030	3000	No	Bali	2020	8%	61%	89%	93%	3.23	14,500	19,200	86,700	10,600	0%	22%
2035	3000	No	Bali	2022	16%	55%	87%	91%	3.15	14,500	19,500	82,200	15,000	0%	10%
2035	5000	No	Bali	2022	12%	44%	88%	92%	3.02	15,800	21,100	84,700	11,200	0%	32%
2040	3000	No	Bali	2025	24%	55%	85%	87%	3.15	14,500	19,500	77,500	17,400	0%	10%
2030	3000	Yes	Bali	2020	5%	64%	83%	89%	2.97	14,600	17,500	80,000	9,400	19%	59%
2035	3000	Yes	Bali	2022	9%	48%	78%	84%	2.78	16,300	19,800	73,900	11,200	7%	43%
2035	5000	Yes	Bali	2022	6%	41%	75%	80%	2.65	16,500	19,800	71,200	9,400	20%	67%
2040	3000	Yes	Bali	2025	15%	44%	75%	80%	2.72	16,900	20,600	69,700	13,900	4%	37%

Attachment 10

Technical details of combined MP

Concept

Given the difficulty in separating MP1 and MP2, and the general view that providing the Commission with two candidate MPs and an (untuned) average MP would not be the best advice the ESC can provide, this document presents an alternative which is a combination of the two current CMPs. There are features of both MP1 and MP1 that appeal, and an integrated combination of those features (as opposed to an untuned average) might best represent them, and provide a single MP (the Bali Procedure BP) that is a genuine representation of all the work member scientists have done.

Details

There are several key features that differ among the CMPs:

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

Empirical MPs have the virtue of being (mostly) simpler to understand and compute, but can often be 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 too complex or over-parameterised, can sometimes behave strangely in the testing phase. In the 2010 OMMP meeting in Seattle this issue seen in the production model based CMPs was addressed at length: non-convergence or hitting boundaries due to complex likelihood surfaces. The simple BREM (biomass random effect model) part of MP1 was shown not to exhibit any of these properties: it always converged and without any apparently strange parameter estimates. Given that in both rounds of MP testing it has clearly demonstrated an ability to reduce variance in both catch and SSB, this suggests that it would form a sensible base point for an MP, irrespective of what is done with the resultant parameters in the HCR.

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, unlike target-based MPs where target mis-specification can be a problem. However, trend-based MPs can get “lost” and fail to recognise a spuriously positive trend at very low stock biomass levels and potentially fail to recover. Both the current MPs are target and trend driven (in relation to CPUE) then 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 we have estimated the lowest recruitments on record. As such, they represent levels of the aerial survey below which we would, ideally, never want to be below and would indeed prefer to be above. In MP2 the tuning parameter is effectively a target level of the future aerial survey which is a multiple of the average historical level of the survey given real data. From paper CCSBTESC/1107/34 in Table 1 we see that the tuned level of this multiple is always less than 1 and mostly in between 0.6-0.8. This means, in effect, that the target level of aerial survey is actually less than that observed in the historical data. This is perhaps not ideal, as we do not want the recruitment level to decrease below the levels seen in the last two decades, so we suggest that the average historical level of the aerial survey forms a kind of limit reference point, and that below this point any MP should act strongly to ensure that the stock is brought above this level as is done in MP1.

Form of the new HCR

To combine the features of both MP1 and MP2 the proposal is to form two candidate TACs, based on the key aspects of each of the previous CMPs, and then take the (arithmetic) mean of the two. 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 $y\text{-}\tau_B+1$ to year y). The second TAC is defined as follows:

$$TAC^2_{y+1} = 0.5 \times \left(TAC_y + C_y^{t\arg}\Delta_y^R\right), \tag{2}$$

where

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

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_y^R is defined as follows:

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

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 can be kept at their respective levels as used in MP1 and MP2 with the single tuning parameter δ. 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, the parameter ε_b is reduced from 0.5 to 0.25. Table 1 details the fixed parameter values in the combined procedure and their values in the individual procedures. Finally, the joint MP 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 MP and their respective values for the two original CMPs.

Parameter	BP	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)

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

The CCSBT Extended Scientific Committee conducted a review of fisheries indicators and updated the Operating Model results in 2011 to provide information on the stock status. This report updates description of fisheries and the state of stock, and provides fishery and catch information, in the light of these evaluations.

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 2010 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 - 2003, 79% of the reported catch was taken by longline and 21% 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 Extended Scientific Committee (ESC) advised that the current spawning stock biomass (SSB) remains very low (0.03-0.07 SSB_0); however, the outlook for the stock is positive.

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

Stock

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

Recruitment

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

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

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

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

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

4. Current Management Measures

At its Seventeenth annual meeting, the CCSBT noted that the advice from the ESC indicated that stocks were still at a very low level (approximately 5% of the unfished spawning biomass) and that taking a precautionary approach was important. The meeting agreed that the current TAC allocation decided at CCSBT 16 was considered a 2 year total TAC, and could be distributed across the two year period, with unused catch from the first year carried forward to the second year The allocation of the TAC amongst Members and Cooperating Non-Members for the 2010 and 2011 fishing seasons is specified below (in tonnes). The meeting also agreed that there would be no carryover of unused quota from 2010/11 to 2012.

<u>Effective Catch Limit for the 2010 and 2011 fishing seasons</u>

<u>Members</u>

The “Nominal Catch” listed below is the catch before any reductions are applied, the “Allocated Catch” is the reduced catch allocated for 2010 and 2011 and the “Effective Catch Limit” is the effective catch after additional agreed voluntary reductions have been applied.

	Nominal Catch	Allocated Catch	Effective Catch Limit
Japan	5,665	2,261	2,261
Australia	5,665	4,270	4,015
Republic of Korea	1,140	859	859
Fishing Entity of Taiwan	1,140	859	859
New Zealand	1000	754	709
Indonesia	750	651	651

Cooperating Non-Members (for 2011)

Philippines	45
South Africa	40
European Community	10

In addition to the reduced TAC, the CCSBT decided that it would work toward implementing a management procedure (MP) in 2011 and that the MP would be the basis for TAC setting in 2012 and beyond. An emergency rule will be developed as part of the MP for exceptional circumstances such as recruitment levels lower than historically low levels. Finally, the CCSBT has agreed to set a TAC of 5,000t-6,000t for the 2012 fishing season in the event that an MP cannot be finalised by 2012, unless the Extended Commission decides otherwise based upon the new stock assessment.

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 harmonised 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

The ESC recommended that the Management Procedure (MP) be adopted.

The Extended Commission was referred to Agenda Item 9 of the ESC report to differentiate MP behaviour under alternate MP criteria (tuning year, maximum TAC change and an increase in the initial TAC setting).

Based on the MP selected by the Extended Commission the following TACs were recommended (assuming a 1-year lag):

Tuning year	**Maximum TAC change (t)**	**Increase in initial TAC setting**	**Recommended TAC (t) (2013-2015)**
2035	3000	Yes	12449
2035	3000	No	9449
2035	5000	Yes	13983
2035	5000	No	9449
2040	3000	Yes	12449
2040	3000	No	9449
2030	3000	Yes	12449
2030	3000	No	9449

The ESC strongly advised that any future TAC changes should be considered in the context of an adaptive MP that reacts to the data inputs.

If a zero-lag is selected, the MP should be retuned, though differences in biomass and catch performance will be minor.

If the MP is implemented in 2011 with a 1-year lag, the ESC recommended that the current TAC of 9449 t remains for 2012 prior to implementation.

Under the MP options above there are only three possible TAC changes at the first implementation (0;+3000t;+4534t). The ESC advised the Extended Commission that it could have additional flexibility in the context of an MP by considering a smaller maximum TAC change for the first implementation only. This could be incorporated together with any of the TAC increase options listed in paragraph 128. This would require retuning of the MP prior to the Commission meeting.

Noting the importance of accurate data inputs for the performance of the MP, the ESC recommended that the Extended Commission continue to take steps to ensure accurate future catch and effort reporting.

6. Biological State and Trends

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

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

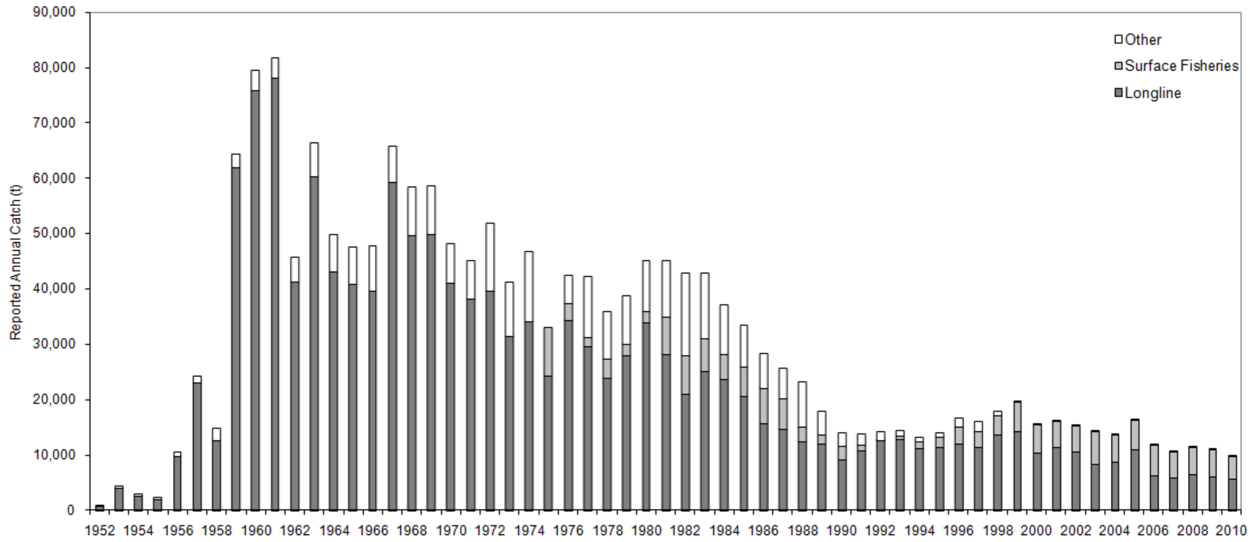

Figure 1: Reported southern bluefin tuna catches by fishing gear, 1952 to 2010. Note: a 2006 review of SBT data indicated that catches over the past 10 to 20 years may have been substantially under-reported.

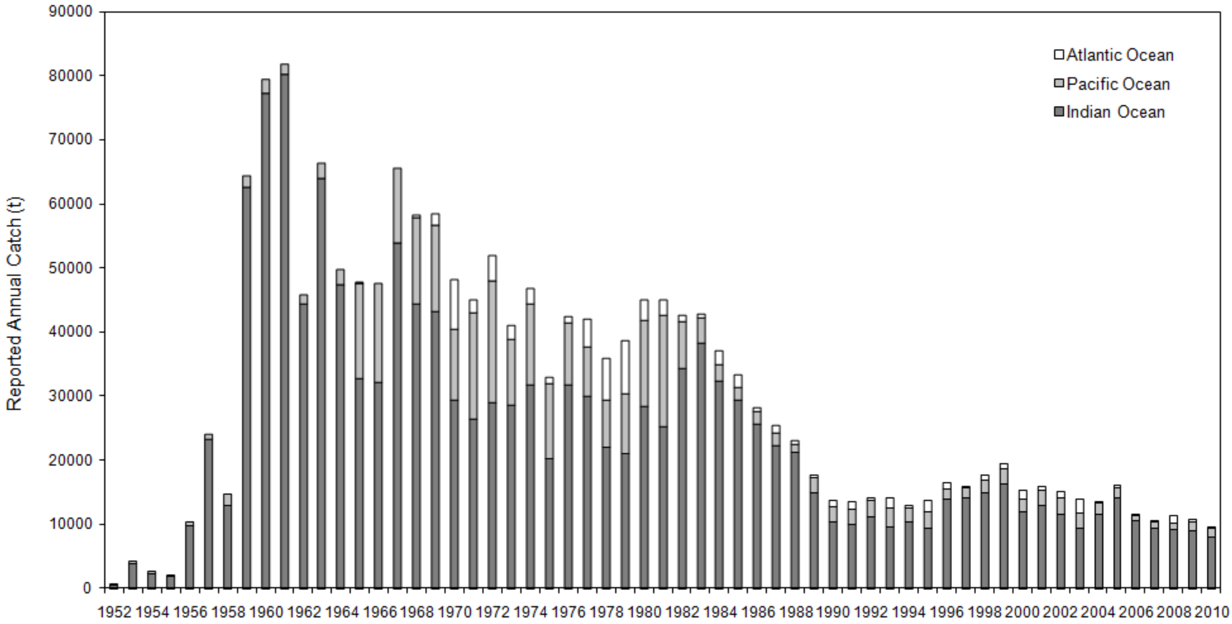

Figure 2: Reported southern bluefin tuna catches by ocean, 1952 to 2010. Note: a 2006 review of SBT data indicated that catches over the past 10 to 20 years may have been substantially under-reported.

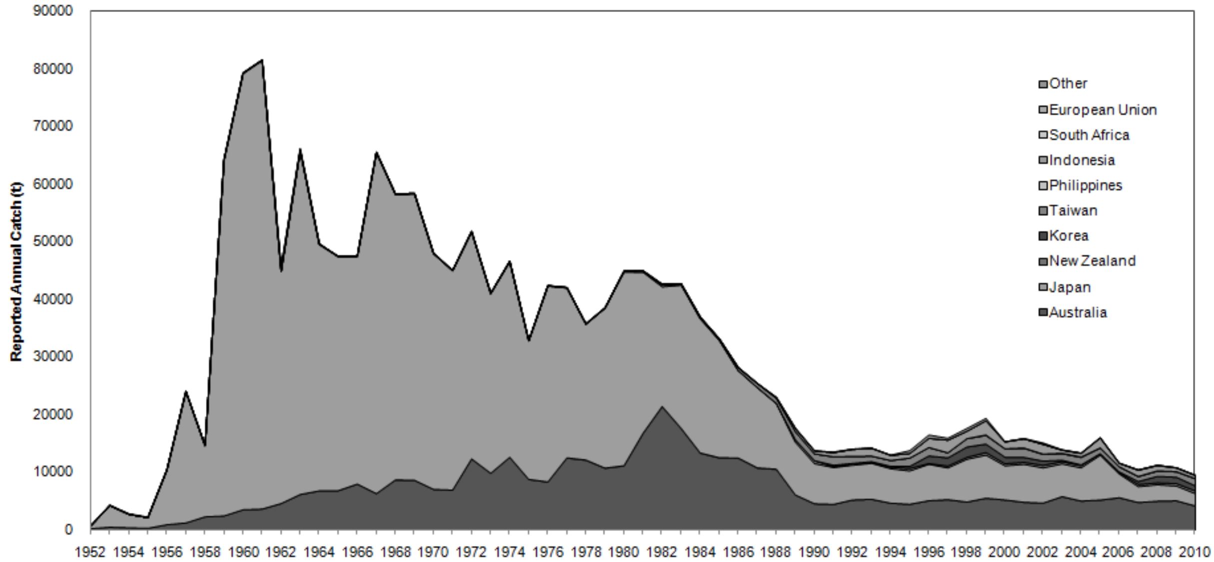

Figure 3: Reported southern bluefin tuna catches by flag, 1952 to 2010. Note: a 2006 review of SBT data indicated that catches over the past 10 to 20 years may have been substantially under-reported.

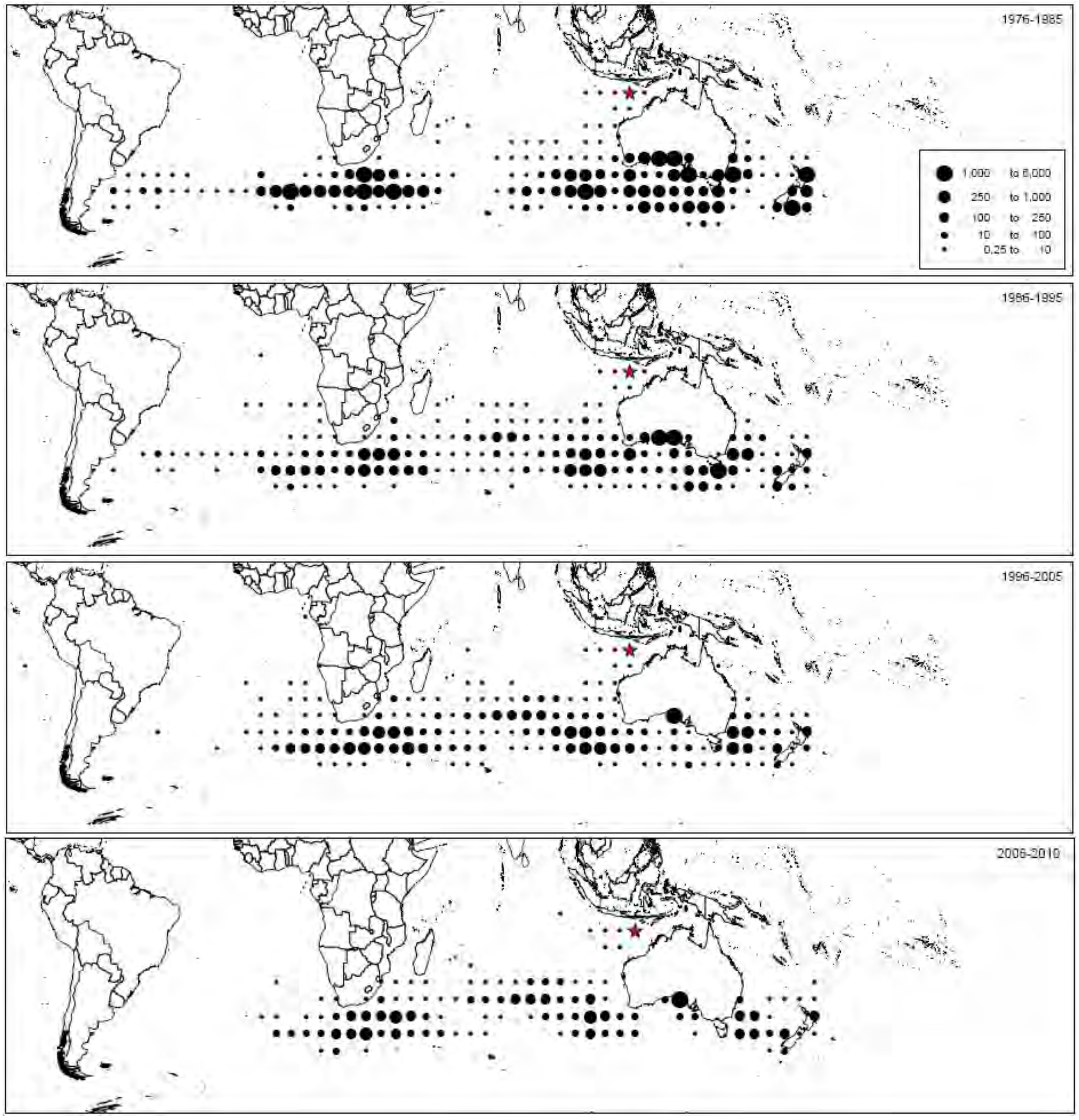

Figure 4: Geographical distribution of average annual southern bluefin tuna catches (t) by CCSBT members and cooperating non-members over the periods 1976-1985, 1986-1995, 1996-2005 and 2006-2010 per 5° block by oceanic region. The area marked with a star is an area of significant catch in the breeding 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.

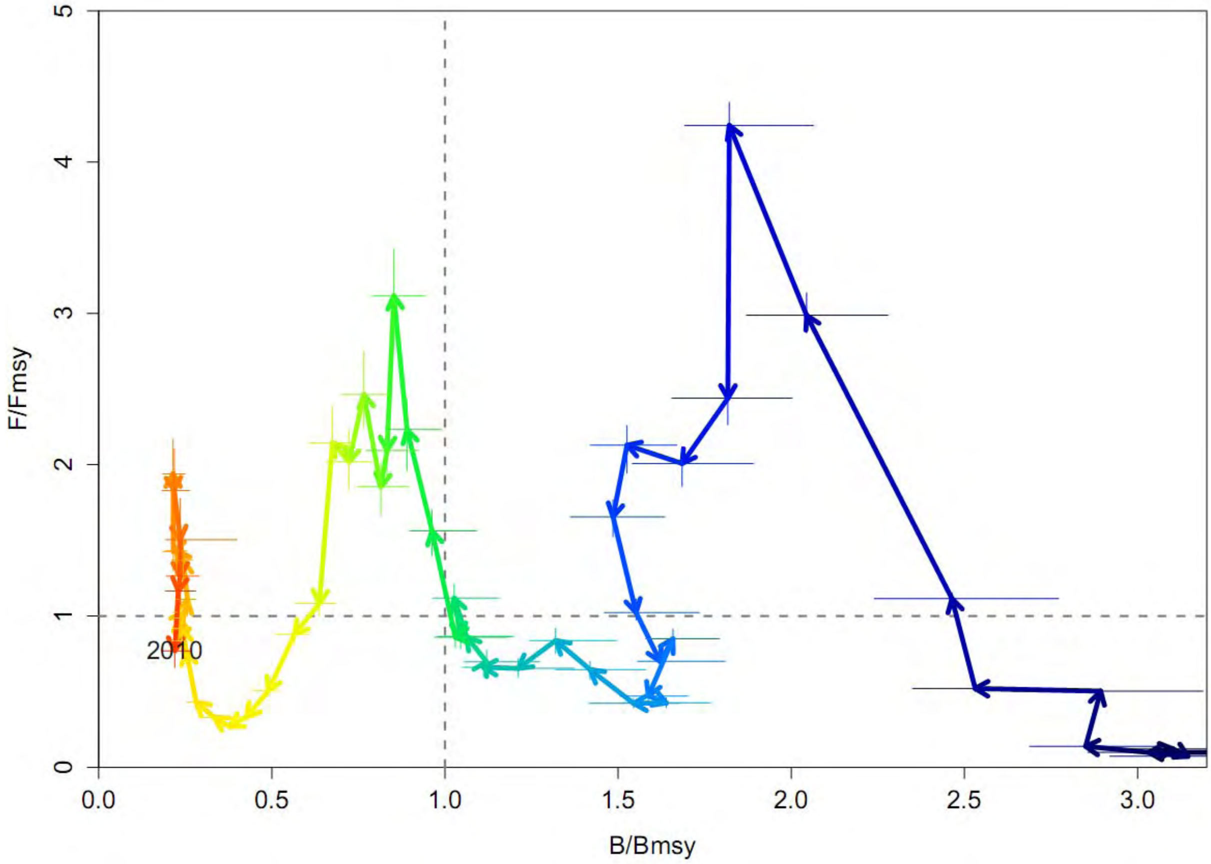

Figure 5. Time trajectory from 1952 to 2010 of median fishing mortality over the F_{msy} (for ages 2-15) versus spawning biomass (B) over B_{msy}. The fishing mortality rates are based on biomass-weighted values and the relative fishery catch composition and mean SBT body weights in each year. Vertical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

Data Exchange Requirements for 2012

Introduction

Draft data exchange requirements for 2012 are provided in Annex A. The attachment shows the proposed data that are to be provided during 2012 and the dates and responsibilities for the data provision.

These requirements are based on the 2011 data exchange requirements, with some changes where the Secretariat considered appropriate. ***Changes from the 2011 requirements (apart from minor editorial changes and incrementing the year) are tracked within Attachment A***.

Catch effort and size data should be provided in the identical format as were provided in 2011. 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 2012 to allow development of the necessary data loading routines.

Data listed in Attachment A should be provided for the complete 2011 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 2010 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 2010 data) must be accompanied by a detailed description of the changes.

Annex A

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
CCSBT Data CD	Secretariat	31 Jan 12	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 2011 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 2011on 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 12	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 12	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 12	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 12	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 12	The mortality allowance (kilograms) that was used in the 2011 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 12 (New Zealand)[2] 30 Apr 12 (other members, South Africa & Secretariat) 31 July 12 (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
Historical effort for areas 14 and 15)	Korea	30 Apr 12	The complete historic time series for areas 14 and 15 of all Members needs to be revised to provide full fishing effort in areas 14 and 15. *This was to be provided as part of the 2007 data exchange (before SAG8) by all Members who had fished in areas 14 and 15. Only one Member has yet to provide (or advise in relation to) this information.*
Non-retained catches	All Members	30 Apr 12 (most Members) 31 July 12 (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 12	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 12	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 12	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. <u>Secretariat Comment</u>: *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 12	Shot by shot data for New Zealand joint venture vessels in statistical areas 5 and 6 for 2011. 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 12	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).
Observer length frequency data	New Zealand	30 Apr 12	Raw observer length frequency data as provided in previous years.

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
Raised Length Data	Australia, Taiwan, Japan, New Zealand	30 Apr 12 (Australia, Taiwan, Japan) 7 May 12 (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 12	Raw Length Frequency data from the South African Observer Program.
RTMP Length data	Japan	30 Apr 12	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 12	Raw length/weight measurement data should be provided by Korea instead of raised length data. *However, Korea has advised it has greatly improved its sampling size, and will investigate providing Raised Length Data for future Data Exchanges.*
Indonesian LL SBT age and size composition	Australia Indonesia	30 Apr 12	Estimates of both the age and size composition (in percent) is to be generated for the spawning season (July 2009 to July 2010 and July 2010 to June 2011). Length frequency for the 2010calendar year and age frequency for the 2010 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 will work together to provide age composition data (based on direct ageing) according to current data exchange protocols.
Direct ageing data	All Members	30 Apr 12	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 12	Estimates of the different trolling indices for the 2011/12 season (ending 2012), including any estimates of uncertainty (e.g. CV).
Tag return summary data	Secretariat	30 Apr 12	Updated summary of the number tagged and recaptured per month and season.
Catch at age data	Australia, Taiwan, Japan, Secretariat	14 May 12	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 12	The 2011 catch of SBT in numbers and weight and the number of vessels fishing for SBT for each port and month. Also the 2011 total catch by weight of each species.
Global SBT catch by flag and by gear	Secretariat	22 May 12	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 12[7]	These data will be provided for July 2010 to June 2011in the same format as previously provided.
Raised catch-at-age for Indonesia spawning ground fisheries. **For OM**	Secretariat	24 May 12	These data will be provided for July 2010 to June 2011 in the same format as on the CCSBT Data CD.
Total catch per fishery each year from 1952 to 2011. **For MP/OM**	Secretariat	31 May 12	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 12	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 12	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 12	Calculate the total catch-at-age in 2011 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 12	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.
Core Vessel CPUE Series **For OM**	Japan	31 May 12	Provide the Core Vessel CPUE series for use in the OM and MP

[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
Tag releases / recoveries and reporting rates. **For OM**	Australia	31 May 12	The RMP tag/recapture data for the period 1991-1997 will be updated for any changed/new data in the database.
CPUE series.	Australia / Japan	15 Jun 12 (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.
Aerial survey index	Australia	31 Jul 12 (every attempt will be made to provide this at least 4 weeks earlier)	Estimate of the aerial survey index from the 2011/12 fishing season, including any estimates of uncertainty (e.g. CV).
Commercial spotting index	Australia	31 Jul 12	Estimate of the commercial spotting index from the 2011/12 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.