Commission for the Conservation of
Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of the Seventh Meeting of the Stock Assessment Group

4 - 11 September 2006
Tokyo, Japan

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Agenda Item 1. Opening

1. The Independent Chair, Dr. John Annala, opened the meeting and welcomed participants.
2. Participants introduced themselves. The list of participants is at **Attachment 1**.

Agenda Item 2. Appointment of rapporteurs

3. Members appointed rapporteurs to produce the text of the report.

Agenda Item 3. Adoption of agenda

4. A minor amendment was made to the draft agenda. The adopted agenda is at **Attachment** 2.

Agenda Item 4. Admission of documents and finalisation of document list

5. The draft list of documents for the meeting was considered. The agreed list is at **Attachment 3**.
6. The meeting assigned individual documents from the list to relevant agenda items.

Agenda Item 5. Consideration of implications of independent panel reports on stock assessment inputs, including catch levels and their allocation to fleets, CPUE indices and their weighting factors etc

7. Japan stated that when examining results of the market panel, the SAG should take into account stock assessments that were conducted in the past by the Scientific Committee
8. Papers 24, 25, 29, 31, 33, 39, and 42 were presented as relevant to item 5.
9. CCSBT-ESC/0609/24 explored information relevant to the relative plausibility of the different CPUE scenarios for how catch anomalies of SBT may have affected CPUE time series. It noted that the Market Review (Lou et al; 2006) identified four potential sources for the catch anomaly. The four sources are not mutually exclusive. Not all potential sources of anomaly necessarily affect the estimates of CPUE used

in assessments and management procedures. CCSBT-ESC/0609/24 noted that prior to 1989, official catches were on average 7.1% greater than the weight of the catches estimated from the log books. Since 1989, the opposite has occurred and the logbook catches have generally been greater than the official catches by an average of 5.4% and by as much as 12% in 1993.

10. CCSBT-ESC/0609/24 identified two potentially important issues that have implications for the interpretation of the market statistics as annual catches: (1) the year of the catch to which the annual estimates of catch sold in the market apply and (2) the status of unidentified frozen SBT catches that did not go through the auction process. Consideration of a lag in the taking of the catches and the sale of the catches in the market affects the estimated magnitude of the catch anomaly each year. For Case 1 it also affects when the decline in the catch anomaly began to occur, which could be a factor when considering the relative plausibility for different hypotheses for why this occurred. CCSBT-ESC/0609/24 also identified the need to resolve the implications of reported non-Japanese catches which may not have been accounted for in the Market Review. It was noted that this issue does not relate to the potential sources of the catch anomalies. How these reported catches are treated has little effect on the general temporal trends in the estimated catch anomaly in the different cases, but their treatment can affect the estimated overall magnitude by up to 45% in a given year and the cumulative total by 23% and 17% for Cases 1 and 2 respectively.

11. CCSBT-ESC/0609/24 compared catch rate estimates from vessel reported data and observed data (from Japanese longline vessels,) collaborative Real Time Monitoring Program (i.e. the RTMP during 1991-1995)) and AFZ observer program (1991-1997). For both the RTMP and AFZ data, the vessel reported catch rates tended to be similar to, or to exceed, those reported by observers. Overall, the RTMP and AFZ observer data provide no indication of consistent under-reporting of SBT catch rates in the logbook data used for the estimation of CPUE trends, at least for the period 1991 to 1997.

12. CCSBT-ESC/0609/24 also examined the potential for historical latent effort within the Japanese SBT fleet. It found that no more than 36% of the available fishing days for SBT vessels would have fallen within official SBT seasons, indicating that substantial latent effort existed within the SBT fleet. Hence, it cannot be considered implausible that potential fishing activity derived from this latent effort was a potential source of a component of the SBT catch anomaly.

13. CCSBT-ESC/0609/24 also calculates estimates of the number of days that would have been required to catch the additional catch indicated by the catch anomaly, assuming that all of this additional catch came from Japanese SBT vessels but outside of the period and/or areas used in the CPUE calculations. Based on these result the hypothesis that CPUE was unaffected by the catch anomaly can not be considered implausible. Further, if the vessels taking the catch anomaly were able to concentrate their effort in areas and time periods with high catch rates, then the number of days that would have been required would have been similar to that before there was any substantive catch anomaly. CCSBT-ESC/0609/24 further noted that reported effort in Area 2 increased dramatically after catch quotas became

restrictive on the Japanese fleet, but catch rates there remained low. This could reflect displacement of effort towards bigeye tuna, when the SBT fishery was closed, or to an area where catches, and possibly location of effort, was mis-reported. Calculations of the amount of SBT that this effort in Area 2 could have caught indicate that it would have been sufficient to have been an important component contributing to the catch anomaly.

14. A summary of ESC/0609/33 was presented. The paper applies economic and administrative principles to data to assess the most plausible catch and CPUE levels for fishing areas and months. The summary noted that the ICCAT Stock Assessment Group in 2006 had relied mostly on similar principles to estimate the recent catches of Atlantic Bluefin, in response to concerns about the reliability of reported catches. The paper noted that the current SBT catch anomaly process had first been identified by assessing that the declared longline catches were highly unlikely to have been commercially sustainable. Applying these principles to the new data on SBT, the paper concluded that the catch anomaly estimates and CPUE were very uncertain for 2004 and 2005, and contended that making any conclusions using information from those years was very difficult. This conclusion was based on the large decline in fish price from 2002 (ESC/0609/33, p 10), and the increase in the main operating cost (ie fuel) from 2004 (ESC/0609/33, p 11), and that these processes would have inevitably changed the proportion of catch going to auction – the major driver of the level of catch anomaly in the Review of the Japanese Market. The paper concluded that the economic data suggest that a substantial part of the catch anomaly was logically taken by the declared fleet in the core areas and months, on the basis that this was the only way that fleet could have been economically viable.

15. Some participants noted that the recent declines in CPUE for the Japanese domestic fleet were also observed in the Japanese vessels operating under charter arrangements in New Zealand waters (with 100% observer coverage) and New Zealand's domestic fleet.

16. Some participants noted the utility of the economic analysis and suggested that more detailed analyses were warranted by technical experts more qualified in the analysis of economic issues. It was also noted that reports from some members indicated that the economic conditions (declining prices, increasing operating costs) since the 1990's have increased economic pressures on fleets and that this has resulted in reductions in the number of vessels fishing and, in some cases, large accumulated deficits.

17. It was noted that Japanese longline operators have been working to reduce the operation costs and there has been about 40% reduction in the operation costs.

18. Paper CCSBT-ESC/0609/31 presents analyses of a range of reported catch and effort data sources aimed at narrowing the range of plausible CPUE series. A comparison of the IOTC and CCSBT databases did not show any substantial inconsistencies. A visual analysis of trends in catch and effort provide some support for a substantial portion of the unreported catch being attributed to Japanese effort outside core areas and times (outside areas 4-9, months 4-9) (CCSBT-ESC/0609/31, Figures 7- 15). If the majority of the unreported SBT catch was caught by the Japanese fleet outside

core areas and times, and the CPUE trends inside and outside core areas and times are opposing, there may be need to re-consider the times and areas used in the nominal CPUE.

19. CCSBT-ESC/0609/39 provides results of comparison of CPUE from RTMP operation as reported by vessels and as observed by the scientific observers for the same Japanese vessels and comparison of nominal and standardized CPUE between RTMP vessels with and without scientific observers. The CPUE values reported by the science observers and reported by the RTMP vessels over 1992-2004 were virtually identical. Standardized CPUEs indicated that CPUE when an observer was present was somewhat higher in the late 1990s, but that there was no clear general trend overall. Time had been insufficient to allow the statistical significance of this to be checked fully; further analysis is required.

20. Technical issues were raised in regard to the standardisation analysis in CCSBT-ESC/0609/39 related to the non-independent nature of the CPUE data which would lead to over estimation of precision.

21. The SAG noted that there was insufficient information in the independent reviews of the market statistics and in the papers presented to the meeting to definitively resolve a number of important issues relating to assessing the plausibility of alternative CPUE scenarios and their resulting implications for the current stock status and future projections.

22. The SAG noted that analyses of the available data for observed versus non-observed fishing by longline vessels (CCSBT-ESC/0609/24 and 39) did not indicate any consistent pattern of appreciable under-reporting of catch. Some participants noted, however, that this does not exclude the possibility of an appreciable proportion of the catch anomaly having been taken by the main SBT fleet in the core areas (4-9) either within or outside the main fishing season, due to the large latent effort in the fishery.

23. The SAG noted that SC10 reported that “Provision of fine-scale catch and effort data has been discussed extensively at previous ESC meetings. It has been recognised that, “for scientific purposes, access to data at the finest spatial and temporal scale is desirable to assist resolution of key uncertainties in assessments such as CPUE standardisation” (Report of SC8, Christchurch, 2003)”.

24. Japan stated that requests for the provision of fine scale data need to be clearly justified. Such requests need to specify in advance the possible outputs of the analysis of the fine scale data planned, and in particular how it would be expected to improve analyses based on 5x5 degree data. Previous cooperative studies on SBT fine scale data between Japanese and Australian scientists had taken place in the 1990’s but they had had limited utility.

25. Australia stated that the results of these collaborative fine scale analyses made important contributions to improved interpretations and understanding of the Japanese CPUE. Amongst other things, the B-ratio CPUE index, which in proxy form is one of the agreed indices used in assessments since 2000, was developed as part of this work

26. Paper CCSBT-ESC/0609/29 reviews the "Report of the Australian SBT Farming Operations Anomalies". It was noted that the paper was a review by Professor Trevor Hastie, a statistician from Stanford University in the USA, who was commissioned by the Australian government to conduct this review. The review considered the statistical basis and reliability of estimates of two different potential biases in catch estimates considered in the Australian Farm Review (AFR). It was noted that the main conclusion of the paper was "..that neither of these biases can be estimated satisfactorily from the available data". The review then considered Chapter 7 of the AFR, which attempted to demonstrate and estimate bias in the 40 fish sample, and identified numerous statistical and logical issues with the analysis. The author concluded "I have no faith in the results reported, because I have no faith in most of the building blocks. Even if I did, the results are estimates of bias, and without standard errors are useless". Chapter 4 of the AFR, which examined weight loss during the tow, was also reviewed. It concluded that "..there appears to be some evidence of a bias due to fish tow, but I am not comfortable it can be quantified with the data available".

27. The SAG questioned whether it was also fair to interpret this as saying that the data available to the panel did not support the conclusion that catch anomaly is not occurring in the Australian SBT farming industry, i.e. the data available to the panel members were not sufficient to determine if there was or was not any bias.

28. Japan questioned the utility of the statistical review of the report of the Australian SBT Farming Operation Anomalies, believing that estimation of the catch anomaly required a biological analysis.

29. Australia noted that the paper had been commissioned by Australia under a confidentiality agreement, consistent with the provisions of the Commission. The author of the paper reviewed the methods and results of the Australian SBT farming operation anomalies panel report without data that was provided to the farming panel.

30. Australia noted that they will be implementing additional measures for monitoring catches of farm operations.

31. Paper CCSBT-ESC/0609/25 lists six assumptions that need to be made to implement the scenarios (as specified in the Commission’s Attachment 7 to the report of the Special meeting of July 2006), and to interpret the information in the two Catch Reviews in terms of inputs to the operating model. With respect to the longline unreported catch, one of the assumptions is the extent of the lag between market statistics and actual removals from the stock. One of the major uncertainties is how unreported longline catches may have affected the CPUE, and the paper considers a wide range of possibilities. The paper notes that the way in which the scenarios for the farm catches were specified in Attachment 7, that is, with no change to the age frequency of the catch, implies an increase in the number of fish caught by the surface fishery. This is because the operating model uses catch in weight as input and age distribution of the catch to infer the catch in numbers. An increase in the modelled catch numbers is inconsistent with the conclusion from the Australian Farm review that there appeared to be little scope for catch anomalies via misreporting of tuna numbers.

32. The SAG agreed that specification of the grid integration[1] would need to be reconsidered in light of the results of the diagnostics presented in CCSBT-ESC/0609/25 and CCSBT-ESC/0609/42, but that this would not be feasible in the context of this meeting. Some participants suggested that it may also be necessary to reconsider whether the criteria for the advice formulated at SAG 6 were appropriate in light of these results. The SAG agreed that the criteria along the lines used for advice at SAG 6 were still appropriate given the concern about the short-term risk to the stock, but that it may be necessary to consider additional criteria in light of the catch anomaly and results of the indicator analyses, and that these would need to be formulated in the context of the outcomes of the final scenarios and sensitivity analyses.

Agenda Item 6. Revision of operating model and analysis of impact of overcatch scenarios on stock status

33. Paper CCSBT-ESC/0609/42 provided results from fitting the SC/MP operating model with a range of catch anomaly scenarios. The proposal of the Advisory Panel for a minimum set of scenarios was used to provide the basic input assumptions and scenarios in running the model. This analysis shows that the longline catch anomaly has appreciable impacts on the likely status and future yields. In particular, natural mortalities (M0 and M10) shift towards lower values. On the other hand, the surface fishery catch anomaly has relatively little influence on the projections, even if the maximum farm anomaly (S3 option) is assumed. CPUE adjustments for longline in relation to catch anomaly scenarios have a major effect on parameter and stock status estimates. As the fraction of existing reported effort that is associated with longline catch anomaly becomes larger, the M10 distribution shifts towards smaller values. Furthermore, when steepness parameter selection is based on likelihood weighting, the distribution shifts towards higher values. This indicates that configuration of the grid integration needs to be reconsidered in relation to fixed or likelihood-based sampling. This paper also suggested that rather than assuming the market anomaly for 2006 and 2007 to be the same as for 2005, it is more reasonable to assume a linear regression of the anomalies for 2003-2005. The assessment result under this new assumption is almost identical to those for the original scenario; future projections are, however, slightly more optimistic.

34. Paper CCSBT-ESC/0609/42 also showed projection results at different constant catch levels. In all projections, default catch allocation (average ratios of 2003-2005 using nominal catches as at July 2006) and the Japanese voluntary quota cut in 2006 (about 1,600t) are assumed. Projections at the current catch level (14,925t) indicate the catch anomaly scenarios provide more optimistic projections than the original reference case. If no catch anomaly is assumed, the TAC reduction to satisfy a

[1] Each scenario integrates the uncertainty along several axes (steepness of stock-recruitment relationship, natural mortality at ages 0 and 10, CPUE series, power function of the abundance-CPUE relationship, sample sizes used for length/age composition data, age-range used to standardize CPUE) by first conditioning the model over a grid of 540 cells obtained from a full cross of all the factors and then sampling from the grid giving weights to each of the cells.

criterion for short-term risk adopted at the 6th SAG meeting (a median spawning biomass in 2014 no lower than that in 2004) would be about 9,000t, i.e. a TAC of about 6,000 tons. On the other hand, if the largest catch anomaly option for longliners (C0S0L2) is assumed, the reduction drops to 4,000 t, i.e. a TAC of 11,000t. The largest catch anomaly scenario, both for longline and surface fisheries (C0S3L2), provides projections that are more optimistic in the long term. However, the TAC reduction required in terms of the criterion remains about the same at some 4000t. Furthermore, in scenarios which assume 50% and 100% CPUE adjustments (C1S3L2 and C2S3L2), the current catch level is sustainable in terms of the ratio of spawning biomass in 2032 to that in 2004.

35. The analyses in CCSBT-ESC/0609/42 indicated that there is no alternative to an appreciable TAC reduction to deal with the consequences of low recruitments in 2000 and 2001 if the spawning stock biomass is to be maintained at or above the current level during the next decade. However, given that the current abundance is estimated to be higher in absolute terms, and that the projected depletion over the next few years would not be as large as estimated for the no-catch anomaly scenario, the authors suggested that alternative criteria for short-term risk need discussion and that the SC recommendations for the 2007 TAC should show options across a range of such criteria, and further take account also of the rate of recovery projected thereafter.

36. Paper CCSBT-ESC/0609/25 was presented, describing the operating model behaviour with the alternative catch scenarios requested by the Commission, as well as several others to explore the sensitivity of results. Results were generally similar to those reported in CCSBT-ESC/0609/42. The paper reports on the goodness of fit diagnostics, the implications for sampling from the grid for integration purposes and on results of projections. Scenarios where 100% of the unreported catch affects CPUE fit rather poorly as is evident in very high values of autocorrelation in the CPUE. The best fits for the alternative catch scenarios generally occur at low values of juvenile and adult natural mortality, and the low value for adult mortality (M10=0.07) was included in the grid of parameter space for the scenario modelling conducted in this paper. This affects the sampling of the grid which selects almost exclusively the lowest value of adult natural mortality (M) and the two lowest values of juvenile natural mortality (m), even when CPUE is assumed to be unaffected by the unreported catch.

37. Results presented in CCSBT-ESC/0609/25 for estimates of current and relative spawning stock biomass are most sensitive to the proportion of the unreported catch that is assumed to affect CPUE. The median relative biomass (B2006/B0) is between 7% and 18% for the full range of CPUE assumptions (0% to 100% of the catch anomaly affecting CPUE). Projections based on the assumption of a constant catch of 14,930t in 2006 and from 2007 onward, suggest that the probability of B2014 being greater than, or equal to, B2004 is between 9% and 29%. For illustrative purposes, projection runs were conducted with 7,770t catch from 2007 onward. For these projections, most of the scenarios get close to, or exceed the B2014>B2004 criterion (probabilities range between 40% to 69%). Projections were also run with a proportional reduction of total catch (~48% reduction) as the means of

compensating for potential catch anomalies as noted in the 2005 SC management advice. This reduction implies future catch levels of around 10,000-11,000t (depending on the scenario). In these projections, the attainment of a 50% probability of B2014>B2004 is dependent on the scenario. These results are based on the assumption that there is a one year lag between the CPUE and the catch anomaly, i.e. the catch anomaly in 2006 determines the adjustment to CPUE in 2005. Various assumptions were made to provide alternative estimates of the 2005 and 2006 catch anomaly and the adjustment to the CPUE in 2004 and 2005.

38. The sensitivity trials in Appendix 2 of CCSBT-ESC/0609/25 show that results are somewhat sensitive to (a) the assumption made about unreported catch in 2005 and (b) the inclusion or exclusion of the last one or two CPUE data points (2004, 2005). The sensitivity of relative biomass estimates is quite small, for example, 14% versus 18% for B2006/B0. However, there are substantial differences in other estimates, depending on whether the adjusted CPUE points for 2004 and 2005 are included or not. For example, in all cases assuming a catch of 14930t, results for CPUE included up to 2005 imply that there is less than a 50% probability of B2014 being above B2004, whereas some (but not all) results for CPUE included only up to 2003 imply a greater than 50% probability that B2014 would be above B2004. In general, results using CPUE only up to 2003 indicate a larger and more productive stock than results using CPUE up to 2004 or 2005.

39. The SAG discussed the nature of the poor agreement between the predicted and observed catch rates in operating model scenarios with the extreme CPUE interpretation (assumption that 100% of catch anomaly affects the catch rates). Since these results were based on the long market anomaly time series (market scenario 2), it was not thought that the lack of fit was an artefact of the discontinuity in the market anomaly time series (as might have been particularly evident for market scenario 1), but was probably indicative of a systematic incompatibility between the model and data. It was recognized that the scenarios are probably unrealistic in terms of the actual trends and should be treated primarily as illustrative in nature. However, it was generally felt that the more extreme CPUE scenarios were implausible because they predict that the true recent catch rates would have been near the levels observed in the early 1970s, and this is in major contradiction with the fishery indicators and general perceptions of recent stock status.

40. The SAG recognized a prevailing contrast between the population dynamics results arising from the operating model results for the catch anomaly scenarios and the stock assessment results reported in recent years. Around 5 years ago, catch and CPUE trends appeared to both be relatively steady, leading to the conclusion that current catches were probably near sustainable levels. Given the alternative catch scenarios, some SAG participants expected that the scenarios with catch anomaly would result in higher estimates of recent recruitment, a more productive stock, and higher current sustainable yields.

41. In discussion it was suggested that the change in perceived stock dynamics was partly attributable to the low recruitment at the turn of the millennium and changes in the catch and CPUE trends as a result of the catch anomalies. It was noted that simple exploratory modelling based on hypothetical simulations did indicate that,

given a one-way declining stock trajectory, followed by several years of stable catches and stable CPUE, then the introduction of alternative catch scenarios (beginning at the start of the stable period and constant over time) would not necessarily lead to more optimistic stock status (i.e. depending on how productivity and depletion interact, the current sustainable yield could increase or decrease).

42. The SAG also noted that there is a major problem in adjusting the CPUE series to account for the catch anomaly, (particularly the last two years) because the market anomalies in 2006 and 2007 are unknown (i.e. there is a 1-2 year lag between the timing of the catch and appearance in the market). Various assumptions have been made on recent trends or averages of the documented catch anomalies to adjust the CPUE in these years.

43. There are clear uncertainties in adjusting the CPUE data to incorporate estimates of the unreported catch as discussed above, but in case of the CPUE for 2004 and 2005 there is additional sensitivity. This is due to the time delays in the catch reaching the market, therefore market information that may affect CPUE in 2004 and 2005 will not be available until after 2005. Various extrapolations to calculate the possible unreported catch that would affect the CPUE in these years were made. This increases the uncertainty in the adjustment to CPUE that is appropriate for the years 2004 and 2005. Furthermore information was provided that due to economic and other factors, the continuity of the CPUE series after 2003 may be in doubt (CCSBT-ESC/0609/33). Accordingly it was decided to run a series of scenarios excluding the CPUE data for these two years, while still including other information such as size composition and estimates of total catch (see paragraph 53 in 7.1).

Agenda Item 7. Stock Assessment

7.1 Assessment of stock status and constant-catch projections using the operating model

Introduction

44. Advice from the Commission on market and farm anomalies (Attachment 7, Report of the Special Meeting of the Commission) represented potentially over 100 scenarios (once combinations and alternative technical interpretations are considered) and calculations for all these scenarios was not possible within the time available. However, a large set of scenarios were explored, some of which were presented in CCSBT-ESC/0609/25 and CCSBT-ESC/0609/42 (Agenda Item 6).

45. In addition to the time constraints associated with running large numbers of scenarios, the full cross (all possible combinations) of all scenarios could have produced a large, indigestible amount of output. The SAG used two approaches to reduce the volume of scenarios while retaining the range of uncertainty implied by the Commission's request.

46. Some of the technical discussions associated with this agenda item were discussed in a small technical group which then reported back to plenary.

47. The group first considered the scenarios that had been specified prior to the meeting through email discussion between member scientists and the panel (these incorporate the Commission's specific requests), and which had been run prior to the meeting. These scenarios are as specified in CCSBT-ESC/0609/42 and in **Attachment 4**. Three scenarios were chosen to span the range of behaviour seen, particularly with respect to the median of B20014/B2004, and to illustrate the importance of particular axes of uncertainty. Projection results for these scenarios under different assumptions about future catch are presented below.

48. The second approach to reduce the number of scenarios was based on CCSBT-ESC/0609/25 which provides tables showing results of a full cross of the original Commission proposed scenarios. Analyses of variance (ANOVA's) of the results of Table 7 from CCSBT-ESC/0609/25 were used to explore whether the main effects of assumptions are more important than the interactions between 2 or more assumptions. In the case of the median of B2014/B2004, the main effects explained 73% of the total variation, suggesting that presenting output for these main effects provides an adequate description of results. Results also indicated that the assumptions about the adjustment of CPUE have by far the largest effect (explaining 58% of the total variation). Results are shown in **Attachment 5**.

49. The ANOVA analyses showed that it would be sufficient to consider a 'central' scenario and show deviations from that scenario along other relevant axes of uncertainty. These findings were used to specify additional runs which were computed during the meeting.

Additional scenarios run at the meeting

50. During discussion of the results in CCSBT-ESC/0609/25 and CCSBT-ESC/0609/42, the SAG identified issues related to the interpretation of the scenarios for input to the operating model. Five issues were considered for further scenario runs to be computed at the meeting:
    (i) lagging of the official catches when calculating the Market Review anomalies to take account of the period between catch and sale
    (ii) the assumptions required to calculate the unreported catch in 2005
    (iii) including or excluding the 2004 and 2005 CPUE inputs
    (iv) adjusting the age structure of the surface fishery catch when calculating the Australian Farming Operation anomalies

    The fifth issue does not specify a scenario, but relates to the way in which projection results are integrated over the grid, either using objective function weights or prior weights for juvenile natural mortality level. Each of these issues are further explained below.

(i) lagging of the official catches when calculating the Market Review anomaly

51. The Market Review anomalies were based on subtracting un-lagged official, reported Japanese catches from the overall market volume of SBT that was considered as domestic products at the market. It is known that there is a lag between the capture of fish and the time those fish go through the market. The group

considered that this lag could be between 12 to 18 months. Although a lag had been taken into account in results presented in CCSBT-ESC/0609/25 and CCSBT-ESC/0609/42, the lag was applied to the market anomalies, the calculations for which had not taken a lag into account. For consistency, the group recalculated the market anomalies, lagging the official reported catches before subtracting them from the overall market volume to calculate the market anomaly. The assumption was that 70% of the catch caught in, say, 2003 was sold in the market in 2004, and 30% was sold in the market in 2005. The details of the recalculated total catches which were used in the scenario runs computed at the meeting are given in **Attachment 4**.

(ii) the assumption about unreported catch (catch anomaly) in 2005

52. Given that there is assumed to be a lag between the year of capture and the year when those catches appear in the Market statistics, the catch anomaly for 2005 need to be based on some additional assumptions, and is therefore more uncertain than the estimates for the earlier years in the scenarios. Two assumptions were considered for input to the operating model: 1. the unreported catch in 2005 was the same as in 2004, and 2. the unreported catch in 2005 followed the decreasing trend seen in the unreported catches estimated for 2002 to 2004. Details are given in **Attachment 4**.

(iii) including or excluding the 2004 and 2005 CPUE data points

53. For scenarios which assume some of the catch anomaly affect CPUE (i.e. is associated with the reported Japanese longline effort used to calculate CPUE), the assumptions about lags between capture of fish and the time those fish appear in the market affect the estimated catches in 2004 and 2005, and also affect the CPUE in those two years. Some members expressed concerns about the inclusion of CPUE inputs based on catches which themselves are based on assumptions, because their associated Market statistics are not yet available. They also considered that vessel operating patterns had also changed for these two years, rendering their compatibility with earlier CPUE data questionable. The group therefore considered additional runs which exclude the CPUE inputs for 2004 and 2005 when fitting the operating model. All size and age frequency data for 2004 and 2005 were nevertheless still included.

(iv) adjusting the age structure of the surface fishery catch

54. Scenarios which have additional catch weight for the surface fishery and no change to the surface fishery age frequency inputs are interpreted by the model as in increase in the number of fish in the catch. This implication in the model is therefore at variance with the conclusion in the Farm Review that "there appeared to be little scope for over-catch via misreporting of tuna numbers" (p134 of Independent Australian Farm Review). The SAG therefore considered a scenario where the age frequency distribution of the surface catch is shifted towards older fish such that the numbers stay the same as those implied by the reported catch, but the total catch weight is increased to the extent required for the scenario. Details of the surface fishery inputs for runs computed at the meeting are given in **Attachment 4**.

55. The SAG noted that the model estimates of stock size would not be affected by the possibility of a decrease in weight of the fish during towing. This is because the catch from the surface fishery is estimated in terms of numbers which are then multiplied by a (potentially biased) mean weight to obtain catch in weight. The model, however, divides by the same mean weight and uses the numbers in the population dynamics. Projections, on the other hand, would be affected because numbers would be multiplied by a (potentially biased) mean weight.

(v) using likelihood/objective function or prior weights for juvenile natural mortality

56. Both documents CCSBT-ESC/0609/25 and CCSBT-ESC/0609/42 noted that the scenarios with catch anomaly fit better at lower values of natural mortality, particularly juvenile mortality. The default specification of sampling from the grid for integrating projection results uses the likelihood/objective function value for selecting amongst the values specified for juvenile and adult natural mortality. This leads to sampling from the grid which reflects a strong preference for only the lowest juvenile natural mortality (m=0.3). Two concerns were expressed. First, that the high weight on the lowest juvenile natural mortality only is not entirely compatible with previous perceptions based on analyses of tagging data from the 1990's. It was, however, recognised that those tagging data would need to be reanalysed in the light of implications of the new catch information on reporting rates. Second, that weighting by the likelihood/objective function suggests that the catch and CPUE scenarios, which are still very uncertain, contain strong information about natural mortality, and there had been insufficient time to fully investigate whether this is fully justified by refitting the model with different assumptions about structural features or input parameters. The group therefore also considered projection results based on prior weights of (0.4, 0.4, 0.2) for juvenile natural mortality values of (0.3, 0.4, 0.5).

57. The range of CPUE adjustments to use for these scenarios was also considered following the discussions under Agenda item 5. The group noted that there is still uncertainty in the catch series which is used to adjust CPUE in the different scenarios. The group also noted that there is very little information to inform a choice of any particular % of catch anomaly which may be associated with the reported effort. On the whole, the group considered that it would be more relevant, and possibly more realistic, to consider a range between 25% and 75% (including 50% in the middle of the range) than to consider the extremes of 0% and 100% for the new set of scenarios. In particular the 100% case was considered implausible as it would imply levels of CPUE equivalent to rates in the 1970's. Resolving this issue should be a high priority for Members over the intersessional period.

58. In this regard, the group also noted that a constant adjustment factor over the whole period may be inappropriate. Scenarios to explore this were not constructed, because there is currently no information on which to base such scenarios. The results from such scenarios may, however, lead to rather different results from those which assume a constant adjustment factor over time.

59. The scenarios are of course sensitive to the level of catch anomaly implied by the market review. Thus a smaller catch anomaly would tend to be similar in effect to the lower cpue scenarios. A higher catch anomaly would tend to be similar in effect to the higher CPUE scenarios. Clearly this cannot be assessed at present, but points to the need for further work on the level of catch anomaly.

60. The group considered that the changes outlined under points (i) and (iv) to the technical interpretation of the scenarios derived from the market and farm reviews are an improvement over the original set which was run prior to the meeting. The full list of additional scenarios are specified in Table 1 of **Attachment 6**.

'Diagnostic' checks

61. The group looked at comparisons between model results for the scenarios and two indicators: the aerial survey and estimates of fishing mortality from the recent CCSBT tagging data. Estimates of aggregated age 2-4 biomass and estimates of juvenile fishing mortality were extracted from the scenarios for this purpose. **Attachment 6** (Figures 21 to 23) contains the relevant figures.

62. The patterns of fishing mortalities over time for ages 2, 3 and 4, are very similar for all the scenarios considered. In general, the estimates from the operating model seem to be too low during the 1990's compared to perceptions based on the tagging during the 1990's for all three age classes. In the most recent years, estimates for ages 3 and 4, based on age 1 releases during the recent tagging program (in the 2000's) are, in broad terms, not too dissimilar from the model estimates (CCSBT-ESC/0609/15, Figures 14, 15). The model estimates for age 2 are, however, much higher than the tag-based estimates (CCSBT-ESC/0609/15, Figure 13).

63. Combined estimates of fishing mortality for ages 2-4 also show relatively high fishing mortalities in the mid-1980's, but not as high as those implied by returns from tagging in the 1980's when around 60% of tags released in the GAB (in 1983/4) were returned.

64. With respect to patterns of aggregated biomass for ages 2-4, there is again great similarity between scenarios, all of which show a sharp decline since 2000. The most recent two years (2005 and 2006) are the lowest in the time-series and are well below the levels in 1999 and 2000. In contrast, the aerial survey (CCSBT-ESC/0609/19, Figure 1) shows a general decline between 1993 and 2000. The 2005 and 2006 indices are similar to, and certainly not well below, the 1999 and 2000 values. Overall, the time-series patterns of age 2-4 biomass from the operating model scenarios are different from the pattern indicated by the aerial survey index. There is also a lack of coherence between the aerial survey index and the model estimates of juvenile biomass in the mid 1990. The index based on commercial spotting data (CCSBT-ESC/0609/19, Figure 2) also does not show a continued decline between 2002 and 2006 indicated by the operating model scenarios.

65. The group considered time series of recruitment for a single grid cell over a range of scenarios. Recruitments in 2002 and 2003 are estimated in the operating model to be low and this leads to the very high estimates of age 2 fishing mortality in 2004 and

2005. The estimates of recruitment need to be interpreted with great caution for two reasons. First, they are based on limited information because those cohorts have only just entered the fisheries and are therefore only represented, or observed, once or twice in the size/age frequency data. Second, all the scenarios assume that the size frequency data for LL1 are representative, and that the catch anomalies for the longline fleet have the same size distribution as the reported catch. These assumptions may not be appropriate, but unfortunately there is no information contained in the Market Review report to test these assumptions.

66. Document CCSBT-ESC/0609/40 provides RTMP data on size frequency distributions of the Japanese LL catches for 2006, which only became available after the exchange of data for the 2006 SAG analyses. These data have not yet been incorporated into the operating model. The size frequencies show the strong modes for small fish (75-105cm fish; ages 2-4) over a wide geographic range. This suggests that the 2003 and 2004 year classes are not as weak as currently suggested by the operating model.

67. Taken together, the low current SSB and the operating model low recruitment estimates for 1999-2003 in the scenarios are likely to have a strong effect on spawning biomass in medium term projections. If the assumptions about the longline size frequency data being appropriate for the total catch are incorrect, and the size distribution of the catch anomalies contains more small fish than the reported catch, then the projections may be pessimistic but as noted above unfortunately there is no information contained in the Japanese market review to test this assumption.

68. The sharp drop in age 2-4 biomass in recent years in the scenarios would have a strong effect on spawning biomass in medium term projections. If the aerial survey index is more representative of real trends, this would suggest that the scenario projections may be pessimistic. The aerial survey is, however, conducted in the GAB and therefore only represents a portion of the population as a whole. If the proportion that goes to the GAB each summer has changed over time, or if the geographic distribution of the stock has changed, this conclusion of possible pessimism in the operating model results may not be correct.

69. The group further noted that the low estimates of juvenile fishing mortality from the operating models and, to a lesser extent, the lack of a decline in the 2-4 year old biomass estimated in the operating model in the early to mid 1990s, may imply a degree of undue optimism in the operating model results since they would imply relatively high escapement into the longline fishery which could carry over into spawning biomass in the mid 2000’s.

70. In conclusion the group reached the consensus that there is insufficient information to come to any firm conclusions about the implications of the incompatibilities between model results from scenarios and the indicators (tagging data and aerial survey). There has also been insufficient time to conduct some of the analyses that may shed further light, for example, re-analyses of the 1990s tagging data, outside of the operating model, using reporting rates adjusted for new information about catches. Furthermore, it should be noted that the scenario runs are not assessments,

in the sense that alternative assumptions about structural features or input parameters were not explored.

Scenario Results

71. All projection results presented in this section are predicated on the assumption that catches were underreported in the past, but that from 2006 catches would be equal to catches specified in the projections.

72. The SAG also noted that all projections were run with the inter-fleet split of future catches in the proportions implied by the historic catch allocations implicit in the 14,925t. The projections therefore implicitly assume that future catches by Indonesia are controlled at the levels implied by the product of the catch level and the 'allocation' proportion.

73. The three scenarios (A, B, C) chosen from the original set are discussed first and descriptions of these scenarios are given in the table below.

Table 1: Scenarios developed and run prior to the SAG.

Scenario reference	Naming convention	CPUE	2004 & 2005 CPUE data	Surface gear age composition shift	70-30 lagged LL1 unreported Catch	Recent Anomaly regression	M_0 weights
0	C0S0L0	-	-	-	-	-	-
A	C0S0L1	-	-	-	-	-	-
B	C1S1L2	50%	-	-	-	-	-
C	C2S3L2	100%	-	-	-	-	-

74. Results of current depletion (B2006/B0) and absolute biomass (B2006) for the three scenarios (A, B, C) chosen from the original set are shown in the table below. These scenarios span the full range of CPUE adjustments, 0 to 100%.

Table 2: Median spawning biomass in 2006 and spawning biomass in 2006 relative to pre-exploitation spawning biomass for three scenarios chosen from the original set. The no-catch-anomaly scenario is shown for comparison.

	B2006 (t)			B2006/B0		
Scenario	10%	median	90%	10%	median	90%
O	42,662	59,826	99,116	0.061	0.084	0.123
A	47,725	61,397	127,893	0.061	0.075	0.098
B	73,364	152,271	322,807	0.086	0.117	0.161
C	129,831	297,559	414,611	0.122	0.173	0.194

75. Projection results at three levels of future catch for the three scenarios (A, B, C) chosen from the original set specified by the Commission are given in tables 3 to 5 below for: B2014/B2004, B2022/B2004, the probability that B2014>B2004 and the lower 10th percentile of B2014/B2004 and in the tables below. The "no-catch-

anomaly" scenario (O) is shown for comparison. This information is also shown graphically in **Attachment 6**.

Table 3: B2014/B2004.

	14,925 t constant catch			9,925 t constant catch			4,925 t constant catch		
	10%	50%	90%	10%	50%	90%	10%	50%	90%
O	0.24	0.57	0.86	0.56	0.81	1.09	0.82	1.06	1.37
A	0.47	0.73	1.08	0.74	1.01	1.39	0.92	1.30	1.72
B	0.71	0.87	1.09	0.83	0.99	1.28	0.91	1.11	1.47
C	0.80	0.94	1.11	0.87	1.02	1.23	0.94	1.10	1.36

Table 4: B2022/B2004.

	14,925 t constant catch			9,925 t constant catch			4,925 t constant catch		
	10%	50%	90%	10%	50%	90%	10%	50%	90%
O	0.00	0.27	1.62	0.29	1.15	2.58	1.07	2.10	3.63
A	0.00	0.47	2.11	0.59	1.45	3.30	1.15	2.46	4.52
B	0.48	0.94	1.83	0.84	1.39	2.54	1.12	1.85	3.29
C	0.71	1.10	1.80	0.94	1.40	2.25	1.14	1.70	2.75

Table 5: Probability that B2014 > B2004.

	14,925	9,925	4,925
O	0.03	0.19	0.63
A	0.15	0.52	0.84
B	0.19	0.48	0.73
C	0.29	0.56	0.76

76. The SAG noted that results for A and C should be considered in the context that the associated CPUE adjustments of 0% and 100% for catch anomaly were regarded as likely to be outside the plausible range.

77. Eight additional scenarios were run, and the two methods of grid integration (likelihood/objective function weighting or prior weighting on juvenile mortality, as explained in paragraph 56 were applied for each scenario. Following initial consideration of results the group considered that it would be sufficient to present results for only 5 of the 8x2 scenarios. The subset of 5 was chosen using the approach identified above, of taking a 'central' scenario together with additional scenarios on the main axes of uncertainty. The main axes of uncertainty which are represented in the subset are:

- the % of catch anomaly assumed to affect CPUE (scenarios b, c, d)
- the exclusion of CPUE in 2004 and 2005 (scenario g)
- the prior weights on juvenile natural mortality (scenario c_)

78. The 5 scenarios are described in the table below and descriptions of all the scenarios can be found in **Attachment 4**.

Table 6: Subset of scenarios put forward for presentation from the SAG meeting.

Scenario reference	CPUE	2004 & 2005 CPUE data	Surface gear age composition shift	70-30 lagged LL1 unreported Catch	Recent Anomaly regression	M_0 weights
b	25%	Yes	Yes	Yes	-	-
c	50%	Yes	Yes	Yes	-	-
d	75%	Yes	Yes	Yes	-	-
g	50%	-	Yes	Yes	-	-
c_	50%	Yes	Yes	Yes	-	Yes

79. The effect of the two different assumptions about the catch anomaly in 2005 was found to be small compared to the effect of the other axes of uncertainty. It was therefore decided to use the assumption that catch anomaly in 2005 was the same as in 2004.

80. Results for all scenarios are presented in **Attachment 6**; results for the subset of 5 are presented here.

81. Results for current depletion (B2006/B0) and absolute spawning biomass (B2006) for the five scenarios (b, c, d, c_, g) are shown in the table below and Figure 1 (**Attachment 6**). The median current depletion ranges between 10% and 13% for the 5 scenarios (it is about 8% for the no-catch-anomaly scenario, see Table 2. The median absolute biomass ranges between about 110,000 and 160,000 tonnes (it is about 60,000t for the no-catch-anomaly scenario).

Table 7: Spawning biomass in 2006 and spawning biomass in 2006 relative to pre-exploitation spawning biomass at 10th, 50th, and 90th percentiles for the selected scenarios.

	B2006/B0			B2006		
Scenario	10%	50%	90%	10%	50%	90%
b	0.073	0.101	0.128	60,124	112,272	216,293
c	0.089	0.119	0.167	70,707	142,858	304,431
d	0.092	0.127	0.177	76,602	153,666	341,488
c_	0.080	0.112	0.144	73,323	142,995	257,773
g	0.086	0.124	0.172	80,340	166,312	316,285

82. The group initially ran projections for all scenarios under three levels of future catch, 14,925t, 9,925t and 4,925t with the view that the implications of intermediate catch levels can be obtained by linear interpolation between these three levels. One of the scenarios (c) was, however, run with two additional catch levels (12,425t and 7,425t) to check whether linear interpolation would be appropriate. Results of the projections at the 5 levels of future catch confirmed that linear interpolation is appropriate for all the quantities of interest. The only statistic which showed some deviation from linearity was the probability of B2014>B2004, though linear

interpolation should still be acceptable in the region around the median (i.e. where the probability is around 0.5).

83. Results of projections, and interpolated values, at 5 future catch levels for each of the 5 scenarios are presented in the set of tables below. The SAG noted that implications of catch levels between those shown in the tables can again be obtained by linear interpolation between the catch levels in the tables.

Table 8: Summary statistics for the 5 selected scenarios under different levels of future constant catch. Italicized values represent results from interpolations.

B2014/B2004 median					
Scenario	14,925 t	12,425 t	9,925 t	7,425 t	4,925 t
b	0.85	*0.94*	1.02	*1.11*	1.20
c	0.89	0.96	1.03	1.10	1.17
d	0.91	*0.98*	1.04	*1.10*	1.17
c_	0.86	*0.93*	1.00	*1.07*	1.14
g	0.94	*0.99*	1.05	*1.11*	1.17

B2014/B2004 10th percentile					
Scenario	14,925 t	12,425 t	9,925 t	7,425 t	4,925 t
b	0.66	*0.74*	0.82	*0.88*	0.93
c	0.73	0.79	0.85	0.90	0.94
d	0.74	*0.80*	0.86	*0.90*	0.95
c_	0.70	*0.77*	0.83	*0.88*	0.93
g	0.75	*0.81*	0.87	*0.91*	0.95

B2022/B2004 median					
Scenario	14,925 t	12,425 t	9,925 t	7,425 t	4,925 t
b	0.88	*1.18*	1.48	*1.79*	2.10
c	0.99	1.23	1.47	1.72	1.97
d	1.06	*1.27*	1.48	*1.72*	1.95
c_	0.89	*1.13*	1.36	*1.60*	1.83
g	1.00	*1.21*	1.42	*1.63*	1.84

B2022/B2004 10th percentile					
Scenario	14,925 t	12,425 t	9,925 t	7,425 t	4,925 t
b	0.33	*0.58*	0.82	*0.99*	1.16
c	0.51	0.70	0.88	1.02	1.16
d	0.54	*0.72*	0.91	*1.04*	1.18
c_	0.42	*0.62*	0.82	*0.98*	1.13
g	0.52	*0.70*	0.88	*1.02*	1.15

	Probability of B2014 > B2004				
Scenario	14,925 t	12,425 t	9,925 t	7,425 t	4,925 t
b	0.20	*0.37*	0.55	*0.68*	0.82
c	0.25	0.40	0.57	0.71	0.79
d	0.28	*0.44*	0.59	*0.70*	0.81
c_	0.19	*0.34*	0.50	*0.64*	0.78
g	0.32	*0.48*	0.64	*0.73*	0.83

84. Projections were also run at future catches assumed to be equal to the catch in 2005 in the specified scenario, in other words future catches above 14,925t (to include the catch anomaly). These results are all substantially more pessimistic than the results shown for a future catch of 14,925t in the tables above. Some results are shown in **Attachment 6**.

85. Figures 11 to 14 (**Attachment 6**) show the implications of different future catch levels for four spawning biomass quantities (median B2014/B2004, median B2022/B2004, the probability of B2014>B2004 and the lower 10^{th} percentile of B2014/B2004), for the 5 scenarios. This is the same information that is presented in the Table 8.

86. Figure 11 (**Attachment 6**) and Table 8 show that under a future catch level of 14,925t, all the 5 scenarios have a median B2014/B2004 less than 1.0, and all 5 scenarios therefore have a probability of less than 50% that B2014 would be above B2004 (Figure 13, **Attachment 6**). Figure 12 (**Attachment 6**) and Table 8 show that only three of the five scenarios have a median spawning biomass in 2022 that is at or slightly above B2004, under projections at a catch level of 14,925t.

87. The future catch level at which the median B2014/B2004 is equal to 1.0 (i.e. where there is a 50% probability that B2014>B2004) differs between the scenarios, but can be seen in Figure 11 (**Attachment 6**) where the scenario lines cross the horizontal line at 1.0, or can be obtained from Table 8 above by linear interpolation.

88. Figure 14 (**Attachment 6**) and Table 8 show that at a future catch level of 14,925t would imply the lower 10^{th} percentile of B2014/B2004 being below 0.8 for all scenarios. Under a future catch level of 9,925t the range is between about 0.8 and 0.9, and under a future catch level of 4,925 all values are above 1.1. Implications for intermediate catch levels can be obtained from Figure 14 (**Attachment 6**) and Table 8 above by linear interpolation.

89. Results of projections at a constant catch of 14,925t, in terms of B2014/B2004 and B2022/B2014 are shown in Figure 2, and in Figure 3 (both in **Attachment 6**) for projections at a constant catch of 9,925t.

90. Time-series trajectories of median spawning biomass are shown in Figure 4 (**Attachment 6**) for the 5 scenarios under a 5000t reduction from 14,925 (i.e. a catch of 9,925). The figure shows an increase in median spawning biomass from about 2014 for all five scenarios.

91. Figure 5 (**Attachment 6**) shows time-series trajectories of median spawning biomass for scenario c only, but under five different levels of future catch. The figure shows

median spawning biomass increasing in the short term, but then decreasing until some time between 2013 and 2015, before increasing again. The extent of the drop and the year in which it starts to increase depends on the catch level. This pattern is likely to be driven by the low recruitments estimated by the model for 1999-2004, of which the 2003 and 2004 estimates are less certain (see also paragraphs 43 and 53). The figure confirms that it remains relevant to consider the ratio of B2014/B2004, because B2004 represents the recent minimum biomass and the year 2014 closely approximates the time of a probable medium term future minimum biomass.

92. Figure 9 (**Attachment 6**) shows projected median LL1 CPUE for scenario c under a range of levels for future catch. The assumed 'historic' CPUE, i.e. adjusted for 50% of the catch anomaly in the scenario, is also shown from 1986 to 2005. Recall that the CPUE is assumed to reflect LL1 selectivity weighted abundance of age 4 and older fish in the population and trajectories will therefore not be the same as spawning biomass trajectories. The median CPUE is projected to increase under all scenarios, though the extent depends on the future catch level, and there is a projected initial drop under some of the higher future catch projections (e.g. 14,925t and to a smaller extent for 12,425t). The size of this drop is less than projected at the previous meeting, i.e. prior to the considerations of the catch anomaly. Note that 14,925t represents a substantial reduction from recent catch levels assumed in the scenarios.

93. Although there are difficulties in providing unequivocal advice about the relative likelihood of the various scenarios, nevertheless there does appear to be a reasonably robust set of outcomes about the status of the stock from the scenario modelling.

94. Tables 7-8 above and Figures 8, 9 and 11-14 (**Attachment 6**) summarise the results for the key scenarios. In general terms, the results for these scenarios are rather similar:

- all scenarios show a substantial depletion, B2006/B0 (median levels between 10% and 13%)
- all scenarios show median spawning biomass levels in 2006 (110-170 thousand tonnes) that are well above those estimated in 2005 (median of 50 thousand tonnes) as a result of the incorporation of catch anomalies
- a catch level of 14,925t does not lead to longer term rebuilding or to meeting an objective of a 50% probability of B2014>B2004 for any of the scenarios
- the catch levels that will result in a short term target of a 50% probability of B2014>B2004, are in a relatively narrow range (see Table 8)
- with catch levels moderately lower than 14,925t, all scenarios lead to a projected longer term increase in estimates of median spawning biomass, varying only in the timing and extent
- the median CPUE in all scenarios is projected to increase in the medium term
- continuation of catches in excess of 14,925t are likely to result in continuing decline of spawning biomass

95. The SAG noted that the higher estimates of current spawning biomass from the scenario modelling compared to the estimates from the assessment in 2005 (i.e.

without the unreported catch) have important implications for medium term projections. Any of the catch levels considered in the projections is now a smaller proportion of spawning biomass because of this increase. This implies that the sensitivity (in relative terms) of medium term projections for spawning biomass to different future total catches is less than would have been the case at lower absolute spawning biomass as estimated in 2005.

96. It was noted that this should be seen in the context of the possible effects of the model structure (a plus group without any senescence) and higher sampling frequency of the low adult natural mortality on spawning biomass.

7.2 Analysis of fisheries indicators

97. Paper CCSBT-ESC/0609/10 was presented, detailing the catch of SBT by the Indonesian longline fishery operating out of Benoa and Cilacap, Bali in 2005. The paper reports a total catch of 1,741t of SBT in 2005, compared to a total catch of 642t in 2004. Sampling during 2005 covered 49% of the total Indonesian SBT landings. During 2005 there have been two substantial changes in the Indonesian fleet dynamics. The Indonesian fleet has been operating further south, reaching statistical area 2. There has also been a substantial increase in fuel cost, as a result of both a reduction in the fuel subsidy and an increase in global fuel costs which has had a significant impact on the number of landings with catches since October 2005. During 2005 there was a substantial increase in the proportion of SBT in the Indonesian catch, potentially a result of the increased operations south of the spawning grounds. This did not occur in the 2005-2006 season.

98. Paper CCSBT-ESC/0609/11 was presented, updating the length and age distribution sampling of SBT landings in the Indonesian fishery. The size and age distribution of SBT catches on the spawning grounds during 2004/05 appear largely consistent with landings since 2003/04. There has been an increase in younger SBT landed in 2004/05 from areas south of the spawning grounds.

99. Paper CCSBT-ESC/0609/16 was presented, updating analysis and methods used in the aerial survey index of abundance. The 2006 aerial survey was completed between December and March with a reduced total distance surveyed as a result of adverse environmental conditions. The index was slightly lower in 2006 than in 2005 and was 66% of the mean of 1994 to 1998 estimates, but higher than the figures for 1999 and 2000. The method of analysing the aerial survey data was refined to provide further standardization of the index for environmental conditions during the survey incorporating fine scale 3 day window SST data as a covariate. Attempts at calibration of observers has been unsuccessful in recent years due to weather conditions post-survey. The 2007 survey design will include an additional plane and an extra observer to ensure calibration occurs.

100. Paper CCSBT-ESC/06/17 was presented, updating the commercial spotting index in the Australian surface fishery. The series was updated with the same data as collected in previous years between the months of December 2005 and March 2006. The commercial spotting data are collected from planes operating in conjunction

with surface fishing operations. The data have been standardized for weather and spotter effects. However, a change in the pattern of effort by spotters has resulted in an imbalance in the data set that required an alternative method of analysis and further work may improve this. The 2005/06 season commercial spotter index was at or slightly above the average level of the past 5 years of the index and above the two low levels in the 2002/3 and 2003/4 seasons.

101. The Australian industry provided comments on a number of questions raised by the SAG. During January 2006, air temperature was higher than for any previous year for which the index was available. However, the air temperature in the main catching month, February, was much lower than normal. A correlation has previously been established between air temperature and abundance, with industry establishing that the increased air temperature coincides with clear skies and increased surfacing of SBT schools.

102. Paper CCSBT-ESC/0609/18 was presented, describing the annual update of the reported Japanese longline catch, effort and catch rates (including spatial and temporal patterns of effort, and nominal catch rates by age and cohort). There was little change in the CPUE, however, the paper recognized that the reliability of these analyses were in doubt given the review of market anomalies and uncertainty in the manner in which catch anomalies might have affected reported catch rates.

103. CCSBT-ESC/0609/46 presented results of CPUE standardization of southern bluefin tuna caught by Taiwanese longline fishery. The standardized CPUE of positive catches fluctuated after 1996. The standardized proportion of positive catches revealed a decreasing trend in recent years, but the relative abundance index fluctuated as the CPUE of positive catches and showed no trend from 2000 to 2003.

104. It was noted that there are potential biases in the late 1980s and potentially also the early 1990s of the Fishing Entity of Taiwan’s CPUE series as a result of raised catch data being used with varied coverage rates over time and changes in targeting. The SAG suggested that the analysis should reconsider the area definitions used in the analyses since the CCSBT statistical areas used in the analyses presented in CCSBT-ESC/0609/46 are very large. Although some limitations were evident for the early years of the series, the group considered that if these issues could be addressed in future analysis the series has potential as a useful indicator.

105. Paper CCSBT-ESC/0609/SBT Fisheries/New Zealand was presented, focusing on information related to fishery indicators. Nominal CPUE for the charter vessels operating in New Zealand waters in CCSBT region 6 (west coast of the South Island) was reported. This region was chosen as it accounted for approximately 90% of the catch taken in this region (1989-2005). CPUE averaged around 3 SBT per 1000 hooks over 1997-2002 before declining dramatically in 2003 and has stayed at these historically low CPUE levels in 2004 and 2005. This decline is thought to be linked to recent absence of recruitment to the New Zealand fishery.

106. Furthermore, CPUE for the New Zealand domestic fishery decreased from 1999 to 2003 followed by increases in 2004 and 2005. It was difficult to interpret these patterns as both reduced recruitment to the fishery, and dramatic changes in fleet

composition, are likely to be influencing the trends. If the fleet becomes more stable in the future, it may be useful to develop an index for this fleet.

107. CCSBT-ESC/0609/SBT Fisheries – New Zealand shows there has been a very clear reduction in the range of sizes of SBT taken in the New Zealand charter fishery since 2001 and new data suggest that this has continued in 2006. There is evidence of the growth (progression of modes) over this period, but there is no evidence of recruitment of smaller fish to the New Zealand fishery. Data for 2006 do show a scattering of small numbers of recent recruits, but there is still no evidence of new cohorts entering the fishery. This suggests that recruitment to this fishery has been very weak for five years (cohorts from 1999-2003). While observer data is limited for the domestic fleet in early years, the patterns for the size composition of the domestic catch mirror the trends seen in the charter catch.

108. CCSBT/ESC/0609/37 presents the result of the acoustic monitoring survey. The survey using sonar to provide abundance indices of southern bluefin tuna at age one which is the earliest age class potentially monitored by research surveys and fishery information. The acoustic survey continued in 1996 (1995/1996 season), suspended in 2004 and resumed in 2005. There is no major change in 2006 in terms of survey period, survey area, species composition observed, distribution of SBT and age composition of SBT. The acoustic indices in 2006 were quite low at 6.5 tons and around 2,600 individuals. The inability of the survey to detect fish was discussed and thought to be related to the small size of schools encountered. On the other hand, many SBT were caught by trolling. The trolling catch index which recorded 33.9 schools/100 hours in 2006 is higher than those in 2000-2002.

109. CCSBT/ESC/0609/38 presents the result of a trolling monitoring survey. The survey, which is expected to provide an estimate of recruitment level of age one southern bluefin tuna with low cost, was conducted as a feasibility study in January 2006. In the survey, a chartered Australian vessel repeatedly surveys the same straight line (piston-line) using trolling. In eight days for the piston-line survey, 19 SBT schools were found on the piston-line in 42.9 hours. The trolling index is calculated as 44.3 schools / 100 hours.

110. In discussion it was noted that a troll survey had been conducted in the past, but that a review concluded that it was not useful to obtain a quantitative index of recruitment. This led to the question why the troll survey was resumed. In response, it was explained that the troll survey was resumed because of the expectation that the trolling catch may detect a large change of recruitment level such as that occurs in recent years and because the trolling survey is less costly than an acoustic survey. It was enquired why there were also trolling off the line and some concern was expressed about the survey design. It was explained that the piston line trolling survey was primarily conducted along a straight line, but that trolling was also done off the line for comparison and to ensure that there was nothing unusual about the specific placement of the line. The intention of the survey was as a feasibility study at this stage rather than a formal survey design. The SAG agreed that the statistical aspects of this survey need to be carefully considered.

111. With respect to the acoustic survey, the SAG was reminded of past discussions and reviews of this survey. The apparent low ability of this survey to detect SBT was questioned. Acoustic experts associated with the survey have suggested that the very low detection of SBT could be due to the fact that at some small school size (below, say, 5 tonnes) the acoustics cannot detect SBT because there is insufficient signal. It was thought that SBT school size of 1-year olds may have dropped to this level over the past several years. In discussion it was noted that the information from the aerial survey and the commercial spotting in the Great Australian Bight (GAB) cannot be used to infer anything about school size of 1-year olds in Western Australia. The fish in the GAB are primarily 2-4 year olds and fish in the GAB display different schooling and surfacing behaviour. As an aside, it was noted that the school size of 2-4 year olds in the GAB has increased somewhat over the two most recent surveys (CCSBT-ESC/0609/16).

112. CCSBT/ESC/0609/47 presents a new simpler calculation method of ST windows. The current ST windows index is calculated basing on two different methods to prepare the ratio of age 4+ between periods 1969-1999 and 2000-2005 (The age 4+ ratio is used for calculating catch for that age). To avoid future confusion in developing this index, a revised method was developed that can be applied for the whole period. In this new method, the information of catch for age 4+ fish and effort data in 5x5 degree and the number of 1x1 degree fished square in each 5x5 degree was utilized. Because there was no substantial difference in the trend between two ST indices windows calculated by the current and new method, the paper recommended the new method be used from now on.

113. In discussion it was noted that the figure in the paper shows hardly any difference between the old and proposed new way of calculation. The SAG suggested that the proposed new way of calculation be referred to the CPUE working group for further evaluation. Although this CPUE series (ST Windows) is one of the five series that was chosen to be considered in the management procedure work, it was noted that, given the relatively narrow spatial (area) and time focus of this series, it may be more sensitive to under-reported catch issues. This matter was flagged for future consideration by the CPUE working group.

114. The Secretariat reported that joint work with Japan has confirmed that results for the ST window series from the Secretariat's software are to the same as results from the Japanese software.

115. CCSBT-ESC/0609/23 presents updated estimates of juvenile growth rates in recent years, using direct ageing and tag-recapture data available up to the end of April 2006. The results reinforce the findings presented last year in that juvenile growth has not declined. In fact with the additional data available this year, it now appears they growth rates may have increased, between the early 1990s and early 2000s, although the recapture data corresponding to releases in the 2000s are still reasonably limited, both in numbers and in lengths of time at liberty. Nevertheless, if the recent increases in growth rates are confirmed with additional data, they mean that a fish of length 80cm (~2 years old) would take ~5 years to grow to 150 cm in the 2000s compared to ~6 years in the early 1990s (i.e. an age 7 fish in the 2000s would be expected to be of a similar length to an age 8 fish from the early 1990s).

While these differences are not as great as those detected between the 1960s and 1980s, they are still of sufficient magnitude to have implications with respect to recent stock trends if the changes in SBT growth rates are related to population density.

116. The question was asked whether information on the length-weight relationship of SBT was available from the tagging program. Weights are not generally collected from tagged fish. The issue of changes in the weight length relationship was last investigated in 1994 and those data tended to suggest that there is a seasonal and area variability, but there was nothing to suggest that the relationship was different from the historical length-weight relationship currently being used in CCSBT assessments.

117. Other documents presented to the SAG (e.g. CCSBT-ESC/0609/Info 1 and CCSBT-ESC/0609/16) show some information which supports the seasonal and area dependence of growth, for example, fat pre-spawning fish and lean post-spawning fish which fit in with historical understanding of the length-weight relationship.

118. When asked about the estimate of growth rate in 2005, the author cautioned that this estimate was still based on short term recaptures, which could reflect short term tagging effects on growth, and small sample sizes. This estimate should therefore be treated as preliminary.

119. CCSBT-ESC/0609/14 provided update estimates of the tag reporting rate for the Australian surface fishery for 2003 to 2005 based on tag seeding experiments. These estimates of reporting rates are an essential input into the analyses of fishing mortality rates from the recent SRP tagging programs. The estimates presented in CCSBT-ESC/0609/14 represent a substantial improvement over the previous preliminary estimates as a number of statistical estimation matters that were identified as needing further exploration have been addressed – particularly with respect to the estimation of shedding rates for the seeded tags. The update analyses indicate that tag shedding is not a large factor affecting the number of returns that have been recovered from these tag-seeding experiments. The estimates of the reporting rates significantly decreased over the three years from 65% in 2003, to 48% in 2004 and to 36% in 2005. The CV for the estimates of the reporting rates was at most 10%. The substantive decrease is a concern for the SRP tagging experiments and this issue will need to be considered when discussing the future SRP tagging activities.

120. CCSBT-ESC/0609/15 presented analyses of the release and recapture data from the CCSBT SRP tagging program. A tag attrition model was used to estimate cohort and age-specific fishing mortality rates for different groups of tag releases conditional on estimates of natural mortality, tag shedding and reporting rates. The estimated fishing mortality rates are independent of the catch and catch-at-age data. There appear to be tagger and age of release effects in the return data. The results suggest high fishing mortality rates in 2003, 2004 and 2005 for ages 3 and 4 for those fish tagged at age 2 and above. However, rates based on age 1 releases, which primarily occurred in Western Australia, tend to be lower, but were still substantial at age 3 (i.e. 0.20 or greater). This suggests either higher tagging mortality or natural mortality or changes in the spatial dynamics for age 1 fish. The spatial distribution of

longline returns suggest a possible change in spatial dynamics with few tagged fish moving into the Tasman Sea (but this may be confounded by reporting rate issues). Estimates of fishing mortality rates from the tag attrition model at age 2 were very near zero for the 2000 and 2001 cohorts, which appears inconsistent with the catch data from the surface fishery. Nevertheless, the estimates for age 2 indicate an increasing trend between 2002 and 2005. In addition, recapture rates from releases in the GAB early in the season indicate very high exploitation rates for fish found in the GAB in December – particularly in 2004, where over 50% of the tagged age 3 and 4 fish in December are estimated to have been caught within the fishing season, taking into account the estimates of reporting rates from tagging seeding experiments. Estimates of the number of tags returned per 1000 fish caught in the surface and longline fisheries presented in CCSBT-ESC/0609/15 also suggest possible inconsistencies with the catch data. In particular, not enough older fish appear to have been caught in the surface fishery relative to the number of tags returned from fish at older ages.

121. Given the relatively low number of returns of tags from 2-year olds in the surface fishery, the SAG asked whether there was any evidence of selectivity change of age classes in the surface fishery. Australian Industry representatives explained that there was no evidence for this and that it is very difficult to select for specific age classes. This is because, once a tow cage is set up in a location on the fishing grounds it remains there until it is filled, and it takes between 5 and 6 shots to fill a pontoon. Therefore, targeting of that nature would be difficult. It was also suggested that evidence in CCSBT-ESC/0609/15, Figure 29 suggests that small fish may not be going to the offshore shelf area, so there may also be some spatial separation of age classes.

122. The SAG discussed the importance of mixing and heterogeneity for analysis of tagging data and considered whether a spatial model may be more appropriate for the analysis of the SRP tagging data. It was noted that the kind of differences identified in the recent tagging data (the low number of returns at age 2 for fish tagged as age 1 off Western Australia) was not evident in the tagging data from the 1990's. There are several possible hypothesis for this, including that a differential annually variable proportion of age 2's may be going to the GAB (than elsewhere). Another hypothesis is that there has been an increased natural mortality on age 1 SBT in recent years.

123. A spatial model had been applied to the 1990's tagging data, but this did not lead to results that were different from results based on a non-spatial model (CCSBT-ESC/0609/Info-01). With respect to the current (2000's) tagging data, however, there are many complications with applying a spatial model. First, there is a lack of information on reporting rates for the longline fisheries. Second, there are very few releases from areas other than WA or the GAB. If there had been tagging in all areas and/or good estimates of reporting rates for all fleets then catch-at-age information is not essential. In the absence of reporting rates and poor tagging coverage, catch at age data would be required. In the light of the current issues with unreported catches, it is therefore not clear whether a spatial approach to analysis of the tagging data would be at all feasible.

124. The SAG was reminded that the current (2000's) tagging data have not yet been incorporated into the operating / assessment model. It was suggested that attempts be made to compare estimates of fishing mortality from the operating model with the estimates obtained from the tagging data analyses.

125. The returns from the central Indian Ocean mainly north of statistical areas 8 and 9 were confirmed as being almost exclusively from Taiwanese vessels following direct contact and increased liaison effort.

126. The SAG noted the aerial survey and the tagging data are essentially the fishery independent information. The relationship between these two pieces of information and the timing and location of the surface fishery was briefly considered. It was noted that the tagging results suggest a high level of exploitation rate in the surface fishery. Although there is a strong overlap between commercial fishing and the area covered by the commercial spotting, the aerial survey has wider coverage. Mention was made of the aerial "stock-take" carried out by commercial spotters for the Australian Government after the 2004/5 fishing season which suggested a high level of escapement of 3 and 4-year olds at the end of that fishing season.

127. CCSBT-ESC/0609/28 provided preliminary results on the east-west movements of juvenile SBT from recaptured archival tags released in 2002-2005 and compares these with similarly released tags in the 1990s. The preliminary results suggest marked differences when compared to the results from archival tags released in the 1990s. None of the 13 recoveries from the 2002-2005 releases moved into the Tasman Sea. This compares to 18 out of 57 (or 32%) of the 1990's releases. The 2002-2005 archival tags also had a tendency not to move to the more western portions of the Indian Ocean. No tagged fish moved farther west than 65°E compared to 11 from the earlier releases. However, the sample sizes are still small and the differences in this case are not significant. The changes evident in the movement patterns from the archival tagged fish with respect to the Tasman Sea are consistent with conventional tag return data and juvenile catch rates (e.g. see CCSBT-ESC/0609/15). Changes in habitat use by a population can arise as a response to (1) changes in the environment, (2) changes in population abundance (e.g. density-dependent responses) or (3) reduction/elimination of a sub-stock/component of the population. Given the available information, any of these causes or a combination of them could be contributing to the observed change in juvenile movements and spatial patterns. Thus, CCSBT-ESC/0609/28 found a substantive difference in the winter SST in the Tasman Sea between the 1990's and subsequently. Additionally, juvenile schools essentially disappeared from the NSW waters in the early 1980's with no signs of appreciable recovery since then indicating that geographic components of the juvenile SBT population are vulnerable to extirpations. Finally, CCSBT-ESC/0609/28 noted the preliminary nature and relatively small sample sizes currently available for the 2000 releases should be kept in mind when interpreting the results.

128. The SAG discussed the results from the paper and considered the alternative hypotheses associated with the very low number of SBT that move East into the Tasman sea, as seen from recent tag returns, compared with tag returns in the 1990s. It was noted that the tagging of an SBT off the West coast of the South Island of

New Zealand and recapture of that fish near Port Lincoln is evidence that there is not a total disappearance of fish from that area, but rather very low numbers compared to the past. In 2006, New Zealand has tagged around 30 fish (mostly under 40kg) with archival tags. It is hoped that data from any fish which are recaptured will provide further information of the spatial dynamics of the stock. The SAG considered that the low abundance of smaller fish in New Zealand waters could be due to changes in distribution (e.g. changes in East-West movement patterns) for whatever reason, but it was thought that catch rates of small fish in the Indian Ocean should then show some increase. This low abundance of small fish could also reflect a range contraction due to smaller stock size, and the SAG was reminded that small fish have historically disappeared from particular areas in the past (e.g. the New South Wales area). There is still, however, insufficient evidence to determine whether the observed changes are likely to be an environmentally driven change, or a range contraction associated with a decrease in stock size. The SAG agreed that it was worth further investigation of the possible changes in the environment in the relevant areas. In this regard, the SAG encouraged members to cooperate and help as much as possible to return archival tags from all fishing fleets.

129. Paper CCSBT-ESC/0609/19 presented a summary of the usual fisheries indicators, with discussion limited only to those which were deemed to be unaffected by market anomalies according to the (authors' interpretation of) the market review panel. All of the indicators discussed were presented in more detail in other papers, except for the following two.

130. CCSBT-ESC/0609/19 described the proportion of archival tags recovered since releases began in 1993. Relatively high (maximum to date of 33% recovered for releases from 2000) suggest that total fishing mortality has been high, and variable among cohorts. The archival tags are assumed to have higher reporting rates than conventional tags because of the large rewards, but the recovery numbers still represent a lower bound of the true number, since there are no reliable reporting rate estimates.

131. CCSBT-ESC/0609/19 also described preliminary results from the Indonesian fishery school CPUE index 2001-2006. This index is derived from the observer-like data collected by students training on longline vessels fishing south of Indonesia. Catch rates were presented both as SBT/1000 hooks and the proportion of sets with non-zero SBT catch. Given the uncertain reliability of the data and incomplete understanding of the fishery operations, it was difficult to discern a time trend from either set of indices. The SAG recognized the potential value of further study of the Indonesian spawning ground index.

132. In discussion it was suggested that with respect to Figure 4 in CCSBT-ESC/0609/19, the spatial separation for the New Zealand CPUE data should be at 40 degrees south rather than 45 degrees south.

133. CCSBT-ESC/0609/30 was presented. The independent reviews have introduced considerable uncertainty in the data that underlies a number of the SBT fisheries indicators. This paper explores the potential impact of the independent reviews on

SBT fisheries indicators based exclusively from information stated in the independent reviews.

134. Based on the executive summary of the market review, imported SBT may be sold as domestic catch in the market with a change in the country of origin label at freezer warehouses in Japan even though the foreign catch was reported. There is no solid evidence that the non-Japanese longline fishing activities had been influenced by the Japanese market anomaly.

135. CCSBT/ESC/0609/40 was presented. Various fisheries indicators were examined to overview the current status of SBT stock. The indices suggested that current stock levels for middle to high age groups were the same levels in the late 1990s (except for age 5). CPUE indices for most age groups showed increasing trends from the late 1990s to 2002. In recent years, the indices for age 3 and 4 have stayed at historically low levels and ones for age 5 and 6&7 have continued to decline. Many indices indicated recent low recruitments of at least 1999 and 2000 cohorts. The acoustic survey indices from Recruitment Monitoring Program suggested continuous low recruitments for six years (1999-2002 cohorts, 2004 and 2005 cohorts). The further careful monitoring of recruitments and serious consideration on impacts of potential low recruitments on stock management are continuous tasks with the highest priority. Indices of the spawning stock are difficult to interpret and thus no specific conclusion was drawn.

136. In discussion it was noted that a figure of catch per shot and catch per search time for the surface fishery (Figure 2.1 in CCSBT-ESC/0609/40) showed an increase in December 2005 compared to the previous 4 years, and the author was asked for possible explanations of this increase. In response it was noted that that the 2005 data point is for one month only whereas the other data points are for the whole fishing season, though the weather during December was generally very good which may have reduced search time. The SAG was also reminded that purse seine CPUE for the surface fishery is very difficult to interpret given the nature of the fishing operation and that these two indices should be treated with great caution as an index of the stock.

137. In discussion it was suggested that, given the indications of changes in East-West movement in the Tasman Sea and the eastern part of the stock distribution, it would be interesting to see how and whether the reported size distributions of fish have changed over time in the more Western part of the stock’s distribution.

Discussion of Indicators

138. During 2006 an independent review of the Japanese SBT market data anomalies and the Australian SBT farm operation were completed and presented to the Special Meeting of the Commission held on 19-20 July 2006. The Special Meeting of the Commission requested scientific advice taking into consideration a range of potential scenarios of unreported catch. The potential influence of unreported catch scenarios on the fisheries indicators will be provided during the discussion of indicators.

139. If none of the LL unreported catch scenarios was taken by effort that contributes to the nominal Japanese LL CPUE, or alternatively, if the level of the anomaly was relatively stable over time, and the way in which the unreported catch relates to the effort was consistent over time, the CPUE trends over time in the Japanese LL fishery may be indicative of trends in the SBT stock. If these assumptions are not met, there are potential biases in the trends.

#1 CPUE Trends Over Time in Japanese LL Fishery

140. Nominal CPUE for the Japanese charter vessels operating in New Zealand waters in CCSBT region 6 (west coast of the South Island) substantially declined in 2003, and has stayed at these low levels in 2004 and 2005. This decline is thought to be linked to a recent absence of recruitment to the New Zealand fishery (CCSBT-ESC/0609/SBT Fisheries/New Zealand, Figure 6). High observer coverage (100% of vessels) in this fishery provides confidence that the trend in the charter vessel CPUE is real.

141. Under the previously mentioned assumption, the following trends are evident. The nominal CPUE index for Japanese LL vessels in Areas 4-9 over April to September for ages 3, 4, 8-11 and 12+ were all up from 2004, while in areas 5 and 6&7 the CPUE for these ages were down from 2003. (CCSBT-ESC/0609/40, Figure 1.1).

#2 CPUE Trends by year class in Japanese LL fishery

142. Under the previously mentioned assumption (see paragraph 139), the following trends are evident. The nominal CPUE for the 2000 and 2001 year classes is very low relative to the historical average, which is consistent with the low numbers of these cohorts in the LL catch in recent years (CCSBT-ESC/0609/40 Figure 1.3).

 # 3 CPUE for other fleets

143. CPUE for the NZ domestic fishery decreased from 1999 to 2003 followed by increases in 2004 and 2005. It is difficult to interpret these patterns as recruitment to the fishery declined, and fleet composition substantially changed, resulting in potentially biased trends (CCSBT-ESC/0609/SBT Fisheries/New Zealand). Further investigation to standardise the CPUE trend of the fleet was viewed as useful.

 # 4 and # 5 Indonesian catch and age composition

144. Total catches estimated from Indonesia (Benoa sampling program) indicated that total SBT longline catches increased in 2005 (CCSBT-ESC/0609/40 Figure 4.1). The age distribution of the Indonesian catch in 2000/01 shifted toward a larger portion of younger spawners. This increase in the proportion of young spawners has remained stable and indicates that cohorts spawned around 1989 are now contributing to the spawning biomass and are continuing to do so but not necessarily in increasing numbers (CCSBT-ESC/0609/11 Figures 9 and 11).

 # 6 Estimate of total global catch of SBT

145. The Special Meeting of the Commission requested scientific advice taking into consideration a range of potential scenarios of unreported catch. Under some of these scenarios there is a substantial increase in the historical global catch of SBT.

 # 7 Acoustic and troll estimates of age 1 off Western Australia

146. The Japanese acoustic survey of 1 year old SBT off Western Australia in 2006 continued to record only a small fraction of the number of SBT that were seen prior to 2000 (CCSBT-ESC/0609/19, Figure 3 and CCSBT-ESC/0609/37 Figure 13). An intensive review held in 2004 indicated a low detection power of SBT by sonar devices and a non-linear relationship between the acoustic index and age 1 abundance in the survey area. During 2006 the acoustic survey was unable to detect small schools of 1 year old SBT that were recorded through troll and visual surveys conducted in the acoustic survey area (CCSBT-ESC/0609/38).

 # 8 Aerial spotting data in the Great Australian Bight

Independent aerial survey

147. The preliminary estimate for the 2006 aerial survey index of aggregated age 2-4 SBT biomass in the Great Australian Bight is similar to the 2005 estimate. The mean from the 2005 and 2006 estimates is about 66% of the mean from 1994-1998 estimates (CCSBT-ESC/0609/19, Figure 1).

Commercial spotting index

148. The 2006 estimate from the commercial spotting index of aggregated age 2-4 SBT in the Great Australia Bight surface fishing grounds is around the average of the 5 year series.

 # 9 Tag Return Data.

149. Estimates of fishing mortality rates based on the SRP conventional tagging program suggest high rates of fishing mortality for ages 3 and 4 in 2004 and 2005, in particular for age 3 in 2004 and age 4 in 2005 (i.e. the 2001 cohort).

150. Fishing mortality estimates for age 1 releases tend to be lower than those for age 2 and 3 releases. Such differences were not seen in the tagging results in the 1990s (CCSBT-ESC/0609/15, Figure 13, 14, 15). These differences in the fishing mortality rate estimates, when combined with the low level of tag returns from the Tasman Sea (CCSBT-ESC/0609/15, Figure 2, 3, 4, 5, 6), and increased western movements and much reduced eastward movements of SBT archival tag returns (CCSBT-ESC/0609/28 Figure 1, 2, 3) suggest possible changes in the juvenile SBT spatial dynamics. The changes in juvenile spatial dynamics could be a result of environmental influences altering juvenile SBT movements or a contraction of

juvenile range resulting from reduced abundance or a collapse of a sub-component of the stock (CCSBT-ESC/0609/28).

 # 10 Size distribution

151. There has been a very clear reduction in the range of sizes of SBT catches in the New Zealand charter fishery since 2001 and new data suggest that this has continued in 2006. During 2006 a small number of recruits were caught, although there is no evidence of substantial recruitment of smaller fish to the New Zealand fishery over this period. This suggests that recruitment to this fishery has been very weak for five years (cohorts from 1999-2003). High observer coverage (100% of vessels) in this fishery provides confidence in the charter vessel size composition data.

152. While observer data are limited for the domestic fleet in the early years of the fishery, the patterns for the size composition of the domestic landings mirror the trends seen in the charter catch (CCSBT-ESC/0609/SBT Fisheries/New Zealand).

153. Assuming a previously mentioned assumption (see paragraph 139), has been met, the Japanese longline catch at size distribution has shown a lack of fish from the 2000 and 2001 cohorts. However, there was an increase in the proportion of juvenile SBT in catches in areas 4, 5 and 6 in May, June and July of 2006 and area 8 in September and October of 2005 (CCSBT-ESC/0609/40, Figure 1-4).

 # 12 Growth Rates

154. There is evidence that the juvenile growth rate of SBT tagged in near shore waters around Southern Australia (i.e. of GAB and Western Australia) ages 2-4 has not declined and appears to have increased between the early 1990's and 2000's during the summer for which almost no information is available either currently or in the past. If substantial numbers of SBT do not enter the GAB during summer, the growth results may not pertain to the entire stock (CCSBT-ESC/0609/23, Figure 23).

Synthesis of indicators

155. The reviews of Japanese SBT market anomalies and Australian SBT farming anomalies raise serious doubts on the reliability of the catch and Japanese LL CPUE indicators, thus interpretation of many of the indicators is more difficult than in previous years.

Interpretation of Indicators of Recruitment

156. The indicators continue to support the previous evidence for poor recruitment in the 2000 and 2001 year class, and ongoing recruitment below the 1994-1998 levels. The size distribution in the NZ LL fishery and the Japanese LL fishery continue to indicate poor 2000 and 2001 recruitments, and the aerial spotting survey and commercial spotting index are both consistent with a reduction in average recruitment below the 1994-1998 levels. The high fishing mortality rate estimates for age 3 and 4 from recent SRP tagging are also consistent with low recruitments in

these years. Trends in year class strength in the Japanese LL fleet show poor strength of the 2000 and 2001 year classes, but recent data indicates an increase in juveniles after the 2002 year class. However, this indicator could be biased by catch anomalies.

Spawning stock biomass

157. Reported catch rates of fish aged 12 and older in the Japanese LL continue to indicate a drop in spawning stock biomass in about 1995, but this is of course potentially impacted by catch anomalies. Since the Japanese LL CPUE is the primary indicator of stock abundance the potential anomalies make the spawning stock status less certain than last year. The increase in tonnage of Indonesian catch as well as the increase in proportion of SBT in the Indonesian catch was associated with a shift in the behaviour of the Indonesian fleet to target SBT south of the spawning ground. This change in behaviour complicates the interpretation of the age and size structure of catches from the spawning stock.

Exploitable biomass for the longline fishery

158. Reported Japanese LL CPUE of SBT for all ages combined suggests that the exploitable biomass for these gears has remained fairly constant during the past 10 years, though this level is low compared to historical values. Confidence in this indicator has diminished considerably due to the uncertainty associated with catch anomalies. Reported CPUE indicate increases in the CPUE of ages 8-11 since about 1992, but there is a slight decline in 2003 and 2004, with a slight increase in 2005. Reported CPUE of fish aged 4-7 has increased since the mid 1980s but has been declining in recent years.

7.3 Overall assessment of stock status

159. Because of the uncertainty in historical catch and CPUE a series of alternative scenarios that encompass a range of possible circumstances was evaluated. The outcomes of these scenarios and their management consequences are consistent with each other. The scenarios are also consistent with the 2005 SAG report regarding overall stock status and suggest the SBT spawning biomass is at a low fraction of its original biomass and well below the 1980 level 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. Recruitments in the last decade are estimated to be well below the levels in the period 1950-1980. All scenarios suggest that recruitment in the 1990s fluctuated with no overall trend. Analysis of several independent data sources and the scenarios indicate low recruitments in 2000 and 2001, and the scenarios suggest low recruitment in 2002 and 2003, although the low estimates of 2003 year class strength is inconsistent with the Japanese length frequency data from 2006.

160. While the scenarios are consistent with each other, there are conflicts between scenario output and some of the indicators, especially regarding the 2002 and 2003 year class strengths.

161. The primary implication of the higher catch levels in the scenarios compared to the assumed catch history used in the 2005 SAG is that estimated total spawning stock size is more than double that assessed at the 2005 SAG.

162. In the scenarios considered, future total catches of 14,925t would result on average in a short-term decline followed by generally stable but not recovering spawning biomass, but it must be appreciated that there is the possibility that the stock will increase or decrease under this level of catch. Any continued catch over 14,925t poses very serious threats to the stock. Rebuilding the spawning biomass requires catch reductions to below 14,925t under all scenarios considered.

Agenda Item 8. Management Procedure Implications

163. Paper CCSBT-ESC/0609/26 described a number of monitoring and data validation measures that could be used to reduce the data uncertainties associated with the market and farm reviews. Proposed measures for reducing longline catch and CPUE uncertainty included exchanging fine scale logbook and observer data, market and fleet research, independent at sea data verification, centralised VMS, international port monitoring and a catch documentation scheme. Uncertainty in catch composition in the farms could be reduced by the addition of stereo video cameras during tow cage transfers and feeding during towing to reduce weight loss.

164. The SAG recognized the great potential in adopting the measures of the type described, and suggested that some sort of prioritization process would be required to ensure that resources are invested to achieve the greatest benefit. The SAG identified its role as providing recommendations on the scientific data requirements for attaining Commission objectives, and the risk implications associated with failing to obtain the required data. The SAG recognized that non-scientific feasibility concerns (e.g. related to expense, commercial confidentiality) would require consideration by the Commission in deciding whether or not to adopt certain recommendations.

165. CCSBT-ESC/0609/44 presents changes to the Japanese regulation system for the SBT fishery in 2006. There are no longer any restrictions on the fishing season or area and individual quotas have been introduced. Possible effects on CPUE as a stock abundance index resulting from the new regulations are complicated; some factors are likely to increase and others decrease representativeness relative to the past. From the point of view of conducting accurate stock assessment, it is important to carefully monitor and interpret information from Japanese longline fishing. Furthermore, it would be beneficial to develop reliable indices of stock from the data in purse seine fisheries of Australia and in longline fisheries of Australia, Korea, Indonesia, South Africa and Taiwan, as well as the data from scientific research.

166. The SAG recognized that it would be critical to the assessment and MP process to quantify the changes to the Japanese longline fishery in relation to the interpretation of relative abundance indices. Members considered it important for non-Japanese scientists to be able to access key data (including species composition/targeting information and fine spatial resolution data), to analyse these changes, as well as inconsistencies that could lead to biases in catch rate standardization. It was hoped that some arrangements could be made for sharing the confidential data for scientific analysis (whether through temporary access agreements, collaboration with Japanese scientists within Japan, or some other means).

167. Japan commented on the desire expressed to get industry cooperation in maintaining CPUE spatial and temporal coverage consistent with historical patterns, but as such arrangements are currently voluntary, there was not much confidence that this could be achieved. It was suggested that industry might be more receptive to the idea if some incentive could be realized, such as increased confidence in the MP process.

168. The question was raised as to whether the majority of the Japanese quota was expected to be taken off Cape Town in 2006. Japan reported that the SBT fishing activity in this region was seasonal and had essentially ceased by the time the preliminary update was written. Vessels observed in Cape Town could represent port calls from Atlantic and tropical Indian Ocean fleets in addition to the SBT fleet.

169. SAG discussions based around the above two papers and CCSBT-ESC/0609/24 (presented previously), focused on the outstanding issues related to MP development in light of the market and farm reviews and the changing nature of Japanese SBT fishery management. The SAG recognized that the market review had a major impact on perceptions of what an MP could deliver in the short-medium term, as there is now, and will likely remain, considerable uncertainty about catch and CPUE time series over the period 1985-2005. It was agreed that data collection and MP development in the next 5-10 years should be prioritized to focus on rebuilding the stock to a point where the biological and economic risk associated with the current high depletion and high fishing mortality is greatly reduced. Objectives of identifying and moving toward optimal reference point targets might be established over the longer term, once the stock is rebuilt to safer levels and reliable data collection and monitoring procedures are established.

170. The SAG identified the following data for potential use in an MP, noting the need to independently verify the data:

- Total Catch
  - including discards and other fishing-related mortality
- Commercial CPUE
  - at sufficient spatial-temporal resolution and coverage
  - including species composition to quantify targeting
  - CPUE based on observer data if coverage was sufficiently high
- Catch size sampling
  - linked to CPUE data for size/age-based indices

- Industry-based, scientifically-designed CPUE sampling
- Aerial survey in GAB
- Tags
  - conventional
  - potentially based on genetic markers

171. It was recognized that all these data are desirable for stock assessment, but the SAG would work toward identifying a more parsimonious list of 'required and sufficient' data that would meet the specific needs for an MP. It was noted that effective MP decision rules might be based on a relatively small subset of data (but the operating model conditioning process should attempt to draw on as much information as possible to quantify the uncertainty in the system and ensure robustness).

172. For the short term, it was accepted that the Japanese longline CPUE would likely continue to provide the only index of stock abundance for use in a management procedure. However, it was suggested for the medium to long term, alternatives need to be sought in the near future. Because of the CPUE reliability issue associated with the market anomalies, and potential changes to the nature of the CPUE series as a result of recent changes to Japanese fishery management, there will likely be substantive inconsistencies in the CPUE series before and after 2006. These inconsistencies will be problematic for assessments and operating model conditioning. Some of the data required to reduce the uncertainty in historical catch and CPUE may exist in industry archives, and the SAG considered it worthwhile to continue to try to gain access to these data. However, it was considered likely that some inconsistency will remain and will best be handled through scenario modelling and the development of management procedures that are robust to these uncertainties.

173. A CPUE technical working group was convened with Prof. John Pope as chair, and tasked with identifying the issues associated with using commercial CPUE in an MP and will report to the Extended Scientific Committee.

Agenda Item 9. Other business

174. There was no other business.

Agenda Item 10. Finalisation and adoption of meeting report

175. The report of the meeting was adopted.

Agenda Item 11. Close of meeting

176. The meeting was closed at 8:40pm, 11 September 2006.

List of Attachments

Attachment

1 List of Participants

2 Agenda

3 List of Documents

4 Formulation of alternative scenarios

5 Simplifying Outputs from Scenario runs

6 Figures and Tables for selected scenario evaluations of the 7th SAG

7 A Selection of Relevant Indicators Considered by the SAG7 Meeting

Attachment 1

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Seventh Meeting of the Stock Assessment Group
4 - 11 September 2006
Tokyo, Japan

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Attachment 2

Agenda
Seventh Meeting of the Stock Assessment Group
4-11 September 2006
Tokyo, Japan

1. Opening

   Introduction of participants and administrative matters

2. Appointment of rapporteurs

3. Adoption of agenda

4. Admission of documents and finalisation of document list

5. Consideration of implications of independent panel reports on stock assessment inputs, including catch levels and their allocation to fleets, CPUE indices and their weighting factors etc.

6. Revision of operating model and analysis of impact of overcatch scenarios on stock status

7. Stock assessment
   7.1 Assessment of stock status and constant-catch projections using the operating model
   7.2 Analysis of fisheries indicators
   7.3 Overall assessment of stock status

8. Management Procedure Implications

9. Other business

10. Finalisation and adoption of meeting report

11. Close of meeting

Attachment 3

List of Documents
7th Meeting of the Stock Assessment Group and
Extended Scientific Committee for the 11th Meeting of the Scientific Committee

(CCSBT-ESC/0609/)

01. Draft Agenda of 7th SAG
02. List of Participants of 7th SAG
03. Draft Agenda of the Extended SC for 11th SC
04. List of Participants of the 11th SC and Extended SC
05. List of Documents - The Extended SC for 11th SC & 7th SAG
06. (Secretariat) 4.2. Secretariat Review of Catches
07. (Secretariat) 6.4. SBT Tagging Program
08. (Secretariat) 7. Data Exchange
09. (Secretariat) Farm and Market Reviews - Advice to SAG-SC
10. (Australia) The catch of SBT by the Indonesian longline fishery operating out of Benoa, Bali in 2005: Proctor, Andamari, Retnowati, Herrera, Poisson, Fujiwara and Davis
11. (Australia) Update on the length and age distribution of SBT in the Indonesian longline catch: Farley, Proctor and Davis
12. (Australia) An update on Australian Otolith Collection Activities: 2005/06: Stanley and Polacheck
13. (Australia) Estimates of proportions at age in the Australian surface fishery catch from otolith ageing and size frequency data: Farley
14. (Australia) Estimates of reporting rate from the Australian surface fishery based on previous tag seeding experiments and tag seeding activities in 2005/2006: Polacheck, Hearn, Stanley and Rowlands
15. (Australia) Analysis of tag return data from the CCSBT SRP tagging program: Polacheck and Eveson
16. (Australia) The aerial survey index of abundance: updated analysis methods and results: Eveson, Bravington and Farley
17. (Australia) Commercial spotting in the Australian surface fishery, updated to include the 2005/6 fishing season: Basson and Farley
18. (Australia) Trends in reported catch, effort and nominal catch rates in the Japanese longline fishery for SBT - 2006 update: Hartog, Polacheck and Cooper
19. (Australia) Fishery indicators for the SBT stock 2005/06: Hartog, Preece and Kolody
20. (Australia) Description of the data provided by CSIRO for the 2006 CCSBT Data

exchange: Preece, Hartog and Cooper

21. (Australia) Update on the Global Spatial dynamics Archival Tagging project-2006: Polacheck, Chang, Hobday and West

22. (Australia) Proposed use of CCSBT Research Mortality Allowance to facilitate electronic tagging of juvenile and adult SBT as part of Australia's contributions to the CCSBT SRP in 2005-06: Polacheck and Gunn

23. (Australia) Increased growth rates of juvenile SBT in recent years (1990s to present): Eveson, Polacheck and Farley

24. (Australia) Information and Issues Relevant to the Plausibility and Implications of Alternative Catch and Effort Time Series for Southern Bluefin Tuna Stock Assessments: Polacheck, Preece and Hartog

25. (Australia) Investigation of the implications of information in two catch reviews (Japanese Market review and Australian Farm review) for SBT stock status and short term projections: Basson, Hartog, Polacheck, Lawrence and Findlay

26. (Australia) Consideration of requirements for monitoring and data validation for stock assessment and management procedures in light of independent catch reviews: C. Davies, T. Polacheck, J. Hender, J. Findlay

27. (Australia) The Status of Cited Working Papers and Attachment 3 from Working Paper 1 from the 2005 Extended Scientific Committee Meeting: Polacheck, Basson, Kolody and Hartog

28. (Australia) Comparison of East-West Movements of Archival Tagged Southern Bluefin Tuna in the 1990s and early 2000s: Polacheck, Hobday, West, Bestley and Gunn

29. (Australia) Peer review of the report of the independent review of the Australian SBT farming anomalies

30. (Australia) Fisheries indicators and the impact of the Independent reviews: J. Hender, J. Findlay, C. Davies

31. (Australia) Implication of the Japanese market review anomaly on CPUE interpretation: J. Hender, J. Findlay

32. (Australia) Preparation of the BRS component of Australia’s data submission for 2006: P. Sahlquist, P. Hobsbawn, K. McLoughlin

33. (Australia) Background information on catch levels: B.Jeffriess

34. (Japan) Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2005: Itoh, Narisawa and Tanabe

35. (Japan) Activities of otolith collection and age estimation and analysis of the age data by Japan in 2005: Itoh, Hirai and Omote

36. (Japan) Report of activities for conventional and archival tagging of southern bluefin tuna by Japan in 2005/2006 and proposal of tagging in 2006/2007: Itoh, Takahashi, Kurota and Oshitani

37. (Japan) Acoustic Index of age one southern bluefin tuna abundance by the acoustic survey in 2005/2006: Itoh