Commission for the Conservation of Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of the Fifth Meeting of the Stock Assessment Group

6-11 September 2004
Seogwipo City, Jeju, Republic of Korea

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Agenda Item 1. Opening

1.1 Introduction of participants

1. The Independent Chair, Dr. John Annala, opened the meeting and welcomed participants.
2. Dr SungKwon Soh (Korea) welcomed participants to Jeju and expressed his desire for a productive meeting.
3. Participants were introduced and the list of participants is at **Attachment 1**.

1.2 Administrative matters

4. Administrative arrangements for the meeting were presented by the Deputy Executive Secretary.

Agenda Item 2. Appointment of rapporteurs

5. Each member appointed rapporteurs to produce the text of the report relating to technical discussions.

Agenda Item 3. Adoption of agenda

6. The draft agenda was adopted. The agreed agenda is at **Attachment 2**.

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

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

Agenda Item 5. Stock assessment

5.1 Discussion of inputs to assessments

9. CCSBT-ESC/0409/41 documents the discussion leading to the change in decision and details of the final decision on which data to use in the 2004 stock assessment.

10. CCSBT-ESC/0409/27 discusses the post-processing by CSIRO of exchanged data, and differences between the data used in this and in the previous assessment (SAG 2001). For the first time, the data came predominantly from the CCSBT database. Two data components used in assessments in the past, but not currently in the CCSBT database are: size data for the early years of the New Zealand domestic fishery and data on non-retained catches in 1995 and 1996 in the Japanese longline fishery. The paper considered that the latter could lead to inaccurate estimates of recruitment in the early 1990s.

11. CCSBT-ESC/0409/11 updates the catch estimates for SBT by the Indonesian longline fishery. The catch for the 2002 spawning season (2001/02) was the highest on record. The estimated catch for the 2002/03 spawning season was one of the lowest since monitoring began and there was a further decline in the 2003/04 spawning season. The paper considered that various possible contributing factors to the marked decline in catch could include a drop in CPUE, a reduction in effort in the fishery and possibly unusual environmental conditions.

12. CCSBT-ESC/0409/12 provides an update on the length and age distribution of SBT in the Indonesian longline catch. Results show a change in the age distribution with a larger proportion of young adult fish. It was not clear the extent to which this reflects more young fish entering the spawning stock or a decrease in the number of older fish, or a change in selectivity. Differences in mean length at age of males and females at ages above 14 years, suggesting sexual dimorphism, was also noted. The sex ratio in the samples was not 1:1 but females dominated length classes up to 185cm after which males dominated.

13. There was a short discussion regarding the change in the size frequency of the Indonesian longline catch in recent years, and whether the changes are likely to be reflecting changes in the stock or changes in the fishery e.g. a change in targeting. Although more small SBT are caught at deeper depths where bigeye are targeted, it was noted that interpretation of the signals are confounded by the declining trends in bigeye catch rates in the Indian Ocean. It is therefore not possible to say with any confidence whether the changes in the size frequency distributions reflect changes in the fishery or in the stock.

14. CCSBT-ESC/0409/31 described preparation process of catch, effort, and size data of Japanese fleet for 2004 CPUE series calculation, assessment and mechanical update of the Operating Model. The sources of data were those used historically for 1952-64, NRIFSF logbook statistics for 1965-94, and the CCSBT database (addition of 2003 and update of 2002) for 1995-2003. CPUE series used in the assessment were shown in CCSBT-ESC/0409/34.

15. The differences in effort of the Japanese longline fishery in different regions and the drop in the number of squares fished in recent years and possible implications for CPUE was briefly discussed. It was confirmed that both the constant squares and variable squares CPUE showed marked differences from the nominal CPUE trend between 2002 and 2003. Such a large discrepancy has not been seen before between

the nominal and constant square index, which attempts to account for the effects of concentration of effort. It was also noted that nominal CPUE among the different CCSBT statistical areas does not show the same trend.

16. The question was asked whether the changes in recent size frequency distributions from the Japanese longline fishery showing a lack of small juveniles could be due to changes in the fishery to different areas or different times of year. Although there are differences in size compositions from different areas and times of year, the data for the most recent fishing seasons did not appear to show any appreciable spatial-temporal patterns or changes in fishing effort in Areas 8 and 9 compared to previous years, though there has been a reduction in the spatio temporal extent of fishing in Areas 4-7.

17. CCSBT-ESC/0409/SBT Fisheries-Taiwan shows CPUE for the Taiwanese longline fishery from 1981 to 2003. Reasons for the increase in the CPUE over this period were sought. In response, Taiwan cautioned against concluding that the Taiwanese CPUE follows an increasing trend since the data collection is not the same prior to and after 1996. Before 1996, the landing of SBT was grouped with NBT and little information on SBT was reported. Since 1996, the weekly report was required for vessels that have caught SBT and the fishing ground shows more consistency than before.

18. CCSBT-ESC/0409/21 described the length frequency data used in the operating model for LL2 (essentially the Fishing Entity of Taiwan longline fishery) from 2000 onward has been collected by Taiwan. Data prior to 2000 come from weight sampling at Mauritius. The two data sources are not comparable and care should therefore be taken when using these data in assessments.

19. Korea reported that vessels in the Korean fleet have continued to shift from the Indian Ocean to the Pacific for economic reasons, resulting in a drop of the total Korean catch in 2003.

20. New Zealand reported that their charter longline fishery has shown a general decline in CPUE in the last 3 years over all age classes and that there have also been fewer small fish in the catch of both charter and domestic fleets.

5.2 Stock assessment

21. CCSBT-ESC/0409/23 presents results of assessments carried out with the operating model (i.e. by conditioning) developed by the CCSBT with some additional features. A large number of runs over a range of different input assumptions were conducted, and sensitivity runs were conducted with (i) alternative growth curves, (ii) a ‘hockey stick’ stock-recruitment curve, (iii) inclusion of the aerial survey and (iv) different CPUE series. The assessment results show current SSB is between 3-14% of the average equilibrium unfished level and about 14-59% of the 1980 level. Most results suggest a current upward trend in SSB, while some results show a downward trend. The models suggest that there has been a marked decline in recruitment for the 2000 and 2001 cohorts if longline selectivity is assumed to be fairly constant over the recent period. Projection results suggest that there is approximately a 72%

chance that current catches will lead to lower SSB in 2020, if steepness is weighted according to the agreed steepness probability priors from the CCSBT-MP workshop.

22. There was some discussion about the fitting of a Beverton-Holt versus a so-called "Hockey stick" stock-recruit relationship. CCSBT-ESC/0409/23 did not consider it worth pursuing this issue further since the new dataset appeared to suffer less from the problem of unrealistically low steepness. However, the issues associated with early recruitment (very low prior to the start of the fishery and very high at the start of the fishery, with apparently high autocorrelation) and the generally poor fit to the Beverton Holt stock-recruit curve remain. There is still a need to consider alternatives to the Beverton-Holt stock-recruitment curve.

23. Two updated sets of VPA results were presented. CCSBT-ESC/0409/32 presented results of the ADAPT VPA based on catch-at-age data together with future projections, and CCSBT-ESC/0409/33 presented results of length based VPA based on catch-at-length data. The basic model structures were the same as those used in the 2001 assessment. Both assessment results showed similar trends in SSB and recruitment. SSB has been stable since early 1990s after a declining trend. Recruitment also showed a similar trend to SSB. However, the most recent estimates of recruitment (1999 for ADAPT VPA, 2000-01 for length based VPA) were low. CCSBT-ESC/0409/32 compared the 2004 assessment and projection results with the 2001 results. The results were similar and suggested that there has been no large change in stock status since the 2001 assessment.

24. The SAG recalled deliberations from the SAG meeting in 2001 where the advisory panel recommended (and the SC subsequently endorsed the view) that further work using the ADAPT VPA model not be pursued. Results in CCSBT-ESC/0409/32 were intended only to provide a direct comparison between ADAPT assessment results obtained in 2001 and those obtained this year with updated data up to 2003 and should be considered in that context. By keeping the method the same, the effects of changes in, and updates to, the data can more easily be seen in results. There was no intention of further work on the ADAPT VPA for assessment purposes because of the problems identified in 2001.

25. During discussion it was noted that care should be taken when comparing results of spawning biomass ratios from different papers, because different assumptions about the age at maturity has been used in some cases (ie. the historical value of age 8 was used in the ADAPT VPA).

26. With regard to the length-based VPA, it was noted that, as in the past, the CPUE at length cannot be fitted well at all sizes, and in this regard, results tend to be sensitive to the choice of size class which is fitted well.

27. Due to concerns about time to complete all agenda items, the time for discussion of data inputs and assessments was limited.

5.3 Fishery indicators

28. CCSBT-ESC/0409/20 emphasized three aspects in the recent Japanese longline data considered important for the general analysis of the fishery indicators :

- Fishing effort has continued to become more concentrated spatially and temporally with 2003 having the smallest number of 5°X5°square/month strata ever fished.
- The percentage of effort (number of hooks) in 5°X5°square/month strata in which no SBT were caught has declined from a high of 21% in 1994 to less then 0.2% in 2003 most likely as a result of declines in effort targeting species other than SBT.
- Catch rate trends have varied spatially and temporally among areas in recent years: a fairly continuous increase in Area 9 for all ages since the mid-1990s, with a decline between 2002 and 2003; for Areas 4-7 the indices for the three oldest age classes have been declining since 1999; in Area 8 they have been decreasing for nearly all ages since 2000, with small increases in 2003.

The paper noted that the first two of these factors indicate an increasing concentration of fishing effort in areas of higher SBT densities, and such concentration induces a positive bias in CPUE trends (i.e. any increase would be an overestimate and any decrease would be an underestimate) in both nominal and standardized CPUE indices.

29. In discussion, attention was drawn to the impact of operational factors on this reduction in the number of 5*5 square/month strata fished in the past, and the fact that the index incorporated temporal as well as spatial integrations, and hence might overestimate the extent of any spatial contraction. The preliminary nature of the most recent year's catch and effort data was noted and caution is required when comparing this to historical data.

30. CCSBT-ESC/0409/21 reviews changes in fisheries indicators first assessed in 1988 and additional indicators on the status of the SBT population and fishery. In the paper, the overall performance of each indicator is assessed/judged over the medium (last 10-14 years) and short (last 3 to 4 years) term, by classifying performance as either 'positive' (overall positive trend or general improvement in indicator), 'negative' (overall negative trend or concerns about value of indicator) and 'neutral' (no clear trend or no indication of improvement /deterioration). Over the medium term, the indicators suggest a mixture of positive, neutral and negative results which is consistent with stock assessment results in the recent past (1998). Over the recent shorter time period, neutral and negative indicators predominate..

31. CCSBT-ESC/0409/21 notes that the large number of indicators indicating substantial declines in juvenile abundance would suggest that a marked decline in recruitment may have occurred in recent years unless there have been large and wide-spread operational changes across all fisheries. The paper notes that given the low spawning stock, even a few years of low recruitment would have important implications for the sustainability of current catches.

32. Finally, CCSBT-ESC/0409/21 notes that there are increasing problems with the quality and interpretability of the data available for assessing the SBT stock. The SRP is intended to rectify some of these problems, but the paper considers that as yet

there have been few tangible improvements because of a number of issues such as coverage, data access, implementation, verification and logistical difficulties. The paper concluded that unless these are resolved and there are real improvements in the information for assessing the SBT stock, assessments are likely to become increasingly uncertain and difficult to interpret.

33. In considering Korean length frequency data presented in CCSBT-ESC/0409/21 as a fishery indicator, it was noted that Korean fishermen have routinely collected size of SBT on board but the data should be used with caution due to relatively small sample size and inadequate validation. Korea deployed one observer on a SBT fishing vessel and thus it is expected that more and accurate length frequency data will be collected. The CPUE of Korean-caught SBT appeared to be very low compared with that of the previous year. This is based on the data submitted to the CCSBT Secretariat by the deadline, which represents low coverage rate in terms of catch. It is also noted that since that time Korea has collected more data and therefore the CPUE for the year 2003, in particular, is subject to future change.

34. CCSBT-ESC/0409/34 examined various fisheries indicators to overview the current stock situation. Indices suggested the abundance of middle to high age-groups was stable or increasing, though many indices indicated low recruitments of at least the 1999 cohort and possibly the 2000 cohort. The further careful monitoring of recruitments and impacts of potential low recruitments to stock management merit serious consideration.

35. Due to concerns about time to complete all agenda items, the time for discussion was also limited.

5.6 Overall assessment (summary of stock status)

36. SAG5 was requested by CCSBT 10 to conduct an updated SBT assessment. Assessments of the SBT stock were last considered by SAG in 2001. In interim years advice was provided after consideration of stock indicators. This section provides an overview of the current assessments and the standard indicators for SBT. It also describes the extent to which available indicators support the outcome of assessments and summarizes the results of projections. The figures referred to in this Section are provided at **Attachment 4**.

Indicators

37. These data are independent of any stock assessment models and are drawn from papers CCSBT-ESC/0409/21 and CCSBT-ESC/0409/34. This section first describes important changes in the standard indicators that were agreed for exchange at the ESC in 2002 and secondly discusses all relevant indicators that relate to important aspects of stock status.

Stock status indicators and trends agreed for exchange in ESC 2002.

#1 CPUE Trends Over Time

38. The nominal CPUE index for Japanese LL vessels in areas 4-9 in months 4-9 for ages 4-7 and 8-11 and 12+ was down very slightly from 2002, but the overall trend, and level compared to historical values is effectively unchanged from last year. The trend since the 2001 assessment has been slightly upwards for ages 4-7 and 8-11 and flat for 12+. Nominal catch rates for chartered Japanese longline vessels in New Zealand waters in 2003 were down from 2002 and have declined to roughly half of the value in 1999. Figures 1-3.

#2 CPUE Trends by year-class in LL fishery

39. Nominal CPUE for the year-classes of the first half of the 1990s were higher at ages 8-11 than year-classes in the previous decades. The 1995-1999 year-classes were generally similar in strength at ages 4-6 to the year-classes from the first half of the 1990s except the 1999 year-class which was very weak as 4 year olds. Figure 4.

#3 Total catch in surface fishery and estimated age composition

40. The total catch in the Australian surface fishery in 2003 was 5,822 tonnes[1]. Figure 5. The average length of fish in the Australian surface fishery was unchanged in 2003.

#4 & #5 Indonesian catch and age composition

41. The catch of SBT in the Indonesian fishery declined from 2500 t in 2001/2002 season, to 740 t in 2002/2003 season and to 430 t in 2003/2004 season. The method of catch estimation changed between the 2001/2002 and 2002/2003 seasons. As in 2001/2002 and 2002/2003, the age distribution in 2003/2004 was shifted so that age 11-15 dominate the catch, whereas ages 15-25 dominated the catch in 1995-2000. Figures 6-7.

#6 Estimate of total global catch of CCSBT

42. The total catch was estimated to be 14,024 in 2003, and 15,212 in 2002. Most notable is the decline in the Korean and Indonesian catches to only 254 t and 556 t respectively in 2003. The age composition of the catch is notable for the shortage of age 3 and 4 fish in 2003 in all longline fleets.

 # 7 Acoustic estimates of age 1 off Western Australia

43. The Japanese acoustic survey of 1 year old SBT off Western Australia detected almost no fish, from 2000-03. The acoustic survey did not operate in 2004. Figure 8.

Other Indices

[1] The Australian fishing quota year runs from 1 Dec to 30 Nov. and hence total catches in any given calendar year may be higher or lower than the national allocation.

44. The “biomass sighted per mile searched” in the aerial commercial spotting in the Great Australian Bight declined from 2002 to 2003 and from 2003 to 2004[2].

45. Papers CCSBT-ESC/0409/21 and CCSBT-ESC/0409/34 show both the Fisheries Indicators agreed for exchange in 2002 and other available indicators. Summarised below is what they indicate about the following important issues.

Interpretation of Indicators

Recruitment

46. A number of catch related indicators from all longline fisheries exploiting juveniles suggest markedly lower recruitments in recent years. Reduced CPUE is seen in Japanese LL CPUE data at ages and 3 and 4 which show reductions of 80% and 50% respectively from 2002 to 2003. These data could be explained by lower abundance or by these ages being less selected in 2003. There were no major changes in fishing pattern to account for a change in selectivity. Preliminary Japanese LL data for the 2004 season again shows very few small fish (<120cm) were caught. Generally catches of smaller fish have formed progressively smaller proportion of Japanese longline catches over the last 5 years (particularly in area 4) (Figure 9). A sharp decline of about 90% between 2002 and 2003 is seen in the catch proportion of smaller fish (<120cm) made by Japanese charter vessels fishing in New Zealand waters. Declines were seen between 2001 and 2003 in the proportion of smaller fish (<120cm) in the Taiwanese LL fleet when fishing in winter in more Northerly areas. Small fish also formed a much smaller proportion (approx 20%) of New Zealand domestic catches in 2003 compared to 2001-02. In Korean longline fisheries the proportion of fish smaller than 120cm has declined since a peak in 1999.

47. Other data also give some indication of recruitment trends. Markedly lower recruitment is supported by the Japanese acoustic estimates of age 1 fish (Figure 8) that gives low estimates for all year-classes from 1999 to 2002). There was no acoustic survey in 2004 to estimate the abundance of the 2003 year class. Fishery independent aerial surveys of the Great Australian Bight suggest a reduction in recruitment over the 1990s until 2000.There was no aerial survey in 2001. The Biomass sighted per mile from aerial commercial spotting from 2002-2004 suggest a 50% decline from 2002 to 2004 but cannot be compared to previously collected commercial spotting data.

48. In summary: the indicators of recruitment suggest markedly lower recruitment in recent years. These markedly lower recruitments are a serious concern.

Spawning stock biomass

49. Catch rates of fish aged 12 and older in the Japanese LL indicate a smaller spawning stock biomass since about 1995 (Figure 3). The Indonesian catch of SBT on the spawning grounds in 2002/3 was less than 1/3 of the average catch level for the 1996/7 – 2001/2 spawning seasons. In addition to reductions in fishing effort, this

[2] Due to the nature of the Australian purse-seine fishery, its’ CPUE trends were considered uninformative.

catch reduction could possibly be due to a decline in SBT abundance on the spawning grounds. The age structure of the Indonesian fishery (Figure 7) indicates that smaller/younger adult fish increasingly dominate the spawning in more recent years. Fish smaller and younger than those seen in the earlier years of catch at age series (1994, 1995) were increasingly common after about 1998. This might result from increased juvenile survival following the quota restrictions, leading to more adults now contributing to the spawning stock biomass. It might also indicate a change in selection in the Indonesian longline fishery, which is directed at other tuna species or a decrease in abundance of older SBT on the spawning ground.

50. In summary the Japanese longline CPUE suggest a decline in spawning biomass in the mid 1990s and no trend since then. The Indonesian catch and age-composition suggest possible declines in abundance and average age.

Exploitable biomass for the longline fishery

51. Japanese LL CPUE of SBT for all ages combined suggest that the exploitable biomass for these gears has remained fairly constant during the past 10 years though this is low compared to historical values. Results indicate increases in the CPUE of ages 8-11(Figure 2) since about 1992, but there is a slight decline in 2003. CPUE of fish aged 4-7 (Figure 1) has increased since the mid 1980s and remained broadly constant over the last 10 years. In the same period the CPUE of Korean LL has declined while since 1996, when the current reporting system was established, the CPUE of Taiwan LL (Figure 10) has remained approximately stable.

52. In summary, the CPUE indicators generally suggest stable exploitable biomass over the last 10 years.

Growth

53. Analysis of tag returns and of otoliths indicate that historically growth rate has increased as the stock has been reduced.

Distribution

54. Contraction of range is a possible response of fish stocks to reduced abundance and would likely result in a positive bias in CPUE as an index of abundance. The number of rectangles fished by Japanese LL has declined since records began in the late 1960’s and has continued to decline, by about a half over the last decade. This decline has resulted from stepwise operational changes but it might also indicate a reduction in stock distribution area.

55. Distribution has apparently contracted in the juvenile fish areas around Australia and these range contractions generally appear to have persisted since they were noted in 1980s.

56. It was recognised that distributional changes are a potentially valuable indicator of stock status independent of stock assessments.

Model-Based Assessments

57. At this meeting assessments were presented using the MP Conditioning Model (CCSBT/ESC/0409/23), and by making updates of ADAPT VPA (CCSBT/ESC/0409/32) and of the Length Based VPA (CCSBT/ESC/0409/33). The ADAPT VPA and Length Based VPA were provided in order to see how the additional three years data since the last assessment affected the outputs using the identical model as in 2001. Figure 11 shows a comparison of the spawning stock biomass trends for the ADAPT VPA model runs using the data through 2001 and 2004. The MP Conditioning Model is the model that has been used for evaluating Management Procedures, and is the form of model that the 2001 SC recommended that the SAG move towards using. Figure 12 shows the spawning stock biomass trends for the MP Conditioning model. A wide range of sensitivities to model structure and parameters in the MP Condition model were explored. The different models use different definitions of spawning biomass so the numbers given below are not totally comparable. As in the 2001 assessments the estimated spawning stock biomass are low relative to the unexploited stock (3-15% for the MP Conditioning Model, 29% for the Length Based VPA) and significantly below 1980 levels (14-59% for the MP Conditioning Model and 32-68% for ADAPT, 53% for Length based VPA. The overall recruitment is also similar to the 2001 results, with recruitment since 1990 half of that prior to 1980 (Figure 13), but the ADAPT VPA estimates poor recruitment for the 1999 year class and the MP Conditioning Model and length-based model estimates poor recruitment for the 2000 year class.

The following results are comparable to the 2001 assessment

- At the time of the most recent round of quota reductions (1988), spawning stock size was well below levels in 1980 with trends since the late 1990s either upward or slightly downward with a slight upward trend more likely.
- The models consistently indicate a long-term decline in estimated recruitment with recruitments in the 1990s less than half of those in earlier years. Recruitment is estimated to increase somewhat in the late 1990’s.
- The models consistently indicate the combination of high recruitment and high spawning stock in the period 1950-1970, with low recruitment and low spawning stock since then.
- Quota reductions in all fisheries in 1988 (and earlier) and earlier changes in selectivity in the surface fishery (i.e. around 1984) initially reduced juvenile fishing mortality rates and hence led to an increase in escapement of younger fish. These increases in young fish escapement led to increases in estimates of abundance of intermediate ages and these fish are now of spawning age.
- Age structured models show strong autocorrelation in recruitment residuals: Better than expected recruitment tends to be followed by better than expected recruitment and lower than expected recruitment by lower than expected recruitment. This observation may be partially due to aging errors resulting from length-at-age assumptions, shifts in the environmental regime of SBT and/or inappropriate stock recruitment curves.

The following are important differences between the 2001 and 2004 assessments

- Of concern is the recruitment in 1999 and 2000. The data show a marked reduction in the abundance of small fish in the longline fishery in 2002 and 2003 and as a result the ADAPT VPA estimates low recruitment in 1999 (the last year class estimated), and the MP condition model and length-based model estimates poor recruitment in 2000 but recruitment near the recent average for 1999.

Projections

58. Model projections under current catches produced a wide range of scenarios for SSB that both increased and declined. Projections using the Conditioning Model and assumptions in paper (CCSBT/ESC/0409/23) indicates current catches are not sustainable under the low and medium steepness assumptions but spawning stock size would be expected to increase over time with a high steepness assumption (Figure 14). The ADAPT assessments (paper CCSBT/ESC/0409/32) and assumptions (updated on the same basis as used in 2001) show some projections of SSB that increase under current yield and others that decrease under current yield (Figure 15).

Synthesis of information in the assessments and all available indicators.

59. Assessments are designed to provide a synthesis of catch, size/age composition of catch and relative abundance data and fishery independent data (tagging, acoustic and aerial surveys). However, it is difficult to include informative data in assessments when these have short time series, when they only cover parts of fish distributions or when they are based upon more qualitative information. In contrast indicators can show events on time and space scales finer than assessments can handle and information that the assessments do not consider. It is therefore helpful to consider indicators as well as assessments particularly when, as at present, important results of assessments are based only upon limited data.

60. Overall, both assessments and indicators agree on the historical decline in SBT. They indicate that the past 10 years have been a period when stock decline has been arrested, but where there was relatively little rebuilding and where some negative signals persist. Both assessments and the indicators provide evidence for markedly low recruitment in the most recent years. Model estimates of recruitment in the last few years are known to be modified by subsequent assessments, but the indicators generally provide consistent evidence for a markedly lower recruitment from 1999 to 2001.

61. The impressions that assessments and indicators give of spawning stock state differ in detail with the indicators suggesting concerns about the spawning stock size and age composition that have yet to show up in assessments. However there are several possible interpretations of the change in Indonesian catch-at-age and catch.

Summary of stock status

62. The current assessments suggest the SBT spawning biomass is at a low fraction of its original biomass and well below the 1980 biomass. The stock is estimated to be well below the level that produces 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. Assessments estimate stable recruitment in the 1990's but very low recruitments in 1999 or 2000 in different assessment models. Analyses of fishery indicators provide evidence of a markedly lower recruitment from 1999-2001. Indicators also show that the Indonesia LL fishery on spawning fish catches fewer older individuals. One plausible interpretation is that the spawning stock has declined in average age and may have declined significantly in abundance. This is in contrast to the assessment models perspective that the spawning stock has been largely stable over the last decade and increased slightly over the last 4 years.

63. Projections with 15,000 t annual catch provide highly variable results depending upon assessment assumptions and suggest the stock is more likely to decline with the MP Conditioning Model while the ADAPT model shows roughly equal probability of decline or increase. In comparison to the 2001 assessment, the current stock size and pattern of recruitment in the 1990s are similar. What has changed are the indications of low recruitment from 1999 to 2001 and the indications of changes in the age distribution and possible decline in abundance of the spawning stock in Indonesian waters.

64. Given all the evidence, the probability of further stock decline under current catch levels is now judged to be greater than in 2001, when an increase or decline under current catches were considered equally likely.

Agenda Item 6. Management procedure

6.1 Panel evaluation of updated operating model

65. Results of the July 2004 advisory panel meeting were presented in CCSBT-ESC/0409/42. The July meeting was intended to examine the updated Reference Set Operating Model and to propose changes that might result in an improved reference set to be used for MP evaluations so that the original MP development timeline of finalizing MPs in September 2004 could be met. Updating of the conditioning data to include 2001-2003 (plus some other data alterations documented in CCSBT-ESC/0409/41) resulted in a number of technical problems with the OM Reference Set, including: natural mortality estimates for ages 10+ (M10) appeared to be too high and too well estimated, steepness tended toward the upper bound and was too well-determined within each steepness sub-level, selectivity for the Indonesian fishery was increasing with age up to age 30, and the recruitment estimates for 2000 and 2001 appeared to be too well-determined. Alternative proposals by the panel were also recognized to be flawed due to similar issues and lack of convergence in the MCMC posteriors. It was recognized that the operating model could not be

finalized without further development and wider consultation with the CCSBT MP community.

6.2 Revised reference set of operating models for management procedure evaluation

66. Paper CCSBT-ESC/0409/24 described a number of concerns about the Reference Set OM that need consideration in relation to quantifying uncertainty and weighting results in evaluating MPs. These included observations from the April 2004 workshop: the near-certain OM prediction that longline CPUE would decline from 2000 to 2003 and the observation that this had not occurred, under-representation of uncertainty around 1998-99 recruitment estimates, poor predictions about the recent absence of small fish in the Japanese longline fishery and the recent low catch on the Indonesian spawning grounds. A number of additional issues were described, including concerns about representing uncertainty about parameters that are poorly estimated from the data (M and steepness), other implications from assessment results (CCSBT-ESC/0409/23), such as the impact on projections of using different CPUE series and of varying the age range over which average catchability is assumed to be constant (so-called qa8-12 vs qa4-30).

67. Papers CCSBT-ESC/0409/25, 29 and 44 described the performance of several MPs (FXA, FXR, CPU, D&M, HK5) that were devised for the April 2004 MP workshop III, and applied to the proposed OMs panel_tag, panel_notag and mechanical update. In all cases, the behaviour of the MPs showed substantially different behaviour than they did when applied to the April Reference set. Many of the rules tended to prescribe increases to TAC at the first possible opportunity, despite the lower biomass levels in the new OMs. These papers illustrated a general concern that the initial specifications of the reference set OM under-represented the uncertainty about the SBT system, and had resulted in MPs that were not adequately robust in their response to the new data. It was noted that imposing additional external constraints on some of the MPs (irrespective of input data) would probably be sufficient to remove the worst features of MP behaviour. Other details relating to the relative performance of different MPs and differences in OM characteristic were also noted – in particular it was observed that higher steepness OMs can lead to greater risk than lower steepness because the productive scenarios have lower initial biomass with less reserve for poor initial MP decisions.

68. A small technical group was convened to resolve the issues and to reach consensus on an approach for completing the MP work in 2005.

69. Issues of concern with the existing models were identified. Categories were specified in order of priority, recognizing that there are interrelations between them.

	Priority	Notes
Recruitment		
Uncertainty (including low recent recruitment)	1	
Projection/autocorrelation approaches (ER, paper 23)	1	
Stock-recruitment curve (including spawning potential?)	3	
Low recent recruitment-depensation?	3	
Estimation		
Mortality (for ages 10+); high M with relatively low CVs	1	
Steepness (ER, paper 23)	2	
Selectivity		
Indonesian fishery (shape)	2	
Longline parameterisation	3	Likely related to M
Longline non-retention (by size)	3	Impact of EFP Catch
Observation-error assumptions		
Tagging model	3	
Data weighting (e.g., tagging, variance vs bias wrt to growth assumptions)	1	
Interaction between time-varying and age-aspects of selectivity (process error) versus measurement/observation error assumptions	2	
Error structure in projection (age and size composition)	1	
CPUE		
Variability (low estimated CV)	3	
Age range (for catchability) 4-30 vs. 8-12	1	Interacts with selectivity
Series to use (nominal vs median vs other)	1	
Omega	3	

70. A series of sensitivity analyses were conducted in order to understand the source of the problems and to identify possible ways to address them. Results of these analyses are summarized in **Attachment** 5.

71. Two basic approaches were considered for integrating the operating model uncertainty into a new reference set: an MCMC approach similar to that used in 2003 and a new approach called the GRID approach. In the MCMC approach, a reduced set of scenarios is used to form the reference set, each scenario encompassing a wide range of uncertainty about possible parameter combinations using Bayesian posteriors. By contrast, the GRID approach involves construction of the reference set based on projections from a large number of MPD results that span the range of uncertainties in some fundamental parameters (e.g. steepness, natural mortalities, CPUE-abundance relationship), structural assumptions (e.g. age-specific catchabilities) and input data (e.g. different CPUE series), and weighting these depending on choices of priors, likelihoods, or some combination of the two.

72. The SAG considered pros and cons of the two alternatives. The advantages of the MCMC approach included (1) it had been already accepted and applied in 2003, (2) it uses an objective method to assign weights to alternative parameter combinations so that it is generally preferred from first principles, (3) further uncertainty in initial abundance is incorporated into the projections and (4) there is a substantial sampling of the full parameter space.

73. The problem with the MCMC approach arises because the most recent versions of the operating model conditioned on the updated data had convergence problems. This was the case of the two sets discussed in the Panel report (CCSBT-ESC/0409/42). The parameter M10 showed poor convergence and its posterior distribution tended to be narrow and centred around high M10 values. A number of changes to model assumptions were explored during the meeting (results are summarised in **Attachment 5**), including varying selectivities for the Indonesian and LL1 fisheries. While lower M10 values were obtained in some of these fits (e.g. S3), the convergence problems persisted in MCMCs. The SAG concluded that non-trivial changes in model structure would be needed in order to improve MCMC performance and to achieve posterior distributions that span the full range of uncertainty in key parameters (steepness and M) to represent the prior believes.

74. An additional problem identified with the MCMC approach was related to the parameterisation of selectivities using curvature penalties. This parameterisation, while it can work well for MPD estimates, tends to result in unrealistically ragged selectivities in MCMC trials. Alternative model structures were discussed, including changing the parameterisation of selectivities to use functional forms (e.g. double-half-Gaussian functions) and some extra variability to account for process error, especially affecting younger age classes. The error structure of the age and length composition data might also be changed to allow for error in the data unrelated to sampling considerations. Specific assumptions for a likely reference set and robustness trials were discussed and are detailed in Attachment 4.

75. The SAG concluded that the MCMC approach would be preferred in principle, but in practice there would not be sufficient time to code all the changes, examine alternatives and guarantee successful performance of MCMC by the end of the SAG.

76. Further work was therefore devoted to specifying the reference set and robustness trials under the GRID approach and to develop code to produce an initial set of MPDs that could be examined during the course of SC9.

77. The SAG made a number of decisions, which define the basic structure of the reference set. The axes for the grid will include the following parameters: steepness (*h*), natural mortalities (M0 and M10) and the shape of the CPUE-abundance relationship (omega). In addition, a likely axis to be included is the use of the five individual CPUE series (as opposed to the median). Other axes could be included depending on the results of sensitivity analyses.

78. MPD fits will be used as initial conditions for stochastic projections. The results from the series of MPD fits in the grid will be integrated into the reference set by assigning weights. These weights determine the number of replicates to be simulated from each MPD fit to produce a total of 2000 replicates. Two weighting options were considered: (i) input weights (e.g. 0.2, 0.6, 0.2 for the three h values) or (ii) a combination of input weights and likelihood-based weights. Decisions about the weights and the final size of the grid will be made after examination of MPD results. A trade-off between grid size and number of replicates per cell was noted.

79. MPD results will be checked for convergence by examining the maximum gradient and inspecting for extreme behaviour. The fits at the corners of the grid, which are

likely to be more problematic, will need to be examined in more detail including using different initial values to check convergence.

80. The basic operating model is defined as S3 in Attachment 4. This model involves estimating variable selectivity parameters for the Indonesian fishery up to age 30, and other specifications as in the Panel_TAG set (CCSBT-ESC/0409/42).

81. The assumptions about recent recruitments will remain unchanged in the conditioning code, including the use of autocorrelation (AC) as part of the likelihood affecting recruitment estimates from 2002 and later. In order to incorporate uncertainty around recruitment estimates for 2000-2004, a lognormal error will be added to the vector of initial abundances at ages 0 through 4 in 2004. This will be implemented in the projection code. Details are provided in Attachment 4. In order to examine robustness of MP performance under higher recruitment levels, a full set will be generated with no autocorrelation (noAC) in the conditioning. In this set, the MPD estimates of recruitment for 2002 and 2003 will be determined by the stock-recruitment curve.

82. Further details about sensitivity analyses conducted and robustness tests are provided in **Attachment 5**.

Agenda Item 7. Research and technical requirements for future stock assessment and management procedure evaluation

83. This agenda item overlapped in its scope with agenda items 6 (Management Procedure) and 7 (Workplan issues for 2005) of the SC9 meeting. Given this overlap, and noting that analytical work on the Operating Model of the Management Procedure would continue in the margins of SC9, it was concluded that this agenda item would not be completed at the SAG, but instead finalised at SC9.

84. Several options were identified for managing future development of the management procedure. These are set out in **Attachment 6**. The preferred option would be selected by SC9 in the light of the further analytical work.

85. There was considerable discussion about what type of analyses could be undertaken in 2005 to provide information on the status of the stock. It was noted that conducting a full stock assessment would divert resources from the completion of the MP. It was agreed that the evaluation of a suite of stock indicators would provide a useful indication on stock status. To this end, it was agreed that within the margins of SC9, a small technical group would convene to evaluate the current suite of Fisheries Indicators and other potential Fisheries Indicators. This group would also discuss further analyses that could be undertaken to provide improved indicators of recruitment and the Indonesian fishery. It was also noted that there should also be some general discussion of the process for formulating meta-rules. The outcome of these discussions is at **Attachment 7**.

Agenda Item 8. Other business

86. There was no other business.

Agenda Item 9. Finalisation and adoption of meeting report

87. The report of the meeting was adopted

Agenda Item 10. Close of meeting

88. The meeting was closed at 7:45pm, 11 September 2004.

List of Attachments

Attachment

1 List of Participants

2 Agenda

3 List of Documents

4 Appendix to Section 5.6 (Overall assessment – summary of stock status)

5 Technical Issues Related to Specification of Reference Set and Robustness Tests

6 Alternative Timeline Options for MP Completion

7 Evaluation of Fisheries Indicators

Attachment 1

List of Participants
Fifth Meeting of the Stock Assessment Group
6 - 11 September 2004
Seogwipo City, Jeju, Republic of Korea

CHAIR

Dr John ANNALA
Chief Scientific Officer
Gulf of Maine Research Institute
PO Box 7549
Portland, Maine 04112
USA
Phone: +1 207 772 2321
Fax: +1 207 772 6855
Email: jannala@gmri.org

ADVISORY PANEL

Dr Ana PARMA
Centro Nacional Patagonico
Pueto Madryn, Chubut
Argentina
Phone: +54 2965 451024
Fax: +54 2965 451543
Email: parma@cenpat.edu.ar

Dr James IANELLI
REFM Division
7600 Sand Pt Way NE
Seattle, WA 98115-6349
USA
Phone: +1 206 526 6510
Fax: +1 206 526 6723
Email: jim.ianelli@noaa.gov

Professor Ray HILBORN
School of Fisheries Box 355020
University of Washington
Seattle, WA 98195
USA
Phone: +1 206 543 3587
Fax: +1 206 685 7471
Email: rayh@u.washington.edu

Professor John POPE
The Old Rectory
Burgh St Peter
Norfolk, NR34 0BT
UK
Phone: +44 1502 677377
Fax: +44 1502 677377
Email: PopeJG@aol.com

SCIENTIFIC COMMITTEE CHAIR

Mr Andrew PENNEY
Pisces Environmental Services (Pty) Ltd
22 Forest Glade
Tokai Road, Tokai 7945
South Africa
Phone: +27 21 7154238
Fax: +27 21 7154238
Email: apenney@pisces.co.za

CONSULTANT

Ms Vivian HAIST
6224 Groveland Drive
Nanaimo, B.C.V9V1B1
Canada
Phone: +1 250 985 0518
Fax: +
Email: haistv@shaw.ca

AUSTRALIA

Dr James FINDLAY
A/g Program Leader
Fisheries & Marine Science Program
Bureau of Rural Sciences
Dept. of Agriculture, Fisheries & Forestry
PO Box E11, Kingston ACT 2604
Phone: +61 2 6272 5534
Fax: +61 2 6272 3882
Email: james.findlay@brs.gov.au

Dr John GUNN
Research Group Leader
Deputy Chief, Research
Division of Marine Research
CSIRO
GPO Box 1538
Hobart, Tas 7001
Phone: +61 3 6232 5375
Fax: +61 3 6232 5012
Email: john.gunn@csiro.au

Dr Tom POLACHECK
Senior Principal Research Scientist
CSIRO
GPO Box 1538
Hobart, TAS 7001
Phone: +61 3 6232 5312
Fax: +61 3 6232 5012
Email: tom.polacheck@csiro.au

Dr Marinelle BASSON
Senior Fisheries Research Scientist
Division of Marine Research
CSIRO
GPO Box 1538
Hobart, Tas 7001
Phone: +61 3 6232 5492
Fax: +61 3 6232 5012
Email: marinelle.basson@csiro.au

Dr Dale KOLODY
Research Scientist
Division of Marine Research
CSIRO
GPO Box 1538
Hobart, Tas 7001
Phone: +61 3 6232 5121
Fax: +61 3 6232 5012
Email: dale.kolody@csiro.au

Mr Jay HENDER
Policy Officer
International Fisheries
Dept. of Agriculture, Fisheries & Forestry
GPO Box 858, Canberra ACT 2601
Phone: +61 2 6272 3608
Fax: +61 2 6272 4875
Email: jay.hender@daff.gov.au

Mr Andy BODSWORTH
Manager
Southern Bluefin Tuna Fishery
Australian Fisheries Management Authority
PO Box 7051
Canberra Mail Centre ACT 2610
Phone: +61 2 6272 5290
Fax: +61 2 6272 4614
Email: Andy.Bodsworth@afma.gov.au

FISHING ENTITY OF TAIWAN

Ms. Shiu-Ling LIN
Specialist
Fisheries Agency
Council of Agriculture
No.2 Chaochow Street
Taipei 100
Phone: +886 2 3343 6129
Fax: +886 2 3343 6268
Email: shiuling@ms1.fa.gov.tw

Dr. Chin-Hwa SUN (Jenny)
Professor and Director
Institute of Applied Economics,
National Taiwan Ocean University
2 Pei-Ning Road,
Keelung 20224
Taiwan
Phone: +886 2 2462 2324
Fax: +886 2 2462 7396
Email: jsun@mail.ntou.edu.tw

JAPAN

Dr Sachiko TSUJI
Section Chief
Temperate Tuna Section
National Research Institute of
Far Seas Fisheries
5-7-1 Shimizu-Orido, Shizuoka 424-8633
Phone: +81 543 36 6042
Fax: +81 543 35 9642
Email: tsuji@affrc.go.jp

Dr Kazuhiko HIRAMATSU
Section Chief
Mathematical Biology Section
National Research Institute of
Far Seas Fisheries
5-7-1 Shimizu-Orido, Shizuoka 424-8633
Phone: +81 543 36 6014
Fax: +81 543 35 9642
Email: hira@affrc.go.jp

Dr Tomoyuki ITOH
Senior Reseacher
Temperate Tuna Section
National Research Institute of
Far Seas Fisheries
5-7-1 Shimizu-Orido, Shizuoka 424-8633
Phone: +81 543 36 6043
Fax: +81 543 35 9642
Email: itou@affrc.go.jp

Dr Norio TAKAHASHI
Senior Researcher
Temperate Tuna Section
National Research Institute of
Far Seas Fisheries
5-7-1 Shimizu-Orido, Shizuoka 424-8633
Phone: +81 543 36 6043
Fax: +81 543 35 9642
Email: norio@affrc.go.jp

Dr Hiroyuki KUROTA
Researcher
Temperate Tuna Section
National Research Institute of
Far Seas Fisheries
5-7-1 Shimizu-Orido, Shizuoka 424-8633
Phone: +81 543 36 6043
Fax: +81 543 35 9642
Email: kurota@affrc.go.jp

Mr Hiroshi SHONO
Researcher
Mathematical Biology Section
National Research Institute of
Far Seas Fisheries
5-7-1 Shimizu-Orido, Shizuoka 424-8633
Phone: +81 543 36 6039
Fax: +81 543 35 9642
Email: hshono@affrc.go.jp

Prof Doug BUTTERWORTH
Department of Mathematics and Applied
Mathematics
University of Cape Town
Rondebosch 7701
South Africa
Phone: +27 21 650 2343
Fax: +27 21 650 2334
Email: dll@maths.uct.ac.za

Mr Takashi KOYA
Deputy Director
International Affairs Division
Fisheries Agency of Japan
1-2-1 Kasumigaseki, Chiyoda-ku
Tokyo 100-8907
Phone: +81 3 3502 1086
Fax: +81 3 3502 0571
Email: takashi_kouya@nm.maff.go.jp

Mr Katsumasa MIYAUCHI
Planner
Fisheries Agency of Japan
1-2-1 Kasumigaseki, Chiyoda-ku
Tokyo 100-8907
Phone: +81 3 3591 6582
Fax: +81 3 3595 7332
Email: katsumasa_miyauchi@nm.maff.go.jp

Mr Hajime TAGUCHI
Section Chief
Fisheries Agency of Japan
1-2-1 Kasumigaseki, Chiyoda-ku
Tokyo 100-8907
Phone: +81 3 3501 5098
Fax: +81 3 3592 0759
Email: hajime_taguchi@nm.maff.go.jp

Mr Nozomu MIURA
Assistant Chief
International Business and Planing
Federation of Japan Tuna Fisheries
Cooperative Associations
3-22 Kudankita 2-chome, Chiyoda-ku
Tokyo 102-0073
Phone: +81 3 3264 6167
Fax: +81 3 3234 7455
Email: miura@ japantuna.or.jp

NEW ZEALAND

Dr Talbot MURRAY
International Scientist
Ministry of Fisheries
PO Box 1020, Wellington
Phone: +64 4 494 8270
Fax: +64 4 494 8261
Email: talbot.murray@fish.govt.nz

Dr Shelton HARLEY
Senior Scientist
Ministry of Fisheries
PO Box 1020, Wellington
Phone: +64 4 494 8267
Fax: +64 4 494 8261
Email: shelton.harley@fish.govt.nz

REPUBLIC OF KOREA

Dr Dae Yeon MOON
Senior Scientist
National Fisheries Research &
Development Institute
408-1 Shirang-ri, Kijang-gun
Busan 619-902
Phone: +82 51 720 2320
Fax: +82 51 720 2337
Email: dymoon@nfrdi.re.kr

Dr Soon Song KIM
Scientist
National Fisheries Research &
Development Institute
408-1 Shirang-ri, Kijang-gun
Busan 619-902
Phone: +82 51 720 2321
Fax: +82 51 720 2337
Email: sskim@nfrdi.re.kr

Dr Kyu Jin SEOK
Research Scientist
International Cooperation Office
Ministry of Maritime Affairs and Fisheries
50 Chungjeong-No, Seodaemun-Gu
Seoul 120-715
Phone: +82 2 3148 6994
Fax: +82 2 3148 6996
Email: pisces@momaf.go.kr

Dr Sung Kwon Soh
Counselor for Fisheries Affairs
International Cooperation Office
Ministry of Maritime Affairs and Fisheries
50 Chungjeong-No, Seodaemun-Gu
Seoul 120-715
Phone: +82 2 3148 6995
Fax: +82 2 3148 6996
Email: sksoh@momaf.go.kr

Dr Chang Ik ZHANG
Professor
Pukyong National University
Daeyeon 3 dong, Nam-gu
Busan 608 737
Phone: +82 51 620 6124
Fax: +82 51 622 3306
Email: cizhang@pknu.ac.kr

CCSBT SECRETARIAT

PO Box 37, Deakin West ACT 2600
AUSTRALIA
Phone: +61 2 6282 8396
Fax: +61 2 6282 8407

Mr Brian MACDONALD
Executive Secretary
Email: bmacdonald@ccsbt.org

Mr Yukito NARISAWA
Deputy Executive Secretary
Email: ynarisawa@ccsbt.org

Mr Robert KENNEDY
Database Manager
Email: rkennedy@ccsbt.org.

INTERPRETERS

Ms Saemi BABA

Ms Kumi KOIKE

Attachment 2

Agenda
Fifth Meeting of the Stock Assessment Group
6 - 11 September 2004
Seogwipo City, Jeju, Republic of Korea

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. Stock assessment
   - 5.1 Discussion of inputs to assessments
     - biology and stock structure of SBT
     - country reports
     - estimates of catch
   - 5.2 Evaluation of models used
   - 5.3 Evaluation of assessment results
   - 5.4 Evaluation of stock projection results
   - 5.5 Fishery indicators
   - 5.6 Overall assessment

6. Management procedure
   - 6.1 Panel evaluation of updated operating model
   - 6.2 Revised reference set of operating models for management procedure evaluation
     - review of conditioning results using alternative model structures
     - consistency with other assessment results
     - choice of final reference set of operating models

7. Research and technical requirements for future stock assessment and management procedure evaluation

8. Other business

9. Finalisation and adoption of meeting report

10. Close of meeting

Attachment 3

List of Documents
Fifth Meeting of the Stock Assessment Group and
Extended Scientific Committee for the Ninth Meeting of the Scientific Committee

(CCSBT-ESC/0409/)

01. Draft Agenda of 5th SAG
02. List of Participants of 5th SAG
03. Draft Agenda of the Extended SC for 9th SC
04. List of Participants of the Extended SC for 9th SC
05. List of Documents－The Extended SC for 9thSC&5th SAG
06. (Secretariat) 4. Review of SBT Fisheries
07. (Secretariat) 8.1. Characterization of SBT Catch
08. (Secretariat) 8.4. SBT Tagging Program
09. (Secretariat) 9. Development of the CCSBT Database
10. (Secretariat) 10. Data Exchange
11. (Australia) The catch of SBT by the Indonesian longline fishery operating out of Benoa, Bali in 2003.: R. Andamari, D. Retnowati, T.L.O. Davis, M. Herrera, F. Poisson and C.H. Proctor.
12. (Australia) Update on the length and age distribution of SBT in the Indonesian longline catch on the spawning ground.: Farley, J.H. and Davis, T.L.O.
13. (Australia) An update on Australian Otolith Collection Activities: 2003/04.: Stanley, C. & Polacheck, T.
14. (Australia) Review of Methods for Estimating Tag Reporting Rates and Their Applicability to SBT Longline Fisheries.: Tom Polacheck, Paige Eveson and Geoff Laslett.
15. (Australia) Update on Tag Seeding Activities and Preliminary estimates of reporting rate from the Australian surface fishery based on tag seeding experiments.: Tom Polacheck and Clive Stanley.
16. (Australia) Exploring trade-offs in experimental design of a 2-fishery integrated tag-recapture and catch model for estimating mortality rates and abundance.: Paige Eveson, Tom Polacheck and Geoff Laslett.
17. (Australia) An evaluation of abundance estimates from tagging programs when tag returns are only available from one component of a multi-component fishery: an example based on the 1990's southern bluefin tuna tagging program.: Tom Polacheck, Paige Eveson and Geoff Laslett.
18. (Australia) A Proposal for Multi-lateral Co-ordination and Co-Operation in Electronic Tag Deployment under the CCSBT Scientific Research Programme.: T.

Polacheck, J. Gunn and A. Hobday

19. (Australia) Aerial survey indices of abundance: comparison of estimates from line transect and “unit of spotting effort” survey approach.: Farley, J., Bestley, S. Campbell, S. and Hartmann, K.
20. (Australia) Trends in catch, effort and nominal catch rates in the Japanese longline fishery for SBT – 2004 update.: Hartog, J., T. Polacheck and S. Cooper.
21. (Australia) Fishery indicators for the SBT stock 2003/04.: T. Polacheck, D. Kolody, M. Basson, J. Gunn.
22. (Australia) Further consideration of issues related to setting rebuilding objectives for southern bluefin tuna in the context of management procedures.: M. Basson and T. Polacheck.
23. (Australia) Assessment and projections of SBT stock assessment and summary of agreed stock status reference points.: M. Basson, D. Kolody, T. Polacheck, A. Preece, J. Hartog.
24. (Australia) Implications for management procedure evaluation: the mechanical update and further exploration of the operating model.: M. Basson, T. Polacheck, D. Kolody, A. Preece, J. Hartog.
25. (Australia) Examples of management procedure behaviour changes in response to operating model updating.: D. Kolody, J. Hartog.
26. (Australia) Preparation of Australia's Catch and Effort Data Submission to the CCSBT Stock Assessment Group and Management Procedure Workshop 2004.: Hobsbawn, P.I., Sahlqvist, P.C., McLoughlin, K.J.
27. (Australia) Data post-processing for input to the 2004 stock assessment and comparison of the 2001 and 2004 assessment datasets.: A. Preece, S. Cooper, J. Hartog.
28. (Australia) The need for an aerial survey to provide a fishery independent index of recruitment for SBT.: A. Hobday, J. Gunn, T. Polacheck, M.V. Bravington.
29. (Japan) Tuning of the D&M Management Procedure under the Panel’s Updated Operating Models.: Doug Butterworth and Mitsuyo Mori
30. (Japan) Observer Program Report.: T. Itoh, K. Miayuchi.
31. (Japan) Preparation of Japanese catch/effort and size data and CPUE series for 2004 stock assessment and mechanical update of Operating Model.: S. Tsuji, N. Takahashi, M. Nagasaka, T. Itoh.
32. (Japan) Update of ADAPT VPA and projection in 2004.: K. Hiramatsu, S. Tsuji.
33. (Japan) Update of length-based VAP in 2004.: H. Kurota, N. Takahashi.
34. (Japan) Summary of fisheries indicators in 2004.: S. Tsuji, T. Itoh, N. Takahashi.
35. (Japan) Consideration on alternative Management Objectives for the CCSBT.: S. Tsuji.
36. (Japan) Review of the current CCSBT Tagging Program and potential improvements.: N. Takahashi, S. Tsuji, H. Kurota.

37. (Japan) Report of 2003/2004 results and proposal for 2004/2005 activities on CCSBT tagging by Japan.: T. Itoh, N. Takahashi, S. Tsuji.
38. (Japan) Report of 2003/2004 activities using the Research Mortality Allowance (RMA) and application for 2004/2005 RMA.: H. Taguchi
39. (Japan) Results of SBT spawning area surveys.: T. Itoh, H. Kurota, A. Hirai.
40. (Japan) Draft proposal of Recruitment Monitoring Program Review Workshop.; S. Tsuji, J. Gunn.
41. (Secretariat) Record of discussion leading to a change in decision on data to be used in the 2004 Assessment.
42. (Advisory Panel) Report from Panel Meeting Held at NOAA Alaska Fisheries Laboratory, Seattle, 20-23 July 2004 (to be prepared by Panel).
43. (Japan) Attempt for multiple imputation of SBT-CPUE using new statistical method.: Hiroshi SHONO.
44. (Japan) Behaviors of the HK5 management procedure under the updated operating models.: Hiroyuki KUROTA.
45. (Japan) Proposed procedure of selecting agreeable Management Procedure and results of feasibility experiment.: S.Tsuji, T.Kouya, K.Miyauchi
46. (Australia) Report on Australia's SRP Tagging Activities in 2003/2004 and Plans for 2004/2005.: Tom Polacheck, John Gunn, Thor Carter and Jay Hender.
47. (Taiwan) A short report on the collection and reading of otoliths collected from Taiwanese longline vessels.: Jen-Chieh Shiao and Wann-Nian Tzeng.

(CCSBT-ESC/0409/SBT Fisheries)

Australia	Australia's 2002-03 Southern Bluefin Tuna Fishing Season.: Hobsbawn, P.I., Findlay, J.D., McLoughlin, K.J. and Curran, D.
Japan	Review of Japanese SBT Fisheries in 2003.: Itoh, T. and Miyauchi, K.
Fishing Entity of Taiwan	Review of Taiwanese SBT Fishery of 2002/2003
New Zealand	The New Zealand Southern Bluefin Tuna Fishery in 2003.: Kendrick. T. and Murray, T.
Republic of Korea	Korean SBT Longline Fishery.: Moon, D., Koh, J. and Kim, S.

(CCSBT-ESC/0409/Info)

01. (Secretariat) CCSBT Report to ICCAT (to be prepared at SC9)
02. (Australia) An approach for assessing the compatibility between a stock assessment and fishery independent indices of juvenile abundance.: M. Bravington, W.N. Venables, P. Toscas

03. (Australia) Extracts from SESAME: a simulation-estimation stock assessment model evaluation project focused on large pelagic species.: Kolody, D.S., P.C. Jumppanen, D.G.Ricard, J.R. Hartog, A.L. Preece, T. Polacheck.

05. (Japan) Report of the 2003 Shoyo-maru cruise – SBT spawning ground survey.: NRIFSF

06. (Japan) Cruise proposal for the 2004/2005 SBT Acoustic Monitoring Survey of the Recruitment Monitoring Program.: NRIFSF, JFA.

(CCSBT-ESC/0409/Rep)

01. Report of Tagging Program Workshop (October 2001)

02. Report of the First Meeting of Management Procedure Workshop (March 2002)

03. Report of the CPUE Modeling Workshop (March 2002)

04. Report of Direct Age Estimation Workshop (June 2002)

05. Report of the Third Stock Assessment Group Meeting (September 2002)

06. Report of the Seventh Meeting of the Scientific Committee (September 2002)

07. Report of the Ninth Annual Commission Meeting (October 2002)

08. Report of the Second Meeting of the Management Procedure Workshop (April 2003)

09. Report of the Indonesian Catch Monitoring Review Workshop (April 2003)

10. Report of the Fourth Meeting of the Stock Assessment Group (August 2003)

11. Report of the Eight Meeting of the Scientific Committee (September 2003)

12. Report of the Tenth Annual Meeting of the Commission (October 2003)

13. Report of the Fifth Meeting of the Ecologically Related Species Working Group (February 2004)

14. Report of the Third Meeting of the Management Procedure Workshop (April 2004)

15. Report of the Special Meeting of the Commission (April 2004)

Attachment 4

Appendix to Section 5.6 (Overall assessment – summary of stock status)

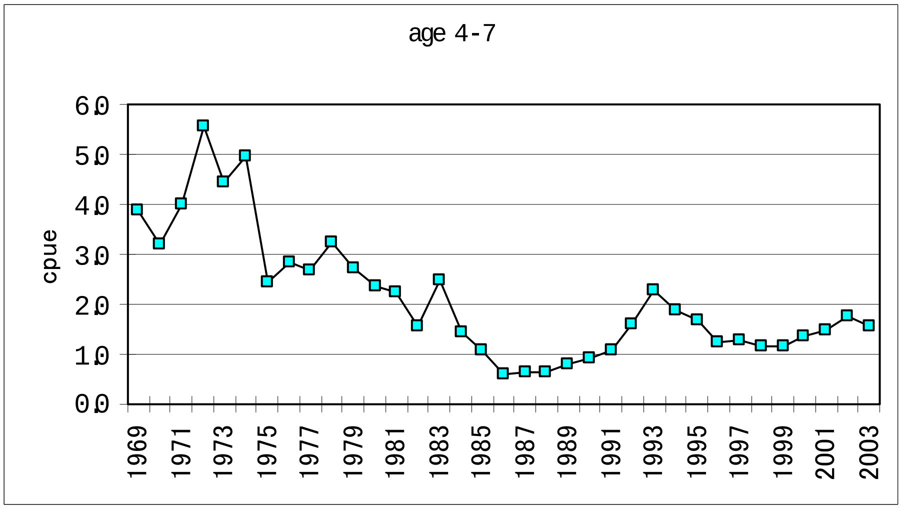

Figure 1 (from CCSBT-ESC/0309/21, figure 6): Trends in nominal SBT catch rates of ages 4-7 (numbers per 1000 hooks) for Japanese longliners operating in statistical areas 4-9 in months 4-9.

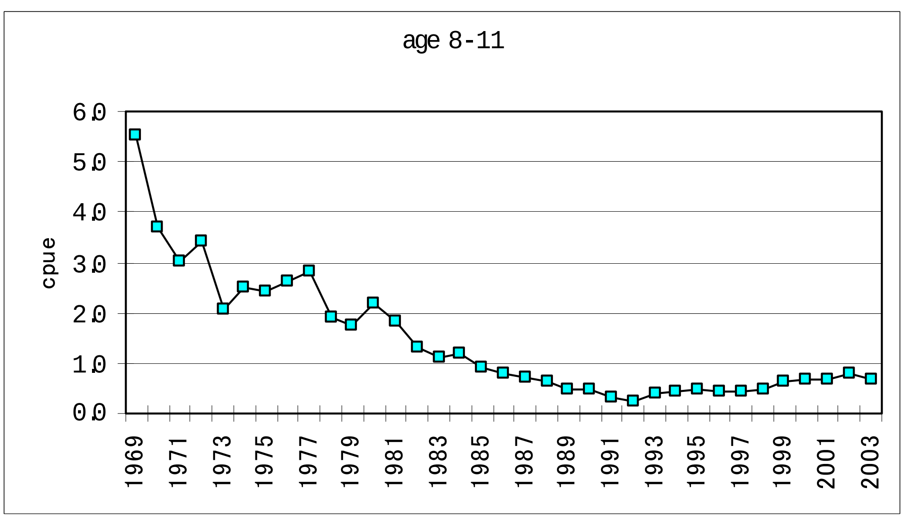

Figure 2 (from CCSBT-ESC/0309/21, figure 7).

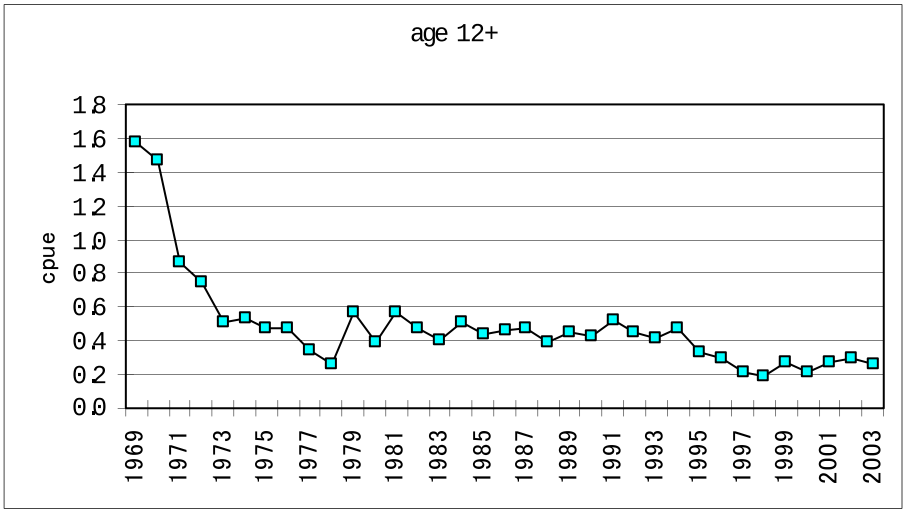

Figure 3 (from CCSBT-ESC/0309/21, figure 8).

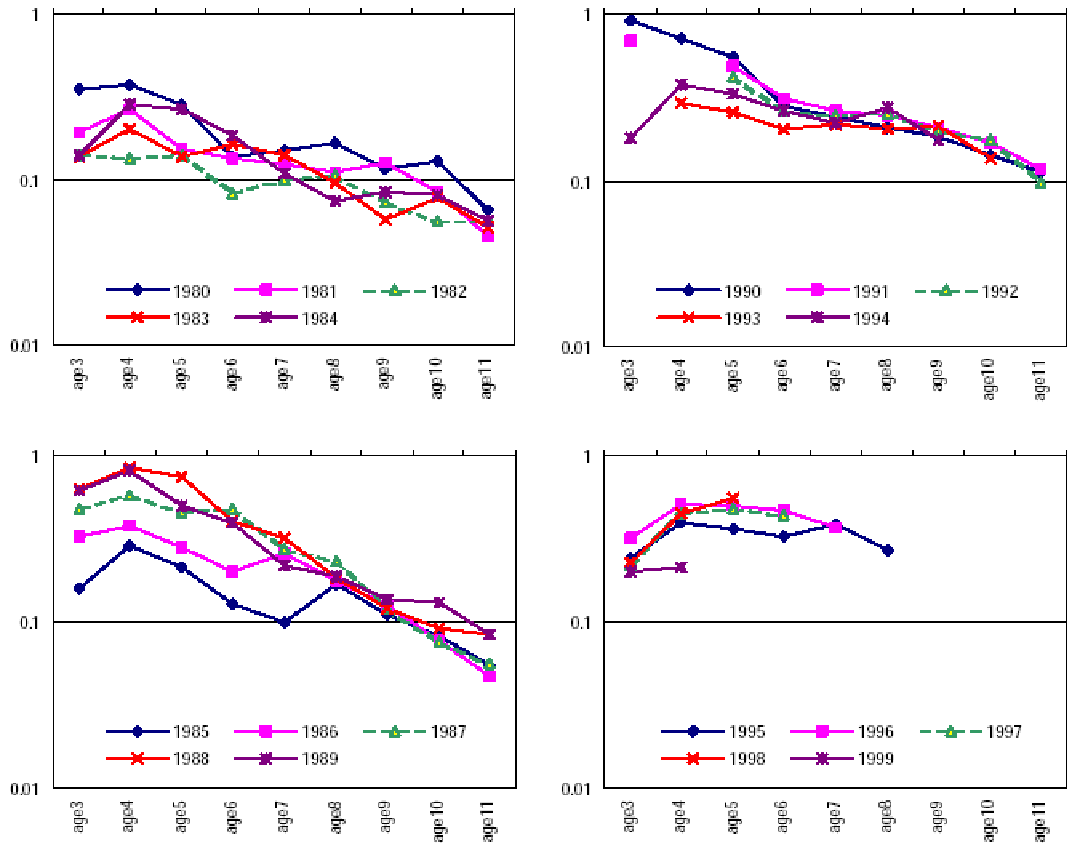

Figure 4 (from CCSBT-ESC/0309/34, figures 1-3): Nominal CPUE by cohort on a log-scale.

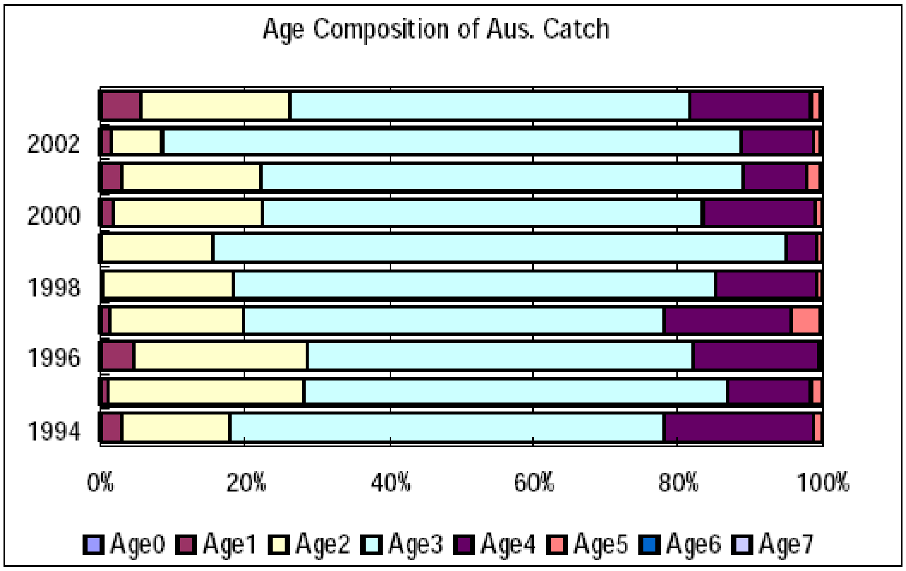

Figure 5 (from CCSBT-ESC/0309/34, figure 2-2): Changes in age composition of Australian surface catches.

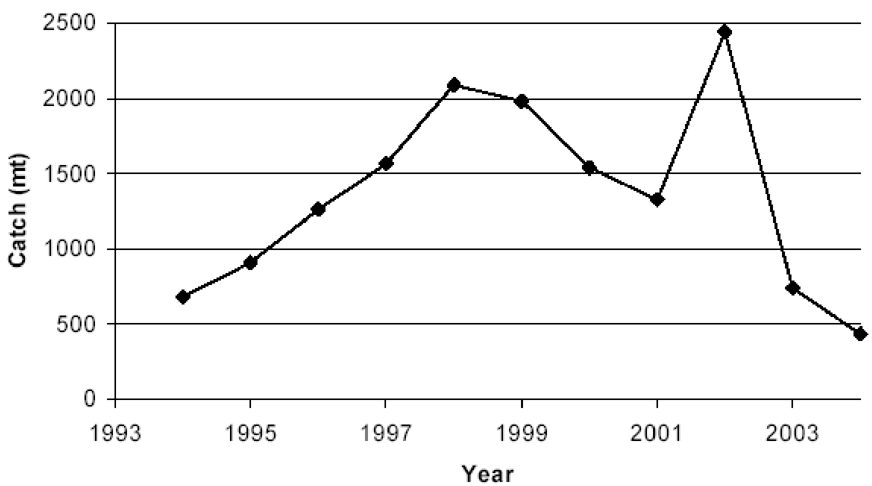

Figure 6 (from CCSBT-ESC/0309/21, figure 5): Estimated landings of tunas (tonnes round weight) at Benoa by spawning season. A spawning season is defined as July 1 of the previous year to June 30 of the given year. The catch estimates for 2004 are preliminary and do not include June data.

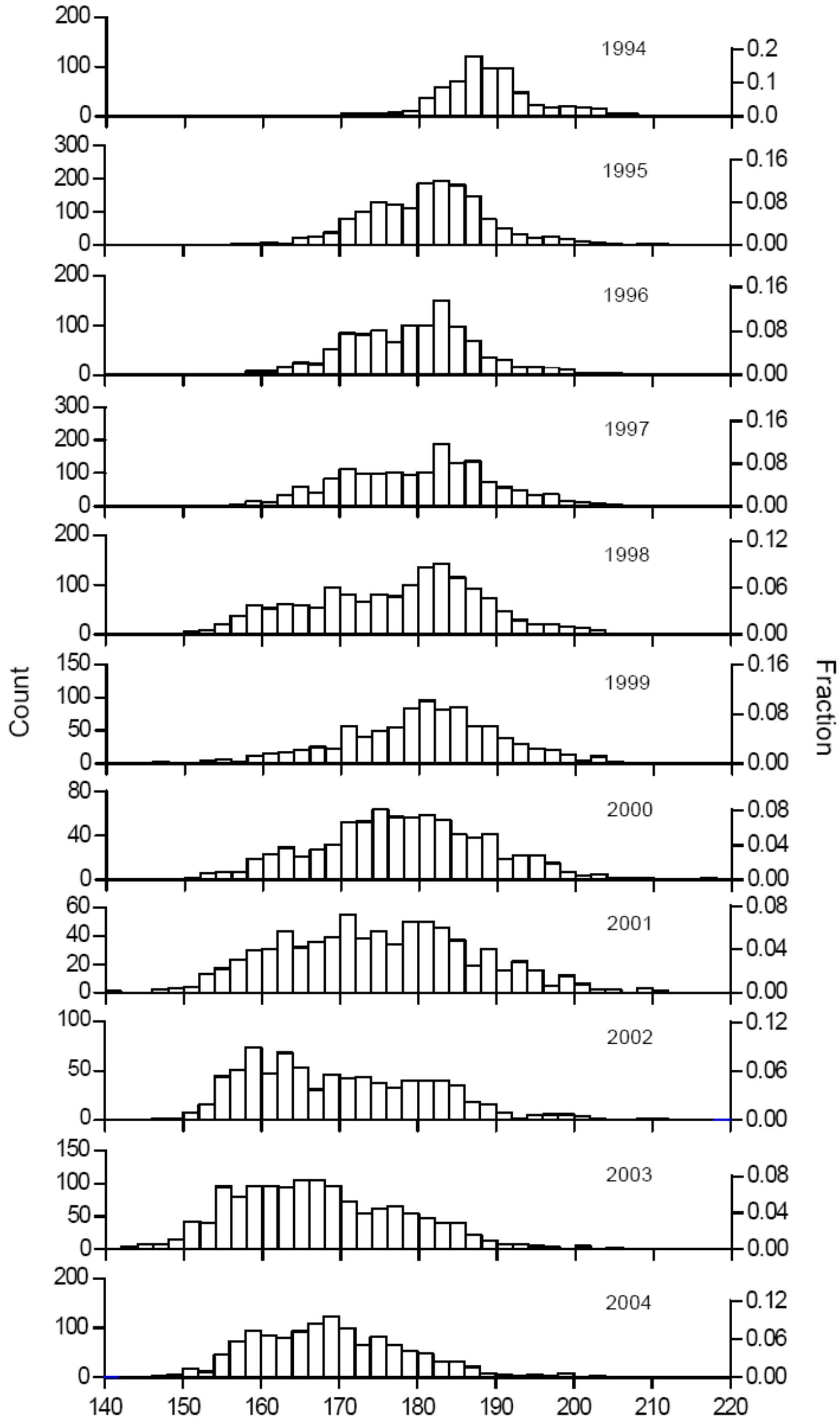

Figure 7 (from CCSBT-ESC/0309/21, figure 25): Length frequency (2 cm intervals) of Indonesian SBT catch during the spawning season. A spawning season is defined as July 1 of the previous year to June 30 of the given year.

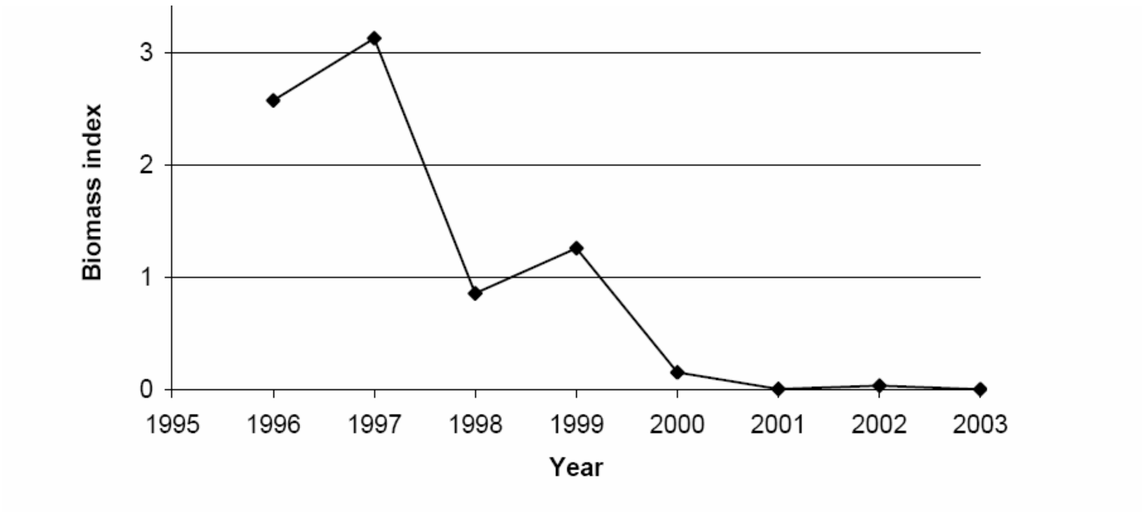

Figure 8 (from CCSBT-ESC/0309/21, figure 30): Relative biomass index for one year old SBT off Western Australia from acoustic surveys. The index has been standardized to the mean value over all years.

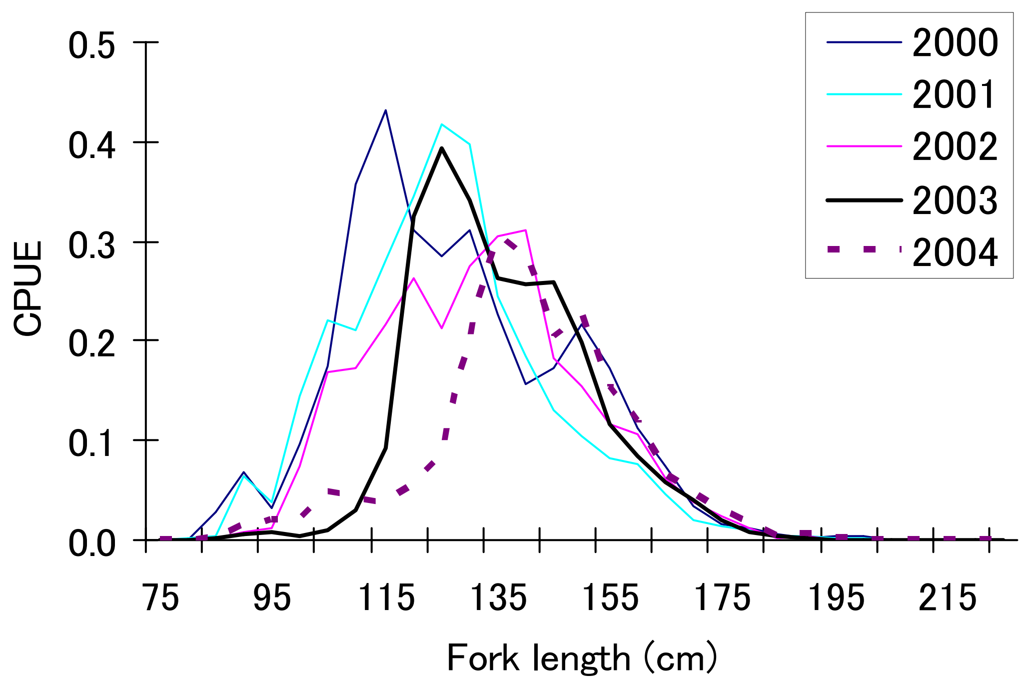

Figure 9 (from CCSBT-ESC/0309/34): Changes in size composition of nominal CPUE of RTMP data from 2000-2005 illustrated by results from June in area 4.

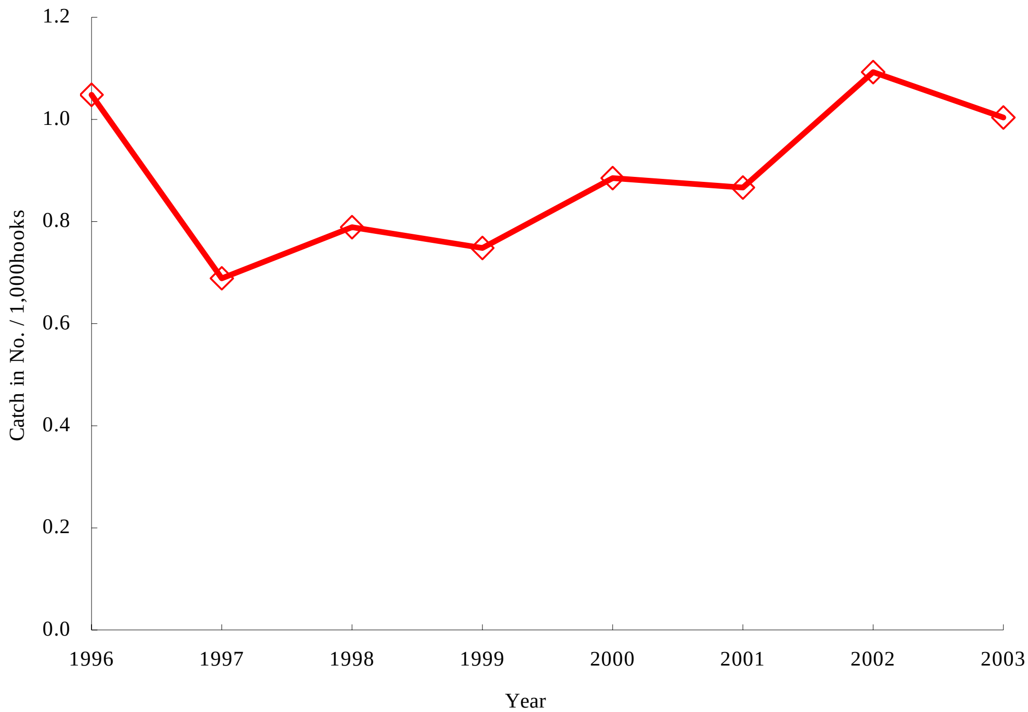

Figure 10 (from CCSBT-ESC/0309/Fisheries-Taiwan, figure 18): Nominal CPUE for Taiwan longline.

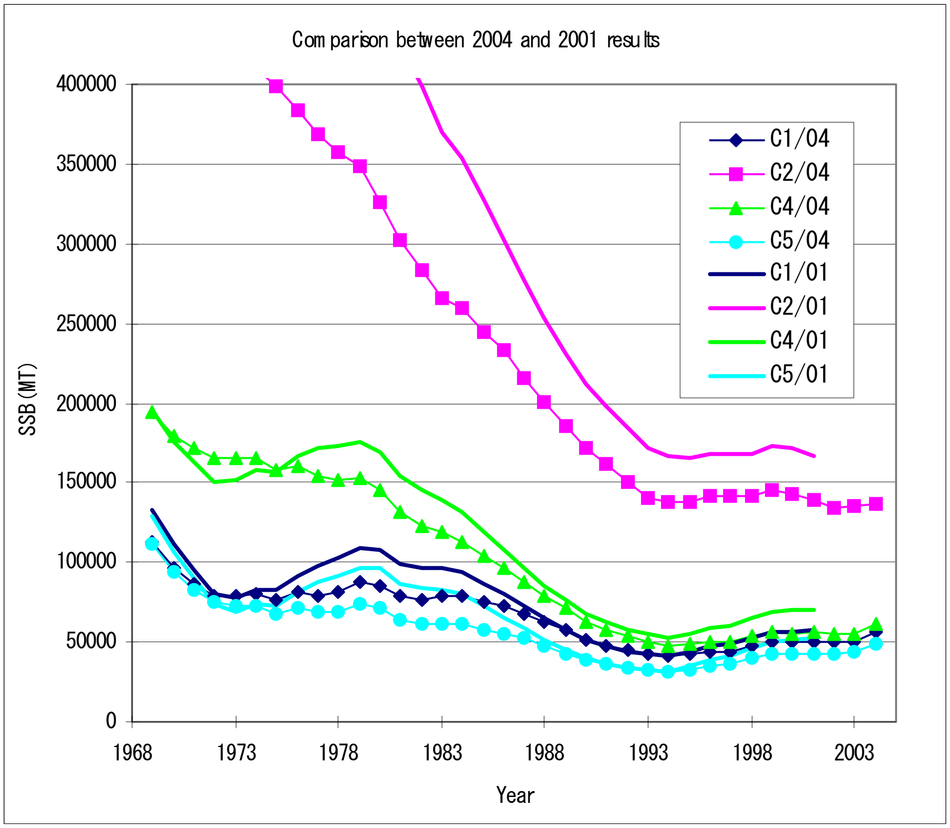

Figure 11: Trajectories of ADAPT estimates of SSB for different assessment year (2004 and 2001) and plus group options (C1, C2, C4, and C5) based on W08 index. The 2004 results are shown with a marker and the 2001 results are shown without a marker.

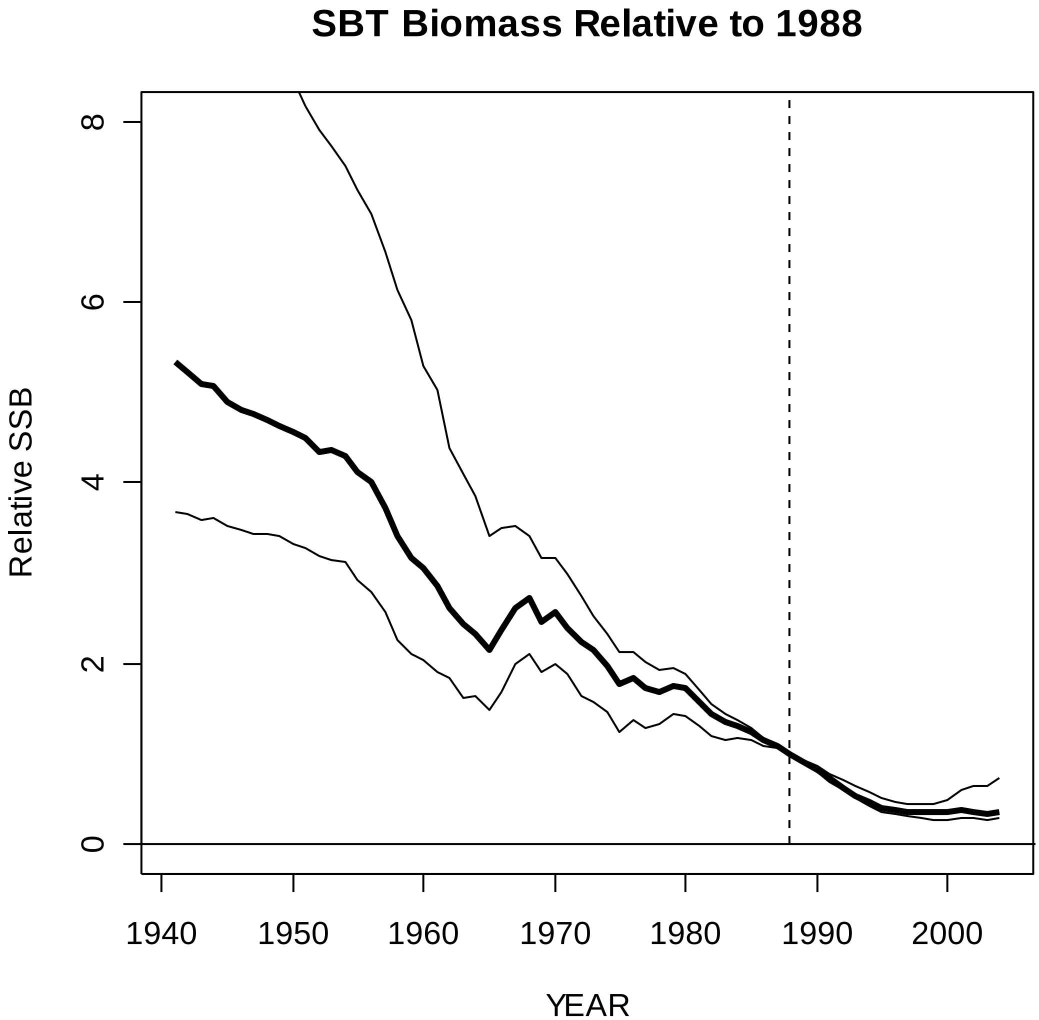

Figure 12: 5th, Median and 95th percentiles of SBT biomass trends estimated from a range of plausible specifications to the MP Conditioning Model, weighted by the stock recruitment curve steepness prior probabilities assigned by the CCSBT-MP workshop.

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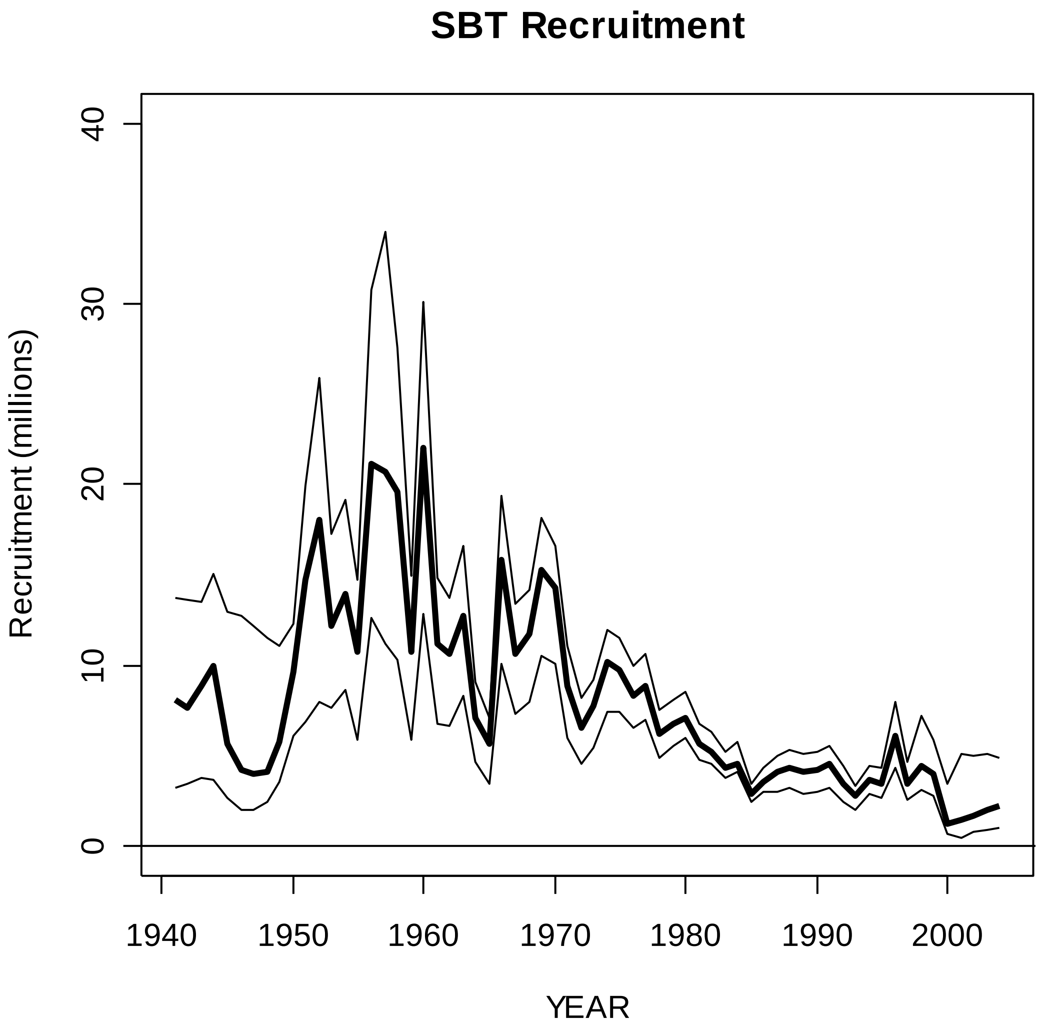

Figure 13: 5th, Median and 95th percentiles of SBT recruitment trends estimated from a range of plausible specifications to the MP Conditioning Model, weighted by the stock recruitment curve steepness prior probabilities assigned by the CCSBT-MP workshop.

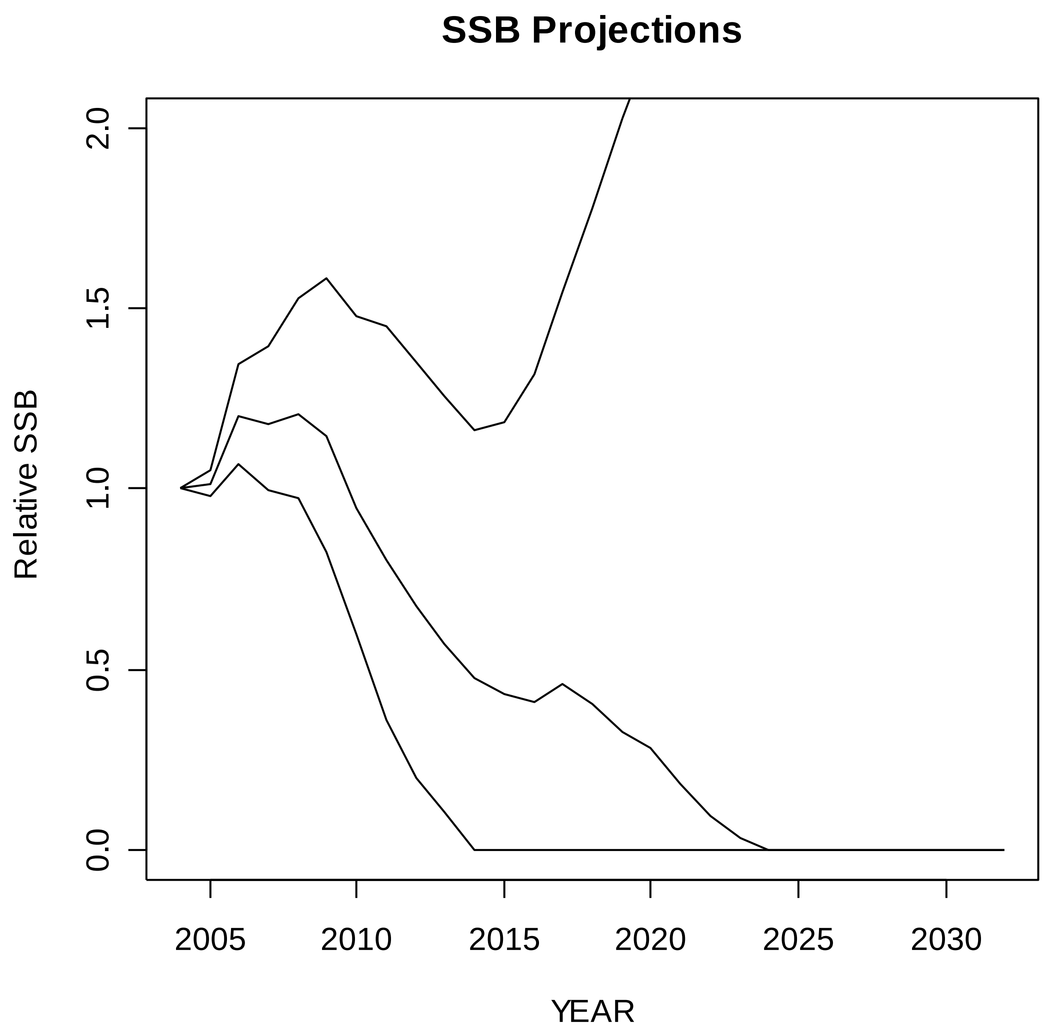

Figure 14: Current catch projections estimated from a range of (214) specifications to the MP Conditioning Model from CCSBT-ESC/0409/23. The three lines correspond to median results from three stock recruitment curve steepness (h) assumptions (the dominant factor driving projection behaviour) as described in paper CCSBT-ESC/0409/23. Probabilities are h = 0.4 (bottom line, 20%), h = 0.55 (middle line, 60%) and h = 0.8 (top line, 20%). These levels are similar to, but slightly more optimistic than the agreed bins from the Second MP workshop.

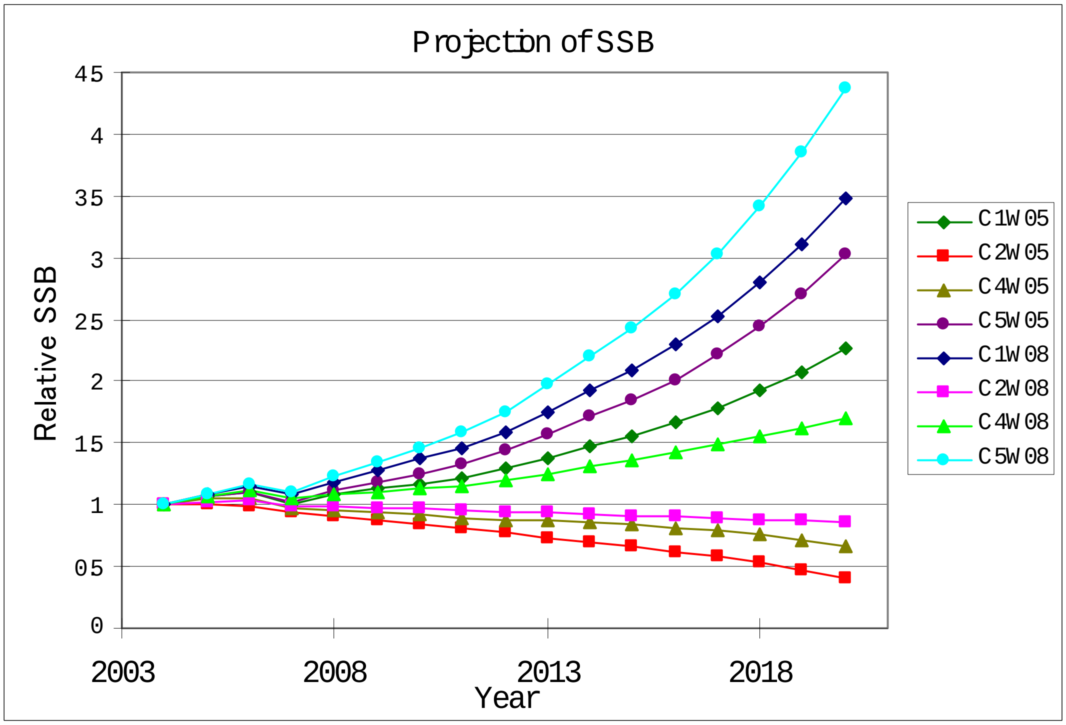

Figure 15: Projection of SSB based on ADAPT estimates for different plus group options (C1, C2, C4, and C5) and abundance indices (W05 and W08).

Sensitivity analyses

The following models were constructed to examine the impact of alternative assumptions about the Indonesian fishery and the effect of changing the range of ages over which average catchability is assumed constant.

Name	Indonesia data weight	Age plus for Indonesia selectivity	Indonesia selectivity over time	Age CPUE Catchability	Time-Variability Longline 1 selectivity
Panel_Tag	Normal	22	Constant	4-30	MU
S7	Normal	30	Constant	4-30	MU
S1	High	22	Constant	4-30	MU
S2	High	30	Constant	4-30	MU
S3	Normal	30	Varying	4-30	MU
S4	High	22	Constant	8-12	MU
S5	High	30	Constant	8-12	MU
S6	Normal	30	Varying	8-12	MU
S8	Normal	22	Varying	4-30	MU
S9	Normal	22	Constant	4-30	Variable 90-95
S10	Normal	30	Constant	4-30	Variable 90-95

Results

Table 1 presents a summary of results for some preliminary models. Recruitment and spawning biomass trajectories for selected models are presented in Figs. 1 and 2, respectively. The lines cluster according to whether a larger emphasis was placed on the Indonesian fishery age compositions (Models S1, S2, S4 and S5; Fig. 1). Recruitments for 1986-1991 were lower when the Indonesian catch-at-age data were given higher weight.

Model S3 showed that the selectivity for the Indonesian fishery shifted (allowing a change every 2 years) toward young fish in recent years (Fig. 2). This resulted in lower estimated mortality and higher abundance. Figures 3, 4, and 5, show summary output for Models S7, S3, and S6, respectively.

Table 1. Summary of model results. See legend and CCSBT-ESC/0409/42 for further explanation of model descriptions and parameter values.

	Name	Panel_Tag	s7	s1	s2	s3	s4	s5	s6	s8	s9	s10
Rho	1931-Y	0.71	0.70	0.75	0.75	0.63	0.76	0.74	0.67	0.70	0.70	0.70
	1965-1998	0.60	0.59	0.75	0.75	0.47	0.77	0.75	0.58	0.57	0.61	0.60
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.45	0.45	0.46	0.46	0.40	0.47	0.45	0.42	0.45	0.45	0.45
	1965-1998	0.35	0.35	0.39	0.38	0.31	0.41	0.39	0.35	0.34	0.36	0.36
CPUE	1969-Y	0.07	0.06	0.11	0.11	0.23	0.34	0.09	-0.01	0.02	-0.26	-0.27
Autocorr.	1990-2000	0.24	0.24	0.19	0.21	0.51	0.10	0.14	0.30	0.26	-0.34	-0.35
	Steepness	0.60	0.60	0.71	0.73	0.35	0.63	0.52	0.44	0.55	0.64	0.64
Likelihood	Total	482.4	479.4	686.1	665.9	467.3	699.4	667.8	461.4	472.1	459.2	456.7
	LL1	144.20	143.05	157.76	156.93	135.85	159.82	149.35	136.92	139.84	131.64	130.88
	LL2	48.54	48.57	49.14	49.14	48.70	48.97	48.58	48.06	48.80	48.57	48.60
	LL3	106.28	106.18	107.10	107.09	108.26	107.92	108.86	107.95	106.27	106.33	106.23
	LL4	138.07	138.07	138.07	137.77	135.24	135.37	134.92	135.64	138.00	137.64	137.68
	IND	34.08	32.56	198.21	176.48	24.58	199.98	184.16	22.07	26.65	29.62	27.95
	SURF	32.85	32.98	43.15	43.89	32.92	44.02	44.80	32.74	32.61	33.43	33.52
	CPUE	-59.89	-59.84	-56.57	-55.94	-57.37	-49.62	-56.80	-62.96	-61.55	-65.57	-65.53
	Tags	4.05	3.99	5.72	5.91	4.00	5.43	5.44	4.45	3.82	5.00	4.98
Priors	Sel.Ch	32.11	31.73	39.03	38.68	35.21	40.28	38.63	34.46	35.25	29.39	29.27
	Sel.sm	19.30	19.37	20.65	22.20	21.05	21.59	26.64	20.95	19.46	20.37	20.30
	Sg.R	-17.93	-18.00	-16.92	-17.14	-21.48	-16.39	-18.11	-19.95	-17.96	-17.99	-18.03
	M(0)	0.00	0.00	0.04	0.12	0.07	0.34	0.12	0.26	0.07	0.02	0.05
	M(10)	0.69	0.72	0.60	0.57	0.03	0.93	0.62	0.31	0.72	0.69	0.71
	Steepness	0.02	0.02	0.14	0.18	0.21	0.03	0.01	0.07	0.00	0.04	0.04
Ref. Pts	msy	28,418	28,529	30,069	30,698	17,970	29,204	27,618	23,751	27,270	29,244	29,369
	S(msy)	141,266	141,091	112,107	108,863	479,990	125,405	195,404	269,776	161,361	131,593	130,951
	S(msy)/Bo	0.31	0.31	0.26	0.25	0.43	0.30	0.35	0.39	0.33	0.29	0.29
	M(0)	0.40	0.40	0.39	0.38	0.42	0.37	0.38	0.43	0.39	0.39	0.39
	M(10)	0.17	0.17	0.17	0.16	0.11	0.18	0.17	0.15	0.17	0.17	0.17
	S(2004)/S(0)	0.08	0.09	0.09	0.10	0.10	0.10	0.07	0.06	0.11	0.09	0.10
Resids												
LL1	std.	0.47	0.47	0.49	0.49	0.46	0.50	0.48	0.46	0.46	0.45	0.45
	mar	0.27	0.27	0.29	0.29	0.26	0.30	0.28	0.27	0.27	0.26	0.26
LL2	std.	1.22	1.22	1.18	1.18	1.23	1.18	1.17	1.21	1.25	1.19	1.19
	mar	0.37	0.37	0.35	0.35	0.37	0.36	0.36	0.36	0.37	0.38	0.38
LL3	std.	0.57	0.57	0.57	0.57	0.59	0.58	0.60	0.59	0.57	0.57	0.57
	mar	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.19	0.19	0.19	0.19
LL4	std.	1.04	1.03	1.05	1.04	1.01	1.04	1.03	1.02	1.03	1.03	1.03
	mar	0.42	0.41	0.41	0.41	0.42	0.41	0.41	0.41	0.41	0.41	0.41
IND	std.	0.63	0.61	1.50	1.40	0.52	1.51	1.43	0.50	0.56	0.59	0.56
	mar	0.42	0.39	1.03	0.94	0.36	1.06	0.95	0.35	0.35	0.40	0.36
SURF	std.	0.50	0.50	0.58	0.58	0.50	0.58	0.59	0.50	0.50	0.50	0.51
	mar	0.21	0.21	0.22	0.22	0.21	0.22	0.23	0.21	0.21	0.21	0.21
CPUE	std.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93
	mar	0.59	0.60	0.55	0.57	0.73	0.72	0.52	0.46	0.56	0.42	0.42
Tags	std.	0.47	0.47	0.56	0.57	0.46	0.55	0.54	0.47	0.46	0.52	0.52
	mar	0.30	0.29	0.31	0.29	0.31	0.25	0.29	0.35	0.23	0.38	0.37
	2000-2001											
Recruitment	Avg	1,147	1,164	1,290	1,365	994	1,176	965	880	1,168	1,214	1,232
	CV	37%	37%	38%	39%	36%	39%	37%	35%	37%	37%	38%
	Steepness	0.603	0.603	0.708	0.729	0.354	0.628	0.520	0.438	0.554	0.636	0.638
	CV Steepness	15%	15%	13%	13%	43%	16%	17%	20%	17%	14%	15%
	M0	0.403	0.396	0.388	0.380	0.415	0.367	0.381	0.429	0.385	0.392	0.387
	CV M0	9%	9%	8%	9%	9%	9%	9%	9%	9%	9%	9%
	M10	0.171	0.172	0.166	0.164	0.114	0.182	0.167	0.147	0.172	0.171	0.171
	CV M10	8%	8%	7%	7%	19%	8%	7%	13%	7%	8%	8%
	Omega	0.871	0.869	0.885	0.871	0.882	1.000	0.985	0.964	0.928	0.889	0.887

CV Omega	7%	8%	7%	7%	8%	0%	7%	8%	8%	7%	7%

To explore relationships between key variables, pairwise plots from the CCSBT-ESC/0409/42 Panel_Tag MCMC results were constructed (Fig. 6). In particular, the MCMC output specifications were modified to display aspects of the older age-group selectivity for the Indonesian fishery and for the Japanese Longline fishery.

Sensitivity analyses done with full grid at SAG meeting:

Base:
Sets with low M10 values have very low likelihood. The fit of the CPUE series is much worse, with negative residuals in the first 5-6 years of data. The fit of the Indonesian catch-age data also deteriorates substantially at low M values.

No tag:
Under the current model formulation, the tagging data result in rather tight estimates of population at age for the younger ages of those year-classes that span the years when tagging data are available (1992-1997, ages 2 –8). This provides information about mortality leading to high M10 values. Without the tagging data, the fits under low M10 are more likely (see comments below under “Further factors to be explored by members”).

Constant Indonesian selectivity for ages 22 and above:
The low M10 sets are not acceptable under constant Indonesian selectivity for ages 22 and above. Not only do they have very poor fit, but they still have a dome-shape selectivity for ages younger than 22. Only the high M10 sets are acceptable. It was decided that in order to simulate flat selectivity it would be better to flatten selectivity from age 18 and above.

Assumptions for core set using the GRID approach

Attachment 6 outlines the process that will be followed for completion of MP work. At the SAG, a core set and a list of sensitivity MP test were selected as specified below. These will constitute the basis for the choice of the final reference set and robustness trials.

Basic model structure:

Model assumptions will be as in model S3, except that tagging data will be discounted.

Name	Weight to tagging	Weight to Age/Len comp data	Age plus for Indonesian selectivity	Indonesian selectivity	CPUE age-range	Time-Variability LL 1 selectivity
Core	Nill	Reduce sample size (details below)	30	Variable	4-30	As in old reference set

Sample sizes for age/length composition data: assumptions correspond to those used by the Panel in the sets developed in July 2004 (CCSBT-ESC/0409/42). Sample sizes used in the old reference set were considered to be too large (e.g., n=500 for LL1 in final years) to be used in conjunction with constrained changes in selectivity as assumed in the model. They were reduced for all age and length compositions by taking sqrt of n times 5. This reduces the contrast in sample sizes over time (see notes under "Further factors to be explored by members").

Selectivities are as follows:

- LL1 selectivity changes (CV=0.5) every 4 years, with change in 1997 and 2001 (last block is only three years).
- LL2, LL3 and LL4 are constant.
- Indonesian selectivity is constant up to 1996 when it starts changing every two years with CV=0.5.
- Australian selectivity changes (CV=2) by blocks of 4 years up to 1997 when it starts changing every year.

Specification of grid axes:

Factor	No. of levels	Values			Prior	Weights
Steepness	3	0.385	0.55	0.73	0.2, 0.6, 0.2	As in prior
M0	3	0.30	0.40	0.50	uniform	Prior × Likelihood-based
M10	3	0.07	0.10	0.14	uniform	Prior × Likelihood-based
Omega	2	0.75	1		0.4, 0.6	Prior × Likelihood-based
CPUE series	5	5 series			0.2 to each	As in prior

Note: when different series are used in conditioning, the MPs tested in projections will still use the median CPUE for the historical period.

Recent recruitments in projection:

Lognormal autocorrelated error will be added to initial abundance (numbers at age 0 through 3 in 2004) within the projection code.

Let τ_y represent the lognormal recruitment deviate in year y and $\hat{\tau}_y$ its MPD estimate. Then to project recruitments we have available from the conditioning

1) $\hat{\tau}_{2001}$ estimated from model fit

$$\hat{\tau}_{2002} = \hat{\rho}\,\hat{\tau}_{2001}$$
$$\hat{\tau}_{2003} = \hat{\rho}^2\,\hat{\tau}_{2001}$$
$$\hat{\tau}_{2004} = \hat{\rho}^3\,\hat{\tau}_{2001}$$

where $\hat{\rho}$ is the empirical estimate of autocorrelation based on recruitments for years 1965-1998.

2) Stochastic projections

$$N_{2004,3} = \hat{N}_{2004,3} \text{ (unchanged)}$$
$$N_{2004,2} = \hat{N}_{2004,2} \exp\left\{\varepsilon_{2002}\right\}$$
$$N_{2004,1} = \hat{N}_{2004,1} \exp\left\{\hat{\rho}\,\varepsilon_{2002} + \varepsilon_{2003}\right\}$$
$$N_{2004,0} = \hat{N}_{2004,0} \exp\left\{\hat{\rho}^2\,\varepsilon_{2002} + \hat{\rho}\,\varepsilon_{2003} + \varepsilon_{2004}\right\}$$

where $\varepsilon_y \sim N\left(0,(1-\rho^2)\sigma_R^2\right)$.

Process for assigning weights and integrating over grid cells

The approach used to assign weights to the different cells differs depending on the grid axis, as detailed in the Table above. For some axes (M0, M10 and omega) the weights are based on Likelihood × prior. In other axes, the prior weights override the likelihood. The latter is the case of all factors related to changes in data input (CPUE series), and also the case of the steepness parameter. Given problems in model structure, the likelihood was not considered an adequate basis to assign weights to steepness. In particular, the lack of account for autocorrelation in recruitment in the likelihood and the use of a Beverton-Holt curve were discussed in connection to steepness.

Once weights are assigned, the code samples cells with probabilities based on these weights. In order to assure adequate coverage on the steepness axes, the number of realizations for each *h* level is fixed and other axes are sampled within each *h* level.

In the case of the CPUE series, because the grids are computed separately (one for each of the five series), samples of 400 realizations from each CPUE grid (400 = 0.2 × 2000) will be appended into the file that goes into the projection code. In case users want to use only a subset of the 2000 realizations (e.g. 500 to start tuning procedures), they may want to randomize the records to avoid biases due to the change in CPUE series.

Sensitivity MP tests to be conducted

Tests		Number of trials	Full integration	Grid cells
Tagging data	Include tagging data, use reduced weight as in panel_TAG (1/4 weight in the old reference set)	1	×	
Recruitment	No AC	1	×	
	Number of years of low recruitment (details below)	1	×	
Indonesian selectivity	Max estimated age = 18	2		M10 high M0 central *h* low and central Omega =1 CPUE median
CPUE	As in core	1	Full cross except CPUE	CPUE median
	Age-rage a8-12	1	Full cross except CPUE	CPUE median
	Catchability up/down	2		M10 central M0 central *h* low and central Omega =1 CPUE median
Carrying capacity	Carrying capacity change	1		M10 central M0 central *h* low and central Omega =1 CPUE median
Uncertainty in catches	Uncertainty in catches	1		M10 central M0 central *h* low and central Omega =1 CPUE median

Details on some runs:
Number of years of low recruitment: set R for 2002-2005 equal to R_{low}, the average of $\hat{N}_{2000,0}$ and $\hat{N}_{2001,0}$, then autocorrelated stochastic starting in 2006. The code should be general so that the number of years with low recruitment can be changed by the user.
Note: averaging of 2000 and 2001 recruitments can be done in the projection code as full vector of recruitments is passed.

$$N_{2004,3} = \text{unchanged}$$

$$N_{2004,2} = \frac{\hat{N}_{2004,2}}{\hat{N}_{2002,0}} R_{\text{low}}$$

$$N_{2004,1} = \frac{\hat{N}_{2004,1}}{\hat{N}_{2003,0}} R_{\text{low}}$$

$N_{2004,0} = R_{\text{low}}$, same for $N_{2005,0}$ and so on.

This formulation involves holding constant the fishing mortality of one year olds in 2003.

Further factors to be explored by members

Members will examine the impact of other changes in the assumptions and input data, namely:

Update of tagging data and weight given in conditioning:

It was noted that the tagging recovery data contain some errors resulting from the fact that the data were not corrected when the fisheries' seasons were changed for the MP work. As noted in previous meetings, there are other structural problems in the way the model handles the tagging data: (i) reporting rates are assumed known and based on several assumptions that may not hold, (ii) recoveries are lumped over releases. The working group decided to exclude the tagging data from the core set and to conduct a sensitivity MP test including the tagging data. Projections conducted excluding the tagging data in conditioning and including them showed markedly different results, with the core set (no tagging) resulting in more pessimistic projections. This was related to a higher weight given to the low-M scenarios, which had very low likelihood when the tagging data were included. In addition, tagging data leads to higher absolute abundances estimated at the intermediate M level. Further examination of this issue was considered a high priority for the analyses to be tabled at the next meeting. These analyses would need to investigate why the tagging data are so informative about M under the current model structure. Because of the importance of this issue, the working group recommended that errors in the tag recovery data be corrected as soon as possible in order to provide updated data files to use for further analyses. It was anticipated that these data might be made available by the end of September.

More variable selectivity options:

The working group noted that the assumptions about the variability in the LL1 selectivity can impact the estimates of M and the fit to the Indonesian catch-at-age data.

CV of CPUE observations:

The working group suggested that variability around linear relationship between CPUE and predicted abundance could be checked both historically and in projections to evaluate consistency. The projection code will need to output numbers at age 4 and above and age 4 on its own. These will be written into a different data file. The check will be done independently of conditioning/projection code.

Age-dependent M:

To explore different forms of age-dependency in M, the function get_M needs to be modified in the conditioning code. This is a simple modification because the vector of mortalities at age is defined up to the oldest modeled age.

Sample sizes for age- and length-composition data:

As explained earlier, the core set uses the square-rooted weights computed by the panel in July 2004. The working group suggested examining other alternatives for reducing the sample sizes used in the old reference set (other than one fifth the square root), such as:

- old reference set weights (as in the mechanical update, MU) divided by two.
- old reference set weights divided by a factor to match average weights used in core set.

Alternative error structures were also suggested, such as the robust multinomial and a log-normal distribution with variances based on the multinomial assumption and an additive variance term to account for additional process error. In this case sample sizes would be those used in the old reference set and the value of the additive variances could be adjusted for each fishery. The type of likelihood used is hardwired in the code (prop_ltype=0 corresponding to multinomial). There is a version of the conditioning code (Ana Parma) that allows for the lognormal likelihood (prop_ltype = 3). This option requires an additional data file named “var_added.dat”, which contains the value of the additive variance for each of the six fisheries. There was no time during the SAG/SC to examine these options.

Requested changes to projection code and to grid code:

Changes are listed in order of priority in terms of when these changes will be needed. The first two changes are needed for the analyses of the core set. As such, they are needed as soon as possible. The remaining three are needed only to conduct sensitivity tests or to consider further additions to the robustness tests.

(1) output numbers at age 4 and total abundance for age 4 and older.
(2) implement ability to identify grid cell to stratify projections (requires additional structure in the grid-computation code).
(2) allow for ability to change CV used for CPUE projections (likely a command line so that data structure is unchanged).
(3) allow for ability to change sample sizes by constant factor in projections (likely a command line so that data structure is unchanged).
(4) Coding of low-recruitment sensitivity scenario (sensitivity run).

Future releases

Pending programming work involves:

(1) Clean/check code used to do grid computations.
(2) Release core set data files and tagging sensitivity data files and conditioning code.
(3) Implement ability to identify scenarios and release code used to compute grid.
(4) Introduce other code changes specified above.

(5) Release sensitivity tests.

Tasks (1) –(3) will be completed as soon as possible. Time for completion of tasks (3) and (4) will depend on whether Option (A) (two meeting) or Option (B) (three meeting) is adopted. Sensitivity tests would be required at least a month prior to the MP workshop. Under option (B) it would be desirable to have them prior to the mini-meeting but this is not essential.

Discussion of assumptions under MCMC approach:

[this section records discussion prior to decision to adopt the grid approach]

1) Recent recruitment estimates and variability in projections.
    - uncertainty in most recent estimates (2000-2001): addition of process error in selectivities of younger ages, with variances based on residuals for converged cohorts.
    - projections for 2002-2003 and following: two alternative scenarios, one with AC on and the other without AC (noAC). Emphasis in tests will be on robustness. Note that recruitment of 2002 is the first assumed to be correlated with the recruitment on the previous year.
    - impact on tuning: tuning will be done based on the AC scenario and the noAC will be used as a robustness test.

2) CPUE series.
    - Reference set based on conditioning on the median. Conduct robustness test with most pessimistic CPUE series (i.e. B-ratio).

3) Shape of Indonesian selectivity
    - bound the age parameter for the selectivity on a narrower range of ages that is realistic.
    - Check behavior in conditioning by forcing a flat top selectivity.

4) Projected selectivities: Because selectivities at age are passed to the projection code, an approach similar to the one used for the old reference set could be applied. It would be important to check if future and past variability are consistent. The variability in the time series for projected selectivities may need to be larger for younger ages as opposed to age-invariant as it is now.

5) Error structure for simulating future age-length compositions.
    - keep current assumptions.

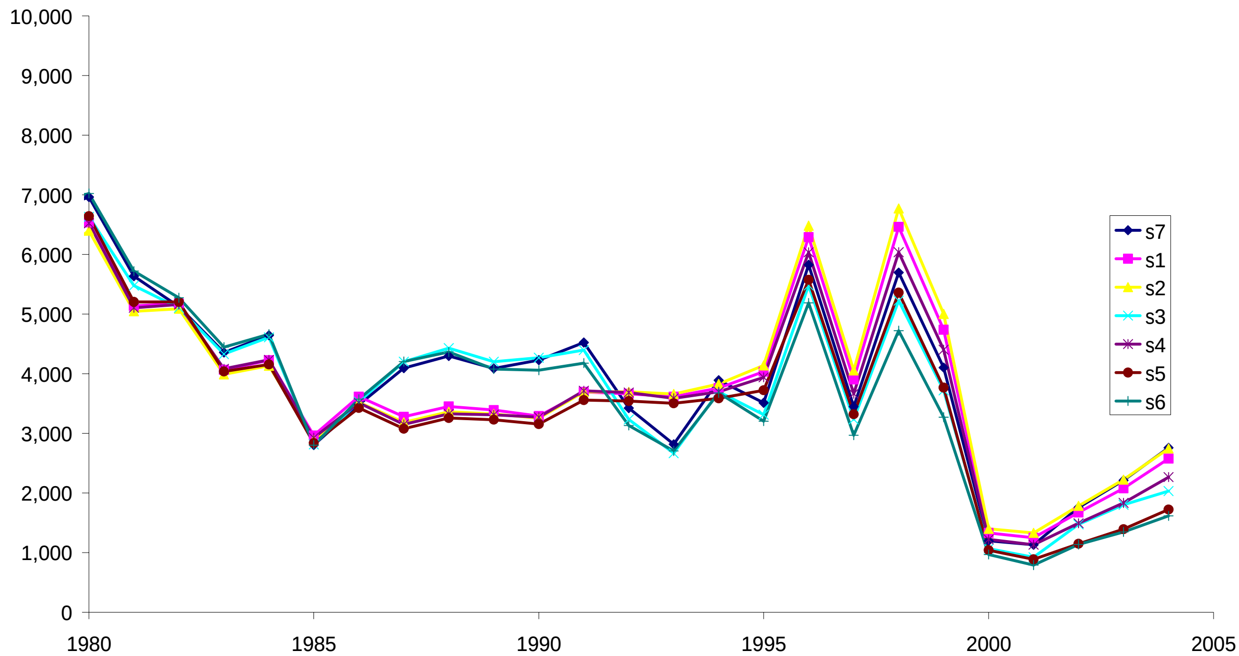

Figure 1. Trajectories of recruitment for a subset of the models.

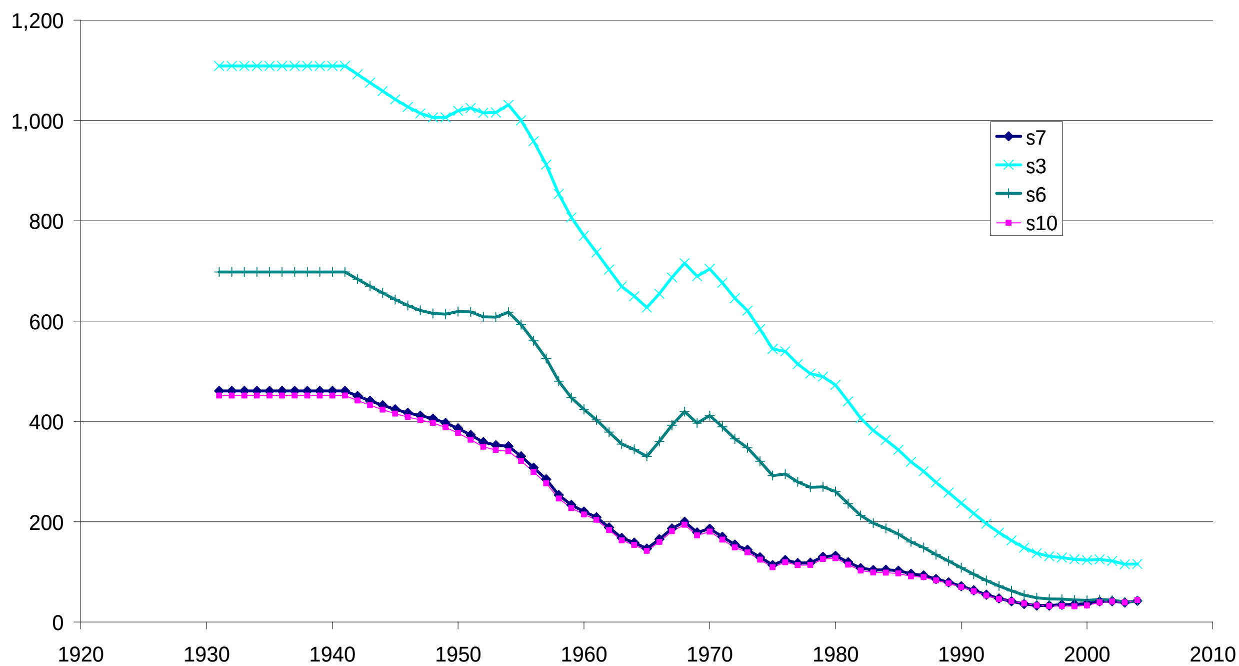

Figure 2. Spawning biomass trajectories for models S7, S3, S6, and S10.

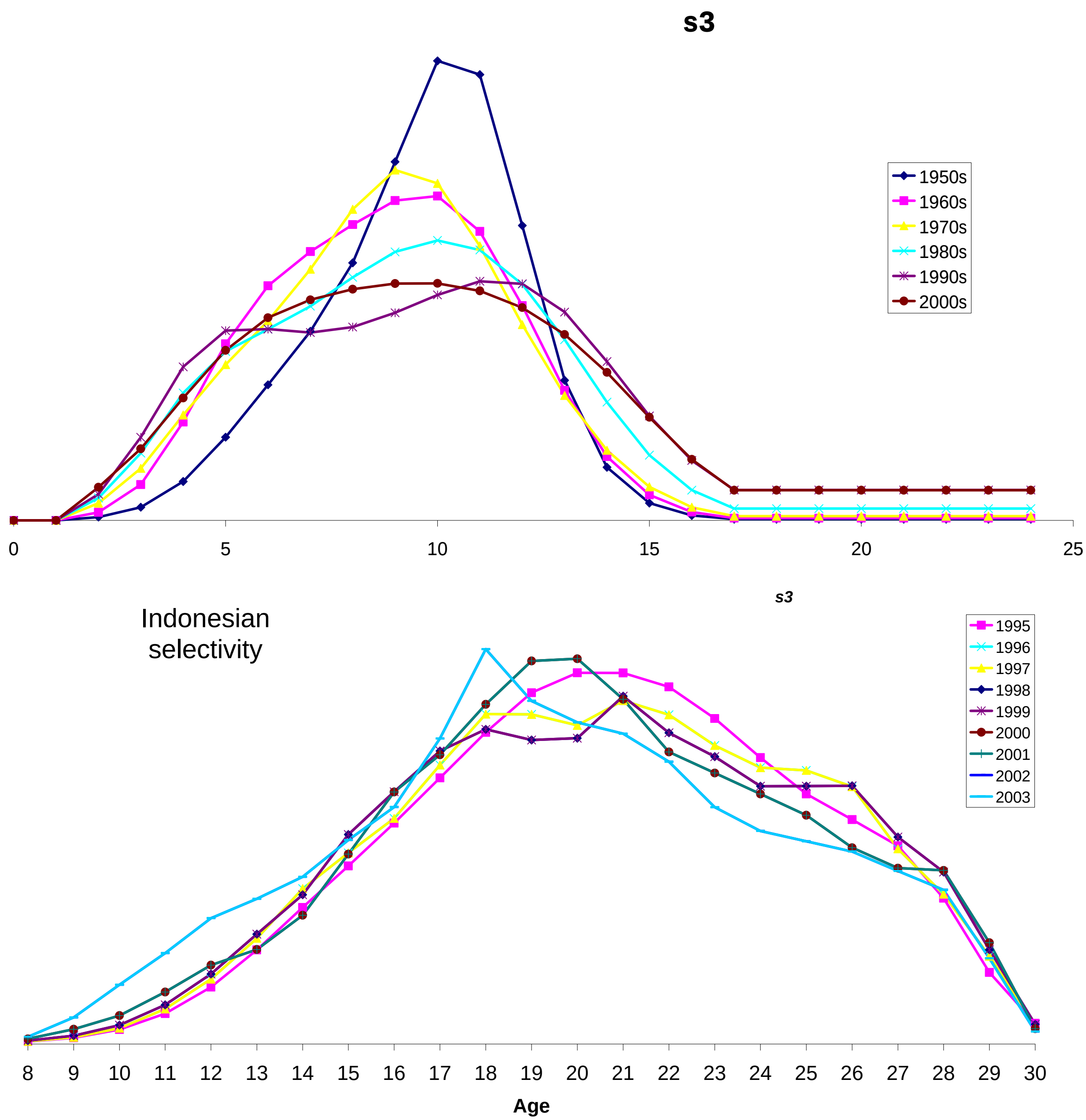

Figure 3. Selectivity for Longline 1 fishery (top panel) and the Indonesian fishery (lower panel) under Model S3.

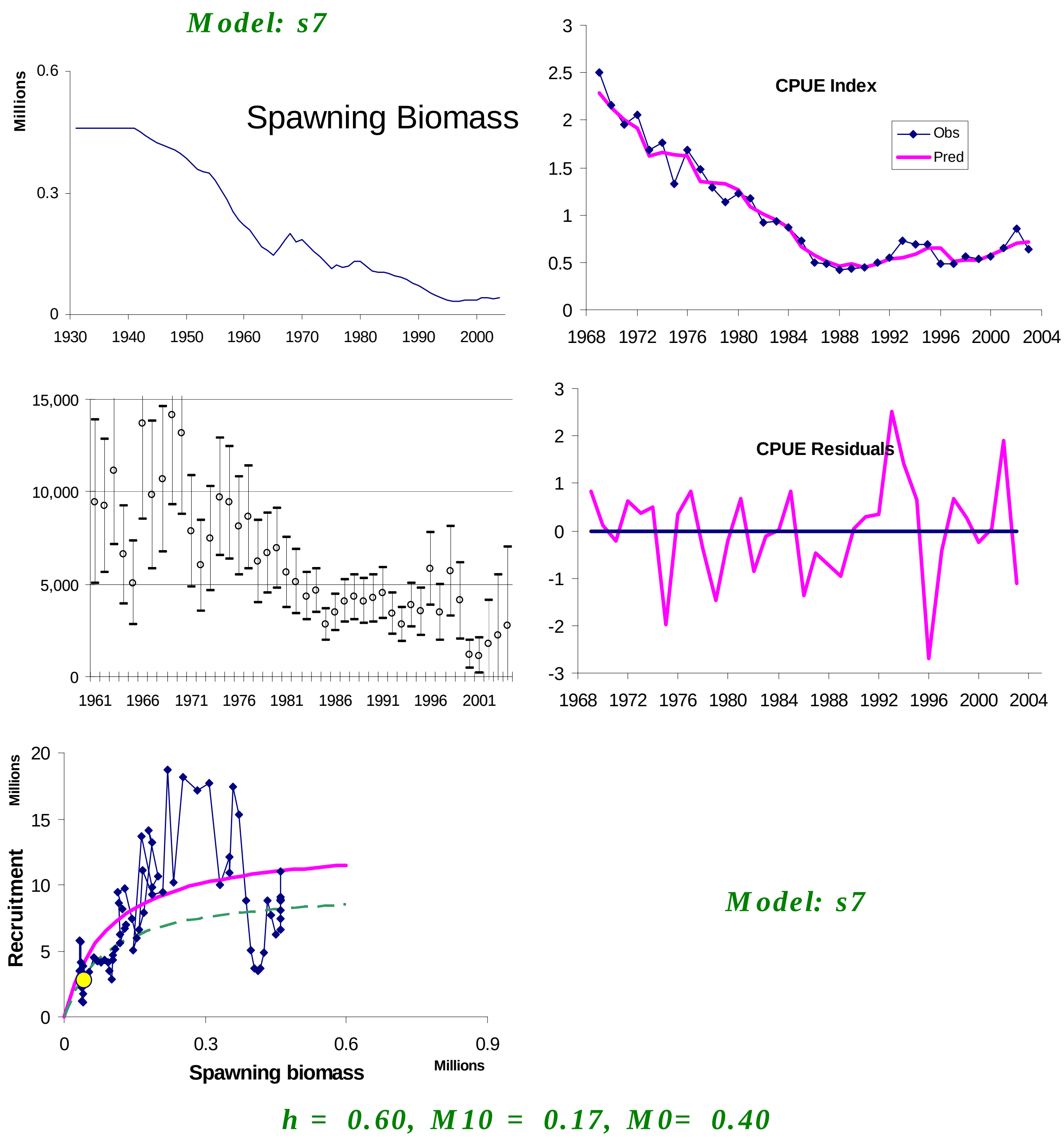

Figure 4. Summary figures for Model S7.

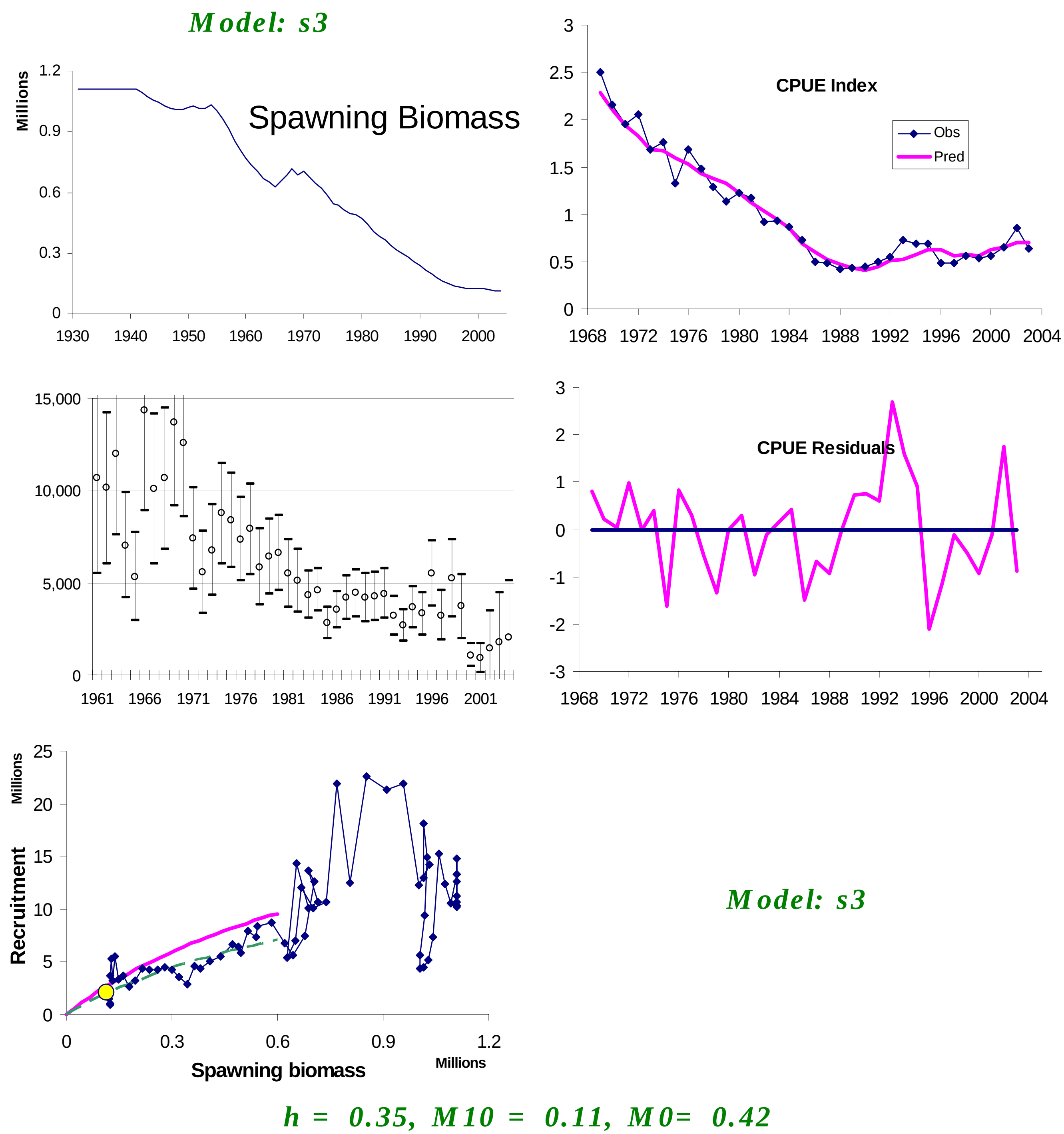

Figure 5. Summary figures for Model S3.

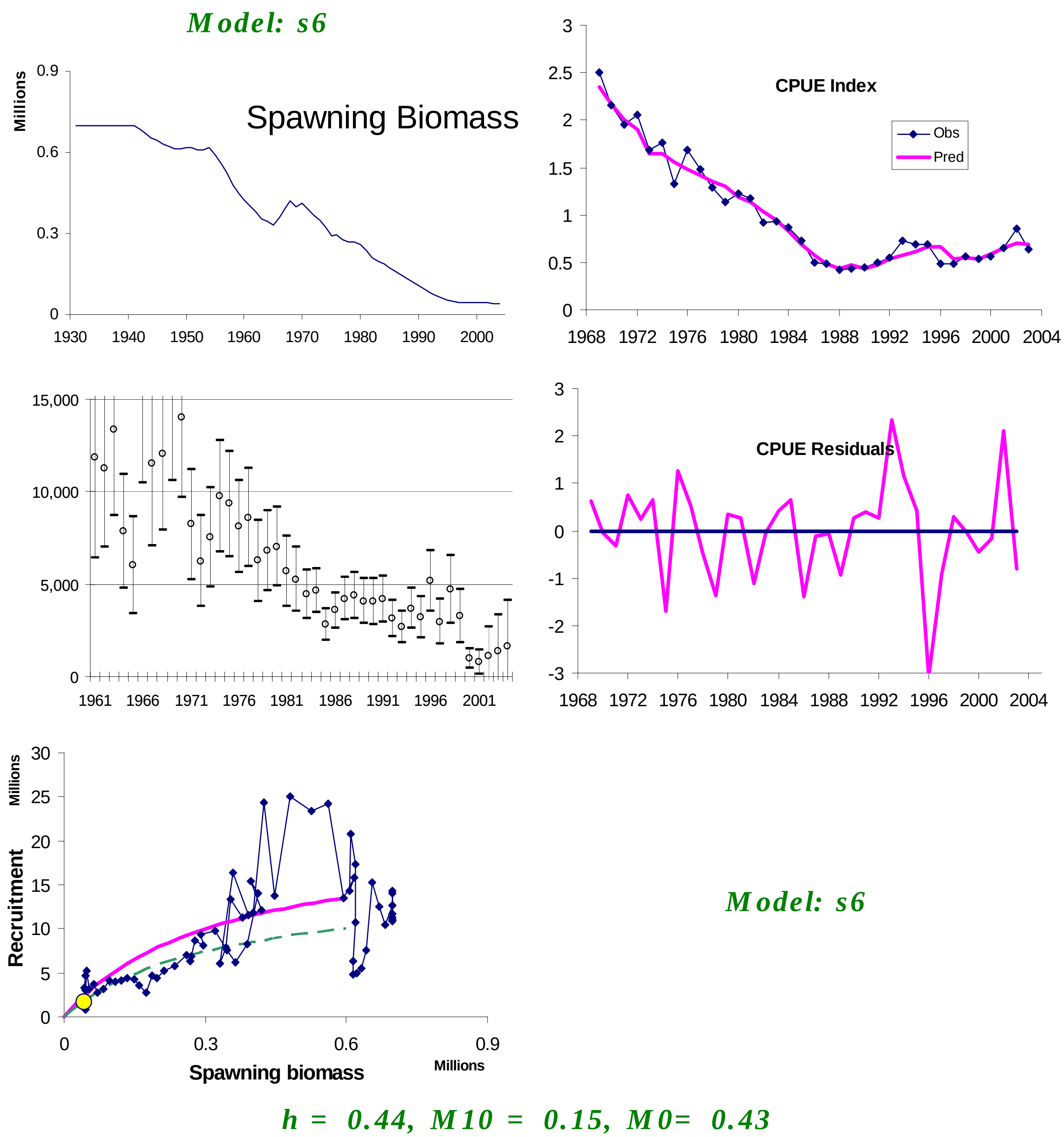

Figure 6. Summary figures for Model S6.

Attachment 6

Alternative timeline options for MP completion

The general approach for completion of MP work will involve the following steps:

1- Specify “core” grid and “sensitivity” trials.
2- Finalization of step 1) is both necessary for further progress, and is unchanged whatever future path forward might be adopted.
3- Use those to start refining the fours MPs, with median recovery tuned to “core”.
4- Eventually, recovery tuning will be based on final “reference” set.
5- The final reference and robustness trials, together with weighting of factors within reference set may change (though hopefully not too greatly) from the “core” and “sensitivity” trials specified in 1). The main factors, identified at this meeting are likely to be the same for the “reference” and “robustness” combination as for the “core” and “sensitivity” combination. Factors may be switched when moving from the “core” & “sensitivity” to the “reference” & “robustness” sets (e.g. a factor in the “sensitivity” trials may be moved to the “reference” rather than “robustness” trial). This may mean that the “reference” set ends up with more factors than the “core” set, which was chosen to be relatively simple for pragmatic reasons. Furthermore, the levels of factors and the grid-related weightings may also be modified.
6- Debate will take place on the extent to which final recommendations by the SC to the Commission regarding adoption of an MP will be based on recovery tuning for the final reference set only, or also recovery performance and some qualitative weighting for robustness trials.
7- In parallel with this process:
    - work on other issues such as meta-rules and implementation considerations.
    - regular interactions will be sought with Commissioners to refine their understanding of and preferences for various performance features shown by candidate MPs.

Option (A): Two-meetings

1) 2004 SAG/SC

   - Finalize specification of core and sensitivity trials.

2) Between meetings:
   - Circulate code for core/sensitivity trials.
   - Further exploration of OM and appropriate weightings (by members). There will not be enough time to evaluate and implement structural changes to the code, therefore exploration of OM should be conducted within the current model structure.
   - Findings will be discussed by email, including convergence problems, potential bugs, etc.
   - Application of MPs to core/sensitivity trials to permit their refinement.

3) 2005 MP workshop:
   - Finalize reference set and robustness trials.
   - Finalize process to integrate final results at SAG to formulate recommendations, subject to final review at the SAG.
   - Review and compare performances of candidate MPs, as refined, in terms of Commission's advice on performance preferences.
4) Between meetings:
   - Circulate code for reference and robustness trials.
   - Further refine MPs on basis of these trials, with recovery tuning to the reference set.

5) 2005 SAG/SC
   - Final review of process to integrate final results from trials.
   - Review and compare performances of candidate MPs, as refined, in terms of Commission's advice on performance preferences.
   - Make recommendations to Commission on which candidate MPs to consider, and provide results across a range of recovery level tunings.

Option (B): Three-meetings

1) 2004 SAG/SC
   - Finalize core and sensitivity trials (specifications).

2) Between meetings:
   - Circulate code for core/sensitivity trials.
   - Further exploration of OM and appropriate weightings (by members). There will not be enough time to evaluate and implement structural changes to the code, therefore exploration of OM should be conducted within the current model structure.
   - Findings will be discussed by email, including convergence problems, potential bugs, etc.
   - Application of MPs to core/sensitivity trials to permit their refinement.

3) 2005 mini-meeting (externals plus limited number of SAG members):
   - Finalize reference and robustness trials.

4) Between meetings:
   - Circulate code for reference/robustness trials.
   - Refine MPs by applying to these trials, with tuning to reference set.
5) 2005 MP workshop:
   - Finalize process to integrate final results at SAG to formulate recommendations.
   - Review and compare performance of candidate MPs, as refined, in terms of Commission's advice on performance preferences.
6) Between meetings:
   - Further refine MPs
7) 2005 SAG/SC:
   - Final review of process to integrate final results from trials.
   - Review and compare performances of candidate MPs, as refined, in terms of Commission's advice on performance preferences.
   - Make recommendations to Commission on which candidate MPs to consider, and provide results across a range of recovery level tunings.

Attachment 7

Evaluation of Fishery Indicators and Analyses for 2005

Agreed indicators for 2003SAG/SC

1. CPUE indices (nominal, i.e. number of fish per 1000 hooks)

Nominal CPUE of the Japanese fishery by year for the months of April – September for areas 4 – 9.

Nominal CPUE of the New Zealand charter and domestic fleets for portions of areas Area 5 and 6 within the EEZ by year for the months of May – June.

2. CPUE by cohort for Japanese longline

Nominal CPUE of the Japanese fishery by year for the months of April – September for areas 4 – 9.

3. Total catch in surface fishery and estimated age composition

Total catch in the Australian surface fishery by fishing year from 1988/89 to the most recent year. [Do we want to include duration of catching period within each fishing year?]

Age frequency histograms from 1994/95 to the most recent year. Age frequency will be derived from cohort slicing of the raised catch at length data based on the length sampling from fish going into farms and video counts of total numbers including fishing or towing mortalities.

4. Total Indonesian catch by month and % of Indonesian LL catch that is SBT

The estimated total catches of SBT by the Indonesian fleet for the period 1992 to the most recent year by financial year/spawning season and calendar year.

[The relative proportions of SBT, BET and YFT in sampling of the Indonesian catch by spawning season.]

5. Indonesian age composition

Proportional age composition of the Indonesia catch by spawning season from cohort slicing of the length data. The period shall be 1992/93 to the most recent year by spawning season/financial year.

6. Estimate of total global catch of SBT

Total weight of catch per year with subdivision by flag for CCSBT members, cooperating non-members and Indonesia.

7. **Acoustic estimates of age 1 off Western Australia**

Index of abundance of age 1 fish estimated from the acouswtic survey.

8. **Aerial spotting data in Great Australian Bight**

Fishery independent surveys

Fishery independent aerial spotting data from line transects in the Great Australian Bight as a fishery independent index of aggregated 2-4 year old abundance. Analysis as in Cowling et al. (2002), with modification if required for calibration.

Cowling, A., Hobday, A. and Gunn, J. 2002. Development of a fishery independent index of abundance for juvenile southern bluefin tuna and improvement of the index through integration of environmental, archival tag and aerial survey data. FRDC Final Report 96/111 and 95/105.

Commercial spotting surveys

Index of abundance for 2-4 year olds based on commercial spotting data of sightings per unit of searching effort.

9. **Tag returns**

Three tables for the CCSBT surface fishery tag/recapture data providing:

- Number of releases by year (for each release age class)
- Number of recaptures (of each release age class) in the first year of release
- Number of recaptures (of each release age class) excluding those recaptured in the year of release

8 tables (one for each reporting rate option) showing the reporting rate for each year for each release age class.

<u>Suggested additional indicators</u>

1. **Length frequency by fleet**

Length frequency of each fleet by year and area. Areas are each of Areas 1 – 10, 11, and total. Also indices in the area north of 35 S. in the Indian Ocean.

2. **Proportion of fish less than 110 and 120 cm by stat area/fleet/time**

Estimates of the percent composition of the catch in two size classes (fork length <110 cm and <120 cm) by fleet, statistical area and year since 1999. Sample size should accompany estimates.

3. **Age composition of catch (otolith aged)**

Specifications to be provided.

4. **Information of fishermen's experience and knowledge**

Assuming that fishermen on board fishing vessels can usually assess changes to stock status from the results of their fishing operations, the following indicators can be used to monitor decreases in abundance – continuous decrease (at least 3 consecutive years) in the number of vessels in the fleet, in the number of months fished per vessel, in the number of sets per vessel, in the average amount of time spent locating fish.

5. **Number of squares fished by fleet, including zero catches**

Total number of squares fished and total number of squares in which SBT were caught in each calendar (or fishing?) year for each fleet (5^ox5^osquares for longline, 1^ox1^o squares for surface fisheries). The entire available time series shall be provided

6. **Indonesian CPUE from observer data**

Nominal CPUE for a subset of the Indonesian Benoa-based longline fleet derived from fishery high school and RIMF observer data.

7. **Growth rates**

Annual time-series of weight at age from representative areas and times. Other possible indicators might be otolith growth increment studies (Australian to add to this if considered worth while) or tagging results.

8. **Price of fish by size class/grade**

It would help interpretation of CPUE and catch size distributions to better understand market values of different sizes of SBT. The essential need would be an annual time series of value (or value differential) by size or relevant size group. The detailed specification would best match any series available from the past.

9. **Weight/length changes over time and area from Japanese fishery**

Changes in the relationship between weight and length can be an indicator of changes in condition. It is suggested that comparison of the length-relationship for each quarter and for areas 4 – 7 (combined), 8 and 9 for each year be calculated from RTMP data and be compared as indicators of SBT condition.

10. **Distribution of juvenile fish around Australia**

This is likely to be more dependent on qualitative records than other indicators but could be useful. Possible sources are discussed in paper 21. Possible form of indicator might be a brief statement from Australia summarising available information.

Suggested analyses

1. **Tagging data and estimates of fishing mortality**

Specifications to be provided.

2. **Standardised CPUE**

Calculation of standardised CPUE indices assuming constant squares and variable squares.

3. **Lorenz curves and GINI coefficients for analysis of distributional data**

Data on the spatial and temporal extent of catch and effort can often provide important information on the exploitable biomass and provide additional information critical for the interpretation of CPUE. Several graphical and statistical approaches have been described within the fisheries literature to summarize spatial and temporal trends in fisheries data, e.g. the Lorenz curve and Gini coefficient. A range of concentration indices should be calculated to summarize longline catch and effort data (5x5 degree by month and year) and data for other fisheries where it is available.

4. **Cluster analysis of major fishing grounds**

The spatial and temporal distribution of catch and effort often changes between years due to changes in fleet behaviour. By analysing the 5 x 5 degree catch and effort data using cluster analysis techniques, the major fishing grounds can be identified and changes in fleet behaviour evaluated to standardise CPUE analyses between years.

5. **Reproductive potential from biological samples**

Mean GSI in the year of first maturity for both sexes.

6. **Catch rate trends by area**

[As per CPUE in earlier indicators for consistency but] divided by fleet by month/quarter by CCSBT Statistical Areas (1-9 or 4-9?)