Annex 4

REPORT OF THE ALBACORE WORKING GROUP WORKSHOP

International Scientific Committee for Tuna and Tuna-like Species
in the North Pacific Ocean

12-19 October 2010
La Jolla, California, USA

1.0 INTRODUCTION

An intercessional workshop of the Albacore Working Group (ALBLWG or WG) of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) was convened at the Southwest Fisheries Science Center in La Jolla, USA, on 12-19 October 2010. The goal of this workshop was to explore and prepare the fisheries data for the upcoming stock assessment of the North Pacific albacore stock (*Thunnus alalunga*) in March 2011. Specific objectives of the workshop included: (1) complete fishery definition work begun at the April 2009 workshop; (2) review input data series (catch, size composition, CPUE) for consistency with the new fishery definitions and conflicts in primary data sources; (3) discuss model parameterization for the SS3 (and VPA-2Box); (4) conduct exploratory runs of the SS3 model to assess the impact and develop solutions to parameterization issues; and (5) determine how the VPA model will be used at the assessment workshop. In addition, matters related to the future work plan for the working group and the necessity of preparing for independent peer-review of the upcoming assessment were included on the agenda for this workshop.

Ms. Kristen Koch, Deputy Science Director, Southwest Fisheries Science Center, welcomed participants to the Southwest Center and La Jolla and wished the participants a productive meeting. John Holmes, Chair of the ALBWG, welcomed 17 participants from Chinese Taipei, the Inter-American Tropical Tuna Commission, Japan, and the United States of America (USA) to the workshop (Appendix 1) and provided opening remarks outlining workshop objectives, the agenda, and a schedule for the following seven days.

2.0 DISTRIBUTION OF DOCUMENTS AND NUMBERING OF WORKING PAPERS

Eleven working papers were submitted and assigned numbers for the workshop (Appendix 2). Working paper authors were asked by the Chair if they wished to make the full paper publicly available through the ISC website. Some authors agreed to make their papers available, other authors require additional time for approval from their agency/institution. In the interim, contact details of these authors will be provided on the ISC website.

3.0 REVIEW AND APPROVAL OF AGENDA

A provisional agenda was circulated prior to the meeting and was revised by the Chair based on email discussion among the WG. Participants at the meeting adopted this revised agenda (Appendix 3), noting that discussion on some agenda items would occur over several days.

Several agenda topics were combined during WG discussions and are reported here as combined sections of the report rather than as separate items as on the approved agenda. Agenda item 10 (Review of fishery indicators) was discussed and combined with item 9 (Final evaluation of fishery definitions). Similarly, sensitivity analyses (Agenda item 14) were outlined by the WG during discussion on reference case assumptions and their rationale (Agenda item 11). Lastly, Other modeling scenarios (Agenda 13) were introduced and discussed throughout the reference case (Agenda 11) and Exploratory model run (Agenda 12) discussions.

4.0 APPOINTMENT OF RAPPORTEURS

Rapporteuring duties were assigned to Chiee-Young Chen, John Holmes, Momoko Ichinokawa, Hidetada Kiyofuji, Suzy Kohin, Hui-hua Lee, Takayuki Matsumoto, Sarah Shoffler, Yukio Takeuchi, Steven Teo, Koji Uosaki, and Vidar Wespestad. Holmes had the overall responsibility for assembling the workshop report.

5.0 FUTURE CONSIDERATIONS

5.1 Interim Reference Point (IRP)

The Northern Committee (NC) of the Western and Central Pacific Fisheries Commission (WCPFC) re-affirmed at its sixth regular session in September 2010 (NC6) that it will continue to use the interim management objective for north Pacific albacore. The interim management objective for North Pacific albacore is to maintain the spawning stock biomass (SSB) above the average level of its 10 historically lowest points (ATHL). The fishing mortality rate that would likely cause SSB to fall below this level with a probability greater than 50% is referred to as the interim reference point (IRP).

The ALBWG noted that for the next stock assessment it will be necessary to compare current SSB against the SSB-ATHL threshold level and estimate $F_{SSB\text{-}ATHL}$ (50%) when assessing stock status. The WG briefly discussed other reference points, particularly for presenting F relative to MSY-based reference points, but there was no consensus on how or what to choose.

5.2 Independent Peer-review of Stock Assessments

The ALBWG Chair introduced the topic of peer-review. Independent peer-review of stock assessments is a recommendation of the Kobe II process and has been taken up by both the Inter-American Tropical Tuna Commission (IATTC) and the WCPFC. The ISC is exploring ways to initiate a peer review process for its assessments, but no conclusions have been reached at present. A proposal for peer-review of ISC stock assessments (WCPFC-NC6-WP-07), beginning with the upcoming north Pacific albacore assessment, was discussed at the NC6 meeting. Although this proposal was rejected by NC6, it is clear that north Pacific albacore likely will be the test case for peer-review as it is the next assessment on the schedule. It was clarified that the process to be used for peer-review has not been determined at present and that a peer-review would occur after the assessment is approved by the ISC in July 2011, i.e., it will not occur between March 2011 and July 2011 when the WG is in the midst of the assessment. Nonetheless, the WG should be prepared to respond to any concerns and suggestions based on a peer review. The Chair would like the assessment document produced by the WG to be as comprehensive as possible in order to address questions concerning assumptions, methodologies and sensitivities in advance of the review. The Chair noted that the agenda for this workshop was designed in part to address these needs since the workshop reports used by ISC WGs are generally weak on these points. To that end, the WG will begin at this meeting to draft a skeleton assessment document, and input and output files for at least the base-case runs may need to be included as appendices.

5.3 Timing of Future Assessments

The WG Chair noted that 5 years will have elapsed between the last assessment in 2006 and the next assessment in 2011. The ISC has recommended a 3-yr interval between assessments and NC6 also recommended no longer than 3 years between assessments. The WG discussed these recommendations and generally agreed that a 3-yr interval between assessments is desirable and tractable for albacore and recommends 2014 as the target date for the next assessment cycle following the 2011 assessment. Some careful coordination of workloads with the other ISC WGs (PBFWG, BILLWG, Shark WG) will be necessary because many scientists on the ALBWG are members of other ISC WGs as well.

6.0 VPA AND SS3 COMPARISON RUNS

The WG discussed (below) the plan to conduct both the VPA and SS3 runs at the March 2011 meeting. There was a lengthy debate about the purpose of the updated VPA run. If the objective is to see how closely the results of the VPA track the results of SS3, then the WG would want to reconfigure the VPA input files to match more closely the SS3 fishery definitions and other input data. If the objective is to compare the new SS3 model run with the previous assessment as it was conducted in 2006, then the VPA input files would remain essentially unchanged from 2006 with the exception that the data from 2006-2009 would be added and slightly revised CPUE indices would be used. The WG felt that both objectives were valuable, but recognized that SS3 and VPA runs are never going to provide identical results given the differences in the models. In addition, given the need to focus on the SS3 model and the additional work that would be required to prepare entirely new VPA input files as opposed to just updating the recent years, the WG agreed that the VPA results using the same configuration as in 2006 would be the basis for comparison. The WG will use the updated VPA run internally as a tool to investigate and understand differences between the SS3 and VPA runs. The WG will include the results of the VPA update run in the assessment report, but will not present the VPA as an alternative assessment for management purposes. SS3 will be the only assessment considered for developing stock status and conservation advice for management purposes.

The most recent updated catch-at-age and CPUE data prepared for the VPA were compared with the 2006 assessment and the data for SS3 by Takayuki Matsumoto (ISC/10/ALBWG-3/11). Current catch-at-age and CPUE data for the VPA model were compared with data from the last (2006) assessment and current catch data for SS3 to check for errors occurring during the creation of these datasets and to identify differences which could affect analytical results. Some differences between the current and last catch-at-age datasets are due to errors in compiling the data. Some differences were also found between the current and age-aggregated CPUE data used in the VPA model. Slight differences in catch were observed between the catch-at-age data prepared for the VPA and SS3 models. The cause of these differences will be investigated.

Discussion

It was clarified that the VPA used different fishery definitions from those devised for SS3, particularly for the JPN LL fisheries and that this VPA run was conducted using data summarized as of 08 October 2010. These data underwent two revisions since they were first distributed to WG members in September. There was some discussion of the difference in catch between the VPA and SS3, with the VPA numbers usually larger. However, the reason(s) for this difference are not clear, although the author is investigating the issue. One hypothesis raised by the WG is that the standardization procedure may be the cause. The peak in the standardized CPUE of the JPN PL occurs around 1999 in the 2006 VPA. Comparing the standardized and nominal CPUEs might tell us if standardization is the cause. If there is no peak in the nominal CPUE around 1999, then standardization may be a causal factor.

The WG also discussed the use of the TKO LL fishery (Taiwan, Korea and Others) in the VPA. Some of the difference in total catch between the VPA and SS3 may be explained by the use of TKO in the VPA and separate TWN LL and KO LL in SS3. The author will address and try to resolve this issue in time for the stock assessment workshop in March 2011.

A preliminary population analysis using VPA2BOX and PRO2BOX for the North Pacific albacore was presented by Hidetada Kiyofuji (ISC/10/ALBWG-3/10). The VPA-2BOX model is a backward-estimation method using catch-at-age data and ancillary information (e.g., indices of relative abundance) and was used to conduct the previous assessment in 2006. The objectives of this exploratory work were (1) to conduct VPA analysis using input datasets updated with three additional years of data, (2) to confirm the configuration of future projection scenarios, and (3) to discuss and determine the configuration of future projection scenarios for SS3. Substantial changes were made to both the catch-at-age (CAA) matrix and indices of relative abundance to update them from the 2006 assessment and considerable sensitivity analysis (model comparison) was conducted in a hierarchical fashion using different model scenarios based on combinations of past and current (updated) datasets. These model configurations ranged from a scenario (D1rev) using the same catch-at-age (CAA), weight-at-age (WAA), index data (1966-2005), and parameterization as the 2006 assessment model to a scenario (G1) using CAA and abundances indices updated to 2008 that most closely resemble the parameterization of exploratory SS3 runs conducted by the ALBWG. When an updated CAA matrix to 2008 was used, SSB for recent years became higher and current F became lower and when a longer time series of abundance indices was used, the SSB for recent years became higher and current F became lower. Similarly, when abundance indices from the TWN LL and USA LL fisheries were removed from the analysis, the SSB for recent years became higher and current F became lower. The authors recommend that (1) VPA should be prepared and conducted as alternative assessment model for the next stock assessment, (2) that VPA Model Scenario should also be discussed, and (3) that the configuration of the future projection should be discussed as well as SS3.

The WG noted that this working paper summarizes effects using updated CAA data (3-yr) and modeling scenarios similar to those envisioned for SS3 on VPA output. The WG agreed that it will use the updated VPA run to examine parameterization issues in SS3 during the transition to the SS3 model. The WG discussed the VPA model several times during the workshop in the context of addressing SS3 parameterization issues and the outcomes of these discussions are recorded in Section 12 of this report. The goal of these comparison runs is to determine if the WG can satisfactorily justify and explain differences in output observed between similarly configured models. If the answer is yes, then there will be no further work on the VPA model.

7.0 SUMMARY OF THE APRIL AND JULY 2010 WORKSHOPS

The WG Chair provided a brief summary of the two previous meetings of the WG in 2010. The primary focus of the 20-26 April 2010 meeting in Shimizu, Japan, was on the spatial/temporal definitions of fisheries for length-based modeling (i.e., ensuring constant length selectivity), assessing abundance indices and size composition data for these fisheries, developing indices of SSB abundance to monitor stock status between full assessments, and work planning and assignments for the next stock assessment. The WG was also tasked by the ISC Chair with developing and providing information on potential biological reference points for North Pacific albacore in response to a request from NC5. The WG next met on 12-13 July 2010 in Victoria, Canada, in advance of ISC 10. This meeting focused on updating fishery statistics, completing the fishery definition work, providing a qualitative update on stock status using the SSB index, and planning for the next stock assessment.

8.0 COMPLETION OF FISHERY DEFINITION ASSIGNMENTS

At the July 2010 ALBWG meeting 12 distinct fisheries were defined as input to the model. At the present meeting these definitions were reviewed and the fisheries identified were subject to further scrutiny to examine the input data to ensure data completeness and to make appropriate modifications to increase the usefulness of available data series.

8.1 Chinese Taipei (TWN) Longline

Chiee-Young Chen presented working paper ISC/10/ALBWG-3/08 on "Standardized CPUE and catch-at-age time series of North Pacific albacore exploited by Taiwanese longline fisheries, 1995-2008". Working paper ISC/10/ALBWG-2/07 (Chen et al. 2010) was presented at the July 2010 meeting and during discussion the WG requested clarification of the CPUE standardization procedure. The present study was conducted to elucidate the CPUE and catch-at-age times series of north Pacific albacore exploited by Taiwanese longline fisheries between 1995 and 2008. Clustering analysis of catch composition data clearly defined nominal catch statistics into two groups. Group 1 is defined as albacore-targeting sets with much higher albacore CPUE, while Group 2 consists of non-albacore-targeting sets. These groups were confirmed by discriminant analysis, including operating area, month, and number of hooks per basket as discriminant variables, with only a 3% error count. Group 1 data were used to estimate standardized CPUE with GLM and year, season, and area as the main explanatory variables (Watanabe et al. 2006) plus interaction terms. A knife-edge-cutting method was also applied to the TWN LL albacore length data to estimate the catch-at-age times series based on Suda's (1966) growth equation.

<u>Discussion</u>

It was clarified that most albacore targeting by the TWN LL fleet occurs in the northern end of the range fished by this fleet. In the south, the fleet is fishing deeper and targeting other species such as bigeye tuna, and few large albacore are taken. Most of the albacore catch is taken in the target fishery, but length data from both the target and non-target fisheries operating north of 10 °N were utilized to construct the catch-at-age matrix for the TWN LL catch from 1995 to 2008.

The Working Group agreed to separate the TWN LL catch from the Taiwan, Korea and Other LL combined (TKO) fishery, establishing the TWN LL and KO LL as separate fisheries in the assessment model. The WG also agreed to estimate the average catch-at-age in the TWN LL fishery for 1996-1998 (the period with adequate length frequency data) and apply this average to the 1966-1995 and 1999-2002 periods for the VPA.

There was considerable discussion concerning the standardization procedure for the TWN LL fishery. This fishery is not large in terms of catch, but it covers a large area so the number of empty year-quarter strata is quite large and may influence the standardization of CPUE with GLM. The WG requested further analysis in which catch is pooled into larger time-area strata than originally used in the working paper (ISC/10/ALBWG-3/08). Originally 14 areas in the north Pacific defined by Watanabe et al. (2006) were used in this analysis but in the revised analysis the number of areas was reduced to the 4 areas currently used for the JPN LL and then to 3 areas as not many TWN LL vessels operate near Japan. In addition, the effect of substituting mean values for empty strata was examined. The revised analysis was based on three case studies: (1) 4 seasons, 3 subareas, substitution in empty strata, (2) 3 seasons, 3 subareas, substitution in empty strata, and (3) 4 seasons, 3 subareas, no substitution. All of the models were significant, but the standardized CPUE pattern for Case 3 was closest to the nominal Group 1 CPUE pattern. The WG accepted Case 3 as the most appropriate approach to use with GLM standardization of TWN LL CPUE data. Working paper ISC/10/ALBWG-3/08 was revised at the workshop to reflect the new analysis reviewed above.

Quarterly size data input for SS3 during the early period of the TWN LL fishery have many quarters with very small sample sizes that are inadequate for length composition estimation. A number of scenarios were proposed, however, further work is needed to compare the TWN LL size data from 1996-1998 with both the US LL and JPN PL size data before the WG can decide on the appropriate use of these size data.

8.2 Japan Longline Fisheries

At the July 2010 meeting, the WG noted that there was a steep decline in the JPN LL F1 (smaller averaged-size fish) abundance index at the beginning of the time series, 1966-1971, and requested further investigation into the cause of the decline and how to deal with this issue. Two working papers were presented at this workshop (ISC/10/ALBWG-3/04, ISC/10/ALBWG-3/05) addressing issues with regard to Japanese longline CPUE standardization and how to deal with 1960s CPUE data that may be biased by changes unrelated to the status of the albacore stock.

Takayuki Matsumoto discussed "Suggestion about how to deal with albacore CPUE by Japanese longline during 1960s in the northwest area" (ISC/10/ALBWG/05). Albacore CPUE by the Japanese longline fishery in the northwest Pacific Ocean was re-examined to determine if the sharp decrease during late 1960s reflects a change in stock status. Examination of catch and effort data did not reveal substantial spatial or temporal changes in the operation of the longline fishery that could affect albacore CPUE. However, a change in targeting from albacore to bigeye tuna probably occurred around the mid- to late 1960s. This hypothesis is supported by socio-economic information including an increase in vessel size, decrease in fishing effort and albacore catch in the northwest Pacific, increase in fishing effort in other areas, and a decrease in the price of albacore below the price of bigeye tuna. Based on this evidence, it is likely that the decrease in albacore CPUE during late 1960s reflects not only a decline in albacore abundance, but also a change in targeting unrelated to changes in the albacore stock. The author recommends eliminating the albacore CPUE in the northwest Pacific during late 1960s from the CPUE standardization procedure.

Discussion

Examination of the albacore catch, effort and market data by Japanese scientists led to the conclusion that the decline in CPUE between 1966 and 1971-1972 was global in scope for JPN albacore LL fisheries and was due to changes in vessel size (to larger vessels which permitted vessels to travel much further offshore), improved freezer technology in vessels (which permitted vessels to fish for longer periods of time between port landings) and species switching so there is a need to consider how the 1966-72 data should be treated. The WG considered several options including omitting the first 6 years (1966-1972) of CPUE, using the whole time series, but establishing a block and modeling the CPUE with random walk or linear increase (estimate different q), keeping the whole time series (status quo), and conducting separate CPUE standardizations on the 1966-1972 and 1972-2009 periods. The WG agreed to the option to omit the first 6 years as a default for both SS3 and the VPA. The other options will be used as sensitivity analyses.

Abundance indices of north Pacific albacore by Japanese longline for SS3 and VPA analyses (ISC/10/ALBWG-3/04), also presented by Takayuki Matsumoto, updates analysis of JPN LL abundance indices and incorporates additional interaction terms and change of areas. CPUE standardization for Japanese longline fisheries were conducted based on current fishery definitions for SS3 analyses decided at the April and July 2010 meetings of the ALBWG. Several interactions were incorporated in the standardization of F1 (northwest Qt1-2). As for F2 (northwest Qt3-4 and southwest all season), interactions could not be employed, and as an alternative, an index of month-area combined was used. CPUE trends for both fisheries were similar except for early period (1960s), when CPUE for F1 declined sharply. A provisional CPUE for the VPA was also estimated by a weighted mean of the two CPUEs for SS3. This CPUE was similar in trends to that for F2 in the SS3 model.

Discussion

The analysis in this working paper examined various area/time block combinations for computing CPUE indices and produced two CPUE trends for the area/time blocks. The WG noted that residual patterns in the F1 fishery in the 1960s have a different pattern than observed from around 1970 onwards. The WG considered the differences in residual patterns as additional supporting evidence for the separation of the time series. After review and considerable discussion on the options, the WG recommended using a weighted average of the two CPUE trends for VPA, but suggested consideration of two different weighting options: area weighting and catch weighting. The WG asked the author to examine the effects of both weighting options on the CPUE index. The WG also considered the additional option of using two separate indices in VPA, obtaining partial catch-at-age data from SS3. Following the discussion of ISC/10/ALBWG-3/05, the WG concluded that the CPUE data should be divided into two separate blocks, 1966-1971, and 1972-2009, and standardized separately for the SS3 model. The dividing year (1972) was chosen based on the fact that the steep decline in catch and effort was over. The author presented revised CPUE time series for 1967-1972 and 1972-2009 at the workshop.

8.3 Japan Pole and Line Fisheries

The WG requested some clarifications of the CPUE standardization used for the JPN PL fisheries at the July 2010 meeting. Hidetada Kiyofuji presented "Revision of standardized CPUE for albacore caught by the Japanese pole and line fisheries in the northwestern North Pacific" (ISC/10/ALBWG-3/07) which provides these clarifications. Catch-per-unit-effort (CPUE) standardization for albacore caught by the Japanese pole and line fishery were revised accordingly from the last ISC ALBWG meeting in July 2010. The main changes from the last meeting were: (1) the temporal effect was changed from quarter to month, (2) model configuration (using a delta-lognormal rather than lognormal model due to high zero catch rates) and selection procedures (based on the results of a reduction of parameters and interaction terms from the full model and Bayesian information criterion, BIC), and (3) calculation of standard error for SS3. Area-weighted standardized CPUE indices were estimated for the PL fisheries. The authors recommend that: (1) CPUE indices for North Pacific albacore caught by Japanese pole and line fisheries should be estimated with a delta-lognormal model rather than a log-normal model due to high percentage of zero-catches in PL2 and PL3; and that (2) standardization of CPUE in PL3 should be conducted separately for the 1972-1984 and 1985-2009 periods.

Discussion

This working paper presented two time series for the JPN PL fisheries based on new fishery definitions produced previously by the WG. The time series for JPN PL LF (larger average-size fish includes 3 area/month blocks, and JPN PL SF (smaller average-size fish) with 4 area/month blocks. JPN PL LF data primarily comes from months 5-7 and other months have many zero catch values. JPN PL SF has a slightly different distribution of catch, with months 5-7 the predominant non-zero catch period in 1972-84, and months 6,7,8 the predominant non-zero catch period in 1985-2009. The reanalysis of the CPUE and length frequency data provided three standardized catch series to utilize in modeling: a single 1972 to 2009 time block for JPN PL LF and 1972 to 1984 and 1985-2009 for JPN PL SF. The WG accepted the reanalysis of these data and clarification of the data series and recommended their inclusion in the upcoming assessment.

8.4 Japan Gillnet Fishery

The WG noted in the April and July 2010 meetings that there were limited size data for the JPN GN fishery, but that the available data indicated that it captured small average-size fish. Based on this observation, the WG considered examining the effect of substituting JPN PL SF size composition data through sensitivity runs. This work was not undertaken for the present meeting due to time constraints. However, the WG determined that the length composition data available from gillnets suggest that JPN PL SF length composition data are similar and can be used to develop age composition for JPN GN catches. In SS3 runs it was recommended that JPN PL SF selectivity be used for the JPN GN catch data. For the VPA run, age proportions from the JPN PL SF fishery will be used as in the base case for the 2006 assessment.

8.5 USA/Canada Troll Fishery
Steve Teo presented "Joint standardized abundance index of US and Canada albacore troll fisheries in the North Pacific" (ISC/10/ALBWG-3/01) The US and Canadian troll fisheries operate in similar ways, have overlapping fishing areas and report similar size compositions in their catches. Previous stock assessments have only used data from the US fishery to derive a standardized abundance index but the ALBWG suggested developing a joint US/Canada index for the upcoming assessment. A joint US/Canada index was developed and compared with US-only and Canada-only indices. The main sources of data used in this paper were catch-effort information from logbooks of the US (1966-2008) and Canadian troll fisheries (1995-2008). Both US and Canadian logbook catch and effort data were aggregated into 1° x 1° spatial blocks by month. A lognormal generalized linear model was used to standardize CPUE and 1000 bootstrap runs were used to estimate confidence intervals. The joint US-Canada standardized abundance index was comparable to the US-only and Canada-only indices for their respective periods. Based on the results of this study, the authors recommend that the ALBWG use the merged US-Canada abundance index in the upcoming stock assessment model.

Discussion
The WG noted that in general the data were similar and could be combined. There was some discussion of different data cell configurations and impacts on results. The analyst agreed that there was a need for additional examination of data weightings, but these were felt to be minor and would be addressed prior to the assessment.

8.6 Fitting the SS3 Model to Biological and CPUE Data
Hui-hua Lee presented working paper ISC/10/ALBWG-3/03, "Estimating input sample size for length-frequency data in Stock Synthesis: US longline and US troll fisheries". In commercial fisheries, the sample of fish of a particular species measured is usually not a random sample of individual fish from the entire population but a sample of n clusters (trips or sets). Fish caught together in cluster designs tend to have more similar characteristics, such as length or age, than those in the entire population. Therefore, samples collected by cluster sampling will have less information about population length distribution than samples from random sampling design. One way to measure the information contained in a sample of length measurements is to estimate the number of fish that one would need to sample at random to obtain the same information on length contained in the cluster samples. By comparing the variance of the estimator for cluster sampling with the variance of the same estimator from simple random sampling, the actual sample size being measured by the cluster design can be adjusted to derive the input sample size. The results of this comparison show that the variance of the population mean length from cluster sampling is larger than the variance of the same estimator when simple random sampling is used, implying that the estimates of the length distribution from cluster sampling were less precise.

Discussion
There was considerable discussion on this topic and its application to other fisheries. The WG felt that a similar method could be applied to JPN LL and PL fisheries, but the difference in scale of these fisheries required a separate analysis to determine the appropriate effective sample size. The WG agreed that the method presented in the working paper will be used to calculate the input effective sample size of the US/Can troll and USA LL fisheries. Since the WG was concerned that the analysis did not consider differences in sample size among quarter, it

recommended further investigation into reweighting the effective sample size outside of the model to reflect the quarterly differences in sample size. Getting the input sample size is important because it acts as a weighting factor for size composition data, with a higher input sample size reflecting stronger influence and tighter model fit to those data, i.e., greater confidence in the representativeness of the size composition data.

9.0 FINAL EVALUATION OF THE CURRENT GROUPING OF FLEETS WITHIN FISHERIES

The objective of this agenda item was to consider whether the new fishery definitions make sense in light of catch and size data for the fleets. The WG specifically looked for conflicting trends in these data sources.

Steve Teo presented ISC/10/ALBWG-3/02 on "Time series associated with albacore fisheries based in the Northeast Pacific Ocean". Time series of catch, size composition, and relative abundance are important inputs into the stock assessments of North Pacific albacore. This paper describes the data sources and methods used to develop these time series from albacore fisheries based in the Northeast Pacific Ocean. Time series were developed for both the length-based SS3 and VPA models. For the SS3 model, time series were developed for: 1) catch in numbers of fish for the US/Canada troll, US longline, and EPO miscellaneous fisheries; 2) size compositions for the US troll, and longline fisheries; and 3) standardized abundance indices for the US/Canada troll and US longline fisheries. For the VPA, time series were developed for: 1) catch-at-age in numbers of fish for the EPO surface and US longline fisheries; and 2) standardized abundance indices for the US/Canada troll and US longline fisheries. Three main sources of data were used to develop the time series: 1) albacore landings in metric tons from fisheries based in the Northeast Pacific (1966-2008); 2) logbook data from the U.S. troll (1966-2008), Canadian troll (1995-2009), and longline (1991-2008) fisheries; and 3) albacore size data (fork length in cm) from the U.S. troll (1966-2008) and longline (1994-2008) fisheries.

Discussion

A question was asked about the potential influence of inshore-offshore differences on CPUE. Plots of nominal inshore and offshore CPUEs were prepared and shown at the workshop. The WG recommended further analysis of the potential differences in CPUEs in the future after the upcoming stock assessment. It was noted that the GLM standardization procedure used for the US/Can troll CPUE, which lacks an area-quarter interaction term, was the same as used for the last stock assessment.

The WG had a lengthy discussion concerning the USA LL data. The size composition residuals show a change in pattern (the absence of small fish) from 2000 to 2004, which corresponds to regulatory changes affecting the shallow-set swordfish fishery. The swordfish fishery catches smaller average-size albacore as bycatch than the deep-set bigeye fishery. A recommendation was made to drop this abundance index from the model since the catch in this fishery is very small relative to other fisheries and it may reflect localized Hawaiin phenomena rather than population trends, but use it as sensitivity run. After much debate, the WG decided that this index should be retained in the model because it catches the largest sized fish of all fisheries

(100-120 cm compared to 100-110 cm from the JPN LL LF) and it is one of the only remaining LL fisheries operating in the EPO.

Additional discussion focused on the fact that the USA LL CPUE is clearly affected by regulatory changes affecting the swordfish fishery after 2001. Two options were identified to address this issue: (1) leave the index as currently constructed, or (2) block out the pre- and post-2001 periods. After examining model fits to other indices from several SS3 model runs, the WG decided to use the blocking option.

Takayuki Matsumoto presented "Methods for creating data for VPA and SS3 analyses for Japanese albacore fisheries" (ISC10/ALBWG-3/06), which describes the methods used to prepare input data from Japanese longline and pole and line fisheries. CPUE standardization is presented in a separate working paper (ISC/10/ALBWG-3/04). Input data matrices for catch (annual and quarterly), size (catch-at-size or length frequency of measured fish) and catch-at-age for each fishery were created. Annual and quarterly catches were calculated from logbook data and/or catch statistics. When logbook data (spatial information) were not available for a fishery or some period within a fishery, then quarterly catch and size compositions of the catch were assumed to be the same as that of another year/fishery. Catch-at-size/age was calculated by substituting size data from another time/area stratum, or data for different period or fishery were used when size data sample was not sufficiently large. Ages for calculating catch-at-age matrices were assigned based on visual slicing of length frequency histograms or by fitting a normal mixture distribution to the mode of normal distributions following the growth equation. Both length frequency of measured fish and catch-at-size were created for size data of longline and pole-and-line fisheries for SS3, and some differences were seen between the two.

Discussion

The WG noted that there may be potential problem of heterogeneous sampling within strata (area/quarter) in the aggregation of Japanese sample data for SS3 (not catch at length). The WG agreed that size frequency data will be recalculated for SS3 based on new thresholds of sample size and a better way to derive a weighted length frequency for substitution. The WG establish minimum thresholds for sample size of 200 for longline and 500 for pole and line. Size data will be substituted from other time/area strata into a stratum in which sample size is below these thresholds.

The WG also discussed the units of catch that should be used in SS3. Preliminary work prepared for this meeting converted all catches to catch in number. However, the WG decided that it was better to use catch in weight. For most fisheries, catch in weight is the natural unit of reporting, but for the JPN OLLF1, JPN OLLF2, and TWN LL catch is reported in number (1,000s of fish) and will not be converted to catch in weight.

At the conclusion of this discussion the WG reviewed the current status of fishery definitions, the adequacy of the definitions, and an assessment of conflicting trends among data sources. The review considered catch, CPUE, and size composition data. At the completion of the review, the WG concluded that the fishery definitions shown in Table 1 were the best available and suitable for inclusion in the upcoming stock assessment. WG decisions concerning the fitting of CPUE and size composition data by the model are also documented in Table 1.

The WG found that all of the proposed data preparations were acceptable for inclusion in the next assessment models. There was additional work on the CPUE indices and length frequency data selection based on different criteria throughout the meeting and those that were completed provided further refinement. There may be further examination that could produce additional refinement in the input data between this meeting and the March 2011 stock assessment.

Table 1. Fishery definitions and boundaries developed by the ALBWG for the length-based SS3 model to be used for the upcoming stock assessment. The table also documents WG decisions concerning the use of data in the model and fitting of the model to the

FISHERY	FISHERY CODE	FISHERY DESCRIPTIONS	FISHERY BOUNDARIES AND TEMPORAL COVERAGE	TARGET SIZE	CATCH UNIT	BIOLOGICAL DATA	FITTED	CPUE DATA	FITTED
1	UC LTN	USA/CAN troll (A)	10-55°N latitude by 160°E-120°W longitude	60-80 cm	mt	√	√	√	√
2	USALL	USA LL	10-45°N latitude by 170°E-130°E longitude	> 100 cm	mt	√	√	√	√
3	EPOM	EPO miscellaneous	E.E.Z. along US, Canada west coast and Mexico west coast		mt				
4	JPN PL LF	JPN PL (larger average-size fish)	25-35°N latitude by 130°E-180° longitude in Q2	≥ 90 cm	mt	√ (C@S) 1966-	√	√ 1972-	√
5	JPN PL SF	JPN PL (samller average-size fish)	35-45°N latitude by 140°E-180° longitude in Q2 and Q3	60-90 cm	mt	√ (C@S) 1966-	√	√ 1972-	√
6	JPN OLLF1	JPN Off-LL	25-40°N latitude by 120°E-180° longitude in Q1 and Q2	80 cm	1,000 fish	√ (C@S) 1966-	√	√ 1966-	√
		(Fishery I - smaller average-size fish)	25-40°N latitude by 120°W-180° longitude in Q1						
7	JPN CLLF1	JPN Coast-LL	25-40°N latitude by 120°E-180° longitude in Q1 and Q2	80 cm	mt				
		(Fishery I - smaller average-size fish)							
8	JPN OLLF2	JPN Off-LL	25-40°N latitude by 120°E-180° longitude in Q3 and Q4	100 cm	1,000 fish	√ (C@S) 1966-	√	√ 1966-	√
		(Fishery II - larger average-size fish)	25-40°N latitude by 120°W-180° longitude in Q2-Q4						
			10-25°N latitude by 120°E-120°W longitude all year round						
9	JPN CLLF2	JPN Coast-LL	25-40°N latitude by 120°E-180° longitude in Q3 and Q4	100 cm	mt				
		(Fishery II - larger average fish)	10-25°N latitude by 120°E-120°W longitude all year round						
10	JPN GN	JPN gill net	20-55°N latitude by 120°E-160°E longitude	60 cm	mt	√	X		
11	JPN M	JPN miscellaneous	E.E.Z. along Japan coasts		mt				
12	TWN LL	TWN LL	10-55°N latitude by 120°E-120°W longitude		1,000 fish	√	√	√ 1995-	√
13	KO LL	KOR, others (KO) LL	10-55°N latitude by 120°E-120°W longitude		mt				
14	TK GN	TWN, KOR (TK) gill net	20-55°N latitude by 120°E-180° longitude		mt	√	X		

(A) Includes USA pole and line catch

A checkmark (√) in a data column indicates that these data will be used in modelling and

a checkmark (√) in a fitted column indicates that the model will be fitted to this time series.

JPN Offshore LL consists of vessels > = 20 tonnes

JPN coastal LL is characterized by vessels < 20 tonnes

9.1 Review fishery indicators

The ALBWG did not explicitly review fishery indicators as a separate agenda item as shown in the approved agenda (Appendix 3). As fishery definitions were reviewed in Agenda Item 9, they were also checked for conflicts among the data sources (catch, CPUE, size composition). Visual inspection of all CPUE indices grouped by fishery type (surface, longline) showed that they exhibit similar trend patterns, but have slightly different scaling (amplitude) in some cases (Figure 1). Correlations between all surface and all LL fishery CPUEs were reasonably positive. The WG concluded that these results are indicative of consistency among like CPUE series, i.e., they do not exhibit major conflicts. However, discrepancies in recent trends since 2000 between the US and TWN LL CPUEs and the JPN LL CPUE are potentially problematic.

10.0 REFERENCE CASE ASSUMPTIONS AND SENSITIVITY ANALYSES

The WG discussed structural and parameter assumptions for the next assessment model:

Stock structure: Based on available information, the WG recommended that north Pacific albacore be assumed to consist of a single well-mixed stock for this assessment. The WG also recommended further research into stock structure and mixing of north Pacific albacore.

Steepness (h): The ALBWG noted that in the previous assessment a steepness of 1.0 was implicitly used in the future projections (recruitment randomly drawn). The WG agreed to use a steepness of 1.0 as a default for the upcoming assessment, but other possibilities will be explored during the assessment workshop through sensitivity runs and likelihood profiles.

Natural Mortality (M): Due to the lack of information or data on M for north Pacific albacore, the WG recommended continuing to use the M from the previous assessment, i.e., M = 0.3 for all age classes, which is the assumed value of M for Atlantic albacore tuna (ICCAT 2009). Since there is uncertainty in the value of M, the WG also recommended sensitivity runs and likelihood profiles at other values (e.g., 0.4 – which is the approximate average value of the M at age vector used for south Pacific albacore (Hoyle and Davies 2009)).

Growth: The WG noted that in the last stock assessment catch-at-age data for surface fisheries were not estimated using Suda's growth curve. The ALBWG recommended using the growth parameters from Suda (1966, Von Bertalanffy Growth Function) as the default option. However, the WG also recognized that there is uncertainty in these parameter estimates and is open to the use of different growth parameters. The L_∞ currently assumed for the model is 146.46 cm, which the WG believes may not be appropriate. A simple method to estimate an alternative L_∞ value is to calculate the 95th percentile of the cumulative size frequency distribution in different fisheries. For example, the 95th percentile of the annual size compositions from the US longline fishery (the fleet that captures the largest north Pacific albacore) calculated during the workshop ranges

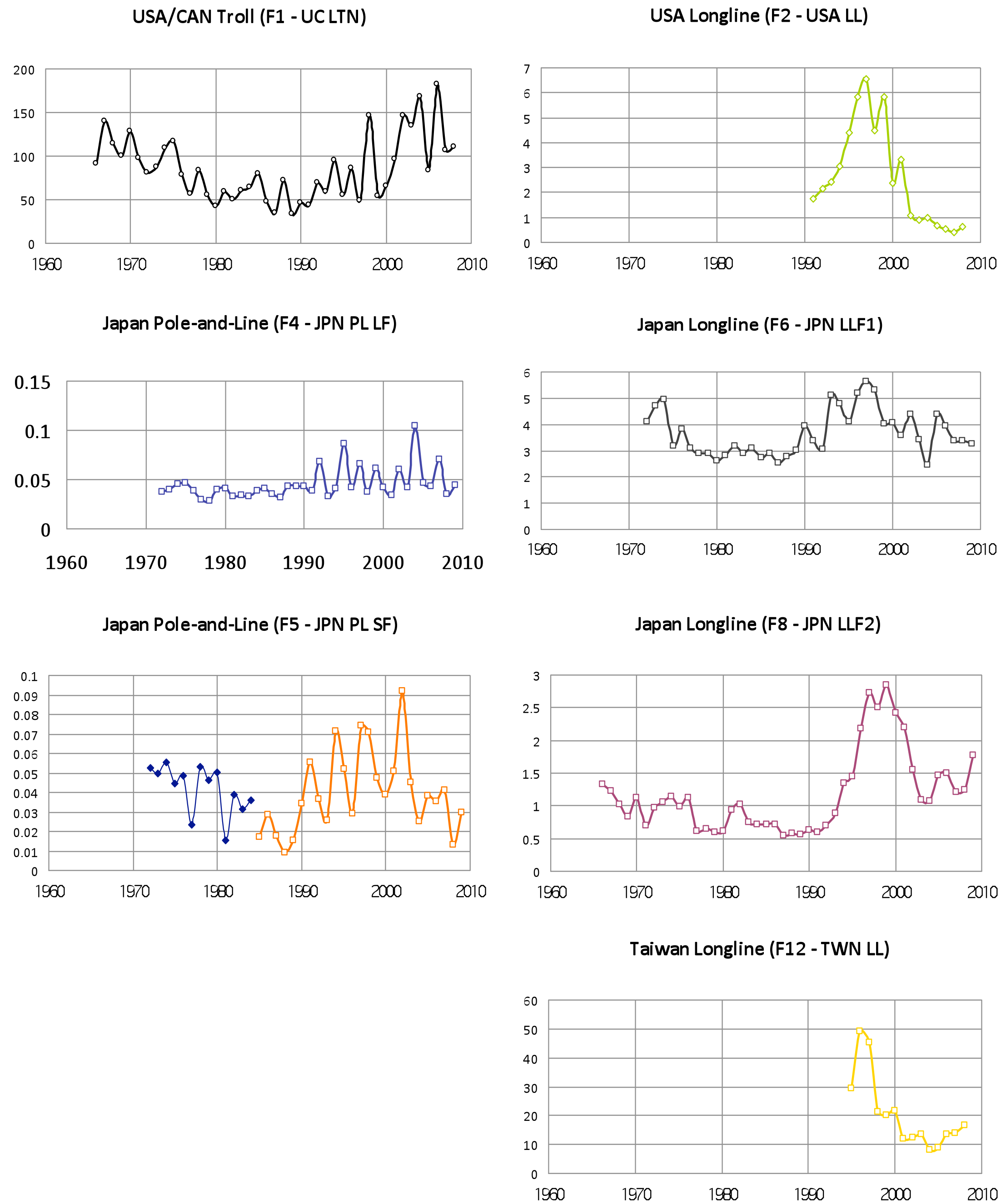

Figure 1. Time series of standardized CPUE for the major surface (left column) and longline (right column) fisheries defined in Table 1 by the ALBWG. Time series vary in length from the TWN LL (shortest) to the JPN LL (longest). Note the difference in scaling of the standardized CPUE indices along the y-axis.

between 112-116 cm fork length. In addition, the ALBWG also discussed investigating the sensitivity of the model to alternative growth parameters (e.g., L_∞, k) by running sensitivity analyses using parameters from other albacore stocks, e.g., south Pacific albacore. The WG recommended that age and growth studies be conducted for North Pacific albacore to improve the growth parameter estimates.

Maturity schedule: The WG recommended retaining the assumption of 50% and 100% maturity at age 5 and 6, respectively, used in the last stock assessment and that sensitivity runs with different maturity schedules should be performed. The WG also recommended that maturity studies be conducted for north Pacific albacore to improve the maturity parameter estimates.

Length-weight: The WG tentatively recommended using the season-specific length-weight relationships estimated by Watanabe et al. (2006). However, the WG was not able to demonstrate that these relationships could be used successfully in SS3 during the workshop. The WG recommended that the methodology for using season-specific LW relationships required further investigation by December 2010. Since Watanabe et al. (2006) also estimated an annual length-weight relationship, the WG recommended using the annual length-weight relationship as a sensitivity run.

Length at Age 1: The WG recommended setting this parameter to be consistent with the growth curve used. For example, if the growth parameters estimated by Suda (1966) are used, then length of age 1 fish at the beginning of Quarter 2 should be 40.2 cm.

Maximum age: The WG tentatively recommended age 12 as the maximum age, but it also recognized that there is large uncertainty in this parameter. Therefore, the WG also recommended investigating a range of 10-20 years for this parameter as sensitivity runs.

Sex ratio: The WG recommended using a combined sex model because sex ratio data are not currently available data for north Pacific albacore. The WG also recommended future research to determine the sex ratio of north Pacific albacore as these data could be used to estimate natural mortality and other parameters of interest.

CV of CPUE time series: The WG recognized that the CVs associated with the CPUE time series may be too low. Several options were discussed but no consensus has been reached yet on how to proceed on this point. Therefore, the WG recommended that the options for adjusting CVs of the CPUE time series continue to be investigated. A decision on which option will be used will be made during the modeling subgroup meeting (16-21 March 2011) prior to the stock assessment workshop.

A provisional reference case scenario was developed during the workshop and the parameterization for this scenario and suggested sensitivity runs are shown in Table 2. The WG does not consider this scenario to be the base case scenario for the upcoming stock assessment since further investigation is needed to confirm some of the decisions. This work will be completed in time for the March 2011 stock assessment workshop.

Table 2. Provisional reference case assumptions and sensitivity runs for the next stock assessment.

Parameter	Base Case Assumption	Sensitivity Runs & Likelihood Profiles
Steepness	1.0	0.7-1.0
Natural Mortality	0.3	0.2-0.4
Growth	Tentatively use Suda (1966) unless the WG agrees to use new information from: (1) age-at-length and growth curve based on otoliths collected in EPO by USA; (2) estimating mean length-at-age from surface fisheries and approximating it for longline fisheries with Suda.	L_∞ from US longline and estimate K for VBGF (use various L_∞). Also use Richards growth curve. South Pacific albacore growth parameters.
Maturity	50% and 100% maturity at age 5 & 6	50% at ages 4-6
Length-weight	Season-specific area-combined length-weight relationship by Watanabe et al (2006)	Annual area-combined length-weight relationship by Watanabe et al (2006)
Length at Age 1	Consistent with growth curve used - 40.2 cm	36.1 cm; other values for mean length at age 1
Maximum Age	12	10-20
Maximum length bin	140	120, 130
Sex structure	None	
CV of CPUE time series	Adjusted from raw CV provided	Various adjustments to CV
CVs for growth parameters	Fixed; age 1 – 8%, age at infinity – 10%	Estimate CVs for both
Fishery selectivities	US LL and JPN LL logistic, remaining dome-shaped	Only US LL logistic, all others dome-shaped
Termination year for estimating recruitment deviations	2007	2008 or 2009, depending on variability pattern or retrospective analysis results
Initial age composition	Age 1 to Age 4	All ages
Effective sample size	ISC/10/ALBWG-3/03 for US LL and troll and down weighting less precise quarterly data; Scale JPN fisheries to average sample size from US LL and troll, depending on whether deep or surface fishery.	Variance adjustment for input sample size
Initial F	US troll and JPN LLF1 (F6) estimated; not fitting to catches from these fisheries	Consider different fisheries such as JPN PL and another LL.

TWN LL size composition	Super year for early period, 1996-1998; blocking of size data from 2003-2008	Mirror JPN PL2 for early period and estimate selectivity for later period
CPUE Tuning	JPN LL; equal weighting for all other CPUEs	Sequentially drop CPUEs; equal weighting for the remaining indices

11.0 EXPLORATORY ANALYSIS OF SS3 OUTPUT BASED ON FISHERY DATA THROUGH 2008

Over the course of the workshop many SS3 runs were made using the new fishery definitions (Table 1). Some of these runs assisted in establishing the reference case parameterization described in Table 2. The majority of runs were aimed at investigating the potential causes of misfits to size compositions and CPUE data, scaling problems resulting in implausibly low total biomass and SSB estimates and time series trends, and divergence in trends of total biomass, SSB, and recruitment after 2000 relative to VPA results. This section briefly summarizes some of the findings provided by these exploratory analyses and potential options/solutions for parameterization issues that WG addressed at this workshop.

The CPUE fits seemed to be reasonable and fit especially well for the Japanese longline fishery. The WG discussed a range of options on the CV of the CPUE time series, including to estimate additional CV for the CPUE time series within the model, scaling the CV outside the model, and setting a minimum CV. It was also suggested that the maximum value of length bins for size data should be decreased because fish length at the maximum age (10+) in the model is around 120cm.

The WG was concerned about the appearance of a large number of fish > 100 cm fork length in the size composition data of the USA troll and JPN PL fisheries around 1987-88. The WG recommended verifying that these large fish were representative of the fisheries because the selectivity curve for the fisheries may be biased by these larger fish. Later in the workshop, US scientists confirmed that the majority (but not all) of the large fish sampled in 1987 and 1988 were from a US troll/gillnet fishery that was pooled with the troll data and were removed from the troll size composition data. Japan will investigate its pole and line fishery size composition data and report to the WG at the assessment workshop in March 2011.

The residual patterns of the size composition fits for the USA LL and TWN LL fisheries were a concern for the WG. A domestic USA ban on shallow swordfish-targeting longline sets in the North Pacific from 2001-2004 changed the size compositions of the USA LL fishery during this period. The WG recommended establishing a time block from 2001-2004 for estimating selectivities of the USA LL fishery.

The TWN LL size composition data were reviewed again during the workshop and resulted in a lengthy discussion.. First, in several years (1995, 1999, 2000, 2002), the working group concluded that the size composition data are not representative of the fishery in terms of spatial or temporal scope of the collection (the size data are from a restricted geographic area and shorter time period than the fishery was operating). The WG confirmed the decision made in the July 2010 workshop not to use size data from these years. No size composition data are available for 2001 nor the historical period 1966-1994.

Second, the available early period size composition data (1996-1998) are qualitatively different from those in 2003-2008. These early period data consist of much smaller fish than in the later period and there is much more variability in the early period size composition data, i.e., modes are not stationary over this period. In contrast, modes are stationary in the later period when larger fish were caught and the WG concluded that size composition from this later period were representative of the current TWN LL fishery. These differences in size compositions between the early and late periods are consistent with a change in the targeting behaviour of the TWN LL fleet: prior to 2003 the fleet used fewer hooks per basket, which is interpreted as an indicator that they were fishing in shallower surface waters inhabited by younger albacore whereas after 2003 more hooks per basket were employed indicative of a switch in targeting to deeper dwelling species such as bigeye tuna and larger mature albacore. The WG recommended establishing a time-block before and after 2003. In addition, the WG suggested that Chinese Taipei clarify the year at which its longline operations changed to catching larger albacore, and that the time-block be with consistent with this information. The WG also considered using a "super-year" to aggregate size data for all the years in the pre-2003 period due to insufficient size composition data as an option. An additional option that was suggested based on a preliminary examination of the data and exploratory runs, is to compare the size compositions and selectivities of the JPN PL, USA swordfish-targeting LL, and TWN LL fisheries to investigate the possibility of mirroring the selectivity of the TWN LL fishery during the pre-2003 period.

The WG noted that the Fs for older fish in recent years (after 2000) seem to be unreasonably high in some of the SS3 model runs. These high Fs may be part of the explanation for the divergence in VPA and SS3 trends in total biomass and SSB after 2000. Based on further exploration of the model, it appears that changing the growth parameters to be more in line with observed sizes of the largest fish caught and other albacore stocks tends to alleviate the issue of high Fs on older fish.

Several SS3 runs with different growth curve parameterizations showed that the scaling of SS3 output may be driven by sensitivity to the growth curve used in the model. If the growth parameters are estimated in the model, then there is a tendency to estimate higher k and lower L_∞ than Suda (1966). Currently, the L_∞ value in the reference case is 146.46 cm, which the WG believes may be too high. Alternatively, the value used for south Pacific albacore (101.7 cm) may be too low for north Pacific albacore. The Suda growth curve is based on fish < 7 years old and is extrapolated to older ages. This kind of extrapolation tends to be biased high because it applies growth dynamics from younger faster growing fish to older, slower growing mature fish. As a quick way to estimate a more appropriate L_∞ value, it was proposed that the WG check the 95th percentile of the cumulative length frequency distributions for the USA and JPN LL fisheries. This approach was applied to the USA LL data during the meeting and resulted in an estimate between 112 and 116 cm. However, this fishery is relatively recent and so the estimate should be confirmed using the Japanese LL data prior to 1965 if possible.

Several SS3 runs were conducted in which US and TWN LL CPUEs were dropped and weightings of other indices were changed. The results of these runs confirmed to the WG that the JPN LL CPUE is a more reliable representation of stock trends than other indices and that the USA and TWN LL CPUEs are not highly informative concerning stock trends. The WG discussed methods for down weighting these indices that are internal and external to the SS3 model, but did not reach any consensus at the workshop. Therefore, the WG recommends further investigation to identify a single method by March 2011.

To summarize the discussion and findings of the exploratory work on SS3 runs, the WG noted that relative trends in total biomass, SSB, and recruitment from VPA and SS3 runs configured with the reference case scenario in Table 2 were highly similar until about 2000. After 2000 these trends diverge with the SS3 trends being lower than the VPA results (Figure 2). Comparison of absolute estimates of total biomass, SSB and recruitment revealed scaling differences between the VPA and SS3 results, with the SS3 estimates lower than the VPA results (Figure 2). The WG recognizes that the VPA results do not necessarily represent the truth, but are using them here as a reference to investigate parameterization issues affecting the SS3 model.

Because the relative trends only diverge in recent years and absolute estimates show a consistent difference, the WG concluded that parameters such as natural mortality and maturity, which are common to both the VPA and SS3, were unlikely to be causes of these differences. The WG identified several potential mechanisms that might explain the scaling differences and divergence after 2000, all of which require further investigation before the stock assessment meeting in March 2011. These mechanisms include:

1. CPUE indices fitted in the SS3 model differ from those in the VPA. The SS3 model was tuned to the JPN LL index and the other indices were weighted by the extra CV component estimated by the model. The VPA indices are weighted differently;
2. Parameterization of the Suda growth curve, especially L_∞, k, and the mean length-at-age 1. Many exploratory runs demonstrated that by adjusting growth parameters SS3 can mimic VPA results;
3. Fishing mortality (F) of the older ages in the SS3 model was significantly > 1, which causes a rapid drop in SSB and may explain the drop in SSB in the most recent years; and
4. High juvenile F in SS3 may reduce survival to adult ages and thus may drive the scaling difference observed throughout the SSB time series.

12.0 PROJECTION SCENARIOS

The Working Group identified three projection scenarios:

1. Constant F and recruitment sampled from estimated recruitment. This is a standard projection scenario that was used in the last assessment and is the scenario that the WG recommends for the upcoming assessment in developing management advice.
2. Sample high and low recruitment periods as examples of the extremes. This scenario is recommended as a way of bracketing what could happen if recruitment varies significantly from average.
3. Constant catch. The WG notes that constant catch is not a realistic scenario for north Pacific albacore since the fishery tends to fluctuate with recruitment. However, the ISC Plenary requested this scenario. As a result, the WG recommends a constant total catch by quarter scenario for SS3. The number of years used to calculate quarterly catch constants could range from 3 to 5. It would be best if this period is consistent with the definition of current F.

The WG discussed the estimation of current F. In the last stock assessment the geometric mean of three years (2002-2004) prior to the terminal year (2005) was used to reduce outlier effects. Depending on the age used for the reference value, the absolute value of F may change. The WG will decide in March 2011 meeting the method for calculating current F (number of years and ages to use). Using the relative value of F (F-multiplier) will be presented with respect to reference points for assessing stock status.

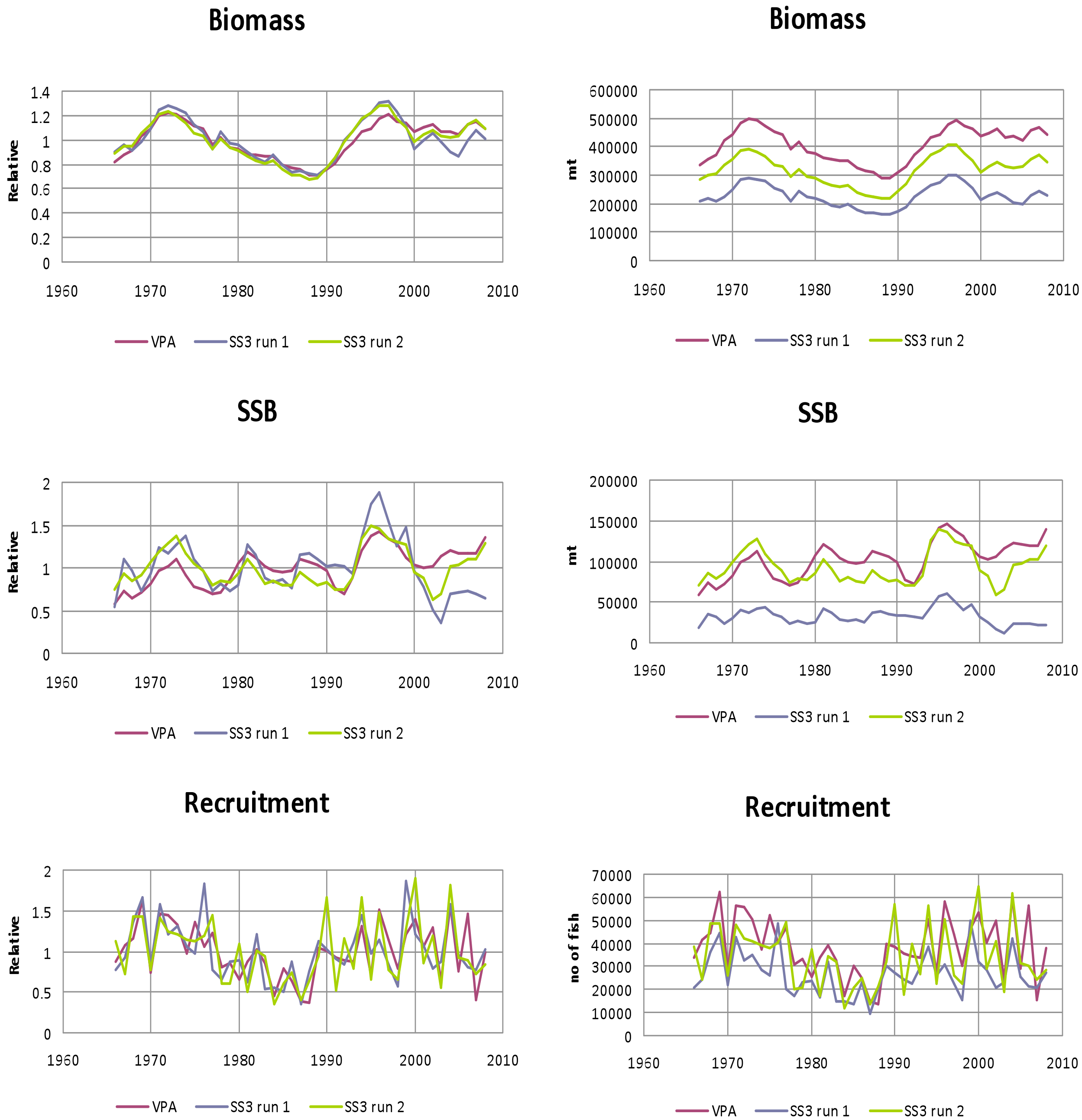

Figure 2. Trends in relative (left column) and absolute (right column) estimates of total biomass, spawning biomass and recruitment from representative VPA and SS3 runs conducted by the ALBWG at the La Jolla workshop, 12-19 October 2010.

When to start future projections was also discussed. In some cases, the terminal year – 1 is used, but this becomes complicated because of the recruitment deviation calculations. Because SS calculates recruitment at age 0 rather than age 1, it will lack 2 years of recruitment at the terminal year, e.g., no estimates for 2008 or 2009. There are two ways to deal with this problem: use model estimates or historical estimates. The WG did not develop a consensus, but noted that test runs were needed to evaluate these options at the assessment workshop in March 2011.

The WG noted that the estimation of $F_{SSB-ATHL}$ needs to be more clearly specified for the stock assessment. There are two ways that this quantity can be estimated: (1) the average of the 10 lowest points in each bootstrap run, or (2) the 10 lowest points averaged over all bootstrap runs. The WG will decide which method it will use at the March 2011 workshop.

Momoko Ichinokawa presented “Preliminary runs of future stochastic projections from outputs of SS for the North Pacific albacore” (ISC/10/ALBWG-3/09). This paper provides details on a set of functions coded by R for conducting future stochastic projections with Stock Synthesis outputs. The R-code has been used by the PBFWG for its stock assessment. The R-code uses the bootstrap results of Stock Synthesis, and conducts stochastic future projections with optional assumptions on future recruitment and harvesting scenarios. Currently, recruitment scenarios include resampling of historically observed recruitment and assuming a spawner-recruitment relationship with lognormal error. In addition, a hockey-stick assumption, in which future recruitments are scaled below a SSB threshold, can be applied to both recruitment scenarios. The available harvesting scenarios consist of constant fishing mortality, which can be adjusted by year and fisheries, and quarterly constant catch, where a constant partial catch ratio by fleet is assumed. The R-code produced almost the same results as those from a deterministic projection by SS, which suggests that the performance of the R-code would be acceptable for stochastic projections in the upcoming stock assessment of north Pacific albacore.

Discussion
The WG noted the work that underlies the code in this application and appreciates its availability for the upcoming assessment. It was clarified that the results shown in this working paper were generated with output from SS3 calculation engine 3.11b.

13.0 RECOMMENDATIONS

13.1 Stock Assessment

i. The WG will use the updated VPA run internally as a tool to investigate, understand, and explain divergences between the SS3 and VPA models. Although the results of the VPA update run will be included in assessment report, only output from SS3 will be used for developing stock status and conservation advice for management purposes.

ii. The WG also noted that it would be useful to investigate the impact that different fisheries have had on the depletion of the north Pacific albacore stock. This kind of study is conducted for IATTC and the WCPFC stock assessments and consists of simulations in which the biomass of albacore estimated to be present in the north Pacific Ocean if fishing had not occurred is projected over the historic period of the assessment (1966-2009), using the time series of estimated recruitment in the absence of fishing. To estimate the impact that different fisheries have had on the depletion of the stock, simulations are run in which each gear is excluded and the model is run forward as in the no-fishing simulation. The difference between the trajectory for the simulated population that was not exploited and that predicted by the stock assessment model represents the impact of fishing on the north Pacific albacore stock.

iii. USA/Canada Troll size frequency data. The WG recommends that US scientists verify US troll size frequency data, in particular the representativeness of large albacore (> 100 cm) that appear in the 1987 and 1988 data.

iv. Japanese pole and line size frequency data. The WG recommends that Japanese scientists verify Japanese pole and line size frequency data, in particular the representativeness of large albacore that are occasionally sampled in these data, especially in 1987 or 1988.

v. The WG recommends that Chinese-Taipei scientists identify when the shift in targeting of their longline fleet from small albacore to large albacore occurred. A detailed study of changes in the seasonal distribution catch and effort might provide information pinpointing the targeting shift.

vi. Japanese size frequency data for pole and line (JPN PLLF, JPN PLSF) and longline (JPN OLLF1, JPN OLLF2) fisheries for SS3. The WG recommends that Japanese scientists update the pole and line and longline fisheries using the new thresholds for substitution (500 and 200, respectively). The WG also recommends that the length frequency data used for substitution i.e., larger areas and season, be weighted by recorded catch.

vii. While some catch data time series for Stock Synthesis were updated during workshop, the WG recommends that all scientists verify these updated catch data as well as their consistency with the catch-at-age input matrix for the VPA.

viii. The WG recommends that USA, Japanese and Chinese Taipei scientist to compare USA swordfish longline, Japanese pole and line, and Taiwanese longline size frequency data to explore the justification for applying the JPN PLSF fishery selectivity to Taiwanese longline fishery early period, when this fishery is assumed to target smaller albacore.

ix. The WG accepts the method presented to estimate effective sample size for USA LL and troll fisheries (ISC/10/ALBWG-3/03) as an appropriate technique for calculating effective sample size outside of SS. However, the WG also recommended that USA scientists update their estimates of effective sample size to reflect quarterly differences in sample size because these differences were not considered in the original analysis. Although this method may be applicable to the JPN LL and PL fisheries, there is a difference in the scale of these fisheries. The WG recommended a separate analysis to determine the appropriate effective sample size for the Japanese fisheries.

x. The WG tentatively approved the following method for calculating current F in the upcoming assessment: current F will be the geometric mean of the three years (2006-2008) prior to the terminal year (2009), which will not be used. This decision may be updated at the March 2011 assessment workshop if the WG detects evidence of bias in the fishing mortality estimate by this method.

xi. The WG recommends that Japanese scientists estimate the 95th percentile of the cumulative size-frequency distribution of the JPN OLLF2 (larger average-size fish) based on data collected prior to 1965 as an alternative estimate of maximum length.

xii. The WG has noted the influence of growth curve parameters on SS3 run output and the large uncertainties in these parameters. The WG recommends the use of a growth curve consisting of mean length-at-age estimated from juvenile size frequency data in surface fisheries and mean length-at-age for adult fish from the Suda growth curve. This curve was implicitly used with the VPA in the last stock assessment. Although mean length–at-age of non-adult fish estimated from the size frequency data of surface fisheries may be better than estimates derived from Suda's (1966) growth curve, there is no consensus within the WG with respect to mean length-at-age estimates for adult albacore. The WG also recommends studies investigating alternative ways to estimate mean length-at-age or that will provide new data (e.g., otolith aging of large fish collected by the USA).

xiii. The WG recommends using Ver. 3.11b of SS3 for the next stock assessment as long as no substantial coding errors are detected in this version of the calculation engine.

xiv. The WG agreed to use the catch history for north Pacific albacore fisheries (1952-2009) updated with Chinese data at the meeting (13 October 2010) (Appendix 4) for the stock assessment in March 2011.

13.2 Research

13.2.1 Age and Growth

The many exploratory runs of SS3 at the workshop in which growth curve parameters were replaced with other estimates (e.g., south Pacific albacore estimates) demonstrated to the WG the influence of the growth curve on stock status. The WG also recognized that the growth curve parameters currently used for north Pacific albacore (Suda 1966) were estimated from the scale data of small juvenile albacore extrapolated to larger mature fish. As a consequence, there are large uncertainties in these growth curve parameters, particularly the estimate of maximum length (L_∞). The WG recommends that age and growth studies of north Pacific albacore as are priority for all scientists, with special emphasis on the age and growth of larger, older fish.

13.2.2 Maturity

The WG recognized that maturity parameters currently used in the stock assessment were developed from studies conducted more than 40 years ago and recommended that studies to update these parameters be conducted as soon as practical.

13.2.3 Sex Ratio

Recognizing that potential utility of sex ratio data by size of large albacore, it is recommended that length measurement with sex information be encouraged from longline fleets.

14.0 WORK PLAN FOR STOCK ASSESSMENT WORKSHOP

The WG identified several data modifications and studies of several issues during the workshop. The recommended modifications and studies are outlined in this section by deadlines for completing the work. All work items are linked to recommendations in Section 13.0

November 15, 2010 (Data submission)

- Updated catch data and time series through 2008 (Recommendation VII) submitted to Hui-hua Lee (SS3) and Takayuki Matsumoto (VPA).
- Japanese LL and PL fisheries data should be updated and length frequency data should be revised for these fisheries using new substitution thresholds and weighted by catch (Recommendation VI).
- Verification of large albacore (> 100 cm) occasionally sampled in size frequency data for the USA/Canada Troll fishery (Recommendation III) and the Japanese pole-and-line fishery (Recommendation IV), especially in 1987 and 1988.
- Verification of SS catch in weight data for Japanese fisheries.
- Update estimates of effective sample size for USA/CAN troll and USA LL fisheries to reflect quarterly differences in sample size (Recommendation IX). Strata with small sample sizes will be down weighted. The other sample size will be average of the US troll and Hawaiian fisheries.

November 30, 2010

- Distribution of input data through 2008 submitted for SS3.

December 1, 2010

- Submission of 2009 data for VPA and SS3. December 1, 2010 is the control date for the data used in the next assessment. Modifications of the data after this date will not be used in the upcoming assessment.

December 15, 2010

- Distribution of VPA and SS3 input files updated through 2009.

January 1, 2011

- Investigate the transition in targeting from small to large fish in the TWN LL fishery (Recommendation V). The WG has assumed that a shift in targeting occurred around 2002-2003 based on the TWN LL size-frequency data, but this assumption should be corroborated with independent evidence from other sources. For example, mapping fishing areas by quarter in conjunction with size frequencies or interviews to determine when the number of hooks per basket was increased.
- Sometime between January 1 and the assessment workshop, the results of these investigations will be discussed to determine a final configuration for the selectivity of TWN LL fishery.
- Comparison of length data from the early periods of the TWN LL, USA swordfish LL, and JPN PLSF fisheries to justify the application of the JPN PLSF fishery selectivity to the early period of the TWN LL fishery (Recommendation VIII).

March 2011 Stock Assessment Workshop

- Calculate effective sample size for all fisheries (Recommendation IX).
- Check Japanese longline length data to determine an alternative maximum length (L_∞ value) based on the 95th percentile of the cumulative length-frequency distribution collected prior to 1965 (Recommendation XI)..
- In order to demonstration a length-based SS3 run comparable to VPA the WG will need to choose an appropriate growth curve (Recommendation XII). This decision is probably needed by January 2011. There are three options:
  - fitting mean length-at-age used to produce catch-at-age for surface fisheries in the VPA and approximating mean length-at-age of adult albacore from the Suda growth curve as was implicitly assumed in the last stock assessment using VPA,
  - a growth curve based on a hybrid of slicing and the Suda growth curve that was briefly presented at the end of the workshop by Takayuki Matsumoto. This curve requires further investigation, but used the following parameterization: L_∞ - 146.46 cm; K - 0.162; t_0 -0.420), and
  - a growth curve based on new information from otoliths collected and aged by US scientists that may be available early in 2011..

15.0 TIME AND PLACE OF NEXT WORKSHOP

The next meeting of the ALBWG will be the stock assessment workshop, 22-29 March 2011, hosted by the National Research Institute of Far Seas Fisheries in Shimizu, Japan. The modeling subgroup will meet at NRIFSF in advance of the workshop on 16-21 March 2011. The modeling subgroup consists of Yukio Takeuchi, Hidetada Kiyofuji, Koji Uosaki, Hui-hua Lee, Momoko Ichinokawa, and Steve Teo.

16.0 OTHER MATTERS

16.1 Future Schedule

The ALBWG has not established a schedule beyond the stock assessment workshop in March 2011. The WG Chair proposed that the Working Group hold an informal half-day session (no workshop report) in July 2011 before the ISC11 plenary to prepare the stock assessment presentation . The WG Chair noted that annual updates of fisheries data and other administrative matters would have to be completed at the March 2011 stock assessment workshop. The WG agreed with this proposal. The WG Chair will inform the ISC Chair of this change in plans.

The WG Chair also proposed that there be no intercessional workshop between ISC11 and ISC12, and that the WG request a 2-day meeting prior to ISC12. The WG also agreed that there will be no intercessional workshop between ISC11 plenary and ISC12 plenary.

16.2 Expert Advice on SS Modeling

The WG discussed the merits of seeking expert advice on SS parameterization issues for north Pacific albacore from Rick Methot, developer of the SS modeling platform, via email prior to the workshop. This debate was picked up at the workshop after examining scores of SS3 and VPA runs. The consensus of the WG was that advice from Rick Methot would be helpful. The WG

Chair will draft a letter formally requesting this advice and circulate it to the modeling subgroup for comment prior to sending it to Methot.

17.0 CLEARING OF REPORT

A rough draft of the report was reviewed by the WG prior to adjournment of the meeting. After the workshop, the WG Chair distributed a second draft of the report via email for review, comment, and approval by the participants. Subsequently, the Chair evaluated suggested revisions, made final decisions on content and style, and provided the report to the ISC Chair for Plenary review at ISC11.

18.0 ADJOURNMENT

The ALBWG meeting was adjourned at 18:00 on 19 October 2010. The WG Chair (John Holmes) thanked the hosts (NOAA/NMFS Southwest Fisheries Science Center and staff) for their hospitality and overall meeting arrangements, which served as the foundation for meaningful scientific discussion and a productive meeting. He also thanked all of the participants for their attendance and contributions and finally, stressed to the modeling subgroup in particular, the rest of the WG in general, the need to maintain ongoing communication and cooperation concerning the exchange of research results concerning the implementation of the SS3 model for the next stock assessment.

19.0 LITERATURE CITED

Chen, , C.-Y., Cheng, F.-C., and Yeh, S.-Y. 2010. Standardized CPUE trend and age composition of north Pacific albacore exploited by Taiwanese longline fisheries, 1995-2008. ISC Albacore Working Group Workshop, 12-13 July 2010, Victoria, Canada. ISC/10/ALBWG-2/07, 26 p.

Hoyle, S., and Davies, N. 2009. Stock assessment of albacore tuna in the south Pacific Ocean. Western and Central Pacific Fisheries Commission, Scientific Committee, Fifth Regular Session, 10-21 August 2009, Port Vila, Vanuatu, WCPFC-SC5-2009/SA-WP-6, 134 p.

ICCAT 2009. Report of the 2009 ICCAT albacore stock assessment session. Madrid, Spain - July 13 to 18, 2009. International Commission for the Conservation of Atlantic Tunas, Madrid, Spain. 100 p. http://www.iccat.int/Documents/Meetings/Docs/2009_ALB_ASSESS_ENG.pdf

Suda, A. 1966. Catch variations in the north Pacific albacore VI. The speculation about influence of fisheries on the catch and abundance of albacore in the north-west Pacific by use of some simplified mathematical models (continued paper-1). Rep. Nankai Reg. Fish. Res. Lab. 24: 1-14.

Watanabe, K., Uosaki, K., and Ichinokawa, M. 2006. Standardization of age specific abundance index for north Pacific albacore caught from the Japanese large and small longline fisheries, 1966-2005: Improvement of general linear model. ISC Albacore Working

Group Workshop, November 28-December 5, 2006, Shimizu, Shizuoka, Japan. ISC/06/ALBWG/07, 16 p.

Western and Central Pacific Fisheries Commission (WCPFC). 2010. A proposal on peer review process. Brought forward by Japan at the Northern Committee, Sixth Regular Session, 7-10 September 2010, Fukuoka, Japan. WCPFC-NC6-WP-07.

APPENDIX 1

List of Participants

Canada
John Holmes
Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Drive
Nanaimo, BC, Canada, V9T 6N7
Tel: 1-250-756-7303; Fax: 1-250-756-7056
Email: john.holmes@dfo-mpo.gc.ca

Chinese Taipei
Chiee-Young Chen
National Kaohsiung Marine University
Department of Marine Environmental Engineering
No. 142, Hai-Chuan Road, Kaohsiung
Tel: 886-07-365-1481; Fax: 886-07-368-1210
Email: chency@mail.nkmu.edu.tw

IATTC
Alexandre Aires-da-Silva
Inter-American Tropical Tuna Commission
8604 La Jolla Shores Drive
La Jolla, CA, 92037-1508, USA
Tel: 1-858-546-7022; Fax: 1-858-546-7133
Email: alexdasilva@iattc.org

Mark Maunder
Inter-American Tropical Tuna Commission
8604 La Jolla Shores Drive
La Jolla, CA, 92037-1508, USA
Tel: 1-858-546-7027; Fax: 1-858-546-7133
Email: mmaunder@iattc.org

Japan
Momoko Ichinokawa
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan 424-8633
Tel: 81-54-336-6039; Fax: 81-54-335-9642
Email: ichimomo@fra.affrc.go.jp

Hidetada Kiyofuji
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan 424-8633
Tel: 81-54-336-6037; Fax: 81-54-335-9642
Email: hkiyofuj@affrc.go.jp

Takayuki Matsumoto
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan 424-8633
Tel: 81-54-336-6037; Fax: 81-54-335-9642
Email: matumot@affrc.go.jp

Yukio Takeuchi
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan 424-8633
Tel: 81-54-336-6039; Fax: 81-54-335-9642
Email: yukiot@fra.affrc.go.jp

Koji Uosaki
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan 424-8633
Tel: 81-54-336-6036; Fax: 81-54-335-9642
Email: uosaki@affrc.go.jp

United States

Paul Crone
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA, 92037, USA
Tel: 1-858-546-7069; Fax: 1-858-546-5651
Email: paul.crone@noaa.gov

Kristen Koch
NOAA/NMFS SWFSC
3333 North Torrey Pines Court
La Jolla, CA, 92037-1023, USA
Tel: 1-858-546-7000; Fax: 1-858-546-7003
Email: kristen.c.koch@noaa.gov

Suzy Kohin
NOAA/NMFS
Southwest Fisheries Science Center
8604 La Jolla Shores Dr.
La Jolla, CA 92037 USA
Tel: 1-858-546-7104; Fax: 1-858-546-7003
Email: suzanne.kohin@noaa.gov

Hui-hua Lee
NOAA/NMFS
Pacific Islands Fisheries Science Center
2570 Dole St.
Honolulu, HI 96822 USA
Tel: 1-808-983-5352; Fax: 1-808-983-2902
Email: huihua.lee@noaa.gov

Gary Sakagawa
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037 USA
Tel: 1-858-546-7177; Fax: 1-858-546-7003
Email: gary.sakagawa@noaa.gov

Sarah Shoffler
NOAA/NMFS SWFSC
3333 North Torrey Pines Court
La Jolla, CA, 92037-1023, USA
Tel: 1-858-546-5678; Fax: 1-858-546-7003
Email: sarah.shoffler@noaa.gov

Steven Teo
NOAA/NMFS
Southwest Fisheries Science Center
8604 La Jolla Shores Dr.
La Jolla, CA 92037 USA
1-858-546-7179, 1-858-546-7003 (fax)
steve.teo@noaa.gov

Vidar Wespestad
American Fisherman's Research Foundation
21231 8th Pl. West
Lynnwood, WA 98036, USA
Tel: 1-425-672-7603; Fax: 1-425-672-1357
Email: vidarw@frontier.net

APPENDIX 2

List of Working Papers

	List of Working Papers	Availability
ISC/10/ALBWG-3/01:	Joint standardized abundance index of US and Canada albacore troll fisheries in the North Pacific. Steven L.H. Teo, John Holmes, and Suzanne Kohin	Paper available on ISC website
ISC/10/ALBWG-3/02:	Time series associated with albacore fisheries based in the Northeast Pacific Ocean. Steven L.H. Teo, Hui-hua Lee, and Suzanne Kohin.	Paper available on ISC website
ISC/10/ALBWG-3/03:	Estimating input sample size for length-frequency data in Stock Synthesis: US longline and US troll fisheries. Hui-hua Lee	Paper available on ISC website
ISC/10/ALBWG-3/04:	Abundance indices of north Pacific albacore by Japanese longline for SS3 and VPA analyses. Takayuki Matsumoto	Contact details – checking for full availability
ISC/10/ALBWG-3/05:	Suggestion about how to deal with albacore CPUE by Japanese longline during 1960s in the northwest area. Takayuki Matsumoto	Contact details – checking for full availability
ISC/10/ALBWG-3/06:	Methods for creating data for VPA and SS3 analyses for Japanese albacore fisheries. Takayuki Matsumoto	Contact details – checking for full availability
ISC/10/ALBWG-3/07:	Revision of standardized CPUE for albacore caught by the Japanese pole and line fisheries in the northwestern North Pacific albacore. Kiyofuji, H and Uosaki, K.	Contact details – checking for full availability
ISC/10/ALBWG-3/08:	Standardized CPUE and catch-at-age time series of North Pacific albacore exploited by Taiwanese longline fisheries, 1995-2008. Chiee-Young Chen, Fei-Chi Cheng, and Shean-Ya Yeh.	Contact details only
ISC/10/ALBWG-3/09:	Preliminary runs of future stochastic projections from outputs of SS for the North Pacific albacore. Momoko Ichinokawa and Yukio Takeuchi	Paper available on ISC website
ISC/10/ALBWG-3/10:	Preliminary population analysis using VPA2BOX and PRO2BOX for the north Pacific albacore. H. Kiyofuji, T. Matsumoto, K Uosaki, M. Ichinokawa, and Y. Takeuchi	Contact details – checking for full availability
ISC/10/ALBWG-3/11:	Comparison of data for catch-at-age and CPUE with those for 2006 assessment and for SS3. T. Matsumoto.	Contact details – checking for full availability

APPENDIX 3

Revised Agenda

ALBACORE WORKING GROUP (ALBWG)
INTERCESSIONAL WORKSHOP AGENDA

12-19 October 2010
SWFSC, La Jolla, CA, USA

1. Opening of Albacore Working Group (ALBWG) Workshop -
   - Welcoming Remarks
   - Chair's Remarks (context, objectives, outputs, procedures)
   - Meeting Arrangements
   - Introductions

2. Distribution of documents and Numbering of Working Papers

3. Review and approval of agenda

4. Appointment of rapporteurs

5. Future Considerations
   - Interim reference point (IRP) - assess against SSB-ATHL and determine $F_{SSB\text{-}ATHL}$
   - Peer-review
   - Timing of future assessments

6. VPA and SS3 parallel base-case run discussion – need, goals, workplan, discussion of how to compare outputs, particularly if there are large differences in trends, scaling, etc.

7. Summary of the April & July 2010 Workshops

8. Completion of Fishery Definition Work Assignments
- JPN LL
- JPN GN
- TWN LL
- JPN PL
- CAN/USA troll
- Decisions on fitting to biological and CPUE data for some fisheries

9. Final evaluation of the current grouping of fleets within fisheries

10. Review fishery indicators for new fishery definitions for conflicts among sources
    - Catch data
    - CPUE
    - Size compositions

11. Reference case scenario assumptions and rationale
    i. Structural assumptions (M, h, one-stock, etc.)
    ii. Biological parameter estimates
        - Natural mortality, M
        - Growth curve
        - Length-at-maturity schedule

12. Exploratory analysis of SS3 output based on fishery data through 2008

13. Other modelling scenarios
    - Alternative selectivity assumptions
    - Fixed and time-varying catchabilities for CPUEs
    - Initial conditions
    - Other possibilities?

14. Sensitivity analyses
    - Natural mortality
    - Steepness of stock-recruitment relationship
    - Growth Curve Sensitivity (k)
    - Maturity
    - Weighting of size and CPUE series
    - Inclusion of secondary CPUEs
    - Size of equilibrium catches relative to base case
    - Effective sample size

15. Projection scenarios

16. Recommendations
    - Stock Assessment
    - SS3 Version for Stock assessment
    - Research

17. Work plan for stock assessment workshop

18. Time and place of next meeting

19. Other matters
    - Future meeting schedule (beyond March 2011)
    - Advice from Rick Methot

20. Clearing of Report

21. Adjournment

APPENDIX 4

Table 1. [1] North Pacific albacore catches (in metric tons) by fisheries, 1952-2009. Blank indicates no effort.
-- indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ().

Year	Japan							Korea		Chinese-Taipei		
	Purse Seine	Gill Net	Set Net	Pole and Line	Troll	Longline	Other	Gill Net	Longline	Gill Net	Water Longline	Offshore Longline
1952	154		55	41,787	--	26,687	182					
1953	38		88	32,921	--	27,777	44					
1954	23		6	28,069	--	20,958	32					
1955	8		28	24,236	--	16,277	108					
1956			23	42,810	--	14,341	34					
1957	83		13	49,500	--	21,053	138					
1958	8		38	22,175	--	18,432	86					
1959			48	14,252	--	15,802	19					
1960			23	25,156	--	17,369	53					
1961	7		111	18,639	--	17,437	157					
1962	53		20	8,729	--	15,764	171					
1963	59		4	26,420	--	13,464	214					
1964	128		50	23,858	--	15,458	269					
1965	11		70	41,491	--	13,701	51					
1966	111		64	22,830	--	25,050	521					
1967	89		43	30,481	--	28,869	477				330	
1968	267		58	16,597	--	23,961	1,051				216	
1969	521		34	31,912	--	18,006	925				65	
1970	317		19	24,263	--	16,222	498				34	
1971	902		5	52,957	--	11,473	354		0		20	
1972	277	1	6	60,569	--	13,022	638		0		187	
1973	1,353	39	44	68,767	--	16,760	486		3		--	
1974	161	224	13	73,564	--	13,384	891		114		486	
1975	159	166	13	52,152	--	10,303	230		9,575		1,240	
1976	1,109	1,070	15	85,336	--	15,812	270		2,576		686	
1977	669	688	5	31,934	--	15,681	365		459		572	
1978	1,115	4,029	21	59,877	--	13,007	2,073		1,006		6	
1979	125	2,856	16	44,662	--	14,186	1,139	0			81	
1980	329	2,986	10	46,742	--	14,681	1,177	6	402	--	249	
1981	252	10,348	8	27,426	--	17,878	699	16		--	143	
1982	561	12,511	11	29,614	--	16,714	482	113	5,462	--	38	
1983	350	6,852	22	21,098	--	15,094	99	233	911	--	8	
1984	3,380	8,988	24	26,013	--	15,053	494	516	2,490	--	--	
1985	1,533	11,204	68	20,714	--	14,249	339	576	1,188	--	--	
1986	1,542	7,813	15	16,096	--	12,899	640	726	923	--	--	
1987	1,205	6,698	16	19,082	--	14,668	173	817	607	2,514	--	
1988	1,208	9,074	7	6,216	--	14,688	170	1,016	175	7,389	--	
1989	2,521	7,437	33	8,629	--	13,031	433	1,023	27	8,350	40	
1990	1,995	6,064	5	8,532	--	15,785	248	1,016	1	16,701	4	
1991	2,652	3,401	4	7,103	--	17,039	395	852	0	3,398	12	
1992	4,104	2,721	12	13,888	--	19,042	1,522	271	1	7,866	--	
1993	2,889	287	3	12,797	--	29,933	897		21		5	
1994	2,026	263	11	26,389	--	29,565	823		54		83	
1995	1,177	282	28	20,981	856	29,050	78		14		4,280	
1996	581	116	43	20,272	815	32,440	127		158		7,596	
1997	1,068	359	40	32,238	1,585	38,899	135		404		9,119	337
1998	1,554	206	41	22,926	1,190	35,755	104		226		8,617	193
1999	6,872	289	90	50,369	891	33,339	62		99		8,186	207
2000	2,408	67	136	21,550	645	29,995	86		15		7,898	944
2001	974	117	78	29,430	416	28,801	35		64		7,852	832
2002	3,303	332	109	48,454	787	23,585	85		112		7,055	910
2003	627	126	69	36,114	922	20,907	85		146		6,454	712
2004	7,200	61	30	32,255	772	17,341	54		78		4,061	927
2005	850	154	97	16,133	665	20,420	234		420		3,990	483
2006	364	221	55	15,400	460	21,027	42		138		3,848	469
2007	5,682	226	30	37,768	519	22,336	44		56		2,465	451
2008	825	1,531	101	19,060	549	22,386	(15)		365		2,490	579
2009	(2,151)	(1,531)	(101)	(32,421)	(549)	(17,518)	(15)		(365)		(1,866)	(512)

Table 1. (Continued)

Year	United States								Mexico		Canada	Other		Grand Total
	Purse Seine	Gill Net	Pole and Line 2	Albacore Troll 3	Troll & Handline	Sport	Longline	Other	Purse Seine	Pole and Line 4	Troll	Troll 5	Longline 6	
1952				23,843		1,373	46				71			94,198
1953				15,740		171	23				5			76,807
1954				12,246		147	13							61,494
1955				13,264		577	9							54,507
1956				18,751		482	6				17			76,464
1957				21,165		304	4				8			92,268
1958				14,855		48	7				74			55,723
1959				20,990		0	5				212			51,328
1960				20,100		557	4				141			63,403
1961			2,837	12,055		1,355	5	1	2	39	4			52,649
1962			1,085	19,752		1,681	7	1	0	0	1			47,264
1963			2,432	25,140		1,161	7		31	0	5			68,937
1964			3,411	18,388		824	4		0		3			62,393
1965			417	16,542		731	3	1	0		15			73,033
1966			1,600	15,333		588	8		0		44			66,149
1967			4,113	17,814		707	12				161			83,096
1968			4,906	20,434		951	11				1,028			69,480
1969			2,996	18,827		358	14		0		1,365			75,023
1970			4,416	21,032		822	9		0		390			68,022
1971			2,071	20,526		1,175	11		0		1,746			91,240
1972			3,750	23,600		637	8		100	0	3,921			106,716
1973			2,236	15,653		84	14		0		1,400			106,839
1974			4,777	20,178		94	9		1	0	1,331			115,227
1975			3,243	18,932		640	33	10	1	0	111			96,808
1976			2,700	15,905		713	23	4	36	5	278			126,538
1977			1,497	9,969		537	37		3	0	53			62,469
1978			950	16,613		810	54	15	1	0	23			99,600
1979			303	6,781		74	--		1	0	521			70,745
1980			382	7,556		168	--		31	0	212			74,931
1981			748	12,637		195	25		8	0	200			70,583
1982			425	6,609		257	105	21	0	0	104			73,027
1983			607	9,359		87	6		0	0	225			54,951
1984	3,728		1,030	9,304		1,427	2		107	6	50			72,612
1985	26	2	1,498	6,415	7	1,176	0		14	35	56			59,100
1986	47	3	432	4,708	5	196			3	0	30			46,078
1987	1	5	158	2,766	6	74	150		7	0	104			49,051
1988	17	15	598	4,212	9	64	307	10	15	0	155			45,345
1989	1	4	54	1,860	36	160	248	23	2	0	140			44,052
1990	71	29	115	2,603	15	24	177	4	2	0	302			53,693
1991	0	17	0	1,845	72	6	312	71	2	0	139			37,320
1992	0	0	0	4,572	54	2	334	72	10	0	363			54,833
1993		0	0	6,254	71	25	438		11	0	494			54,125
1994		38	0	10,978	90	106	544	213	6	0	1,998	158		73,345
1995		52	80	8,045	177	102	882	1	5	0	1,763	94		67,947
1996	11	83	24	16,938	188	88	1,185		21	0	3,316	469	1,735	86,207
1997	2	60	73	14,252	133	1,018	1,653	1	53	0	2,168	336	2,824	106,756
1998	33	80	79	14,410	88	1,208	1,120	2	8	0	4,177	341	5,871	98,229
1999	48	149	60	10,060	331	3,621	1,542	1	0	57	2,734	228	6,307	125,542
2000	4	55	69	9,645	120	1,798	940	3	70	33	4,531	386	3,654	85,052
2001	51	94	139	11,210	194	1,635	1,295		5	18	5,248	230	1,471	90,189
2002	4	30	381	10,387	235	2,357	525		28	0	5,379	466	700	105,224
2003	44	16	59	14,102	85	2,214	524		28	0	6,861	378	(2,400)	92,804
2004	1	12	127	13,346	157	1,506	361		104	0	7,856	--	4,375	90,595
2005		20	66	8,413	175	1,719	296		0	0	4,845	--	4,315	63,198
2006		3	23	12,524	95	385	270		109	0	5,832	--	5,136	66,345
2007		4	21	11,887	98	1,225	250		40	0	6,075	--	3,539	92,717
2008	0	1	1,059	10,732	29	257	353	0	10		5,478		2,812	68,633
2009	(39)	(3)	(2,088)	(10,700)	(99)	(541)	(203)	(0)	(17)		(5,685)		(1,581)	(77,947)

AEB:
not updated, need HI

AEB:
not updated, need HI totals

1 Data are from the ISC albacore working group July 12 2010, except as noted
2 Albacore pole-and-line catches for 2008 and 2009 are estimated from new procedures.
3 Albacore troll catches prior to 2008 contain an unknown proportion of pole and line catch.
4 Mexico Pole and line catches for 1999 and 2000 include 34 and 4 metric tons, respectively from longline.
5 Other troll catches are from vessels registered in Belize, Cook Islands, Tonga, and Ecuador.
6 Updates for Other Longline 2004-2009 from Peter Williams, pers. com.
7 Korea Longline series 2009-1994 entirely consistent with Table 1 data from ISC ALBwg July 2010 final report (p18)