Annex 4

REPORT OF THE ALBACORE WORKING GROUP WORKSHOP

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

8-14 November 2016
Nanaimo, British Columbia, Canada

1. OPENING AND INTRODUCTION

1.1 Welcome and Introduction

An intersessional workshop of the Albacore Working Group (ALBWG or WG) of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) was convened at the Pacific Biological Station, Nanaimo, Canada 8-14 November 2016. John Holmes, Chair of the ALBWG, welcomed nine scientists (Attachment 1) from Canada, Chinese Taipei, Japan, the United States of America (USA), and the Inter-American Tropical Tuna Commission (IATTC) to the workshop. After briefly commenting on the history of the meeting site and emergency procedures, he noted that scientists from Mexico, Korea, China, and the Secretariat of the Pacific Community (SPC) did not attend the workshop.

1.2 Meeting Protocol

The ALBWG Chair noted that the efforts of the WG at this meeting would be collegial and follow the scientific method with an emphasis placed on empirical testing, open debate, documentation and reproducibility, reporting uncertainty, peer review and constructive feedback to authors and presenters. He recalled the progress made in 2014 and observed that the WG needed to continue to show progress in addressing high priority issues for the 2017 assessment.

1.3 Review and Adoption of Agenda

A draft agenda was circulated prior to the meeting and was revised at the meeting. The revised agenda was adopted at the meeting (Attachment 2.)

1.4 Assignment of Rapporteurs

Rapporteuring duties were assigned to Chiee-Young Chen, John Holmes, Hidetada Kiyofuji, Junji Kinoshita, Hirotaka Ijima, Daisuke Ochi, Carolina Minte-Vera, Kevin Piner, and Steven Teo. John Holmes had the overall responsibility for assembling the report.

1.5 Distribution of Documents and Working Paper Availability

Twelve (12) working papers (WP) were submitted and assigned numbers for the workshop (Attachment 3.) Working paper availability (public or lead author contact details) also is noted in Table 3.

2. SUMMARY OF CURRENT MEETING OBJECTIVES

The ALBWG is tasked with completing a new North Pacific albacore (NPALB) stock assessment in April 2017. This workshop is the data preparation workshop and will review all data to be used in the upcoming assessment. The objectives of this workshop are to:

(1) Define fisheries and review input data series for consistency with definitions and conflicts in primary data sources;
(2) Assess CPUE indices for inclusion in the model using criteria adopted by the WG during in March 2013;
(3) Review model parameterization, assumptions, and diagnostic tools for the base-case model;
(4) Review performance of newly developed projection software; and
(5) Develop a project charter document that describes the expectations for the base case and projections to produce model runs for stock assessment meeting in April 2017.

3. WORK ASSIGNMENT REVIEW

Work assignments developed at the previous meeting of the ALBWG in preparation for the stock assessment were reviewed and their status was noted in Table 1.

4. INFORMATION NEEDS IN DOCUMENTS SUPPORTING FISHERY DEFINITIONS AND CPUE INDICES

4.1 Information Needs

The WG developed information guidelines for working papers describing fisheries and CPUE development for the 2014 stock assessment (ALBWG 2013) and decided to apply them for the 2017 assessment. These guidelines (Table 2) were briefly reviewed and it was noted that they were designed to ensure that decisions supporting fishery definitions and CPUE standardization procedures are well documented.

4.2 Criteria used to assess strength/weaknesses of indices

The WG also reviewed a list of criteria that were used to judge the strengths and weaknesses of potential CPUE indices in the preparations for the 2014 stock assessment (Table 3). **Since these criteria remain relevant, the WG decided to apply them during preparations for the 2017 assessment to assist the WG in providing information supporting decisions to include or exclude indices in the assessment model.**

5. CONCEPTUAL MODEL OF STOCK SPATIAL STRUCTURE AND MOVEMENTS

The WG began the discussion of fishery definitions by describing a conceptual model of NPALB distribution and migration (Figure 1) using size by area, growth and maturity information reported by Otsu and Uchida (1963), Nishikawa et al. (1985), and Ichinokawa et al. (2008). The premise of this model is that movements and the resulting spatial structure are age-related. The primary area of age-0 fish is centered on 20°N, between 140 and 170°E, i.e., on the northern periphery of the spawning area. Young albacore spend about a year in this area and then begin to disperse northward and eastward, where they begin to appear in surface gear fisheries as 2-year old fish. There seem to be two juvenile groups, one in the western Pacific and the other in the eastern Pacific, with presumably some annual west to east trans-Pacific movement. Fish recruit to the pole and line (and former drift net fishery) in the 2nd quarter and to EPO surface fisheries along the coast of North America at the end of the 2nd and the 3rd quarters, when they are available to the troll fisheries of Canada and USA. In the area north of 30°N albacore are found by the USA longline fishery in 1st and 4th quarters. The WG hypothesizes that as juveniles grow and begin maturing, they move southward into the tropical waters of the putative spawning area between Taiwan-Philippines and Hawaii (0-15°N) where they remain and are available to the longline fleets during all quarters of the year.

The WG hypothesizes that these movements are age-related and agreed to use this conceptual model as the underlying working hypothesis for the construction of the population dynamics model; no spatially explicit model will be constructed for this assessment, rather the "areas-as-fleet" approach will be used (e.g., Waterhouse et al. 2014). The group decided that the process of movement will be modelled as an age-based process, represented in the model by selectivity at age. The selectivity-at-age for an area will be the same for all fleets that operate in the same area (i.e., by mirroring the age-based selectivity among fleets), while the length-based selectivity will capture the gear and other operation effects. Thus a selectivity at age will be estimated by fleet (some fleets may be mirrored depending on the gear operation regardless of the fishing area). As a result a shared juvenile age selectivity will be applied to fleets operating in northern areas (N of 30°N) where juvenile fish predominate, to capture differences in availability of fish related to age. Similarly, a shared mature fish age selectivity will be applied to fleets operating south of 30°N, to account for adult movements.

The WG also agreed to consider this conceptual model (Figure 1) in decisions regarding fishery area definitions and attempt to make these definitions consistent with the conceptual model based on inspection of catch and size frequency data for a fleet. It was noted that some differences may be necessary due to unusual characteristics of a particular fleet (e.g., the southern boundary of the TWN LL north fleet is 25°N rather than 30°N – see Section 6.2), but that for the most part fishery definitions should conform to this model.

6. FISHERY DEFINITIONS

Five working papers were reviewed and discussed by the WG and feedback was provided to the authors. The goal of this review of the principal fisheries is to ensure that the most consistent and robust data are utilized in the model and that preliminary fleet definitions are consistent with the WG's understanding of the movements and biology of the stock (e.g., Figure 1).

6.1 Japan Longline and Pole-and-Line and Other Fisheries

6.1.1 *New fisheries definition from Japanese longline North Pacific albacore size data. D. Ochi, H. Ijima, J. Kinoshita, and H. Kiyofuji. (ISC/16/ALBWG-02/03)*

In this study, fisheries definitions for the North Pacific albacore (*Thunnus alalunga*) caught by the Japanese longline (JPN LL) were reconsidered based on size data from JPN LL. Cluster analysis was applied to the size data to investigate spatial characteristics of fish size. As results of cluster analysis, three major groups were identified from different fish size caught by the JPN LL.

Discussion - Longline fleet area definitions were discussed in this section along with pole and line fleet area definitions. In addition to the area definitions, the WG also discussed potential uses of data for specific fleets (by area) (see Figure 2).

The authors proposed five area definitions for the longline fleet that differed slightly from the definitions used in 2014. The WG noted that the newly proposed area 2 was originally two separate areas in the 2014 assessment. Additionally the newly proposed area 4 was partitioned out of the single EPO area that was used in the last assessment. It was further noted that the western boundary of the newly proposed area 4 is farther west than the EPO area from the last assessment. Areas 2 and 4 were defined using the clustering analysis described in the WP and the other 3 proposed fishery definition areas were assumed to be the same as in the 2014 assessment. The WG questioned whether the clustering could have been used to address the other areas, **but agreed that plotting average size by quarter and area (5°x5° or 10° x10°) should be enough to define fisheries for this assessment. It was also noted that a time (year or season) component to the fleet definition may be needed to help define gear (length) and/or availability (age) components of selectivity.**

<u>Longline fleet:</u> **The WG agreed with the five fishery areas definitions proposed in WP-03, with the exception that the WG recommends that the western boundary of area 4 should be set at 160°E (further west than proposed by the authors) and the southern boundary of area 3 should be set at 30°N.** The WG requested that the authors provide plots of the proposed fishery areas lines plotted on the maps of average size (FL) by 5x5 degree strata by quarter of the year to confirm its decision on these definitions. **After reviewing these plots, the WG agreed that the five proposed areas (with boundary modifications recommended above) were suitable for the Japanese longline data and that they will be used for the upcoming assessment. These WG considers these decisions to be preliminary at this time, pending a further review of size composition data raised to the catch prior to the stock assessment workshop.**

<u>Pole and line fleet:</u> **The WG recommended a similar analysis to that for longline be performed on the pole and line fleet using only pole and line data to define areas.** Results of that analysis were provided in a presentation the following day using the PL area from the 2014 assessment, 25-45°N and 130-180°E. After reviewing these results and plots of the defined area overlaid with clusters, average size and catch in 5°x5° strata, **the WG recommends applying the Area 2 and 3 Japanese LL fleet definitions to the pole-and-line fleet (Figure 2).** The

majority of catch occurs in Area 3, with low catches of larger fish coming from Area 2. To reduce fleet complexity in the model, it is recommended that PL catches below 30°N could be added to the LL catches in the same region or treated as a separate fleet. The WG tentatively agreed to add pole-and-line catch from area 1 to Japanese LL catch in the same area. **This decision will be reviewed after examining size composition data raised to the catch from both fleets.** CPUE and length composition for areas 2 and 3 are to be inputted into the model. For the PL fleet in area 2 (below 30°N), selectivity could be borrowed from another fleet (and not fit to the length composition) if catch magnitude is small and model parsimony is desired. Later in the meeting the WG reviewed quarterly plots of PL raw (not raised) size composition data and tentatively confirmed most the decisions and recommendations described above. It was noted that in previous assessments the PL fleet was split seasonally because the area definition used to develop the fleet data was not appropriate, but the seasonal effect on fish size disappeared with the new fleet area definition. **The WG agreed that the pole-and-line CPUE should be developed for area 3 (north of 30°N and east of 140°E, the light green area in Figure 2) because it is the main fishing area. The WG requested that the results of this analysis for the PL fleet should be documented in a new working paper at the upcoming assessment workshop.**

6.1.2 *Japanese catch statistics of North Pacific albacore tuna (Thunnus alalunga) for Stock synthesis 3. Hirotaka Ijima, Daisuke Ochi and Keisuke Satoh. (ISC/16/ALBWG-02/02)*

The Japanese catch statistics of North Pacific albacore tuna for ISC stock assessment correspond to ISC table 1 that was summarized by fishery and annually. However, in the ISC stock assessment, this data sets needs to be divided year, area and quarterly and that calculation procedure is complicated. In this document, we summarized Japanese catch of North Pacific albacore tuna and suggested new compilation method. This revision is a minor update. However, part of the new procedure will be clarified and will keep consistency with each fishery.

Discussion - Discussion on this paper was focused on how to create the catch series for longline and pole-and-line gears by area, quarter, and year. For other miscellaneous gears the discussion included fishery definitions.

<u>**Longline catch:**</u> Catch for small scale coastal long liners were derived from yearbook estimates of total longline catch after subtracting out the Coastal LL catch from logbooks. **The WG agreed to use the yearbook derived catch for small scale LL and logbook records for Offshore-Distant water LL (OSDWLL) and Coastal LL (CLL) catch (after 1994) in the assessment. The WG also agreed to use the proportions of year-area-quarter catch from logbooks, rather than CPUE, to allocate annual small scale coastal longline catch to quarter-area strata as recommended by the authors. The WG agreed to input OS DWLL and CLL (after 1994) catch into the assessment model as catch in numbers.**

<u>**Pole and line catch**</u>**: The WG decided to separate catch into quarters in the Pole and Line fleet prior to 1972 based on the average proportion of the same fleets quarterly catch (1972-1974 -added together) as recommended by the authors.**

<u>Miscellaneous catch (including drift gillnet and purse seine)</u>: The WG reviewed high seas driftnet (DN) length composition data from 1990 and 1991 (the only years for which these data are available) and noted that the majority of fish are smaller (<75cm) than fish sampled in the PL fleet. The WG recommends that driftnet size composition data be raised to match catch and be made available for the assessment model (by quarter) for inclusion as likelihood component. Spatial distribution of the DN fleet when it operated corresponds to area 3 and the EPO area in the Japanese LL fleet definitions, but **the WG recommends that the DN fleet be treated as a single fleet operating in the area 30-45°N and 140°E-145°W. Once the DN fleet is removed from the miscellaneous gears, the remaining catch should remain aggregated as two separate Japanese Miscellaneous fleets (above and below 30°N) based on the ratio of purse seine catch by area (from logbook data) since purse seine accounts for most of the catch in these fleets and assuming that these other gears are used in the same proportion as the pole-and-line fleet.**

6.2 Other Longline Fleets

6.2.1 *The development of Taiwanese longline fishery in the North Pacific Ocean and estimation of albacore CPUE exploited by albacore-targeting fishery, 1995-2015. Chiee-Young Chen, Fei-Chi Cheng. (ISC/16/ALBWG-02/09)*

The historical development of Taiwanese longline fisheries operated in the North Pacific Ocean was reviewed in this study. Before 2000, fishing effort was not much, and mainly concentrated in the central North Pacific Ocean north of Lat. 25°N. Their catch was mostly contributed by albacore. Thereafter, increasing fishing efforts expanded to the tropical waters and increasing catch of tuna species other than albacore were reported. During this period, a gradual change in the fishing strategy of the longline fleets was observed, and it was coincided with a quite different species composition in their catch. Taking these changes in fishing strategy and species composition into account, the catch statistics of Taiwanese longline fishery were then categorized into albacore-targeting and non-albacore-targeting fisheries for further analyses. Then, general linear model was applied to estimate the CPUE trend, which is believed to be more informative to the stock status of North Pacific albacore exploited by Taiwanese longline fishery.

NOTE: This WP was submitted as WP11, but was revised based on the comments captured in the discussion below and resubmitted as WP09. The WG reviewed the revised paper and agrees with the analysis and conclusions of the authors.

Discussion – The TWN LL fishery began in 1995 and was operating north of 25°N in the central Pacific Ocean. The fishery expanded to tropical waters between the equator and 15°N around 2000 and has continued to operate in these two areas ever since this time. The analysis conducted by the authors shows that the north component of the fishery has a larger catch share than the tropical component and that the two components target albacore (northern) and bigeye tuna (tropical). **The WG agreed to split the TWN LL fishery into a southern and northern fishery as recommended by the authors. The northern juvenile albacore targeting fishery is between 25 and -45°N and 140°E to 140°W. It was noted that the southern boundary does not line up with the conceptual model divide at 30°N, but the use of 25°N was justified based on catches occurring between 25 and 30°N.**

6.2.2 *A Review of North Pacific Albacore Fishery Data Reported by Non-ISC Countries. John Holmes. (ISC/16/ALBWG-02/01)*

North Pacific albacore fishery data (catch, spatial distribution of catch and effort, size composition of catch) reported by non-ISC countries to the IATTC and WCPFC are reviewed in preparation for the upcoming stock assessment in April 2017. Although up to 13 countries have reported catches of north Pacific albacore, only China and to a lesser extent Vanuatu, have sufficiently complete time series to permit considering the establishment of separate fisheries in the assessment model. It is recommended that a tropical longline fishery operating along the equator between 0 and 20°N be used for Chinese catches and that the Vanuatu catches be pooled into a temperate longline fishery operating between 30 and 40°N. It is also recommended that catches from other non-ISC countries be pooled in the Chinese longline fishery as the limited spatial information shows that these catches are made in tropical waters and size compositions are similar to the Chinese catch. It is not clear whether Chinese CPUE and size composition data are representative of the fishery and it is recommended that these data not be used in the upcoming assessment model.

Discussion – Although 20 non-ISC countries have reported catches of north Pacific albacore since 1970, more than 95% of this catch was made by China and Vanuatu since 2000. Maps of the spatial distribution of the Chinese and Vanuatu longline fisheries were examined along with plots of quarterly size composition data. The WG requested maps of the spatial distribution of Vanuatu and China longline catch at a 5°x5° stratum, which were provided the next day and inspected by the WG. The Vanuatu longline fleet operates in tropical waters along the equator in the eastern Pacific Ocean, but the main area of operation, based on catch, is north of 30°N. In contrast, while the Chinese longline fleet also operates north of 30°N, the main area of catch is in tropical waters between 0 and 15°N in the eastern and western Pacific Ocean. Only two years of quarterly size composition data were available from Vanuatu. Several years of size composition data are available for China, but the WG was concerned about bias in the sampling program since there were no details about the sampling available and previous meetings with Chinese scientists (in 2013) had raised concerns about restricted sampling from a few vessels that do not target albacore, meaning the albacore targeting component of fleet was not sampled. **The WG agreed that size composition data from Vanuatu and China should be included in the model as a guide to the choice of fleet for mirroring selectivity, but these data should not be used for fitting.** Given the spatial distribution of these fleets, the TWN northern albacore longline or US shallow-set longline are potential choices for mirroring selectivity. **The WG agreed that the catches for both fleets should be split at 30°N, consistent with Japanese longline fishing areas.**

The WG briefly discussed the Korean longline fleet. This fleet had relatively high albacore catches in the 1970s but a change in operations has resulted in minor amounts of bycatch (<100 t) since the late 1980s. Since catch levels are not high enough to make a separate fishery and no size composition data are available to clarify the size of fish targeted by the Korean fleet, **it was recommended adding the Korea longline to the Japanese longline fleets with the same areas definitions, as was done in the 2014 assessment. The WG requested plots of quarterly 5°x5° catch by Korea LL fishery for decisions concerning seasonal/area splits prior to the assessment workshop.**

The EPO surface fishery were also discussed. The WG notes that this fishery should include the catch of the Mexican purse seiners, US miscellaneous fleets as well as the Canadian and US troll fleets. The model should be fit to the size composition of the US troll fisheries, as in the 2014 assessment. **Since no EPO surface fishery WP was prepared for this meeting, the WG requested that US and Canadian scientists prepare a WP for the assessment meeting.**

6.2.3 *Spatiotemporal definitions of the US albacore longline fleets in the North Pacific for the 2017 assessment. Steven L. H. Teo. (ISC/16/ALBWG-02/08)*

In the previous assessment in 2014, the albacore working group (ALBWG) modeled the deep-set and shallow-set components of the US pelagic longline fishery as separate fleets. The primary aim of this study was to re-examine the size composition data from the US pelagic longline fishery in finer detail and develop fleet definitions for the stock assessment with more consistent size compositions. These fishery definitions were subsequently used to develop quarterly size compositions that were raised to the catch, as well as the appropriate sample sizes. The eastern North Pacific Ocean was divided into 22 10°x10° areas with available size composition data. A clustering approach was taken to discern areas with relatively consistent size compositions. In order to reduce the dimensionality of the problem, the size composition data was aggregated to approximate age group compositions using the size-at-age information in the 2014 assessment. The results of k-means and agglomerative hierarchical clustering of the size composition data were consistent with each other, suggesting between two to four clusters. There appears to be a core large adult area (areas 12, 13, 17, 18) with the vast majority of fish (>80%) being large adults ≥100 cm FL, and a peripheral area (areas 6, 14, 19, and 21) with a smaller proportion of large adult fish (~55%) and a larger proportion of small adult fish (85 – 100 cm FL). There also appears to be a core juvenile albacore area (areas 8, 9, 10, and 11), especially in seasons 1 and 4, with ~56% of the albacore being juveniles <85 cm FL, and a peripheral area with a lower proportion of juveniles (areas 7 and 15) (~29 %). Therefore, I recommend using the two clusters (F1: areas 6, 12, 13, 14, 17, 18, 19, and 21; F2: areas 7, 8, 9, 10, 11, and 15) as the two fleets for the US pelagic longline in the upcoming assessment. The seasonal size compositions (raised to the catch) for the proposed fleet definitions for the US pelagic longline fishery were shown. The proposed input sample sizes ranged from 1 to 16 for F1 (north area; predominantly juvenile), and 1 to 20.5 for F2 (south area; predominantly large adult).

Discussion – Cluster analysis of the size composition data of the US longline fleet that operates around the Hawaiian Islands indicates a separation of two main areas of operation. The first area is northeast of Hawaii, where shallow sets are used to target swordfish mainly in the 4th and 1st quarters (October to March), and albacore of smaller average size are caught. The second area southwest of Hawaii is the core area for albacore catches; the average sizes of albacore are much larger in this area than the northwest area. The data support a diagonal separation of the fleet in space. **The WG supported this analysis and recommends using this diagonal separation into two fleets and noted that although the new definitions might not make much difference in the assessment, they are consistent with the conceptual model. The WG will fit size composition data from both US longline fisheries in the model.**

Preliminary fishery definitions are captured in Table 4 and are overlaid on the conceptual model of stock structure and movements in Figure 2. It should be noted that these definitions are based solely on spatial criteria at present, they do not include seasonal considerations.

7. CPUE INDICES

7.1 Taiwan Longline

The WG reviewed the TWN LL CPUE index. The index is derived from the northern albacore-targeting fleet. Sets by this fleet use 4-13 hooks per basket (HPB), while bigeye targeting sets use 14-20 HPB. However, beginning in 2012 some albacore sets have used 21-25 HPB. The WG questioned the authors about whether this new method was included in the CPUE standardization procedure and noted that all albacore targeting sets were pooled, regardless of HPB. The WG requested that the authors redo the standardization procedure using a categorical factor for HPB. The authors did this during the meeting and noted that high HPB fishing is spatially restricted to the northeast area and effort is relatively low (10,000-30,000 hooks per 5°x5° area). The new GLM trends were nearly identical to the original trends but slightly higher in magnitude. **The WG recommended adding the new analysis to a revised WP11 and using the original standardized CPUE index in the upcoming assessment (no HPB factor). However, Taiwan scientists should continue to monitor higher HPB fishing for future assessments.**

7.2 *Update standardized CPUE for North Pacific albacore caught by the Japanese pole and line data from 1972 to 2015. Junji Kinoshita, Daisuke Ochi and Hidetada Kiyofuji. (ISC/16/ALBWG-02/04)*

In this document, we estimated standardized catch per unit effort (CPUE) of North Pacific Albacore (NPALB) that were caught by the Japanese distant-water pole and line (JPN PLDW) from 1972 to 2015, with delta-lognormal GLM model in the same way as previous document (Kiyofuji 2014). In this model, we used four explanatory variables—year, quarter (two levels: 1st and 2nd quarters combined; 3rd and 4th quarters combined), 5°×5° grid squares as area, and vessel ID—as categorical factors and separated the period (1972–2015) into two periods (1972–1989 and 1990–2015). We also updated and reformed data set for estimating CPUE; accordingly, relative abundance indices are mostly same with previous values, but the index in 1987 largely increases compared with the previous index. In addition, the index in 2015 shows the lowest level. Further comparison between simple-updated estimates and quarter-changed estimates indicates that quarter-changed estimates appear to be more suitable trend.

Discussion – The fishery went through a change in seasonal catch distribution from predominately the 2nd quarter prior to 1990 to the 2nd and 3rd quarters combined after 1990. The WG noted that the majority of effort and catch occurs in the area corresponding to longline area 3, with some in Area 1 and very little south of 30°N. **The WG agreed that the PL catch data should be divided into fisheries north and south of 30°N.** However, CPUE standardization used all DWPL data in Areas 1, 2, and 3. **The WG recommended that the authors recalculate the DWPL index using data from Area 3 only**.

7.3 Japan Longline Index

H. Ijima briefly reviewed some concerns about the Japan longline index used in the 2014 assessment and ongoing research to address the issue. An evaluation of the 2014 longline index (GLM using binomial distribution and 2014 area definitions) found that there is an annual trend in the residuals, which was not fully removed by the standardization process. Research is ongoing to develop a Bayesian standardization model with 10°x10° spatial strata as a random effect. Preliminary results based on the previous area definitions appear promising in terms of reducing the width of credibility intervals around the index. **The WG supports the Bayesian approach to CPUE standardization and recommends splitting the Japanese longline into two indices: Area 2 and Area 4 (large fish). The WG requests that Japan prepare a CPUE WP for the assessment workshop.** It was noted that the new index could be the main index in the assessment model. However, since the outcome of this work is uncertain at present, the WG discussed an alternative plan which is to standardize indices using the procedure from the 2014 assessment (GLM with binomial error distribution) and the new area definitions.

7.4 USA Longline Index

S. Teo provided a presentation on the development of a US longline index. The index is based on data from the southwest area around Hawaii (previously called the deep-set fishery) and includes a few more 10°x10° blocks than were used in the fishery definition. A Delta log-normal GLM was employed using a binomial distribution for zero catches and lognormal for non-zero catches. Residuals show a pattern at low values, but are otherwise fine. It was suggested that the residual patterns show that a different error model should be used for the lognormal component. While this is true, the WG did not consider it to be an issue since **it recommended that this index be used as a sensitivity run rather than a primary model index. The WG also agreed that the index should be split into 1991-2000 and 2005-2015 segments due to changes in regulations in the 2001-2004 period. Lastly, the WG requested that a WP at the assessment workshop describing the standardization process and quality control procedures.**

7.5 EPO Surface Fishery Index

The WG discussed the EPO Surface Fishery index, which is based on US and Canada troll data. This troll fishery is largely coastal and it was expected that there would be few changes, other than updating data, from the index used in the 2014 assessment**. The WG recommended dropping the 2012 data point from the index due to different trends in US and CAN CPUE most likely related operational constraints due to the absence of a fishery regime in the Canada-United States bilateral tuna treaty for 2012. Since no WP was prepared for this meeting, the WG requested that US and Canadian scientists prepare a WP describing the index and standardization procedure for the assessment workshop.**

8. SIZE COMPOSITION DATA

A brief discussion of size composition data noted that in the 2014 assessment many of the size compositions were based on raw data and that this approach may have affected fitting to these data. **The WG recommends raising all size composition data to the catch (quarter, fleet, area month strata) for the 2017 assessment in an attempt to reduce noise related to observation error and improve fits to size composition.**

8.1 Taiwan

The WG recommends using Taiwan longline size composition data from 2003 onwards as shown in WP09. These data are sampled from the northern albacore-targeting fleet. After much effort during the 2011 and 2014 assessment preparations, the WG has concluded that the size composition data sampled prior to 2003 are biased and are not salvageable for use in the assessment model. It was noted that the Taiwan longline size composition data (albacore-targeting fleet) are currently shown as raw data in WP09. Taiwan longline size composition sample size should be the number of days (since there is 1 set per day) sampled for the size compositions, and downscaled to the 'number of trips' (probably using the US longline data for this down scaling). **The WG requested that Taiwan scientists provide size composition raised to the catch as well as the number of days sampled and that a WP be submitted at the assessment workshop.**

8.2 US Longline

The WG examined plots of raw and raised size compositions from the US longline fleet. It was noted that there was some noise in the raised plots due to the small number of trips sampled in some strata. **The WG recommended that only strata with a minimum of 3 or 5 trips be included in the analysis.** This filtering will lead to results representing the core area where the bulk of the catch occurs. A sample size based on the weighted number of trips is considered appropriate by the WG. Strata with poor or missing size composition data but with catch, will be assumed to have the same size composition as the overall size composition for the fleet. The WG discussed this assumption and agreed that this is appropriate since the analysis from the WP-08 suggests that size compositions in each fleet are relatively consistent. **The WG requested that a WP be submitted to the assessment meeting on the size compositions and the number of trips sampled.**

8.3 Japan Longline

The WG reviewed size composition data compiled using the updated fishery area definitions (Section 6.0). The new Area 4 definition appears to be more consistent with the availability of large (>125 cm) fish. The size samples in Area 3 (>30°N) appears to be relatively poor but there is a large amount of catch in Area 3. Size samples in Area 2 (<30°N) appears to be well sampled.

Plots of size composition data raised to the catch need to be produced and evaluated by the WG. If size compositions raised to the catch do not appear to be representative of the size of fish from that area, then it may have to be assumed that the size of fish caught in Area 2 is similar to pole-and-line caught fish. A conference call/webinar will be arranged for January 2017 once Japan has completed the work, to evaluate the results and decide on the need for temporal splits in longline fisheries.

8.4 Japan Pole-and-Line

A review of raw size composition data from the 2nd and 3rd quarters appears to show similar sizes are caught, i.e., that it may not be necessary to implement a seasonal split. **However, the WG needs to evaluate size composition raised to the catch to confirm this decision and will do so during the conference call/webinar in January 2017 described above.**

8.5 Others

The raw size composition data from the JPN Purse seine is similar to the size composition of the JPN PL fleet. **The WG tentatively recommends including Korean longline data in Area 4, pending a review of quarterly 5°x5° catch plots prepared by the WG Chair.**

The size composition of the driftnet fishery from 1990 and 1991 shows that the majority of fish measured were <75 cm FL. **The WG requested that Japan prepare size compositions for this gear raised to the catch, if possible, for further examination and describe the process in a WP for the assessment workshop.** No decision has been made on whether the model will be fitted to the driftnet data at this time.

9. UPDATING DATASETS AND 2014 MODEL RESULTS

H. Ijima described a short presentation documenting the results of using updated Japanese datasets (to 2015) and carryover for other datasets with the 2014 model structure and fishery definitions. The goal of this analysis is simply to document what happens when the only change to the model is new data. As expected, trends in SSB and recruitment were similar to 2014, but SSB and R_0 were lower because catch and CPUE decreased from 2012 to 2015. The WG noted that some CPUE trends may change due to new analyses presented at this workshop. **The WG recommends including a fuller report on these results in the assessment workshop report (not the assessment document).**

10. BASE CASE SCENARIO: ASSUMPTIONS AND RATIONALE

The WG discussed structural and parameter assumptions for the 2017 and developed a provisional base case scenario parameterization during the workshop. This parameterization and the rationale behind these decisions are shown in Table 5.

10.1 *Meta-analysis of north Pacific albacore tuna natural mortality. Michael John Kinney and Steven L. H. Teo. (ISC/16/ALBWG-02/07)*

The instantaneous rate of natural mortality (M) parameter was identified as a key source of uncertainty in the 2014 stock assessment of north Pacific albacore tuna (NPA), and was identified by the albacore working group (ALBWG) as being in need of updating prior to the next assessment in 2017. Meta-analyses of four empirical relationships between life history factors (i.e., maximum age, age at maturity, growth, and gonadosomatic index [GSI]) and M were used to calculate prediction intervals and priors for M of NPA. These multiple M priors were combined using weights based on the degree of overlap in the data sets used for the meta-analyses (data independence weights). Preliminary results indicated that M priors produced using GSI as the predictor variable were inconsistent with the results from other meta-analyses. The methods used to estimate GSI values for NPA may also have been inconsistent with the methods used in the study examining the relationship between M and GSI. Without the influence of the GSI prior, the estimated adult M (age 6+) distribution for NPA had a median of 0.39 (95%: 0.16 - 0.95). Age-specific M for juvenile NPA (ages 0-5) were estimated using the Lorenzen relationship between size and M, and an adult M of 0.39 for NPA at age 6, and ranged from 1.71 at age-0 to 0.39 at age-6+. Overall, we recommend using the age-specific M estimates from this study in the next albacore stock assessment. With a higher M, it would indicate that the NPA stock may be more productive than previously assumed. Although this analysis is still based on some subjective decisions and the influence of life history variability between different geographic regions and substocks was not explored thoroughly, the resulting M estimates are likely more appropriate than previous estimates. In addition, the derived M distribution should also suggest the appropriate bounds for sensitivity analyses or M priors in future assessments. Although the derived M distribution is wide, we consider this to be a realistic representation of our uncertainty in the M estimates of NPA, due to the large uncertainty in the relationships between M and various life history parameters.

Discussion - **The Working Group agreed that the meta-analysis was a significant improvement for the setting of M in the stock assessment.** The WG interpreted the results of the new analysis (M=0.39) as supportive of the original assumption (M=0.3). However the WG noted that the meta-analysis estimate of M was highly uncertain. The WG also noted that rescaling juvenile M using the Lorenzen relationship resulted in surprisingly high mortality for juveniles, especially age 0 and 1. **The WG recommends exploring 4 potential base case assumptions for M: 1) the original M= 0.3 for all age classes and both sexes, 2) age specific M based on the meta-analysis (from table 5 WP-07), 3) age 3+ M=0.39 with Lorenzen rescaling for ages 0-2, and 4) re-analysis of M (with methodology described WP-07) that accounts for sex specific mortality based on observed longevity. The M=0.3 for all age classes (option 1) is assumed to be the default base case setting unless one of the 3 alternatives is shown to be demonstratively better. The WG requested that a WP be prepared for the assessment workshop describing these scenarios.**

10.2 *Sex ratio, spawning season, spawning fraction and size at maturity of North Pacific albacore (Thunnus alalunga) caught in subtropical western North Pacific. Hiroshi Ashida, Toyoho Gosho, and Hidetada Kiyofuji. (ISC/16/ALBWG-02/05)*

In order to clarify the reproductive activity in north Pacific albacore, we examine the sex ratio, spawning season, spawning fraction and relationship between fork length (FL) and maturity rate. The histological observation was conducted in ovarian samples. Although the sex ratio was biased to females significantly between 80-84.9 and 85-89 FL class, the proportion of female in FL class were decreased significantly in 100-104.9, 105-109.9 and 110-114.9 cm FL class. The spawning fish in female observed between February and October and active mature phase were observed all year around except for January. Spawning fraction (intervals) throughout spawning season were 0.39 (2.56 days) and it increased between May and August. Minimum size at maturity and predicted 50% maturity size were 88.1 and 86.3 cm FL.

10.3 *Estimation of sexual maturity-at-length of the North Pacific albacore. Kuo-Shu Chen, Chien-Chung Hsu, Chiee-Young Chen, Fei-Chi Cheng, and Hirotaka Ijima. (ISC/16/ALBWG-02/10)*

This working paper is aiming to estimate the maturity-at-length of North Pacific albacore, in an attempt to provide up-to-date information for future stock assessment of the albacore stock. In total, 293 specimens were collected from North Pacific Ocean dating 2001-2008, including 160 male and 133 female specimens, respectively. Sexual maturity of these samples was determined based on histological examination of testes or gonads. The maturity ogive of each sex using length-maturity data was constructed, and results were obtained as $P=1/(1+\exp(23.9271-0.2807L_F))$ for the male, and $P=1/(1+\exp(38.8609-0.4517L_F))$ for the female, where P is the probability of being mature at fork length L_F. The fork length at 50% maturity (L_{50}) were also estimated as 85.2 cm and 86.0 cm for the male and female, respectively. The 50% female maturity age was then obtained as 5.07 based on the female L_{50}.

Discussion - The WG discussed the implications of WP05 and WP10 together. The WG noted that there may be a spatial component to maturation, but that accounting for this effect may be difficult at this time. The WG also considered whether maturation is an age or length-based process. Data were presented that were ambiguous regarding the relative importance of age or length-based processes on maturation. It was noted that an age based assumption of maturation is more consistent with the Conceptual Model of albacore structure and the assumption used in the prior assessment. **Therefore, the WG recommends continuing with the past approach of modelling maturity at age.**

The ALBWG discussed the spatial trend of sex ratio and noted that there is a possibility of different spatial distribution and/or natural mortality by sex. If this hypothesis is true, then the estimated female spawning biomass will change. It was suggested that one approach to address this issue is to estimate female natural mortality while holding male natural mortality fixed at $M=0.3\ yr^{-1}$.

10.4 Growth Modeling

C. Minte-Vera made a presentation exploring the paired age-length data for albacore. Several potential biases related to estimating length-at-age were discussed including: size selective gears, size based sampling at docks, and spatial availability of different age classes. The importance of sex-specific growth models was also discussed, noting that good evidence exists for sexual dimorphism in north Pacific albacore. **The WG recommends that sex-specific growth be estimated using paired age-length data assuming random at length and integrated with tagging data outside the dynamic model.** The WG notes that this method accounts for length based processes (such as gear or sample selection) affecting mean length at age in the otolith data but does not account for age based processes (such as movement). **The WG also recommends estimating sex-specific growth with an alternative approach using the paired age-length data inside the assessment model assuming random at length and the length composition data which assumes random at age.** The WG notes this approach will account for length based processes and age based processes if a combination of both length and age selectivity is estimated. However, estimation of growth may lead to assessment model convergence or running time issues. **Therefore, a third option is to estimate sex-specific growth in the assessment model as described above, but using a two-step iterative process 1) estimate growth parameters conditioned on the dynamics (fixed model parameters) and then 2) estimated dynamics conditioned on growth(fixed growth parameters).** This approach should be followed until step 1 and 2 give the same estimates. **The WG requested that a WP on growth be developed for the assessment workshop and that a WP describing the age-at-length data be developed in case growth is estimated within the model.**

C. Minte-Vera later in the workshop walked the WG through a presentation describing some ideas about the integrated tagging-otolith-length frequency growth model that she is preparing for the assessment workshop in April 2017. Preliminary results of a “straw man” model run sparked discussion on the fact that the growth model may need to account for life history attributes such as age of change in habitat/age of maturity, growth by sex and mortality by sex and the model probably needs a “layer” of observation models that take into account selectivity and sampling design. The WG was impressed with the thinking behind the model and requested copies of the presentation and the Excel “strawman” model, which C. Minte-Vera subsequently provided with instructions to use the Excel model to think about how to model growth of north Pacific albacore**. The WG recommends this modeling approach as the first option for growth in the upcoming assessment model. The backup plan is to use the two-sex growth model used in the 2014 assessment.**

10.5 Initial Conditions

Initial conditions will consist of estimating F on the JPN PL and LL fisheries, which is the same procedure used in the 2014 assessment. No recruitment offset will be estimated, but recruitment deviations for 10 years prior to 1966 will be estimated. The goal is to have as few assumptions as possible at the start of the model period.

The WG will evaluate catchability and selectivity once size compositions raised to catches are available. Thus, decisions concerning fitting time varying process are deferred until the data are in the model at the assessment workshop.

The WG discussed structural and parameter assumptions for the 2017 assessment model and developed a provisional base case scenario parameterization shown in Table 5.

11. DIAGNOSTIC ANALYSES

The WG reviewed the diagnostics analyses proposed at its May 2016 workshop (Table 6) and confirmed that these analyses are planned for the upcoming assessment.

12. SENSITIVITY ANALYSES

The WG discussed a suite of potential sensitivity analyses to be completed during the 2017 stock assessment and confirmed that it still plans to address these sensitivities (Table 7). It was noted that the full range of sensitivity runs will not be determined until completion of the stock assessment, but a preliminary set of runs is given in Table 7.

13. FUTURE PROJECTIONS

13.1 *New future projection program for North Pacific albacore tuna (Thunnus alalunga): considering two-sex age-structured population dynamics. Hirotaka Ijima, Osamu Sakai, Tetsuya Akita and Hidetada Kiyofuji. (ISC/16/ALBWG-02/06)*

In 2014, International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) albacore working group (ALBWG) conducted a stock assessment for North Pacific albacore tuna. In this assessment, ALBWG assumed two-sex age-structured population dynamics and R software package SSfuture was used for future projection. However, ALBWG couldn't predict total biomass and expected albacore catch, because SSfuture couldn't calculate sex-different population dynamics. Here we constructed new future projection program considering two-sex age-structured population dynamics. We used R software package Rcpp which makes a seamless integration between R and C++. To clarify this new program work, we addressed simple future projection and compared with the projection result from Stock Synthesis 3 (SS3). The new future projection program worked approximately same as SS3. Hence this program is useful for next North Pacific albacore tuna stock assessment.

Discussion – **Although this package is a work in progress and requires additional testing, the WG considers the new code to be a substantial improvement over the previous code. The WG recommends using this new code for the 2017 assessment.** The authors also suggest that the low, average, and high recruitment scenarios employed in the 2014 assessment not be used in the upcoming assessment because they are not all that realistic. Instead, they recommend an auto-correlated recruitment model estimated from the original recruitment (see Punt 2010 for details**). The WG agreed with this recommendation and the suggestion that the estimated CV of the SSB be used as the indicator of the uncertainty in the initial population structure, instead of bootstrapping the assessment model.** H. Ijima noted that he is still working and testing the code and that when finalized, he will upload it to Github for distribution and notify the WG when this occurs.

A discussion of the length of projections led to agreement that 30 years was too long. The WG agreed that the projections are produced to give managers a look ahead in the period prior to the next assessment. **Thus, the WG agreed that 5 year projections would be used for the 2017 assessment.**

13.2 *Reference points under the hypothesis of a sex-specific life-history. Tetsuya Akita and Hirotaka Ijima. (ISC/16/ALBWG-02/12)*

The detailed description of several reference points under a sex-specific model was proposed and were applied to North Pacific albacore based on the stock assessment in 2014. Commonly confused settings of reference points which come from sex specific properties were pointed out, providing a material for further discussion towards the next stock assessment in 2017. R source code that was used for this document was attached.

Discussion – The main issue identified in this WP is that the definition of reference points under a two-sex model is not clear; some reference points relate specifically to female biomass, others do not. The WG agreed that it needs to be clear what is included in the estimate (both male and female or female only). It was noted that the WG should take the issue up with the ISC plenary, that there is confusion in the definitions of reference points among managers. Based on a more general discussion, **the WG agreed to drop F_{MED} as an estimated reference point since it cannot be well estimated for this stock and include total biomass in the reference point table, in addition to the female SSB and total equilibrium yield.** The authors of WP12 will continue to work on this issue and will provide a WP at the assessment workshop.

14. RECOMMENDATIONS

14.1 Schedule and Deadlines

- ALBWG Chair will formally invite Alan Hicks (IPHC) to attend the assessment workshop as part of the US delegation. The US will cover his travel expenses;
- ALBWG Chair and C. Minte-Vera will work to invite Chinese assessment scientist – Jiang Feng Zhu to the stock assessment workshop;
- 30 November 2016 – WG members to report on any travel restrictions related to the stock assessment workshop in April 2017 and the US will advice about hosting in La Jolla. The WG will decide location of assessment workshop via email;
- 16 January 2017 – data format spreadsheet distributed to WG members;
- 09 January 2017 – ALBWG Chair will organize a conference call/webinar to discussed raised size composition data;
- 31 January 2017 – data submission deadline to S. Teo and WG Chair. Life history data, maturity, growth curves, weight-length relationships should also be included in the data template;
- 06 February 2017 - data files checked and distributed to WG members for quality control;
- 13 February 2017 – feedback from WG members on distributed data only if differences are observed by WG members;
- 24 March 2017 - WPs for discussion at assessment workshop submitted ALBWG Chair; and
- 4-13 April 2017 – Stock assessment workshop, location to be determined around Nov 30.

14.2 SS3 Version

The WG reviewed a short presentation by S. Teo comparing SS 3.24 and 3.30 output. Trends in female SSB are similar from both and relative magnitude is the same. The format of the data and control files have changed in 3.30 and it also provides finer temporal control of recruitment to the month and fraction of a month. SS3.30 is currently in beta and so is not available for widespread use at present. **S. Teo recommends using the latest release of SS 3.24 for the 2017 assessment and the WG agreed.** S. Teo and K. Piner will obtain the latest release of 3.24 and distribute to the WG when data compilation has been completed.

14.3 Assessment Workshop Location

The WG has scheduled the assessment for 4-13 April 2017 in Shimizu, Japan. However, due to travel restrictions on IATTC scientists, a request was made for a change of location to La Jolla, CA. The WG Chair requested that all members determine whether they have similar restrictions and be prepared to discuss the location by 30 November 2016.

15. WORK PLANS AND ASSIGNMENTS FOR STOCK ASSESSMENT WORKSHOP

1. WP describing JPN pole-and-line CPUE developed for Area 3 (north of 30°N and east of 140°E) – H. Kiyofuji, H. Ijima;
2. WP describing JPN longline CPUE indices in Areas 2 and 4 (large fish) and Bayesian standardization procedure used – H. Ijima, D. Oochi;
3. Plots of quarterly 5°x5° catch by Korea LL fishery for decisions concerning seasonal/area splits prior to the assessment workshop – J. Holmes;

4. WP describing the US/CAN troll index and standardization procedure in the EPO, dropping the 2012 data point – J. Holmes and S. Teo;
5. WP describing the US LL index and standardization procedure – S. Teo;
6. WP describing TWN LL size composition data raised to the catch of the TWN LLN fleet – C.-Y. Chen;
7. WP describing the US LL size compositions raised to the catch – S. Teo;
8. WP describing the EPO surface fishery size compositions raised to the catch – S. Teo;
9. WP describing size composition data raised to catch for JPN LL and PL fisheries – H. Kiyofuji;
10. WP describing effective sample size for JPN LL and PL fisheries – D. Oochi, H Ijima;
11. WP describing updating M meta-analysis and scenarios discussed in Section 10.1 of this report – S. Teo;
12. WP describing growth model options for the assessment model discussed in Section 10.3 of this report as well as the age-at-length data in case the decision to estimate growth within the assessment model is made – C. Minte-Vera;
13. WP providing more detail and algorithms for estimating reference points in a two-sex model – H. Ijima.
14. WP or presentation describing ASPM model diagnostics of assessment model - C. Minte-Vera
15. Discuss Maunder growth model for tropical tunas informed by maturity data, if available from #8 (presented at SAC in 2015) C. Minte-Vera
16. Initial sample sizes for size composition based on set or trip data, which should be included in size composition data WPs – JPN, US, TWN;
17. Contact Chinese scientist about catch data and invite to participate in stock assessment process – J. Holmes and C. Minte-Vera;
18. Distribute the latest release of SS 3.24 to the WG when data compilation has been completed - S. Teo and K. Piner; and
19. Provide catch, size composition, and CPUE (if available) data up to 2015. Investigate availability of 2016 catch data for assessment – all WG members.

16. FUTURE ASSESSMENT SCHEDULING

The WG discussed the assessment schedule developed by the Bluefin WG consisting of benchmark, update, and research, and concluded that the current 3-yr cycle was appropriate for albacore. The WG will determine whether an assessment will be an update assessment (same structure assumptions but update input data) or a benchmark assessment during planning for the assessment.

17. OTHER MATTERS

No other matters of substance were raised or discussed.

18. CLEARING OF THE REPORT

The WG Chair prepared a draft of the report, which was reviewed by the WG prior to adjournment of the workshop. After the workshop, the WG Chair evaluated and incorporated suggested revisions, made final decisions on content and style and distributed a second draft of the report via email for approval by the WG members. Subsequently, the WG Chair provided the report to the Office of the ISC Chair for review at the ISC17 Plenary Session.

19. ADJOURNMENT

The ALBWG meeting was adjourned at 12:30 on 14 November 2016. The WG Chair thanked WG members for their meaningful scientific discussion and a productive meeting and stressed the need to maintain ongoing communication and cooperation concerning the exchange of data and results as the WG gears up for the stock assessment workshop.

20. LITERATURE CITED

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Table 1.Work assignments for the data preparation workshop developed at the May 2016 ALBWG meeting

Assignment	Lead Scientist(s)	Status
New JPN fishery definitions and the development of a pre-1975 longline index	H. Ijima, H. Kiyofuji, and S. Teo	Preliminary definitions completed will be discussed at data preparation workshop (WP03). LL index in progress and will be completed for assessment workshop
Estimate standardized CPUE indices and report results in WPs containing the information identified in Table 3	H. Ijima, H. Kiyofuji, S. Teo, C.-Y. Chen	Completed for JPN (WP04) and TWN (WP11) and will be discussed at data preparation workshop; in progress USALL and US/CAN troll and will be completed for assessment workshop
Develop WP investigating alternatives for estimating M (Lorenzen with 0.3 for adults, SPC M vector, use tagging data) before the assessment	S. Teo	Completed and will be discussed at data preparation workshop (WP07)
Investigate potential travel funding for independent scientific expert to attend stock assessment workshop	S. Teo	Completed
Develop new code for future projections based on two sex, constant F;	H. Ijima	Completed and will be reviewed at data preparation workshop (WP06)
Explore combining otolith and tagging data to estimate growth in model	C. Minte-Vera and H. Ijima	In progress; report expected at assessment workshop
Conduct ASPM model diagnostics for stock assessment workshop	C. Minte-Vera	In progress; report expected at assessment workshop
Check if maturity at length data available and reformulate maturity ogive if possible	H. Ijima	Completed and will be discussed at data preparation workshop (WP5, 10)
Consider Maunder growth model for tropical tunas informed by maturity data, if available from #8 (presented at SAC in 2015)	C. Minte-Vera	In progress and will be discussed at assessment workshop
Chen (2010) paper expresses relationship between gonad weight and length; work up data if possible for NPALB	C.-Y. Chen to retrieve raw data and collaborate with H. Ijima	Completed and will be discussed at data preparation workshop (WP10)

Initial sample sizes for size composition based on set or trip data	H. Ijima, H. Kiyofuji, C.-Y. Chen, and S. Teo	In progress and WP expected at stock assessment workshop
Contact Chinese scientist about catch data and invite to participate in stock assessment process	C. Minte-Vera to make contact and J. Holmes to issue invitation	In progress; invitation will be made for stock assessment workshop
Develop a comparison of output from SS 3.24 and 3.30 for the data preparation meeting	S. Teo	Completed, results reviewed at data preparation workshop
Provide catch, size composition, and CPUE (if available) data up to 2015. Investigate availability of 2016 catch data for assessment	All ALBWG Members	In progress

Table 2. Information requirements in working papers to support the development of abundance indices. Taken from ALBWG (2013).

Fishery description	Describe fishery including catch, effort, size composition of catch, nominal CPUE by area, season, history of fishery development and changes
Analysis description	Describe data selection, CPUE standardization model, and CPUE estimates. Include any data filtering, outlier removal
Statistical Results	Provide model diagnostics and goodness-of-fit criteria relative to alternative model configurations; ANOVA tables, etc.
Nominal/Standardized	Comparison plot of nominal and standardized indices
Diagnostic plots	QQ, residuals, etc.
Point estimate & variability	Characterize uncertainty in estimates of standardized CPUE; SE or CV of standardized CPUE (generated or assumed)

Table 3. Criteria for evaluating the strengths and weaknesses of candidate abundance indices to represent relative abundance of north Pacific albacore in the 2014 stock assessment model. Taken from ALBWG (2013).

Criterion	**Description**
Spatial distribution	Portion of north Pacific covered by fishery; latitude and longitude
Size/age range	Distribution of size or ages in catch
Fishing ground map	Showing area of operations for each fishery by season/decade
Relative contribution	Proportion of total catch in fishery
Temporal coverage	Time period of data collection
Temporal consistency	Change in spatial location of fishing grounds over temporal period, e.g., decadal changes/seasonal changes
Temporal consistency in size composition	Decadal and seasonal changes in size of fish captured
Statistical soundness	Standardization method, diagnostic plots and CPUE variability provided
Targeting	ALB primary target, by-catch species
Catchability Changes (due to management, fishing practices, etc.)	External factors affecting catchability (e.g., management practices, fishing technology, targeting changes)
Socio-economic factors	Price, demand, technological changes (e.g., freezers), etc.

Table 4. Preliminary fishery definitions and descriptions for use in the 2017 north Pacific albacore stock assessment model. N or W in the acronym signify fisheries with catch units in number of fish or weight, respectively.

Fishery Number	Fishery (acronym)	Gear	Spatial Location	Catch History	Catch Units	Documentation
F01	JPN LLA1N	longline	25-35°N, 130-140°E	1966-2015	Number	May be further split by season
F02	JPN LLA1W	longline	25-35°N, 130-140°E	1966-2015	weight	
F03	JPN LLA2N	Longline	0-30°N, 130-160°E	1966-2015	Number	
F04	JPN LLA2W	Longline	0-30°N, 130-160°E	1966-2015	Weight	
F05	JPN LLA3N	Longline	30-45°N, 140-180°E	1966-2015	Number	
F06	JPN LLA3W	Longline	30-45°N, 140-180°E	1966-2015	Weight	
F07	JPN LLA4N	Longline	0-30°N, 160°E-140°W	1966-2015	Number	Catches large fish >100cm
F08	JPN LLA4W	Longline	0-30°N, 160°E-140°W	1966-1993	Weight	Catches large fish >100cm
F09	JPN LLEPON	Longline	30-45°N, 145-180°W	1966-2015	Number	
F10	JPN LLEPOW	Longline	30-45°N, 145-180°W	1966-1993	Weight	
F11	JPN PLN	Pole and line	30-45°N, 140-180°E	1966-2015	Weight	
F12	JPN PLS	Pole and line	25-30°N, 130-180°E		Weight	Catch may be added to area 2 LL (F03)
F13	USA LLS	Longline	0-40°N, 140-180°W	1966-2015	Weight	Logbook and observer data for 1991-present
F14	USA LLN	Longline	30-45°N, 120-180°W	1966-2015	Weight	Logbook and observer data for 1991-present
F15	TWN LLN	Longline	25-45°N, 150°E-145°W	1995-2015	Number	Albacore targeting fleet

F16	TWN LLS	Longline	0-15°N, 130°E-130°W	1995-2015	Number	Tropical, non-albacore targeting fleet
F17	CN LLS	Longline	0-20°N, 120°E-100°W	2002-2016	Weight	Tropical fishery – divide into 2 areas at 150W
F18	CN LLN	Longline	20-40°N, 120-160°W	2002-2015	Weight	Temperate; combine with TWN LLN fleet (F15)
F19	VU LLS	Longline	0-20°N, 80-180°W	2002-2015	Weight	Low caches
F20	VU LLN	Longline	25-45°N, 150°E-120°W	2002-2016	Weight	Catch will be put in TWN LLAT fleet
F21	KR LL	Longline	10-45°N, 130-180°E	1970-2015	Weight	Include in JPN LLA2&A3 fleets
F22	JPN DN	Driftnet	30-45°N, 140°E-145°W	1975-1993	Weight	High seas driftnet in Area 3, including TWN and KR GN
F23	JPN MNN	Various	30-45°N, 140-180°E	1966-2015	Weight	Primarily purse seine, includes other minor gears
F24	JPN MNS	Various	10-30°N, 130-160°E	1966-2015	Weight	
F25	EPO	Various	20-50°N, 120-180°W	1966-2015	Weight	Primarily troll, but includes CAN, US, MEX

Table 5. Preliminary parameterization of the base case model for the 2017 stock assessment of north Pacific albacore.

Parameter	Tentative value	Notes
Model period	1966-2015-16	Initial assumption, but WG will consider alternative starting time if evidence supports it. 2016 catch included if available.
Stock structure	Single, well-mixed stock	
Natural mortality	0.3 yr^{-1} all ages as in 2014 assessment. Sensitivity run to new series proposed in WP-07	The WG should continue to investigate appropriate choice for M.
Growth	2 sex integrated tagging-otolith model external to SS and use otolith data in SS to estimate growth (random at length) as alternative base-case approach	Iterative process of estimating growth conditional on dynamics and estimating dynamics conditional on growth until model converges (maybe) as sensitivity run.
Stock-recruitment	Beverton-Holt, steepness = 0.9	Based on the midpoint value between two studies (Brodziak et al. 2011b; Iwata et al. 2011) on albacore steepness (0.95 and 0.85)
Maturity	50% at age-5, 100% at age-6	Based on analysis of Ueyanagi (1957) and Chen et al. (2010)
Length-weight	Seasonal length weight relationships from Watanabe et al. (2006)	
CV of indices	Additive constant to CV to make average CV of an index to be 0.2	This is the initial CV of the index, which may be re-weighted relative to other indices, depending on model fits; Bayesian estimates may be used.
Size composition effective sample size	Use the appropriate model process to match sampling error in the data. This is the goal of raising size compositions to catch and redoing fishery definitions.	If process approach is not fully successful, use Harmonic mean or Francis B method to re-weight composition data if needed. Re-weighting of indices is appropriate as final step as indices are prioritized data.

Table 6. Proposed diagnostic analyses for the 2017 north Pacific albacore stock assessment.

Analysis	**Rationale**	**Comments**
Recruitment (R_0) profiling	Model performance	Identifies data providing scale to the model and potential conflicts between data types
Residuals	Model performance	Standard statistical test; model misspecification
Fit to indices, size comps	Model performance	Standard statistical test; model misspecification
Age structured Production Model	Model performance	Highlights conflicting trends in different data types; model misspecification;
Model convergence	Globally optimized	Jitter analysis
Retrospective	Model performance	Bias in terminal year estimates of biomass and recruitment needed for projections

Table 7. List of sensitivity model configurations for 2017 stock assessment of North Pacific Albacore tuna.

Sensitivity run	Alternative assumption	Justification	Comments
Natural Mortality	Age specific M based on the meta-analysis (WP07); age 3+ M=0.39 with Lorenzen rescaling for ages 0-2, and re-analysis of M (see WP07) that accounts for sex specific mortality based on observed longevity.	model performance	
Natural Mortality	Range between 0.3 and 0.4	range of uncertainty	
steepness	Range 0.75-0.9	range of uncertainty	
Growth form	Paired age-length data inside the model assuming random at length and the length composition data which assumes random at age; Estimate sex-specific growth in the model using a two-step iterative process between growth conditioned on dynamics and dynamics conditioned on growth.	model performance	Evaluate importance of composition data on scale
Alternative CPUE	USA LL, TBD	model performance	
Starting years	1952, 1975, 1994	model performance	
Fit to equilibrium catch	Average pre-1966	model performance	
Drop Juvenile CPUE	PL, Troll, Small longline	model performance	Minimize influence of missing movement process on estimated dynamics
Selectivity	All domed	model performance	Evaluate influence of selection assumption

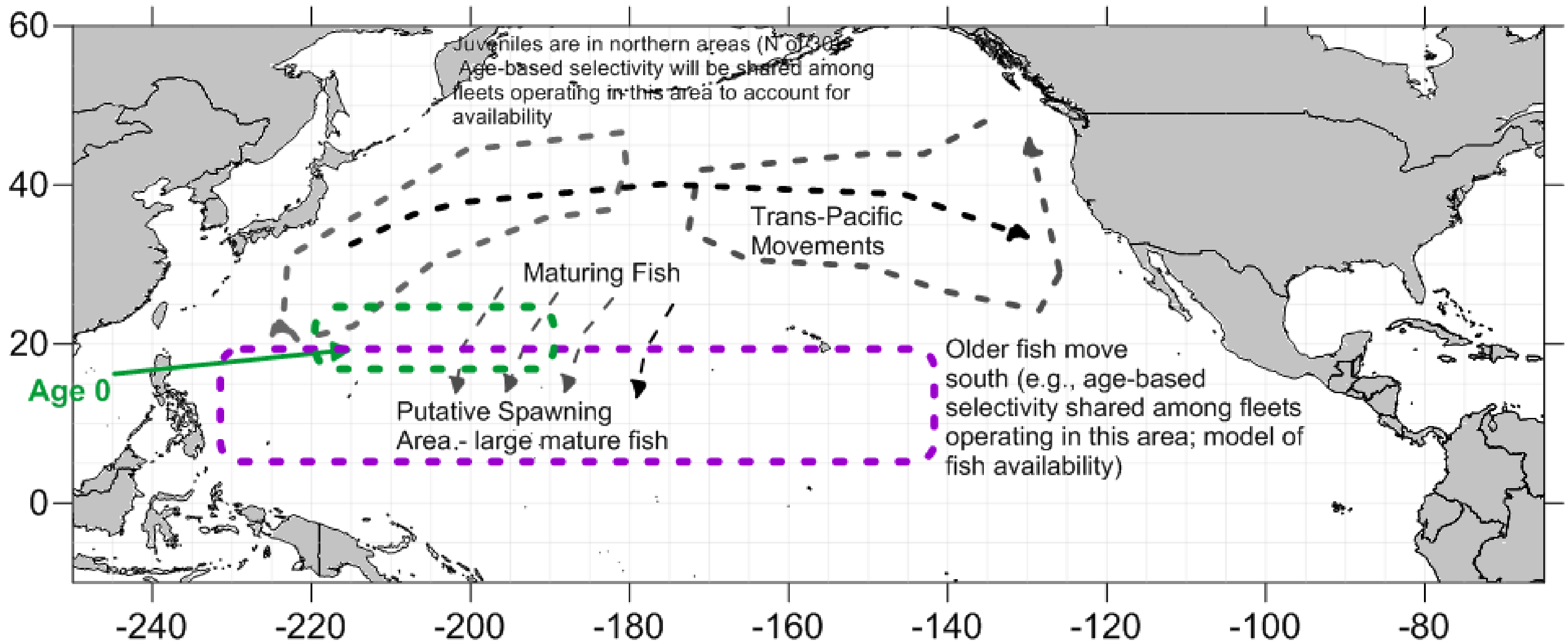

Figure 1. Conceptual model of north Pacific albacore spatial structure and movement patterns.

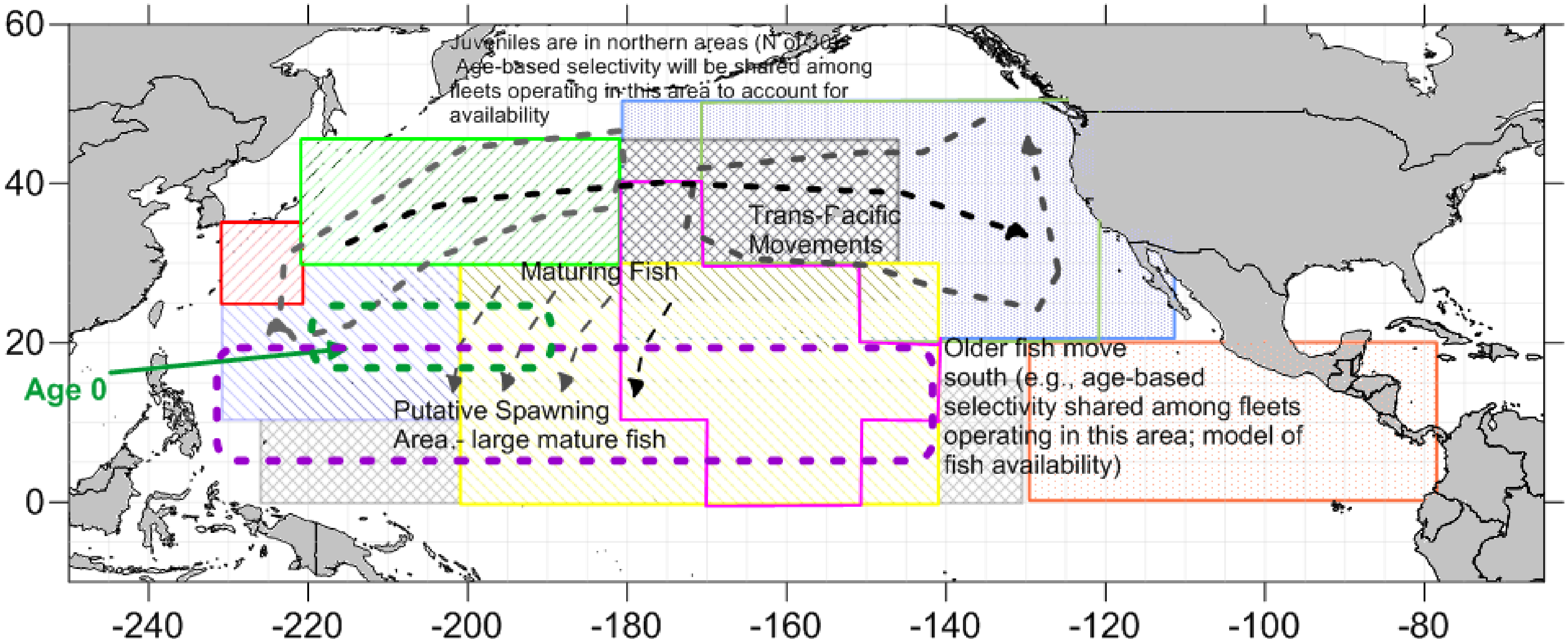

Figure 2. Conceptual model of north Pacific albacore spatial structure and movement patterns overlaid with preliminary fishery definitions developed by the ALBWG for the 2017 assessment model. Areas corresponding JPN LL Area 1 (red), JPN LL Area 2 (blue), JPN LL Area 3 (green), JPN LL Area 4 (yellow), EPO surface fisheries (light blue), USA LL (purple).

ATTACHMENT 1

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ATTACHMENT 2

ALBACORE WORKING GROUP (ALBWG)
INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC OCEAN

INTERSESSIONAL WORKSHOP

8-14 November 2016
Pacific Biological Station, Nanaimo, Canada

Revised and Adopted Agenda

1. Opening of the Workshop
    - Welcoming Remarks
    - Chair’s Remarks (context, objectives, outputs)
    - Meeting Arrangements
    - Introductions
2. Meeting Logistics
    - Meeting Protocol
    - Review and Adoption of the Agenda
    - Distribution of documents and Working Paper Availability
    - Assignment of Rapporteurs
    - Group Photo
3. Review Work Assignments (see attachment)
4. Information Needs Supporting Fishery Definitions and CPUE Indices
    - Information for fishery definitions in WPs
    - Criteria used to assess strength/weaknesses of CPUE indices (see attachment)
5. Conceptual model of structure: Movement Hypotheses, spatial patterns – age vs length-based, sex ratio, growth – Minte-Vera, Kiyofuji
6. Fishery Definitions WP1,2,3,8,11
    - Japan fisheries – PL, LL, other gears; - Piner, Chen
    - TWN LL, USA LL, China/Vanuatu LL?? Kiyofuji, Minte-Vera
    - CAN/USA troll – no one
7. CPUE indices – Ochi, Holmes
8. Size Composition – Teo, Kinoshita
9. Review 2014 assessment model using updated datasets – looking at effects on model results; Holmes
10. Base case scenario: Assumptions and rationale WP 5,7,11,12; Piner, Ijima
    - Model period
    - Structural assumptions (one-stock, etc.)
    - Biological parameters - M, growth form, maturity schedule
    - Primary abundance index/indices for fitting (based on assessment of strengths/weaknesses)
    - Assessing Stock Status – WP 12
    - Initial conditions
    - Catchability and Selectivity

- Weighting of input data types

11. Diagnostic Analyses Chen, Ochi
    - Recruitment profiling
    - Residuals
    - Fits to indices, size composition data
    - Age Structured Production Model
    - Model Convergence
    - Retrospective
12. Sensitivity analyses Chen, Ochi
    - Natural mortality
    - Steepness of stock-recruitment relationship
    - Growth form
    - Starting years
    - Fitting to alternative CPUE indices?? Drop Juvenile CPUE?
    - Size of equilibrium catches relative to base case
13. Future Projections WP 6; Kiyofuji, Teo
    - Review of new projection software
    - Harvest Scenarios (constant F only)
14. Recommendations
    - Data format and submission deadlines
    - Invitation to Independent Stock Assessment Expert
    - SS3 Version for Stock assessment (3.24s or u; 3.30)
    - Assessment meeting location
    - Research
15. Work plan and assignments for stock assessment workshop
16. Scheduling of future assessments and research – frequency of update and benchmark assessments
17. Other matters
    - MSE Update (NC12, US Analyst)
18. Clearing of Report
19. Adjournment

ATTACHMENT 3
List of Working Papers

WP Number	Title and Authors	Availability
ISC/16/ALBWG-02/01	A Review of North Pacific Albacore Fishery Data Reported by Non-ISC Countries. John Holmes	Contact details
ISC/16/ALBWG-02/02Rev	Japanese catch statistics of North *Pacific albacore tuna (Thunnus alalunga*) for stock synthesis 3. Ijima et al. **Note: this paper was revised based on comments captured in Section 6.1.2 and the revised version is made publicly available.**	Public
ISC/16/ALBWG-02/03	New fisheries definition from Japanese longline North Pacific albacore size data. Ochi et al.	Public
ISC/16/ALBWG-02/04	Update standardized CPUE for North Pacific albacore caught by the Japanese pole and line data from 1972 to 2015. Kinoshita et al.	Public
ISC/16/ALBWG-02/05	Sex ratio, spawning season, spawning fraction and size at maturity of North Pacific albacore (*Thunnus alalunga*) caught in subtropical western North Pacific. Ashida et al.	Contact details
ISC/16/ALBWG-02/06	New future projection program for North Pacific albacore tuna (Thunnus alalunga) : considering two-sex age-structured population dynamics. Ijima et al.	Public
ISC/16/ALBWG-02/07	Meta-analysis of M for north Pacific albacore. Steve Teo	Public
ISC/16/ALBWG-02/08	Definition of US longline fishery	Public
ISC/16/ALBWG-02/09Rev	The development of Taiwanese longline fishery in the North Pacific Ocean and estimation of albacore CPUE exploited by albacore-targeting fishery, 1995-2015. Chiee-Young Chen, Fei-Chi Cheng. **Note: this paper is a revised version of WP11 based on comments in Section 6.2.1**	Public
ISC/16/ALBWG-02/10	Estimation of sexual maturity-at-length of the North Pacific albacore. Kuo-Shu Chen, Chien-Chung Hsu, Chiee-Young Chen, Fei-Chi Cheng, and Hirotaka Ijima	Contact details
ISC/16/ALBWG-02/11	The development of Taiwanese longline fishery in the North Pacific Ocean and estimation of albacore CPUE exploited by albacore-targeting fishery, 1995-2015. Chiee-Young Chen, Fei-Chi Cheng	Withdrawn
ISC/16/ALBWG-02/12	Reference points under the hypothesis of sex-specific life history. Tetsuya Akita and Hirotaka Ijima.	Public