FINAL

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ANNEX 07

23rd Meeting of the
International Scientific Committee for Tuna
and Tuna-Like Species in the North Pacific Ocean
Kanazawa, Japan
July 12-17, 2023

REPORT OF THE ALBACORE WORKING GROUP WORKSHOP

July 2023

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ANNEX 07

REPORT OF THE ALBACORE WORKING GROUP WORKSHOP

International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC)

March 20 – 27, 2023
Southwest Fisheries Science Center
La Jolla, CA, United States of America

1. 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 Southwest Fisheries Science Center (SWFSC), La Jolla, CA, USA. The objectives of this workshop were: (1) to complete a new assessment of the North Pacific albacore tuna stock, and (2) to develop scientific advice and recommendations on current status, future trends, conservation and research needs of North Pacific albacore tuna.

Kristin Koch, Director of the Southwest Fisheries Science Center, welcomed 10 scientists from Canada, Chinese Taipei, Japan, the United States of America (USA), and the Inter-American Tropical Tuna Commission (IATTC) to the Southwest Fisheries Science Center, both in-person and virtually (Attachment 1). She spoke about the importance of the work done by the ALBWG and wished the group a productive meeting.

This report is a record of the discussions and decisions of the ALBWG during the workshop in which the 2023 stock assessment of North Pacific albacore was conducted. The 2023 stock assessment model structure and assumptions, results, interpretation, scientific advice and recommendations are documented in a separate assessment report available from the ISC website at: http://isc.fra.go.jp/.

2. MEETING LOGISTICS

2.1 Meeting protocol

The ALBWG Chair thanked the WG for their ongoing cooperation and noted that the efforts of the WG at this meeting would be collegial and follow the scientific method with an emphasis on empirical testing, open debate, documentation and reproducibility, reporting uncertainty, peer review, and constructive feedback to authors and presenters.

2.2 Review and adoption of agenda

The draft agenda was circulated prior to the meeting and adopted at the workshop. The agenda was revised throughout the workshop as the ALBWG addressed data issues and model development progressed. The revised agenda is shown as Attachment 2.

2.3 Assignment of rapporteurs

Rapporteuring duties were assigned to Carolina Minte-Vera and Haikun Xu. Sarah Hawkshaw had the overall responsibility for assembling the report.

2.4 Distribution of Documents and Working Paper Availability

Seven (7) working papers (WP) were submitted and assigned numbers for the workshop (Attachment 3). Working papers will be publicly available through the ISC website (http://isc.fra.go.jp/) and author contact details will be provided for the other related materials.

3. REVIEW WORK ASSIGNMENTS

The WG briefly reviewed the work assignments from the 2022 data preparation meeting in Yokohama, Japan (**ISC/23/ANNEX/06)**. The WG updated the status of existing assignments and made recommendations for 2023 assessment and future work in Table 1.

4. REVIEW WORKING PAPERS AND INPUT DATA

The WG reviewed data sources and preparation methods that had been identified during the data preparation meeting in Yokohama, Japan **(ISC/23/ANNEX/06)**. These presentations and discussions highlighted issues and decisions made by the WG for the 2023 North Pacific albacore stock assessment.

4.1. Catches

Summary of 2023 assessment catch data from Japanese North Pacific albacore longline fisheries. Y. Tsuda (*presentation*)

Y. Tsuda provided a presentation documenting the North Pacific albacore Japanese longline fisheries catch data submission for the 2023 assessment. Japanese longline fishing vessels are divided into five categories based on fishing area and size. Distant (>120gt), Offshore (>20-120gt), Coastal (>20gt), and Small Scale Coastal (<20gt) longline vessels require a permit from the Minister of Fisheries, however a number of Small Scale Coastal (<20gt) had not turned in log books at the time of the 2023 data submission. A number of Small Scale Coastal (<10gt) longline vessels also operate and do not submit logbook data. In 2008 new requirements for vessel monitoring systems (VMS) on all Small Scale Coastal (<20gt) longline vessels were introduced along with a new database. The catch data submitted to ISC is from landing slips collected at the ports, covers all catches for Japan and is reported in weight only. For the stock assessment data the unreported catch data is estimated based on subtracting the database catch in weight from the ISC catch tables data and proportioning the remaining catch to the small scale fisheries areas.

<u>Discussion</u>

The WG recommended that Japanese scientists prepare a working paper for the next assessment cycle describing the best method to estimate the unreported Japanese longline fisheries catch data for use in the NPALB stock assessment. The WG agreed that the corrected data submission was the best available for the 2023 stock assessment.

A Summary of North Pacific Albacore Tuna Fishery Data Reported by Non-ISC Countries. S. Hawkshaw (ISC/23/ALBWG-01/01)

The Albacore Working Group (ALBWG) of the International Scientific Committee on Tuna and Tuna-like Species in the North Pacific Ocean (ISC) will be conducting a benchmark assessment of the North Pacific albacore stock (NPALB) in 2023. This Working Paper summarizes the annual catch, size composition, and the spatial distribution of catch from 1994 to 2021 reported for NPALB by countries that do not submit data directly to the ISC. These countries do submit data to the two Regional Fisheries Management Organizations (RFMOs) responsible for the management of NPALB: the Inter-American Tropical Tuna Commission (IATTC) and the Western and Central Pacific Fisheries Commission (WCPFC). These two data sources were reviewed for the inclusion in the upcoming 2023 stock assessment. Several non-ISC countries have reported catches of NPALB, however only China and Vanuatu, have significant catches and time series to incorporate into the assessment model. The data were also compared to data used in the 2017 and 2020 stock assessments. Relatively large differences in the catches of China and Vanuatu longline fleets were noted between the 2017 and 2020 data submissions (**ISC/23/ALBWG-01/03)**. For the 2023 data no difference was found between 2020 and 2023 catch data reported by China and only minor differences in the Vanuatu catches in some years. It was also found that Vanuatu had some minor catches reported in numbers of fish, rather than in weight, in the IATTC area in 2016-2021.

Discussion

The WG agreed that the most recently compiled catches were the best available science and will be used for the current stock assessment. **The WG recommended that the minor Vanuatu catch data reported in numbers of fish from 2016 to 2021, in the IATTC area, should be combined in the stock assessment model with the Japanese longline data that is reported in the same units, numbers of fish, in Areas 4 and 5 (Figure 1).**

4.2. CPUE Indices

Juvenile index of North Pacific albacore tuna: Japanese longline CPUE standardization using a spatiotemporal model. H. Ijima and J. Matsubayashi (ISC/23/ALBWG-01/02)

At the North Pacific albacore tuna data preparatory meeting, the ALBWG requested that Japanese scientists provide CPUEs for juvenile albacore tuna. We standardized the Japanese longline CPUE in this study. First, we analyzed the first quarter's longline logbook data from Areas 1-3. Using a mixture model, we isolated this data that indicated juvenile albacore fish were being caught. We then built several models using R-INLA and selected the best model by WAIC model selection. The selected best model was a spatiotemporal model with a negative binomial distribution. The standardized CPUE was calculated by the least squares means, and the posterior distribution was obtained from resampling.

Discussion

The WG thanked the authors for preparing this analysis of the juvenile CPUE standardization method using the updated fleet structure identified in the data preparatory meeting for the Area 1/3 and Quarter 1 data. The WG agreed that there are still issues with the presence of adults in the data for Quarter 1 in Areas 1/3. **The WG recommended that work on a juvenile index should continue and data from Area 1/3 in Quarter 2 may be more appropriate, with the caveat of decreased targeting in this quarter.**

CPUE standardization for North Pacific albacore caught by Japanese longline fishery from 1996 to 2021 in Area 2 and Quarter 2. J. Matsubayashi, H. Ijima, N. Matsubara, Y. Aoki and Y. Tsuda (ISC/23/ALBWG-01/03)

This investigation undertook standardization of the CPUE for North Pacific Albacore in Area 2 during Quarter 2, utilizing operational data from the Japanese longline fishery and a geostatistical model. The CPUE of albacore for Area 2 during Quarter 2 can potentially serve as an indicator of the abundance of adult female individuals. This study encompassed spatiotemporal effects by utilizing the Stochastic Partial Differential Equations (SPDE) methodology to develop spatiotemporal models. The objective was to model the catch of Albacore with a zero-inflated negative binomial error distribution, incorporating the year effect, location effect, hooks per basket, fleet type, and vessel name. The model converged efficiently and did not appear to have significant issues, as evidenced by randomized quantile residual plot. The standardized CPUE estimates were relatively consistent with the nominal CPUE until 2007, but decreased compared to the nominal CPUE after 2008.

Discussion

The WG briefly reviewed the use of the CPUE standardization method developed for the Area 2 Quarter 1 at the data preparation meeting as this was the method applied for this WP. The WG noted that the abundance index for Area 2 Quarter 1 shows great year-to-year changes, the scale of which does not seem to be believable based on what is known about the biology of the stock and is potentially an artifact of changes in fishing operations and data collection caused by the COVID-19 pandemic. The WG discussed other potential reasons for the changes seen in the Area 2 Quarter 1 data including potential migration changes for the stock.

The CPUE data in Area 2 Quarter 2 for the last 2 years were slightly less variable however there was still a notable drop in 2020. **The WG recommended that the CPUE standardization method include the information from all seasons by applying an AR-1 process across time to incorporate information from the other seasons and then the Quarter 2 estimates would be isolated for use as the primary index. The WG recommended that the authors prepare a WP describing this change and to use this method as the primary indicator of the abundance for adult female NPALB in the 2023 stock assessment.**

Additional Japanese longline logbook data analysis for adult albacore tuna CPUE. H. Ijima and Y. Tsuda (ISC/23/ALBWG-01/08)

We report the Japanese longline CPUE standardization results conducted during the North Pacific albacore tuna stock assessment. At the request of the ISC Albacore Working Group (ALBWG), we addressed two analyses using the R software package R-INLA, which includes 1) using data from the first quarter of Area 2 only and 2) data from all quarters of Area 2 and extracting only the results from the second quarter. Although the all-quarter-data model converged successfully, the resampling program for the posterior distribution of standardized CPUE did not work effectively, and we could not obtain the coefficient of variation. We plan to address this issue by modifying the program in the future.

Discussion

The WG thanked the authors for completing this additional analysis during the stock assessment development. The WG discussed the issue with calculating the CVs for the estimates and model convergence. The authors noted that the issue with calculating CVs was in the resampling step using R-INLA and that the model did converge. **The WG recommended using this model for the 2023 stock assessment. The WG also recommended additional work to improve the adult CPUE index model be done during the next model improvements meeting.**

4.3. Size and Sex Compositions

Sex specific size data for North Pacific albacore (Thunnus alalunga) in Japanese research/training vessels. Y. Aoki, T. Senda, H. Ijima, N. Matsubara, J. Matsubayashi, and Y. Tsuda (ISC/23/ALBWG-01/04)

We prepared and summarized the length composition data of North Pacific albacore caught by Japanese Research/Training Vessels for longline and pole-and-line fisheries in the period from 1994 to 2021. Sampling locations for the longline fishery were concentrated on southern areas, whereas those for the pole-and-line were located on northern areas. Fork lengths of individuals caught by the longline fishery (mainly 80-120 cm) were generally larger than those of individuals caught by the pole-and-line fishery (mainly 45-90 cm). Sex ratio is skewed towards the male in the large individuals, but the trend is not found in the small individuals.

Discussion

The WG agreed that the data from the Japanese research/training vessels are bias particularly in Area 4 where there appears to be a higher proportion of males than in other areas and the reasons for this may be related to the sex specific differences in natural mortality, growth and movement. The data also has high observation error due to the inexperience of the trainees conducting the survey. The sampling was concentrated in Area 4 for longline and Area 3 for the pole-and-line gear and in season 1. The WG briefly reviewed the sex specific biology used in the stock assessment model which is primarily based on combined otolith samples from Taiwanese, Japanese and US. The samples suggested different Linf values based on the different areas. These data were collected in different areas and by different fleets, indicating that they are not robust enough to represent growth differences among areas. **The WG noted the regional differences in growth and recommends that research on sex specific growth and mortality should continue as new information becomes available. The WG recommended investigating sensitivity runs in the 2023 assessment that investigate estimating growth as well as sex specific natural mortality rates.**

Juvenile and adult classification with clustered mean weight data in Japanese longline fishes in areas 1 and 3. Y. Aoki, H. Ijima, and Y. Tsuda (ISC/23/ALBWG-01/05)

This WP described the split of size composition and catch data from Japanese longline fishery in areas 1 and 3 for all quarters. Length frequency in juveniles and adults of quarters 1 and 2 show consistent trends with the juveniles and adults clustered by mean body weight. The results of quarters 3 and 4 did not indicate good classifications of juveniles and adults by the clustering method. Historical changes in length composition of quarters 1 and 2 did not indicate changes in trends through years, though a separate trend around year 2000 was distinguished in juveniles of quarter 3. Juveniles of quarter 4 and adults of quarters 3 and 4 have several modes that could be both juveniles and adults.

Discussion

The WG thanked Japanese scientists for providing a WP describing the split of catch and size composition data from JPLL fisheries data in Areas 1 and 3 for all quarters using the new fleet structure which used weight data to split the fleets, described in ISC/22/ALBWG-02/03. The WG further discussed the impacts of the new split fleet structure in the assessment model. The F1 fleet has some evidence of a double mode indicating that there may be some adults. This may make using this as a juvenile index inconsistent. **The WG recommended not using Area 1/3 in quarter 1 JPLL fisheries data for a juvenile index. The WG recommended investigating**

the size compositions in the JPLL fisheries in Area 1/3 in quarter 2 to investigate use in a juvenile index, recognizing that there may also be issues with targeting other tuna species during this quarter.

Spatiotemporal definitions of Taiwanese albacore longline fishery in the North Pacific Ocean based on a regression tree analysis of size data. Z. Yeh, Y. Chang, J. Hsu (ISC/23/ALBWG-01/06)

The objective of this study is to assess the suitability of the 25°N boundary used to delineate the Taiwanese longline fleet in the albacore tuna assessment. The study analyzed the size composition of albacore tuna caught by the Taiwanese longline fishery from 1995 to 2021, utilizing a multivariate regression tree model. The analysis was conducted with a minimum spatial-temporal resolution of season and 5◦ area. The study findings revealed that using latitude 25°N as the boundary had the highest explainable variation and was most effective in capturing the spatial differences in the size composition of the albacore. The southern group exhibited larger albacore sizes, with an average weight of 22.3 ± 5.8 kg, while the northern group had smaller albacore sizes, with an average weight of 13.8 ± 4.3 kg. Therefore, the study concluded that using latitude 25°N as the boundary could best reflect the spatial differences in the size composition of albacore caught by the Taiwanese longline fleet.

Discussion

The WG thanked the authors for presenting the analysis using weight frequency data to support the latitudinal split used to split the Taiwanese longline fisheries data to be used in the stock assessment. The WG noted that the split for the other fleets in the stock assessment is at 30°N but this can vary from year to year. For the Taiwanese longline fisheries the split also varies from year to year between 30°N and 25°N but this analysis indicates that it is more consistently at 25°N. The authors also presented the length size composition data from the Taiwanese longline fisheries and discussed the impacts of these data in the stock assessment. The WG noted that the sample size from the Taiwanese longline fishery is important because it is the largest size composition dataset and some other fleets in the stock assessment are mirrored after these data. **The WG recommended using latitude 25°N as the boundary for the Taiwanese longline fleet data as it best reflected the spatial differences in the size composition of albacore caught by the Taiwanese longline fleet. The WG also recommended to use the Taiwanese longline size composition data start in 2003 in the stock assessment because the data in the early 90s – 2000 time period were quite variable.**

4.5. Data Issues

The WG noted significant variation in the CPUE abundance index and size composition data for Area 2 Quarter 1 from the Japanese longline fishery in the most recent years. Due to this unrealistic variation, the WG suggested using data from the Area 2 Quarter 2 Japanese longline fishery, however this only decreased the variation slightly. The WG noted that the scale of change in the adult CPUE index for Area 2 Quarter 2 Japanese longline fishery is still unlikely for 2020 and 2021. Therefore, the **WG recommended that the index during these years should be down-weighted in the stock assessment by adding 0.1 to the CVs in 2020 and 2021 as there is evidence of changes in fishing operation and sampling procedures due to the COVID-19 pandemic which likely biased the data for 2020 and 2021.**

There is also evidence of impacts on the size composition data due to changes in fishing operation and sampling procedures due to the COVID-19 pandemic which likely biased the data for 2020 and 2021. Therefore, **the WG recommended that all length composition data in 2020 and 2021 be down weighted by 0.1 multiplier on the sample sizes**.

The WG also noted issues with the Taiwanese longline fishery size composition data. These data are not consistent with the Japanese longline data and fit poorly in the model according the Pearson residual. Using the new fleet structure for the Japanese fisheries has split the size composition data for the Japan fleets leaving the Taiwanese longline fleet with the largest sample size for size composition data, and potential to have large impacts on the stock assessment model estimates. As a result, the **WG recommended down-weighting this data in the assessment model through Francis weighting**.

The WG agreed that the stock assessment report should provide some explanations regarding the recent trends in catches and effort data that may be related to changes in operations and data collection due to the COVID-19 pandemic. It was also noted that recruitment estimates in the last five years are very uncertain due to the lack of information about these cohorts as they have not fully recruited into the fishery yet.

5. BASE CASE MODEL DEVELOPMENT

The WG used a stepwise approach to develop the base case model for the 2023 stock assessment. Updated data from 2019 to 2021, submitted by ALBWG members, was first incorporated into the model and initial model runs were conduct based on the previously agreed upon model structure and biological parameters, and improvements identified during the data preparation meeting. The NPALB stock assessment model includes three types of data: fishery-specific catches, size composition, and abundance indices.

The WG reviewed and discussed several preliminary model runs that investigated the data issues discussed above and the structural and biological assumptions of the stock assessment. The WG first investigated the updated JPLL CPUE index. The WG agreed that the A2Q1 JPLL index (F12) represented the best information on trends for the adult age-classes of female albacore, had good contrast, and the results of age-structured production model analyses provided evidence that the F12 index was informative on both population trend and scale.

The WG developed the preliminary parameterizations of the base case model (further details in Table 3):

1. Period: 1994 – 2021
2. Fleet structure: Updated fleet structure splitting size classes of the JPNLL fleets
3. Fitting to one primary index: F12 index (JPNLL in A2Q2 from 1996 to 2021 using an AR1 process across time in the standardization method
4. Age- and sex-specific M vectors
5. Steepness of the Beverton-Holt stock-recruitment relationship is fixed at 0.9
6. Fixed sex-specific growth parameters
7. Length selectivities by fleet and several fleets fishing predominantly on juvenile fish had additional age selectivities to represent the availability by age.
8. Time blocks by fleet

5.2. Review initial conditions

The initial conditions for the base-case model are the same as that used in the 2020 assessment:

1. estimate an initial F for TWN LL (F28) while not fitting to equilibrium catch, to capture the initial fished state of the population;
2. estimate 10 years of early recruitment deviations, to set up the initial age structure, and
3. estimate a deviation from the virgin recruitment (R1) at the start of the model.

6. DIAGNOSTIC ANALYSES

The WG recommended that the same diagnostic analyses in the 2020 assessment be used for

the 2023 assessment along with some other diagnostics identified by the WG during the data preparation workshop: 1) Model convergence (jitter analysis); 2) Age-Structured Production Model (ASPM) diagnostic; 3) Likelihood profile on virgin recruitment (R0); 4) Residual analysis (CPUE and size composition data); 5) Retrospective analysis; 6) Fits to indices, size composition data; 7) Hindcasting; and 8) Catch curve analyses.

The WG reviewed the above analyses for the base case model. Based on the jitter analysis the current base case model appears to be the best maximum likelihood estimate (MLE). The ASPM analysis indicated that the base case model produced a production function and the catch does explain to some degree the changes in the index. The R0 profiling shows that both the CPUE index and the size composition data influence population scale greater on the low side and very slightly on the high side of the population scale. The residual analysis and catch curve analysis also both suggested that the information on population scale from the size composition data appears to be consistent with the information on population scale from the CPUE index. There is a clear retrospective pattern observed in the SSB and recruitment when 1-3 years of data are removed. However, the WG agreed that is to be expected given that a historic low seen in the last 3 years of data that are pulling the estimates down. **The WG agreed that diagnostic results satisfactorily meets the conditions that the base case model provide the best representation of north Pacific albacore population dynamics.**

7. SENSITIVITY ANALYSES

The WG identified several sensitivity runs to include with the base case model in order to assess model performance or the range of uncertainty associated with a particular parameterization:

1. Natural mortality (M):
   a. constant M of 0.3 across sexes and ages (same as approach used in 2014 assessment);
   b. constant M of 0.48 and 0.39 for female and male of all ages, respectively; and
   c. estimated M with Lorenzen based on prior from Kinney and Teo (2017).
2. Stock-recruitment steepness (h):
   a. alternative values for the steepness parameter (h=0.75; 0.80 and 0.85); and
   b. adding prior based on Brodziak et al. (2011).
3. Growth:
   a. CV of Linf is fixed higher (0.06 or 0.08) than base case; and
   b. estimating growth.
4. Size composition weighting:
   a. not down weighting F11 fleet with natural weight;
   b. downweighing of fleets not down weighted in base case using 0.1 multiplier

   c. not down weighting the 2020 and 2021 size composition data.
5. Index weighting:
   a. not down weighting 2020/21 combined with size comp weighting; and
   b. not down weighting 2020/21.
6. Selectivity:
   a. not assuming that the US longline fishery in Area 2 and 4 has an asymptotic size selectivity; and
   b. time varying selectivity for JPNPL Quarters 2/3.
7. Index standardization models:
   a. INLA Adult index: Area 2 & Quarter 1 (JPNLL) – Quarter 1 only estimate;
   b. Delta GLM Juvenile: Area 3/5 & Quarter 2/3 (JPNPL); and
   c. GLM Juvenile: Area 3/5 & Quarter 3/4 (EPO).
8. Initial conditions
   a. Investigate other initial fleets
9. Same model structure as in 2020 stock assessment.

The WG had a discussion on which sensitivity analyses to include in the reference points table for managers and in the executive summary. The WG agreed that growth is one of the major uncertainties in this assessment and that the Linf CV=0.06 scenarios and a scenario where all growth parameters are estimated should be included in the table. Along with the sensitivity model that used a similar model structure to the 2020 assessments.

8. FUTURE PROJECTIONS

Uncertainties of future projection in North Pacific albacore tuna stock assessment. Ijima, H. (ISC/23/ALBWG-01/07)

This study presents adjustments to the future projection program (SSfuture C++) required to conduct the North Pacific albacore tuna stock assessment. First, a comparison was made with the latest SS3 (SS3 V3.30.20) future projection results, and second, the handling of uncertainty was explored. Uncertainty attempted to account for process errors in recruitment and variation in initial values of number at age and fishing mortality at age. Comparing the results of the deterministic future projection, the results of SSfuture C++ and SS3 3.30.20 were in perfect agreement. Uncertainty in the initial value of the number at age could be created by assuming a multivariate normal distribution using the variance-covariance matrix output by SS3. However, several alternatives are proposed since no variance-covariance matrix is available for fishing mortality at age.

Discussion

The WG thanked the author for the improvements made to the future projections model and discussed additional adjustments that would be needed in order to evaluate the new management objectives for the NPALB stock adopted by the WCPFC and the IATTC in 2022 (Table 4). The projection model in the 2020 stock assessment included two sources of uncertainty in the initial number at age and the process error of the projected recruitment but the results showed that the 95% confidence intervals were shrinking each year of the projections. In the updated analysis presented the 95% confidence interval still appeared to be quite similar across the projection period, which is not expected given that the process error in projected recruitment should lead to increasingly wider 95% confidence intervals from year to year. The WG agreed with the author that it was important to account for all sources of uncertainty in the projection including recruitment, initial values of number at age, and fishing mortality at age. Otherwise the future projection uncertainty would be underestimated which would not be ideal for the new conservation objective which specifies the need to evaluate if the SSB is above the LRP with >80% probability.

The WG discussed the approaches to incorporate uncertainties in fishing mortality at age in future projections. The WG agreed that using age selectivities uncertainty for only Quarter 1, which is output by the SS3 model, was inconsistent because more fish are caught and Japanese pole and line fishery has large catches in this season causing F to be higher and the SSB to be underestimated. The WG agreed that the uncertainty in age selectivities would be needed for all quarters in order to produce uncertainties for the F at age. **The WG recommended to include the uncertainty in F at age in the projection, which is estimated based on historical estimates between 2005-2019.**

Although the WG agreed that the method presented in this WP should be used for the 2023 stock assessment, they requested that the authors include uncertainty of the fishing mortality at age in the projection model and update the WP to describe this adjustment. This adjustment is particularly important inform the newly adopted IATTC and WCPFC management objectives.

Revision of future projection software SSfuture C++. Ijima, H., Y. Aoki, and Y. Tsuda (ISC/23/ALBWG-01/09)

This working paper outlines the specifications of SSfuture C++, a software designed for the future projection of the fish stock. Its application will be utilized during the ISC North Pacific Albacore tuna stock assessment in 2023. The SSfuture C++ underwent various updates to cater to the ISC Albacore Working Group (ALBWG) needs for the albacore stock assessment. The primary changes include the capability to modify the fishing mortality at age every year and the inclusion of estimation errors from Stock Synthesis 3 to account for uncertainties in the initial values. The uncertainties considered are the number at age, F multiplier, R0, and SSB0. Moreover, the dynamic B0 (SSBF=0) for all future projection runs was calculated using R0, SSB0, and recruitment deviation. The accuracy of future projections has considerably improved compared to the previous stock assessment. However, the estimation errors for selectivity and recruitment deviation are to be considered and require further development.

Discussion

The WG thanked the authors for completing this updated work. The WG discussed the uncertainties included in the projection model and noted that the uncertainty envelope seemed uniform over the projection period and that it was expected to increase over time. The WG agreed that this projection model was an improvement over the model used in the 2020 stock assessment which had shrinking uncertainty in the projections. **The WG recommended that this model be used to inform conservation information for NPALB in the 2023 stock assessment. The WG also recommended that the authors continue to explore including estimation error for selectivities at age and recruitment deviations in the next stock assessment cycle. The WG also recommended the authors archive the code used for this version of the projection model for future research.**

9. STOCK STATUS AND CONSERVATION

9.1 Biological reference points and Kobe plots

The WG discussed the reference points that would be estimated and presented in the stock assessment and agreed to estimate the new reference points identified by the IATTC (IATTC-100-North Pacific Albacore Harvest Strategy) and WCPFC (Harvest Strategy for North Pacific Albacore Fishery (16Sep) - Rev.02 (Adopted)) in 2022 (Table 5). The WG agreed to use the SPR Approach used in the 2020 assessment for fishing intensity reference points.

Table 5. List of important stock assessment estimated values and reference points from the 2020 stock assessment and those proposed for the 2023 stock assessment.

2020 Assessment Estimates	Preliminary 2023 Assessment Estimates
MSY (t)	MSY (t)
SSB_{MSY} (t)	SSB_{MSY} (t)
SSB_0 (t)	SSB_0 (t)
SSB_{2018} (t)	SSB_{2021} (t)
	B_{2021} (t)
	$SSB_{current,\ F=0}$ (2021 estimate)
	$SSB_{2021}/SSB_{current,\ F=0}$
$SSB_{2018}/20\%SSB_{current,\ F=0}$	$SSB_{2021}/14\%SSB_{current,\ F=0}$
$F_{2015\text{-}2017}$	$SSB_{2021}/30\%SSB_{current,\ F=0}$
$F_{2015\text{-}2017}/F_{MSY}$	$Depletion_{B2021}/\ Depletion_{B2006\text{-}2015}$
$F_{2015\text{-}2017}/F_{0.1}$	$F_{\%SPR,2018\text{-}2020}/F_{\%SPR,MSY}$
$F_{2015\text{-}2017}/F_{10\%}$	$F_{\%SPR,2011\text{-}2020}$
$F_{2015\text{-}2017}/F_{20\%}$	$F_{\%SPR,2018\text{-}2020}$
$F_{2015\text{-}2017}/F_{30\%}$	$F_{\%SPR,2011\text{-}2020}/F_{45\%}$
$F_{2015\text{-}2017}/F_{40\%}$	$F_{\%SPR,2018\text{-}2020}/F_{45\%}$
$F_{2015\text{-}2017}/F_{50\%}$	$F_{\%SPR,2018\text{-}2020}/F_{\%SPR,2002\text{-}2004}$

The WG also discussed updating the Kobe plots to reflect the new reference points and agreed to prepare two plots; one for the base case model with annual trajectory and another with key sensitivities (Figure 2).

9.2 Review exceptional circumstances criteria

The WG reviewed the text describing the criteria for exceptional circumstance (Attachment 5) and agreed to seek approval from the ISC Chair to present at IATTC SAC meeting in 2023. The WG discussed the importance of stressing that these are preliminary criteria and are subject to change with the adoption of a HCR.

9.3 Stock status and conservation advice

The WG reviewed the text describing current stock status and conservation information for the executive summary and stock assessment report. The WG recommends the following for stock status.

The WG recommends the following for stock status:

1. The stock is likely not overfished relative to the threshold (30%$SSB_{current, F=0}$) and limit (14%$SSB_{current, F=0}$) reference points adopted by the WCPFC and IATTC, and
2. The stock is likely not experiencing overfishing relative to the target reference point ($F_{45\%SPR}$).

The WG recommends the following conservation information:

1. If fishing intensity over the next ten years is maintained at the current fishing intensity (F2018-2020), the female SSB is expected to increase to 90,098 t, and it is likely that the management objectives of IATTC and WCPFC will be met.
2. If fishing intensity over the next ten years is similar to the 2005 – 2019 period, the female SSB is expected to increase to 87,669 t, and it is likely that the management objectives of IATTC and WCPFC will be met.

The WG noted that the stock status and conservation advice developed in the 2023 stock assessment are consistent with the management objectives of IATTC and WCPFC for this stock: 1) maintain SSB above the limit reference point, with a probability of at least 80% over the next 10 years; 2) maintain depletion of total biomass around historical (2006 – 2015) average depletion over the next 10 years; and 3) maintain fishing intensity at or below the target reference point with a probability of at least 50% over the next 10 years (WCPFC HS 2022-01; IATTC Resolution C-22-04).

10. RESEARCH RECOMMENDATIONS

10.1. Update on sex identification genetics project by US scientists. *Hyde, J. (Presentation)*

John Hyde, NOAA/NMFS SWFSC, provided a brief update on the progress the NOAA genetics lab has made on developing a genetic assay for sex-specific markers for tuna. Several albacore samples from Japan, Taiwan, and USA were analyzed.

<u>Discussion</u>

The WG thanked Dr. Hyde for providing this update and that they looked forward to hearing more progress soon. **The WG recommended discussing during the next model improvements meeting how these analyses could be used to design a sampling program to collect sex composition data to be used be used for the NPALB stock assessment.**

10.2. Additional Research Recommendations

The WG identified the following recommendations to improve the stock assessment model:

1. Further investigation of the data, especially CPUE, from 2020 and 2021 to better understand if and how COVID-19 safety protocols affected these data;
2. Further investigation of appropriate adult abundance index for the NPALB stock especially with respect to expanding the spatial domain of the CPUE standardization model to reduce the effect of time-varying availability on the standardized abundance index, which in the model is assumed to be proportionally influenced solely by population abundance;

3. Reexamine fleet structure for the NPALB stock;
4. Evaluate potential juvenile indices from the Japanese longline fisheries in northern areas (Areas 1, 3 and 5), the Japanese pole-and-line and/or EPO surface fisheries;
5. Investigate why model estimates are very sensitive to the variability in Linf;
6. Investigate how to better model variability in availability in size and/or age to the juvenile fisheries (JPPL and EPO fisheries selectivities);
7. Investigate the conflict in size composition data between fleets;
8. Collect of sex-specific age-length samples using a coordinated biological sampling plan to improve current growth curves, and examine regional and temporal differences in length-at-age;
9. Collect of sex ratio data by fleet;
10. Estimate and document historical high seas drift gillnet removals by member countries;
11. Explore ocean productivity as drivers of albacore trends and dynamics.

11. ADMINISTRATIVE MATTERS

11.1. Workplan for Completing Assessment Report

The WG is required to submit its stock assessment report to the Office of the ISC Chair no later than June 13, 2023. In order to meet this deadline the WG agreed to do additional work on developing the stock assessment and will have another virtual meeting on April 19/20, 2023 (EPO) April 20/21, 2023 (WPO) and June 8, 2023 (EPO) and June 9, 2023 (WPO) to present further analyses and clear the meeting report.

11.2. Update National Contacts for the ALBWG

The following were confirmed as national contacts for ALBWG matters:

Canada – Sarah Hawkshaw
Chinese Taipei – Yi-Jay Chang
Japan – Yuichi Tsuda
Korea - Mi Kyung Lee
Mexico - Michel Dreyfus
USA –Steve Teo
IATTC – Haikun Xu
SPC – Graham Pilling
Data Manager – TBD

11.3. Time and place of next ALBWG meeting

The WG developed a work plan for completing the 2023 stock assessment and other meetings attended by the WG members for 2023 (**Attachment 4**).

12. OTHER MATTERS

12.1 NC19 and IATTC SAC preliminary stock assessment results

The WG discussed presenting provisional stock assessment results and the criteria for exceptional circumstances at the upcoming IATTC Science Advisory Committee (SAC) meeting in May 2023 and WCPFC Northern Committee meeting in July 2023.

12.2 Upcoming election

The WG vice-Chair reminded the WG that his second term would be ending in 2023 and an election would need before the ISC23 plenary in April 2023. The WG agreed and supported a re-election of Steve Teo for a one-year extension. Steve Teo encouraged the other WG members to prepare to elect a new vice chair by the 2024 ISC plenary.

13. Clearing of Meeting Report

The WG Chair prepared a draft of the meeting report, which was reviewed at the end of a follow up meeting by the WG prior to adjournment. After the meeting, the WG Chair distributed another draft and the WG provided final suggested revisions. The WG Chair incorporated final edits, then distributed a final draft via email for approval by WG members. The final report will be forwarded to the Office of the ISC Chair for review and approval by the ISC23 Plenary.

14. Adjournment

The ALBWG meeting was adjourned at 8pm (Victoria, BC time) on June 8, 2023.

15. Literature Cited

Ijima, H. 2020. The test run of future projection for North Pacific albacore stock using the SSfuture C++ and the multivariate normal distribution. ISC/20/ALBWG-01/03. Working document submitted to the ISC Albacore Working Group Meeting, 6-15 April 2020, by Webinar.

Kinney, M. J., and S. L. H. Teo. 2016. Meta-analysis of north Pacific albacore tuna natural mortality. ISC/16/ALBWG-02/07. Nanaimo, British Columbia, Canada.

Teo, S. L. H. 2017. Meta-analysis of north Pacific albacore tuna natural mortality: an update. ISC/17/ALBWG/07. Working document submitted to the ISC Albacore Working Group Meeting, 11-19 April 2017, Southwest Fisheries Science Center, La Jolla, California, USA.

Xu, Y., T. Sippel, S. L. H. Teo, K. Piner, K. Chen, and R. J. Wells. 2014. A comparison study of North Pacific albacore (Thunnus alalunga) age and growth among various sources. ISC/14/ALBWG/04. Working document submitted to the ISC Albacore Working Group Meeting, 14-28 April 2014, Southwest Fisheries Science Center, La Jolla, California, USA.

Table 1. Work assignments identified at the May/September 2022 ALBWG meetings, progress at the December 2022 data preparatory meeting and the March 2023 stock assessment meeting.

Assignment	Lead(s)	Status in May/Sept 2022	Dec 2022 Progress	Mar 2023 Stock Assessment
Improve the fleet definition of Japanese longline fishery	Ijima, H., Matsubayashi, J., and Tsuda, Y.	Updates on analysis presented in September 2022. WG requested additional analyses.	WP presented at data preparation workshop (**ISC/22/ALBWG-02/03**). WG agreed to use new fleet structure based on analysis for the 2023 assessment and compare to previous fleet structure.	The WG agreed to use the new fleet structure in the 2023 assessment. The data was not available for the old fleet structure for sensitivity runs so the WG recommended comparing the fleet structures again in the next assessment cycle.
Development of a new strategy for CPUE standardization for JPNLL and JPNPL fleets using spatial-temporal models using INLA	Matsubayashi, J., Ijima, H., Matsubara, N., Aoki, Y. and Tsuda, Y.	In progress and will be discussed further at the data preparatory meeting.	Two WPs presented for JPNLL (**ISC/22/ALBWG-02/04**) and JPNPL **(ISC/22/ALBWG-02/06**) CPUE standardization. WG recommended the new strategy be use for the Adult JPNLL fishery index in 2023 stock assessment as primary abundance index and a comparison will be made to the previous method (non-INLA). WG recommended using the old JPNPL (non-INLA) index in sensitivity model runs and continue working on the new JPNPL (INLA) index for the next assessment cycle.	The WG agreed to use CPUE standardization method presented at the Dec meeting (ISC/22/ALBWG-02/04) for the primary adult index in 2023 stock assessment. However due to evidence of juveniles in A2Q1 and changes in operations of the JPNLL fishery in recent years the WG decided to use A2Q2 data (**ISC/23/ALBWG-02/05)** which required slight modifications to the method. A WP will be prepared to document these standardization methods and the WG decided on several sensitivity runs.
Updated standardized CPUE from Taiwanese distant-water longline fisheries	Jhen Hsu, Cheng-Hao Yi, Chun-Wei Chang, Yi-Jay Chang	WP presented at May 2022 meeting (**ISC/22/ALBWG-01/03**).	Updated analysis presented at data preparation meeting (**ISC/22/ALBWG-02/08**). The WG recommended authors continue work on this analysis and present updated results during the next assessment cycle.	WP in preparation for next stock assessment cycle.

Assignment	Lead(s)	Status in May/Sept 2022	Dec 2022 Progress	Mar 2023 Stock Assessment
Evaluate potential juvenile indices from the Japanese longline fisheries in northern areas (Areas 1, 3 and 5).	Ijima, H., Matsubayashi, J., and Tsuda, Y.	Progress will be discussed at data preparation workshop.	Analysis is still in development. WP potentially available for the stock assessment meeting.	WP was presented at 2023 stock assessment workshop. The WG recommended that this was not a useful index as it was inconsistent and had adults and juveniles in the data.
Summary of size data update for North Pacific albacore in Japanese fisheries	Aoki, Y., Senda T., Ijima, H., Matsubara, N., Matsubayashi, J., and Tsuda, Y.		WP presented summarizing updated size composition data for Japanese fisheries (**ISC/22/ALBWG-02/02).** WG recommended that a WP be presented at the 2023 stock assessment meeting describing the split of size composition data from JPNLL in Areas 1 and 3 using new fleet structure (ISC/22/ALBWG-02/03) compared to previous fleet structure.	WP presented at 2023 stock assessment workshop. WG recommended not using Q1 data for a juvenile index and to continue to explore Q2 in the next stock assessment cycle.
Candidate relative abundance indices of juvenile albacore tuna for the US surface fishery in the north Pacific Ocean	Teo, S.		WP presented summarizing the analysis (**ISC/22/ALBWG-02/11).** WG recommended not to fit to these indices in the base case model and use the old GLM index for the EPO index in sensitivity model runs. Additional analyses recommended for the next assessment cycle.	WG recommended not to fit to these indices in the 2023 assessment base case model and use the old GLM index for the EPO index in sensitivity model runs.
Evaluate and document historical high seas drift gillnet catch by member countries.	Teo, S.		Detailed summary was presented at data prep meeting. WG recommended a collaboration with the SHARKWG to publish the analyses of these data a scientific journal and explore appropriate data storage protocols for the observer data within the ISC.	Progress to be presented at 2024 WG meeting.

Assignment	Lead(s)	Status in May/Sept 2022	Dec 2022 Progress	Mar 2023 Stock Assessment
Options for exceptional circumstances triggering additional MSE simulations	Hawkshaw, S.		Options were presented and developed by the WG and results are summarized in **Attachment 5** of the data preparation meeting report. Criteria will be updated as the harvest strategy is updated at IATTC and WCPFC meetings in 2023.	WG recommended sending the criteria for exceptional circumstances to the ISC chair for plenary review.
Investigate impacts of recently passed IATTC and WCPFC harvest strategies	Hawkshaw, S.		Details presented and discussed by WG. WG recommended updating stock assessment estimates and reference points presented in the stock assessment **(Table 5)**.	Newly identified reference points were estimated in the 2023 assessment and were used to inform the stock status and conservation advice.
Update catch, size composition, and CPUE (if available) data for 2023 assessment	All ALBWG Members	Progress and format will be discussed at data preparation workshop	All WG members agreed to provide catch, size composition, and CPUE data up to 2021. S. Teo will distribute the format template to the WG to be filled in for 2023 assessment.	All updated data was considered for use in the 2023 stock assessment.

Table 2. Descriptions of candidate abundance (CPUE) indices for adult and juvenile and preliminary decisions concerning use in 2023 stock assessment model. A: Area; Q: Quarter.

Criteria	INLA Adult: A2 & Q1 (JPNLL)	STAN Adult: A2 & Q1 (JPNLL)	INLA-AR1 Adult: A2 & Q2 (JPNLL)	INLA Juvenile: A1/3 & Q1 (JPNLL)	Delta GLM Juvenile: A3/5 & Q2/3 (JPNPL)	INLA Juvenile:vA3/5 & Q2/3 (JPNPL)	GLM Juvenile: A3/5 & Q3/4 (EPO)	INLA Juvenile: A5 & Q3 (EPO)	VAST sub-Adult: A2-5 & Q1-4 (TWNLL)
Preliminary Decisions	Sensitivity	Sensitivity – using 2020 assessment inputs only	Primary index	No sensitivities as WP showed index was not consistent	Sensitivity	Next assessment cycle	Sensitivity	Next assessment cycle	Next assessment cycle
Supporting Working Paper	ISC22-ALBWG-02/04	Developing: WP assessment meeting	Developing: WP assessment meeting	Developing: WP assessment meeting	Developing: WP assessment meeting	Developing: WP assessment meeting	ISC213-ALBWG-03/06	ISC22-ALBWG-02/11	ISC22-ALBWG-02/08
Time series	1996 – 2021	1996 – 2021	1996 – 2021	1996 – 2021	1972-2021	1972-2021	1999 - 2021	1999 – 2021	1995 - 2021
Spatial Distribution	Area 2	Area 2	Area 2	Areas 1/3	Areas 3/5	Areas 3/5	Areas 3/5	Area 5	Areas 2-5
Does the index cover the spatial distribution of adult females Yes/No/maybe - describe	Yes- Majority of adult female distribution	Yes- Majority of adult female distribution	Yes- Majority of adult female distribution	No- Majority of Juvenile distribution	No- Majority of Juvenile distribution	No- Majority of Juvenile distribution	No – catch consists of juvenile albacore	No – catch consists of juvenile albacore	
Size/age range	Larger averaged size with peak 100cm (approximate range: 80-120cm)	Larger averaged size with peak 100cm (approximate range: 80-120cm)	Larger averaged size with peak 100cm (approximate range: 80-120cm)	The main range of size is from 70-110 cm	The main range of size is from 40-90 cm	The main range of size is from 40-90 cm	Primarily ages 2 - 4	Primarily ages 2 - 4	
Fishing ground map available? Yes/No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Albacore catch relative to total catch: total catch is defined as catch of all species	73.7% (1996 – 2021 average)	73.7% (1996 – 2021 average)	59.6% (1996 – 2021 average)	84.6% (1996 – 2021 average)	20.2% (1972-2021 average)	20.2% (1972-2021 average)	100% (albacore is the primary catch)	100% (albacore is the primary catch)	85% (1995 – 2021 average)
Temporal consistency of fishing grounds – spatial effects	Consistent – no long-term changes in fishery location	Consistent – no long-term changes in fishery location	Consistent – no long-term changes in fishery location	Slightly shrinking– especially in eastern waters	Shrinking- especially after 1990s	Shrinking- especially after 1990s	Consistent for 1999 – present. Previous periods had expanded fishing grounds (1966 – 1978 & 1979 – 1998)	Consistent for 1999 – present. Previous periods had expanded fishing grounds (1966 – 1978 & 1979 – 1998)	Consistent – no longer term changes in fishery location
Temporal consistency in Size composition	Consistent size composition	Consistent size composition	Consistent size composition	Consistent size composition	Fluctuating size composition in each year	Fluctuating size composition in each year	Consistent size composition. Primarily Q3.	Consistent size composition. Primarily Q3.	Size composition data were limited spatially and temporally prior to 2003.

Criteria	INLA Adult: A2 & Q1 (JPNLL)	STAN Adult: A2 & Q1 (JPNLL)	INLA-AR1 Adult: A2 & Q2 (JPNLL)	INLA Juvenile: A1/3 & Q1 (JPNLL)	Delta GLM Juvenile: A3/5 & Q2/3 (JPNPL)	INLA Juvenile:vA3/5 & Q2/3 (JPNPL)	GLM Juvenile: A3/5 & Q3/4 (EPO)	INLA Juvenile: A5 & Q3 (EPO)	VAST sub-Adult: A2-5 & Q1-4 (TWNLL)
Targeting	Primary target species	Primary target species	Primary target species	Primary target species	Albacore and Skipjack	Albacore and Skipjack	Primary target species	Primary target species	Primary target species
Catchability Changes	Constant – hooks per basket (hpb) and catch composition remain stable	Constant – hooks per basket (hpb) and catch composition remain	Constant – hooks per basket (hpb) and catch composition remain	Slight temporal shift in hooks per basket (hpb) but catch composition remain stable	Change – Fishing device developing and decreasing the number of vessels	Change – Fishing device developing and decreasing the number of vessels	Variability in migration to core fishing grounds in EPO leads to catchability & availability variability	Variability in migration to core fishing grounds in EPO leads to catchability & availability variability	Constant – hooks per basket (hpb) and catch composition remain stable
Best Available Science Information Development in Working Paper									
Is a fishery description Available? Yes/No	Yes -Described in terms of historical catch, effort, size composition, seasonal distribution of fishing grounds, and potential target species.	Yes -Described in terms of historical catch, effort, size composition, seasonal distribution of fishing grounds, and potential target species.	Yes -Described in terms of historical catch, effort, size composition, seasonal distribution of fishing grounds, and potential target species.	Yes -Described in terms of historical catch, effort, size composition, seasonal distribution of fishing grounds, and potential target species.	Yes -Described in terms of historical catch, effort, size composition, seasonal distribution of fishing grounds, and potential target species.	Yes -Described in terms of historical catch, effort, size composition, seasonal distribution of fishing grounds, and potential target species.	Yes - Described in terms of historical catch, effort, size composition, seasonal distribution of fishing grounds.	Yes - Described in terms of historical catch, effort, size composition, seasonal distribution of fishing grounds.	Described in terms of historical catch, effort, size composition, seasonal distribution of fishing grounds, and potential target species.
Analysis	Zero-inflated negative binomial model (ZINB) with GLMM for standardiz-ation. Hooks per basket, fleet type, & vessel ID included as random effects. Location (1°×1°) & year included as spatio-temporal effects.	Zero-inflated negative binomial model (ZINB) with GLMM for standardiz-ation. Explanatory variables were year, hooks per basket and fleet type. Area (5°×5°) and vessel ID were included as random effects.	Zero-inflated negative binomial model (ZINB) with GLMM for standardiz- ation. Hooks per basket, fleet type, & vessel ID included as random effects. Location (1°×1°) & year included as spatio-temporal effects and auto-regression 1 (AR1) process assuming correlation between the preceding and following quarters.	Zero-inflated negative binomial model (ZINB) with GLMM for standardiz- ation. Hooks per basket, fleet type, & vessel ID included as random effects. Location (1°×1°) & year included as spatio-temporal effects.	Negative binomial distribution with GLM for standardizatio-n. Explanatory variables were year, poles. VesselID was included as fixed effect. Standardized CPUE values are estimated as least squares means in the GLM.	Tweedie distribution with GLMM for standardiz- ation. Explanatory variables year & quarter were included as fixed effect. VesselID was included as a random effect. Area (5° × 5°) was included as a spatial effect.	GLM-based approach: catch and effort data were aggregated into strata of 1 x 1° spatial blocks by month.	GLMM-based approach: strata were vessel-specific catch and effort by fishing day.	VAST model: Gaussian random fields to model spatial correlation and spatio-temporal autocorrelation with the Matérn covariance function.
Nominal & Standardized Index	Compares nominal and standardized CPUE	Compares nominal and standardized CPUE	Compares nominal and standardized CPUE	Compares nominal and standardized CPUE	Compares nominal and standardized CPUE	Compares nominal and standardized CPUE	Compares nominal and standardized CPUE	Compares nominal and standardized CPUE	Compares nominal and standardized CPUE

Criteria	INLA Adult: A2 & Q1 (JPNLL)	STAN Adult: A2 & Q1 (JPNLL)	INLA-AR1 Adult: A2 & Q2 (JPNLL)	INLA Juvenile: A1/3 & Q1 (JPNLL)	Delta GLM Juvenile: A3/5 & Q2/3 (JPNPL)	INLA Juvenile:vA3/5 & Q2/3 (JPNPL)	GLM Juvenile: A3/5 & Q3/4 (EPO)	INLA Juvenile: A5 & Q3 (EPO)	VAST sub-Adult: A2-5 & Q1-4 (TWNLL)
Model Diagnostic	Model convergence, residual and Q-Q plots	Frequency distribution of catch, hooks per basket by year, residuals from standardized index.	Model convergence, residual and Q-Q plots	Model convergence, residual and Q-Q plots	Residual and Q-Q plots indicate that the model is fitting the data well	Residual and Q-Q plots indicate that the model is fitting the data well	Residual and Q-Q plots indicate that the model is not fitting the data well at low and high CPUE values.	Lacking sufficient model diagnostics.	
Point estimate and variability in index values described	Point estimates of index both in graphical and tabular format.	Point estimates of index both in graphical and tabular format.	Point estimates of index both in graphical and tabular format.	Point estimates of index both in graphical and tabular format.	Point estimates of index both in graphical and tabular format.	Point estimates of index both in graphical and tabular format.	Point estimates and CVs of index both in graphical and tabular format.	Point estimates and CVs of index both in graphical and tabular format.	
Notes from WG	WG recommends using for sensitivity run.	WG recommended potential use for sensitivity run.	WG recommended use in 2023 stock assessment as primary abundance index.	This analysis is in progress and an update will be provided at the next stock assessment meeting. Potential sensitivity run.	Potential sensitivity run	This analysis is in progress and an update will be provided at the next stock assessment meeting.	WG recommends using for sensitivity run. Same as previous assessments.	Not using in assessment. This analysis is in progress and an update will be provided at the next assessment cycle.	This analysis is in progress and will be reviewed again in the next assessment cycle.

Table 3. Preliminary parameterization of the base case model for the 2023 stock assessment of north Pacific albacore. Parameterization implemented in 2017 and 2020 stock assessment were also shown for comparison.

Parameter	2017 Assessment	2020 Assessment	2023 Tentative	Notes
Model period	1993-2015	1994-2018	1994-2021	Will not do 1966 to 2021 sensitivity run due to issues with early squid driftnet bycatch data.
Stock structure	Single, well-mixed stock	Same as 2017	Same as 2020	Single, well-mixed stock
Fleet structure		Fleets added	Updated JPNLL fleet structure	The 2023 assessment used the updated fleet structure for the JPNLL fisheries.
Natural mortality	Female age-0: 1.36 y^{-1} Female age-1: 0.56 y^{-1} Female age-2: 0.45 y^{-1} Female age-3+: 0.48 y^{-1} Male age-0: 1.36 y^{-1} Male age-1: 0.56 y^{-1} Male age-2: 0.45 y^{-1} Male age-3+: 0.39 y^{-1}	Same as 2017	Same as 2020	Fixed parameter; 2023 assessment investigated estimating differential in the sex specific mortality. Based on Teo (2017); Kinney and Teo (2016).
Growth	Sex-specific growth model; Length at age-1 (L_1): CV=0.06 Female: 43.504 cm Male: 47.563 cm Asymtotic length (L_∞): CV=0.04 Female: 106.57 cm Male: 119.15 cm Growth rate (K): Female: 0.29763 yr^{-1} Male: 0.20769 yr^{-1}	Same as 2017	Same as 2020	Fixed parameter; 2023 assessment investigated estimating growth model to include in a sensitivity run. Based on Xu et al. (2014).
Stock recruitment	Beverton-Holt, steepness = 0.9	Same as 2017	Same as 2020	Fixed parameter; 2023 assessment investigated estimating
Maturity	50% at age-5, 100% at age-6	Same as 2017	Same as 2020	Based on Ueyanagi (1957); Chen et al. (2016)
Fecundity	Proportional to spawning biomass	Same as 2017	Same as 2020	Ueyanagi (1957)
Spawning season	2	Same as 2017	Same as 2020	Ueyanagi (1957); Chen et al. (2010)
Length-weight	Seasonal length weight relationships	Same as 2017	Same as 2020	Watanabe et al. (2006)
Selectivity			Selectivities by fleet	See stock assessment report
CV of indices	Average CV of 0.2 only if CV is less than 0.2	Same as 2017	Fixed CV of 0.2 for all years except 2020 and 2021 which had fixed CV of 0.3.	

Parameter	2017 Assessment	2020 Assessment	2023 Tentative	Notes
Size composition effective sample size	Based on number of fish or sets sampled to the number of trips from an analysis of the US longline fisheries. Based on this analysis, we assumed that 17.7 fish per trip were sampled for the other fisheries. Size composition records with <3 sample sizes were considered unrepresentative and removed. The input sample sizes for each fishery were further rescaled by a multiplier so that the average input sample size for each fishery was approximately the same as for the US longline fisheries (~7)	Since most albacore fisheries only record the number of fish, an analysis of the EPO surface fishery (F33) was used to relate the number of fish sampled to the number of trips. Based on this analysis, it was assumed that 100 fish sampled were equivalent to a sampled trip. Size composition records with sample size of <1 were considered unrepresentative and removed. The input sample sizes for each fishery were further rescaled by a multiplier (0.1626) so that the average input sample size for fishery with the most fish sampled (F01) was ~30	Since most albacore fisheries only record the number of fish, an analysis of the EPO surface fishery (F33) was used to relate the number of fish sampled to the number of trips. Based on this analysis, it was assumed that 100 fish sampled were equivalent to a sampled trip. Size composition records with sample size of <1 were considered unrepresentative and removed. The input sample sizes for each fishery were further rescaled by a multiplier (0.274) so that the average input sample size for fishery with the most fish sampled (F28) was ~30. The 2020 and 2021 size composition data were down weighted by a 0.1 multiplier	2023 assessment investigated several potentially weighting scenarios.
Initial conditions	initF and early recruitment deviates estimated without fitting to initCatches. This is to initialize the model age structure to be consistent with the abundance index and composition data during the model historical period. The TWN LL fleet in areas 3/5 was used as the initF fleet due to the wide range of sizes of fish that were caught.	Same as 2017	Same as 2020	2023 assessment investigated other initial fleets

Table 4. List of future projection runs to for the 2023 assessment that are consistent with the management objectives described in the harvest strategies adopted by IATTC and WCPFC.

2020 Assessment	2023 Assessment
Software package: SSfuture C++; ssfcpp; ssfcpp20191125.cpp *(Ijima 2020)*	**Software package:** SSfuture C++; ssfcpp; Updated version *(***ISC/23/ALBWG-01/07***)*
Future Harvest Scenarios: 1) Constant catch (average of 2013-17) 2) Constant $F_{2015\text{-}2017}$	**Future Harvest Scenarios:** 1) Historical F (2005-2019) 2) Constant $F_{2017\text{-}2019}$
Outputs: SSB and fixed line for preliminary LRP (20**%$SSB_{current,F=0}$)**	**Outputs:** 1) Annual SSB 2) **Obj A:** Annual SSB with respect to new LRP (**14%$SSB_{current,F=0}$); Showing 60% and 95% CIs** 3) **Obj B:** Annual depletion (Age1+) relative to average **depletion** (Age1+) **in 2006-2015** 4) **Obj C:** Annual $F_{\%SPR}$ relative to **TRP ($F_{45\%}$)**

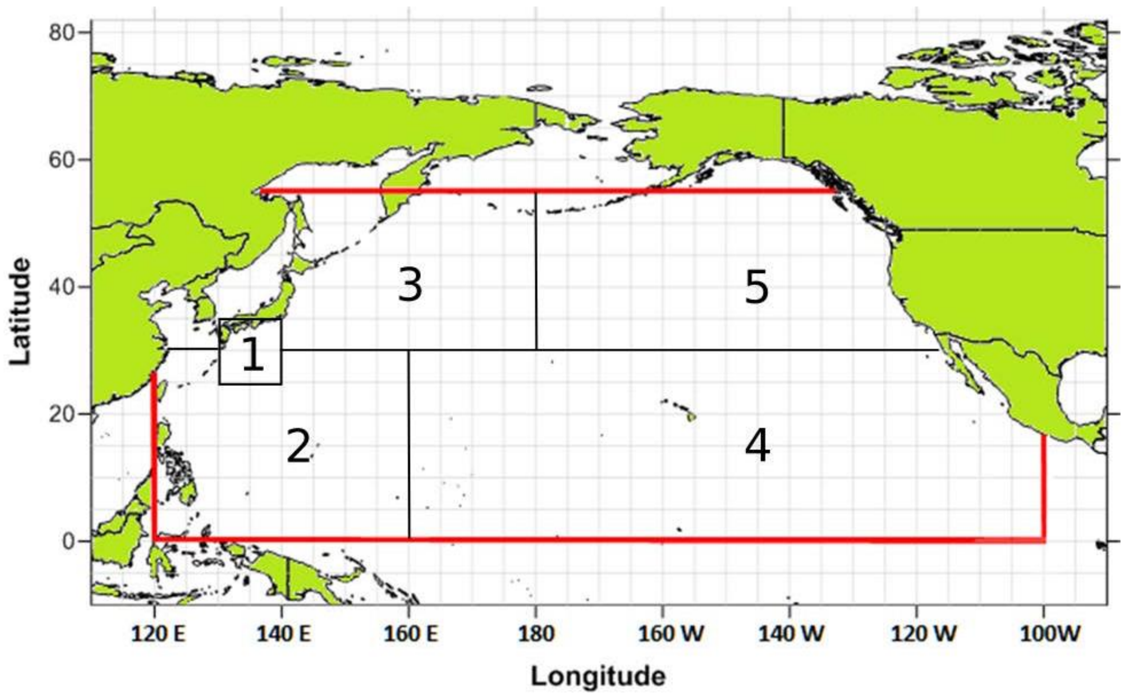

Figure 1. Spatial domain (red box) of the north Pacific albacore stock (*Thunnus alalunga*) in the 2020 stock assessment. Fishery definitions were based on five fishing areas (black boxes and numbers) defined from cluster analyses of size composition data.

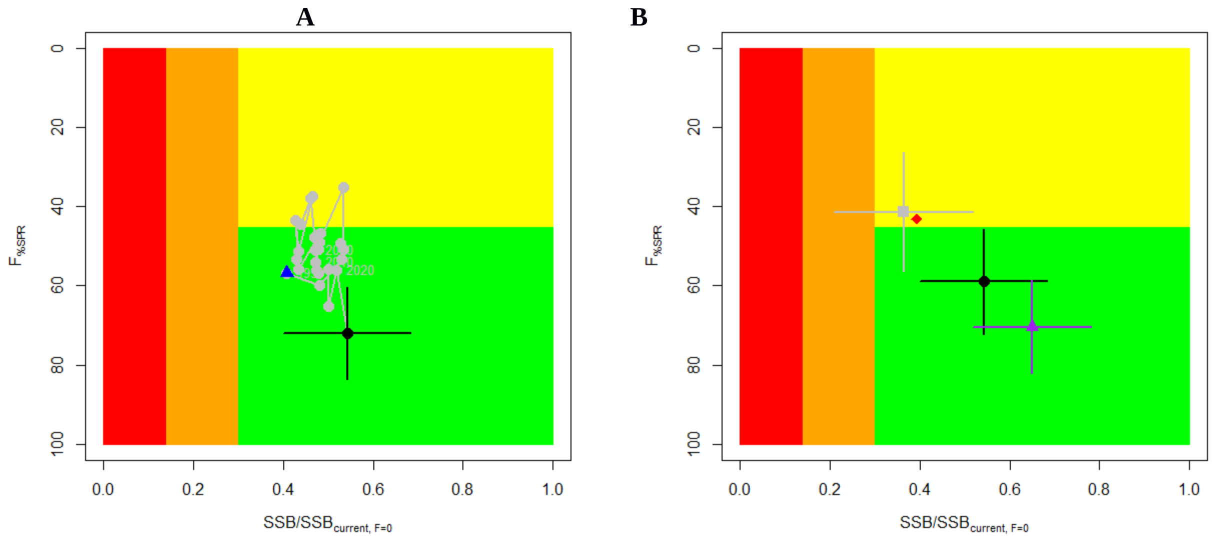

Figure 2. (**A**) Stock status phase plot showing the status of the north Pacific albacore (*Thunnus alalunga*) stock relative to the biomass-based threshold (30%SSB$_{current, F=0}$) and limit (14%SSB$_{current, F=0}$) reference points, and fishing intensity-based target reference point (F45$_{\%SPR}$) over the base case modeling period (1994-2021). Blue triangle indicates the start year (1994) and black circle with 95% confidence intervals indicates the terminal year (2021). (**B**) Stock status plot showing current stock status and 95% confidence intervals of the base case model (black circle), an important sensitivity run of CV = 0.06 for L_{inf} in the growth model (gray square), an important sensitivity run with an estimated growth model (purple triangle), and a model representing an update of the 2020 base case model to 2023 data (red diamond). 95% confidence intervals are not shown for the update of the 2020 base case model (red diamond) because the model did not have a positive definite Hessian matrix and uncertainty estimates are unreliable. Red areas in both panels indicate female SSB falling below the limit reference point while the orange areas indicate female SSB between the threshold and limit reference points. Green areas indicate female SSB above the threshold reference point and fishing intensity below the target reference point. Yellow areas indicate female SSB above the threshold reference point and fishing intensity above the target reference point. Fs in this figure are based on spawning potential ratio (SPR) and calculated as $F_{\%SPR}$ so that the Fs reflects changes in fishing mortality. A higher %SPR indicates lower fishing intensity. SPR is the ratio of the equilibrium SSB per recruit that would result from the year's pattern and intensity of fishing mortality relative to that of the unfished population. Current fishing intensity is calculated as the average fishing intensity during 2018-2020 ($F_{2018-2020}$), while current female spawning biomass refers to the terminal year of this assessment (i.e., 2021). The model representing an update of the 2020 base case model is similar to but not identical to the 2020 base case model due to changes in data preparation and model structure.

APPENDIX 1. LIST OF PARTICIPANTS

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The Albacore Working Group 2022 *(left to right) – Haikun Xu, Sarah Hawkshaw, Carolina Minte-Vera, Steve Teo, Hirotaka Ijima, Yoshinori Aoki, Yuichi Tsuda, and Yi-Jay Chang (on screen, participated virtually). Jhen Hsu also participated virtually and Kevin Hill is behind the camera.*

APPENDIX 2. AGENDA

ALBACORE WORKING GROUP (ALBWG)

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

STOCK ASSESSMENT WORKSHOP

20-27 March 2023

Southwest Fisheries Science Center

La Jolla, CA, UNITED STATES OF AMERICA

Revised AGENDA

1. Opening of workshop
   1.1. Welcoming Remarks
   1.2. Chair’s Remarks
   1.3. Meeting Arrangements
   1.4. Introductions
2. Meeting Logistics
   2.1. Meeting Protocol
   2.2. Review and Adoption of Agenda
   2.3. Assignment of Rapporteurs
   2.4. Group Photo
3. Review Work Assignments
4. Review Working Papers and Input Data -
   4.1. Catch
   4.2. CPUE Indices
   4.3. Size Compositions
   4.4. Other Data (Aging Data, Sex Composition, etc.)
   4.5. Data Issues
5. Base Case Model Development
   5.1. Review structural and biological assumptions
   5.2. Review initial conditions
6. Diagnostic Analyses
7. Sensitivity Analyses
8. Projections Scenarios
9. Stock Assessment Report and Section Assignments
10. Stock status and Conservation
    10.1. Biological reference points and Kobe plots
    10.2. Review exceptional circumstances criteria
    10.3. Stock status and conservation advice
11. Research Recommendations
    11.1. Update on sex identification genetics project by US scientists
12. Administrative Matters
    12.1. Workplan for Completing Assessment Report
    12.2. Update National Contacts for the ALBWG
    12.3. Time and place of next ALBWG meeting
13. Other matters
    13.1. NC19 and IATTC SAC preliminary stock assessment results
    13.2. ALBWG elections
14. Clearing of Meeting Report
15. Adjournment

APPENDIX 3. LIST OF WORKING PAPERS AND PRESENTATIONS

Number	Title and Authors	Availability
ISC/23/ALBWG-01/01	A Summary of North Pacific Albacore Tuna Fishery Data Reported by Non-ISC Countries. Sarah Hawkshaw	ISC Website
ISC/23/ALBWG-01/02	Juvenile index of North Pacific albacore tuna: Japanese longline CPUE standardization using a spatiotemporal model – Hirotaka Ijima and Jun Matsubayashi	ISC Website
ISC/23/ALBWG-01/03	CPUE standardization for North Pacific albacore caught by Japanese longline fishery from 1996 to 2021 in Area 2 and Quarter 2. Jun Matsubayashi, Hirotaka Ijima, Naoto Matsubara Yoshinori Aoki and Yuichi Tsuda	ISC Website
ISC/23/ALBWG-01/04	Sex specific size data for North Pacific albacore (Thunnus alalunga) in Japanese research/training vessels. Yoshinori Aoki, Tetsuro Senda, Hirotaka Ijima, Naoto Matsubara, Jun Matsubayashi, and Yuichi Tsuda	ISC Website
ISC/23/ALBWG-01/05	Juvenile and adult classification with clustered mean weight data in Japanese longline fishes in areas 1 and 3. Yoshinori Aoki, Hirotaka Ijima, and Yuichi Tsuda	ISC Website
ISC/23/ALBWG-01/06	Spatiotemporal definitions of Taiwanese albacore longline fishery in the North Pacific Ocean based on a regression tree analysis of size data. Zi-W Yeh, Yi-Jay Chang and Jhen Hsu	ISC Website
ISC/23/ALBWG-01/07	Uncertainties of future projection in North Pacific albacore tuna stock assessment. Hirotaka Ijima	ISC Website
ISC/23/ALBWG-01/08	Additional Japanese longline logbook data analysis for adult albacore tuna CPUE. Hirotaka Ijima and Yuichi Tsuda	ISC Website
ISC/23/ALBWG-01/09	Revision of future projection software SSfuture C++. Hirotaka Ijima, Yoshinori Aoki, and Yuichi Tsuda	ISC Website
Presentation 01	Summary of data preparation for Japanese longline fisheries. Yuichi Tsuda.	Contact the author
Presentation 02	Update on sex identification genetics project by US scientists. John Hyde.	Contact the author

APPENDIX 4. MEETINGS AND WORKPLAN

Date	Location	Task/Event
March 20-27, 2023	La Jolla, USA	ALBWG workshop: Stock Assessment
April 19/20, 2023 (EPO) **April 20/21, 2023 (WPO)**	Virtual	ALBWG workshop: Follow-up Stock Assessment Meeting
May 15-19, 2023	La Jolla, USA	IATTC SAC: Preliminary Stock Assessment
June 8, 2023 (EPO) **June 9, 2023 (WPO)**	Virtual	ALBWG workshop: Follow-up Stock Assessment Meeting
July, 2023	Japan	WCPFC NC19: Preliminary Stock Assessment
July, 2023	Japan	ISC Plenary
TBD	Virtual	NC19: Update following ISC Plenary
August, 2023	Palau	SC19: Stock Assessment
Early 2024	TBD	Biological modeling, data collection, and index improvements
Early 2025	TBD	Model improvement meeting
Late 2025	TBD	ALBWG workshop: Data Preparation
Next benchmark assessment 2026	TBD	ALBWG workshop: Stock Assessment 2026

APPENDIX 5.

Subject to Change as more Information Becomes Available to the ISC
At this time the ALBWG stresses that the criteria developed in this document are incomplete and without implementation indicators based on adopted HCR(s) the application of these incomplete criteria may bias results and introduce uncertainty.

Preliminary Criteria for identifying exceptional circumstances for north Pacific albacore tuna

The Albacore Working Group (ALBWG) of the International Science Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) was tasked by the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC) with developing criteria for the identification of exceptional circumstances that would result in suspending or modifying the application of the adopted harvest strategy, and potentially may require updated Management Strategy Evaluation (MSE) simulation work. Exceptional circumstances define situations outside the range of scenarios over which robustness of the harvest strategies was evaluated in the MSE analysis, and for which a different management action than specified by the adopted harvest strategy may have to be taken. This preliminary guidance document provides an outline of the process for identifying exceptional circumstances. However, the document does not provide all necessary actions to apply should an exceptional circumstance be identified, nor does it cover all possible exceptional circumstances.

These criteria for identifying exceptional circumstances for north Pacific albacore tuna (NPALB) were developed by the ALBWG based on criteria developed by other Regional Fisheries Management Organizations (RFMOs), such as the International Commission for the Conservation of Atlantic Tunas (ICCAT), for other tuna stocks. The ALBWG noted that not all the elements of a harvest strategy [e.g. harvest control rules (HCRs)] for NPALB were fully developed by the IATTC and WCPFC in 2022. Therefore, the WG could not develop detailed criteria for some aspects of exceptional circumstances. For example, some exceptional circumstances include criteria based on implementation failure of the HCRs but detailed HCRs have not yet been included in the harvest strategy. Therefore, these potential exceptional circumstances will need to be reexamined once control rules are adopted.

To identify exceptional circumstances for NPALB, the ALBWG will continue to conduct benchmark stock assessments for the stock every 3 years with updated data sources and research as well as examine new evidence about the current stock status and environmental conditions.

The following general elements will be considered when examining signals of possible exceptional circumstances for NPALB:

Stock and Fleet Dynamics: Evidence from stock assessment estimates that the stock is in a state not previously simulated in the MSE (e.g., current or projected SSB estimates are outside the range of uncertainty, or new evidence about the biology of the stock is presented). As well as evidence that the fleet structure or fishing operations have changed substantially.

Application: Data collection required to produce the stock assessment is no longer available and/or appropriate to apply the adopted harvest strategy.

Implementation: The implementation of the management action is substantially different from what is prescribed by the HCRs (Note that HCRs have not yet been adopted for NPALB). For example, the total removals or effort by the fishery differ substantially (i.e. more than what was specified by the implementation error used in the MSE) from what is prescribed by the HCRs.

Based on the general elements above, several indicators for NPALB were identified by the ALBWG and are summarized in the following table:

Element	Indicator	Range	Evaluation Schedule
Stock and Fleet Dynamics	Depletion stock biomass ($SSB/SSB_{current, F=0}$)	In any year estimates fall outside the range of uncertainty simulated by the operating models (OMs) used in the most recent MSE (accepted by the ALBWG in 2021)	Benchmark stock assessment every 3 years
	Relative fishing intensity ($F_{\%}$) defined as (1-SPR) where SPR is the spawning potential ratio		
	Changes in fleet dynamics	Any substantial differences from the structure and parameterization used in the OMs of the most recent MSE (accepted by the ALBWG in 2021)	As new evidence and research is presented and accepted by the ALBWG
	Biological parameters		
Application	Stock assessment	Not producible or unreliable	Benchmark stock assessment every 3 years
Implementation	TBD (will depend on adopted HCRs)	The implementation of the management action is substantially different from what is prescribed by the HCR	TBD

Should evaluation of the above criteria identify any exceptional circumstances, the ALBWG will assess the severity and potential impacts on the performance of harvest strategies, including the HCRs, and provide advice on the action required, including the need for a change in harvest strategy (e.g., reference points, HCRs) and/or updates to the MSE framework for NPALB.