FINAL

ISC/23/ANNEX/06

ANNEX 06

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 06

REPORT OF THE ALBACORE WORKING GROUP WORKSHOP

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

December 6-12, 2022
Fisheries Resources Institute
Japan Fisheries Research and Education Agency (FRA)
Yokohama, JAPAN

1. OPENING AND INTRODUCTION

An intersessional workshop of the Albacore Working Group (ALBWG or WG) of the International Science Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) was convened at the Japan Fisheries Research and Education Agency (FRA), Yokohama, Japan 6 – 12 December 2022.

Hidetada Kiyofuji, Director of the Highly Migratory Resources Division at the Fisheries Resources Institute, Japan Fisheries Research and Education Agency (FRA), welcomed participants from Canada, Chinese Taipei, Japan, the United States of America (USA), and the Inter-American Tropical Tuna Commission (IATTC) to the workshop, both in-person and virtually, and wished them a productive meeting.

The WG Chair briefly described the objectives of the meeting and the expected outcomes. The objectives of this workshop were to: (1) Review stock assessment input data series for consistency with previous stock assessments and updated research; (2) Assess proposed CPUE indices; (3) Review model parameterization, assumptions, and diagnostic tools for the base-case model and future projection software; (4) Review timelines and the work plan for the 2023 stock assessment.

2. MEETING LOGISTICS

2.1 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 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, reviewed, and adopted at the workshop (**Attachment 2**). A list of working papers and presentations can be found in **Attachment 3**.

2.3 Assignment of rapporteurs

Rapporteuring duties were assigned to Carolina Minte-Vera, Hirotaka Ijima, Yoshinori Aoki, Naoto Matsubara, and Steven Teo. Sarah Hawkshaw had the overall responsibility for assembling the report.

2.4 Distribution of Documents and Working Paper Availability

Eleven (11) 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 PREVIOUS ASSESSMENT IN 2020 AND WORK ASSIGNMENTS

The WG chair briefly presented the 2020 stock assessment focusing on summarizing the fleet and area definitions. The WG discussed potential updates to the previous structure based on updated analyses and the known aspects of North Pacific albacore biology captured in the conceptual model (Figure 1).

Based on the data and discussions, **the WG recommended keeping the fleet structure described in the conceptual model and used in the 2020 assessment for the majority of the fleets. The WG recommended the following key exceptions:**

- **Japan longline fleets in Areas 1 and 3 (F1 to F8 in the 2020 assessment)**

  The WG recommended that the Japanese scientists develop two sets of data for the stock assessment; one set following the fleet structure in the 2020 assessment and the other based on splitting the JPLL fleets based on the finite mixture analysis described in Ijima and Tsuda (2022) (**ISC/22/ALBWG-02/03**). The appropriate fleet structure will then be investigated based on these options during the stock assessment model development process.

- **Taiwan longline fleets (F27 & F28 in the 2020 assessment)**

  The 2020 assessment used a latitudinal split of 25°N for the Taiwan longline based on previous analysis, which suggested that the latitudinal split of 30°N, described by the conceptual model, may not be appropriate for these fleets. The WG recommended that the Taiwanese scientists re-examine this issue and provide a working paper at the assessment meeting to support the decision.

- **U.S. longline fleets (F25 and F26 in the 2020 assessment)**

  The WG recommended that the U.S. longline fleet data in subarea 6 of Teo (2022) (**ISC/22/ALBWG-02/09**) be assigned to the US longline fleet in Area 4 given that the catch in subarea 6 was relatively small and would make the fleet structure more consistent with the conceptual model for the stock.

Work assignments developed at previous WGs meetings were reviewed and their updated status was noted in Table 1.

4. INPUT DATA REVIEW

4.1 Updated North Pacific albacore catch by Japanese fisheries. Tsuda, Y., Matsubara, N., Matsubayashi, J., Aoki, Y. and Ijima, H. (ISC/22/ALBWG-02/01)

North Pacific albacore catch by the Japanese fisheries are mainly caught by the longline and pole-and-line fisheries. The Japanese longline fisheries target medium and large size fish (> 70cm in fork length) mainly in winter around 30°N in the western north Pacific Ocean. These fisheries also target more larger size albacore that are believed to be spawning fish in the area between 10°N and 25°N. On the other hands, Japanese pole-and-line fisheries target younger age class albacore from spring to fall in the western north Pacific Ocean, which is characterized as the Kuroshio extension and Kuroshio-Oyashio transition areas. Other Japanese fisheries targeting albacore are drifting gill net, purse seine and troll fisheries. In this document, Japanese North Pacific albacore catch data for the 2023 stock assessment were updated by the same fleet definitions (Figure 1) and procedure used in the 2020 stock assessment (Kiyofuji et al., 2019).

Discussion

Catch data for the Japanese fisheries were updated up to the year 2020. The WG noted that no official catches were available for 2021, however, it was **recommended that provisional values for 2021 catches be obtained from logbooks by Japanese scientists to be used in the 2023 stock assessment.**

4.2 Additional analysis for Japanese longline logbook data using finite mixture model. Ijima, H. and Tsuda, Y. (ISC/22/ALBWG-02/03)

Japanese longline logbook data was analyzed using a finite mixture model to improve the fisheries definition in the North Pacific albacore stock assessment. Before the data-preparatory meeting, Japan reported the progress of this analysis to the WG, and the addition analyses were requested to improve the overall analysis. This paper reports the updated analyses and the results. The additional analyses isolated potential cohorts distributed in Area 1 and Area 3. In addition, Japan updated the length composition data and compared it to the analysis result. The increase in the length composition data has made the distribution of length composition data relatively similar to the distribution of body mass data in the logbooks. Both the body mass from the logbook and length composition data have different problems. However, at least the length composition data are measured length by individual fish. Thus, the analysis recommends using length composition data for the stock assessment model.

Discussion

A new analysis using mixture models to determine fleet structure was presented to the WG. The analysis used Japanese longline average weight data from logbook data in Areas 1 and 3. The WG noted that the average weight was obtained from catch in weight and catch in numbers for each set. The analysis was able to distinguish between sets that had smaller versus larger average weight. The WG noted that new clusters were identified to define a new fleet structure for the Japanese longline fishery. **The WG agreed that defining longline fisheries in Areas 1 and 3 based on the new clusters for the next assessment is appropriate and requested that the catches and the length frequency data be submitted split by cluster and quarter in addition to the fleet structure used in the 2020 assessment.**

4.3 Updated CPUE standardization for adult North Pacific albacore caught by Japanese longline fishery from 1996 to 2021: the GLMM analysis using STAN. Matsubayashi, J., Ijima, H., Matsubara, N., Aoki, Y. and Tsuda, Y. (ISC/22/ALBWG-02/05)

Adult abundance index (i.e. standardized CPUEs) of albacore from operational data reported by Japanese longline fisheries was presented in this working paper using the same procedures and assumptions of the previous study (Fujioka et al., 2019) and is to be considered as a backup data for stock assessment in 2023. In order to keep the same area and quarter delineation as the previous stock assessment, the data used were from quarter 1 in the Area 2 from 1996 to 2021 and generalize liner mixed model analysis with Bayesian inference was used for the CPUE standardization. The result showed similar trends with the previous CPUE, suggesting that the estimated CPUE is considered reasonable as a backup to the previous one.

<u>Discussion</u>

The Japanese adult longline index was used as the primary index in the 2020 assessment. The data for this analysis to calculate the index values comes from logbook data submitted for Area 2 and Quarter 1, which is when most of the longline catches are taken. The authors noted that the model used to produce the index for the last two assessments, 2017 and 2020, did not account for zero catch probability and erroneously only included the positive catch model when estimating the index values. The WG noted that when including the zero catches in the model the resulting predicted values are closer to the nominal catches. **The WG agreed that the index should be based on modelling both the probabilities for zero and positive catches and recommended that a sensitivity analysis be done in the 2023 assessment to compare the outcomes.**

4.4 CPUE standardization for North Pacific albacore caught by Japanese longline fishery from 1996 to 2021: the GLMM analysis using R-INLA. Matsubayashi, J., Ijima, H., Matsubara, N., Aoki, Y. and Tsuda, Y. (ISC/22/ALBWG-02/04)

This study performed CPUE standardization of adult North Pacific albacore based on Japanese longline fishery operational data using a geostatistical model and compared the results with that of a previous study using Widely-Applicable Information Criterion (WAIC) obtained from Bayesian estimation. The main difference between these models is that the previous study incorporated spatial and temporal effects into the model as random effects, whereas this study incorporated these effects by spatiotemporal models with the Stochastic Partial Differential Equations (SPDE) approach. These models were intended to model albacore catch using year effect, location effect, hooks per basket, fleet type and vessel name. The results of model selection revealed that the application of SPDE significantly improves the performance of the model (WAIC reduced by 63.6% in SPDE model) to standardize CPUE of albacore. In addition, we compared several models with different error distribution and with and without some explanatory variables (hooks per basket and fleet type) to search for the best model. The result of model selection showed that a spatiotemporal model with a zero-inflated negative binomial error distribution and incorporation of all explanatory variables is the best model for CPUE standardization of adult North Pacific albacore.

<u>Discussion</u>

A new procedure for obtaining the index of abundance based on the Japanese longline fishery using zero inflated spatio-temporal models was presented to the WG. The WG noted that the residuals showed some latitudinal trends that may be due to the type of residuals used. The authors would inspect for the use of residuals appropriate for the zero inflated negative binomial model and for patterns of residuals in space in the south. The WG suggested that authors should try to estimate the anisotropy parameter in the spatial correlation matrix. Another suggestion was that the residual patterns in the south may be due to edge effects of the mesh and enlarging the mesh beyond the range of the data might reduce this. An alternative index using data from Quarter 2 was also inspected. This is the quarter when the reproductive activity seems to take place, thus data from this quarter could potentially better represent the female population. However, the estimates posteriors for the Quarter 2 index appear to be problematic and the WG agreed that more work is needed for this index. **The WG discussed the results of this new proposed index method and recommended that the index for Quarter 1 should be used in the base-case model as the primary index for the adults. The WG also recommended that**

the development of an index from Quarter 2 data should continue and be presented at the 2023 assessment meeting to be included as a sensitivity run of the assessment.

4.5 Update standardized CPUE for North Pacific albacore caught by the Japanese pole and line from 1972 to 2021. Matsubara, N., Matsubayashi, J., Aoki, Y., Tsuda, Y., and Ijima, H. (ISC/22/ALBWG-02/07)

This working paper describes the spatial changes in the Japanese pole-and-line (JPPL) fishery location and standardized CPUE. CPUE were calculated using updated data including 2021 as was used in the 2020 albacore tuna stock assessment for the analysis of Standardized CPUE. Fishery locations have been decreasing annually since the 2010s. Recent Standardized CPUE (2019-2021) were highly variable, and historical low level were apparent in 2019 and 2021.

Discussion

The WG thanked the authors for their analysis and **recommended that the updated index be used for sensitivity analyses in the 2023 stock assessment**.

4.6 Standardized CPUE for North Pacific albacore caught by the Japanese pole and line by Geostatistical method. Matsubara, N., Matsubayashi, J., Aoki, Y., Tsuda, Y., and Ijima, H. (ISC/22/ALBWG-02/06)

This working paper provided a summary of a preliminary analysis to calculate a geostatistical standardized CPUE (i.e., relative abundance index) for North Pacific albacore caught by Japanese pole-and-line (JPPL). CPUE were calculated based on four different models, that include two models with/without the Quarter effect, and two models with/without consideration of spatial effects. Based on the WAIC results, the CPUE calculated with the model considering both Quarter and spatial effects was selected. Standardized CPUE showed the opposite trend to nominal CPUE, varying between 0.5-1.7.

Discussion

A preliminary analysis of the Japanese pole and line index was presented to the WG. The data was standardized using spatial models. The WG noted that the results indicated that the standardized CPUE has opposite trend from the nominal CPUE which may be due to the lack of inclusion of temporal effects in the random fields. The WG thanked the authors for this analysis and agreed that more investigation was needed. **The WG recommended that the authors continue their research and update the WG after the 2023 assessment.** It was also suggested that the analysis should consider including a multispecies approach, as the changes in targeting could be the reason for the variation in CPUE.

4.7 Summary of size data update for North Pacific albacore (Thunnus alalunga) in Japanese fisheries. Aoki, Y., Senda T., Ijima, H., Matsubara, N., Matsubayashi, J., and Tsuda, Y. (ISC/22/ALBWG-02/02)

The length composition data of North Pacific albacore caught by Japanese fisheries between 1967 and 2022 was summarized based on the area definition of the 2020 stock assessment (Figure 2). In this update, several old data sources were newly digitized/organized into the database. The updated and newly added data consist of three databases (Size csv, Size org, SKJ NAS), and the newly prepared data has more data than the 2019 data in most years, but the number of data is lower in the period from 1998 to 2000. This period was derived from the use of size csv, instead of using size org, due to missing data from the Yaizu port in 1998-2001 in size csv. Seasonal and historical trends in the length frequency in the 2022 data is similar to those in 2019 data for three fisheries (longline, pole-and-line, drift net) and areas except for the pole-and-line fishery operated in the southern region, which is brought by the additional historical data in this update. Newly updated size data indicated that albacore caught by longline and pole-and-line tended to be smaller in higher latitude areas, and this common trend between fisheries roughly agrees with the insight of change in spatial distribution along with the life stages of North Pacific albacore.

Discussion

The WG noted that the length frequency data from the Japanese fleets was greatly improved by the addition of data from ports that were not used in the previous assessments. The WG recognized the great effort by Japanese scientists to digitize data that was previously only available in paper format. The WG noted the absence of data around 2000 due to the absence of data from the Yaizu port. This is where the large size fish have been reported in the past. Before 1993 the main pole and line and longline port was Yaizu. Japanese scientists contacted their data manager to investigate what may have happened to the Yaizu port data and will follow up with the WG once resolved. The WG asked to see the comparison of the old and the new databases for the same periods. The size frequency aggregated by area looks similar. The WG also inquired about the sampling design for the port sampling. The Japanese scientist explained that the sampling protocol is followed in the main longline port. The WG noted that it is important to obtain good pole and line size data for every quarter and every year, because the stock assessment model estimates time-varying selectivity for this fishery, which is the main fishery for albacore in terms of removals. **The WG recommended that Japan prepare a working paper for the assessment meeting describing the split of size composition data from JPLL data in Areas 1 and 3 for all seasons using the fleet structure from the 2020 stock assessment compared to the fleet structure described in ISC/22/ALBWG-02/03.**

4.8 Catch, length composition, and standardized CPUE of the North Pacific albacore caught by the Taiwanese distant-water longline fisheries in North Pacific Ocean from 1995 – 2021. Hsu, J., Yi, C., Chang, C., Chang, Y. (ISC/22/ALBWG-02/08)

In this working paper, standardized catch rate data and length composition of albacore exploited by Taiwanese distant-water longliners (TWN LL) in the North Pacific Ocean (NPO) from 1995 - 2021 were summarized. Catch data of the albacore caught by Taiwanese longliners in the NPO was also summarized. In addition, albacore-targeting fleets were identified using two-step cluster analysis based on their catch composition, and the fishing strategies between albacore-targeting fleets and non-albacore-targeting fleets were compared. Catch rates were standardized using a Vector-Autoregressive Spatio-Temporal model with year, quarter, vessel, targeting group, spatial, and spatio-temporal effects as explanatory variables. Results showed that the standardized catch rate of the albacore caught by Taiwanese DWLL fleets was relatively stable and has been fluctuating since 1999. Additionally, the length frequency distribution of NPO albacore caught by Taiwanese DWLL fleets during 1995 - 2021 indicated that after 2003, the length frequency distribution appeared to be more consistent, with the mean fork length value fluctuating around 85 cm.

Discussion

The WG discussed how the TWN LL fishery data was used in the 2020 assessment. Initial fishing mortality rates were estimated for the TWN LL albacore targeting fishery in Areas 3 and

5 to represent the fished state at the start of the model because of the wide size range of fish caught by this fishery. The model is not fitted to historical catches before the start year of the model in 1994. The abundance index for the Taiwan longline fishery was also not fit in the 2020 assessment. TWN LL size composition data from 2003-2018 only, for Areas 3 and 5, were fitted in the base case model because length composition data were limited spatially and temporally prior to 2003 and were not considered representative of catches. **The WG recommended that the index for the TWN LL albacore targeting fishery in the northern area (Areas 3 and 5) not be used in the 2023 assessment but continue to be developed for the next assessment cycle.**

The WG noted that the spatial size composition data coverage for Areas 4 and 5 in TWN LL fishery appeared to be better than that in the JPLL fishery and it was discussed whether to use these data for selectivity estimation. The length frequency data, however, were inconsistent with the JPLL data, and the mean body weight data from the TWN LL fishery appeared to provide a more appropriate representation. **The WG recommended that the TWN LL fishery should continue to be split into a southern (Areas 2 and 4) and northern (Areas 3 and 5) fisheries as recommended by the authors, and data submission should include the average weight data and associated CV for the southern area (Areas 2 and 4)**. **The WG also requested that the authors investigate the southern boundary split for the TWN LL data and present a WP at the next ALBWG stock assessment meeting, confirming if the split should be 25°N rather than the 30°N boundary outlined in the albacore tuna conceptual model.**

4.9 Preliminary catch and size composition time series of the U.S. and Mexico surface fishery for the 2023 North Pacific albacore tuna assessment. Teo, S. and Gu, Y. (ISC/22/ALBWG-02/10)

The objective of this paper is to describe the data sources and methods used to develop preliminary, seasonal catch and size composition time series of the U.S. and Mexico albacore surface fleet in the north Pacific Ocean, in preparation for the 2023 stock assessment. The approach was the same as was used for the 2020 assessment. In order to simplify model structure, it is proposed that albacore landings from all U.S. gears, except handline and longline, and all Mexico gears be combined as part of the Eastern Pacific Ocean (EPO) surface fleet. Three main sources of data were used: 1) annual landings of albacore tuna in metric tons by gear in the north Pacific Ocean reported to the ISC by the U.S. and Mexico; 2) catch-effort information from U.S. fishermen logbooks; and 3) size composition (fork length) information from a U.S. port sampling program. Size composition data in 1 cm bins were first matched to logbooks to obtain average fishing location for specific vessel-trips, and subsequently aggregated into area/month/year strata. Strata with <3 sampled trips were discarded because large spikes were evident in preliminary size compositions. Size compositions from these strata were combined into seasonal size compositions by performing a weighted average of the size compositions of all strata by year and season. Strata weights were calculated as the relative proportion of albacore catch in each stratum within each season and year, using the albacore catch in number recorded in the abovementioned logbook program. Similarly, the input sample size for the size composition data was considered to be the weighted average of the number of trips of all strata by year and season. The catch in a season was calculated by multiplying the estimated proportion of catch in weight for that season with the total annual catch of the U.S. and Mexico surface fishery for the year. For the 2020 assessment, an algorithm was developed to match size information from a specific vessel-trip to the corresponding vessel-trip in the logbook database. The same algorithm was used in this study. The difficulty in matching the port sampling data with the logbook data resulted in the size composition time series starting only in 1977, and predominantly in Season 3. The initial input sample sizes ranged from 3 to 217.3, with an average of 40.3. It is recommended that the ALBWG use the catch and size composition time series described in this working paper for the 2023 stock assessment of North Pacific albacore tuna. In addition, it is recommended that the ALBWG rescale the initial input sample size of the size composition data of this and other fleets in the assessment (i.e., reweighting the size composition data) and set a minimum input sample size, before fitting the size compositions in the assessment model. Finally, it is also recommended that the seasonal Canadian albacore catches be combined with the U.S. and Mexico surface fishery for the 2023 assessment.

Discussion

The WG noted that length frequency data for the USA surface fishery is taken by port sampling and it is raised to the catches. More than 80% of the catches occurs in Quarter 3 and Area 4. The author noted that the data for the other quarters is quite sparse making them a poor representation of the catch in those seasons. The WG agreed that substantially more work will be required in the future to improve the matching of U.S. logbook and port sampling databases. **The WG recommended using only the length frequency for Quarter 3 in the 2023 assessment model and that size composition data for all fleets in the assessment be reweighted before fitting in the model.**

4.10 Candidate relative abundance indices of juvenile albacore tuna for the US surface fishery in the north Pacific Ocean. Teo, S. (ISC/22/ALBWG-02/11)

The objective of this paper is to describe the data sources and methods used to develop relative abundance indices of juvenile albacore tuna for the US surface fishery in the north Pacific Ocean. The US surface fishery for albacore tuna consists of troll and pole-and-line vessels that primarily capture albacore tuna ranging from ages-2 to 4. In previous assessments, relative abundance indices for three periods (1966 – 1978, 1979 – 1998, and 1999 – current, excluding 2012), which corresponded to periods of major changes in fishing operations in this fishery, were developed. Here, we focus on the terminal 1999- 2021 period because the assessment model had a start year of 1994 in the 2020 assessment. The standardization approach for these abundance indices in previous assessments was to apply generalized linear models (GLMs) to catch per unit effort data (CPUE; fish per boat day). In this study, we update the post-1999 index by including data until 2021 using the same approach for previous assessments. In addition, this study also developed a series of Bayesian generalized linear mixed models (GLMM) to examine the effect of explicitly incorporating spatial and vessel effects into the standardization approach. The main source of data used in this study was a vessel logbook program. For the GLM-based approach, catch and effort data were aggregated into strata of 1 x 1° spatial blocks by month while for the GLMM-based approach, strata were vessel-specific catch and effort by fishing day. Only logbook data where locations were recorded at ≤1° resolution and the vessel was actively fishing were included. The GLM-based approach used a lognormal model to standardize abundance indices for the three periods using year, quarter, and area as main explanatory factors, and interactions between quarter and area. For the GLMM-based approach, six candidate Bayesian GLMMs were developed using the INLA package to explicitly incorporate spatial and vessel effects into the standardization approach. For these models, the response variables were the number of albacore caught instead of ln(CPUE + 1) for the GLM model. Therefore, discrete probability distributions like Poisson and negative binomial distributions were investigated for the GLMM-based approach. The explanatory variables considered for the GLMM-based approach were: year, month, bathymetry, distance to shore, vessel, and fishing location. A candidate abundance index was developed from the best fitting GLMM and confidence intervals were calculated from the estimated posterior marginal distributions. Residual and Q-Q plots for the GLM indicated that the models were not fitting the data well at low and high CPUE values. The standardization process did not appear to perform well and may not have adequately standardized the changes in catchability for the US surface fishery. For the GLMM-based approach, Model 3 (negative binomial with vessel effects) is the best fitting model with the lowest deviance information criteria (DIC). The abundance index from Model 3 shows similar overall trends to the GLM-based index. It is clear that the negative binomial distribution is a better distribution than the Poisson, and appears to be appropriate for the data. However, including a spatially explicit component, with spatial autocorrelation, did not appear to substantially improve model fit over a model with spatially implicit fixed effects of bathymetry and distance from shore. Given the limited spatial distribution of this fishery during 1999 – 2021, it is not likely that the CPUE of this fishery would be representative of the juvenile albacore stock abundance as a whole. Instead, the CPUE of this fishery would represent the abundance of juvenile albacore that migrated to the North American coast, and would be sensitive to variable movement rates. Given that the assessment model uses a fleets-as-areas approach and is not explicitly spatially structured, it is not recommended to fit to these indices in the base case model. Instead, it is recommended to consider using these indices in sensitivity model runs. If these indices are used in sensitivity model runs, it is recommended to use the index derived from the GLMM Model 3 because the use of a negative binomial distribution is more appropriate than assuming a lognormal distribution.

Discussion

The WG agreed with the author that the CPUE of this fishery does not appear to represent the juvenile albacore stock abundance as a whole but rather the abundance of juvenile albacore that migrated to the North American coast and are therefore sensitive to variable movement rates. Given that the assessment model uses a fleets-as-areas approach and is not explicitly spatially structured, **the 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.**

4.11 Summary of Canadian north Pacific Albacore tuna catch and size composition data. Hawkshaw, S. (Presentation)

Canada has a troll fishery targeting juvenile north Pacific Albacore Tuna in the eastern Pacific Ocean. The fishery operates predominantly within the Canadian and United States waters with in Area 3. Annual fishing effort ranged between 3,301 and 10021 vessel-days in 1995-2021. Fishing effort was relatively high before 2012, and has exhibited a decreasing trend since 2012. Annual catch varied between 1761 and 7851 mt in 1995-2021. Catch had an increasing trend between 1995 and 2004, remained relatively high in 2005-2011, and has shown a decreasing trend since 2011. Catch per unit effort had an increasing trend between 1995 and 2014, declined annually in 2015-2017, but has increased since a low period in 2017. Fork lengths of sampled fish have been measured since 2007 by on board sampling program. The dominant mode of the length frequency distribution in each year remained around 68.1 cm.

Discussion

The WG noted that the Canadian fishery was highly similar to the U.S. surface fishery, and **recommended that the catches from the Canadian fishery be combined with the US and Mexico surface fishery to form an EPO surface fishery.** This was the same approach as the 2020 assessment. Catch and size composition data will be provided by year and quarter for the 2023 stock assessment.

4.12 Preliminary catch and size composition time series of the U.S. pelagic longline fleets for the 2023 north Pacific albacore tuna assessment. Teo, S. (ISC/22/ALBWG-02/09)

The objective of this paper is to describe the data sources and methods used to develop seasonal catch (in metric tons) and size composition (raised to the catch) time series for two U.S. pelagic longline fleets based in the north Pacific Ocean, for use in the 2023 assessment. Noting that the ALBWG has not yet finalized the fleet structure for the assessment, the fleet structure and methods for this study were the same as that used for the 2020 assessment. Two U.S. pelagic longline fleets were defined, based on the consistency of size compositions within areas. Fleet 1 consists of vessels fishing in a northern area with mostly juvenile and sub-adult albacore, using primarily shallow-set fishing gear. Fleet 2 consists of vessels fishing in a southern area with mostly large, adult albacore, using primarily deep-set fishing gear. Size composition data in 1 cm bins from an observer sampling program were subdivided into 10 x 10° area/month/year strata. Strata with <3 observed trips were discarded. Size compositions of stratum in each fleet were combined into seasonal size compositions by performing a weighted average of the size compositions of all stratum in each fleet by year and season. The initial input sample sizes for the size compositions were calculated as the weighted average of the number of trips of all stratum in each fleet by year and season. The total annual landings by U.S. pelagic longline fishery were subdivided into the seasonal landings for Fleets 1 and 2, based on the relative proportion of albacore catch in each area and season using logbook data, and the size composition of albacore in each area and season. Seasonal albacore catch in metric tons for Fleets 1 and 2 of the U.S. pelagic longline fishery in the north Pacific Ocean are shown. Most of the albacore catch occurred in the area defined for Fleet 2. Seasonal size compositions (raised to the catch) for Fleets 1 and 2 of the U.S. pelagic longline fishery are shown. Input sample sizes ranged from 3 to 16 for Fleet 1, and 3 to 20.9 for Fleet 2. It is recommended that the ALBWG use the seasonal catch and size composition time series described in this working paper for the 2023 stock assessment of north Pacific albacore tuna. As in the 2020 assessment, it is also recommended that the ALBWG rescale the initial input sample size of the size composition data of this and other fleets in the assessment (i.e., reweighting the size composition data) and set a minimum input sample size and/or number of fish sampled, before fitting the size compositions in the assessment model.

Discussion

The author noted that the length frequency data from the US longline fleet comes from the observer program, which has 20% coverage. The WG noted that the length data is raised to the catches and is quite spikey potentially due to the raising procedure. The WG also noted that the sampling design is already representative of the catches since the observers are assigned at random to the vessels, and sample 1 of every 3 fish in the catches. **Therefore, the WG recommended that the size compositions for these fleets not be raised to the catch. The WG also recommended that the seasonal catch and size composition time series from this**

fishery be used in the 2023 stock assessment and that size composition data be reweighted for all fleets.

4.13 Summary of north Pacific albacore fisheries data reported by Non-ISC countries. Hawkshaw, S. (Presentation)

The annual catch, size composition, and the spatial distribution of catch and effort reported for north Pacific albacore by non-ISC member countries was summarized. ISC member countries include Canada, China, Chinese-Taipei, Japan, the Republic of Korea, Mexico and the United States of America. All of these countries except China submit fishery data directly to the ISC, thus Chinese data were included in this review of non-ISC member country data. 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 were reviewed in preparation for the upcoming 2023 stock assessment. Several non-ISC countries have reported catches of north Pacific albacore, however only China and Vanuatu, have significant catches and time series to incorporate into the assessment model.

<u>Discussion</u>

The WG recommended that the Non-ISC data be included in the 2023 stock assessment in a similar way to the 2020 assessment. There are some length frequency data available from the China fleet that could potentially be included in the model as a sensitivity. In the 2020 assessment base case model, the selectivities of these fleets were mirrored to other fisheries in the same area and with similar operations. **The WG recommended that additional countries data be pooled with the Vanuatu fleet. The WG also recommended the WG chair confirm that there are no further discrepancies in the Non-ISC catch and size composition data between years.**

4.14 Summary of catch and size compositions of north Pacific albacore by the high seas drift gillnet fisheries. Teo, S. (Presentation)

From the 1980s until the fishing gear was banned in 1993, substantial amounts of north Pacific albacore were caught by the high seas drift gillnet fisheries as targeted catch as well as bycatch. The high seas drift gillnet fisheries consisted of two main gear types using: 1) large-mesh nets primarily targeting tunas, billfishes, sharks (i.e., tuna gillnet); and 2) small-mesh nets targeting flying squid (i.e. squid gillnet). The three main nations using these gears were Japan, Korea, and Taiwan. In previous stock assessments, catches by the high seas drift gillnet fisheries were nominally included in the catch data. However, there are several major problems with these catch data. First, there was no differentiation between the squid and tuna gillnets even though the different mesh size will result in different sizes of fish being caught. Second, the ALBWG has catch data from Korean high seas drift gillnet fisheries in its data set but the origin of this data is undocumented and unclear, with Korean scientists being unable to find the data in their records. However, it is known and documented that Korea had high seas drift gillnet fisheries during the period. Third, based on an analysis of published records and analyses of observer and logbook data, it appears that the records of Japanese drift gillnet catches of north Pacific albacore consisted primarily of landings by tuna gillnets and did not include catch or discarded bycatch by the squid gillnets. Fourth, the scale of removals by the squid gillnet fisheries are substantial and important to stock assessments. Estimates of these unaccounted catches by the Japanese squid gillnet fishery approximated 1.4 and 0.9 million albacore tuna for 1989 and 1990, respectively.

Fifth, the squid gillnet fisheries of Korea and Taiwan were also substantial and on a similar scale to the Japanese squid gillnet fishery. Although there have been no estimates of albacore bycatch for Korea and Taiwan squid gillnet fisheries, a similar analysis for blue sharks suggested that the bycatch amounts would be similar. Overall, it is critical and recommended for the ALBWG to initiate a study to estimate the total removals of both the tuna and squid gillnet fisheries from Japan, Korea, and Taiwan. In addition, size composition data from these fisheries would also be important for future stock assessments. It is recommended that the ALBWG collaborate with the SHARKWG on the study and publish the work in a scientific journal so that it is easily available to the public. To help with this proposed study, catch, effort, and size data collected by observers from the U.S. and Canada on high seas drift gillnet vessels have been obtained. It is recommended that the ISC STATWG be informed of these data and stores these observer data to prevent data loss. However, it should be noted that data was collected on the basis of multiple bilateral agreements between scientists from the fishing nations and the U.S. or Canada. Therefore, it may be necessary to discuss the idea with the ISC Plenary before proceeding.

Discussion

The WG thanked S. Teo for providing a summary of the catch and size compositions of north Pacific albacore by the high seas drift gillnet fisheries and agreed with the **recommendations proposed: 1) exploring a collaboration with the SHARKWG on estimating the historical total removals by the high seas large mesh and squid drift gillnet fisheries, and publishing the work in a scientific journal; and 2) exploring appropriate data storage protocols for the observer data with the ISC Chair and the STATWG.** Subsequently, S. Teo reported that the SHARKWG responded positively to collaborating with the ALBWG on this project.

4.15 Summary of sex composition data from the Japanese longline and pole-and-line research vessels. Aoki, Y. (Presentation)

A summary of the sex composition data from the Japanese longline and pole and line research vessels was presented to the WG.

Discussion

The WG noted that the data may have bias or 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 noted that Area 4 appears to have a higher proportion of males than other areas and the reasons for this may be related to the sex specific differences in natural mortality, growth and movement. **The WG recommended to investigate the use of the long line sex composition data to potentially estimate sex specific natural mortality and/or growth. The WG also requested that Japan prepare a working paper summarizing the sex composition data obtained by the Japanese research vessels and to present the work at the 2023 stock assessment meeting. Data will be submitted by quarter and year.**

4.16 Review criteria and options for primary abundance (CPUE) indices.

The WG reviewed the criteria used to evaluate the suitability of abundance indices developed for the north Pacific albacore tuna stock assessment. The WG updated the criteria and used it to evaluate several new proposed abundance indices for both adult and juvenile albacore (Table 2). The WG considered the adult abundance index from the Japanese longline fishery in Area 2 and

Quarter 1 and standardized using the geostatistical model to be the most important data component for the 2023 assessment and intend to use it as the primary index.

5. Review 2020 assessment model using updated datasets

The WG did a preliminary run of the 2020 assessment model using updated adult abundance index from by Japanese longline fisheries presented in ***ISC/22/ALBWG-02/05***. The WG noted some difference in the outcomes due to the updated method but the stock status was not changed and the fit was reasonable. **The WG recommended that the updated index from *ISC/22/ALBWG-02/05* be included in the 2023 assessment as a sensitivity run.**

6. Base Case Scenario: Assumptions and Rationale

The Chair presented a list of biological parameters and assumptions used in the base case for the 2017 and 2020 assessments. The WG discussed the preliminary scenarios for the base case in the upcoming 2023 assessment (Table 3) and agreed that the biological parameters and assumptions should remain largely the same to those used in the 2020 assessment, unless new information becomes available. The WG members also noted, however, that during the model development phase estimating some additional biological parameters will be investigated.

7. Diagnostic Analyses

The Chair presented a list of model diagnostic analyses that were used in previous north Pacific albacore stock assessments and other potential diagnostic tools summarized by working group members at the May 2022 WG meeting.

The WG members noted that there were recent workshops and meetings organized by IATTC and CAPAM on the subject of assessment model diagnostics. Based on the discussions at those meetings, it was clear that the model diagnostics must be interpreted with care. The WG agreed to perform the following list of model diagnostics for the 2023 assessment, as well as any others identified during the next WG meeting:

a. R0 profiling
b. Residuals (CPUE and size composition data)
c. Fits to indices, size composition data
d. Age Structured Production Model (ASPM) analysis
e. Retrospective
f. Jitter analysis
g. Hindcasting
h. Catch curve analyses

8. Sensitivity Analyses

The WG reviewed the sensitivity analyses from the 2020 assessment and agreed that sensitivity analyses for the 2023 assessment would be similar. However, the WG did identify the need to include sensitivity runs to compare:

1) the adult abundance index (STAN) used in the 2020 assessment (1996-2021) to the updated adult abundance index (STAN) presented in **ISC/22/ALBWG-02/05** (1996-2021) using the 2020 stock assessment model structure; and
2) the updated adult abundance index (STAN) presented in **ISC/22/ALBWG-02/05** to the new adult abundance index (INLA) presented in **ISC/22/ALBWG-02/04** using the 2023 stock assessment model structure.

The WG noted that exact sensitivity analyses will depend on the model structure of the base case model.

9. Future Projections

The WG examined the future projections from the 2020 assessment and identified issues with the treatment of uncertainty in the projections. Most importantly, the uncertainty in the future projections declined over time because the uncertainty of the F-at-age at the terminal year of the assessment was not available in the stock synthesis report and was not included in the future projections. Secondly, the uncertainty of the depletion ratio $SSB_{current}/SSB_{current,F=0}$ was also not available. H. Ijima presented two possible solutions for the identified issues. First, the WG could request SS developers to include options to report the uncertainties of the F-at-age and depletion ratio by year. Second, the uncertainty of the F-at-age could be approximated outside the SS model. **The WG agreed with the recommendation that the first option would be preferable but if the SS developers are unable to include the features requested, the second option would also be appropriate.** Based on the management objectives described in the harvest strategies adopted by IATTC and WCPFC, the WG developed a list of future projection runs that are consistent with the management objectives adopted (Table 4).

10. Recommendations

10.1 Data format and submission deadlines

The WG agreed that the data format for submission would be similar to the 2020 assessment. The WG developed data submission deadlines for the stock assessment scheduled for 2023 (**Attachment 4**).

10.2 Stock Assessment Software Version

The WG agreed that the latest version of SS (3.30.20) would be used for the 2023 assessment and the WG will request that the SS developers include options to report the uncertainties of the $SSB_{current,F=0}$ and depletion estimates as well as the F-at-age by year.

11. Work Plan and Assignments for Stock Assessment Workshop

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

11.1 Stock assessment assignments

1) Provide catch, size composition, and CPUE data up to 2021 – **All WG members**
2) US longline data with new spatial structure – Teo, S.
3) Add Canada catch to EPO surface fleet catch – Teo, S. and Hawkshaw, S.
4) WP describing model development for 2023 stock assessment – Teo, S., et al.
5) WP describing Japan longline CPUE juvenile index for Areas 1 and 3 in Quarter 1 – Ijima, H.
6) WP describing Japan longline CPUE adult index for Area 2 in Quarter 2 – Matsubayashi, J.
7) WP describing the split of size composition and catch data from Japan longline data in Areas 1 and 3 for all Quarters and clusters 1 and 2 described in ***ISC/22/ALBWG-02/03*** – Aoki, Y.
8) WP describing Japanese research vessel sex composition data – Aoki, Y.
9) WP describing future projections updates for 2023 assessment – Ijima, H.

10) WP documenting the appropriate latitudinal split of the Taiwan fisheries data (25°N or 30°N) – Chang, Y. and Hsu, J.
11) WP describing the Taiwan mean weight and CV data in Areas 2 and 4 – Chang, Y. and Hsu, J.
12) WP documenting updated in the non-ISC north Pacific albacore data – Hawkshaw, S.

12. Other Matters

12.1 Exceptional Circumstances for North Pacific Albacore in the MSE context

At NC 18 the ISC ALBWG was tasked 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 require updated MSE simulation work.

The WG examined the criteria developed by other RFMOs for other tuna stocks to identify exceptional circumstances and discussed the approaches for the north Pacific albacore tuna stock. Based on this, the WG developed a preliminary criteria (**Attachment 5**). The WG noted that the harvest strategy and control rules for NPALB were not fully developed by IATTC and WCPFC in 2022. Therefore, the WG could not develop detailed criteria for some aspects of exceptional circumstances. For example, some exceptional circumstances could include criteria based on implementation failure of the harvest control rules, however, given that detailed harvest control rules have not yet been included in the harvest strategy, the criteria for these circumstances will need to be reexamined if adopted in 2023.

12.2 New IATTC and WCPFC Reference Points

The WG reviewed the harvest strategy for north Pacific albacore that were adopted by both the IATTC (IATTC-100-PROP-F-2_VAR) and WCPFC (NC18-WP-03(Rev.01)) in 2022. Several new reference points were identified in the harvest strategy for the north Pacific albacore stock. Based on these new reference points and objectives laid out in the new harvest strategy, the WG identified several new estimates to present in the stock assessment summary table (Table 5). The WG again noted that the harvest strategy and control rules for NPALB are not fully developed yet and more summary statistics will be discussed at the 2023 stock assessment workshop. The WG also noted that a clear definition of F needs to be included in the stock assessment report and that it would also be discussed further at the stock assessment meeting.

13. Clearing of Meeting Report

The WG Chair prepared a draft of the meeting report, which was reviewed by the WG prior to adjournment of the workshop. After the workshop, the WG Chair distributed a second 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 1150AM on December 12, 2022. The WG Chair thanked the WG members for presenting their research and contributing to this successful data preparation workshop.

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.

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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 and progress at the December 2022 data preparatory meeting.

Assignment	Lead(s)	Status in May/Sept 2022	Dec 2022 Progress
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.
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.
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.
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.
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.

Assignment	Lead(s)	Status in May/Sept 2022	Dec 2022 Progress
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.
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.
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 this report. Criteria will be updated as the harvest strategy is updated at IATTC and WCPFC meetings in 2023.
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)**.
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.

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 Adult: A2 & Q2 (JPNLL)	INLA Juvenile: A1/3 & Q1 (JPNLL)	Delta GLM Juvenile: A3/5 & Q2/3 (JPNPL)	INLA Juvenile:A3/5 & 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	Primary index	Sensitivity	Sensitivity (if completed by assessment meeting)	Sensitivity (if completed by assessment meeting)	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 &	Consistent for 1999 – present. Previous periods had expanded fishing grounds (1966 – 1978 &	Consistent – no longer term changes in fishery location

Criteria	INLA Adult: A2 & Q1 (JPNLL)	STAN Adult: A2 & Q1 (JPNLL)	INLA Adult: A2 & Q2 (JPNLL)	INLA Juvenile: A1/3 & Q1 (JPNLL)	Delta GLM Juvenile: A3/5 & Q2/3 (JPNPL)	INLA Juvenile:A3/5 & Q2/3 (JPNPL)	GLM Juvenile: A3/5 & Q3/4 (EPO)	INLA Juvenile: A5 & Q3 (EPO)	VAST sub-Adult: A2-5 & Q1-4 (TWNLL)
							1979 – 1998)	1979 – 1998)	
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.
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	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	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	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	Negative binomial distribution with GLM for standardizati o-n. Explanatory variables were year, poles. VesselID was included as fixed effect. Standardized CPUE	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	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 autocorrelati on with the Matérn covariance function.

Criteria	INLA Adult: A2 & Q1 (JPNLL)	STAN Adult: A2 & Q1 (JPNLL)	INLA Adult: A2 & Q2 (JPNLL)	INLA Juvenile: A1/3 & Q1 (JPNLL)	Delta GLM Juvenile: A3/5 & Q2/3 (JPNPL)	INLA Juvenile:A3 /5 & Q2/3 (JPNPL)	GLM Juvenile: A3/5 & Q3/4 (EPO)	INLA Juvenile: A5 & Q3 (EPO)	VAST sub-Adult: A2-5 & Q1-4 (TWNLL)
	spatio-temporal effects.	random effects.	spatio-temporal effects.	spatio-temporal effects.	values are estimated as least squares means in the GLM.	spatial effect.			
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
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 recommended use in 2023 stock assessment as primary abundance index.	WG recommended potential use for sensitivity run.	This analysis is in progress and an update will be provided at the next stock assessment meeting. Potential sensitivity run.	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	
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 will investigate 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 will investigate 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 will investigate estimating
Maturity	50% at age-5, 100% at age-6	Same as 2017	Same as 2020	Based on Ueyanagi (1957); Chen et al. (2016)

Parameter	2017 Assessment	2020 Assessment	2023 Tentative	Notes
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)
CV of indices	Average CV of 0.2 only if CV is less than 0.2	Same as 2017	Same as 2020	
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.	Same as 2020	2023 assessment will investigate 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 will investigate 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 WCFC.

2020 Assessment	*Preliminary* 2023 Assessment
<u>Software package:</u> SSfuture C++; ssfcpp; ssfcpp20191125.cpp *(Ijima 2020)*	**<u>Software package:</u>** SSfuture C++; ssfcpp; Updated version to be presented at the next stock assessment meeting *(Ijima 2023)*
<u>Future Harvest Scenarios:</u> 1) Constant catch (average of 2013-17) 2) Constant $F_{2015-2017}$	**<u>Future Harvest Scenarios:</u>** 1) Constant catch (average of 2016-20) 2) Constant $F_{2018-2020}$
<u>Outputs:</u> SSB and fixed line for preliminary LRP (20**%$SSB_{current,F=0}$)**	**<u>Outputs:</u>** Depletion with respect to new LRP **(14%$SSB_{current,F=0}$) and ThRP (30%$SSB_{current,F=0}$)**

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)
SSB_{2018}/20%$SSB_{current, F=0}$	SSB_{2021}/14%$SSB_{current, F=0}$
$F_{2015-2017}$	SSB_{2021}/30%$SSB_{current, F=0}$
$F_{2015-2017}/F_{MSY}$	$Depletion_{B2021}$/ $Depletion_{B2006-2015}$
$F_{2015-2017}/F_{0.1}$	$F_{2018-2020}/F_{MSY}$
$F_{2015-2017}/F_{10\%}$	$F_{2011-2020}$
$F_{2015-2017}/F_{20\%}$	$F_{2018-2020}$
$F_{2015-2017}/F_{30\%}$	$F_{2011-2020}/F_{45\%}$
$F_{2015-2017}/F_{40\%}$	$F_{2018-2020}/F_{45\%}$
$F_{2015-2017}/F_{50\%}$	$F_{2018-2020}/F_{2002-2004}$

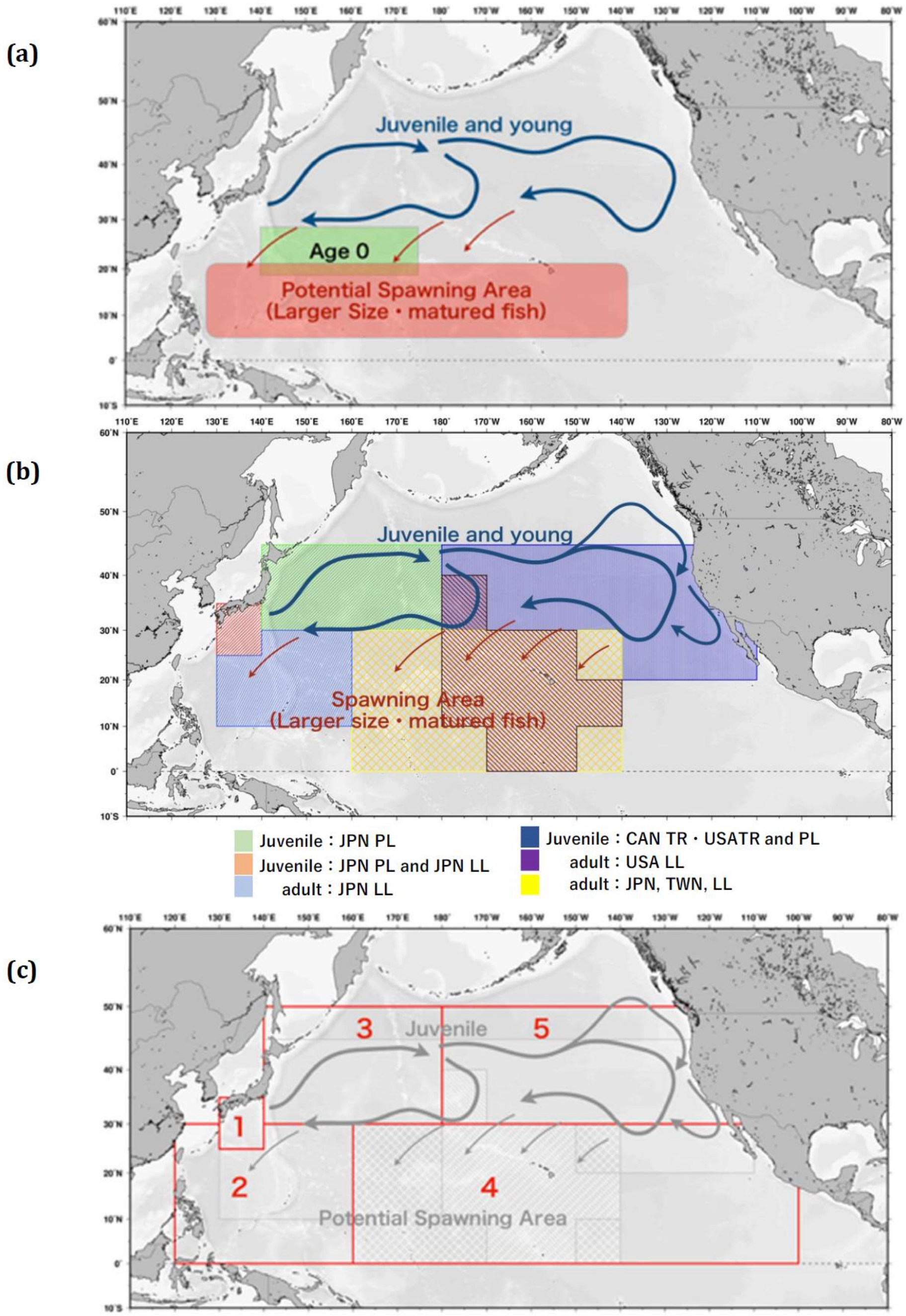

Figure 1. Schematic map of migration and potential spawning area (a) and fishing area by each country (b) and area definitions used for the 2020 north Pacific albacore stock assessment.

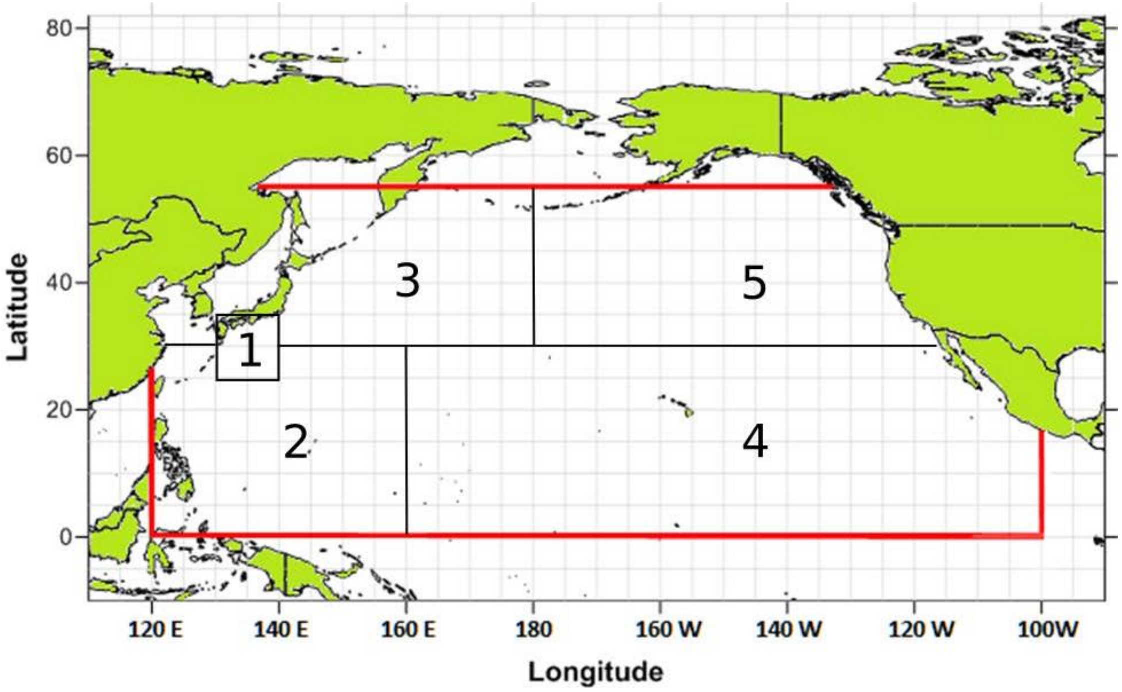

Figure 2. Spatial domain (red box) of the north Pacific albacore stock (*Thunnus alalunga*) in the 2020 stock assessment. Fishery definitions were based on five fishing areas (black boxes and numbers) defined from cluster analyses of size composition data.

APPENDIX 1: LIST OF PARTICIPANTS

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The Albacore Working Group 2022 *(left to right) – Hirotaka Ijima, Naoto Matsubara, Yoshinori Aoki, Jhen Hsu (on screen, participated virtually), Steve Teo, Sarah Hawkshaw and Carolina Minte-Vera. Yi-Jay Chang, Clark Chang, and Desiree Tommasi also participated virtually.*

APPENDIX 2. AGENDA

ALBACORE WORKING GROUP (ALBWG)
INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC OCEAN
DATA PREPARATORY WORKSHOP
6-12 December 2022
Japan Fisheries Research and Education Agency (FRA)
Yokohama, JAPAN
DRAFT AGENDA

1. Opening of workshop
   - Welcoming Remarks
   - Chair's Remarks
   - Meeting Arrangements
   - Introductions
2. Meeting Logistics
   - Meeting Protocol
   - Review and Adoption of Agenda
   - Assignment of Rapporteurs
   - Group Photo
3. Review 2020 NPALB assessment and Work Assignments
   - Fishery Definitions
4. Input Data Review
   - Catch, CPUE Indices, Size Compositions
     a. Japan Longline
     b. Japan Pole-and-Line
     c. Japan Miscellaneous
     d. Taiwan Longline
     e. Taiwan Miscellaneous
     f. EPO Surface
     g. US Longline
     h. Non-ISC Longline
     i. High seas drift net (Japan, Taiwan, & Korea)
     j. Other
   - Other Data (Aging Data, Sex Composition, etc.)
5. Review 2020 assessment model using updated datasets
6. Base case scenario: Assumptions and rationale
   - Historical period
   - Structural assumptions
   - Biological parameters (M, growth form, maturity schedule)
   - Abundance Indices for fitting
   - Initial conditions
7. Diagnostic Analyses
   - R0 profiling
   - Residuals
   - Fits to indices, size composition data
   - Age Structured Production Model (ASPM) analysis

- Retrospective
- Jitter analysis
- Hindcasting
- Others

8. Sensitivity Analyses
    - Natural Mortality
    - Steepness of Stock-Recruitment Relationship
    - Growth
    - Starting Year of Historical Data
    - Others
9. Future Projections
    - Review of Projections
    - Future Harvest Scenarios
10. Recommendations
    - Data format and submission deadlines
    - Stock Assessment Software Version
    - Future Research
11. Work Plan and Assignments for Stock Assessment Workshop
    - Location and Timing of Workshop
12. Other Matters
    - Discussion on Developing Criteria for Identification of Exceptional Circumstances for North Pacific Albacore in the MSE context
    - IATTC and WCPFC Reference Points
13. Clearing of Report
14. Adjournment

APPENDIX 3. LIST OF WORKING PAPERS AND PRESENTATIONS

Number	Title and Authors	Availability
ISC/22/ALBWG-02/01	Updated North Pacific albacore catch by Japanese fisheries. Tsuda, Y., Naoto Matsubara, Jun Matsubayashi, Yoshinori Aoki and Hirotaka Ijima	ISC Website
ISC/22/ALBWG-02/02	Summary of size data update for North Pacific albacore (Thunnus alalunga) in Japanese fisheries. Yoshinori Aoki, Tetsuro Senda, Hirotaka Ijima, Naoto Matsubara, Jun Matsubayashi, and Yuichi Tsuda	ISC Website
ISC/22/ALBWG-02/03	Additional analysis for Japanese longline logbook data using finite mixture mode. Hirotaka Ijima and Yuichi Tsuda	ISC Website
ISC/22/ALBWG-02/04	CPUE standardization for North Pacific albacore caught by Japanese longline fishery from 1996 to 2021: the GLMM analysis using R-INLA. Jun Matsubayashi, Hirotaka Ijima, Naoto Matsubara Yoshinori Aoki and Yuichi Tsuda	ISC Website
ISC/22/ALBWG-02/05	Updated CPUE standardization for adult North Pacific albacore caught by Japanese longline fishery from 1996 to 2021: the GLMM analysis using STAN. Jun Matsubayashi, Hirotaka Ijima, Naoto Matsubara Yoshinori Aoki and Yuichi Tsuda	ISC Website
ISC/22/ALBWG-02/06	Standardized CPUE for North Pacific albacore caught by the Japanese pole and line by Geostatistical method. Matsubara, N., Matsubayashi, J., Aoki, Y., Tsuda, Y., and Ijima, H.	ISC Website
ISC/22/ALBWG-02/07	Update standardized CPUE for North Pacific albacore caught by the Japanese pole and line from 1972 to 2021. Matsubara, N., Matsubayashi, J., Aoki, Y., Tsuda, Y., and Ijima, H.	ISC Website
ISC/22/ALBWG-02/08	Catch, length composition, and standardized CPUE of the North Pacific albacore caught by the Taiwanese distant-water longline fisheries in North Pacific Ocean from 1995 – 2021. Jhen Hsu, Cheng-Hao Yi, Chun-Wei Chang, Yi-Jay Chang	ISC Website
ISC/22/ALBWG-02/09	Preliminary catch and size composition time series of the U.S. pelagic longline fleets for the 2023 north Pacific albacore tuna assessment. Teo, S.	ISC Website

Number	Title and Authors	Availability
ISC/22/ALBWG-02/10	Preliminary catch and size composition time series of the U.S. and Mexico surface fishery for the 2023 north Pacific albacore tuna assessment. Teo, S.	ISC Website
ISC/22/ALBWG-02/11	Candidate relative abundance indices of juvenile albacore tuna for the US surface fishery in the north Pacific Ocean. Teo, S.	ISC Website
Presentation 01	Summary of size data update for North Pacific albacore (Thunnus alalunga) in Japanese fisheries. Aoki, Y., Senda T., Ijima, H., Matsubara, N., Matsubayashi, J., and Tsuda, Y.	Contact the author
Presentation 02	Updated catch and size data from the Canadian north Pacific albacore Tuna Fishery. Hawkshaw, S.	Contact the author
Presentation 03	Updated of North Pacific Albacore Tuna Fishery Data Reported by Non-ISC Countries. Hawkshaw, S.	Contact the author
Presentation 04	Summary of sex composition data collected from Japanese North Pacific albacore (*Thunnus alalunga*) Research Vessel. Aoki, Y.	Contact the author

APPENDIX 4. MEETINGS AND WORKPLAN

Date	Location	Task/Event
January 9, 2023	Email	Data format spreadsheet circulation by Teo, S.
January 23, 2023	Email	Data submission deadline
January 30, 2023	Email	Finalized Data and circulate WG members
March 20-27, 2023	La Jolla, USA	ALBWG workshop: Stock Assessment
May 15-19, 2023	La Jolla, USA	IATTC SAC: Preliminary Stock Assessment
July, 2023	Japan	WCPFC NC19: Preliminary Stock Assessment
July, 2023	Japan	ISC Plenary
TBD	Virtual	NC19: Update following ISC Plenary
August, 2023	TBD	SC19: Stock Assessment

APPENDIX 5.

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.