FINAL

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ANNEX 10

24th Meeting of the
International Scientific Committee for Tuna
and Tuna-Like Species in the North Pacific Ocean
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PACIFIC BLUEFIN TUNA WORKING GROUP INTERSESSIONAL WORKSHOP

June 2024

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ANNEX 10

PACIFIC BLUEFIN TUNA WORKING GROUP INTERSESSIONAL WORKSHOP

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

February 29- March 8, 2024 and April 11-12 (Virtual Meeting)
Kaohsiung Software Technology Park, Kaohsiung, Taiwan

1. OPENING AND INTRODUCTION

1.1. Welcome and Introduction

S. Nakatsuka, Chair of the ISC Pacific Bluefin Tuna Working Group (hereafter PBFWG or the WG), welcomed the participants and opened the meeting. He also expressed the appreciation of the WG to Chinese Taipei for hosting the meeting in Kaohsiung. In order to finalize the projection results and executive summary, the WG held an additional online meeting on April 11-12.

1.2. Adoption of Agenda

The adopted agenda is attached as Annex 1. The lists of participants and documents are attached as Annex 2 and 3, respectively.

1.3. Appointment of Rapporteurs

Rapporteurs were assigned as follows: Item2: S. Teo, Item 3: D. Tommasi and S. Teo, Item 4: Y. Tsukahara, Item 7: HH. Lee.

2. REVIEW OF STOCK ASSESSMENT INPUT DATA

2.1. Biological Parameters and Data for the Stock Assessment

T. Ishihara presented the analysis of aging by Japanese and Taiwanese laboratories. The age of Pacific bluefin tuna (PBF) is estimated based on the number of otolith annual rings, and the age estimation method is manualized. Currently, age estimation of Japanese and Taiwanese catch is conducted by researchers in each country. In this presentation, the coefficient of variance (CV) of fork length (FL) at each age, and factors affecting CV, such as age estimation bias, year class and calendar year, are discussed. Data for landing in Japan (N=2,793) and landing in Taiwan (N=4,694), for a total of 7,487 individuals, was used in the analysis. The age was estimated based on the manual and the month of catch, assuming that the fish hatched on 1st of July. Most individuals were captured after 2005, and age estimates suggest that many individuals belonged to the 1993–2012-year classes. About the CV of FL at each age, the CV gradually decreased from 15% to 7% in the 2-7 age group, to 5-6% in the 8-15 age group and stabilized below 5% after 16 years old. Regarding the age estimation results, there were differences in FL at ages 3-8 between Japan and Taiwan, with individuals landed in Taiwan being larger than those landed in Japan. This was thought to be partly due to an error in the age estimation of individuals landed in Taiwan. Furthermore, it was suggested that the CV of FL at each age group is also influenced by the growth characteristics of each year class and the marine environment of the calendar year.

Discussion

There was a discussion on the effect of the assumed hatch date on the aging results between Japan and Chinese Taipei. However, given that decimal ages were used, the impact may be relatively small. The WG agreed that CV tends to decrease with age and size due to the increasing size of fish (i.e., the denominator of CV), and that this is common for many species. There was a discussion on the impact of aging bias and precision on CV estimates. The WG noted that 50 otolith samples of 3-5 years old landed in Taiwan were previously cross-read between Japan and Chinese Taipei aging labs. The WG agreed that it would be a good idea to perform more cross-reading of otolith samples between labs and estimate reader-specific aging errors in the future. The WG noted that the CV of the aging data appeared reasonably consistent with the CV assumptions in the current assessment model.

Re-evaluation of Coefficient of Variance (CV) in Growth Curve Using the Latest Otolith Data. Presented by Y. Tsukahara (ISC/24/PBFWG-1/01)

Y. Tsukahara presented Re-evaluation of coefficient of variance (CV) in growth curve using the latest otolith data (ISC/24/PBFWG-1/01). Because the growth curve for the PBF stock assessment had been confirmed to be reliable in 2023, the authors reviewed the variance of length-at-age using the conditional-age-at-length function in SS3. There were more than 7,000 data of age and corresponding length for this analysis thanks to continuous effort to collect the otolith. A kind of quasi-ASPM-R analysis, fixing the recruitment deviation and length-based selectivity at MLE in the full dynamics model and estimating scale-related parameters and age-based selectivity, was conducted to eliminate the impact of information of the length composition data from the CV estimation. The results indicated that the CV for age-0 is 0.278 and those for age-3 and older were 0.401. It also showed that the CVs from this analysis made the overall fits to the data better in the full dynamic model.

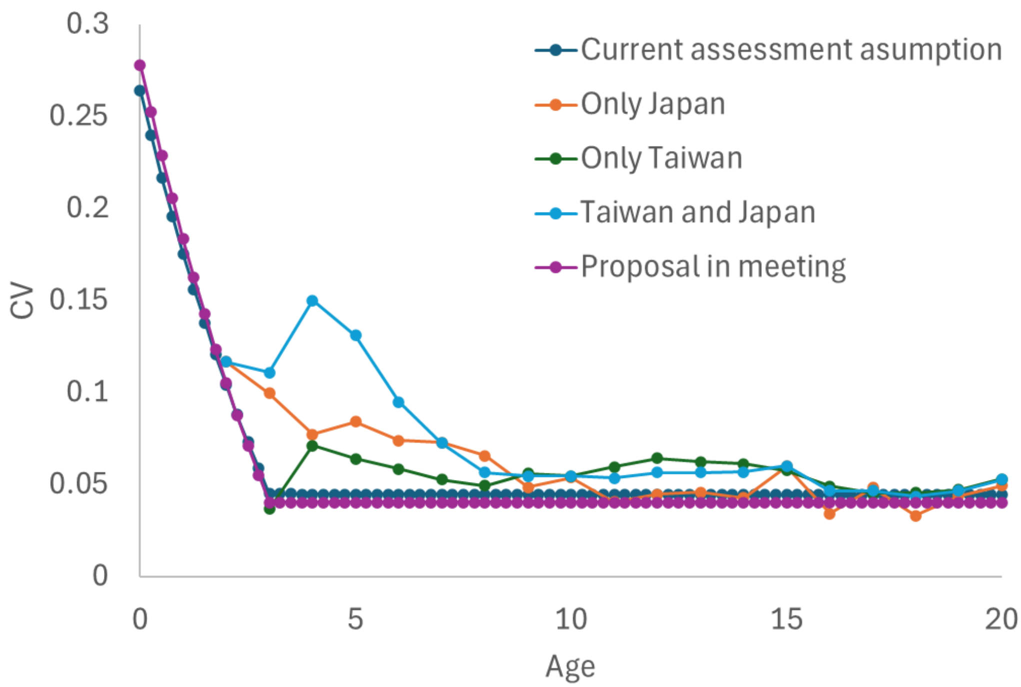

Figure 1. CVs for length at age by various data sources and methods.

Discussion

The WG endorsed the approach and results of this study. The WG recommended that for the future, it would be useful to include lab- and/or reader-specific aging errors into the analysis. The WG compared the recommended SS model CVs with the CVs from the otolith and found that they were reasonably consistent, given the constraints of the SS model parameterization (Figure 1). The WG noted that the high CV (~26%) at age-0 was due to the difference in size of age-0 fish from the two spawning grounds with slightly different main spawning periods but is assumed to be from the one spawning ground and period in the SS model. **The WG recommended using the approach described in the working paper to estimate CVs for the assessment. The WG also recommended that future research be conducted to examine if changing the ages for CV1 and CV2 would improve the CV estimates.**

2.2. Fishery Data for Input of the Stock Assessment Model

PBF Size Composition 2022-2023 From the Mexican Purse Seine Fishery. Presented by M. Dreyfus-Leon (ISC/24/PBFWG-1/02)

M. Dreyfus-Leon presented PBF size composition 2022-2023 from the Mexican purse seine fishery. Data were collected during pen transfer operations. (ISC/24/PBFWG-1/02). The PBF size-compositions from the Mexican catch in 2022 and 2023 were presented. The size data were obtained with stereoscopic underwater cameras as in previous years. Data processing for raising the size data sample from all fishing sets was done with the same procedure starting in 2012. All tuna catch was obtained early in the year and transferred to farming pens in northern Baja California, Mexico. PBF average size was 118 cm FL in both years and the highest mode in both years was 120 cm.

Discussion

The WG thanked the authors and agreed that the data is the best available scientific information for the Mexican purse seine fishery.

Update on Korean Fishery Information and Size Distribution of Pacific Bluefin Tuna. Presented by Y. Kwon (ISC/24/PBFWG-1/03)

Y. Kwon presented Update on Korean fishery information and size distribution of Pacific Bluefin tuna (ISC/24/PBFWG-1/03). Total catch of Pacific Bluefin tuna (PBF) in 2023 was 668 tons caught by offshore large purse seine, set net, and trawl fisheries in the Korean waters. The catch proportion of set net has been increasing in recent years and was highest in 2022. In 2023, the catch of set net fishery was similar to the catch in 2022. The catch proportion of large PBF in 2023 was 67% of the total catch. Most PBF were caught by purse seine fishery during February to March in the eastern part of Jeju island, while set net caught PBF largely from June to September along the coast of the East Sea. The catch by set net, which are located along the coast of the East Sea, were getting higher. As for the PBF size frequency, the large size of PBF has increased since 2016 and was mainly caught in the 1^{st} and 2^{nd} quarters.

Discussion

Y. Kwon noted that there was a research recommendation in the previous assessment to examine the seasonal size compositions of the Korean LOPS fleet and determine if it should be separated into two fleets by season: season 3 catching mostly large fish and the rest catching small fish. The WG examined the details of the sampling over time and found that the data was sufficient for two years but it was likely that time-invariant selectivity would not be able to fit the variable size compositions. The WG also found that although the Korean LOPS fishery caught substantial amounts of small fish, large fish were also caught predominantly in fishing season 3 (quarter 1), which has become more noticeable since 2020. A preliminary SS model with time-varying selectivity for the Korean LOPS fishery found that the model fits were good until the last two years when more large fish were caught. However, the WG thought that the fits to these large fish could be improved by increased flexibility and estimating older ages. Therefore, **the WG recommended keeping the current fleet structure for the Korean fishery and improving model fit by modifying the selectivity setting.** T**he WG also recommended that the authors continue with, and if possible improve, the sampling program for the fishery, and re-examine the fleet structure of KLOPS in a few years in time for the next assessment**. The WG thanked the authors and **agreed that the data is the best available scientific information for the Korean fishery**.

The WG noted that the Korean set net fishery currently has too few samples to consider splitting it from the Korean LOPS fleet. **The WG recommended that the sampling for the Korean set net fishery be improved so that the fleet structure of KLOPS can be addressed in the near future**.

Recruitment Abundance Index of Pacific Bluefin Tuna Based on Real-Time Troll Monitoring Survey Data Using Vector Autoregressive Spatio-Temporal (VAST). Presented by Y. Tsukahara (ISC/24/PBFWG-1/04).

Y. Tsukahara presented Recruitment abundance index of Pacific bluefin tuna based on real-time troll monitoring survey data using Vector Autoregressive Spatio-Temporal (VAST) (ISC/24/PBFWG-1/04). This presentation had the most recent recruitment information based on monitored operations in the waters around Goto and Tsushima Island during November and February in the following year. The authors utilized the chartered operations for this survey to reinforce data collection, which enabled it to be somewhat free from the strict management. Because the terminal year for this assessment is 2022, the tentative index value in 2023 was provided only for informational purposes. The value was the highest in 2023, although the operation information in February was not incorporated in this analysis due to time constraints.

Discussion

The WG enquired about the impacts of management on the operations of the troll fishery and a subset of the troll vessels under real-time monitoring (RTM). The authors responded that management impacts on the RTM and troll fishery were likely negligible until 2017. However, the WG noted that RTM vessels were also likely affected by management for the troll fishery from 2017. In 2021, a supplementary monitoring program called the charter monitoring (CM) program was started. This CM program chartered the same RTM vessels to continue fishing even after their quota was reached, up to a maximum of 10 days per fishing season. Therefore, the WG considered that the RTM program had three main periods: 1) 2011-2016; 2) 2017-2020; and 3) 2021 – current, with possibly different management impacts on fishery operations.

The WG requested several additional analyses to examine if the RTM index retained the same representativeness and catchability over these three periods: 1) provide details on the operations of the RTM vessels over time, especially focusing on how they changed in the three periods; 2) examine how the RTM vessels utilized the extra 10 days of fishing effort in the CM program; and 3) compare the indices using only data from 2021 – 2023 for RTM-only and RTM+CM datasets.

Based on subsequent analyses presented by the authors, the WG agreed that the possibility of management impacts on the RTM vessels during the 2017-current period cannot be denied. For example, a substantial drop in the fishery operations (e.g., the amount of effort recorded) occurred in 2017 and 2020, and likely resulted in changes in catchability that may be difficult to standardize. However, the WG noted that data from the CM program is likely less impacted by management because the vessels are chartered to fish for PBF for at least 1 day a month and up to 10 days for the fishing season. In contrast, for the RTM program, some operations targeting other species may be included in the analysis. After substantial discussion, **the WG recommended that for the 2024 assessment, the RTM index for the 2017-current period be not fit for the base case model**. However, **the index may be useful as a qualitative indicator of recent recruitment**. In addition, the RTM index during 2011-2016 may be useful as a recruitment index, especially if the sales slip index during this period were found to be biased. **The WG also recommended that the authors continue working on the RTM and CM data to see if part of the RTM data could be identified as PBF-targeting data similar to the CM data.**

Developing Abundance Indices for Taiwanese PBF Longline Fishery Using GLMM and VAST, Incorporating SST and Size Data. Presented by SK. Chang (ISC/24/PBFWG-1/05)

SK. Chang presented Developing abundance indices for Taiwanese PBF longline fishery using GLMM and VAST, incorporating SST and size data (ISC/24/PBFWG-1/05). The total catch of PBF of Taiwanese coastal and offshore fisheries (mainly from the longline fishery) had been as high as 3,089 mt in 1999, continuously declined to the lowest record of 214 mt in 2012, and recovered to 1,154–1,497 mt in 2020–2022. The preliminary estimate of the 2023 catch was 2,122 mt, the highest record in the recent twenty years.

The average size of PBF was around 212–220 cm before 2008; after that, the average in the North region stably maintained at 218–224 cm during 2008–2022, while in the South region, the average gradually increased to 235 cm in 2012 and declined to about 210 cm during 2020–2022. However, in 2023, the average size of both regions declined to 208–210 cm. A regression tree analysis on the LF data of 2010–2019 suggested that there was no strong spatial and monthly pattern in the mean length of PBF: the substantial increase in the average size in the South had resulted from the decline of recruitment, and the decrease since 2013 was a response to smaller fish recruited to the region and more large fish being removed.

Based on the suggestions of the last PBFWG meeting in 2023, five sets of standardizations were conducted in this study using GLMM and VAST, with covariate specifications revised to be similar. The results showed that the patterns of the relative CPUEs from GLMM and VAST differed. However, the trends were similar: all CPUE series suggested a decreasing trend from the beginning of the data series to the lowest level in 2011–2012 and a slow recovery after that until 2000, when a fast recovery occurred.

<u>Discussion</u>

The WG enquired about the impacts of management on the operations of the Taiwanese longline fishery. The authors responded that there were two controls on the fleet, with a limit on the number of vessels and a catch quota in metric tons for the entire fishery. The number of vessels is not yet close to the management limit, but the total catch in 2022-2023 was close to but did not exceed the quota. **The WG noted that this index is now the only adult index available and if the operations of this fleet are substantially impacted by management, the ability to monitor trends in the adult PBF population will also be substantially hampered. As noted in the case**

of Japan, management actions which might cause a change in the fishing operations by the vessels could undermine the quality of the index.

The WG agreed that the indices from this analysis were considered the best available scientific information. However, the WG will examine the SS model fits and diagnostics for each of the indices resulting from this analysis and decide which index to use for the base case model and which for sensitivity analyses. Based on an examination of SS model fits and diagnostics for each of the indices, **the WG concluded that for this assessment, it would be best to continue fitting the base case model to the index standardized using the same methodology as the previous assessment in 2022 (i.e., GLMM-South).** Importantly, the GLMM-South index covered a longer time period than the spatiotemporal models because spatial data was only available since 2007. Some of the age-group-specific VAST indices showed some improvements compared to the GLMM-South index, but the improvements were not substantial enough to compensate for a shorter time series. The WG also noted that the growth curve used to specify age-groups from the length data was inconsistent with the growth curve for the assessment, and that the age-group-specific VAST indices for younger fish appeared to be inconsistent with the indices for older fish.

Area Weighted Size Composition Data for Estimation in a Selectivity of Japanese Longline Index Standardized by Spatio-Temporal Model. Presented by Y. Tsukahara (ISC/24/PBFWG-1/06)

Y. Tsukahara presented Area weighted size composition data for estimation in a selectivity of Japanese longline index standardized by spatio-temporal model (ISC/24/PBFWG-1/06). In order to estimate the spatially equal-weighted size composition data for the Japanese longline index, the authors used the weight data in logbooks which were also used for the spatio-temporal CPUE standardization. The area-weighted size co mposition data showed somewhat similar annual trends to those for catch at size data for the longline fishery. On the other hand, the frequencies for larger PBFs were lower than those in CAS, because the weighting of those large fish caught in narrow fishing grounds was reduced due to the spatially equal weighting. The ASPM-R analysis indicates that the selectivity based on the area-weighted size composition data made the fit to the Japanese longline index better.

Discussion

The WG noted that the area-weighted size composition data was relatively spiky but was reasonably fit by the model. The WG also noted that the area-weighted size composition data was equally weighted by area, but recommended that the size composition be weighted by the CPUE in each area, and thus be more representative of the indexed population. The WG noted that one drawback is that size data is being double counted and the weighting of the data in the SS model may need to be adjusted. The WG also noted that the exclusion of operational data where multiple fish were caught could be a source of bias as fish aggregation could differ by size. After much discussion, the WG considered that this approach was generally appropriate but more work was required and may be more appropriate for the next assessment. Therefore, **the WG agreed that the approach from the previous assessment be continued for the 2024 assessment**, but encouraged the authors to continue working on this.

Input Data of Pacific Bluefin Tuna Fisheries for Stock Assessment Model, Stock Synthesis 3; Update for 2024 Assessment. Presented by K. Nishikawa (ISC/24/PBFWG-1/07)

K. Nishikawa presented *Input data of Pacific bluefin tuna fisheries for stock assessment model, Stock Synthesis 3; Update for 2024 assessment* (ISC/24/PBFWG-1/07). For the assessment, the input data file including quarterly catch, quarterly size frequency, and annual catch per unit of effort (CPUE) based abundance indices have been revised and updated up to the fishing year 2022 (up to June in the 2023 calendar year). This presentation was based on the tentative model circulated to the PBFWG on the 27th February 2024. Size composition data in recent years were added to treat the size frequency suitably (e.g., recent Japanese tuna purse seine operated in the Sea of Japan for farming). Abundance indices from Taiwanese longliners and Japanese troll monitoring survey were updated.

Discussion

The WG reviewed the input data and **concluded that the data were considered the best available scientific information**. However, the WG noted that, based on the discussions during this meeting, there were several candidate indices to be included into the dataset. The detailed description of input data will be presented in the stock assessment report.

3. MODEL SETTING AND RESULTS

3.1. Confirmation of Key Model Settings of the Assessment Model

Assumptions and its Alternatives for the Assessment Model in the 2024 Stock Assessment of Pacific Bluefin Tuna. Presented by H. Fukuda (ISC/24/PBFWG-1/08)

H. Fukuda presented *A*ssumptions and its alternatives for the assessment model in the 2024 Stock Assessment of Pacific Bluefin Tuna **(**ISC/24/PBFWG-1/08). This presentation contained: 1) a conceptual model for the PBF stock assessment; 2) Review of the previous PBF stock assessments and possible areas for improvement; 3) Changes in the data and selectivity to improve the removal estimates; 4) Shortening the assessment time periods; 5) Method to reduce a systematic retrospective pattern; and 6) Performance evaluation of the Taiwanese longline CPUE indices.

Discussion

To help develop model settings for the assessment, the author asked the WG to focus discussions on the following topics: 1) model start year; 2) Size data and selectivity for F1 and F2 (JPLL); 3) F5 selectivity; 4) Retrospective pattern; and 5) Taiwan longline index.

Model start year. **The WG agreed that it was appropriate to use a model start year of 1983**. However, it was important to provide a bridging analysis and sensitivity models with the 1952 start year used in the previous assessment. It would also be important to document the reasons for using a 1983 start year in the assessment documents. The WG noted that although there is confidence in the total catch data, there is no size data available for most of the fleets before 1983, and therefore catch-at-age may not be reliable and may be problematic for the assessment. The bridging analysis confirmed that the duration of the model, 1952-2023 vs. 1983-2023, does not change the model behavior (Figure 2).

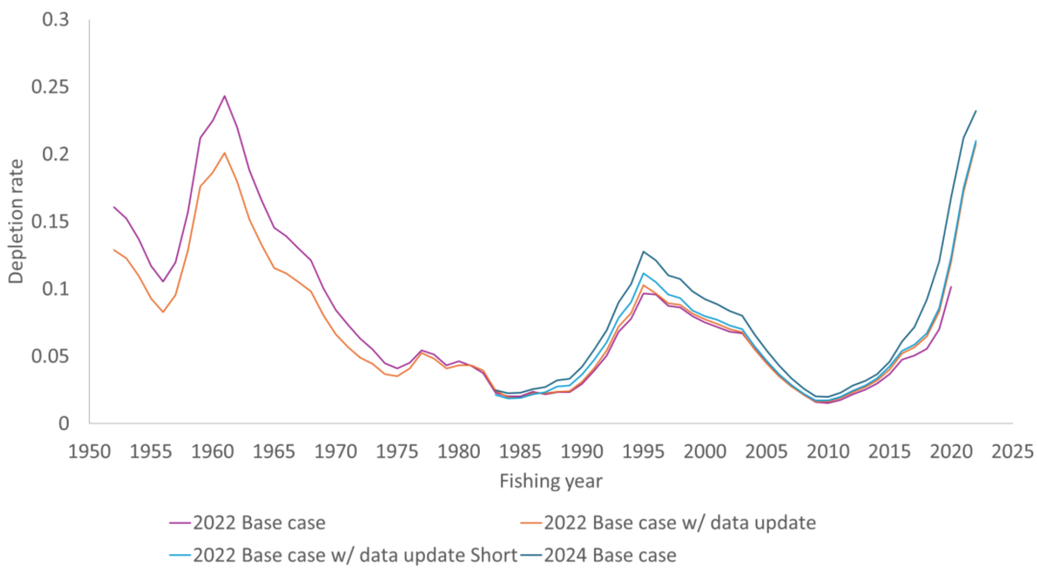

Figure 2. Comparison of the trajectory of relative biomass (depletion ratio) of the assessment models from the 2022 base-case to the 2024 base-case (2022 base-case, 2022 base-case with data-update, 2022 base-case with data-update Short (1983-), and the 2024 base-case model). The 2022 base-case with data-update and the 2022 base-case with data-update Short (1983-) almost overlap towards the end.

Size data and selectivity for F1 and F2 (JPLL). The WG noted the highly spiky size composition data but thought that the proposed procedure was overly complicated and arbitrary. Given the relatively low catches for this fleet, it was more important to estimate the overall selectivity and fit the overall size compositions well because the selectivity is linked to an index. Therefore, **the WG recommended trying downweighting the size compositions and/or using the data super period approach in SS for the F2 size compositions**. The author later proposed to sum up the historical size compositions data to estimate the selectivity, and the WG supported the approach.

F5 selectivity. The WG recommended using extra time blocks for younger ages to improve the model fit to the fishery.

F11 selectivity (KOLPS). After reviewing the results, the WG considered that the model fits well with size data, including the large PBF observed in 2021 and 2022, with refined selectivity.

Retrospective pattern. The WG agreed with the authors that there was some retrospective pattern and that the troll index was the likely cause of the retrospective pattern. Analysis of three preliminary SS models indicated that the model with the troll index for 1983 – 2010 had substantially improved retrospective patterns and prediction skill in comparison to the SS models with troll indices for 1983-2016 and 1983-2013. The WG also noted that farming of juvenile PBF increased substantially after 2010 and mandatory licensing of troll vessels started after 2010 as well, and that this may have degraded the representativeness of the troll index after 2010. The WG also noted that 3 years of the troll index during 2011-2016 were very poorly fit by all models. Based on the discussions, **the WG agreed that the troll index for 1983-2010 be used as the base case model for the assessment**.

Taiwan longline index. After much discussion (see Discussion of ISC/24/PBFWG-1/05 in Section 2.2 for details), the WG concluded that for this assessment, it would be best to continue fitting the base case model to the index standardized using the same methodology as the previous assessment in 2022 (i.e., GLMM-South).

The author presented the results of several assessment runs based on the different selectivity and data assumptions, which were requested from the PBFWG. That presentation also covered the performance evaluation of the recruitment monitoring index, which was shortened time series from 2011 to 2016. After examining model fits and diagnostics of preliminary SS models, the WG also recommended adjusting some selectivity patterns and parameterizations to improve model fits to the size composition. For example, some of the Japan PS fleets were separated into "farming" and "non-farming" fleets but both shared selectivities. Allowing these fleets to estimate separate selectivities substantially improved model fits to size composition data.

3.2. Model Diagnostics

The WG noted a consistent, negatively biased retrospective pattern in the estimated recruitments for the terminal few years. The WG was particularly concerned about the relatively low recruitments during the 2019-2021 period. A comparison with the recruitment monitoring index during the same period suggested that the 2021 recruitment estimate was likely strongly negatively biased and highly uncertain. Although the negative bias of the 2021 recruitment estimate did not substantially affect the SSB estimates, it slightly biased the terminal FSPR estimates. Importantly, the biased 2021 recruitment estimate noticeably affected the projections. Therefore, the **WG decided to include the 2021 recruitment estimate in the base case model to provide stock status with highlighting the likely negative bias of the terminal recruitment estimates**. However, the **WG also decided to start applying resampled recruitments in 2021 for the projections to incorporate the uncertainty and reduce the likely negative bias of those recruitment estimates** (Section 4.0).

The WG noted that some preliminary models had poor convergence and requested that the modelers investigate the causes and improve the models. After substantial work, the modelers found that the highly complex selectivity patterns of some fleets contributed substantially to the identified problems. The modelers also found that some of these highly complex selectivity patterns were unnecessary for good fits to the data, and simplifying these selectivities and size composition data of some fleets resulted in models with good convergence. These changes resulted in negligible changes to model results. The WG thanked the modelers for the work and agreed to proceed with a base case model with these changes. The base case model had a good gradient of <1E-4 and a positive definite Hessian, and follow up jitter analysis indicated that the model had likely achieved convergence.

Y. Tsukahara presented **Bootstrap by the latest version of the Stock Synthesis**. The PBFWG applied two additional data treatments, i.e., multiplier to input sample size and change the minimum constant for fleets with weight size composition, to bootstrap. The data treatments reduced the bias between the point estimation in the base case model and median in bootstrap. The author introduced that the latest version of Stock Synthesis (SS3.30.22.01) uses the doubled number of data bins to resample the size frequency, instead of the input sample size for each size composition data. This revision makes multipliers for the input sample sizes when generating data replicates unnecessary, although an additional treatment for the minimum constant is still required.

The WG examined the bootstrap procedure results and noted that the maximum likelihood estimations (MLEs) of the base case model SSB were reasonably within the bounds of the 90% bootstrap intervals at the terminal year. However, the MLE of fishing intensity was below the 90%

bootstrap intervals, likely due to the low recruitment estimate for the recent period. Therefore, the WG decided to use the normal approximation of the Hessian matrix for the description of uncertainty of the results of the base-case model, while using the bootstrap results for the future projection as it considered that the bootstrap can capture the model uncertainty more accurately.

Illustration of Uncertainties on the Plots for Executive Summary. Presented by Y. Tsukahara (ISC/24/PBFWG-1/13)

Y. Tsukahara presented Illustration of uncertainties on the plots for Executive summary (ISC/24/PBFWG-1/13). Y. Tsukahara presented a way to illustrate the uncertainty on the plot for stock dynamics trajectories and Kobe plot, utilizing the standard error derived from the hessian matrix. Previously, the PBFWG had used the bootstrap procedure to illustrate them. For the illustration of confidence intervals on the trajectory plots, the standard errors estimated in Stock Synthesis were multiplied by certain values to be specific percentages of confidence intervals. For the Kobe plot, the multi-variate lognormal (MVLN) distribution was employed to describe the uncertainty of stock status at terminal year.

Discussion:

The WG confirmed the method to estimate the total biomass and its uncertainty by using the "summary biomass" function of Stock Synthesis. In terms of the confidence interval to be used for the trajectory, the WG supported the use of 90%, rather than 95% confidence intervals to be consistent with previous PBF assessments.

The WG also discussed options for how to present the uncertainty in the Kobe chart. The WG supported the use of the multi-variate log-normal distribution to draw a contour plot and agreed to include it in the executive summary.

Conclusion

The WG noted that this assessment showed a vast improvement in the retrospective pattern for SSB, with Mohn's rho improving to -0.02. However, there was a large retrospective pattern for recruitment. The WG recommended that further research be performed to improve the large retrospective pattern in recruitment in preparation for the next assessment.

The WG examined the model fits of the base case model and an ASPM-R model, and found that the model fits were good.

3.3. Base Case Model Results

The WG examined the results of a bridging analysis and agreed to show the critical results for the development of the base case model, including an update of the 2022 base case model (Figure 2). **After examining the base case model results and diagnostics, the WG considered that the base case model provides the best available scientific information.**

3.4. Model Uncertainty

The WG agreed that the base case model's uncertainty will be described by the normal approximation of the Hessian matrix of the base case model. However, projection uncertainty will be based on the bootstrap runs.

3.4.1. Sensitivity Analysis

The WG examined the list of proposed sensitivity model runs and agreed to move forward with the models listed below;

- Long term model – bridging analysis (starting with the long-term model in the last assessment, then the long-term model in the last assessment with updated data and then the updated short-term model)
- Different data weighting for size composition data (same approach as the previous assessment)
- Increased amount of unseen catch (double the current assumption, same as the previous assessment).
- Inclusion of full troll recruitment index (1983-2016)
- Inclusion of recruitment monitoring index
- Estimate steepness or apply lower steepness
- High and Low M for age 2 and older (same as the previous assessment)

4. FUTURE PROJECTIONS

K. Nishikawa presented future projection settings. For the PBF future projection, 'ssfuture' has been used since the 2012 stock assessment. Since then, the future projection software was updated several times to add options to depict the implemented management measures in the projection model. The presentation provides the explanation of the projection settings and future projection scenarios requested by the IATTC and WCPFC Joint Working Group. Since the request from the JWG included some scenarios which require an exploration of the harvests to meet given conditions.

<u>Discussion</u>

The WG noted that the current SSB is above 20%$SSB_{F=0}$, and current 1-SPR estimates are substantially below 0.8. Therefore, increases in catches would be necessary to "maintain SSB at or above 20%$SSB_{F=0}$ with 60% probability", which is part of the projection specifications from the JWG. However, the rate of increase depends on the time taken to reach 20%SSB0, but the time period is unspecified. Given that, **the WG agreed to use a time period of 20 years as the time taken to reach 20%$SSB_{F=0}$.**

The WG examined the requested performance indicators for the projections. The WG noted that the SSBloss was very low (~2%$SSB_{F=0}$) and would not be useful as a performance indicator because it would not be able to differentiate between different catch scenarios. Therefore**, the WG agreed to provide an additional indicator of 7.7%$SSB_{F=0}$**, which is consistent with the limit reference point used by IATTC for tropical tunas.

The WG compared the distribution of estimated recruitments from the model starting in 1952 versus the current base case model (1983-2022) and noted that the distributions were similar. Therefore, **the WG agreed that the base case projections would use the estimated recruitments of 1983-2020 for resampling**.

The WG noted that the recruitment estimates near the terminal period were highly uncertain and had a retrospective pattern with a negative bias. The 2021 recruitment deviated estimate was also inconsistent with the recruitment monitoring index for the same year. Given the importance of the projections for informing management, the WG considered it important to highlight the uncertainty of the recruitment estimates in the terminal period as well as the likely negative bias from the retrospective pattern. Therefore, **the WG agreed to start applying resampled historical recruitment in 2021 for the projections**.

Preliminary Future Projections for Pacific Bluefin Tuna Stock Based on the 2024 Stock Assessment Base Case. Presented by K. Nishikawa (ISC/24/PBFWG-1/14)

K. Nishikawa further presented Preliminary future projections for Pacific bluefin tuna stock based on the 2024 stock assessment base case (ISC/24/PBFWG-1/14) in the April online meeting. The authors provide the explanation of the latest projection setting, corresponding to the CMMs decided by WCPFC and IATTC commissions and future harvesting scenarios requested by the WCPFC Northern Committee - IATTC Joint Working Group. FY 2021 is adopted as the beginning year of this projections by March 2024 meeting. The requested projection scenarios were performed, and there were consistencies between the previous and current projections.

Discussion:

The WG thanked the authors for a large amount of work. With respect to the performance indicators, the WG agreed to delete the column "median SSB at 10 years after achieving initial rebuilding target" as it was considered no longer useful. The WG further agreed to include the probability of SSB falling below potential TRPs (20%, 25%, 30%, 40%$SSB_{F=0}$) as requested by the JWG. After confirming these modifications, the WG agreed to include projection results into the Executive Summary.

5. STOCK STATUS AND CONSERVATION ADVICE FOR PACIFIC BLUEFIN TUNA

The WG concluded that the 2024 assessment model represents the population dynamics satisfactorily and is the best available scientific information for the stock. The base-case model fits well with the data, which is considered reliable and is internally consistent among most of the sources of data. Based on the results of the new base-case stock assessment model of PBF and its projection, the WG discussed the draft Stock Status and Conservation Advice. The agreed version by the WG is contained in the Stock Assessment Report for further consideration by ISC24.

6. WORK PLAN AND RECOMMENDATIONS

The WG agreed to the following tentative work plan for 2024-2025.

- Online meeting to finalize the projection results: April 11-12 (WPO time)
- Half-day meeting prior to the Plenary (June), for checking catch and presentation.
- Online meeting on MSE: November 5-8 WPO time
- Physical meeting to finalize MSE: Early April 2025

The WG discussed the order of future stock assessment and MP implementation if a 3-year cycle is to be applied. The WG considered that it is beneficial to conduct a stock assessment in the year before MP implementation. For example, the WG anticipates conducting the next assessment in 2027, if a 3-year cycle MP is adopted in 2025.

7. OTHER MATTERS

7.1. Management Strategy Evaluation

Long-term Performance of Pacific Bluefin Tuna Harvest Controls with a 25% Limit on Quota Change under a Low Recruitment Scenario. Presented by D. Tommasi (ISC/24/PBFWG-1/09)

D. Tommasi presented "*Long-term Performance of Pacific Bluefin Tuna harvest controls with a 25% Limit on Quota Change under a Low Recruitment Scenario*." (ISC/24/PBFWG-1/09). Here we assess the impact of a 10-year long shift to a low recruitment phase on PBF spawning stock biomass (SSB), fishing intensity (F), and catch using a 48-year long PBF MSE simulation with no observation, assessment, or implementation error. We use the set of twelve harvest control rules (HCRs) with a constraint on changes in Total Allowable Catch (TAC) between consecutive management periods of no more than 25% proposed at the 8th Meeting of the Inter American Tropical Tuna Commission (IATTC) and Western and Central Pacific Fisheries Commission of the Northern Committee (WCPFC NC) Joint Working Group (JWG) on PBF management. Preliminary results show that the drop in recruitment generates a decline in SSB and catch, triggering a management-driven reduction in F and associated further reductions in catch across all HCRs. All the HCRs are able to rebuild median SSB above their threshold reference point (ThRP) by the end of the simulation and to maintain the probability of breaching the limit reference point (LRP) associated with each HCR to less than 20%. A 10-year low recruitment period has been observed in the past for PBF and this work was useful to assess HCR behavior relative to stakeholder-derived performance metrics in such a case. A similar implementation of a decline in recruitment may be a robustness scenario to consider in the final PBF MSE simulation.

Discussion

The author pointed out that the analyses were based on the last stock assessment, in which the terminal year had not reached 20%$SSB_{F=0}$. Given that the current assessment has reached 20%$SSB_{F=0}$, in future MSE simulations, a drastic initial drop in F will only occur for those HCRs with the threshold RP of 25%$SSB_{F=0}$ or higher.

Questions were raised regarding how the low recruitment period was assumed in the MSE. The author clarified that recruitment was resampled from the low recruitment period (1983-1990, 1992-1993). After a 10-year low recruitment period, the recruitment was set to return to an average level. It was also noted that HCRs with a high target RP maintain a higher biomass and thus their biomass will take a longer time to be reduced to 20%$SSB_{F=0}$ under the low recruitment scenario.

The author pointed out that implementation errors were not included in the analysis, but that discards fleet assuming 6% (EPO release) or 5% (WPO catch) were considered. There was also a suggestion that fleets with a larger catch tend to have higher discards, which could be considered in future uncertainty scenarios, and it was also mentioned that a higher TAC may result in fewer discards.

The PBFWG acknowledged the successful functioning of the MSE framework as intended and encouraged improvements to the graphs. There was a mention of plotting catch and biomass in a trade-off plot, with a suggestion to compare the same plot before and after the TAC limit change.

Implementation of 2-Year Lag Between Stock Status Estimation and Management Action in the Pacific Bluefin Tuna Management Strategy Evaluation. Presented by D. Tommasi (ISC/24/PBFWG-1/11)

D. Tommasi presented "Implementation of 2-year lag between stock status estimation and management action in the Pacific Bluefin tuna management strategy evaluation." (ISC/24/PBFWG-1/11). Previous runs of the Pacific Bluefin tuna (PBF) management strategy evaluation (MSE) set a total allowable catch (TAC) based on the previous year assessment output. In reality, however, due to constraints with data availability, there is a 2-year lag between the end year of the PBF assessment and when its output is used to inform a management action. We therefore modified the PBF MSE code to implement a 2-year lag between assessment and TAC application and show how this change affects fishing intensity (F), spawning stock biomass (SSB), and catch for simulations with and without a 25% limit on TAC changes between assessment periods.

Discussion

The PBFWG highlighted that the final MSE will incorporate a 25% limit on TAC changes between assessment periods and will also account for the lag between the end year of the PBF assessment and when its output is used to inform a management action. A lengthy discussion ensued on the duration of the lag period, considering the difference between the 2024 assessment, which used data up until the second quarter of 2023, and when the assessment is used to inform a management action in 2025. Specifically, the lag duration is one and three-quarters, spanning from the calculation of the terminal SSB on April 1, 2023, to the implementation of HCRs on January 1, 2025.

The decision-making process should be based on the real schedule; thus, the PBFWG requested a 1.75-year lag scenario be implemented in the MSE, rather than the current 1-year lag. Notably, the data lag scenario in the working paper is 1 year and has more recent data compared to the actual management timeframe. Despite no assessment or implementation errors, SSB overshoot levels associated with the F_{target} across all HCRs when both the 25% limit on TAC changes and data lag are implemented.

The author later provided the revised timeline figure in the calendar year during the meeting. A PBFWG member suggested that in the final MSE runs, the first stock assessment should include data up to FY2023 (till June 2024) to inform advice in calendar year 2026. Thus, the operating model would need to include observed catches and the potential future catch limits agreed upon by the RFMOs for 2025 at the start of the MSE.

Revised Method to Tune the Relative Fishing Mortality in the Pacific Bluefin tuna MSE for the Requested Proportional Fishery Impact. Presented by D. Tommasi presented (ISC/24/PBFWG-1/10)

D. Tommasi presented “Revised Method to Tune the Relative Fishing Mortality in the Pacific Bluefin tuna MSE for the Requested Proportional Fishery Impact.” (ISC/24/PBFWG-1/10). The model-based harvest control rules currently being examined by the Pacific bluefin (PBF) management strategy evaluation (MSE) aim to set catch limits that would, over the long-term, reach a specified target fishing intensity. The target fishing intensity is set based on a specified percentage of spawning biomass per recruit (SPR). Since fleets have specific selectivities and target different ages of the PBF population, the proportional fishery impact associated with a specific management measure depends on the relative exploitation pattern across fleets (i.e. allocation). The relative exploitation pattern across fleets also affects the overall catch limit required to reach the desired Ftarget. Thus, in the MSE management module, the relative exploitation pattern needs to be specified for the calculation of the catch limit that will result in the specified Ftarget. While the PBF Joint Working Group (JWG)did not specify an allocation by fleet, it did identify one of the management objectives of the MSE as maintaining an equitable balance between WCPO and EPO proportional fishery impact and proposed two potential WCPO:EPO proportional fishery impact scenarios of 80:20 and 70:30. Tommasi and Lee (2023) illustrated a method to find the relative exploitation pattern across fleets to be input into the PBF MSE that leads to the Ftarget and EPO/WCPO relative fishing impact specified by managers. We modify that method to ensure that while the relative EPO/WCPO fishing impact changes, the relative fishing intensity within the EPO or WCPO stays the same as the 2017-2019 baseline.

Discussion

The discussion focused on how the relative F is calculated between WPO and EPO concerning proportional increases or decreases. It was clarified that relative F is set to sum to 1 between WPO and EPO. There was a mention of plotting WPO fishery impact on the second y-axis of the EPO fishery impact vs. relative F plot. The author later revised the graph during the meeting.

The discussion explored whether the effect of the change in impact between WPO and EPO is instantaneous or pertains to reaching equilibrium. It was also noted that the effect of the instantaneous change in relative F results in a gradual change in fishery impact between WPO and EPO. Questions arose regarding the time it takes to reach an equilibrium state or stabilize, considering recruitment variability and the absence of a 25% limit on TAC change and implementation errors. The discussion emphasized focusing on long-term impacts and stability, with a request to present the trajectory of impact by EPO, WPO, and their catch. The author later presented the trajectory graphs during the meeting.

It was clarified that the procedure in the working paper starts by finding the F at age by fleet that meets the F_{target} given the specified relative fishery impact, biology, and selectivity. Then the TAC by fleet is obtained given the F at age and terminal biomass at age. Then, the algorithm checks if the total TAC is greater (or lower) than 25% of the TAC in the previous management period. If it is, the total TAC is set to 25% more (or less) than that in the previous period and is split across fleets in the same proportions as the TAC derived from the HCR. It was suggested to confirm with managers if this reflects their intention.

There was a reminder that the final MSE results will need to showcase the trajectory of impact under different uncertainty scenarios, including the base case, all the HCRs, an 80:20 ratio, a 70:30 ratio, and a 25% limit.

D. Tommasi made an oral presentation on *Changes in exploitation pattern across fleets between assessments and implications for the management strategy evaluation.* The authors assessed how relative apical fishing mortality (F) for the Eastern Pacific Ocean (EPO) and Western Central Pacific Ocean (WPO), relative SPR for the EPO and WPO, fishing mortality at age, and selectivity changed over the 2017-2019 period between the operating model (OM) for the PBF MSE based on the 2022 stock assessment and the 2024 assessment, which will be the basis of the OMs for the final MSE simulation. It was found that, for the 2017-2019 period, the 2024 assessment has a higher relative WPO SPR than the 2022 OM. This was associated with a decrease in fishing mortality at age for the EPO fleet in the 2024 assessment and also a change in selectivity. The decrease in EPO fishing mortality at age was likely due to the increase in numbers of 3-6 years old in 2017-2019, which are targeted by the EPO fleet, following changes in the latest assessment to reduce the retrospective pattern in SSB. Given the change in OM structure and resulting difference in EPO:WPO impact, the authors suggest that the analysis to find the relative exploitation pattern across fleets to be input into the PBF MSE that leads to the F_{target} and EPO/WPO relative fishing impact specified by managers will need to be carried out again with the new OM based on the 2024 assessment. Changes in relative F, relative SPR, and selectivity in recent years for the 2024 assessment were also shown to aid the selection of a baseline period for the relative F. It was shown that the relative F was consistent for 2017-2019, 2018-2020, and 2019-2021, but there was an increase in EPO relative F in 2022.

Discussion:

The WG thanked the author for the presentation and request to see the relative F for average of 2016 – 2022. After looking at the comparison of relative Fs among different years, the WG requested additional analyses to see the impact of different relative F assumptions by looking at simulation results at the June meeting. The WG also noted that the assumption on F affects the results of the MSE and thus the monitoring of F will be an important part of a monitoring strategy when implementing MP.

Follow-up discussion on OM uncertainty grid analyses in Lee and Tommasi ISC/23/PBFWG-2/12

The PBFWG discussed whether the same analyses need to be conducted based on the current assessment model. To ensure timely completion, the PBFWG expressed satisfaction with the current work but proposed updating analyses to test convergence on selected grids. Specifically, grids that passed more than three diagnostics and neighboring grids that passed at least two tests would be scrutinized. The results will be reviewed at the April intersessional meeting.

Evaluating the Uncertainty Grid Using the 2024 Stock Assessment: Applying Diagnostic Tools. Presented by HH. Lee presented (ISC/24/PBFWG-1/15)

HH. Lee presented *"Evaluating the Uncertainty Grid Using the 2024 stock assessment: Applying Diagnostic Tools"* (ISC/24/PBFWG-1/15). Fishery management can rely on robust management strategy evaluations (MSE) to inform decision-making in the face of uncertainties. MSE assesses feedback-control management strategies by simulating future scenarios, considering uncertainties in the system. For parameter uncertainty, productivity parameters such as length at age 3, natural mortality for age 2 and older, and the steepness of the stock-recruitment relationship greatly impacted the historical trajectory of Pacific bluefin tuna spawning stock biomass. In this working paper, a comprehensive evaluation of multiple diagnostic criteria provided valuable insights. Jitter analyses guided the exclusion of grids with 0% successful runs in subsequent diagnosis and selection processes. The assessment of goodness-of-fit highlighted inconsistent grid profiles among data sources, leading to exclusion from the selection process. Consistency in R_0 profiles and retrospective analyses further emphasized the need to exclude grids with data conflicts and unfavorable Mohn's ρ values. ASPM-R models reinforced the significance of avoiding grids with statistically significant degradation in NLLs. Ensemble diagnostic results consolidated these findings, recommending only grids passing three or more diagnostics for selection. The conflicting information observed underscores the necessity of a comprehensive approach to ensure the robustness and reliability of selected grids for subsequent modeling applications.

Discussion:

The WG appreciated the additional analysis for OM consideration and supported the approach. The WG agreed to use those runs which scored 3 or 4 passes in the examination as the OM reference grid for PBF MSE as presented in the document.

Potential Robustness Trials for the Pacific Bluefin Management Strategy Evaluation. Presented by D. Tommasi (ISC/24/PBFWG-1/12)

D. Tommasi presented *"Potential Robustness Trials for the Pacific Bluefin Management Strategy Evaluation."* (ISC/24/PBFWG-1/12). To facilitate the process of deciding on a final set of uncertainties for the Pacific Bluefin tuna (PBF) management strategy evaluation (MSE), a list of potential uncertainties to be considered for the PBF MSE robustness tests was compiled by reviewing best practices from the literature, those considered in MSEs of other bluefin tuna stocks, and relevant discussions in past PBF working group (WG) reports.

Discussion

The PBFWG addressed the testing of robustness sets in the MSE. It was clarified that reference sets are more plausible scenarios compared to robustness sets, which simulate extreme or unlikely, but still considered possible, circumstances. The PBFWG initially reviewed various robustness sets from other RFMOs and discussed their applicability to PBF.

The following aspects will be excluded from the robustness sets as they were not considered important uncertainties for PBF:

- Alternate CPUE method
- Exclusion of particular years of data
- Sampling frequency
- Data weighting
- Ageing error
- Form of stock recruitment relationship
- Correlation in recruitment
- Reproduction
- Senescence
- Presence of depensation
- Different selectivity form
- Spatial and stock structure
- Initial stock size

Instead, the PBFWG consider the following as high priority for inclusion in the robustness sets:

- No adult longline index.
- Catchability change in the Taiwanese longline index
- Detrimental effects of climate change: Recruitment drops (10-yr long drop like during 1980s)
- Implementation error reflecting higher discards than the currently considered 5% (WPO catch) and 6% (EPO release). There was a discussion of the OM having more discards when the TAC is small. A WG member mentioned that an analysis of the disparity between projected catch with TAC and projected catch without TAC was run to compute the current discard estimate for the WPO.

If time and resources allow, the following medium priority scenario will also be considered:

- Regime sift: time-varying M, time-varying (or density-dependent) growth rate, or time-varying R0

7.2. Response to RFMOs (conversion factor, recruitment scenario)

Several requests were made by the Joint Working Group (JWG) of IATTC and WCPFC-NC to ISC related to the 2024 PBF stock assessment. All of the projection scenarios requested by the JWG, including the one with the maximum application of conversion factor from small fish to large fish, were contained in the projection, and results are presented. The JWG also requested the ISC's opinion regarding the appropriateness of the historical average recruitment assumption used in the projection. As explained above and in the Executive Summary, the WG currently considers that the average recruitment assumption is most probable and appropriate to provide management advice.

The WG also discussed the future work plan of the MSE of PBF. Although the WG does not intend to provide much information regarding the development of PBF MSE this year given that it is an assessment year, the work on MSE is also steadily progressing, and the successful completion of the 2024 stock assessment puts the WG in a good position to complete MSE technical work in 2025 as requested by the JWG. The JWG has already provided necessary input to conduct PBF MSE (management objectives, performance indicators, candidate harvest control rules), and, based on the input by JWG, the WG intends to present the final results of PBF MSE at the JWG in 2025, as requested**. However, given its complexity and for the sake of inclusiveness and transparency, the WG recommends the JWG considers if it is necessary to hold intersessional meeting(s) to review the progress of MSE work and to provide feedback to ISC before the MSE work is completed and the final results are presented to JWG in summer 2025.** As the WG intends to conduct substantial work on MSE in fall and complete it in spring 2025, such meeting(s), if to be held, should be scheduled after the fall meeting but preferably sufficiently before the spring 2025 meeting. It is also possible that each member hold MSE workshops for domestic stakeholders. The agreed MSE work plan is attached as Annex 4.

8. ADOPTION OF THE STOCK ASSESSMENT REPORT EXECUTIVE SUMMARY

The WG adopted the draft stock assessment report Executive Summary, which will appear at the top of its Stock Assessment Report. The executive summary will be forwarded to the ISC Chair for approval before it is submitted to the IATTC SAC in June 2024. The assessment report is to be completed by the middle of May 2024. The sections of the report are assigned to each member as follows: biology - biology group in Japan, input data - Nishikawa, model description - the USA, model results - Fukuda, future projection - Fukuda, major issues - Fukuda, the USA.

9. ADOPTION OF THE MEETING REPORT

The WG reviewed the draft meeting report and adopted it after revision.

10. ADJOURNMENT

The March meeting was adjourned at 11 AM on March 8. Additionally, the WG held an online session on April 11-12.

ANNEX 1 .

PACIFIC BLUEFIN TUNA WORKING GROUP

INTERSESSIONAL WORKSHOP

February 29- March 8, 2024

Kaohsiung Software Technology Park, Kaohsiung, Taiwan

AGENDA

1. Opening and Introduction
    1.1. Welcome and introduction
    1.2. Adoption of agenda
    1.3. Appointment of rapporteurs
2. Review of stock assessment input data
    2.1. Biological parameters and data for the stock assessment
    2.2. Fishery data for input of the stock assessment model
3. Model setting and results
    3.1. Confirmation of key model setting of the assessment model
    3.2. Model diagnostics
    3.3. Base case model results
    3.4. Model uncertainty
        3.4.1. Sensitivity analysis and Robustness test
        3.4.2. Model ensemble
4. Future projections
5. Stock status and conservation advice for Pacific bluefin tuna
6. Work plan and recommendations
7. Other matters
    7.1. Management Strategy Evaluation
    7.2. Responses to RFMOs
8. Adoption of the stock assessment report Executive Summary
9. Adoption of the meeting report
10. Adjournment

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ANNEX 3. LIST OF DOCUMENTS

index	Related Agenda	Title	Author	Contact	Website availability (Yes/No)
ISC/24/PBFWG-1/01	2.1	Re-evaluation of coefficient of variance (CV) in growth curve using the latest otolith data	Yohei Tsukahara, Taiki Ishihara, Shui-Ka	tsukahara_yohei35@fra.go.jp	Y
ISC/24/PBFWG-1/02	2.2	PBF size composition 2022-2023 from the Mexican purse seine fishery. Data collected during pen transfer operations.	Michel J. Dreyfus-Leon and Martha Betancourt	dreyfus@cicese.mx	Y
ISC/24/PBFWG-1/03	2.2	Update on Korean fishery information and size distribution of Pacific Bluefin tuna	Youjung Kwon, Jaebong Lee, Hee Won P	kwonuj@korea.kr	Y
ISC/24/PBFWG-1/04	2.2	Recruitment abundance index of Pacific bluefin tuna based on real-time troll monitoring survey data using Vector Autoregressive Spatio-Temporal (VAST) model analysis	Ko Fujioka, Saki Asai, Yohei Tsukahara, Hiromu Fukuda and Shuya Nakatsuka	fujioka_ko34@fra.go.jp	Y
ISC/24/PBFWG-1/05	2.2	Developing abundance indices for Taiwanese PBF longline fishery using GLMM and VAST, incorporating SST and size data	Tzu-Lun Yuan, Shui-Kai Chang and Haik	eric.skchang@g-mail.nsysu.edu.tv	Y
ISC/24/PBFWG-1/06	2.2	Area weighted size composition data for estimation in a selectivity of Japanese longline index standardized by spatio-temporal model	Yohei Tsukahara and Hiromu Fukuda	tsukahara_yohei35@fra.go.jp	Y
ISC/24/PBFWG-1/07	2.2	Input data of Pacific bluefin tuna fisheries for stock assessment model, Stock Synthesis 3; Update for 2024 assessment	Kirara Nishikawa, Eric? Youjung?, Michel?, HuiHua?, Hiromu Fukuda and Shuya Nakatsuka	nishikawa_kirara68@fra.go.jp	Y
ISC/24/PBFWG-1/08	3.1	Assumptions and its alternatives for the assessment model in the 2024 Stock Assessment of Pacific Bluefin Tuna	Hiromu Fukuda	fukuda_hiromu57@fra.go.jp	Y
ISC/24/PBFWG-1/09	7.1	Long-term Performance of Pacific Bluefin Tuna harvest controls with a 25% Limit on Quota Change under a Low Recruitment Scenario	Desiree Tommasi, Huihua Lee	desiree.tommasi@noaa.gov	Y
ISC/24/PBFWG-1/10	7.1	Revised Method to Tune the Relative Fishing Mortality in the Pacific Bluefin tuna MSE for the Requested Proportional Fishery Impact	Desiree Tommasi, Huihua Lee	desiree.tommasi@noaa.gov	Y
ISC/24/PBFWG-1/11	7.1	Implementation of 2-year lag between stock status estimation and management action in the Pacific Bluef	Desiree Tommasi, Huihua Lee	desiree.tommasi@noaa.gov	Y
ISC/24/PBFWG-1/12	7.1	Potential Robustness Trials for the Pacific Bluefin Management Strategy Evaluation	Desiree Tommasi, Huihua Lee	desiree.tommasi@noaa.gov	Y

ANNEX 4. MSE WORK PLAN

PBF MSE Workplan

From PBF MSE Stocktaking in past WG reports:

- **November 2024**: Decide all the specifications (e.g. Model weighting, MP(s), performance indicators)
- **April 2025**: Confirm the results of MSE

Proposal for timing of future WG MSE meetings:

- Virtual WG meeting in November 2024
- In person WG meeting in April 2025 (La Jolla)

To prepare for intersessional meeting for projections:

- Diagnostics for reference set (Hoo)

To prepare before November meeting:

- Adjust code to work with final base case based on short 2024 assessment model (Desiree)
    - Update to use recent version of SS
    - Re-code data generation to work with new fleet numbering and revise bootstrap fix given new SS version
    - Switch all fisheries in numbers to weight
    - Fix time varying selectivity parameters for forward simulation
    - Modify lag
    - Ensure F multiplier is also saved as output
- Develop new ASPM-R EM based on new assessment and test it (Norio)
- Test code by running simulation same as final MSE but no EM (i.e. with lag, 25% cap, tuned to 2 different impact ratios), and some EM runs (Desiree/Norio)
- Develop/condition all reference/robustness OM scenarios (Hoo and Fukudasan/Desiree/Norio)
- Estimate required run time for all HCRs/OMs and needed iterations (Desiree)
- Test/check code with ASPM-R and EM full and start running some of the required simulations (Desiree and Norio)
- Paper presenting set of final performance metrics and potential graphics – make code available (Desiree)

Decisions at November meeting:

- Model weighting (confirm equal for reference set)
- Final performance indicators
- Confirm final set of simulations and specifications (MPs, OMs, iterations, EM structure)
- Potential graphics to present results to JWG
- How to communicate results: WG report + presentation at JWG + Shiny app(?) + domestic stakeholder workshops?

To prepare before April meeting:

- Finish all required simulations by March
- Collate results in draft report + Shiny app(?)