JOINT IATTC AND WCPFC-NC WORKING GROUP MEETING ON THE MANAGEMENT OF PACIFIC BLUEFIN TUNA
SIXTH SESSION (JWG-06)

ELECTRONIC MEETING
8am-11am, Japan Standard Time
27-29 July 2021

Report of the Pacific Bluefin Tuna Working Group Intersessional Workshop

IATTC-NC-JWG06-2021/IP-02

ISC[1]

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

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ISC/21/ANNEX/12

ANNEX 12

21st Meeting of the
International Scientific Committee for Tuna
and Tuna-Like Species in the North Pacific Ocean
Held Virtually
July 12-20, 2021

REPORT OF THE PACIFIC BLUEFIN TUNA WORKING GROUP INTERSESSIONAL WORKSHOP

July 2021

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ANNEX 12

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

April 20-27, 2021
Virtual Meeting

1. OPENING AND INTRODUCTION

1.1. Welcome and introduction

The meeting was held online due to the COVID-19 pandemic. S. Nakatsuka (Japan), Chair of the ISC Pacific bluefin tuna Working Group (PBFWG or WG), welcomed the participants from Japan, Korea, Mexico, Chinese Taipei, the United States of America, and the Inter-American Tropical Tuna Commission (IATTC) and opened the meeting.

1.2. Adoption of agenda

The adopted agenda is attached as Appendix 1 and the list of participants is provided in Appendix 2. The list of documents reviewed during the meeting is provided in Appendix 3.

1.3. Appointment of rapporteurs

Rapporteurs were assigned by the Chair as follows: Item 2: Y. Tsukahara and K. Nishikawa, Item 3: HH. Lee, Item 4: K. Piner, and Item 5: M. Maunder.

2. REVIEW OF UPDATED INFORMATION

2.1. Catch information for 2020

The data manager of PBFWG (H. Fukuda) presented the latest information on the catch table for PBF, including catch in 2020. The total catch in 2020 was around 13,707 t, which was a little higher than 11,520 t in 2019. The WG reviewed the recent information on the fisheries member by member.

<u>Chinese Taipei</u>

The WG recognized the large increase of catch, which seemed to reflect the increase of spawning stock biomass. The nominal CPUEs both in north and south fishing grounds were increasing, while fishing efforts only slightly increased. The body size of caught PBFs showed different trends between fishing grounds; the mean size was relatively stable in the north, while that in the south gradually decreased recently.

<u>Japan</u>

The WG recognized the increase of catch by longline fishery like in Chinese Taipei, which would seemingly reflect the increase of spawning stock biomass. A participant asked about the consumption rate of quota in 2020. It was responded that fisheries licensed to the national government, such as purse seine and longline, almost exhausted their own quota, while those registered in local governments, such as set-net and troll, left some portion of their quota.

<u>Korea</u>

A question was raised with regard to the allocation of quota for the set-net fishery, whose catches were increasing in recent years. It was clarified that, in principle, the annual PBF catch limit by fishery is allocated under the allocation rate by fishery specified in the Ministerial Directive on Conservation and Management for PBF, and the remaining catch limit of a fishery can be transferred to other fisheries that need more allocation, if any.

<u>Mexico</u>

The WG recognized that the fishing season in 2020 was earlier than before. It was explained that this is because the farming companies desired PBFs at an earlier timing due to the competitive system of allocation. The number of fishing vessels was not changed.

<u>U.S.A.</u>

Clarification was made that the reason for the increase of catch by sports fishery could be the combination of the increase of availability of fish and increase of fishing trips by people looking for outdoor activities due to COVID-19.

Update of Korean fisheries information for Pacific bluefin tuna, Thunnus orientalis. (ISC21/PBFWG-01/01).

M.K. Lee presented ISC21/PBFWG-01/01. The total catch of Pacific bluefin tuna in 2019 and 2020 are 581 ton and 605 ton, respectively, caught by offshore large purse seine, trawl, and set net fisheries in the Korean waters, and catch proportion of set net has been increasing in recent years. In 2020, the proportion of large PBF (>30kg) recorded at the highest of 68% of the total catch. PBF were mostly caught by purse seine fishery during March to April around Jeju island. Some PBF were caught by set net operating along the coast of the East Sea. As for the PBF size, large size of PBF has increased since 2016 and is mainly caught in the 1st quarter. In the 1st quarter of 2020, the fish larger than 100 cm were caught more than ins previous years.

<u>Discussion</u>

A question was raised about the reason for the reduction in the number of purse seine vessels. It was responded that this was not due to management intervention, but because of economic issues. The FWG recognized that the larger sized fish in the Korean fishery was found mainly in the 1st quarter. This fleet currently assumed the time-varying selectivity for fit to the size data including larger sized PBF. It was suggested that Fleet 3 in the current assessment model may be split into two fleets; one is the fishery in the 1st quarter and the other is that in the other quarters. The splitting fleet possibly enables to reduce the number of parameters related to time-varying selectivity. That would be an option for the next benchmark assessment in 2024.

Center Comparison of U.S. Pacific Bluefin Tuna Length Sampling Programs: 2014-2020. (ISC21/PBFWG-01/08).

K. James presented ISC21/PBFWG-01/08. The U.S. recreational fishery (Fleet 15) is a large part of the total U.S. catch of Pacific Bluefin tuna (PBF) and is dominated by commercial passenger fishing vessels (CPFVs). The National Oceanic and Atmospheric Administration (NOAA) conducts both a Pacific Bluefin Tuna Port Sampling Program and supports the Sportfishing Association of California (SAC) Fisheries Sampling Program to determine the length composition of Fleet 15. The length samplings conducted by both programs were compared here to investigate their overlap, potential bias, and how representative they were of Fleet 15. The length compositions between the programs had similar multimodal distributions, but the NOAA program generally sampled larger PBF (median = 97.1 cm FL) due to their port sampling methods. In contrast, the SAC program was able to measure smaller PBF (median = 92.0 cm FL) often filleted at sea and unavailable for port sampling. The SAC program generally sampled fewer vessels than the NOAA program, but a subsampling simulation demonstrated that this did not drastically affect the length composition. The NOAA sampling program measured 4.5% of the CPFV fleet between 2014 and 2019, while the SAC program measured 3.8% of the CPFV fleet between 2015 and 2020; both programs were representative of the CPFV landings of PBF. While the potential of sampling design bias needs to be considered, both programs produced comparable data that are likely more representative of current CPFV landings than the selectivity assumption previously used for the U.S. recreational fleet.

Discussion

It was questioned that if the comparison of size data was done between Fleet 13 and Fleet 15. It was responded that the authors did not have the raw data for Fleet 13. It was pointed out that there were differences in size composition data between SAC program and NOAA. It was explained that the SAC developed a sampling protocol for size measurement onboard to reduce sampling bias. It was also pointed out that the peaks in size composition corresponding to each age were slightly different between SAC and NOAA. That was possible because of the timing of measurement. The investigation of the relationship between the difference of peaks and growth was recommended.

2.2. Review of updated CPUEs used for assessment

Size pattern and relative CPUE of Taiwanese PBF fisheries using delta-generalized linear mixed models (GLMM) and vector-auto-regressive spatiotemporal model (VAST). (ISC21/PBFWG-01/03).

S.K. Chang presented ISC21/PBFWG-01/03. Taking advantage of voyage data recorder (VDR) data, trip data , and CDS data, historical offshore PBF catch and effort data were reconstructed. Applying traditional delta-generalized linear mix model (delta-GLMM) (without consideration of spatial effect) and vector-auto-regressive spatiotemporal model (VAST) (considered spatial effect in the model) to the reconstructed data, standardized relative CPUE was estimated for three regions: southern fishing ground, northern fishing, and both fishing grounds combined, respectively. The results of the GLMM and the VAST models both exhibit a substantial increase in 2020 for all three study regions. For the southern region where its series was considered more representative in previous PBFWG meetings, while the trends from VAST show an obvious sharp decline in the beginning of the study period and a sharp increase in the last year (2020), both GLMM and VAST models suggested that the level of 2020 has recovered to the level of 2006–2007 level.

Discussion

It was questioned that if any control measures have been introduced in the Taiwanese longline fishery to observe the allocation. It was explained that both effort and catch in this fishery were monitored for management, although the annual catch in recent years was much lower than the catch limit. It was also questioned that if the longline fishermen operated in the water around the Philippines recently because the shift of operation area could increase the uncertainty in the spatiotemporal model. It was responded that there have been operations there based on the VMS/VDR data from longline vessels and these data were included in the standardization.

Update of standardized CPUE and Catch at Size for Pacific Bluefin tuna (Thunnus Orientalis) caught by Japanese coastal and offshore longline up until 2019 fishing year. (ISC21/PBFWG-01/04).

Y. Tsukahara presented ISC21/PBFWG-01/04. This document presented the updated results of standardized CPUE and catch-at-length in Japanese coastal and offshore longline fishery. An updated standardized CPUE showed a consistent trajectory with the previous one and continuously increased since the 2011 fishing year. This index indicated there were no unexpected changes in the trend in SSB after the last assessment in 2020. In regard to updated catch-at-length data, small sized fish, which were less than 150cm and hardly observed until the 2015 fishing year, were recently dominant in the size composition in both fishing seasons. This change in size composition was still observed and became noticeable in the 2019 fishing year.

<u>Discussion</u>

A question was raised regarding the effects of small-sized fish in recent size composition on the standardized CPUE. It was responded that smaller fish were mainly caught in the water of eastward area and the data in that area were not included in the standardization due to the difference of fish size. However, the author noted that the small-sized fish were also caught in the other area. Therefore, size data after 2017 were excluded from the estimation of its selectivity in the 2020 assessment, and the feasibility of standardization by size category needs to be investigated. The exclusion of size data in the 2020 assessment was to prioritize the temporal consistency for the index, although this treatment may give inaccurate information to the removal by this fleet.

A participant asked about the monthly suspension in the 2019 fishing year. It was clarified that the suspension is due to the monthly quota, which was newly applied in the 2019 fishing year. The author also noted that Individual Quota system (IQ) was introduced for the Japanese longline since the 2020 fishing year.

The WG agreed to use the updated Taiwanese and Japanese longline CPUE indices for the 2022 update stock assessment. The standardized CPUEs up to FY 2019 are provided in Fig.1.

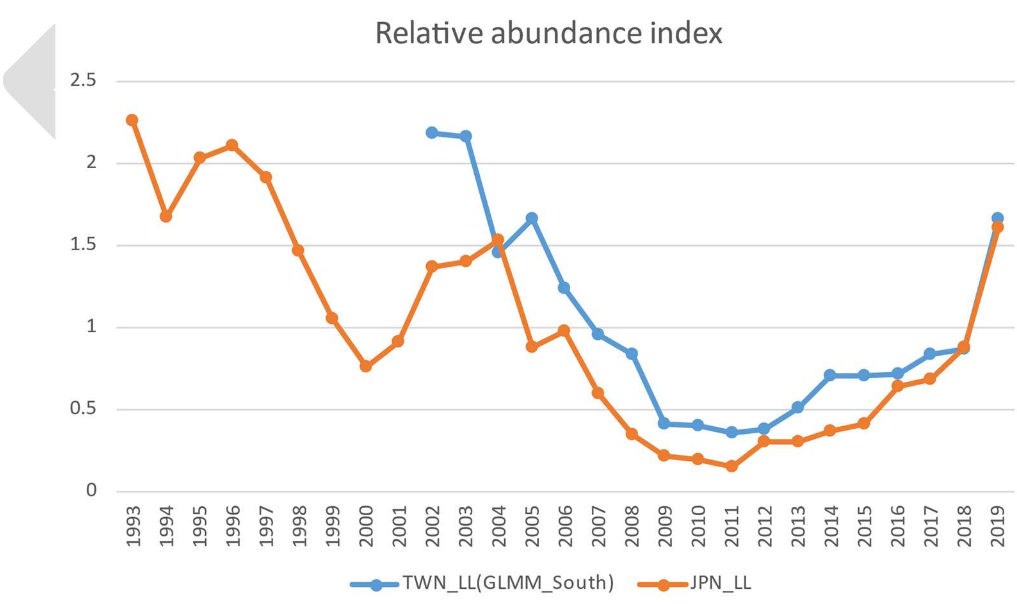

Fig. 1. Updated standardized CPUEs for Taiwanese longline (blue) and Japanese longline fisheries (red).

Update of Age-0 PBF index based on catch per unit effort data from Japanese troll fishery and its associated issues. (ISC21/PBFWG-01/05).

K. Nishikawa presented ISC21/PBFWG-01/05. The Japanese troll CPUE was updated using the fishery data up to the 2019 fishing year, and the same standardization method with the previous assessment was applied. The standardized CPUE in the 2019 fishing year was the lowest during the period. The trend of the estimated index was compared with the Japanese real-time monitoring survey index. Both indices showed a similar trend for the early period (2011-2016) but those became different in recent years (2016-2019). The difference in the trends between both CPUEs would be caused by the availability of the live-release information. After interviews with some people from the Nagasaki prefectural government and troll fishermen, some drastic changes about the nature of the fishery due to management change since FY 2016 were made clear. We propose not to include the CPUE based index from the conventional troll fishery in the future stock assessment for the period when management change is considered to bias the index. The effect of the biased information on the stock status and projection would be limited by the cut off the 2017 data point.

Discussion

The WG noted that the introduction of stricter measures, particularly the release of small PBF might have biased the index negatively. It was mentioned that both conventional CPUE time series based on the sales slip data and alternative index based on real-time monitoring survey were consistent until the 2016 fishing year, and therefore duplicated use of the indices until 2016 would give some information on the alternative index. It was pointed out that the alternative index was estimated from the same fishery, thus it may suffer the same issue under the management as the conventional index. The potential impacts of management on the alternative index should be investigated further. The trajectories of conventional CPUE and alternative CPUE are provided in Fig. 2.

A question was raised regarding the standardization method for the real-time monitoring index. It was responded that the standardization model for the alternative index is basically the same, which is the generalized linear model (GLM), as the conventional index, although there were some small differences such as assumed error distribution.

A participant asked if the live release information from the real-time monitoring survey is useful for the estimation of post-release mortality for the assessment. It was responded that the number of participating vessels for the survey is limited, 14 vessels at current, and thus release information from these vessels is not sufficient to estimate the whole amount of discard. However, this information may be useful to estimate the unaccounted mortality rate of the fleet.

It was pointed out that the performance and validity for both indices can be evaluated with a comparison of fits to the other data component, especially fits to the longline indices. Therefore, it was suggested that the conventional index should be updated until the evaluation is completed, if possible. It was also suggested that the performance of each index may be able to be investigated through short-term projection with an age-structured production model (ASPM).

The authors were requested to re-calculate the conventional index using the same fishing seasons as those in the alternative index for a fair comparison. The WG confirmed that it showed a very similar trend with the conventional index.

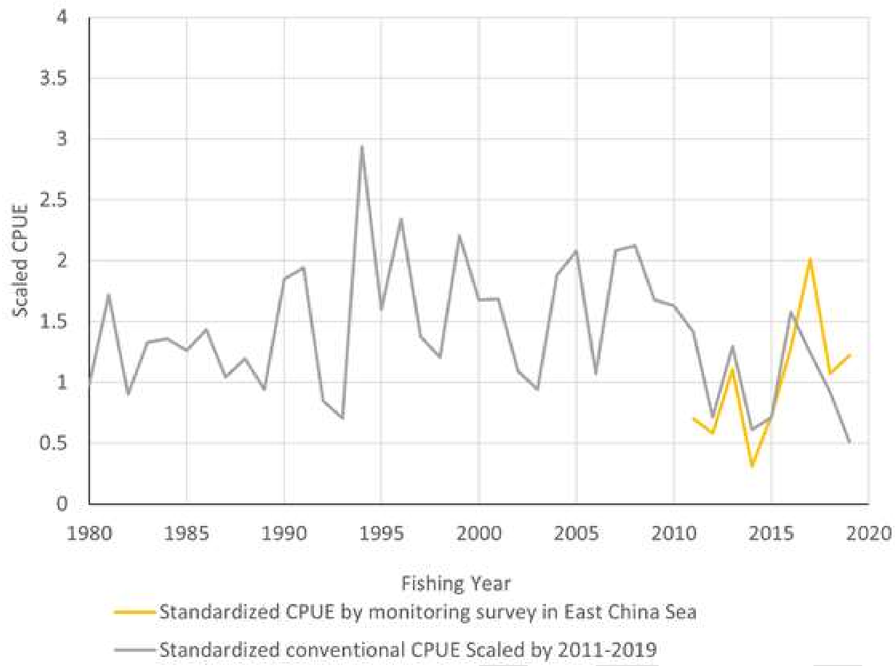

Fig. 2. Standardized CPUEs (conventional and alternative) for recruitment.

Reinforcement of Japanese PBF Recruitment Monitoring Program (ISC21/PBFWG-01/06).

H. Fukuda presented ISC21/PBFWG-01/06. In this document, candidates of alternative recruitment index for the stock assessment of PBF are listed, and those applicability to the assessment were evaluated through qualitative and quantitative analysis. The index from the Japanese troll real-time monitoring survey, which was recommended through the qualitative analysis, showed a similar performance when it was evaluated using the ASPM-R diagnostics. The authors recommended excluding the currently used recruitment index (Survey 4) after 2017 FY from the future PBF assessment due to its possible bias and uncertainty in recent years. As an alternative, they also propose the Japanese real-time monitoring index in the Winter operation, which shows similar performance with the conventional troll CPUE by the ASPM-R model diagnostics.

Discussion

A question was raised regarding the preparatory calculation to estimate recruitment deviations for diagnostics by the ASPM-R model. It was responded that the recruitment deviations came from model results of stock synthesis 3 (SS3) with fitting to the all available data sources including one of each alternative index except for the terminal two years. It was also explained that the setting for selectivity of the alternative index in SS3 was the same as that for the conventional index because the real-time monitoring vessels are part of the fishery submitting the sales slip for the estimation of conventional troll CPUE. Therefore, the author noted that the use of both indices after 2011 can be said to be duplicate in the assessment.

Overall discussion on the recruitment index

Based on the presentations and discussion on recruitment indices, the WG recognized that there are several options for the recruitment index for future assessments, e.g., 1) to use the conventional index, 2) to use the alternative index, or 3) not to use any index.

The recruitment index for Age 0 in the PBF assessment model has impacts on the estimation of recruitment deviations, especially in recent years. It was suggested that the effects of these options should be evaluated not only for assessment periods but for the projection period because age structure at terminal year affects the projection results. It was noted that uncertainty of the recruitment index in recent years would not substantially affect the current recommendation based on the last assessment, because recent recruit fish have not grown to be spawners yet. However, fishing mortality at young ages would be changed due to the change of recruitment.

It was also discussed if the grid modeling approach is applicable in this case. It was pointed out that it is difficult to determine the plausibility weighting among models in a grid approach. It was noted that PBF assessment uses a base case model approach because this assessment showed little conflict among the data components and the WG agreed that in principle the base case model approach should continue.

After reviewing the results of analysis on recruitment indices, the WG considered that the recruitment index based on sales slip may be negatively biased since 2016 due to operational changes responding to strict management measures and thus should not be included in the future assessments for those periods. The challenge is how exactly to incorporate recruitment information in the future assessment models, such as using the real-time monitoring information or not including recruitment index. Further discussed is under agenda item 3.

The WG also noted that the terminal year recruitment estimate was rather low in the last assessment; it was primarily informed by the recruitment index which is likely to be negatively biased. However, the effect of this issue on the stock status or conservation information should be minimal because the assessment and projection considered the possible high uncertainty of recruitment estimates.

3. POSSIBLE IMPROVEMENT OF STOCK ASSESSMENT

3.1. Possible areas of improvement of 2020 assessment

The devil is in the details: Investigating sources of bootstrapped bias in the Pacific bluefin tuna assessment and the associated impact on the future projections. (ISC21/PBFWG-01/07). Presented by H.H. Lee

Pacific bluefin tuna are under management measures to rebuild the stock using two biomass-based rebuilding targets with specific time periods. Simulation-based projections from the bootstrapping stock assessment model were used to calculate the projected SSB and the probabilities of rebuilding to these targets for various harvesting and recruitment scenarios. Biases in spawning stock biomass (SSB) that occurred in the bootstrapping procedure confronted the calculation, and in the interim, these biases were corrected using an ad-hoc method. The purposes of this paper are 1) to identify possible sources of these biases in the bootstrapping procedure and 2) to calculate these probabilities based on the adjusted bootstrapped replicates and compare the associated impact. During the initial investigation that created bootstrapped replicates from the 2020 assessment model, we assumed that biased weight compositions generated for fleet 10 and the small inputted sample sizes were the possible sources. The bootstrapping procedure 1 corrected the biases from the undue usage of adding a constant to the weight compositions when generating the replicates. However, there are negative biases in SSB for early modeling years and biases were reduced after 1975. We further validated this bootstrapping procedure by controlling all the replicates to have the same size compositions (now, the uncertainties were from data other than compositions). This bootstrapping procedure validated the similar pattern of SSB seen in bootstrapping procedure 1. This pattern of SSB disappeared and the overall biases and variabilities of SSB improved when generating the replicates with systematically increased (x 10) small inputted sample sizes. Interestingly, the bias due to the bootstrapping procedures used for the projections appeared to have little impact on management interpretations of the probability to achieve the rebuilding targets. However, understanding the source of the bias and offering solutions to potentially correct that source of bias is preferable to relying on the ad-hoc approach although the ad-hoc approach appeared to be reasonably successful compared to the approach with no adjustment at all.

Discussion

A WG member noted why the medians of relative errors of SSB were more sensitive to different bootstrapping procedures prior to 1980. It was pointed out that prior to 1980, the size data were available for limited fleets. The WG member asked how the added constant value to the weight composition data for fleet 10 could be changed in the stock assessment model. It was clarified that the 0.01 added constant value to the weight composition was to robust if the model fitting due to the highly skewed distribution. The suggestion is to restructure the weight composition for fleet 10 so that the model fits well to the data with a smaller added constant value. The working group generally agreed with the results and agreed to implement the author's recommendation.

3.2. Workplan towards for future assessments

H. Fukuda presented a summary of the basic structure for the 2020 update stock assessment model. The ISC PBFWG has conducted the benchmark stock assessment every four years since 2012. The benchmark assessment involves all the possible improvements including but not limited to the input data preparation, assumption of the population dynamics model, and the parameterization of the assessment model. The PBFWG has also conducted the updated assessment in the middle of the consecutive benchmark assessments to track the current stock status using additional data observations. The results of those assessments are submitted to the WCPFC and the IATTC for review and used as the basis of management actions. Since the PBFWG completed the last benchmark assessment in 2020, the data update assessment is scheduled in February or March of 2022. Usually, in the updated stock assessment, the WG maintains similar specifications from the previous benchmark assessment model with additional data observations. Unless, there is any misspecification of the model, improvement of the data, or a strong rationale for changes, the WG may change the specification of the model or data with the agreement of the members to address the issues in the updated assessment.

Discussion

The WG had a lengthy discussion on the model/data specifications for the 2022 updated assessment. In summary, the WG agreed that the 2022 updated assessment model should use the same biological assumptions and similar model structure to the 2020 benchmark assessment model with two more years of data included. However, in the 2020 benchmark assessment, the WG identified several unresolved issues that need to be addressed in the near future. The WG will take a step forward to explore some model improvements for the 2022 assessment. The detailed specifications and the possible changes for the 2022 assessment are as followed:

1 General specification

1.1 Model platform: Stock synthesis ver. 3.30.14

1.2 Assessment period: 1952-2020 Fishing year (FY, 1952 July to 2021 June/calendar year)

1.3 Estimating parameters: Initial conditions, population scale, catchability of the index, recruitment deviations, and selectivity parameters.

1.3.1 Selectivity: There are 3 types of assumptions about the temporal changes of selectivity. For the fleets which were assumed temporally constant selectivity or annual time-varying selectivity in the 2020 assessment, the WG will estimate two more years of the selectivity parameters using the current form or function. For the fleets which were assumed temporal variation of selectivity using the time block feature, the WG will adjust the time block to cover the additional data and conduct the residual analysis.

1.4 Bootstrap bias correction (referred to section 3.1): Appling the bootstrapping procedure 4 suggested by Lee et al. (2021).

2 Observation models

2.1 Fleet structure: 25 Fleets in the model

2.2 Catch data: Quarterly catch time series should be updated for all fleets including the post-release mortality fleets using the same methodology as in the 2020 assessment.

2.3 Size composition data: It was recommended for all fleets to update the size composition data if data are available.

2.3.1 Fleet 1 Japanese longline (JPNLL): The WG agreed not to include size composition data of Fleet 1 after 2017 FY. The WG clarified the rationales of not including these size composition data are because 1) the management causes that an influx of new migrants that are smaller in the observed size as the population rebuilds; 2) the catch and composition data are from all fishing area, whereas the data used to develop CPUE are from the core fishing area; 3) there is no location information in the composition data that can be separated by the area.

2.3.2 Fleet 15 US recreational fishery: Due to COVID-19, the NOAA program was unable to measure PBF for US recreational fishery in 2020. The WG discussed that the possible treatments are: 1) to have no composition data in 2020 or 2) to use composition data collected from the SAC program in 2020. The decision is not yet made and will be determined at the data preparation workshop.

2.4 Abundance indices

2.4.1 Japanese longline index after 1993: Conduct the spatio-temporal standardization model using data to 2020 FY (2021 June in the calendar year).

2.4.2 Taiwanese longline index: Conduct GLMM (south) model using data to 2020 FY (2021 June in the calendar year). The WG agreed that several other Taiwanese longline indices (using the VAST model with or without size data) will be included but not fit in the 2022 assessment model.

2.4.3 Japanese troll index: The WG agreed to exclude the Japanese conventional troll index (S4) after 2017 FY (use only 1980-2016 FY) in the 2022 assessment model. Since 2017 FY, several management actions including fishery suspension, individual quota, and minimal size regulations have limited the quality and quantity of data. The WG suggests four possible options; 1) use only the Japanese conventional troll index for 1980-2016 FY, 2) use Japanese conventional troll recruitment index for 1980-2016 FY and Japanese real-time monitoring index for 2011-2020 FY, 3) use Japanese conventional troll recruitment index for 1980-2010

FY and Japanese real-time monitoring index for 2011-2020 FY, or 4) do not use any recruitment index. These will be discussed further in the future meeting.

3 Sensitivity analysis: The WG agreed that similar sensitivity analyses will be conducted in the 2022assessment. To include more assessment uncertainty in the future projection, a few sensitivity runs (e.g., the pessimistic model showed a smaller stock size) will be used.

4 Future works: Some ideas to improve the PBF stock assessment were presented but recognized as future works.

4.1 Consistent estimate of selectivity for Fleet 1 and Survey 1.: An alternative approach suggested to address the mismatch between composition data and the index is to create two fisheries for JPNLL; 1) index fleet that assumes time-invariant selectivity and 2) catch fleet that assumes time-varying selectivity. This will be considered in the next benchmark assessment.

4.2 Splitting Korean Large Offshore Purse Seine (KLOPS) fleet into two: Due to the difference in size composition data between season 3 and the rest of the seasons, the WG suggested split the KLOPS fleet into two fleets. The splitting will help to simplify the model with fewer selectivity parameters to be estimated. Given the good 2020 model fits KLOPS composition data, a single fleet structure will be continued to use for the 2022 assessment. The WG agreed that splitting this fleet will be examined in the next benchmark assessment.

4. Management Strategy Evaluation (MSE)

4.1. General discussion on the structure of PBF MSE

4.2. Workplan

Summary

H. Fukuda made an oral presentation about the progress of the discussion for PBF Management Strategy Evaluation (MSE) among the IATTC - WCPFC NC joint working group, the ISC, and a couple of meetings with the stakeholders. He also presented a potential list of uncertainty axis for the consideration of the WG.

Discussion

The WG discussed its role in an MSE process. It was noted that the original schedule is to finish a full MSE in 2024. The WG considers the information quality of the PBF assessment to be quite high and results reliable. The information quality of the assessment likely diminishes the need for a full MSE analysis. Therefore, the WG discussed using an ensemble approach rather than MSE to evaluate harvest strategies. The WG will use simplified versions of the current base case model incorporating additional areas (axes) of uncertainty to create the model ensemble. The ensemble will be created around key life history characteristics. Details such as model weighting in the ensemble will need to be further discussed.

The WG noted that if some kinds of uncertainty are included (ex. missing catch/discard mortality), a traditional MSE with a feedback loop (feedback due to assessment error) will be needed. The WG agreed to discuss further based on the preliminary results of ensemble model in the meeting in fall 2021.

4. OTHER MATTERS

4.1. New scientific information relevant to PBF

Annual variability in the larval distribution and density of Pacific bluefin tuna based on the

larval survey using a two-meter ring net from 2007 to 2019

The larval fish surveys for pacific bluefin tuna were divided into two eras: 1st era (1956-1988) and 2nd era (2007-2019). The objective of this study is to reveal the annual variability in the larval distribution and density of PBF during the 2nd era from a long-term perspective and to analyze feasibility for estimating an abundance index of SSB based on the larval fish survey. A total of ca.15,000 larvae were collected from ca. 3,200 stations during the 2nd era. The larvae of the Nansei area and the Sea of Japan appeared at 25-31 and 23-29.5 °C from early May to late July and early July to early August, respectively. The appearance time of larvae in the Sea of Japan was more limited than in the Nansei area. The larval density was at a low level from 2011 to 2014 but has increased in the latest five years in both areas. Standardization of larval fish CPUE was conducted using the VAST model and calculated separately for two spawning grounds. There seems to be some correlation between the SSB at age and the larval index. In a further study, it will be necessary to include the environmental factors that affect the larval abundance.

Discussion

A participant asked why the larvae became easier to catch than before. It was explained that more larvae were caught in later years because their abundance was higher. A participant asked if the raw data for the first era are available and noted that this data would be particularly interesting to further analyses due to the large decline in spawner abundance during this period. It was explained that the data is available, but some information such as the collection methods used is not available. A participant asked if the larvae abundance and its associated temporal and spatial extent have been compared with recruitment estimated by the stock assessment model. It was explained that this has not been investigated yet.

Effects of age composition on the spatiotemporal distribution of active breeding of Pacific bluefin tuna in the southwestern North Pacific

T. Ishihara made an oral presentation. Taiki Ishihara, T. Shimose, Y. Uematsu, Y. Hiraoka, H. Tanaka, H. Ashida, A. Tawa, and Y. Tanaka presented the relationship between the age and the spatiotemporal distribution of active breeding of Pacific bluefin tuna in the southwestern North Pacific, and the relationship between the age composition in the southwestern North Pacific and the recruitment. The age compositions of PBF caught by Japanese longline fisheries in the southwestern North Pacific from 2007 to 2016 were estimated using the port sampling data from Wakayama, Miyazaki, and Okinawa prefectures in Research Project on Japanese Bluefin Tuna (RJB) and associated age were estimated from collected otoliths. Age composition analysis suggested that the instantaneous mortality rate in this area for individuals older than 9 years old was estimated to be 0.32 and that the 1994 and 1996 year classes were strong in this area. The analysis of the catch location showed 8–10 years old fish mainly spawned in May, while the proportion of >10 years old fish increased in June. The relationship between age composition and recruits suggested that the main group of spawning adults is formed around the age 10 with a long tail age composition may increase the possibility of strong recruits.

Discussion

A participant clarified some information about the size distribution of the Taiwanese fishery that larger individuals were predominantly found in lower latitudes, but this has reversed in recent years. A participant noted that abundance by year class shows different trends, particularly at end of the time series, between the cohort and catch curve methods. It was explained that this may be due to the catch curve method being more uncertain at end of the time series. It was noted that the most productive age for spawners was around age ten, however in years where the age distribution of spawners had a long tail with larger fish, there is good recruitment. A participant noted that the suspension of the fishery in the late part of the longline season due to management restrictions may bias the sampling of the spawners and miss the large fish. So, the long tail of the spawner age distribution may not be observed even if it exists.

4.2. Others (close-kin mark-recapture (CKMR) progress)

Japan

The progress in CKMR research was presented. Japan has developed the kinship detection method based on the results of DNA analysis, which was presented at the ISC CKMR workshop held in Jeju, 2019. As a result of kinship detection, some POP and HSP were found. Japan continues to work on the DNA analysis and the development of the assessment model with CKMR results.

Discussion

A participant noted that reproductive output by age for males and females can be estimated within the close kin analysis if both POP and HSP are analyzed. It was noted that this approach needs more pairs to be informative and that is why data on reproductive output is being used in the analysis. A participant noted that based on the current rate of sampling and POPs found, detection of 50 POPs, which is a minimum recommended number, would need about 18,000 samples. A participant noted that because the PBF assessment was considered reliable, spending time and money on close kin analysis may not need to be a priority. A different participant responded that the assessment may be less reliable in the future as the abundance increases and management is more restrictive, and close kin analysis may become more beneficial. It was also noted that the analysis of genetic data is becoming less expensive and this may improve the applicability of the method.

Korea

Korea has collected samples for close kin since 2016 and analyzed these data to develop candidate SNP markers since 2018 (Table below). Korea will present some results at the next data preparatory meeting.

Table 1. Summary of the number of samples by year for the CKMR by Korea

Year	Number of samples (Korea)
2016	1045
2017	348
2018	249
2019	313
2020	182

Chinese Taipei

Chinese Taipei started collecting tissue samples since 2017, at least 500 samples were collected each year. However, the collection program was stopped in 2021 as it had become difficult to explain the benefit of the project.

Mexico

Mexico started sampling PBF tissue for Close Kin since 2015. Although the requirement was 350 tissue samples per year, Mexico collected and stored 750 samples per year and continues to sample. This effort started as a joint enterprise without a clear view of the path to follow. Mexico is concerned that national efforts might not lead to the original purpose. There are problems concerning sharing tissues to other countries or the bias in DNA analysis by using different labs. This may need to be discussed at the next ISC plenary.

USA

The progress of the US close-kin sampling was not available during the meeting and will be provided in a future meeting.

Discussion

It was noted that the close kin project needs collaboration, and this was discussed in Jeju. It was noted that information needs to be shared among countries such as how many samples to collect and how to analyze the tissue samples and find a set markers. A plan is needed on how to proceed. However, it was also noted that as CKMR includes academically advanced area, there are some areas we can, and some that are difficult. A participant stated that a clear objective and good sampling plan is needed, and this requires a good understanding of the stock.

It was noted that the main problem is that there was not a comprehensive plan at the start of the project and without a comprehensive plan it is difficult to have a meaningful program. A participant noted that it would be good to write up what has been done and the issues that have been encountered. This would help plan the bluefin CKMR, but also help others who are planning close kin studies. WG members agreed to continue its domestic CKMR projects as they see fit. In the meantime, this issue may be raised at ISC Plenary.

A participant suggested that the working group cannot do an assessment, MSE, and close kin at the same time and that close kin is the lowest priority. It was agreed that close kin will be put on the November meeting agenda. A participant asked if close kin will be included in the general model created by CAPAM. It was explained that CAPAM had a workshop on it but is not creating the model. It was also noted that NMFS is creating a new model, but close kin is not included in the proposed features. The model is being developed in phases and the working group could request that it be included.

A participant noted that close kin data can be used to develop stock structure, and it can also be used for estimating movement. A comprehensive close kin model basically uses a stock assessment model.

4.3 Others (Meeting schedules)

A tentative schedule of the PBFWG for the updated stock assessment in 2022 was confirmed and agreed.

November 2021 Data preparation workshop, including MSE progress review (Webinar);

December 31, 2021 Data submission for Catch and Size composition data, and preliminary results for the abundance indices;

January 31, 2022 Data submission for the abundance indices;

Early March 2022 Assessment meeting (TBD);

April 1st, 2022 Submit the Executive summary of the Stock assessment report to the ISC chair for his review.

It was explained that for the next assessment a standard data format will be distributed and it was requested that participants use it.

5. ADOPTION OF THE REPORT

The WG reviewed and adopted the report of the meeting.

6. ADJOURNMENT

The meeting was adjourned.

APPENDIX 1.

Draft agenda

1. Opening and Introduction
    1.1. Welcome and introduction
    1.2. Adoption of agenda
    1.3. Appointment of rapporteurs

2. Review of updated information
    2.1. Catch information for 2020
        - The formal submission of catch data needs to be done in accordance with the procedure developed by STATWG. This is an opportunity for WG to informally go over the 2020 catch. Please submit PBF catch in CY 2020 to Hiromu Fukuda (fukudahiromu@affrc.go.jp) by 1 March.
    2.2. Review of updated CPUEs used for assessment
        - Please present updated CPUEs up to FY2020.

3. Possible improvement of stock assessment
    3.1. Possible areas of improvement of 2020 assessment
    3.2. Workplan towards for future assessments

4. Management Strategy Evaluation
    4.1. General discussion on the structure of PBF MSE
    4.2. Workplan

5. Other matters
    5.1. New scientific information relevant to PBF
    5.2. Others

6. Adoption of the report

7. Adjournment

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APPENDIX 3. LIST OF DOCUMENTS

Working papers

Index	Related Agenda	Title	Author	Contact
ISC21/PBFWG-01/01	2.1	Update of Korean fisheries information for Pacific bluefin tuna, *Thunnus orientalis*.	Mi Kyung Lee, Sung Il Lee, Youjung Kwon and Junghyun Lim	ccmklee@korea.kr
		Withdrawn		
ISC21/PBFWG-01/03	2.2	Size pattern and relative CPUE of Taiwanese PBF fisheries using delta-generalized linear mixed models(GLMM) and vector-auto-regressive spatiotemproal model (VAST).	Tzu-Lun Yuan, Shui-Kai Chang, Hung-I Liu, and Chao-Chin Huang	skchang@faculty.nsysu.edu.tw
ISC21/PBFWG-01/04	2.2	Update of standardized CPUE and Catch at Size for Pacific Bluefin tuna (Thunnus Orientalis) caught by Japanese coastal and offshore longline up until 2019 fishing year	Yohei Tsukahara, Hiromu Fukuda and Shuya Nakatsuka	tsukahara_y@affrc.go.jp
ISC21/PBFWG-01/05	2.2	Update of Age-0 PBF index based on catch per unit effort data from Japanese troll fishery and its associated issues.	Kirara Nishikawa, Yohei Tsukahara, Ko Fujioka, Hiromu Fukuda and Shuya Nakatsuka	kiraranishi@affrc.go.jp
ISC21/PBFWG-01/06	2.2	Reinforcement of Japanese PBF Recruitment Monitoring Program.	Hiromu Fukuda, Ko Fujioka, Yohei Tsukahara, Kirara Nishikawa, and Shuya Nakatsuka	fukudahiromu@affrc.go.jp
ISC21/PBFWG-01/07	3.1	The devil is in the details: Investigating sources of bootstrapped bias in the Pacific bluefin tuna assessment and the associated impact on the future projections.	Huihua Lee, Hiromu Fukuda, Yohei Tsukahara, Kevin Piner, Mark Maunder, and Richard Methot Jr	huihua.lee@noaa.gov
ISC21/PBFWG-01/08	5.1	Center Comparison of U.S. Pacific Bluefin Tuna Length Sampling Programs: 2014-2020.	Kelsey C. James, Liana N. Heberer and Heidi Dewar	kelsey.james@noaa.gov

Oral presentations

Related Agenda	Title	Author	Contact
3.1	Preparation for 2022 PBF assessment.	Hiromu Fukuda	fukudahiromu@affrc.go.jp
5.1	Annual variability in the larval distribution and density of Pacific bluefin tuna based on the larval survey using a two-meter ring net from 2007 to 2019	Atsushi Tawa, Yohei Tsukahara, Taiki Ishihara, Hiroshige Tanaka, Hiroshi Ashida, Yuko Hiraoka, Hirohiko Takeshima, Kenji Nohara, Seiji Ohshimo, Nobuaki Suzuki, Toshiyuki Tanabe, Keisuke Satoh, Osamu Abe and Yosuke Tanaka	atawa2015@affrc.go.jp
5.1	Effects of age composition on the spatiotemporal distribution of active breeding in the southwestern North Pacific	Taiki Ishihara, Tamaki Shimose, Yuki Uematsu, Yuko Hiraoka, Hiroshige Tanaka, Hiroshi Ashida, Atsushi Tawa and Yosuke Tanaka	ishiha@affrc.go.jp