FINAL

ISC/24/ANNEX/04

ANNEX 04

24th Meeting of the
International Scientific Committee for Tuna
and Tuna-Like Species in the North Pacific Ocean
Victoria, Canada
June 19-24, 2024

REPORT OF THE PACIFIC BLUEFIN TUNA WORKING GROUP INTERSESSIONAL MEETING

June 2024

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ANNEX 04

REPORT OF THE PACIFIC BLUEFIN TUNA WORKING GROUP INTERSESSIONAL MEETING

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

November 27-December 1
Virtual Meeting

1. OPENING AND INTRODUCTION

1.1. Welcome and Introduction

The meeting was held online. S. Nakatsuka (Japan), Chair of the ISC Pacific bluefin tuna Working Group (PBFWG or WG), welcomed the participants from Canada, Japan, Korea, Mexico, Chinese Taipei, the United States of America, and the Inter-American Tropical Tuna Commission (IATTC) and opened the meeting. Scientists from New Zealand also attended as external experts.

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 HH. Lee, Item 3: D. Tommasi, and Item 6: Y. Tsukahara and M. Maunder.

2. INPUT DATA

2.1. Catch Time Series

2.1.1. Retained Catch

The Salvage of Forgotten Record. H. Fukuda, K. Kishinami, K. Nishikawa, and S. Nakatsuka (ISC/23/PFWG-2/01)

H. Fukuda presented ISC23/PBFWG-2/01. Fukuda et al. reported an estimation method, estimated values, and results of a sensitivity analysis on the stock assessment for the possible overlooked catch time series by the longline fleet in Okinawa when it was under American occupation during 1945-1971. The estimated catch by Okinawa longline during that period was minor compared with the existent reported catch during the same period, and the sensitivity run with those estimated catches showed a limited impact on the latest stock assessment conducted in 2022. The authors concluded that the current management advice based on the 2022 stock assessment was robust to this uncertainty.

<u>Discussion</u>

It was clarified that the catch amount from this salvage were assumed to be a part of the catch in Fleet 1, which is Japanese longline fleet, because historically almost all of the PBF landed in Okinawa prefecture was caught by longline. Although there was no size measurement data, the selectivity estimated by the length composition data in nearby prefectures was considered applicable due to the similarity of fishing operations. It was noted that the catch time series in this document would not be included in the current short term assessment model which starts from

1983. The author considered that the raw information on species composition was very limited, and hence the estimation method is too rough. **The PBFWG agreed not to include this estimated catch in the ISC official catch records and future PBF stock assessments.**

Information from Members

The WG chair asked for the latest PBF fishery information. S. Hawkshaw responded that there were no fisheries targeting PBF in Canada. H.W. Park from Korea answered that there is no updated information since the last March PBFWG meeting.

H. Fukuda (Japan) presented the updates of PBF catch based on the fleet definition of the assessment. The catch in weight by Japanese offshore purse seine fleets has been relatively constant since those fleets have been catching PBF close to the catch limit. On the other hand, the catch in weight by Japanese coastal fishery fleets (i.e. set-net and troll) showed an increasing trend in recent years since they had some unused quota from past years. The revision of catch to the latest assessment data was made but it was not significant.

S.K. Chang from Chinese Taipei explained the recent fishing situation. The catch amount in 2023 is 2,122 tons, and it is close to the national catch quota which includes the carryover from last year. While the remaining quota is low, there is no mandatory restriction for PBF operations this year. The PBFWG has recognized that the fishery restriction has great impacts on the CPUE standardization from the experience of the Japanese longline fishery. It was noted that the carryover for next year would be much smaller than that for this year, and it will be easier to reach the national quota. Chang explained that the government intends to announce warnings as catch approaches its limit and ultimately prohibit fishing for PBF. In such a case, additional data treatment, e.g., excluding data from the restricted period for CPUE standardization, would be required to keep the abundance index from this fishery available.

HH. Lee presented the PBF annual catch for US recreational and commercial fisheries from 2018 to 2023. The 2023 estimates, as of now, encompass the first three quarters and were preliminary. Within the US commercial catch, categories include gillnet, purse seine, troll/Pole&line, and hook and line fisheries. The count of vessels engaged in PBF capture has generally declined or remained stable since 2018, with the exception being observed in hook and line fisheries. It was hoped that the size data for some of the commercial fishery would be available up to the data submission for the next assessment.

M. Dreyfus from Mexico explained the latest catch information. The catch series from 2005 to 2023 was updated. In particular, he noted minor modifications of the catch of 2020 and 2021 (19 and 1 tons respectively) and the new values for 2022 and 2023, which were 3194 tons and 3399 tons respectively, and which were accepted by ISC23. The catch in recent years was obtained in a few weeks during the month of January. There was a biannual catch limit for the most recent two years of 6973 tons. The Mexican government authorized 300 tons of catch for the small-boat fisheries this year, while the national quota was unchanged. Those vessels will start fishing next year. The fishing grounds for the PBF fishery, which are in the waters off Baja California on the Pacific side, have not varied in the recent year.

Overview of New Zealand Pacific bluefin tuna catches

A scientist and a data analyst from Fisheries New Zealand attended the ISC PBF WG for the first time and presented an overview of New Zealand PBF catches. New Zealand (NZ) PBF catch records begin just after the declaration of the NZ Exclusive Economic Zone in 1979 and peak at 110 tonnes of landing weight in 1982 before declining sharply to below 10 tons in 1985. More recently catches averaged 18 tons in 2005-2019 before increasing to an average of 40 tons in 2020-2022. This increase in catches came despite a continuous decline in the number of NZ surface longliners and the total number of hooks deployed. Pacific bluefin tuna is mainly caught as a bycatch species on NZ surface longliners targeting Southern bluefin tuna; PFB made up 2% of surface longline catches in 2022 compared to 73% Southern bluefin tuna and 10% swordfish. The main fishing season is from March to September, and catches are typically distributed along the east coast of the NZ North Island and the south-west and south-east coasts of the NZ South Island. Data on the size distribution of PBF catches indicates an increase in smaller fish / decrease in larger fish caught in 2022, with most fish weighing around 90-130 kg.

<u>**Discussion**</u>

It was clarified that this presentation focused on the recent commercial fisheries by longline, although there is a recreational fishery which can catch the PBFs. The recreational fishery by chartered boats, which have an obligation to report the weight of each PBF caught, reported very small amount of catch in recent years. Some of the private recreational fishermen provide gamefish catch logbooks on a voluntary basis, as part of a programme mainly targeting the monitoring of striped marlin recreational catches. A question was asked about the recent decreasing trend in the number of hooks, while the quota for Southern bluefin tuna, which is a main target for NZ longliner, increased. It was responded that there was a small decline in landings during the years of the Covid-19 pandemic, but NZ fishers have otherwise reached the Southern bluefin tuna quotas despite the lower hook numbers.

The PBFWG discussed how to obtain the catch data in New Zealand for future assessments. The data manager in this WG explained that historical catch data in NZ during 1991-2006 were obtained through personal communication with a scientist from NZ (ISC7 Plenary meeting Annex 10), and those after 2007 were obtained through the WCPFC catch statistics in previous assessments. NZ catch was treated as part of the catch of the Chinese Taipei longline fleet due to the assumed similarity of the size of caught fish. The PBFWG would appreciate it if NZ could provide catch information directly to ISC for the next assessment because it contains additional information such as fishing month.

The PBFWG also discussed the treatment of NZ catch data in the assessment. The weight composition data in the presentation indicated that the fish recently caught in NZ were apparently smaller than PBFs caught by Chinese Taipei longliners. To facilitate the discussion, the PBFWG asked NZ scientists to provide the weight composition data for the comparison of weight composition data among Japanese, Chinese Taipei, and New Zealand longliners (See details in Section 2.2).

A participant asked if there is information on the maturity condition or spawning in PBFs caught by NZ longliners, because the fish size is large enough to be mature. It was responded that sometimes the fish condition is poor but that data on the maturity condition of PBF is not currently collected in NZ. In response to a question regarding methods to detect spawning events, H. Ashida offered the following. Usually, the assessment of ovarian maturity status in PBF is conducted by histological observation. Histological techniques can directly assess the maturity status of the ovary when the fish is caught, because this technique can observe developmental stages of oocytes in the ovary and some spawning markers such as postovulatory follicles or oocytes, which indicate imminent spawning in the ovary (i.e., germinal vesicle migration oocytes or hydrated oocytes). However, detection of spawning in individuals may be difficult because the duration of these spawning markers in the ovary is very short (less than 1.5 days after spawning). The first step to examine the possibility of the spawning of PBF in New Zealand is to assess the maturity status of ovary in PBF sampled around New Zealand using histological techniques and find fish with yolked oocytes in the ovary (i.e., sexually mature fish). If sexually mature fish are found around New Zealand, the probability of spawning in PBF in this area would become high.

2.1.2. Unseen Mortality

Discussion

The current assessment model has three fleets for unseen catch; one is for discard catch in weight in the Western Pacific, another is for discard catch in number in the Western Pacific, and the other is discard catch in number in the Eastern Pacific. In the Western Pacific, there were no new information on the unseen mortality to revise the current assumption, which is 5% of total catch. It was noted that alternative assumptions could be dealt with in the MSE framework with a wide range of uncertainty on the discard catch amount. The selectivity of the discard fleets in the Western Pacific was mirrored from the selectivity estimated for Fleet 8, which is a Set-net fleet, catching around 5-30 kg PBFs. This assumption is unsuitable for some fisheries, for example the Japanese longline fleet. The selectivity setting for discards will be reviewed for the next assessment and MSE.

HH. Lee presented the data on US recreational dead discards for PBF, covering the first three quarters of 2023. So far, the 2023 estimates have exceeded those of 2022, utilizing the same estimation method based on release and predation records.

A participant from New Zealand introduced recent investigation on the post-release mortality rate of PBF by its longline fishery. The results indicated that survival rates of PBF brought to the vessel are typically around 65% (35% mortality), with higher survival for smaller fish. It was also noted that soak time has an impact on the post-release mortality rate.

2.2. Size Composition Data

2.2.1. Japanese Longline (Fleets 1 and 23)

S. Asai presented the catch-at-size data for the Japanese longline fishery up to the 2022 FY. In this fleet, a strong mode appeared at smaller sizes after the 2017 FY and this change in the size composition was observed continuously. However, as the main size of PBF caught by the Japanese longline fishery in the 2022 FY was 182-206 cm FL, the size has been gradually increasing and is getting back to the same mode as before the 2016 FY. We will determine if to include the 2022FY catch-at-size data in the next assessment after confirming the fit to the size data.

Discussion

A WG member raised a question regarding the inclusion of Japanese longline size data post-2017 in one of the Japanese longline fleets (Fleet 1) designated for the CPUE index. It was clarified that this fleet included catch-at-size data for fishing quarter 4 from 1993 to 2016. However, catch-at-size for fishing quarter 4 after 2017 was included in another Japanese longline fleet (Fleet 23). This decision was made because catches in 2017-2018 occurred earlier in the fishing season, primarily consisting of small-sized adults. The presenter highlighted that the implementation of Individual Quota management in 2021 has led to a more balanced distribution in the size of fish caught, encompassing both small and large adults. In response to another WG member's query about the spatial analysis of length frequency data, the presenter indicated that the development of area-weighted catch-at-size analysis is underway.

2.2.2. Japanese Small Pelagic Purse Seine (Fleets 2, 18, and 20)

Discussion

A WG member inquired about the size of fish caught by these fleets. Three fleets were assigned to the Japanese Small Pelagic Purse Seiners in the East China Sea, Fleet 2 encompassed fishing quarters 1, 3, and 4, Fleet 18 encompassed fishing quarter 2, and Fleet 20 encompassed age-0 farming catch in fishing quarter 4. The presenter clarified that these fleets target age 0 and 1 PBF with some variation depending on the year and season. Fleet 18 caught age 0 and l but caught mostly age 1 in 2020-2021. The data were available in Fleet 2 after 2020.

2.2.3. Korean Offshore Large-Scale Purse Seine (Fleet 3)

Korean members indicated that there have been no updates since the March 2023 meeting.

2.2.4. Japanese Tuna Purse Seine Fisheries in the Sea of Japan (Fleet 4)

Estimation of the Length Composition for the Japanese Tuna Purse Seine with New Data Collected at PBF Farming Operation Using Stereoscopic Camera. K. Nishikawa and H. Fukuda. (ISC/23/PFWG-2/02)

K. Nishikawa presented ISC/23/PBFWG-2/02. In the Sea of Japan, purse seiners operate targeting Pacific Bluefin tuna from May to July. They mainly land PBFs for fresh consumption, but they also provide their catch to farms of PBFs in recent years. We estimate size composition from measurement data from a stereo-camera and raised it by the number of farming PBFs. We also calculated 3 stock assessment models including estimated size composition. From the model results, SSB and Recruitment for the model simply adding farming size composition to fleet 4 and models with a new fleet for farming show similar trends to the 2022 base-case model. From the raised size composition in this document, fish for farming shows a distribution for a bigger size than that of landed PBF. Changing the unit of catch from weight to number could be an advantage for the assessment model. When we add the new fleet and estimate time-varying selectivity, the model requires 29 more parameters than the base case model for an additional 4 quarters of size composition data. On the other hand, there are no additional parameters when the model shares the size and age selectivity between fleet 4 and fleet 26. We suggest adding a new fleet for farming in the Sea of Japan, sharing selectivity with fleet 4.

Discussion

A WG member inquired about the inclusion of size composition data for farming in the 2022 assessment. The presenter clarified that this data was not in the 2022 assessment, although the catch for farming was included. Another question arose regarding the availability of size composition data for the market landings in 2022 for comparison with those for the farming. The presenter will work on the data before the next working group meeting.

2.2.5. Japanese Purse Seine off the Pacific Coast of Japan (Fleet 5)

Japanese members indicated that there have been no updates since the March 2023 meeting.

2.2.6. Japanese Troll (Fleets 6 and 19)

Japanese members indicated that there have been no updates since the March 2023 meeting.

2.2.7. Japanese Set Net (Season 1-3) (Fleet 8) and 2.2.8 Japanese Set Net (Season 4) (Fleet 9)

Estimation of Catch at Size of Pacific Bluefin Tuna Caught by Japanese Set Net Fisheries. K. Nishikawa and H. Fukuda. (ISC/23/PFWG-2/03)

K. Nishikawa presented ISC/23/PBFWG-2/03. In the 2022 PBF stock assessment, the set net size composition data in fishing year 2019 and 2020 were not included in the model because there were spikes in the data. It was found that the double input of certain data was the cause of the spikes and this should be fixed for the 2024 stock assessment. Also, because of strict management and changing management periods, the operation style was changed in Nagasaki Prefecture and catch amount in calendar quarter 1 has increased rapidly. We suggest removing the Nagasaki catch data from CY2017 and thereafter.

<u>Discussion</u>

A WG member inquired about the availability of size data around Nagasaki Prefecture, considering the recent increase in catch during 2022-2023. The presenter replied that there is no size measurement in the Nagasaki area due to historically low catch amounts. In an attempt to raise the size to catch-at-size, the presenter recommended excluding catches from Nagasaki. **The WG agreed to further investigate the results of an assessment model using data excluding Nagasaki Prefecture for raising size composition.**

2.2.8. Japanese Set Net (Hokkaido and Aomori) and Others (Fleet 10)

Japanese members indicated that there have been no updates since the March 2023 meeting.

2.2.9. Chinese Taipei Longline (Fleets 12 and 17)

S.K. Chang from Chinese Taipei presented "Brief investigation of Taiwan PBF length frequency data." The average length of PBF by the Chinese Taipei longline fishery has declined to 208–210 cm in 2023 for both the North and the South fishing grounds. The investigation focused on two questions: did the two-mode length composition result from a variation in fishing operations, and why has the length composition since 2019 become smaller than expected? The analysis indicated no clear spatial pattern in the mean length of PBF around TWN. The two-mode length composition is mainly influenced by recruitment fluctuations rather than changes in the fishing ground, and thus, a monthly or longitudinal split for the fishery was not considered necessary. The overall smaller length composition since 2019 was very likely affected by the strong recruitment of small adult fish.

<u>Discussion</u>

The WG reiterated the options based on the regression tree analyses were to use catch-at-size for the whole fishing area as the first choice. If the division is needed, 24.5N should be the separation from North and South fishing grounds. A WG member asked if the decline in the number of older adults after 2017-2018 in the south fishing ground for Chinese Taipei longliners (Fleet 12) is due to density effects. The presenter replied that there could be many reasons related to the decline in such small areas.

J. Shiao presented the PBF age structure based on otolith reading

Discussion

A WG member asked if the sampling method changed after 2017. The presenter stated that the sampling method, specifically opportunistic sampling, remained the same.

Another WG group member sought clarification on how age was assigned. It was explained that age was not counted to decimal degrees but treated as discrete age assuming the fish ages on July 1st. Subsequently, a question arose about whether there was an interannual difference in the age-length key, or if it was relatively consistent between years. The presenter acknowledged the need to examine the age-length key but that it might be similar to the presented age compositions, which have remained consistent from 2020 onwards. The WG suggested exploring interannual changes in the age-length key, in addition to age compositions.

The WG asked if other analyses are being undertaken to understand if there is evidence of time-varying growth. The presenter stated that an analysis is being carried out and final results are not ready to be shared, but that preliminary results seem to show that growth did not vary a lot in recent years.

The WG group engaged in a discussion about the potential causes for the presence of a mode at younger ages or smaller sizes in the age composition and size frequency data. It was noted that while the older fish are still present, the growing population has led to more young spawners appearing in recent years, keeping the mode of the size frequency distribution at a smaller size. It was also noted that the age-group specific TWLL standardized indices using VAST show that while there is a decline in the index for ages over 18, ages 15-17 are relatively stable, and that younger ages are increasing.

There was a discussion on potential reasons for the abundance of the older ages declining and the appropriateness of a domed-shaped selectivity for the TWLL fleet. The WG group wondered if the older ages are, in fact, declining or if there has been a switch in terms of fishing operations to target areas with many small fish. A Chinese Taipei WG member stated that fishing grounds remained relatively constant, and that vessels did not appear to specifically target schools of small fish. The WG concluded that further discussion would be necessary at the assessment meeting to determine the appropriate selectivity for this fleet.

The WG then discussed if, in light of this new information, it may be worth revisiting the growth assumption in the stock assessment model, particularly the CV of the large fish. It was noted that previous analyses of growth used data up to 2014, when stock biomass was still low, prompting consideration of reassessing growth now that the population is more abundant. The WG suggested that this could be done using the conditional age at length method with TWLL data for this purpose. It was also pointed out that since there is uncertainty in the selectivity of this fleet, it may be difficult to estimate the absolute value of CV for large fish. **The WG agreed to reestimate the CV using the updated otolith data from the TWLL and JPLL, as done in the 2016 assessment, to validate the current assumed CV for older fish.**

2.2.10. New Zealand Longline Fishery

Discussion

The WG acknowledges that New Zealand presented weight frequency measurements from surface longline fisheries, a topic not previously discussed in WG meetings. A WG member sought details on the sampling method and the weighing process for PBF. The presenter explained that weight measurements were retrieved from observer as well as market sale records and included variations such as green weights (pre-processing), gilled and gutted, gilled, gutted, and tailed. Conversion is necessary to standardize the metric.

In response to a question about the timing of the fish corresponding to their size, the presenter conducted additional analyses during the meeting. The plot of the market weights samples obtained for 2018-2022 did not reveal any discernible pattern across months. Based on market data for 2018-2022, fish appears to be caught around the South Island of New Zealand earlier in the year, then around the North Island of New Zealand later. However, the presenter cautioned that further analysis would be necessary to confirm this pattern and that the data may not be sufficient to draw conclusions since for the years analysed it was mainly coming from vessels landing catches at ports in the North Island. If it were true, it was a biologically interesting finding as PBF around NZ is considered to travel from the spawning area in North WCPO.

The WG expressed interest in comparing size measurements among New Zealand longliners, Chinese Taipei longliners, and Japan longliners to gain a better understanding of the fleet definitions. **Although more smaller fish are observed in NZ landing data relative to Chinese Taipei data, the WG considered that it is not a major problem and decided to continue to include NZ catch as part of Chinese Taipei longline catch.**

2.2.11. Eastern Pacific Ocean Commercial Purse Seine (1952-2001) (Fleet13)

This pertains to legacy fisheries, and there have been no updates.

2.2.12. Eastern Pacific Ocean Commercial Purse Seine (2002-) (Fleet 14)

There are no changes to size data procedures. All measurements from underwater stereoscopic cameras and the same statistical process are used to obtain the size composition of the Mexican catch. All sets have a sample size that makes raising more accurate. The total number of fish measured in 2022 and 2023 are 9740 individuals and 10590 individuals, respectively. Preliminary size composition of about 25% of the catch was presented, the rest is being processed. **The PBFWG also encouraged the size data for US hook and line fisheries due to its increase in the catch since 2020.**

2.2.13. Eastern Pacific Ocean Sports Fishery (Fleet 15)

No discussion on size data for Fleet 15.

2.3. Abundance Index

2.3.1. Standardized Chinese Taipei Longline CPUE

PBF abundance indices from Taiwanese offshore longline fisheries using delta-GLMM and VAST incorporating SST and size data. T. Yuan, S. Chang, and H. Xu. (ISC/23/PFWG-2/04)

S.K. Chang from Chinese Taipei presented "PBF abundance indices from Chinese Taipei offshore longline fisheries using delta-GLMM and VAST, incorporating SST and size data" (ISC/23/PBFWG-2/04). Three model designs were applied for PBF CPUE standardization: traditional delta-GLMM with SST effect, VAST with SST effect, and VAST with SST effect and incorporating size data. Standardized CPUE series did not show any noticeable difference for models with or without SST effect for delta-GLMM and VAST, except for the North region of delta-GLMM. The inclusion of SST in standardization models was recommended because it could produce a smaller AIC. The VAST incorporating size data (converted to seven age groups) suggested that the South region has a much higher density than the North (but the general trends are similar for both regions) and that age group 9-11 was the most dominant fish, followed by the 6-8 age group, for recent years. In general, the increase of CPUE for young age groups and the decrease for old age groups occurred in 2015, and the jump of CPUE occurred in 2020.

Relative CPUE series from GLMM and VAST with SST were compared and suggested that the two series in the South and Whole regions have a similar trend; all suggested a decreasing tendency from the beginning of the data series to the lowest level in 2011–2012 and a recovery after that to the recent year. Since (1) VAST has considered the spatiotemporal effect; (2) the series of the VAST-sst and the VAST-sst/size are similar; and (3) the VAST-sst has a more extended time series, the series from the VAST-sst for the Whole region was recommended for the stock assessment, unless the WG considered to use the series of dominant age groups.

Discussion

A WG member inquired about how Sea Surface Temperature (SST) is modeled in the VAST models. The presenter clarified that it is treated as a density covariate, assuming that SST would influence fish density or habitat rather than catchability. Additionally, the SST was formulated with a linear and squared term.

A WG member raised a question regarding the difference in independent variables used in GLMM and VAST models and whether the same results would be obtained from GLMM and VAST when both models use the same independent variables. The presenter conducted additional analyses during the meeting, generally supporting that the two models produced very close abundance indices when the same independent variables were used in GLMM and VAST. In conclusion, the difference of abundance indices between GLMM and VAST models in the working paper was attributed to the consideration of different variables in each analysis.

A WG member raised a question regarding whether the month should be considered as a variable in the VAST model because PBF migrate, with smaller adults appearing on spawning grounds earlier, and this may influence age-based indices. The presenter agreed to conduct the VAST model with size data, incorporating the month as a variable.

In summary, there are six indices available to choose from the TWLL fisheries: an index using GLMM from the south fishing ground (2003-current), an index using GLMM from the whole Taiwan area (North and South fishing grounds, 2003-current), an index using VAST from the south fishing ground (2007-current), an index using VAST from the whole Taiwan area (North and South fishing grounds, 2007-current), an index using VAST including size data (2010-current), and an age-group index using VAST including size data (2010-current). **The WG requested the modeling team to further consider the options for CPUE to be included in the next assessment and present results in the March meeting.**

2.3.2. Standardized Japanese Longline Fishery CPUE

Japanese members indicated that there have been no solutions found for this index which concluded in 2019 fishing year due to interference with the individual quota management.

2.3.3. Japanese Recruitment Monitoring Survey Index

Japanese members indicated that there have been no updates since the March 2023 meeting.

2.3.4. Others

The WG encouraged members to develop new indices, in particular since existing indices face challenges under strict management which could bias fisheries dependent CPUEs.

3. MODELING

Embracing the Latest Version of stock synthesis beyond 3.30.14. H. Lee. (ISC/23/PFWG-2/08)

H. Lee presented the paper ISC/23/PBFWG-2/08. The 2022 stock assessment for Pacific bluefin tuna, which was an update to the 2020 benchmark assessment, used Stock Synthesis SS3.30.14. However, as of November 2023, SS3.30.14 has become significantly outdated, lagging eight iterations behind the latest version, SS3.30.22. The primary objective is to transition to the latest SS version, comparing results among different versions and addressing any discrepancies. Challenges arise from version discrepancies, with the 2022 assessment in later SS versions showing poorer fits to certain data, leading to different estimates for spawning stock biomass. This is primarily related to selectivity estimates, where a narrower parameter bound for F23 resulted in better-aligned likelihood estimates. Jitter analyses assessing convergence toward a global minimum revealed evidence of local minimums for both the original and modified models, with more runs resembling the best-fitting model for the modified version. This work demonstrates a smooth transition to the latest SS version.

Discussion

A WG member asked if the range of the peak selectivity parameter was made narrower only for fleet 23 or also for other fleets. The presenter confirmed that it was only for fleet 23 since when the SS3 version was updated values of the selectivity parameters for the other fleets remained similar to those from the SS3.30.14. The WG discussed the benefit of narrowing the range by increasing the lower boundary also for other longline fleets as most longline fleets have very low lower bounds. It was suggested that narrowing the parameter bounds might be useful as it would shorten the search time and overall run time. A WG member asked if it might be reasonable to also narrow the range of other parameters like R0. The WG agreed that narrowing the range of the selectivity parameters would have the most impact on run time as the assessment model estimates many selectivity parameters. A WG member asked what were the main differences between SS3.30.14 and the newer versions. The presenter clarified that the ADMB version changed from 12 to 13, bugs were removed, and the warning and report files were improved. **The WG agreed in principle to switch to the latest version of SS3 but recommended that the decision be made at the next meeting once the performance of the projection software and PBF MSE framework has been checked with this new version.**

Comprehensive model diagnostics to investigate the cause of a systematic retrospective pattern of SSB in Pacific bluefin tuna stock Synthesis model used for the 2022. H. Fukuda. (ISC/23/PFWG-2/05)

H. Fukuda presented the paper ISC/23/PBFWG-2/05. The productivity assumption in the population dynamics model (recruitment, natural mortality) as well as the input data (size composition data, abundance index) were examined one by one to evaluate if those assumptions or data caused the systematic retrospective pattern shown in the 2022 stock assessment model. The results indicated that the systematic retrospective pattern occurred in the relatively young cohorts of the spawning stock biomass (e.g. ages 3-9), and the recruitment index (S4) contributed primarily to that systematic pattern by providing negatively biased information about the recruitments born in the 2010's. The analysis also showed that the Chinese Taipei longline CPUE based index (S5) as well as some size composition data (i.e. F5 and F23) also emphasized the systematic retrospective patterns in conjunction with the recruitment index. The author showed the results of a candidate model which excluded S4 and S5 indices from the 2022 assessment model, and it did not show the systematic retrospective pattern. The author recommended to the PBFWG to reconsider the choice of the abundance indices for the 2024 stock assessment as well as a method to reduce the residuals for some size composition data.

Discussion

A WG member asked for details on how the time-varying selectivity was handled for the retrospective diagnostic. The presenter explained that in the assessment time-varying selectivity is parametrized in two ways: 1) temporal change by time block and 2) deviations. It was clarified that the time blocks were changed manually for each run, while for the deviations, the parameters were left the same as the base run and only the final year of the assessment was changed. There was also a question on which Mohn's rho calculation was used. It was clarified that the Hurtado-Ferro et al. 2015 Mohn's rho definition based on the average relative difference was used. The WG agreed that the WG should use a consistent, standard calculation of the Mohn's rho, and that the Hurtado-Ferro et al. 2015 definition is the recommended one. A WG member also suggested that, given the life-history of PBF, a 10-year rather than a 5-year retrospective peel should be run as 5 years is not enough time for the recruits to reach the adult phase. The presenter agreed but stated that since biomass was low 6-10 years before the terminal year, the difference between the full model and peeled run model might not be that large for the earlier years. Finally, a WG member inquired if a retrospective run with the full model but down-weighted F5 and F23 fleets was conducted. It was clarified that that option was not run. The WG suggested that it would be informative to look at the relative improvement in the retrospective pattern when only the F5 and F23 were down-weighted.

Following the WG suggestion, H. Lee presented the results of a run of the ASPM-R_{fix} model with a 10 -yr retrospective peel and down-weighted F5 and F23 fleets. The retrospective pattern was still present, but there was a small improvement relative to the model with no downweighing. The fit to the Chinese Taipei and Japanese longline indices data from the full model was also presented. The WG discussed potential sources of the misfit and if it may be worth adding more processes into the model to improve the fit to the size compositions and also the retrospective pattern. It was suggested that the spiky F23 JPLL S1-3 size compositions were due to the influx of new cohorts in accordance with stock recovery as well as changes in fisher behavior. **The WG agreed that it might be useful to investigate further potential avenues to improve the fit to these fleets.**

Is age-0 index unnecessary for the Pacific bluefin tuna assessment? H. Fukuda, K. Fujioka, and Y. Tsukahara. (ISC/23/PFWG-2/06)

H. Fukuda presented the paper ISC/23/PBFWG-2/06. Since a document (ISC23/PBFWG02/06) suggested that the recruitment index based on the Japanese conventional troll CPUE could be one of the major causes of the systematic retrospective pattern in the 2022 PBF assessment, this document tried to highlight the detailed behavior of the population dynamics when the recruitment index was removed/added to the observation model of the PBF Stock Synthesis model. An age structured production model (ASPM) diagnostics as well as retrospective diagnostics were applied to several models, which had a different combination of the recruitment index. The results suggested that the recruitment index based on the Japanese troll CPUE, in particular that after 2010, provided negatively biased information, and exclusion of that data after 2010 could achieve a robust estimation of the recruitment, which eventually led to unbiased SSB. The model which excluded the recruitment index for the whole time series also showed unbiased SSB, but it could not estimate the recruitment in a consistent manner with the base case in the ASPM with recruitment deviation estimation (ASPM-R_{est}). This indicated that the model without the age-0 index relies on the size composition (not the abundance index for adult fish) for the estimation of the recruitment, and it could not estimate that correctly without size composition data. The author recommended excluding the recruitment index during 2011-2016 and to keep that index for the duration of 1983-2010.

Also, the performance of an alternative recruitment index (e.g. Japanese recruitment monitoring survey index) was evaluated through the ASPM-R_{fix} diagnostics, and the model including the Japanese recruitment monitoring survey index showed a slightly better fit to the abundance index of adult fish. However, because of the shortness of the time series (2011-terminal year) of this index, the improvement in the model fit was minor, and the author suggested re-conducting this exercise in the assessment meeting in March for the final consideration to include the recruitment monitoring index in the model or not.

Discussion

A WG member stated that since the analysis only used the JPLL index, which ended in 2019, no abundance information would have been available for 2020, and asked if then it is reasonable to interpret the ASPM-R_{fix} output for the last two years, which show a discrepancy. The presenter clarified that the figure shows 2019 as the final year rather than the 2020 end year of the assessment, so the discrepancy is for 2019 and 2018. The WG also asked for more details on the rationale for removing the 2011 to 2016 data for the recruitment troll index given they were included in the previous assessment. The presenter explained that the decision was based on the presence of the retrospective pattern in recruitment from the 2011-year class onwards presented in the WG paper 05.

The WG also suggested that further analyses should include the TWLL index as that will be the only available adult abundance index for the next assessment. There was discussion of the possibility that cohort targeting and associated selectivity estimation could be causing the observed retrospective pattern instead. It was suggested that the lack of a retrospective pattern for the ASPM-R_{est} model with size composition data for the F1 Japanese longline fleet for which cohort targeting occurs seems to suggest that the misfit may not be due to cohort targeting. It was also clarified that the problematic size compositions are those for F5, the Japanese purse seine fleet which catches large fish, and F23 which is the Japanese longline fleet for Q2-4. A WG member also asked for clarification on the length compositions used for the index of abundance. It was clarified that for the JPLL fleet, fleet F1 was used, for the recruitment index fleet F6, and for the TWLL fleet F12 and that the index uses the same size compositions as the associated fishery.

The WG also discussed the appropriateness of the analyses presented to assess if the recruitment index is providing the right information. The WG suggested that ASPM-R with fixed recruitment deviations coming from the full dynamic model is more appropriate than the ASPM-R with estimated recruitment within the ASPM.

The WG group then discussed the other issues brought up in the presentation, the use or not of the troll recruitment index for 2011-2016 and the assessment of the consistency of the monitoring index with the JPLL index. The WG noted that when data is informative, for the model to not have a retrospective pattern, the data has to be very consistent. There might need to be a balance between keeping more information but some worse fit and some retrospective pattern and having more consistent datasets, but less information. It is necessary to assess if we are excluding data that is informative or excluding data that is providing biased information. **The WG agreed that these issues need careful thought and that a decision will be made at the assessment meeting regarding which indices to include and that the consistency of the recruitment indices also with the TWLL index needs to be evaluated.**

The Setting of Japanese Longline Fleet for Robust Estimation of its Selectivity

S. Asai presented on the setting of Japanese longline fleet for robust estimation of its selectivity. This study focused on improving the parameter estimation of length-composition selectivity in the Japanese longline fishery (Fleet 1). The estimation of selectivity for the length-composition has not been well determined due to the high uncertainty on the parameter estimation of the descending ramp of the dome shape. Some model settings for Fleet 1 were changed to improve parameter estimation and compared with the results of the current model. Estimating the end parameter of the dome shape and cancellation of the time block setting improved the parameter estimation of the descending ramp of the dome shape selectivity. On the other hand, the expected length-composition and shape of selectivity showed little changes, while fitting to size data became slightly worse. The study also evaluated the effects on other fleets and found effects on SSB. In conclusion, the estimation of the end parameter and cancellation of time block settings proved to be effective for optimal parameter estimation, but the effects on fitting of size data and changes in factors such as SSB require careful consideration.

Discussion

A WG member asked for clarification of the dates of the time block that was removed in short time-series model. The presenter clarified that it was from 1993-2019. This was a remnant from the long model starting in 1952 which has size compositions for 1952-1970 and a selectivity block set to 1993-2019 when the newer composition data is available. However, in the short model (start year 1983) there is no available size composition data before 1993 and thus the assumed time block might lead to the model estimating the selectivity of the fishery without data, thus the block was removed. The WG discussed if this estimated shape of the selectivity curve is expected and what might be causing it. It was agreed that the choice of selectivity shape needs careful consideration. **The WG suggestion is to at least cancel the time block, estimate P6 rather than fixing it to a certain value, and at the assessment meeting carefully look at alternative selectivity parametrization for this fleet.**

Selection of an Abundance Index and its Selectivity for the 2024 PBF assessment. H. Fukuda and S. Chang. (ISC/23/PFWG-2/07)

H. Fukuda presented ISC/23/PBFWG-2/07. Although the Chinese Taipei longline (TWLL) CPUE index was the only and important abundance index to inform a trend of large adult PBF population, the document pointed out that the TLL CPUE index currently used possibly caused an instable estimation of the SSB (ISC23/PBFWG02/06). Then, the authors examined the performance in the stock assessment model using ASPM-R_{fix} diagnostics for the alternative indices standardized by spatial-temporal VAST model incorporating size data. The result suggested that the TLL VAST index based on the density of the age 6-8 group as well as that of age 18-20 group showed a high consistency with the current PBF stock assessment model. The authors also conducted a retrospective analysis on the models using those two indices and it suggested that the VAST index for age 6-8 group showed more consistent SSB estimates than that of the VAST index for age 18-20 group. The authors recommended using the TLL index for age 6-8 group standardized by VAST model for the next assessment based on the diagnostics results, with additional examination in March 2024 meeting for the sake of the confirmation of performance in the 2024 assessment model.

Discussion

A WG member asked how size data from the TWLL longline were used in the runs. It was clarified that when the age-based TWLL indices were used, the size data were not used for the survey fleet as age selectivity of the index was fixed and there was no length selectivity. The size data were only used to estimate the length selectivity for the fishing fleet. There was a separate TWLL survey and fishery fleet.

A WG member also noted that catch for some very old ages, such as 18-20 is low, so those indices may be less representative. There was also an inquiry on how ages were determined for the standardization. It was clarified that ages were derived using the growth equation not the age-length key. The WG suggested that the combined index computed from adding the age specific densities could also be tested. The WG discussed the potential causes of conflict between the TWLL age-based indices and other data in the model. It was noted that TWLL indices other than age groups 6-8 or 18-20 seem to conflict with other data. A WG member asked what type of length selectivity was used for the TWLL. It was clarified that the length selectivity was asymptotic. Another WG member asked if the TWLL length frequency data were raised spatially by the catch. It was noted that the TWLL size composition data were raised by the catch, but not spatially and that the JPLL size composition data were also not spatially raised. It was also highlighted that the current analysis is based on the JPLL index and consistency with the current model and so assumes that the current model is the best one. The WG noted that age groups 6-8 and 9-11 make up 85% of the total number of catch in the recent four years, and that therefore it may be important to consider both of those indices in potential models. The age-group indices could be combined into one or both indices could be included as separate fleets. The latter option may be easier to implement as it does not involve the estimation of a survey selectivity for the combined densities.

The WG then discussed the utility of having a model with the TWLL GLMM index. It was noted that it might still be useful to have a model with the GLMM as a base to compare since that's what was included in the last assessment.

The WG group agreed for the assessment team to conduct further analyses assessing the performance of models with alternate TWLL indices and that a decision on which index to use will be made at the March assessment meeting.

Calculating Spawning Potential Ratio in Fishery Groups from a Seasonal Stock. H. Lee and I. Taylor. (ISC/23/PFWG-2/13)

H. Lee presented the paper ISC/23/PBFWG-2/13. The working paper details a methodology for replicating spawning potential ratio (SPR) from the stock assessment and calculating fleet-specific SPRs, emphasizing the intricate processes involved in managing the Pacific Bluefin tuna stock. The findings underscore the reliability and reproducibility of the SPR calculations, affirming the method's effectiveness.

Discussion

A WG member asked for clarification on the numbers by EPO and WCPO in the submitted paper. The presenter clarified that those are the fleet-specific SPRs and that, given SPR is a ratio, those fleet-specific SPRs cannot be added to obtain the overall SPR. One has to either multiply them or take the sum of their logs. The latter could be used to derive a relative SPR by fleet. This methodology may be eventually useful for the MSE, but further work is needed to assess its potential utility in a management strategy.

4. SETTING FOR THE FUTURE PROJECTIONS

K. Nishikawa introduced the projection scenarios requested by the WCPFC NC – IATTC Joint Working Group in July and explained how the Japanese scientists intend to incorporate these scenarios into the projection. The WG noted that some scenarios which require "searching" for a particular harvesting level to achieve the requested probability, i.e. scenarios 4 and 5 by JWG, would use the probability in the final year of projection as the benchmark. As those scenarios will require time to be conducted, the final results may not be available during the March assessment meeting and the WG may need an additional (online) meeting. It was also noted that the comparison of projection results using the current unique program (SSfuturePBF) and the projection function in SS may be presented in the assessment meeting for further discussion for simplification of projection in the future. The list of current projection scenarios is attached as Appendix 4.

5. WORKPLAN TOWARD THE ASSESSMENT MEETING

The following schedule for data submission for stock assessment was confirmed;

Data submission except for CPUE: end of 2023

CPUE: end of January 2024

The WG also confirmed to hold the stock assessment meeting from Feb 29 – March 8, 2024 in Taiwan. SK. Chang informed the WG that the meeting will be held in Kaohsiung. The meeting will not be held as a full-spec online meeting, but the WG agreed to try enabling online participation using available equipment without additional cost.

6. MANAGEMENT STRATEGY EVALUATION

6.1. Review the Progress of Works after March 2023 Meeting

Evaluating the uncertainty grid: Applying diagnotic tools. H. Lee and D. Tommasi. (ISC/23/PFWG-2/12)

H. Lee presented 2023_ISC_PBFWG-2/12. 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, and considering uncertainties in the system. These uncertainties include process uncertainty, parameter uncertainty, model uncertainty, errors in data and observation systems, and implementation uncertainty. 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 the 2022 assessment. Considering all possible combinations of these parameters is impractical. Therefore, a plausible uncertainty grid for productivity parameters was selected based on the following steps. We judiciously determined the range of productivity parameters using available data and life-history information. The 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 provided conflicting grid profiles among data sources, leading to exclusion from the selection process. Consistency in R0 profiles and retrospective analyses further emphasized the need to exclude grids with data conflicts and unfavorable Mohn's ρ values. ASPM-R_{fix} 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

It was suggested that the increase in Mohn's Rho of 0.01 or 0.02 from the "best" model resulting in "fail" in the test may be too restrictive. It was also suggested that the test by retrospective analysis may not be appropriate because they all have a pattern; it's about the same, except for possibly one. It was also discussed if having to pass 3 or 4 diagnostics was too restrictive and would not include enough uncertainty in the OMs. Passing diagnostics is more for assessments than for OMs. It was also requested that the composite trajectory from the ensemble be presented to evaluate the amount of uncertainty included in the OMs.

The authors stated that they were thinking within the stock assessment paradigm when creating the ensemble based on diagnostics and not in terms of the robustness of a MSE. In this sense all the models in the ensemble would be considered to have equal weight. This approach is a balance between uncertainty and plausibility. It was suggested that if a less strict approach is used for including models, then equal weight may not be appropriate.

It was suggested that no data conflict and having a production function are the most important characteristics for a reliable model. Since the index of abundance is the most important data, the R0 profile test should be accepted if the index passes. It was also noted that when there is high data conflict, one approach would be to consider the inclusion of different data sets as different models to consider for the ensemble. It was suggested that dropping data could be part of the robustness tests.

It was noted that the final base-case model in the next stock assessment may not have strong retrospective patterns so the concerns with the retrospective analysis may not be so important.

H. Lee further presented comparisons of SSB and depletion time series with a score of 3 and 4 in the diagnostic evaluation of potential OMs from the grid and densities for Ln(R0) and SSB_Virgin. The WG generally supported the OM selection approach suggested by the author and discussed if it is necessary to repeat the process once the new base-case model is developed at the March meeting. **Given the past stability of the base-case over multiple updates, the WG expected the next assessment model would be consistent with the current one, and in that case, it seems not necessary to repeat the selection process. However, as the retrospective pattern is one of the areas of improvement for the next assessment, retrospective tests may need to be conducted again. The WG will consider further once the assessment model is finalized. The WG was generally happy with the proposed cut-off levels presented in the paper.**

There was a question regarding potentially excluding trajectories that are overlapping, however it was not clear how to measure overlapping and on what trajectories (SSB?, Fraction unfished?). It was suggested to use equal weights and not remove based on actual results, otherwise some potential bias may be introduced by selecting models.

The WG further discussed the development of robustness tests. As the current approach mainly evaluated parameter uncertainties, it was considered that robustness tests should look into other uncertainties, namely process uncertainty, model uncertainty, errors in data and observation systems, and implementation uncertainty. Perhaps recruitment drop or models including or not the recruitment index could be considered to build the robustness set. Some other considerations would be implementation uncertainty. The WG encouraged members to further consider the development of robustness tests.

Further Considerations of the use of SS3 ASPM-R as an Estimation Model in PBF MSE. N. Takahashi, Y. Tsukahara, and H. Fukuda. (ISC/23/PFWG-2/14)

N. Takahashi presented (ISC/23/PBFWG-2/14). This short document was a discussion paper that briefly reported simple comparisons of performance between full Stock Synthesis (SS3) and SS3 ASPM-R_{est} (Age-Structured Production Model with estimated Recruitment deviations) when using these models as the estimation model (EM) in PBF management strategy evaluation (MSE). Based on the previous examination and suggestions from the last PBFWG, the authors further explored to determine what composition data needs to be included and what specifications of ASPM-R_{est} need to be improved. An ASPM-R_{est} specification with fixed selectivities for all fleets except Japanese F1 and Chinese Taipei F12 fleets, and also with log-likelihood functions of size frequency data included only for F1 and F12 (named 'ASPMR_F1F12') was used. The use of ASPMR_F1F12 as the EM was able to reduce computation time by 1/4 as compared to the full model EM. The trajectory of future TAC based on the result from ASPMR_F1F12 was almost the same as those of full SS3, and the TACs appeared to be determined according to the SSB trend. For the explorative purpose of testing candidate management procedures, the use of ASPMR_F1F12 as a tentative EM merits consideration to reduce the computation time.

Discussion

The WG welcomed the development indicating that ASPM-R EM can provide similar results with a full SS EM with substantially shorter run time. It was suggested that the use of the simple EM might depend on the choice of the OM and the HCRs to be tested.

Implementation of New Candidate Harvest Control Rules in the Management Strategy Evaluation for Pacific Bluefin Tuna. D. Tommasi, H. Lee, H. Fukuda. (ISC/23/PFWG-2/09)

D. Tommasi presented ISC/23/PBFWG-2/09. We describe changes made to the Pacific Bluefin tuna (PBF) Management Strategy Evaluation code to allow for testing of the new candidate harvest control rules (HCRs) 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, in simulations with no assessment error and under one base case scenario, all HCRs are able to rebuild biomass and maintain fishing intensity at their specified target levels.

<u>Discussion</u>

It was pointed out that the flat line depicting HCR8 below the limit reference point may result in a misunderstanding of the HCR. A discussion was raised regarding the Y-axis in the HCR plot, which is (1-SPR) for lower fishing intensity to be on the lower side in the graph, while the target values suggested by JWG are just SPR. A participant suggested that the Y-axis be changed to SPR and be inverted for lower fishing intensity to be on the lower side in the graph.

A question was raised about the time-lag between data availability for the estimation model and the actual TAC calculations. In the current MSE framework, TAC was worked using stock status one-year before the TAC determination. However, the data up to two-years before would be available based on the current assessment workload. Therefore, the MSE framework will be modified to use the data for the estimation model up to two-years before.

A participant asked about the future trajectory of SPR, which looked like a 3-year cycle up and down. It was responded that this simulation assumed no estimation error, resulting in a perfect fishing intensity corresponding to the target every 3 years following the assessment time step. In the following 2 years, the SPR varies because of the recruitment variation.

The PBFWG sought clarification on the way TAC was calculated in the current framework. It was clarified that the calculation of F is derived from the apical F and age selectivity estimated in the estimation model. And F is based on quarterly calculations, and hence the seasonal catch is appropriately distributed according to the estimation model. It was also noted that overshooting of TAC never occurs in the current framework unless an implementation error is considered. It is possible to provide TAC at finer scales, such as by fleet.

Impact of 25% limit on quota change in the pacific bluefin tuna management strategy evaluation on quantities of management interest. D. Tommasi and H. Lee. (ISC/23/PFWG-2/10)

D. Tommasi presented ISC/23/PBFWG-2/10. We describe changes made to the Pacific Bluefin tuna (PBF) Management Strategy Evaluation code to implement a constraint on changes in Total Allowable Catch (TAC) between consecutive management periods of no more than 25% as 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 a limit on the change in TAC between management periods leads to a slower build-up of fishing intensity up to the target level, an associated slower increase in catch from the initial, low catch levels, an increase in spawning stock biomass (SSB), and an increase in SSB variability.

<u>Discussions</u>

It was noted that the analysis did not include estimation error and that including estimation error might provide different results. The presenter noted that the result did not reach equilibrium and more years might be needed in the analysis to better show the impact. However, it was also noted that the length of the projection (24 years) was decided after a good amount of discussion with an aim to avoid too long projections and added computation time, so it may not be practical to extend the simulation period for the final MSE runs. **It was recommended that because the catch restriction has a large impact on the results, this work needs to be continued.**

Relationship Between Relative Fishing Mortality Across Fleets and Proportional Fishery Impact for Pacific Bluefin Tuna. D. Tommasi and H. Lee. (ISC/23/PFWG-2/11)

D. Tommasi presented ISC/23/PBFWG-2/11. 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 exploitation pattern across fleets, 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. Here we develop an empirical 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.

Discussion

It was noted that, for stakeholders, it would be important that also the catch distribution among fleets within the same sides of the ocean is “equitable”. Therefore, it was suggested that rather than using an equal percentage added to the relative F, the relative F should be increased by the same proportion. It was also pointed out that because of the 25% limit on TAC change, more years might be needed to get equilibrium results to reach the desired impact ratio but that may not be possible under the current projection period of 24 years.

Other Matters

The WG noted that it is necessary to develop a framework for presenting performance indicators. Recently, several MSEs have been completed for ICCAT species, and they are producing a kind of template to introduce the MSE result. They might be helpful to produce the results on the PBF MSE. It was pointed out that the catch by country may need to be provided by size categories, particularly for the WCPO/EPO split analyses. For finalizing the presentation of performance indicators, the stakeholder input is indispensable and an intersessional meeting would be needed.

7. OTHER MATTERS

CKMR

Y. Tsukahara explained recent progress on the Close-Kin Mark Recapture (CKMR) study in Japan. In 2023, more than 1,000 samples were additionally sequenced by GRAS-Di and the result was analyzed by the same procedure in the previous analysis. This data addition revealed that current filtering is based on the missing rate across markers and samples, and hence some of the samples which could be used for the previous assessment cannot be used for this analysis. The data filtering and kinship identification method are being reviewed and revised to make the CKMR results valid.

<u>Discussion</u>

The WG welcomed the further development of the CKMR work in Japan.

Passing of Yukio Takeuchi

Our esteemed colleague and dear friend, Yukio Takeuchi, passed away on July 21, 2023, at the age of 54. The PBFWG mourns the loss of a dedicated professional who made significant contributions to the WG.

Yukio Takeuchi began his journey with the PBFWG in 2004, bringing with him a wealth of knowledge and invaluable stock assessment skills. His commitment to excellence and passion for his work quickly earned him the respect and admiration of his peers. Yukio's leadership qualities were evident as he assumed the role of PBFWG chair from 2008 to 2013, guiding the group with a steady hand and inspiring those around him.

Throughout his tenure, Yukio's tireless efforts and expertise played a pivotal role in advancing the goals of the PBFWG. His legacy is one of dedication, collaboration, and a relentless pursuit of excellence in the field of tuna stock assessment. Yukio's impact on our organization and the broader international community will be remembered for years to come.

In honoring Yukio Takeuchi's memory, the PBFWG continues to uphold the standards of excellence he set forth and strives to build upon the foundation he helped establish.

8. ADOPTION OF THE REPORT

The meeting report was adopted after review and revision.

9. ADJOURNMENT

The meeting was adjourned at 11 AM on December 1, Japan time.

APPENDIX 1: AGENDA

ISC PBFWG Data Preparatory Meeting
November 2023

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

2 Input Data
- 2.1 Catch Time Series
  - 2.1.1 Retained Catch
  - 2.1.2 Unseen Mortality
- 2.2 Size Composition Data
  - 2.2.1 Japanese Longline (Fleets 1 and 23)
  - 2.2.2 Japanese Small Pelagic Purse Seine (Fleets 2, 18, and 20)
  - 2.2.3 Korean Offshore Large-Scale Purse Seine (Fleet 3)
  - 2.2.4 Japanese Tuna Purse Seine Fisheries in the Sea of Japan (Fleet 4)
  - 2.2.5 Japanese Purse seine off the Pacific coast of Japan (Fleet 5)
  - 2.2.6 Japanese Troll (Fleets 6 and 19)
  - 2.2.7 Japanese Set Net (Season 1-3) (Fleet 8)
  - 2.2.8 Japanese Set Net (Season 4) (Fleet 9)
  - 2.2.9 Japanese Set Net (Hokkaido and Aomori) and Others (Fleet 10)
  - 2.2.10 Taiwanese Longline (Fleets 12 and 17)
  - 2.2.11 Eastern Pacific Ocean Commercial Purse Seine (1952-2001) (Fleet 13)
  - 2.2.12 Eastern Pacific Ocean Commercial Purse Seine (2002-) (Fleet 14)
  - 2.2.13 Eastern Pacific Ocean Sports Fishery (Fleet 15) Abundance index
- 2.3 Abundance Index
  - 2.3.1 Standardized Taiwanese Longline CPUE
  - 2.3.2 Standardized Japanese Longline Fishery CPUE
  - 2.3.3 Japanese Recruitment Monitoring Survey Index
  - 2.3.4 Others

3 Modeling
- 3.1 Follow up Model Setting in the 2022 Stock Assessment (incl. short-term model)
  - 3.1.1 Review of Biological traits and Modeling
  - 3.1.2 Review of Fishery selectivity
  - 3.1.3 Model Diagnostics
- 3.2 Available options for modification

4 Setting for the Future Projections
- 4.1 Description of the Current Software used for the Future Projection
- 4.2 Consideration on the Future Projection Software
- 4.3 Consideration on the Future Projection Scenarios for the 2024 Stock Assessment

5 Workplan toward the assessment meeting

6 Management Strategy Evaluation
- 6.1 Review the discussions at 8th IATTC-WCPFC NC Joint WG meeting
- 6.2 Review the progress of works after March 2023 meeting
- 6.3 Workplan

7 Other Matters

8 Adoption of the Report

9 Adjournment

APPENDIX 2: LIST OF PARTICIPANTS

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APPENDIX 3: LIST OF DOCUMENTS

index	Related Agenda	Title	Author	Contact
ISC/23/PBFWG-2/01	2.1.1	The salvage of forgotten record	Hiromu Fukuda, Ko Kishinami, Kirara Nishikawa and Shuya Nakatsuka	fukuda_hiromu57@fra.go.jp
ISC/23/PBFWG-2/02	2.2.4	Estimation of the length composition for the Japanese tuna purse seine with new data collected at PBF farming operation using stereoscopic camera	Kirara Nishikawa and Hiromu Fukuda	nishikawa_kirara68@fra.go.jp
ISC/23/PBFWG-2/03	2.2.7	Estimation of catch at size of Pacific bluefin tuna caught by Japanese set net fisheries	Kirara Nishikawa and Hiromu Fukuda	nishikawa_kirara68@fra.go.jp
ISC/23/PBFWG-2/04	2.2.10 2.3.1	PBF abundance indices from Taiwanese offshore longline fisheries using delta-GLMM and VAST, incorporating SST and size data	Tzu-Lun Yuan, Shui-Kai Chang and Haikun Xu	skchang@faculty.nsysu.edu.tw
ISC/23/PBFWG-2/05	3.2	Comprehensive model diagnostics to investigate the cause of a systematic retrospective pattern of SSB in Pacific Bluefin tuna Stock Synthesis model used for the 2022	Hiromu Fukuda	fukuda_hiromu57@fra.go.jp
ISC/23/PBFWG-2/06	3.2	Is age-0 index unnecessary for the Pacific Bluefin tuna assessment?	Hiromu Fukuda, Ko Fujioka, Yohei Tsukahara	fukuda_hiromu57@fra.go.jp
ISC/23/PBFWG-2/07	3.2	Selection of an abundance index and its selectivity for the 2024 PBF assessment	Hiromu Fukuda and Shui-Kai Chang	fukuda_hiromu57@fra.go.jp
ISC/23/PBFWG-2/08	3.2	Embracing the Latest Version of Stock Synthesis beyond 3.30.14	Huihua Lee	huihua.lee@noaa.gov
ISC/23/PBFWG-2/09	6.2	Implementation of New Candidate Harvest Control Rules in the Management Strategy Evaluation for Pacific Bluefin Tuna	Desiree Tommasi, Huihua Lee, Hiromu Fukuda	desiree.tommasi@noaa.gov
ISC/23/PBFWG-2/10	6.2	Impact of 25% Limit on Quota Change in the Pacific Bluefin Tuna Management Strategy Evaluation on Quantities of Management Interest	Desiree Tommasi, Huihua Lee	desiree.tommasi@noaa.gov
ISC/23/PBFWG-2/11	6.2	Relationship between Relative Fishing Mortality across Fleets and Proportional Fishery Impact for Pacific Bluefin Tuna	Desiree Tommasi, Huihua Lee	desiree.tommasi@noaa.gov
ISC/23/PBFWG-2/12	6.2	Evaluating the Uncertainty Grid: Applying Diagnostic Tools	Huihua Lee, Desiree Tommasi	huihua.lee@noaa.gov
ISC/23/PBFWG-2/13	3.2	Calculating Spawning Potential Ratio in Fishery Groups from a Seasonal Stock	Huihua Lee, Ian Taylor	huihua.lee@noaa.gov
ISC/23/PBFWG-2/14	6.2	Further Considerations of the Use of SS3 ASPM-R as an Estimation Model in PBF MSE	Norio Takahashi, Yohei Tsukahara, and Hiromu Fukuda	takahashi_norio91@fra.go.jp

APPENDIX 4 LIST OF PROPOSED PROJECTION SCENARIOS FOR 2024 ASSESSMENT

Harvesting scenarios												
Reference No	Scenarios				Catch limit in the projection				Specified fishery impact at 2034		Specified SSB at the last year of projection	Note
	WCPO		EPO		WCPO		EPO		WCPO	EPO		
	Small	Large	Small	Large	Small	Large	Small	Large				
1	Status quo (WCPFC CMM2023-xx, IATTC Resolution 21-05)				4,725	7,609	3,995		-	-		JWG's request 1(NC19 Summary Report, Attachment E; Maintaining the current CMM)
2	Maintaining the current CMM assuming maximum transfer utilizing the conversion factor				3,236	9,799	3,995		-	-		JWG's request 02 (Maximum utilization of transfer from small fish catch limit to large fish catch limit using the conversion factor).
3	No fishing allowed				0	0	0		-	-		JWG's request 03 (No fishing)
4	Status quo +a%	Status quo +a%	Status quo +a%		To be explored	To be explored	To be explored		-	-	20%SSB0 with 60% of probability	JWG's request 04-1 (scenario achieving 20%SSB0 with 60%probability by pro-rata change in catch).
5	Status quo	Status quo +b%	Status quo +b%		4,725	To be explored	To be explored		-	-	20%SSB0 with 60% of probability	JWG's request 04-2 (scenario achieving 20%SSB0 with 60%probability by proportional change in catch among the WCPO large fish catch limit and EPO total catch limit).
6	Status quo +20%	α*(Status quo +a% +(WCPO_small_SQ*(a%-20%)) ton)	α*(Status quo +a%)		5,670	To be explored	To be explored		-	-	20%SSB0 with 60% of probability	JWG's request 04-3 (scenario achieving 20%SSB0 with 60% probability by maintaining the total catch proportion between WCPO and EPO as status quo while limiting the catch limit increase for WCPO small fish as 20% of its original catch limit).
7	Status quo +30%	β*(Status quo +a% +(WCPO_small_SQ*(a%-30%)) ton)	β*(Status quo +a%)		6,143	To be explored	To be explored		-	-	20%SSB0 with 60% of probability	JWG's request 04-4 (scenario achieving 20%SSB0 with 60% probability by maintaining the total catch proportion between WCPO and EPO as status quo while limiting the catch limit increase for WCPO small fish as 30% of its original catch limit).
8	Status quo +e%	Status quo +e%	Status quo +f%		To be explored	To be explored	To be explored		70	30	20%SSB0 with 60% of probability	JWG's request 05-1 (explored constant catch scenario achieving fishery impact ratio between WCPO and EPO as 70% and 30% while maintaining the catch proportion of small and large fish in WCPO as status quo).
9	Status quo +g% (g<e)	Status quo +h% (h>e)	Status quo +f%		To be explored	To be explored	To be explored		70	30	20%SSB0 with 60% of probability	JWG's request 05-2 (explored constant catch scenario achieving fishery impact ratio between WCPO and EPO as 70% and 30% while maintaining the catch proportion of small fish in WCPO lower than that of status quo).
10	Status quo +i% (i<a)	Status quo +j% (j>a)	Status quo +a%		To be explored	To be explored	To be explored		80	20	20%SSB0 with 60% of probability	JWG's request 05-3 (explored constant catch scenario achieving fishery impact ratio between WCPO and EPO as 80% and 20% while maintaining the catch proportion of small fish in WCPO lower than that of status quo).

Once there is confirmation of meeting the second rebuilding target, the ISC shall recommend and provide information on the appropriate recruitment scenario(s) for use in the above projections

Include in the projections results table a metric that calculates the probability of overfishing compared to candidate target reference points.