FINAL

ISC/24/ANNEX/05

ANNEX 05

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 DATA PREPARATORY MEETING OF STOCK ASSESSMENT FOR NORTH PACIFIC SHORTFIN MAKO

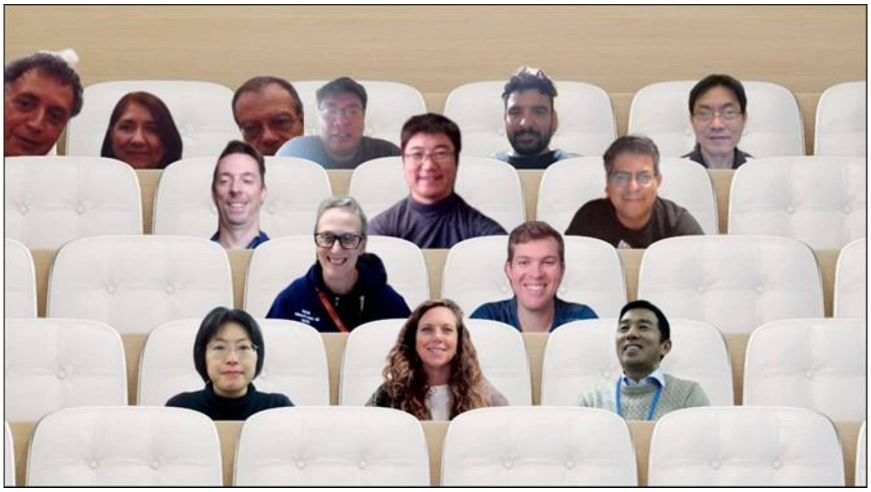
June 2024

ANNEX 05

REPORT OF THE DATA PREPARATORY MEETING OF STOCK ASSESSMENT FOR NORTH PACIFIC SHORTFIN MAKO

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

November 29-30, December 1-2, and 4-7
Hybrid Meeting - Yokohama, Japan with Virtual



1. OPENING AND INTRODUCTION

1.1. Welcome and Introduction

The Shark Working Group (SHARKWG or WG) of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) held an 8-day hybrid meeting in Yokohama, Japan from November 29 to December 7, 2023. The primary goal of the workshop was to prepare for the fishery data as well as biological parameters for the stock assessment of North Pacific (NP) shortfin mako (SMA; *Isurus oxyrinchus*) in 2024. Also, the WG need to discuss the configurations of Stock Synthesis (SS) model based on the conceptual model and to list up data of candidates for the base case model as well as sensitivity analyses. Further, the WG need to determine methods of the model diagnostics and future projections, and to establish future work plans by the pre stock assessment meeting in 2024.

Mikihiko Kai, SHARKWG Chair, opened the meeting at 9:00 am on November 29, 2023 (Japan time). Participants included members from Canada, Chinese Taipei, The Inter-American Tropical Tuna Commission (IATTC), Japan, Mexico, and United States of America (USA) (**APPENDIX 1**). SHARKWG Chair welcomed all participants. He wished for all to enjoy the new place, for a productive meeting and for good work on the data preparation for the stock assessment of NP SMA.

1.2. Distribution of Documents and Numbering of Working Papers

Thirteen working group papers and 7 information papers were distributed and numbered (**APPENDIX 2**). Also, six presentation files (1. Conceptual model, 2. New growth model, 3. US CPUE data, 4. US size data, 5. Genetic population structure, 6. Reproductive cycle discussion) were provided without working paper (WP). All WG papers were approved for posting on the ISC website (http://isc.fra.go.jp/) where they will be available to the public.

1.3. Review and Approval of Agenda

The draft meeting agenda was reviewed, and the agenda was adopted with minor revisions (**APPENDIX 3**).

1.4. Appointment of Rapporteurs

The following participants served as rapporteurs for each item of the approved agenda.

Item	Rapporteurs
1-4.	M. Kai
5.	J.I. Fernández Méndez (Lead), G. Ramírez Soberón
6.	M. Hutchinson (Lead), M. Kinney, D. Ovando
7.	J. King (Lead), Javier, S. Teo, Alberto
8.	S. Teo (Lead), Y, Semba, K.M. Liu
9.	S. Teo (Lead), L.V. González-Ania
10.	K.M. Liu (Lead), D. Ovando
11.	M. Kinney (Lead), M. Kanaiwa
12.	D. Ovando (Lead), M. Hutchinson
13.	J. King (Lead), Y, Semba
14-17.	M. Kai

M. Kai will lead the writing/updating of the meeting report in cooperation with the participants.

2. REPORT OF THE SHARKWG CHAIR

The WG Chair presented the summary of the last stock assessment for NP SMA in 2018 (ISC, 2018). Specifically, the WG Chair explained about the fishery data, biological data and assessment model used in the base case model. The WG Chair also presented the main outputs and results of future projection. Further, the WG Chair presented research needs raised in the previous stock assessment. In addition, the WG Chair presented the summary of recommendation determined in the Western and Central Pacific Fisheries Commission (WCPFC) scientific committee (SC).

This presentation includes basic information about the first full stock assessment of NP SMA conducted in 2018. The WG used Stock Synthesis (SS3, v. 3.24U) model with fishery dependent and independent data for 1975-2016. The WG grouped the catch and sex-specific size composition data into 17 fisheries. In the base case model, the WG used five standardized catch per unit effort (CPUEs): 1) Japan Kinkai shallow longline for 1975-1993; 2) US shallow-set longline for 2005-2016; 3) Taiwanese large-scale longline for 1994-2016; 4) Japanese research and training vessel (JRTV) for 1994-2016, 5) Mexico longline for 2006-2016. The WG used sex-specific growth curve derived from a meta-analysis, constant natural mortality (M = 0.128 per year), and a Beverton-Holt stock recruitment relationship (SRR, steepness = 0.317) in the base case model. Annual catch of SMA by fishery indicated a high uncertainty for the early period (1975-1993) due to no species-specific catch data of sharks for major fleets. Drift gillnets accounted for the highest catches in that period. In the late period (1994-2016), species-specific catch data were available for major fleets and longline catches predominated, due to the ban on driftnets in 1992-93. Annual CPUEs of JRTV and Mexico showed large fluctuations, while those of Taiwanese and U.S. showed increasing trends (more marked for Taiwanese CPUE).

Annual age-0 recruitment did not show a substantial trend with respect to spawner abundance (SA), being proportional to it (SMA shark being a low productivity species). Annual SA showed a decreasing trend until 1990s and then remained stable. Annual fishing intensity (1-SPR) used instead of fishing mortality (F) showed high values in the 1980s. Kobe time series plot indicated that the current stock in 2016 seems to be in a healthy condition (green zone). In the early period during 1981 and 1990, the stock experienced an overexploitation (yellow zone). The WG conducted sensitivity analyses for six different scenarios: 1) Total catch 50% and 20% higher for the early and late periods; 2) Total catch 50% and 20% lower for the early and late periods; 3) A higher uncertainty on CPUEs (CV of Japanese longline in the early period was set at 0.3); 4) Initial conditions estimated without fitting to an initial equilibrium catch (estimated outside the model); 5) Lower steepness (0.260) of the SRR; 6) Higher steepness (0.372) of the SRR. In all those scenarios, the stock statuses were healthy condition (green zone).

For future projections of SA, the WG considered three scenarios for 2017-2026: 1) The same average F as in the 2013-2015 period; 2) The average F as in the 2013-2015 period +20%; 3) The average F as in the 2013-2015 period −20%. The SA was expected to increase gradually if fishing intensity remains constant at, or at a lower level than, the level of the 2013-2015 period. The spawner abundance decreased moderately at the higher level of fishing intensity.

In the assessment report in 2018, the WG pointed out research needs:1) There is substantial uncertainty in the estimated historical catches of SMA shark; 2) Despite the already substantial time and effort spent on estimating historical catch, for the period 1975-1993, these estimations need to be improved. In particular, the WG identified two future critical areas for improvement: 1) Identify all the fisheries that catch SMA in the North Pacific Ocean (NPO), and 2) The methods to estimate SMA catches should be improved, especially for the early period from 1975 to 1993.

SC14 noted the following management advice and implications from the ISC: “Stock projections of biomass and catch of NP SMA from 2017 to 2026 were performed assuming three alternative constant fishing mortality scenarios: 1) status quo, applying the average fishing mortality F as in the 2013-2015 period ($F_{2013-2015}$); 2) average fishing mortality F as in the 2013-2015 period + 20%; and 3) average fishing mortality F as in the 2013-2015 - 20%. Based on these future projections, the following conservation information is provided: 1) If fishing mortality remains constant at $F_{2013-15}$ or is decreased 20%, then the Stock Abundance is expected to increase gradually; 2) If fishing mortality is increased 20% relative to $F_{2013-2015}$, then the SA is expected to decrease in the final years of the projection. It should be noted that, given the uncertainty in fishery data and key biological processes within the model, especially the SRR, the models’ ability to project into the future is highly uncertain”. The same research needs as mentioned above were identified in this recommendation.

Discussion

The WG commented that the combined catch data for large-mesh and high seas squid driftnet fisheries is an issue in the previous assessment and this issue should be discussed in this meeting.

The WG also commented that we should take into consideration a high uncertainty for the fixed proportion of SMA catch to total catch of sharks in the estimates of the CPUE in the early period because the catch of other species such as blue sharks could have a large influence on the proportion of catch for SMA.

The WG pointed out high variability of CPUEs in the late period (since 1994) which is an indication of a relatively high uncertainty, and the WG stressed that this aspect also should be discussed in this meeting.

3. REVIEW CONCEPTUAL MODEL FOR NP SHORTFIN MAKO

2024 ISC Mako Shark Conceptual Model. Nicholas Ducharme-Barth (ISC/23/SHARKWG-1/P1)

This presentation provides a summary of the intersessional online meetings (May & June 2023) to develop a conceptual model for NP SMA. Conceptual models are simplified representations of complex systems and are useful frameworks for helping to organize ideas and guide stock assessment model development. They can also be used to identify knowledge gaps, aide as a communication tool and increase transparency in the decision-making process. The conceptual model for NP SMA was developed by considering the biology (i.e., reproduction, growth, and longevity), ecology (genetic population structure and movement patterns both vertical and horizontal), spatial distribution and fisheries interactions of the species. A draft conceptual model is presented which shows two distinct pupping grounds in the eastern and western NPO, an offshore movement patterns of juveniles and sub-adults, and the potential for large, mature adults to be distributed in the central NPO. The presentation also considered the likely fisheries responsible for SMA shark removals and which fisheries could be candidates to produce a representative index of either juveniles or mature adults. The presentation also identified key uncertainties that should be accounted for in the upcoming assessment: stock structure, biological uncertainty, inability to sample large females, uncertainty in catches, model start period, and choice of a representative index.

Discussion

The WG noted that it is important to consider sample sizes and methodologies when reviewing differences in life history studies – as they may be the largest influential factor and not reflective of structured variation across ocean basins.

The WG discussed how best to use the information gained from the conceptual model during the meeting. It was decided that the WG would review all aspects of the conceptual model on the first day of the meeting and then on following days during specific topic discussions (e.g., growth, reproduction, catch, etc.).

The WG asked what the sex specific natural mortality for females was. The WG answered that it was set to 0.128 per year and was based on the empirical equation with a maximum age of 31 years, which may need to be discussed depending on what maximum age and age at maturity is.

The WG asked if there were any updates to the genetic information for SMA sharks. The WG answered that past 3 studies showed weak evidence of spatial structure globally. There is some evidence of site fidelity to nursery areas, but it is unknown whether these are the mother's natal grounds. The WG noted that there is also evidence to support separate stocks in North and South Pacific Oceans, but further work is needed to resolve whether the NPO is one stock or more stocks. The WG (Japan) mentioned that it is currently working on a project using more advanced genetic techniques to help with issues in the past genetic analysis. The WG also mentioned that it looks like one stock in the NPO based on the preliminary results.

The WG indicated that when we look at the map of size data during the meeting, we should refer to this map to facilitate our discussions. The WG noted that the conceptual model's map and the length frequency analysis's figures should likely go hand in hand when discussing the fleet definitions in later days.

The WG indicated that prior to 2011 there was a Mexican drift gillnet fishery, but it was not used in the previous assessment. Data from this fishery has been shared and it will be worked into the current assessment.

The WG asked what the definition of the shallow- and deep- set for Taiwan fisheries were. The W responded that Taiwan has large-scale (more offshore) and small-scale (coastal) longline fisheries that have different numbers of hooks per basket. The WG noted that the shallow-set longline fishery targets albacore (< 15 hooks per basket) and the deep-set longline fishery targets for bigeye tuna (> 15 hooks per basket). The WG also noted that as such shallow- and deep- set fisheries are separated by target species, small- and large- scale longline fisheries cover different areas spatially (inshore versus offshore). The WG further noted that Chinese Taipei provided a large scale longline CPUE only. The WG mentioned that it might be beneficial to split these fisheries into deep- and shallow- sets as they are likely catching different size SMA sharks. The WG also noted that this will be discussed more details during the presentation of length frequency analysis.

The WG discussed the absence of large adult females in all fishery and survey data. The WG explained that the “Kinkai shallow” longline fishery commonly uses wire leaders and with that gear they can catch large sized SMA sharks, while sharks can bite off and free themselves when they use monofilament. The WG concerned that there is a possibility of spatial overlap of different size classes in the same waters.

The WG also discussed whether high natural mortality of females was possible for it to ramp up enough to account for the lack of adult females in the catch. The WG mentioned that it’s hard to imagine how high natural mortality could happen for the juvenile (pups: more than 60 cm pre-caudal length; PCL) of SMA in the near shore.

The WG discussed an issue of discarding for neonates in the Japanese shallow-set fishery and that this may impact on the selectivity and removals. The WG indicated that the sharp increase of CPUE for juvenile SMAs (<90 cm) in 2014 seen in the spatial-temporal paper published by Kai et. al (2017) was due to an issue of data that a request for the fishermen to keep these sized SMAs that they would normally have discarded. This is an important point for the use of these indices as it’s not a real increase, but a result of changing fishermen’s behavior.

The WG discussed the issue with gathering data from The Republic of Korea. The WG indicated that the Republic of Korea is understaffed, and it will likely not change the situation in the future.

Spatial Analysis of Shortfin Mako Shark Size Compositions in the North Pacific Ocean. Steven L. H. Teo, Felipe Carvalho, Jose Leonardo Castillo-Geniz, Nicholas Ducharme-Barth. Ducharme-Barth, Michael J. Kinney, Kwang-Ming Lui, and Yasuko Semba (ISC/23/SHARKWG-1/6)

In preparation for the next stock assessment of NP SMA in 2024, the ISC SHARKWG is developing a conceptual model of the NP SMA stock and using it to improve the 2024 assessment model. This study follows up on the conceptual model work and used a series of regression tree analyses, using the R package ‘FishFreqTree’, to examine the size compositions used in the 2018 assessment (1981 through 2016), as well as updated data through 2022 for some fisheries. These data were from 10 fisheries: 1) Japan Kinkai Shallow Longline (JPLL_KK); 2) Japan Coastal Longline (JPLL_C); 3) Japan Deep Longline (JPLL_D); 4) US Shallow Longline (USLL_S); 5) US Deep Longline (USLL_D); 6) Mexico Longline North (MXLL_N); 7) Mexico Longline South (MXLL_S); 8) Japan Drift Gill Net (JPDGN); 9) US Drift Gill Net (USDGN), and 10) Taiwan

Large-scale Longline (TWLL). The aim is to identify areas with more consistent size compositions for each fishery and these areas with consistent size compositions could be used as candidate fishery definitions. The analyses were focused on three groups of fisheries in three regions.

Based on the results of this study, we made 9 recommendations to the WG for consideration. We recommended that:

1) the WG perform analyses for each fishery to select the appropriate bin size for each fishery and minimize potential biases from the aliasing.

2) the WG consider using data from the JPLL_D and/or USLL_D fisheries to develop an index for subadult/adult female sharks.

3) the WG examine and understand the source of the JPLL_D data.

4) the USDGN fishery be separated into two fisheries, with one covering the nursery area in the SCB and possibly sharing selectivity with the MXLL_N fishery.

5) the WG consider using fishing area rather than port to separate the MXLL_N and MXLL_S fisheries.

6) the USLL_S be separated into two fisheries, with one north of 30°N and one to the south.

7) the WG consider splitting the JPLL_S and USLL_D fisheries at around 20-25°N.

8) the WG consider separating the JPLL_KK fishery into two fisheries, with one west of 165°E and one to the east.

9) the WG consider separating the TWLL fishery into two fisheries, with one north of 20-25°N and one to the south.

Discussion

The WG mentioned that the data based on PCL were analyzed to see the differences between the length composition by each delegation, and the data of some fleets converted to PCL can lead to aliasing of the size data. The WG also mentioned that care should be taken with the bin size that are selected to perform the analysis (*e.g.*, the 7 cm bin was used for this analysis), in addition to different options for the weighting of length frequency data.

The WG clarified a reason for the high peak around 100 cm PCL for Japan shallow-set longline fishery (Fig. 3 in the WP). The WG responded that Japan had requested fishers to bring more juvenile SMA to port for the sampling of juvenile that commenced in 2014 for the biological study. The WG noted that this is due to artifact which changed the shape of the size composition. The WG also noted that it is very important to document the changes in the operational patterns due to introduction of Japan's management regulations for juvenile SMA since 2016 (Japan, 2017).

The WG mentioned that two of the fisheries in the central and eastern Pacific Ocean (JPLL_D and USLL_D) showed substantially larger average sizes of SMA sharks and substantially larger proportions (18.2 % and 15.6 % for JPLL_D and USLL_D, respectively) of females >200 cm PCL (Table 1 in the WP). The WG mentioned that it is interesting that the samples from these two fisheries mostly come from the central Pacific Ocean (Fig. 1 in the WP).

The WG mainly discussed how best to generate and split the length composition data for the SMA population in the NPO.

The WG discussed Japanese “Kinkai shallow” fishery in figure 3 of WP, and the large number of “spikes” (sudden increases and dips) in the numbers of SMA reported in different size bins. The WG mentioned that these spikes may be problematic as they may reflect issues with the data related to conversion from different measurement types to PCL, rounding strategies by different programs, and the choice of the bin width. The WG noted that the size data is port sampling data where they round to the nearest cm.

The WG suggested to revisit the question of the appropriate bin width to use in the model on a fishery-by-fishery basis to determine a bin width that retains the contrast in the shape of the size composition data but smooths out some of the extreme spikes currently visible in the figures presented in the WP.

The WG noted that it would be good for each fishery to understand the spatial distribution of catch to break up the fishery and re-weight the composition data to be more representative of the actual removals by fishery. The WG also noted that if the samples are not proportional to underlying catch, then size proportional data won’t be reflective of the actual fishery. The WG further noted that the coastal fisheries are not a problem due to small catches, however "Kinkai shallow” had a large amount of catch and is the most important fishery in this dataset.

The WG noted that two fisheries stood out as having larger fish USLL_D and JPLL_D and largest proportion of females > 200 cm PCL. The WG also noted that much of the catch from these fisheries are concentrated around Hawaii, at least the data presented in this WP. The WG raised a question of whether it might be worth exploring an index focused on these larger fish, as the previous index was mostly made up of juveniles and immature fish. The WG commented that potentially added value of having an index more representative of spawning biomass though would need to be weighed against the quality of the data going into that alternative index. The WG noted that development of an alternative index based around the adults would not have to be an “either or”; alternative models could be fit to the prior index, the new proposed index, and both indices at once, conditional on verification of the quality of the new index and resolving of any data conflicts between the two indices.

The WG clarified for the larger fish captured around Hawaii and noted that some of these catches reported in the JPLL_D fleet are dominated by the Japanese training and research vessels. **The WG suggested that those catches should be separated out, particularly to ensure that the size compositions are being matched with the correct removals.**

The WG raised another point is that the Taiwanese longline data are really coming from two different fisheries; one that primarily targets albacore in the “north” and another that targets tropical tuna in the “south”, but they aren’t separated by 25 °N. The WG mentioned that as such, there are likely to be different selectivities for SMA between these two fisheries. The WG noted that changes in the size composition in the Taiwanese longline data may be indicative of shifts in the proportion of the data coming from the north vs. south parts of the fishery over time, not necessarily in changes in the underlying population structure.

The WG noted that at least visually many of the proposed clusters identified by the algorithms were nearly identical, indicating breakpoints that may be detectable to the model but not represent differences with strong biological meaning. The WG concerned that readers might attribute biological meaning (e.g. presence of nursery grounds) to the cluster definitions. The WG pointed out that while some of the proposed clusters might not be different in a biologically meaningful way, they may still help with the convergence of the model and ensuring that removals are properly accounted for in the model. The WG noted that recommendation resulting from this was to shift the language around clustering from a recommendation to guideline, and to explain more clearly the context around the clustering analysis, i.e. to what extent particular clusters were being proposed to resolve model fitting issues versus identifying a plausible "cluster" in the population dynamics of the species (e.g. nursing grounds). Especially since the clustering isn't accounting for seasonality.

The WG agreed that the recommendations in the working paper should be treated as guidelines to define the fleet structure for the assessment.

4. BIOLOGICAL INFORMATION FOR NP SHORTFIN MAKO STOCK ASSESSMENT

4.1. Update of Shortfin Mako Biological Data for the Assessment Including Discussion on Meta-analysis of Growth Curve

NPO Mako Shark Growth Analysis. Nicholas Ducharme-Barth (ISC/23/SHARKWG-1/P2)

This presentation provided an overview of a re-analysis of the meta-analysis (Takahashi et al., 2017). Discussions during the intersessional conceptual model workshops identified two areas where the 2017 meta-analysis could be improved: explicitly accounting for differences in vertebral aging methodology by estimating lab specific age-calibration factors and including a dedicated likelihood for the length-frequency data rather than converting it to age-at-length data using an external growth curve. The presentation laid out the module structure for developing the Bayesian hierarchical model and showed that converting the Bayesian platform of previous analysis from WinBUGS to Stan had minimal impacts to estimated quantities. The presentation showed the estimation of lab-calibration factors from the ISC reference data set which indicated that on average the US aging method detected more band-pairs than the Japanese aging approach (Mexico and Chinese Taipei in the middle). The presentation discussed issues with simultaneously estimating all modules with the Takahashi et al data despite showing that the integrated model worked with simulated data. As a compromise an analysis was developed which took the estimated calibration factors and corrected the age data for Japan, Mexico, Chinese Taipei, and the US before passing it through the Takahashi et al growth model. This analysis considered a sensitivity to the assumption made for the correct aging methodology and hypotheses for the frequency with band-pairs are deposited. Growth parameter estimates were sensitive to these assumptions.

Discussion

The WG noted that fully integrated joint model showed poor convergence. The WG also noted that simulations indicated that current parametrization could work if data are highly informative. The WG mentioned that the model may need to be re-parametrized, and/or priors need to be more informative to work with actual data. The WG also mentioned that the nature of data for old and large sized fish may have small sample size and the mean L-infinity will always be poorly estimated. The WG further mentioned that there is an interest to develop the fully integrated model with a more flexible Richards model which may help fit the data better.

The WG mentioned that the new approach takes β_j estimates and corrects observations outside of the model. The WG discussed whether the length at age 0 ($L0$) should be estimated with a strong prior or fixed to the constat value (60 cm PCL) used in the assessment in 2018. The WG also mentioned that given inherent uncertainties in the growth estimate in relation to alternative assumptions in aging methodology and band-pair deposition, those uncertainties in the growth should be accounted for the assessment model. The WG pointed out that assumed values for M and steepness may need to be revised to reflect this uncertainty in the growth curve.

The WG noted that the assumption of the band pair deposition is influential on the estimation of growth parameters. The WG also noted that there is a variability in the estimated growth curve depending on not only the assumption of deposition rate but also which lab methodology you assume to be the truth.

The WG discussed a hypothesis on different periodicities of growth band formation prior to age 5, specifically that two bands per year form in SMA from the eastern region and one band per year forms in the western region. The WG noted that given the difference in environmental conditions between eastern and western NP, there could be a biological justification for differences. The WG raised a concern that there is still limited understanding of the two band pairs periodicity pattern in the east, and why there is a shift to one pair of bands after 5 years. The WG responded that the eastern ageing methodology has been validated with oxytetracycline (OTC) and the western ageing methodology has been verified with edge analysis, which also supports the hypothesis that there are differences in growth up to age 5. The WG also mentioned that other studies have illustrated that different periodicity patterns might exist for different populations of a species. **The WG agreed to split the ISC reference data into vertebrae from the east and from the west, and to look at the differences in ages from the two different ageing methodologies to see if the validated ageing method consistently detects more bands in western caught sharks than the verified ageing method.** However, the lab calibration data does show that if the eastern age methodology is applied to eastern and western caught fish, then more bands are detected suggesting that differences in observed growth prior to age 5 is an artifact of methodology and not biology.

The WG noted that the detection of visible bands is also dependent on where in the vertebral column of the vertebrae are collected, so perhaps sampling differences add to the differences in ages produced by labs. The WG also noted that when the lab calibration factors are grouped separately for lab ages by source of vertebrae, the US lab calibration factor is always higher than other labs for samples from Japan, Chinese Taipei, or US, while the Japan lab calibration factor is always lower. The WG pointed out that this consistency across origin of samples suggests that differences in estimated periodicity in juveniles reflects a methodological reason rather than a biological reason. The WG mentioned that since the growth curve estimation is not yet completed, a decision on growth curve parameters won't be provided until then. The WG also mentioned that the WP will be completed and presented at the January 2024 web-meeting, which will also include review and summary of all previous age and growth workshops.

4.2. Review of Shortfin Mako Biological Data for the Assessment

The WG described the rationale of each biological parameter used in the 2018 assessment, and the WG discussed if any improvements could be made available for the 2024 assessment.

Discussion

The following table contains the summary of the biological parameters, references, main discussion points, and decisions made for each parameter.

Table 1. Summary of biological parameters used in the previous stock assessment in 2018 (ISC, 2018).

Parameter	Value	Reference	Discussion	Decision
Natural mortality	0.128 y^{-1}	Hoenig 1983	Thought to be uncertain. Previously estimated from the empirical relationship (Hoenig, 1983) with maximum age of 31 years based on bomb radiocarbon analyses (Ardizzone et al., 2006). Some more recent work that questions maximum ageing from bomb radiocarbon that suggests these can be underestimates (Natanson et al., 2018), so it is possible that SMA live longer than 31 years. Age and growth studies for SMA have several estimates of maximum ages that are greater than 31 (38 y for Natanson et al., 2006).	At the upcoming January 2024 web meeting, additional plausible empirical relationships and parameter values for these relationships will be discussed and considered if they should be investigated within the stock assessment model. The US suggested that they will try to develop a WP on this for the January 2024 web meeting using a meta-analytical approach for a variety of empirical relationships.
Max age	31 y	Ardizzone et al. (2006)	See above discussion for natural mortality. Thought to be uncertain.	**The WG agreed to consider other values together with the re-examination of natural mortality.**
Growth	Male (L_∞: 232 cm PCL, k: 0.174 y^{-1}), Female (L_∞: 293.1 cm PCL, k: 0.128 y^{-1})	Takahashi et al. (2017)	There was substantial discussion on this topic (see Section 7.1). However, the WG noted that an updated approach was still being developed and the WG expects a WP to be presented at the January web meeting.	**The WG agreed that a new approach could be investigated if completed prior to the Jan 2024 web meeting. Otherwise, the old growth model will be carried forward.**
Length-weight	Male (a: 4.62×10^{-5}, b: 2.77), Female (a: 3.40×10^{-5}, b: 2.84)	Su et al. (2017)	The WG concluded that the equation used previously appeared to be robust.	**The WG agreed to use the same parameters.**
Length at maturity (L50 and slope)	Male: 166 cm PCL (a:-25.06, b:0.0137),	Semba et al. (2017)	The WG noted that the relationship did not include estimated uncertainty in the relationship (e.g.,	**The WG suggested that modeling should consider the variability around estimates**

	Females: 233 cm PCL(a: -34.23, b: 0.146)		female L50 of 233 cm PCL; CI: 231-238). The WG also noted that this uncertainty was relatively small and not likely to be highly influential.	**whenever possible.**
Steepness	0.317: Beverton Holt	Kai (2018)	The WG noted that the steepness for the 2018 assessment was based on an analysis using several biological parameters being re-examined for the January web meeting. **The WG agreed that the steepness parameter should be consistent with the biological parameters used for the model or model ensemble.**	**The WG agreed to wait until the above biological parameters were agreed upon at the January 2024 web meeting before re-examining the steepness parameter.**
Fecundity	12 pups per litter	Mollet et al. (2000)	The WG examined and discussed three studies on the fecundity-body size relationships. **The WG agreed that all three studies had relatively small data size and were uncertain.**	**The WG agreed that 3 relationships are plausible: 1. constant (12 pups per litter),2. linear function of size (Semba et al 2011),3. power function of size (Mollet et al 2000), but uncertain.**
Reproductive cycle	Once every 2 years	Semba et al. (2011)	Semba et al. (2011) proposed a gestation period of about 1 year, which supports a biennial reproductive cycle. Joung and Hsu (2005) have estimated a gestation period of about 2 years, which supports a triennial reproductive cycle; Sample size in both study is small and there is uncertainty.	**The WG agreed that evidence suggests either a 2- or 3- years reproductive cycle but could not yet agree on whether one was more plausible. The WG agreed to reconsider this again at the January 2024 meeting.**

Past Discussion on Reproductive Cycle of Shortfin Mako (Isurus oxyrinchus) in the North Pacific. Yasuko Semba (ISC/23/SHARKWG-1/P6)

This presentation provided a summarized knowledge on the reproductive cycle of SMA from several studies. First, reproductive system of this species was reviewed, and general reproductive cycle of shark species was explained based on the review by Castro (2009). Regarding the estimates of gestation period by Mollet et al. (2000), Semba et al. (2011) and Joung and Hsu (2005), difference in the approach for the estimation was discussed and author suggested that approach with fitting nonlinear growth model for length at month of embryo (Semba et al. 2011: estimated gestation period of 9.3-12.9) would be better approach, considering the empirical knowledge that embryonic growth was asymptotic. Regarding the resting period, one-year resting period is suggested for biennual cycle with one-year gestation in the review of shark reproduction. Based on this discussion, the author noted that two-year reproductive cycle was more plausible for this population, and it was agreed as the base case model in the last stock assessment for NP SMA in 2018. As no new information to support another hypothesis is available on this topic, the author proposed the continuation of past assumption.

Discussion

See the **Table 1** of section 7.1 above.

The WG commented that there was a lot of uncertainty in the biology, for example, a 3-year reproductive cycle was used in the stock assessment for North Atlantic SMA (Table 9: ICCAT, 2018). Given this and the general uncertainty about some of the key data aspects of the SMA assessment, the WG indicated its preference to further explore an ensemble approach.

5. REVIEW CPUE INDICES FOR NORTH PACIFIC SHORTFIN MAKO STOCK ASSESSMENT

Revisit of Data Filtering for CPUE of Shortfin Mako, Isurus oxyrinchus, Caught by Japanese Shallow-Set Longliner in the North Pacific. Mikihiko Kai. (ISC/23/SHARKWG-1/1)

This WP provides a revisit of data filtering method used in the estimation of catch per unit of effort (CPUE) of SMA caught by Japanese shallow-set longliner in the western and central NP. In the previous data analysis in 2017, two-step data filtering methods were applied to remove the data of mis/under reporting or discarding and to choose reliable vessels using the data in 2000s. Filtering (I) was conducted based on Akaike Information Criterion (AIC) estimated from CPUE standardization, in comparison between longline research vessel and commercial vessel. Filtering (II) was conducted based on visual observations of the positive catch of SMA for each vessel. These two-step filtering methods are however complicated, doubtful verification ability and subjective. The author therefore suggests a simpler data filtering method without using the visual observations of data and the comparison of data between longline research vessel and commercial vessel for the limited area and period.

Discussion

The WG enquired about the amount of data that is removed by the new ‘simple’ filtering method. The WG responded that around 90% of the data in terms of effort is removed but that is variable (Table 1 in the WP). The WG also noted that the nominal CPUE (Fig. 1 in the WP) appeared to be abnormally low for SMA and blue sharks and does not correspond to the CPUE in Table 1 of the WP. The WG responded that the nominal CPUE in the figures were rescaled by mean value and were based on relative units to allow easy comparison of the effects of the filtering. The WG questioned about the target species of "Kinkai shallow" fishery and it was responded that both blue shark and swordfish are the target species for this fishery. The WG asked about the cause of large fluctuations in recent years, and it was responded that the decrease of fishing vessel might have caused this trend. **The WG agreed that 'simple' data filtering method would be appropriate for this dataset.**

Spatio-Temporal Model for CPUE Standardization: Application to Shortfin Mako Caught by Japanese Offshore and Distant Water Shallow-Set Longliner in the Western and Central North Pacific. Mikihiko Kai. (ISC/23/SHARKWG-1/2)

This WP provides a standardized CPUE of SMA, *Isurus oxyrinchus*, caught by Japanese offshore and distant-water shallow-set longline fishery from 1994 to 2022 in the western and central NPO. Since the catch data of sharks caught by commercial tuna longline fishery is usually underreported due to discard of sharks, the author filtered the logbook data using the simple filtering methods applied to the blue shark in the previous analysis. The nominal CPUE of filtered shallow-set data was then standardized using the spatio-temporal generalized linear mixed model (GLMM) to provide the annual changes in the abundance of SMA in the northwestern Pacific. The author focused on seasonal and interannual variations of the density in the model to account for spatially and seasonally changes in the fishing location due to the target changes between blue shark and swordfish. The estimated annual changes in the CPUE of SMA revealed an upward trend from 1994 to 2014, and then downward trend until 2020. Thereafter the CPUE slightly increased in recent years. The estimated CPUE trends from the spatio-temporal model with a large amount of data collected in the most abundant waters in the western and central NP is a very useful information about the abundance of NP SMA.

Discussion

The WG asked about the definition of station, and it was responded that a 'station' is the location of a knot in the model mesh and 100 knots were used in this study. The WG also enquired about the number of parameters of each candidate model, and it was responded that the parameters for the 'best' model were listed in Table 2 of WP. **The WG suggested that it was important to show the information in Table 2 of WP for all the candidate models.**

The WG questioned the three-fold increase of standardized CUPE in 20 years is plausible and it was suggested that it may be plausible if the abundance reflects juvenile abundance, and the plausibility might be checked by approach such as simple age-structured model simulations. The WG also suggested to use different CPUE representing juvenile and adult SMA and enquired the possibility that current index includes several different life stages and there are mixed.

The WG made several requests to the author to better understand the results: 1) plots of the annual trend by station with a color scale based on latitude and longitude; 2) map plots of the average observed CPUE by year and quarter; 3) map plots of the average residuals by year and quarter; and 4) plots of the average size by year.

The WG noted that M3 would be the 'best' model based on BIC while the M5 model would be the 'best' model based on AIC. **The WG mentioned that although the author recommended using BIC and hence M3 as the 'best' model, the WG agreed that the M3 and M5 models had different trends in the terminal 10 years of the data and to bring both indices as candidates**

for further evaluation. The WG therefore recommended further evaluation of these indices with the assessment model during the pre-assessment workshop, with the indices from the M3 and M5 models as candidates.

Spatio-Temporal Model for CPUE Standardization: Application to Shortfin Mako Caught by Longline of Japanese Research and Training Vessels in the Western and Central North Pacific. Mikihiko Kai. (ISC/23/SHARKWG-1/3)

This document paper provides annual changes in standardized catch per unit of effort (CPUE: catch number per 1,000 number of hooks) for SMA caught by longline fishery of Japanese training and research vessels during 1994 and 2022 in the western and central NP. Since the reporting rates of sharks during 2001 and 2013 are clearly lower than those before 2000, the author removed the data with lower reporting rates using a statistical filtering method based on the prediction of the binomial generalized linear model (GLM). The nominal CPUE was then standardized using spatio-temporal generalized linear mixed models (GLMMs) to provide the annual changes in the abundance indices in the NPO. The estimated abundance indices of SMA revealed a flat trend from 1994 to 2005, and then showed two times up- and down- trends for 2009-2013, 2013-2017 and was stable thereafter. The CPUE trends estimated from the fishery-independent data widely collected in the NPO is a very useful information about the abundance in this region.

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

The WG noted that JRTV data is available prior to 1994 and asked if it was possible to start the index before 1994. The WG responded that it is true that JRTV logbook data is available from 1992, however it is concerned about the substantial misreporting and lower data coverage in these early data due to soon after the introduction of new data format of the logbook and would be less reliable than 1994 and after.

The WG asked whether this study used the same number of knots (100) as used in the "Kinkai shallow" fishery and it was responded that the number of knots used for JRTV was 400. The WG pointed out the importance to consider the environmental effect in the large area, though it was not considered in the model.

The WG made several requests to the author to better understand the results: 1) plots of the annual trend by station with a color scale based on latitude and longitude; 2) map plots of the average observed CPUE by year and quarter; 3) map plots of the average residuals by year and quarter; and 4) plots of the average size by year.

The WG enquired about the spatial coverage of the fishery for this index. The WG responded that this question will be answered in the next presentation for the comparisons of Japan CPUEs (ISC/23/SHARKWG-1/7) and the spatial coverage of JRTV becomes smaller and fishing effort in the core area of subadult females is decreasing in recent years. The WG suggested to compare the CPUE trends of US deep-set fishery and JRTV and consider the possibility of merging these two indices. After reviewing the presentation (ISC/23/SHARKWG-1/7), the WG noted that an index from the JRTV would be most useful around the water in Hawaii, where the biggest SMA appeared to be. **The WG therefore requested the authors to provide an index for the core area around Hawaii (20-35N 180-215 E).**

The WG requested to show the annual CPUE for M8 to the WG because the index from the M8 model was not shown in the figure of WP.

Representativeness of Two Japanese Longline CPUEs as Abundance Index of North Pacific Shortfin Mako. Mikihiko Kai. (ISC/23/SHARKWG-1/7)

Japan provided two standardized CPUEs for the stock assessment of SMA in 2024. One is the CPUE of SMA caught by Japanese offshore and distant water commercial longline fishery ("Kinkai Shallow") and the other is those caught by Japanese research and training vessel (JRTVs). The fishery -dependent and -independent data showed inconsistent annual trends. Those two CPUEs were compared from the multiple perspective to discuss the representativeness of the CPUEs as an abundance index of the NP SMA. Both CPUEs may be representative of the abundance indices because of the wide area coverages, wide coverage of the size classes, and statistical soundness of the spatiotemporal model. However, the JRTV CPUE has weak points such as lower catch and effort data coverage and higher variability of the predicted CPUEs compared to the "Kinkai Shallow" CPUE. In addition, "Kinkai Shallow" CPUE indicated the plausible annual increasing trends compared to those in the previous analysis in 2017. The author therefore recommends using the "Kinkai Shallow" CPUE as the abundance index of the NP SMA. Further discussion is necessary to determine the representative abundance indices of SMA during the upcoming data prep. meeting from the other factors such as a consistency of annual trends with the other CPUEs.

Discussion

The WG noted that there was consistent sampling for the JRTV index primarily around Hawaii. The WG noted that there was an area of high CPUE around the northeast area, but that area appeared to be inconsistently sampled. **Therefore, the WG requested that the author recalculate the JRTV index based on the core area (10-20N & 175-205E).** Two ways were suggested: 1) use the same model and observations from M7 and predict for the core area; and 2) rerun the M7 model with only observations from the core area and predict the annual CPUE in the core area. **The WG also requested the annual average size of SMA caught by JRTV for the core area (10-20N & 175-205E) and another area (20-35N & 180-215E).**

The WG also requested that the author to compare the spatial coverage in terms of stations covered over time relative to the entire distribution of the fishery, between the JRTV and "Kinkai shallow" fisheries.

Updated Standardized CPUE and Historical Catch Estimate of the Shortfin Mako Shark Caught by Taiwanese Large-Scale Tuna Longline Fishery in the North Pacific Ocean. Kwang-Ming Liu, Kuan-Yu Su, Chieng-Pang Chin, and Wen-Pei Tsai (ISC/23/SHARKWG-1/12)

In this study, we analyzed catch and effort data of SMA sharks from the logbook records of Taiwanese large-scale tuna longline fishing vessels operating in the NPO from 2005 to 2022. Due to a significant percentage of zero SMA shark catch, we standardized the catch per unit effort (CPUE) using a zero-inflated negative binomial model, presenting the number of fish caught per 1,000 hooks. Both nominal and standardized CPUE of SMA sharks exhibited inter-annual fluctuations with two peaks in 2014 and 2020. The estimated SMA shark catch in weight from the Taiwanese large-scale tuna longline fishery ranged from 0 metric tons (MT) in 1973 to 156 MT in 2015, decreasing thereafter, increasing to 183 MT in 2020, and subsequently decreasing in 2021 and 2022.

Discussion

The WG enquired how this index was used in the 2018 assessment. The WG responded that this index was fitted in the 2018 index and the nominal index was used to estimate the annual catch of the fishery. The WG mentioned that the method of back calculating historical catch in this work can be applied to other country.

The WG noted that "Area A" (north of 25°N) had most of the catches but was assumed to have the same catchability over the entire area while the southern area (south of 25°N) was split into three areas ("Area B, C, and D"). **The WG requested the authors to rerun the model using only data from "Area A" (North of 25N), with three area blocks: <175°E, 175-200°E and 200-225°E. The WG also requested that the authors should try to use a year and area interaction if possible.**

The WG noted that the Taiwanese large-scale longline fishery is known to be composed of two main components, with one targeting albacore tuna mostly in temperate waters north of 25°N and one targeting tropical tunas in tropical waters south of 25°N. The WG also noted that these two components are also thought to fish at different depths. The WG mentioned that it is reasonable to separate this fishery into two components. Following the approach applied to the ISC albacore working group (ALBWG), **the WG recommended that the Taiwanese large-scale longline fishery be separated into two areas by 25°N.**

CPUE of US. Nicholas Ducharme-Barth (ISC/23/SHARKWG-P/3)

The WG provided a presentation for a preliminary look at the plan to provide standardized CPUE for the US Hawaii longline deep- and shallow- set sectors using observer data. The deep-set sector primarily targets tropical tunas (bigeye) by deep-setting (>12-15 HBF) during the daytime and has ~20% observer coverage. The shallow-set longline primarily targets swordfish through shallow-setting at night and has 100% observer coverage. The deep-set predominantly used wire leaders though there was a voluntary switch to monofilament leaders beginning in 2021 before a permanent ban on wire leaders in 2023. A spatiotemporal analysis is proposed to develop indices of abundance for these sectors as the conceptual model indicates that their fishing grounds may overlap with a hypothesized SMA shark mating ground in the central NPO.

Discussion

The WG noted that the annual CPUE from the US deep-set longline is an index for sub-adult fish and would likely be important for the upcoming assessment. **The WG therefore requested that the author develop a standardized CPUE for the USLL deep-set fishery and provide a WP for the web meeting finalizing updated data for the 2024 assessment**.

The WG requested that the authors will show the average size through time, spatial coverage, and CPUE of core area around Hawaii over time like the request for the Japanese JRTV index**.**

The WG also noted that another potentially useful had already been from a survey of juvenile sharks in the Southern California Bight (Runcie et al., 2016). **The WG therefore requested that the US scientists submit that index to the data manager as a candidate of indices in the 2024 assessment.**

Update on Standardized Catch Rates for Mako Shark (Isurus oxyrinchus) in the 2006-2022 Mexican Pacific Longline Fishery Based upon a Shark Scientific Observer Program. José Ignacio Fernández-Méndez, Luis Vicente González-Ania, Georgina Ramírez-Soberón, José Leonardo Castillo-Géniz, and Horacio Haro- Ávalos (ISC/23/SHARKWG-1/11)

Abundance indices for SMA shark (*Isurus oxyrinchus*) in the northwest Mexican Pacific for the period 2006-2022 were estimated using data obtained through a pelagic longline observer program, updating similar analyses made in 2014 and 2021. Individual longline set catch per unit effort data, collected by scientific observers, were analyzed to assess effects of environmental factors such as sea surface temperature (SST), distance from land coast, including islands and time-area factors, year, area fished, quarter and fraction of night hours in the fishing set. Standardized catch rates were estimated by applying hurdle (delta) models. The first part of the model estimates the probability of a positive observation using a binomial likelihood, and a logit link function. The second part of the model (the "count" or "positive" model) estimates the mean response for those non-zero observations, assuming a negative binomial distribution with a log link function. The importance of factors included in the models is discussed. The results of this analysis point at the abundance index trends being close to stability in most of the analyzed period, with a low value in the last year of the series.

Discussion

The WG asked if the environmental factors in the model, like SST, is primarily impacting catchability, which is the aim of the standardization, or is the SST affecting population dynamic processes like recruitment or survival of pups instead, which may not be appropriate for a standardization model. The WG responded that it appears that during higher SST periods, SMA appeared to move further north and potentially out of the range of the fishing fleet. The WG also mentioned that it is currently unclear if changes in SSTs are affecting the population processes like recruitment.

The WG suggested that spatiotemporal models would likely help improve the CPUE standardization. The WG agreed with the suggestion but added that they do not currently have expertise with spatiotemporal models yet.

The WG asked whether this CPUE index should be included in the stock assessment in 2024 and the WG suggested to investigate this index for the stock assessment.

The WG concerned with the likely switch in targeting away from sharks towards swordfish around 2016 and thus potential change of catchability and selectivity. The WG asked if there could be any factors that could be included in the model to account for changes in targeting. The WG responded that, in the present model, the presence/absence of swordfish in the catch of the fishing set was used as a predictor, as a proxy for the characteristics of the fishing set that result in increasing swordfish catch (like the use of light-sticks changes in the depth of the fishing set on which no data are available at present). The WG noted that although the presence of swordfish in the catch is negatively associated with SMA CPUE, the standardization failed in "filtering" the effect of the target species shifting, resulting in a low CPUE value at the end of the series. The WG also noted that one suggestion is to end the index in 2016, which is the year in which targeting appeared to have started switching away from sharks. The WG concerned that doing so would eliminate this index from the end of the time series. The WG advised that another option is to set coefficient of variation (CV) of this index large.

The WG noted that the operation area of the North fleet overlaps the nursery area for the SMA. **The WG requested the authors calculate an index for the north fleet, although recent data of north (Ensenada) fleet is limited.**

6. REVIEW CATCH DATA, DISCARD DATA AND TOTAL CATCH ESTIMATION PROCEDURES FOR NORTH PACIFIC SHORTFIN MAKO STOCK ASSESSMENT

Updated Annual Catches of Shortfin Mako Caught by Japanese Coastal Fisheries in the North Pacific Ocean from 1994 to 2022. Mikihiko Kai (ISC/23/SHARKWG-1/4)

This WP provides update of Japanese annual catch of SMA, *Isurus oxyrinchus*, caught by Japanese coastal fisheries in the NPO for 1994-2022. We used the same estimation methods as those used in the previous analysis in 2017. Since the species-specific shark's data was not included in Japanese official coastal landing data, the catch amounts of SMA caught by multiple coastal fisheries were estimated using several available species-specific data. The proportion of estimated total catch of SMA for both longline fisheries and large-mesh driftnet fishery accounted for more than 89 % of annual total catch amounts except the catches in 2005 (83%) and 2022 (76%). The annual total catch of SMA largely fluctuated between 151 and 638 *t* throughout the period. After 2016, it had continuously decreased until 2022 due to the reduction of catch for large mesh driftnet fishery. The annual trends of catch amounts of SMA for 1994-2016 were almost similar between previous and updated estimates.

Discussion

The WG agreed to combine these fleet into three groups (1. coastal and offshore longline, 2. large mesh driftnet fishery, and 3. trap net and miscellaneous fishery). The WG discussed to check the different operational waters (East China Sea and Pacific of northeast Japan) of driftnet fisheries in Japan. The WG encouraged to investigate the proportion between the catch between them.

Update of Annual Catches for Shortfin Mako Caught by Japanese Offshore and Distant Water Longliner in the North Pacific Ocean from 1994 to 2022. Mikihiko Kai and Toshikazu Yano (ISC/23/SHARKWG-1/5)

This WP provides update of Japanese annual catches of SMA, *Isurus oxyrinchus*, caught by Japanese offshore and distant-water longline fishery in the NPO for 1994-2022. Since the landings of sharks is frequently underestimated due to the lower market value than any other teleost species such as tunas and billfishes, total annual catches of SMA including retained, discard and released catches were estimated using a product of standardized annual CPUEs and the total annual fishing effort (the number of hooks) for 1994-2022. The calculation was separated by the shallow-set and deep-set longline fisheries. The annual catch number for shallow-set longline fishery was estimated using the season-year specific CPUEs for Japanese offshore and distant water shallow-set longline fishery with the fishing efforts of the shallow-set fishery, while those for deep-set longline fishery was estimated using the annual CPUEs for Japanese research and training vessels with the fishing efforts of the deep-set fishery. Further, the annual catch number was converted to annual catch weight using an average weight of SMA by area and season. The results showed that the annual catch was stable between 1200 *t* and 1700 *t* until 2017, and then it had gradually decreased and reached around 500 *t* in recent years due to the continuous reduction of fishing effort, especially for the deep-set fishery.

Discussion

The WG requested to estimate the discarded catch using the observer data because small sized SMA is low value and having a high possibility to be discarded without recording. The WG agreed to use the catch in number for SS.

Reconsideration of Catch of Shortfin Mako (Isurus oxyrinchus) Caught by Japanese Large-Mesh Driftnet Fishery Between 1975 and 1993 in the North Pacific. Yasuko Semba, and Mikihiko Kai (ISC/23/SHARKWG-1/8)

The catch of SMA (*Isurus oxyrinchus*) caught by large-mesh driftnet fishery in the NP between 1977 and 1993 at high seas was revisited due to high uncertainty in the previous estimate and recent update for the catch of blue shark by this fishery. Considering the possible underreporting of sharks and lack of species-specific reporting system of this species in the logbook data of large-mesh driftnet fishery, estimation using species compositions (three values) derived from observer data (1990-1991) on this fishery (approach 1) and survey data for pomfret (1978-1984) with similar gear modification and operation area with commercial vessel (approach 2), and a mixture of the species composition derived from approaches 1 and 2 (approach 3) were applied to the landing statistics of "sharks" in Japanese statistical yearbook. The estimated catch derived from approach 3 was chosen by considering the annual variability of the species composition and ranged from 81.5 to 606.5 ton. These estimates were smaller than those used in the previous stock assessment for this population in 2018, but the previous catch estimate of this fishery was likely to be overestimate, considering that the ratio between SMA catch per blue shark catch was unreasonably higher than that derived from observer and survey data. Although work for further improvement needs to be continued, we propose to use the estimated catch in this WP for the upcoming stock assessment of SMA in the NP in 2024.

Discussion

The WG suggested to estimate the catch ratio of SMA to blue shark (or SMA to total shark catch) using spatiotemporal model with combined observer and survey data. The WG also suggested to estimate the catch of SMA caught by Taiwanese large-mesh driftnet fishery in the early period before 1993 using the catch ratio of SMA shark to albacore from Japan and applying it to Taiwanese albacore catch. The WG clarified the starting year of Taiwanese large-mesh driftnet fishery in the NPO, and it was responded that the starting year for the fishery was unknown.

Estimate of Catch of Shortfin Mako Caught by Japanese Squid Driftnet Fishery Between 1981 and 1992 in the North Pacific. Yasuko Semba, Minoru Kanaiwa, and Mikihiko Kai (ISC/23/SHARKWG-1/9)

The catch of SMA (*Isurus oxyrinchus*) caught by Japanese squid driftnet fishery in the NP between 1981 and 1992 at high seas was estimated, following the methodology used for blue shark in 2021 (Fujinami et al., 2021). Catch of sharks in the logbook data was species aggregated ("sharks") and the zero-catch rate of sharks was high, so that the annual catch of SMA was estimated from the standardized CPUE of observer data and logbook data. The annual catch (in number) ranged from 55 (1981) to 1,768 (1988), corresponding to 2.1 in 1981 to 67.6 ton in 1988. The estimated catch of squid driftnet fishery was much smaller than that of large-mesh driftnet fishery. This may be partly because lower overlap between fishing area of this fishery and core distribution area of SMA shark than that of large-mesh driftnet fishery. In general, catch by "Japanese driftnet fishery" fleet, combining updated catch of large-mesh driftnet (*ISC/23/SHARKWG-1/8*) and current estimate, was much lower than catch of F12 in previous assessment in 2018. Although further improvement is necessary to be continued, this indicates the impact of driftnet fishery before 1993 might be lower than assumed previously.

Discussion

The WG suggested to estimate the catch of SMA caught by high seas driftnet fisheries of The Republic of Korea and Chinese Taipei using the catch rates of blue sharks of three countries including those two countries and Japan (see Table 1; ISC, 2022). **The WG requested to estimate the early annual catches of those countries by extrapolating them through linear regression.** The WG noted that the operational area is overlapped with core area of SMA in 1970s.

6.1. Other catches

6.1.1. Taiwanese Large-Mesh Driftnet Catch Based on the Albacore Catch

Discussion

The WG asked if 1987 was the first year of the large-mesh drift net fishery for Chinese Taipei. The WG indicated that there is information that the large-mesh driftnet fishery for Chinese Taipei could have operation as early as 1980s and the WG noted that it may be necessary to estimate the value for earlier years before 1987 (Yeh et al., 1994).

6.1.2. The Republic of Korea and Taiwanese Squid Driftnet Catch

Discussion

The WG asked again if 1981 was the first year or if it goes back further. The WG answered that there is possibly data from previous years, but it is very small and so no need to extrapolate back any further. The WG mentioned that, however, there needs to be a note added into the analysis explaining why there is no extrapolation back to the start of the fishery.

6.1.3. Japanese "Kinkai Shallow" Discard Ratio

Discussion

The WG noted that the discard mortality, estimated from Japanese observer data, ranged from 20-37% for the data available from 2014 to 2019. The WG also noted that SMA released are consistently smaller than those retained, typically <100 cm PCL. T**he WG agreed to use an average discard rate for 2014-2019 to calculate the annual "Kinkai shallow" discards of SMA.** The WG also noted that post release survival of the live discards for SMA would also not likely be 100%, and less than 30% of the live discards would not be expected to survive (Francis et al., 2023). **The WG recommended using this post release mortality rate on the live discards of "Kinkai Shallow" fleet** because total discard is the combination of dead discard and proportion of dead shark from live release.

Unless there is evidence to the contrary, **the WG recommended assuming that the historical discard rates of fishery were the same as those of the observed period and estimating the discards for all available years**. The WG tentatively suggested putting these annual discards into a separate discard fleet with the size composition data for 2014-2019.

The WG provided additional information about the mortalities of SMA shark in the Pacific Ocean (see **APPENDIX 4**).

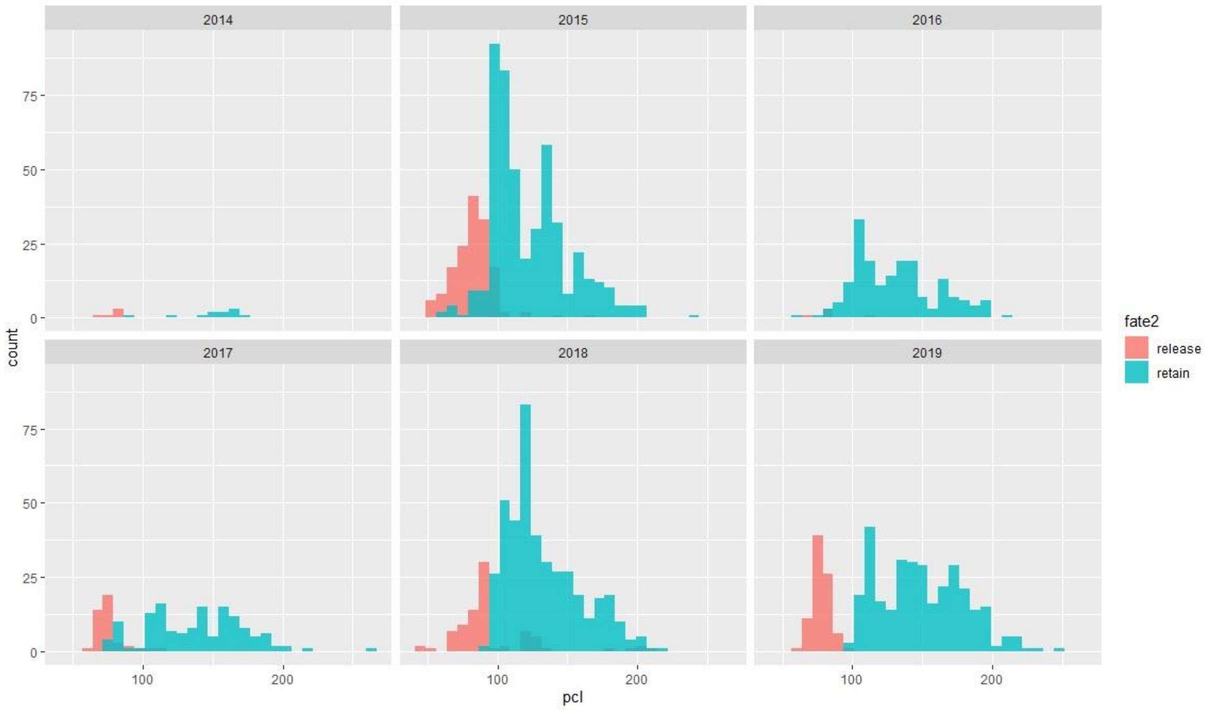


Figure 1. Annual length composition of SMA caught by "Kinkai shallow" fishery (observer data) with information about release (red) and retain (blue).

7. REVIEW SIZE DATA FOR NP SHORTFIN MAKO STOCK ASSESSMENT

Update of Sex-Specific Size Frequency of Shortfin Mako (Isurus oxyrinchus) Collected by Japanese Commercial Vessel and Research Program. Yasuko Semba (ISC/23/SHARKWG-1/10)

In this document, size frequency and annual trend of mean size of SMA (*Isurus oxyrinchus*) were described by Japanese fishery and research data with consideration of area effect in some data sources. Port sampling data comes from offshore shallow-set longline, small-scale longline (mostly coastal) and driftnet fishery, while research data comes from shallow-set and deep-set longline survey, research and training vessel, and observer program. Generally, coastal fisheries including driftnet fishery, shallow-set longline research, and small-scale longline operated in the west of the dateline larger amount of catch for juveniles (< 150 cm PCL) compared to deep-set longline research mainly operated in the area east of the dateline. Regarding juvenile ratio, 86-95% of males and almost 100% of females were juveniles in these coastal fisheries, while 58% of males and 4.7% of females were adults in deep-set longline research. "Kinkai-shallow" commercial fishery also catches mainly juveniles smaller than 150 cm PCL, but 20% of males were adults with juveniles dominated in females. Different size structure was also observed, depending on data sources even if the same fishery and operation type were used in the same area. Difference in the pattern of landing and reporting between commercial vessel and research and less overlap of the operation area between them in more fine scale may explain this difference. It is suggested that Japanese fishery can be divided into shallow-set longline, deep-set longline and driftnet fishery as in past and no continuous trend of mean size was observed in "Kinkai-Shallow" commercial landing data, deep-set longline research data and driftnet fishery if the possible artificial effect was excluded. From the perspective of data availability, "Kinkai-Shallow" commercial fishery has provided good amount of size data as representative fleet in Japan, while that of deep-set longline research becomes getting worse by year.

Discussion

The WG noted clear differences in size frequencies even across the same gear type. The WG also noted that one example of this was the clear difference between the port sampling and the non-port sampling data. The WG explained that this may be that port sampling is not surveying part of the population due to newer regulations requiring the release of juvenile SMAs. The WG further explained that this regulation may explain the emergence of a discrepancy between the at-sea data, which contains entry from smaller individuals caught but not retained, and the port-sampling data which only sees the larger retained individuals.

The WG also noted that if this regulatory change is what is causing the discrepancy between the at-sea and port sampling, while we know the sizes it affects. The WG members do not yet know the proportion of the catch being caught and discarded to comply with this regulation. The WG commented if it is a meaningful amount, we may need to include a discard fleet in the assessment, particularly since these are the smallest animals in the population and so failure to account for this source of mortality could have large impacts.

The WG mentioned if we don't include a separate discard fishery, then the port sampling data might not be representative since we know that some smaller individuals are being caught but then released with some degree of post-release mortality.

The WG noted that discards are likely to be present in the shallow-set and deep-set fisheries. The WG also noted that the issue is larger for the deep-set fishery because it seems like the discards might be spread out over the size range, whereas with the shallow-set with the regulations in place there might be cause discards to be disproportionately made up of juveniles, which could bias assessment results if not accounted for. The WG suggested to treat the "Kinkai shallow" catch as a fishery of landing, and to use the port-sampling data to inform the selectivity for the fishery of landing, and then to have a separate fishery for the discards. The WG questioned what can cause the bimodal of research shallow-set longline and discard ratio of "Kinkai Shallow" fishery. The WG responded that reporting rate may be related to discard rate such as high reporting rate may also have high discarding rate. The WG suggested considering simulations of discards after 2015 in stock assessment in 2024.

Updated Size Composition of Shortfin Mako Shark Caught by the Taiwanese Tuna Longline Fishery in the North Pacific Ocean. Kwang-Ming Liu, Kuan-Yu Su, and Chieng-Pang Chin (ISC/23/SHARKWG-1/13)

This study presents size data of SMA sharks caught by two types of Taiwanese tuna longline vessels: large-scale tuna longline vessels (LTLL,≧100 GRT) and small-scale tuna longline vessels (STLL,＜100 GRT). Size data were obtained by converting recorded measurements to PCL using available conversion equations. For STLL, spanning from 1989 to 2019 in the NP, female SMA sizes ranged from 61 to 338 cm PCL (n = 116,281), and males ranged from 60 to 262 cm PCL (n = 108,505). The logbook data for LTLL from 2005 to 2019 included 11,173 individuals (sexes combined) with sizes ranging from 61 to 303 cm PCL. Size distribution analysis revealed bimodal patterns in STLL catches, indicating a prevalence of immature fish (female < 228 cm, male < 172 cm PCL). The capture of a high proportion of immature sharks poses sustainability concerns for the fishery.

Discussion

The WG noted a strong bimodal pattern in the data from the STLL fishery. The WG commented that it is unclear whether this bimodal is due to differences in selectivity within the same gear (e.g. related to unmeasured differences in fishing practices) or to different fishing grounds, containing different sized sharks, being included in the same dataset.

The WG mentioned that the LSLL fishery caught smaller sharks than the STLL, which might be due to differences in fishing grounds between two fisheries as well as differences in fishing practices (such as what species they are targeting).

The WG requested to provide original (unsexed) weight-based size and catch number data (by vessel size if it is possible). The WG also requested to provide size data by area (north and south of 25°N) for LTLL to match the standardized CPUE.

US Size Data. Nicholas Ducharme-Barth, (ISC/23/SHARKWG-1/P4)

This presentation provided a preliminary look at length composition data from the US Hawaii longline deep and shallow sets as recorded by onboard observers. The aggregate distributions show a fat tail, heavy shoulder towards the largest sizes for both sectors though this is more pronounced in the shallow-set data. Breaking up the distributions by month indicate that largest individuals of both sexes are typically encountered during the middle months of the year in both fisheries. This appears to occur northeast of the main Hawaiian Islands though more analysis is needed to confirm this. Trends in mean length by latitudinal band are largely flat though with considerably fewer samples in recent years. Average size is largest for the middle latitudes of 22.5 to 32.5 north.

Discussion

The WG noted a strong seasonal component to the size composition data in the shallow-set fishery, however, it is unclear currently whether this seasonality reflects changes in the size distribution of sharks within the same fishing grounds or shifts in the fishing grounds of the fleet to areas with different size of SMA.

8. DISCUSSION OF KEY ASSESSMENT TOPICS USING THE CONCEPTUAL MODEL FRAMEWORK

8.1. Stock Structure (Possible Scenarios)

Genetic Population Structure of Shortfin Mako (Isurus oxyrinchus) Using Mitogenomics and Nuclear-Genome-Wide Single-Nucleotide Polymorphism Genotyping. Yasuko Semba and Hirohiko Takeshima (ISC/23/SHARKWG-1/P5)

This presentation provided a preliminary result of global genetic population structure of SMA (Isurus oxyrinchus). Samples were collected from 16 sampling units including Northwestern and Northeastern Pacific Ocean. In this analysis, reconstruction of whole mitogenome was tried and usability of a GRAS-Di analysis from nuclear genome GBS were tested. Based on the mitochondrial genomics and Nuclear-genome-wide single-nucleotide polymorphism (SNP) genotyping, analyses of an individual-based large-scale data set was conducted from both genomes. Phylogenetic reconstruction based on the mitogenome data sets clearly showed the existence of two distinct clades and no geographic patterns within the areas analyzed (but samples of NP has not yet been analyzed). SNP genotyping analysis suggested no geographic patterns within the Pacific Ocean. Preliminary results of nuclear genome suggest single stock structure at least within the NP, but conclusion is not drawn because result of analysis for the mitogenome data is not available at present.

Discussion

The WG clarified how much extent current results can be used to consider the stock structure in the assessment. The WG responded that the results reflect the information accumulated during a long period and that kinship analysis is better to understand more recent genetic structure of population. The WG also clarified that more SNPs are necessary for kinship analysis and number of DNA marker and cost necessary for this which depends on the population size, genome size, diversity of genome and its balance. The WG introduced the guidance of sampling as roughly 1% of total population size for the close kin mark recapture (CKMR) analysis. The WG noted that CITES-listing may cause administrative barriers to sharing samples of SMA sharks among member countries.

8.2. Fleet Structure (Informed by the Stock Structure)

Discussion

The WG noted that US shallow-set and deep-set longline seem to have seasonal patterns which means it might be more proper to provide catch data seasonally/quarterly so that the WG can consider seasonal selectivity. The WG asked if other nations could provide their data seasonally as well so that the lead modeler could model the selectivity quarterly. The WG (Japan) mentioned that some of their fisheries would require more work to do but they could try except for minor fleets. The WG (Chinese Taipei) mentioned that small-scale longline could easily be done, but the large-scale longline would take more work, but they would try. The WG (Mexico) mentioned that they may only have such seasonal data over the last 5 years. The WG mentioned that WCPFC data could be provided seasonally. The WG also mentioned that due to time constraints it may not be possible to do this for all fleets until next data prep. web meeting in January, however, it was suggested that in the future it would be best if data be presented seasonally instead of annually. The WG confirmed that size data is already available seasonally.

The WG asked Chinese Taipei to separate the large-scale longline into North and South (separated at 25°N). The WG also asked if the size data could be submitted as weight prior to converting it to length for the Taiwanese small-scale longline fishery. The WG responded that the CPUE north and south separation work has been completed. The WG also mentioned that the size data in weight up to 2016 had already submitted, but it is necessary to do work for providing the more recent size data since 2017.

The WG asked what the discard rate is for the Japan “Kinkai shallow” fishery. The WG also asked if the Mexico catch data includes all gears, or just longline fishery. The WG answered that the catch data only came from large scale vessels, so from longlines. The WG mentioned that Mexico has data for their artisanal fisheries but only for the last 6 years. The WG also mentioned that if this is the case then the WG would need more catch data covering the other fishing methods of Mexico. The WG further asked about the availability of late 1980 early 1990 drift gillnet data but it was answered that it will be very difficult to obtain that data, but the WG mentioned that it will be tried.

The WG mentioned that logbook data for WCPFC does not consider discarding and so it may be useful to do a catch reconstruction based on observer data, but this may be a bit much for this year so could be future work. The WG also mentioned that the best approach here would be to ask the data manager to calculate the discard ratio. The WG further mentioned that it would be useful to get size data from the WCPFC.

The WG mentioned that it would be very good for the molders to know if the provided size data has been raised to the catch. The WG confirmed it and summarized in a catch worksheet (Table 2) which no current size data being raised to the catch, but some countries (US) indicated that such a thing could be possible.

The WG asked what the exact procedure was for raising the size data to the catch (across a 5 x 5 area), especially given size specific size information. The WG explained that it is a challenging endeavor so it may not be something that the WG members can complete by the next January web-meeting. **The WG requested that, if possible, members provide size data that has been raised to the catch across 10 x 20 areas or if that can't be done then to simply indicate that provided size data has not been raised to the catch.**

8.3. Use of CPUE Indices

In response to the requests in the sections 8.2, 8.3, and 8.4, the WG (Japan) showed results of assignment for Japanese indices during the meeting.

c1). Assignment for Japan “Kinkai Shallow”

Figure 2. Plots of the mean annual trend by latitude (upper panel) and longitude (lower panel).

Figure 3. Spatial distribution of the average observed CPUE on the logscale by year and quarter for 1994-2003.

Figure 4. Spatial distribution of the average observed CPUE on the logscale by year and quarter for 2004-2013.

Figure 5. Spatial distribution of the average observed CPUE on the logscale by year and quarter for 2014-2022.

Figure 6. Spatial distribution of the average residuals (observed-expected) by year and quarter for 1994-2003.

Figure 7. Spatial distribution of the average residuals (observed-expected) by year and quarter for 2004-2013.

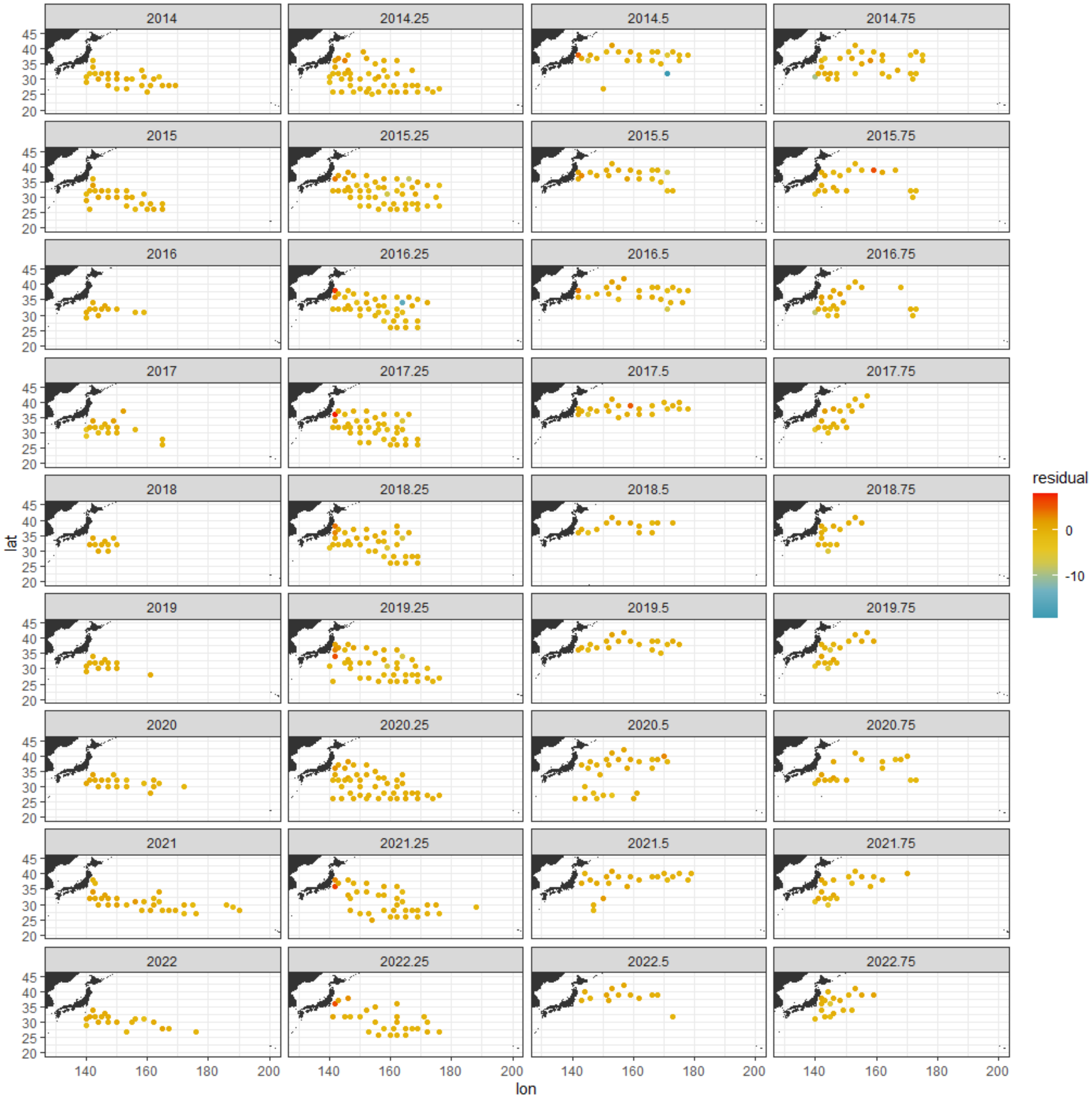
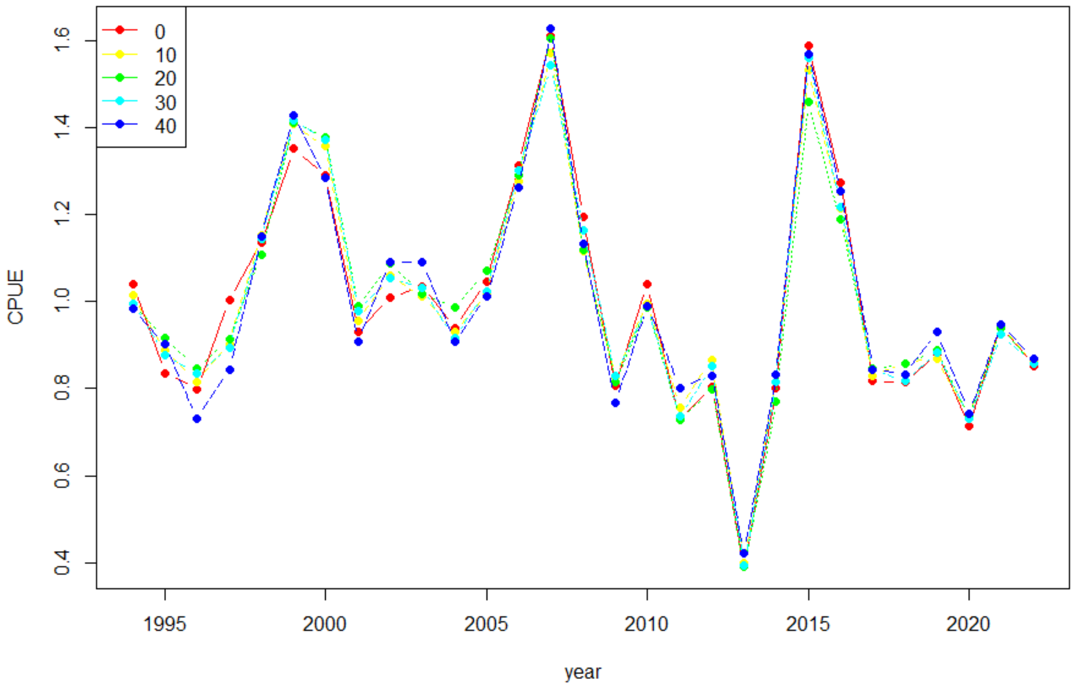


Figure 8. Spatial distribution of the average residuals (observed-expected) by year and quarter for 2014-2022.

C2). Assignment for JRTV



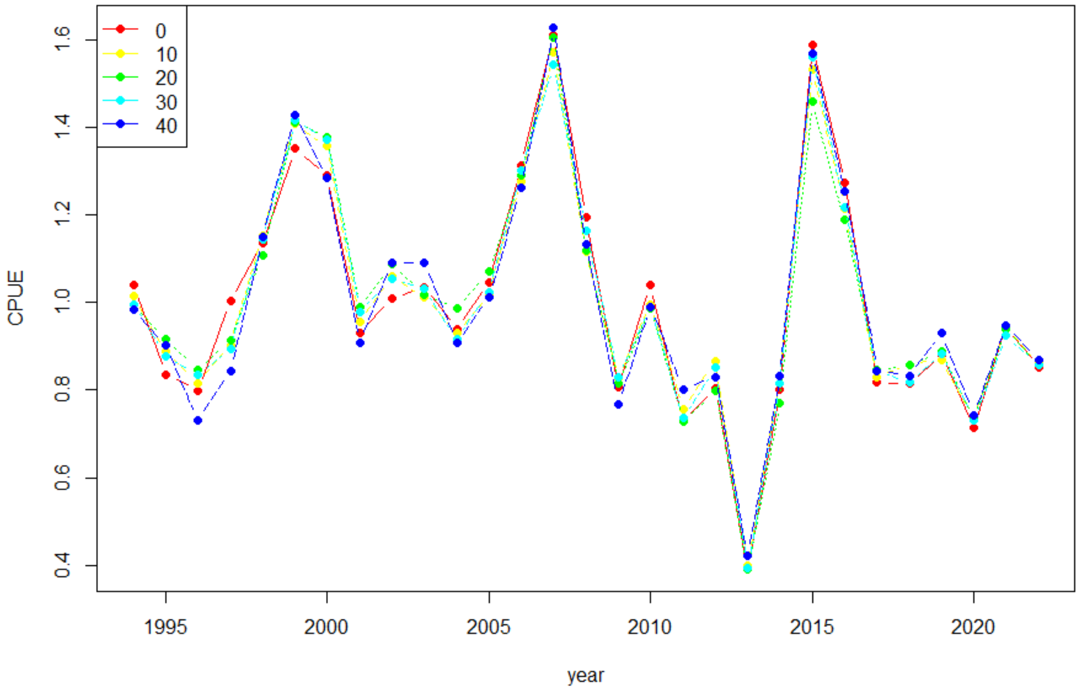


Figure 9. Annual trend of scaled CPUE by latitude (upper panel) and longitude (lower panel).

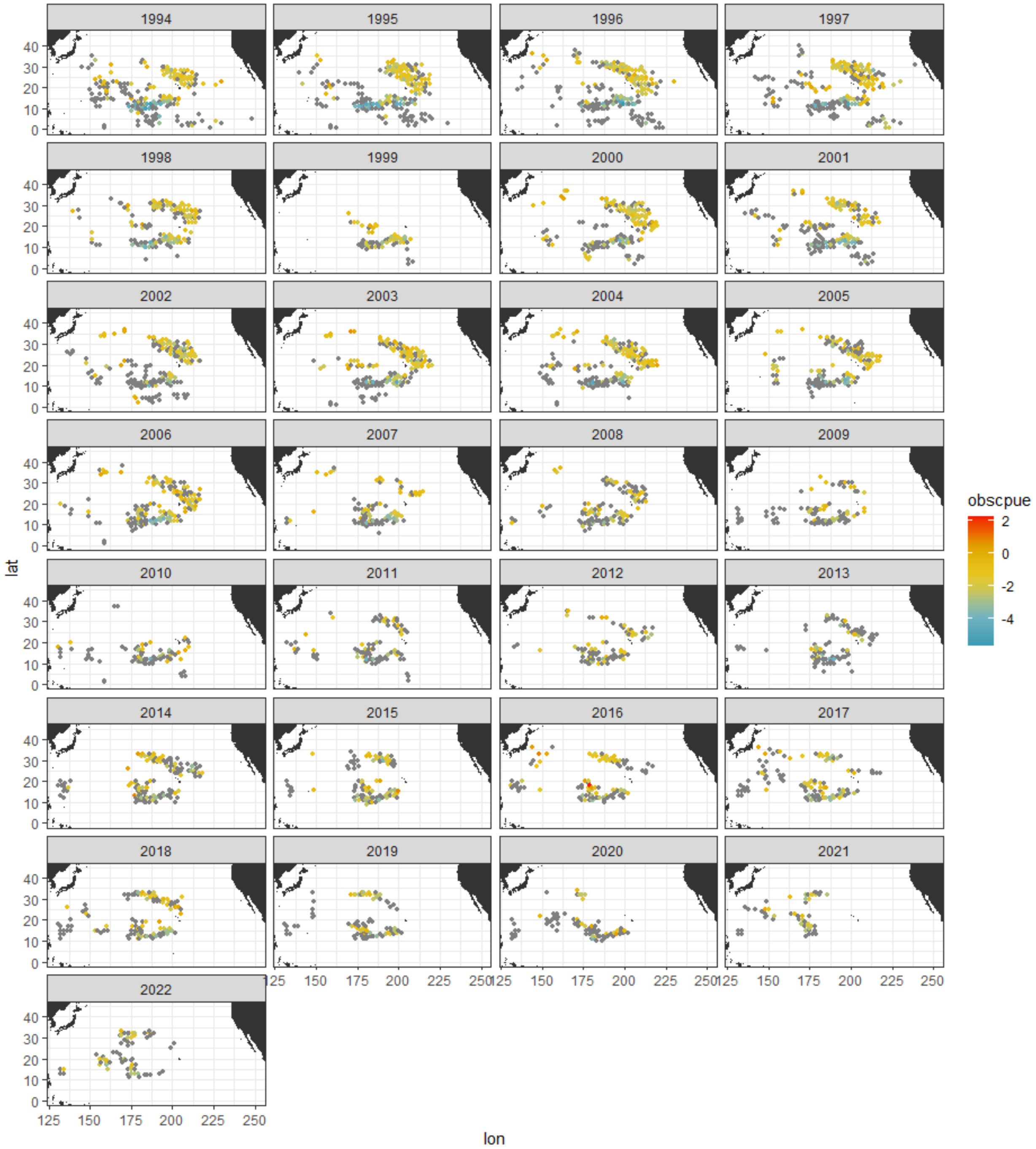


Figure 10. Spatial distribution of observed CPUE on the logscale for 1994-2022.

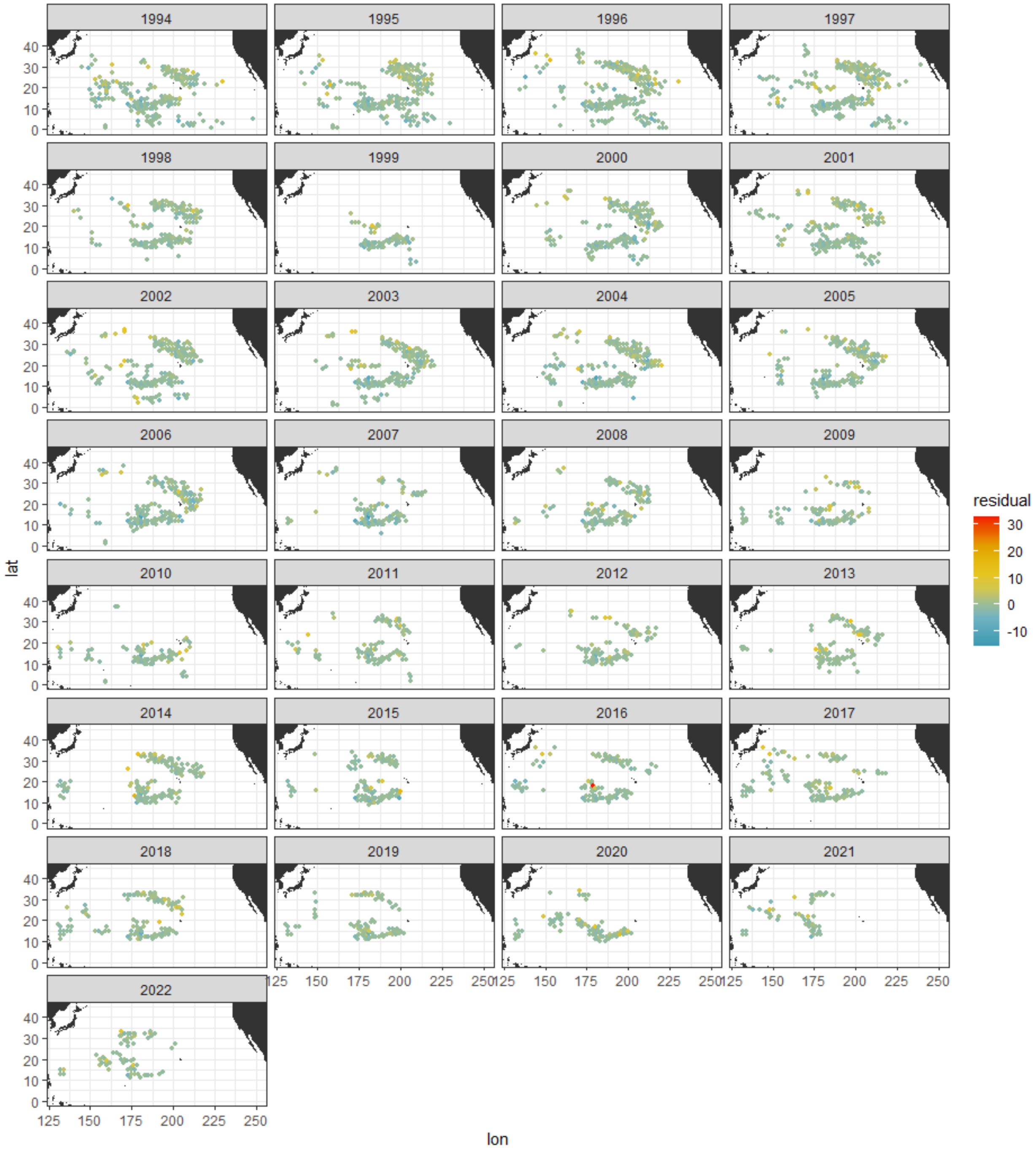


Figure 11. Spatial distribution of the residuals (observed-expected) for 1994-2022.

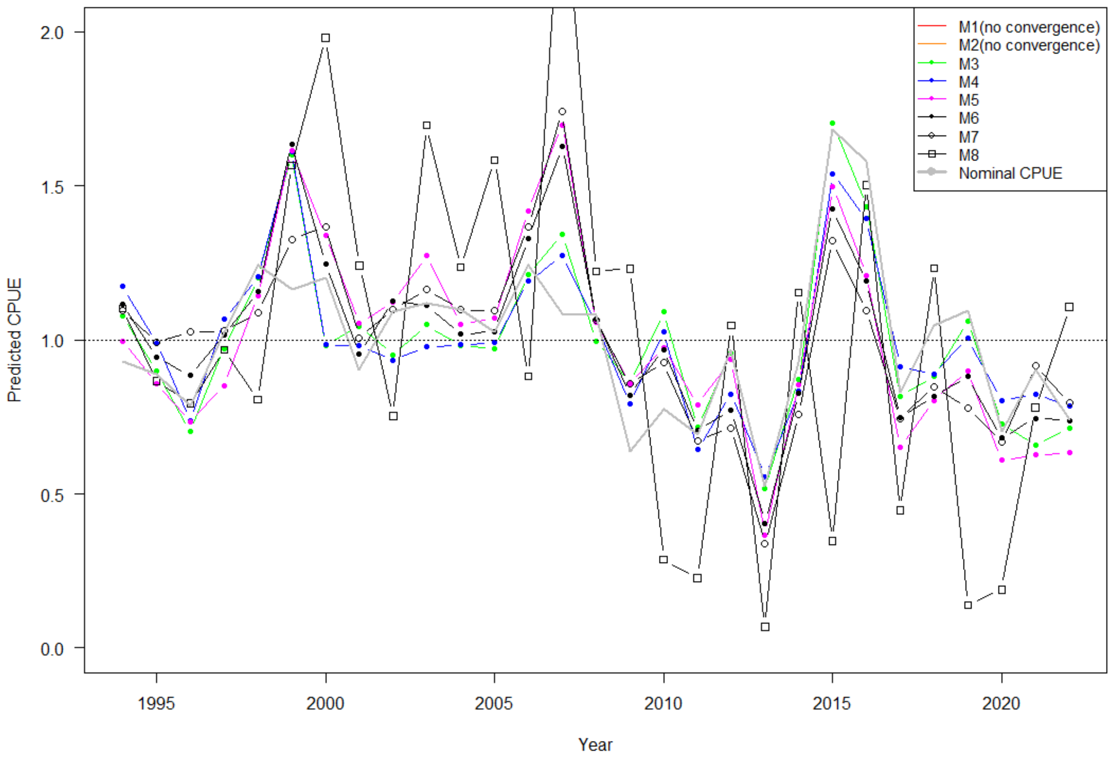


Figure 12. Comparison of annual CPUE among different model structures. M8 was added to gear effect (shallower and deeper deep sets divided by 10 hooks per basket) as a fixed effect.

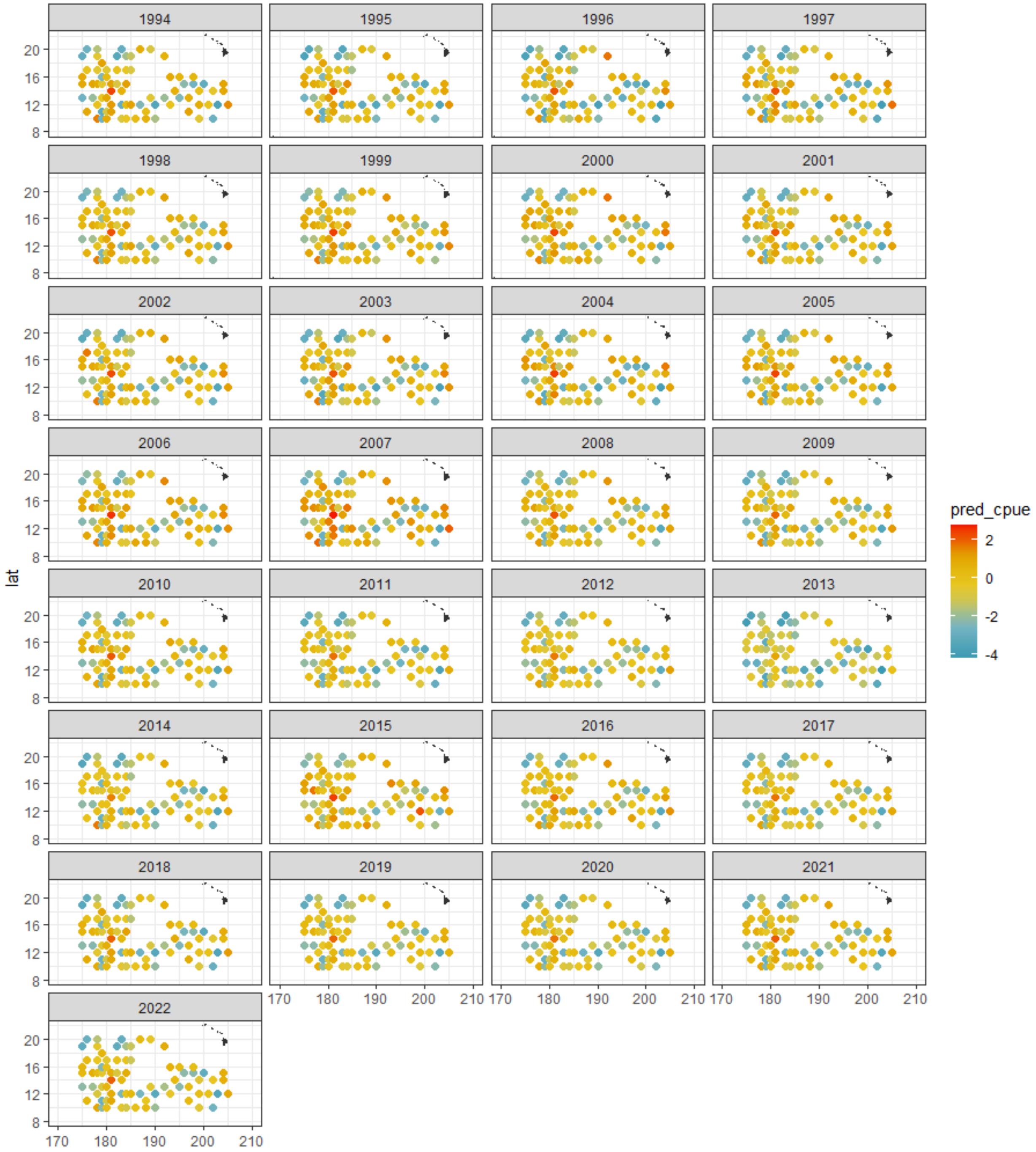


Figure 13. Spatial distribution of CPUEs in the core area (10-20 °N, 175-205 °E) for 1994-2022 extracted from the spatial temporal model in the entire area.

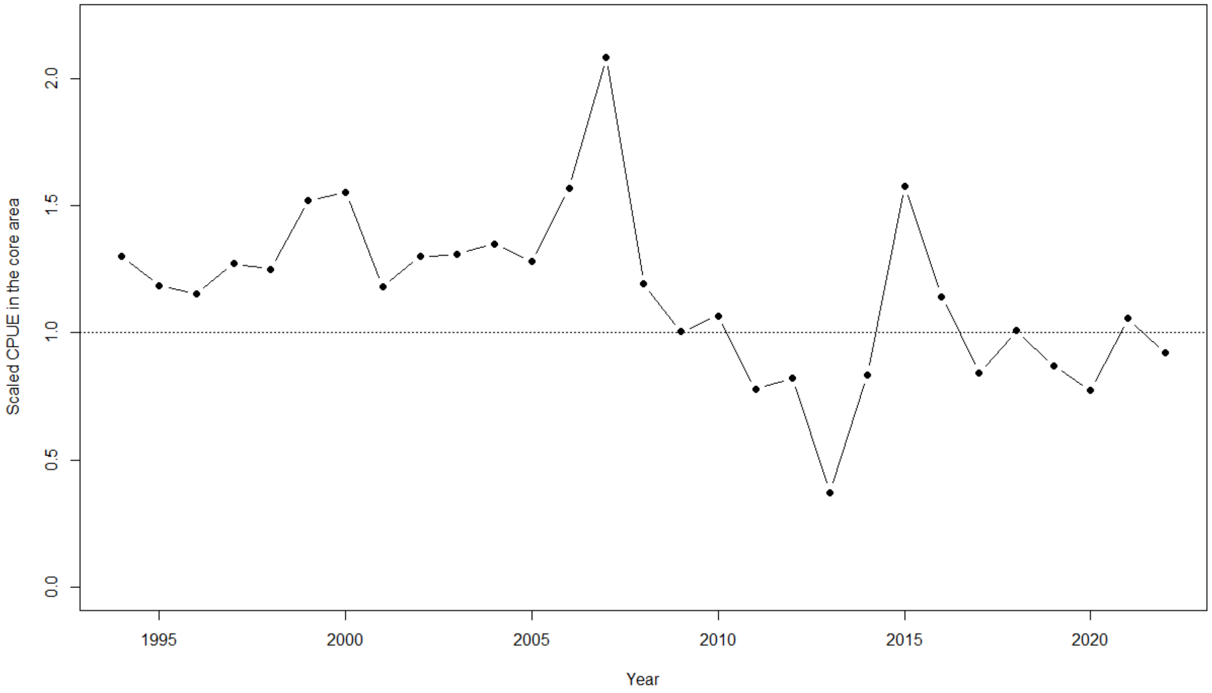


Figure 14. Annual CPUE in the core area (10-20 °N, 175-205 °E) for 1994-2022 extracted from the spatial temporal model in the entire area.

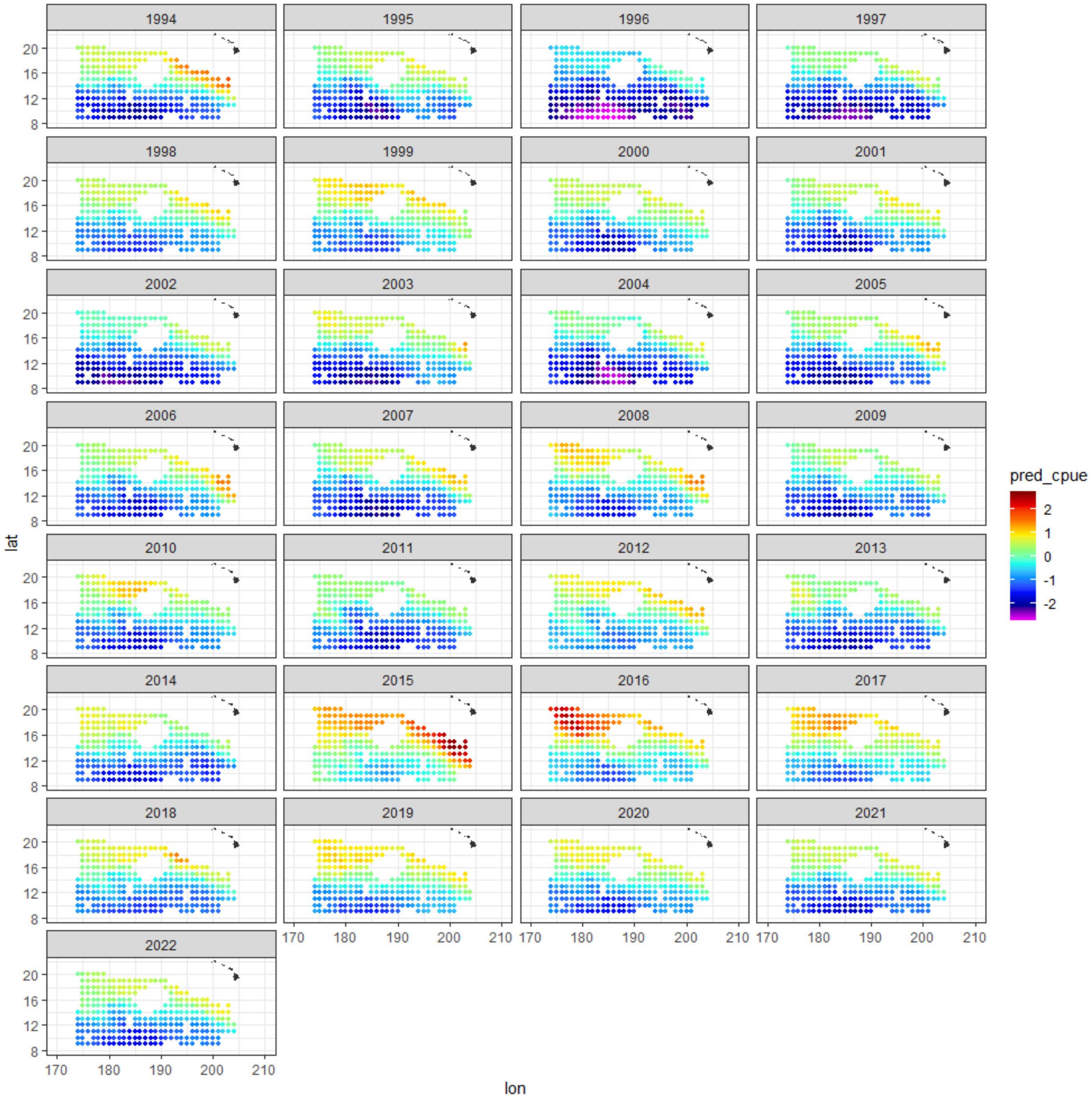


Figure 15. Spatial distribution of CPUEs in the core area (10-20 °N, 175-205 °E) for 1994-2022. The spatiotemporal model was rerun using the data in the core area.

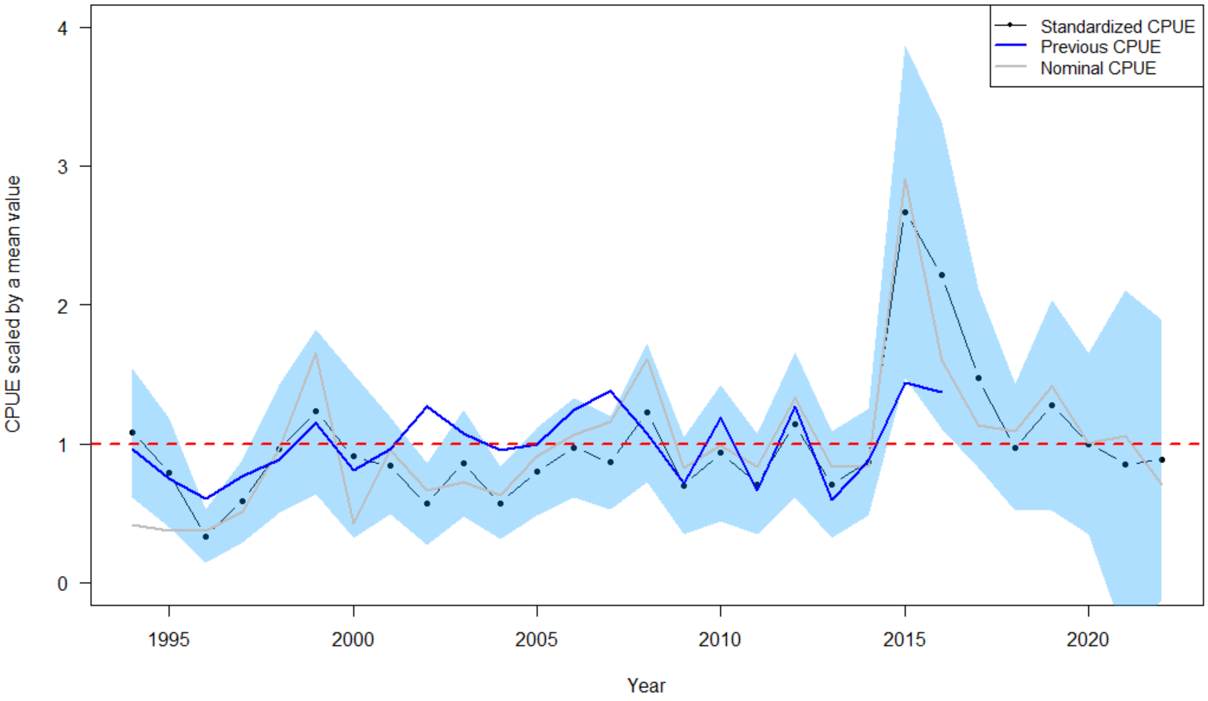
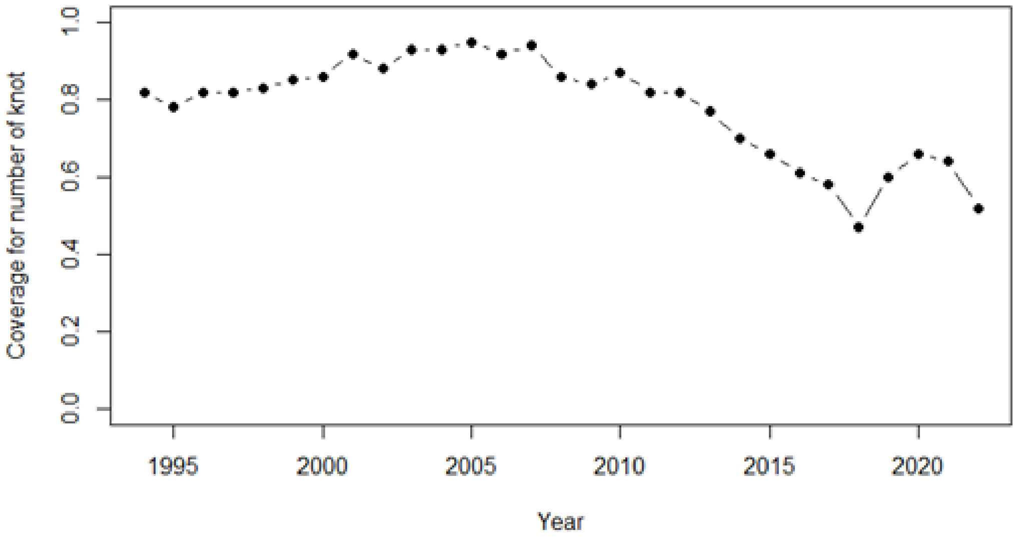


Figure 16. Annual CPUE in the core area (10-20 °N, 175-205 °E) for 1994-2022 The spatiotemporal model was rerun using the data in the core area.

C3). Assignment for “Kinkai shallow” and JRTV



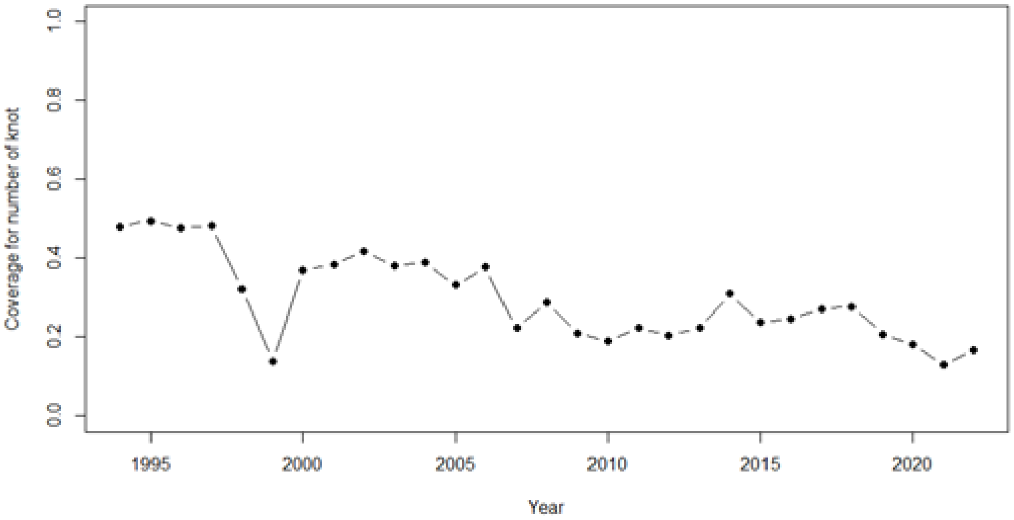


Figure 17. Comparison of the spatial coverage in terms of stations covered over time relative to the entire distribution between “Kinkai shallow” (upper panel) and JRTV (lower panel).

C4). Assignment for size data of JRTV

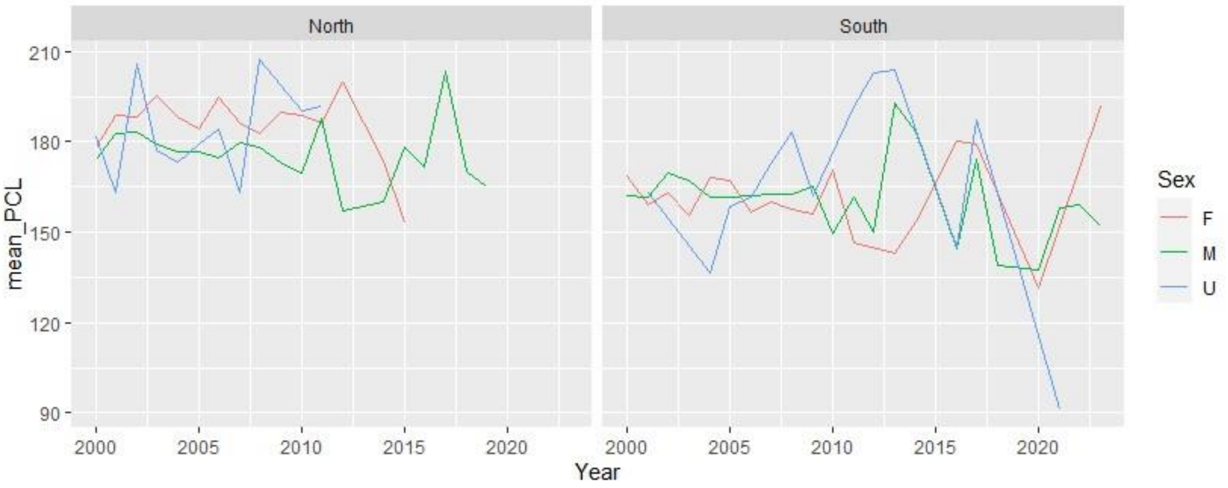
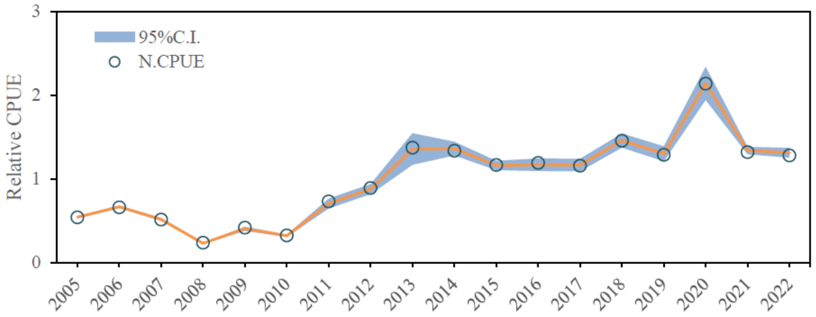


Figure 18. Annual average size of SMA caught by JRTV in the core area (10-20 °N, 175-205 °E) and another area (20-30 °N, 180-215 °E).

(a) north of 25ºN



(b) 0º-25ºN

Figure 19. Relative nominal (open circle) and standardized CPUE with 95 % confidence intervals of SMA shark by the Taiwanese large-scale tuna longline fishery in the NPO from 2005 to 2022.

Discussion

The WG noted that estimated trend indicates overlapped trend in general, but some difference was observed by station (e.g., longitude), suggesting different annual trend spatially. The WG also noted that there is possibility that aggregated trend includes annual index from different life stages. The WG mentioned that the effect of historical change of operational coverage (i.e., eastern area) on the prediction and suggested to calculate the alternative index from area and/or season with good coverage of data (e.g., area with north of 25°N and west of 160/170°E, quarter 2) to investigate the assumption.

The WG discussed the gear effect in the modelling of index (i.e., Shallow-set and Deep-set longlines) and the effect of gear type on the recent fluctuation in the index. The WG also clarified that gear effect (i.e., number of hooks per basket) was not directly included in the modelling while possible historical change of number of hooks per basket were shown in the WP. The WG proposed to extract the data of deep-set (mainly east of dateline) and run the model with gear effect retained to see how it works.

The WG enquired the definition of coverage ratio of station (i.e., denominator of ratio) and author clarified that denominator was 100 for "Kinkai-shallow" and 400 for JRTV. Regarding the target area (i.e., dimension of area) for this analysis, that of JRTV is also wide because current data for this analysis includes both west and east of the dateline. The WG mentioned that the number of knot is different depending on the data source due to the difference of the observation, thus the effect of the decline of coverage is necessary to be considered. The WG enquired the effect of knot without any data on the annual trend and it was suggested that changing the knot will not affect the prediction because the data of core area is likely to be predominant factor for the prediction and index estimated from the core area (only) did not affect the annual trend.

The WG (Chinese Taipei) presented new annual CPUEs separated by north and south in the Fig. 4 of WP (*ISC/23/SHARKWG-1/12*). The WG indicated that based on the Taiwanese size composition data it appears that adults are more prevalent in the north and so the WG may look to focus on just the north CPUE.

The WG asked that the US Juvenile Survey be added to the list of CPUE's provided by the US (Runcie et al., 2016). The WG agreed to add it.

The WG discussed an adult focused area in the waters north of Hawaii that Japanese could split out of its catch. The WG (Japan) will work to produce catch from this area north of Hawaii soon.

The WG requested that when available CV values should be included with all annual CPUE data.

8.4. Model Time Span (When to start the model)

Discussion

The WG indicated that a decision on time span could be postponed until a later date and did not need to be covered now.

8.5. Biology/Growth (Several scenarios based on meta-analysis as well as fleet and stock structure)

Discussion

The WG continued the discussion about the calibration of growth data as a method to determine if the eastern age methodology, when applied to western caught fish, might produce more growth bands, suggesting that differences observed in the analysis summary discussion could be only the result of the methods used by each country and not real biological differences related to the periodicity of growth bands formation. **The WG agreed that this work will continue to address such issue and probably will prepare for a WP for the next January web-meeting. The WG also mentioned that the time to prepare such WP is also mainly issue.**

The WG mentioned that a WP with a review on history and development of ageing comparisons among the lab countries during the past several years could be provided in the next web meeting. Such a paper might be very helpful to avoid confusions and to review what has been done to date to standardize the ageing of the SMA.

The WG also mentioned that the importance of determining confident growth parameters as they will affect other important biological parameters for the stock assessment such as natural mortality, longevity, steepness, and among others. The WG also mentioned that it is necessary to determine if the new model produces substantial different parameters compared to those of the metanalysis from the previous assessment. The WG suggested that if there is no substantial progress in the new approach, those methods from the previous assessment should be used in the upcoming assessment in 2024. The WG also suggested to use the same values applied in the previous assessment in 2018 to other biological and productivity parameters, including gestation period, reproductive cycle, etc. The WG commented that sensitivity analysis would be necessary due to the uncertainty in some of these parameters, for example the duration of reproductive cycle. The WG suggested if no new information or studies about them exist, then growth parameters (any alternative scenarios) should come from the previous study (Takahashi et al., 2017).

9. CREATE A MODELING STRAW-MAN BASED ON THE ABOVE KEY ASSESSMENT TOPICS

9.1. Decide on Broad Modeling Approach (e.g. single base case, ensemble…)

Discussion

The WG mentioned that it could be possible to show the base case model, however, it might be difficult to identify the best outcome because uncertainties are included in the biological parameters as well as fishery data. The WG therefore suggested that best practices will be to show the uncertainty using ensemble models because uncertainty in the reproductive cycle, uncertainty in pups per litter will make a big difference in the assessment. The WG commented that ensemble approach has an issue of weighting of parameters for a variety of parameters, so the approach doesn't make sense to decide on now. The WG also commented that the scientist should choose a small number of candidate models and parameters based on their scientific knowledge.

The WG discussed reproductive cycle of SMA. The WG commented that it is uncomfortable with decision to use 2 years as the reproductive cycle now, rather using the ensemble approach. The ensemble puts forward the uncertainty that we do have and seems a more accurate reflection and honest representation of the understanding that some of the biologists have on these parameters as well. The WG also commented that the WG should attempt to find the best available parameter first – at this moment we don't need to decide on which approach – it will depend on the data and the parameters in the data provided. **The WG agreed that the approach will be decided in the January web-meeting based on which is more plausible based on past scientific information.**

9.2. Decide on Diagnostic Methods

Discussion

The WG agreed not to prescribe the diagnostics method at this moment. The WG suggested to use best practices as established in the literature.

- Joint residual plots
- Likelihood (R0) profiles
- Age-structured production model (ASPM)
- Retrospective analysis
- Hindcast Cross-validation
- Jitter analysis etc.

9.3. Decide on Future Projection Method and Scenarios.

Discussion

The WG discussed plausibility and suitability of stochastic future projection for SMA in the 2024 stock assessment. The WG questioned about the software used in the albacore WG and it was responded that it has been done using separate software in SS, bespoke software, basically C++ code. The WG commented if male and female selectivities are separate, the coding might be different due to the different data structure behind it. The WG also commented that they've previously used unsexed data. The WG suggested that there might not be time this cycle to do stochastic projections to account for sex specific selectivities.

The WG agreed to use the same future projection method (i.e., deterministic model) as those used in the previous stock assessment in 2018: Four scenarios (Average F+ 20% F_{msy}, F_{msy}, Average F-20%, Average F-in recent years); Projection period (10 years); Recruitment from the S-R relationships; Fixed selectivity.

The WG commented that if there are no alternative biological parameters, the WG will use the previous biological parameters as a single best estimate because the WG had already spent a lot of time to choose those parameters in the previous assessment.

The WG suggested using fixed reproductive cycle with 2- and 3- years period with equal weighting because 3- year reproductive cycle has been used in the Atlantic Ocean (ICCAT, 2017). The WG considered that there must be some uncertainty in the assessment model because we don't catch mature females to validate our 2- or 3- years reproductive cycle.

Some WG members have agreed that equal weighting of 2 and 3 years for the reproductive cycle in an ensemble type approach but the **WG agreed to wait until January web meeting for the decision.**

The WG discussed the spatial structure of SS model and gave a preference to using a single stock structure as shown by presentation by Semba and Takeshima (ISC-SHARKWG-23-1/P5). However, the WG also gave the modeler discretion to explore separate eastern and western models (if time allows and data fits seem plausible).

The WG asked whether we will use the simple model such as a Bayesian production model as an alternative approach. The WG responded that simple model is a backup plan if integrated model doesn’t work with new data. The WG commented that if we are going to use the simple model, we need to calculate the intrinsic rate of growth. **The WG agreed to postpone the decision for the use of alternative modelling approach.**

10. ESTABLISH WORK PLAN FOR THE PRE-ASSESSMENT AND FINAL DATA SUBMISSION DEADLINE

Discussion

The WG had discussed the workplan for each delegation by the JAN web-meeting using the annual time series of catch and CPUE table below. **The WG agreed that deadline to submit data is the January web meeting in 2024. The WG also agreed to finalize biological parameters and fishery data in the January meeting.**

The WG summarized the fishery data (Catch, CPUE and size data) provided in this meeting (**Table 3 and 4**).

Table 3. Annual catch table of NP SMA by fleets.

	Canada	US	US	US	US	Taiwan	Taiwan	Taiwan	Taiwan	Taiwan
	Commercial fishery(mt)	**Hawaii SHALLOW +California Longline(mt)**	**Hawaii DEEP (mt)**	**Other commercial +Drift Gillnet (mt)**	**Charter and private recreational (mt)**	**Taiwanese small-scale tuna longline (n)**	**Taiwanese large-scale tuna longline North (n)**	**Taiwanese large-scale tuna longline South (n)**	**Taiwanese Large mesh drift net fishery(mt) early**	**Taiwanese high seas squid drift net fishery(mt) early**
1970	0.00	0.00	0.00	0.60	0.00				0.00	0.00
1971	0.00	0.00	0.00	3.98	0.00				0.00	0.00
1972	0.00	0.00	0.00	0.16	0.00				0.00	0.00
1973	0.00	0.01	0.00	0.55	0.00				0.00	0.00
1974	0.00	0.17	0.00	4.57	0.00				0.00	0.00
1975	0.00	0.07	0.00	6.65	0.00				0.00	0.00
1976	0.00	0.46	0.00	1.09	0.00				0.00	0.00
1977	0.00	1.16	0.00	12.28	0.00				0.00	0.00
1978	0.00	1.80	0.00	16.73	0.00				0.00	0.00
1979	0.00	10.39	0.00	13.46	0.00				0.00	0.00
1980	0.09	13.70	0.00	91.17	2.72				0.00	0.00
1981	0.00	19.11	0.00	168.24	13.03				0.00	1.04
1982	0.00	6.39	0.00	354.22	1.50				0.00	1.41
1983	0.00	0.56	0.00	222.54	1.08				0.00	2.22
1984	0.00	2.43	0.00	161.61	2.63				0.00	4.88
1985	0.00	0.02	0.00	153.06	9.34				0.00	3.11
1986	0.04	1.27	0.00	318.71	4.84				0.00	2.08
1987	0.10	3.50	0.00	409.94	21.89				57.42	2.54
1988	0.00	156.34	0.00	174.13	14.47				102.90	1.73
1989	0.00	4.76	0.00	257.55	6.14				118.14	5.04
1990	0.00	15.20	0.00	368.25	6.27				290.28	2.78
1991	0.00	23.26	0.00	201.31	6.17				125.39	1.59
1992	0.04	2.16	0.00	143.69	6.17				343.14	0.64
1993	0.00	0.80	0.00	124.55	3.91				0.00	0.00
1994	0.00	20.78	0.00	110.61	13.59				0.00	0.00
1995	0.00	0.23	0.59	90.81	5.49				0.00	0.00
1996	0.00	0.14	0.32	93.62	2.24				0.00	0.00
1997	0.00	0.12	0.31	132.91	5.21				0.00	0.00
1998	0.00	0.11	0.40	98.70	1.91				0.00	0.00
1999	0.00	0.12	1.00	57.97	1.18				0.00	0.00
2000	0.00	0.30	0.97	75.33	2.39				0.00	0.00
2001	0.00	0.00	1.13	40.83	5.41				0.00	0.00
2002	0.00	0.00	1.87	81.52	5.84				0.00	0.00
2003	0.00	0.00	2.02	68.00	3.99				0.00	0.00
2004	0.00	0.15	1.71	53.21	3.27				0.00	0.00
2005	0.00	1.04	2.09	33.46	1.42				0.00	0.00
2006	0.00	0.60	2.27	45.18	1.72				0.00	0.00
2007	0.00	0.81	2.37	43.46	0.84				0.00	0.00
2008	0.00	0.97	2.73	32.00	0.60				0.00	0.00
2009	0.00	0.80	2.94	29.61	0.70				0.00	0.00
2010	0.00	0.88	3.05	20.55	0.39				0.00	0.00
2011	0.00	0.61	2.61	17.39	0.36				0.00	0.00
2012	0.00	0.43	2.51	21.68	0.87				0.00	0.00
2013	0.00	0.37	3.36	29.06	0.88				0.00	0.00
2014	0.04	0.57	3.57	16.40	0.58				0.00	0.00
2015	0.00	0.78	4.26	13.15	0.23				0.00	0.00
2016	0.00	0.99	4.03	25.69	0.23				0.00	0.00
2017	0.00								0.00	0.00
2018	0.00								0.00	0.00
2019	0.00								0.00	0.00
2020	0.00								0.00	0.00
2021	0.00								0.00	0.00
2022	0.00								0.00	0.00
Size data Submission		Not yet	Not yet	Not yet	Not yet	Not yet for Weight data (2017-2022)			No data?	No data?
Raising size data by catch	No	Yes (tentative)	Yes (tentative)	Yes (tentative)	Yes (tentative)	Yes	5 by 5 is Difficult?	5 by 5 is Difficult?	No	No

Table 3. to be continued.

	Japan	Japan	Japan	Japan	Japan	Japan	Japan	Japan	Japan	Japan	Japan
	Japanese offhore and distant water shallow-set_early_period LL(mt)	**Japanese offhore and distant water shallow-set_late_period LL(n)**	**Kinkai-shallow discard (n)**	**Japanese offhore and distant water shallow-set_early_period LL(mt)**	**Japanese offhore and distant water shallow-set_late_period LL(n)**	**Japanese coastal water and othe LL(mt)**	**Japanese coastal water and othe LL discard (mt)**	**Japanese trapnet and other fishery(mt)**	**Japanese Large mesh drift net fishery (mt) late**	**Japanese Large mesh drift net fishery(mt) early**	**Japanese high seas squid drift net fishery(n) early**
1970	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1971	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1972	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1973	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1974	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1975	721.00	0.00		232.00	0.00	0.00	0.00	0.00	0.00	199.98	0.00
1976	1002.00	0.00		433.00	0.00	0.00	0.00	0.00	0.00	368.31	0.00
1977	1351.00	0.00		588.00	0.00	0.00	0.00	0.00	0.00	606.52	0.00
1978	1097.00	0.00		550.00	0.00	0.00	0.00	0.00	0.00	370.52	0.00
1979	1200.00	0.00		774.00	0.00	0.00	0.00	0.00	0.00	274.48	0.00
1980	1144.00	0.00		918.00	0.00	0.00	0.00	0.00	0.00	199.27	0.00
1981	1013.00	0.00		1076.00	0.00	0.00	0.00	0.00	0.00	195.47	55.42
1982	637.00	0.00		774.00	0.00	0.00	0.00	0.00	0.00	195.83	601.19
1983	510.00	0.00		842.00	0.00	0.00	0.00	0.00	0.00	147.29	934.54
1984	397.00	0.00		836.00	0.00	0.00	0.00	0.00	0.00	160.43	1329.49
1985	352.00	0.00		769.00	0.00	0.00	0.00	0.00	0.00	154.48	1182.81
1986	416.00	0.00		565.00	0.00	0.00	0.00	0.00	0.00	171.82	1365.41
1987	333.00	0.00		486.00	0.00	0.00	0.00	0.00	0.00	152.99	1121.88
1988	299.00	0.00		645.00	0.00	0.00	0.00	0.00	0.00	126.36	1768.36
1989	274.00	0.00		747.00	0.00	0.00	0.00	0.00	0.00	105.23	1404.24
1990	257.00	0.00		512.00	0.00	0.00	0.00	0.00	0.00	105.40	786.58
1991	333.00	0.00		505.00	0.00	0.00	0.00	0.00	0.00	125.50	853.82
1992	344.00	0.00		0.00	8463.85	0.00	0.00	0.00	0.00	118.70	476.86
1993	431.00	0.00		0.00	14311.92	0.00	0.00	0.00	0.00	0.00	0.00
1994	0.00	7172.36		0.00	14547.64	68.92		21.68	110.46	0.00	0.00
1995	0.00	8437.70		0.00	17441.72	65.43		15.41	92.55	0.00	0.00
1996	0.00	9401.01		0.00	10884.90	398.68		18.02	90.76	0.00	0.00
1997	0.00	10084.54		0.00	10649.76	205.95		16.63	114.49	0.00	0.00
1998	0.00	10316.03		0.00	11044.33	21.08		13.12	116.95	0.00	0.00
1999	0.00	11503.65		0.00	16196.32	218.93		14.23	158.45	0.00	0.00
2000	0.00	13941.12		0.00	11489.31	104.37		15.89	139.72	0.00	0.00
2001	0.00	13239.97		0.00	9611.23	210.23		15.61	139.86	0.00	0.00
2002	0.00	11162.55		0.00	9372.86	120.39		4.69	121.94	0.00	0.00
2003	0.00	11113.14		0.00	9347.89	19.30		5.68	228.74	0.00	0.00
2004	0.00	13146.99		0.00	7173.26	26.27		0.79	133.50	0.00	0.00
2005	0.00	14228.91		0.00	6367.90	61.32		42.85	154.95	0.00	0.00
2006	0.00	14922.93		0.00	7961.96	9.56		5.65	177.88	0.00	0.00
2007	0.00	17793.77		0.00	7477.91	43.08		14.63	243.83	0.00	0.00
2008	0.00	14201.63		0.00	4524.37	121.07		13.69	212.49	0.00	0.00
2009	0.00	18095.45		0.00	2616.23	341.85		1.48	294.17	0.00	0.00
2010	0.00	17541.97		0.00	3156.06	150.87		19.65	272.00	0.00	0.00
2011	0.00	9857.25		0.00	2828.10	47.74		11.36	146.36	0.00	0.00
2012	0.00	12586.61		0.00	2522.05	9.53		1.83	206.07	0.00	0.00
2013	0.00	10075.22		0.00	1374.86	46.76		9.33	344.67	0.00	0.00
2014	0.00	14560.64		0.00	2704.70	7.23		3.31	263.22	0.00	0.00
2015	0.00	14186.39		0.00	3918.35	2.25		11.34	334.13	0.00	0.00
2016	0.00	17239.42		0.00	2328.38	32.32		15.66	445.69	0.00	0.00
2017	0.00	12274.50		0.00	1256.13	23.33		9.80	271.13	0.00	0.00
2018	0.00	13910.62		0.00	1375.13	19.28		28.24	223.22	0.00	0.00
2019	0.00	12421.62		0.00	1394.91	15.49		3.30	213.61	0.00	0.00
2020	0.00	8277.80		0.00	963.33	4.09		15.81	194.27	0.00	0.00
2021	0.00	6695.01		0.00	847.71	16.37		22.97	133.47	0.00	0.00
2022	0.00	8961.67		0.00	417.51	4.64		54.78	159.75	0.00	0.00
Size data Submission	Yes	Yes		Yes	Yes	Yes		No data	Yes	Check	Check
Raising size data by catch	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No?	No

Table 3. to be continued.

	Mexico	Mexico	Mexico	IATTC	Korea	Korea	China	WCPFC
	Landings Baja California state and Sur(mt)	**Landings Sinaloa, Nayarit, Colima (mt)**	**Driftnet and artisanal catch (last 6 years for artisanal available)**	**Purse seine(mt)**	**Longline(n)**	**Korean high seas squid drift net fishery(mt) early**	**Longline(n)**	**Logbook data of LL(n) excluding JP, TW, US, CH,KR**
1970	0.00	0.00	0.00	0.00	0	0	0	0
1971	0.00	0.00	0.00	0.047	0	0	0	0
1972	0.00	0.00	0.00	0.038	0	0	0	0
1973	0.00	0.00	0.00	0.047	0	0	0	0
1974	0.00	0.00	0.00	0.055	0	0	0	0
1975	0.00	0.00	0.00	0.062	0	0	0	0
1976	66.00	7.00	0.00	0.071	0	0	0	0
1977	64.00	8.00	0.00	0.062	0	0	0	0
1978	92.00	11.00	0.00	0.093	0	0	0	0
1979	43.00	21.00	0.00	0.088	0	0	0	0
1980	51.00	14.00	0.00	0.088	0	0	0	0
1981	38.00	19.00	0.00	0.077	0	3.61	0	0
1982	61.00	15.00	0.00	0.061	0	4.41	0	0
1983	58.00	10.00	0.00	0.045	0	6.70	0	0
1984	40.00	10.00	0.00	0.047	0	14.76	0	0
1985	35.00	7.00	0.00	0.033	0	13.91	0	0
1986	57.00	29.00	0.00	0.039	0	17.06	0	0
1987	177.00	19.00	0.00	0.041	0	19.06	0	0
1988	231.00	16.00	0.00	0.055	0	31.36	0	0
1989	114.00	20.00	0.00	0.051	0	30.53	0	0
1990	257.00	30.00	0.00	0.044	0	28.95	0	0
1991	198.00	30.00	0.00	0.035	0	23.04	0	0
1992	350.00	26.00	0.00	0.034	0	9.26	0	0
1993	354.00	89.00	0.00	0.072	0	0	0	0
1994	274.00	61.00	0.00	0.017	0	0	0	0
1995	276.00	58.00	0.00	0.044	0	0	0	0
1996	337.00	76.00	0.00	0.044	0	0	0	0
1997	328.00	73.00	0.00	0.091	0	0	0	0
1998	332.00	56.00	0.00	0.012	0	0	0	0
1999	353.00	85.00	0.00	0.026	0	0	0	0
2000	431.00	108.00	0.00	0.007	0	0	0	0
2001	422.00	70.00	0.00	0.031	0	0	0	0
2002	392.00	96.00	0.00	0.041	0.00	0	15.00	0.00
2003	348.00	124.00	0.00	0.036	0.00	0	32.00	9.00
2004	530.00	334.00	0.00	0.043	0.00	0	461.00	220.00
2005	388.00	220.00	0.00	0.068	0.00	0	188.00	19.00
2006	380.00	260.00	0.00	0.182	0.00	0	143.00	265.00
2007	344.00	345.00	0.00	0.115	0.00	0	57.00	230.00
2008	400.00	209.00	0.00	0.161	0.00	0	29.00	278.00
2009	438.00	214.00	0.00	0.030	0.00	0	35.00	438.00
2010	550.00	211.00	0.00	0.052	2.00	0	3230.00	140.00
2011	520.00	238.00	0.00	0.125	0.00	0	13823.00	289.00
2012	488.00	226.00	0.00	0.072	28.00	0	5649.00	100.00
2013	478.00	234.00	0.00	0.021	306.00	0	123.00	792.00
2014	925.00	542.00	0.00	0.013	219.00	0	215.00	1393.00
2015	1253.00	400.00	0.00	0.010	65.00	0	1595.00	1217.00
2016	401.00	259.00	0.00	0.014	25.00	0	931.00	1507.00
2017	672	264		0.026	26.00	0	439.00	2837.00
2018	780	218		0.031	14.00	0	2747.00	2816.00
2019	1256	539		0.017	65.00	0	2263.00	2330.00
2020	1361	516		0.006	18.00	0	1225.00	2289.00
2021	457.2	102.6		0.008	21.00	0	111.00	2579.00
2022	299.5	172		0.015	43.00	0	325.00	1428.00
Size data Submission	Yes	Yes		No data	No	No	No	No
Raising size data by catch	No	No	No	No	No?	No?	No?	No?

Table 4. Annual CPUE of NP SMA by fleets.

	S1:US-SH-LL	S2:US-DE-LL	US-Juvenile Survey (LL) Luncie et al.?	S3:TW-LA-LL	S3:TW-LA-LL (North > 25N)	S3:TW-LA-LL(South)	S4:JP-OF-DW-SH-LL(M3)	S4:JP-OF-DW-SH-LL(M5)	S4:JP-OF-DW-SH-LL(core area_M3)	S4:JP-OF-DW-SH-LL(core area_M5)	S5:JP-OF-DW-DE-LL(M7)	S5:JP-OF-DW-DE-LL(core area)	S4:JP-OF-DW-SH-LL(Juvenile)	S4:JP-OF-DW-SH-LL(Immature)	S8:MX-Com-LL	S8:MX-Com-LL (North)	S8:MX-Com-LL(South)
1994							0.41	0.18	0.43	0.19	1.09	1.06					
1995							0.51	0.27	0.53	0.29	0.99	0.96					
1996							0.65	0.43	0.69	0.47	1.03	1.04					
1997							0.63	0.42	0.66	0.44	1.03	0.97					
1998							0.65	0.50	0.68	0.53	1.09	1.03					
1999							0.66	0.48	0.67	0.48	1.33	1.28					
2000							0.65	0.48	0.65	0.47	1.37	1.37					
2001							0.73	0.58	0.72	0.57	1.01	1.00					
2002							0.66	0.50	0.67	0.53	1.10	1.04					
2003							0.75	0.62	0.85	0.71	1.17	1.12					
2004							0.81	0.68	0.84	0.70	1.10	1.04					
2005				0.30	0.54	2.39	0.96	0.86	0.97	0.88	1.09	1.06					
2006				0.38	0.66	1.16	1.00	0.89	1.08	0.99	1.37	1.38	1.42	0.83	2.56	2.49	1.23
2007				0.26	0.51	1.04	1.06	0.95	1.12	1.03	1.74	1.67	1.00	0.76	1.29	0.83	0.69
2008				0.16	0.23	1.72	0.91	0.84	0.92	0.83	1.07	1.02	0.81	0.71	1.25	0.66	1.00
2009				0.23	0.40	2.55	1.21	1.10	1.22	1.12	0.86	0.83	1.24	1.11	1.14	1.38	0.59
2010				0.12	0.32	0.88	1.14	1.08	1.17	1.11	0.93	0.89	0.88	1.03	1.02	0.78	0.70
2011				0.28	0.70	2.81	1.30	1.33	1.29	1.38	0.67	0.63	0.65	1.00	1.82	1.38	1.32
2012				0.19	0.88	0.34	1.40	1.47	1.35	1.36	0.71	0.68	0.49	1.06	2.91	2.80	1.05
2013				0.54	1.36	0.70	1.16	1.12	1.18	1.18	0.34	0.32	0.61	1.01	1.56	0.87	1.86
2014				0.60	1.36	0.67	1.56	1.78	1.45	1.61	0.76	0.71	1.90	1.49	1.06	0.72	0.66
2015				0.35	1.16	0.41	1.52	1.86	1.57	1.93	1.32	1.29			1.54	0.90	0.32
2016				0.47	1.17	0.28	1.42	1.73	1.40	1.79	1.09	1.01			1.09	0.95	0.63
2017				0.17	1.16	0.20	1.40	1.77	1.48	2.03	0.75	0.71			1.22	0.51	1.91
2018				0.4	1.46	0.59	1.39	2.03	1.31	1.85	0.85	0.82			0.52	0.42	0.38
2019				0.44	1.30	0.66	1.24	1.60	1.16	1.44	0.78	0.73			2.32	2.46	0.77
2020				0.78	2.14	0.65	0.98	1.00	0.93	0.93	0.67	0.63			0.87	1.09	0.38
2021				0.57	1.34	0.43	1.10	1.09	1.04	1.04	0.92	0.88			3.01	3.73	0.28
2022				0.43	1.31	0.54	1.15	1.35	0.98	1.12	0.79	0.76			0.50	0.64	0.28

Table 5. Annual CV of CPUE for NP SMA by fleets.

	S1:US-SH-LL	S2:US-DE-LL	US-Juvenile Survey (LL) Luncie et al.?	S3:TW-LA-LL	S3:TW-LA-LL (North)	S3:TW-LA-LL(South)	S4:JP-OF-DW-SH-LL(M3)	S4:JP-OF-DW-SH-LL(M5)	S4:JP-OF-DW-SH-LL(core area)	S4:JP-OF-DW-SH-LL(core area)	S5:JP-OF-DW-DE-LL(M7)	S5:JP-OF-DW-DE-LL (core area)	S4:JP-OF-DW-SH-LL(Juvenile)	S4:JP-OF-DW-SH-LL(Immature)	S8:MX-Com-LL	S8:MX-Com-LL (North)	S8:MX-Com-LL(South)
1994							0.25	0.15	0.22	0.13	1.09	1.09					
1995							0.23	0.15	0.20	0.14	0.99	0.99					
1996							0.20	0.14	0.17	0.13	1.03	1.03					
1997							0.19	0.14	0.17	0.12	1.03	1.03					
1998							0.17	0.13	0.15	0.12	1.09	1.09					
1999							0.17	0.12	0.15	0.11	1.33	1.33					
2000							0.16	0.12	0.15	0.11	1.37	1.37					
2001							0.15	0.12	0.15	0.11	1.01	1.01					
2002							0.16	0.13	0.14	0.11	1.10	1.10					
2003							0.13	0.11	0.13	0.11	1.17	1.17					
2004							0.14	0.12	0.13	0.11	1.10	1.10					
2005				0.04	5.90	7.67	0.12	0.11	0.11	0.10	1.09	1.09					
2006				0.04	3.88	12.13	0.13	0.12	0.11	0.10	1.37	1.37	0.13	0.09	0.22	0.20	0.33
2007				0.05	5.47	12.46	0.12	0.11	0.11	0.10	1.74	1.74	0.12	0.07	0.47	0.31	0.46
2008				0.07	12.10	11.51	0.14	0.13	0.13	0.12	1.07	1.07	0.12	0.08	0.33	0.16	0.44
2009				0.08	11.52	13.78	0.12	0.12	0.11	0.11	0.86	0.86	0.15	0.09	0.39	0.37	0.50
2010				0.08	13.02	11.94	0.13	0.13	0.12	0.12	0.93	0.93	0.15	0.10	0.30	0.25	0.37
2011				0.07	12.43	10.14	0.15	0.15	0.13	0.14	0.67	0.67	0.21	0.12	0.25	0.25	0.36
2012				0.08	8.06	20.53	0.15	0.15	0.14	0.14	0.71	0.71	0.17	0.10	0.26	0.20	0.34
2013				0.04	2.96	21.12	0.16	0.16	0.15	0.14	0.34	0.34	0.21	0.17	0.28	0.27	0.36
2014				0.06	5.11	21.39	0.15	0.16	0.14	0.14	0.76	0.76	0.17	0.16	0.42	0.36	0.45
2015				0.05	5.60	14.93	0.15	0.17	0.14	0.15	1.32	1.32			0.23	0.36	0.25
2016				0.04	5.07	11.75	0.16	0.18	0.14	0.16	1.09	1.09			0.09	0.15	0.40
2017				0.07	5.60	22.64	0.17	0.19	0.15	0.17	0.75	0.75			0.33	0.28	0.30
2018				0.04	3.43	11	0.19	0.21	0.18	0.19	0.85	0.85			0.41	0.18	0.47
2019				0.03	2.75	9.97	0.18	0.20	0.17	0.18	0.78	0.78			0.23	0.25	0.39
2020				0.03	2.67	19.18	0.18	0.18	0.17	0.16	0.67	0.67			0.48	0.25	0.31
2021				0.03	2.91	16	0.18	0.17	0.17	0.16	0.92	0.92			0.24	0.19	0.33
2022				0.03	2.81	9.33	0.18	0.20	0.18	0.19	0.79	0.79			0.44	0.46	0.21

11. OTHER MATTERS

No discussion.

12. FUTURE SHARKWG MEETINGS

Discussion

The WG agreed the venue and time for the following meetings.

a) Online meeting to finish the remaining tasks of data prep. meeting (January)
    a. Japan time (9 am – 1 pm; January 23-25, 2024).
    b. California time (4 pm – 8pm; January 22-24, 2024).
b) Pre-stock assessment meeting for SMA（La Jolla FEB 5-9 in 2024）
c) Stock assessment meeting for SMA (Honolulu April 29-3 May in 2024)
d) ISC Plenary (Canada, JUNE 19-24 in 2024)

13. CLEARING OF REPORT

A draft of the report was reviewed by the participants and the content accepted. The Chair will make minor editorial changes and circulate a draft for comments before finalizing the report.

14. ADJOURNMENT

The WG Chair thanked everyone for a productive meeting! The meeting was adjourned at 14:52 on Thursday December 7, 2023 (Japan time).

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APPENDIX 2: MEETING DOCUMENTS, PRESENTATIONS, AND INFORMATION PAPERS

WORKING PAPERS

ISC/23/SHARKWG-1/1	Revisit of data filtering for CPUE of shortfin mako, *Isurus oxyrinchus*, caught by Japanese shallow-set longliner in the North Pacific. **Mikihiko Kai** (kaim@affrc.go.jp)
ISC/23/SHARKWG-1/2	Spatio-temporal model for CPUE standardization: Application to shortfin mako caught by Japanese offshore and distant water shallow-set longliner in the western and central North Pacific. **Mikihiko Kai** (kaim@affrc.go.jp)
ISC/23/SHARKWG-1/3	Spatio-temporal model for CPUE standardization: Application to shortfin mako caught by longline of Japanese research and training vessels in the western and central North Pacific. **Mikihiko Kai** (kaim@affrc.go.jp)
ISC/23/SHARKWG-1/4	Updated annual catches of shortfin mako caught by Japanese coastal fisheries in the North Pacific Ocean from 1994 to 2022. **Mikihiko Kai** (kaim@affrc.go.jp)
ISC/23/SHARKWG-1/5	Update of annual catches for shortfin mako caught by Japanese offshore and distant water longliner in the North Pacific Ocean from 1994 to 2022. **Mikihiko Kai and Toshikazu Yano** (kaim@affrc.go.jp)
ISC/23/SHARKWG-1/6	Spatial analysis of shortfin mako shark size compositions in the North Pacific Ocean. **Steven L. H. Teo, Felipe Carvalho, Jose Leonardo Castillo-Geniz, Nicholas Ducharme-Barth. Ducharme-Barth, Michael J. Kinney, Kwang-Ming Lui, and Yasuko Semba** (steve.teo@noaa.gov)
ISC/23/SHARKWG-1/7	Representativeness of two Japanese longline CPUEs as abundance index of North Pacific shortfin mako. **Mikihiko Kai** (kaim@affrc.go.jp)
ISC/23/SHARKWG-1/8	Reconsideration of catch of shortfin mako (*Isurus oxyrinchus*) caught by Japanese large-mesh driftnet fishery between 1975 and 1993 in the North Pacific. **Yasuko Semba, and Mikihiko Kai** (senbamak@affrc.go.jp)
ISC/23/SHARKWG-1/9	Estimate of catch of shortfin mako caught by Japanese squid driftnet fishery between 1981 and 1992 in the North Pacific. **Yasuko Semba, Minoru Kanaiwa, and Mikihiko Kai** (senbamak@affrc.go.jp)

ISC/23/SHARKWG-1/10	Update of sex-specific size frequency of shortfin mako (*Isurus oxyrinchus*) collected by Japanese commercial vessel and research program. **Yasuko Semba** (senbamak@affrc.go.jp)
ISC/23/SHARKWG-1/11	Update on standardized catch rates for mako shark (*Isurus oxyrinchus*) in the 2006-2022 Mexican Pacific longline fishery based upon a shark scientific observer program. **José Ignacio Fernández-Méndez, Luis Vicente González-Ania, Georgina Ramírez-Soberón, José Leonardo Castillo-Géniz, and Horacio Haro- Ávalos** (ignacio.fernandez@inapesca.gob.mx)
ISC/23/SHARKWG-1/12	Updated standardized CPUE and historical catch estimate of the shortfin mako shark caught by Taiwanese large-scale tuna longline fishery in the North Pacific Ocean. **Kwang-Ming Liu, Kuan-Yu Su, Chieng-Pang Chin, and Wen-Pei Tsai** (kmliu@mail.ntou.edu.tw)
ISC/23/SHARKWG-1/13	Updated size composition of shortfin mako shark caught by the Taiwanese tuna longline fishery in the North Pacific Ocean. **Kwang-Ming Liu, Kuan-Yu Su, and Chieng-Pang Chin** (kmliu@mail.ntou.edu.tw)

PRESENTATIONS

ISC/23/SHARKWG-1/P1	2024 ISC mako shark conceptual model. **Nicholas Ducharme-Barth** (Nicholas.ducharme-barth@noaa.gov)
ISC/23/SHARKWG-1/P2	NPO mako shark growth analysis. **Nicholas Ducharme-Barth,** (Nicholas.ducharme-barth@noaa.gov)
ISC/23/SHARKWG-1/P3	CPUE of US. **Nicholas Ducharme-Barth,** (Nicholas.ducharme-barth@noaa.gov)
ISC/23/SHARKWG-1/P4	US size data. **Nicholas Ducharme-Barth,** (Nicholas.ducharme-barth@noaa.gov)
ISC/23/SHARKWG-1/P5	Genetic population structure of shortfin mako (*Isurus oxyrinchus*) using mitogenomics and nuclear-genome-wide single-nucleotide polymorphism genotyping. **Yasuko Semba and Hirohiko Takeshima** (senbamak@affrc.go.jp)
ISC/23/SHARKWG-1/P6	Past discussion on reproductive cycle of shortfin mako (*Isurus oxyrinchus*) in the North Pacific. **Yasuko Semba** (senbamak@affrc.go.jp)

INFORMATION PAPERS

ISC/23/SHARKWG-1/INFO-1	Steven E. Campana, Warren Joyce, Mark Fowler, and Mark Showell. 2016. Discards, hooking, and post-release mortality of porbeagle (*Lamna nasus*), shortfin mako (*Isurus oxyrinchus*), and blue shark (*Prionace glauca*) in the

	Canadian pelagic longline fishery. ICES Journal of Marine Science. 73: 520-528.
ISC/23/SHARKWG-1/INFO-2	José I. Castro. 2009. Observations on the reproductive cycles of some viviparous North American sharks. aqua, International Journal of Ichthyology. 15: 205-222.
ISC/23/SHARKWG-1/INFO-3	Shoou-Jeng Joung* and Hua-Hsun Hsu. 2005. Reproduction and Embryonic Development of the Shortfin Mako, *Isurus oxyrinchus* Rafinesque, 1810, in the Northwestern Pacific. Zoological Studies. 44: 487-496.
ISC/23/SHARKWG-1/INFO-4	Henry F. Mollet, Geremy Cliff, Harold L. Pratt Jr., and John D. Stevens. 2000. Reproductive biology of the female shortfin mako, *Isurus oxyrinchus* Rafinesque, 1810, with comments on the embryonic development of lamnoids. Fishery Bulletin. 98: 299-318.
ISC/23/SHARKWG-1/INFO-5	Yasuko Semba, Ichiro Aoki, and Kotaro Yokawa. 2011. Size at maturity and reproductive traits of shortfin mako, *Isurus oxyrinchus*, in the western and central North Pacific. Marine and Freshwater Research. 62: 20-29.
ISC/23/SHARKWG-1/INFO-6	Shijie Zhou, Roy A. Deng, Matthew R. Dunn, Simon D. Hoyle, Yeming Lei, Ashley J. Williams. 2022. Evaluating methods for estimating shark natural mortality rate and management reference points using life-history parameters. Fish and Fisheries. 23: 462-477.
ISC/23/SHARKWG-1/INFO-7	Malcolm P. Francis et al. 2022. Post-release survival of shortfin mako (*Isurus oxyrinchus*) and silky (*Carcharhinus falciformis*) sharks released from pelagic tuna longlines in the Pacific Ocean. Aquatic Conservation: Marine and Freshwater Ecosystems. 33: 366-378.

APPENDIX 3. DRAFT AGENDA OF HYBRID MEETING IN NOVEMBER AND DECEMBER 2023

SHARK WORKING GROUP (SHARKWG)

INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC

Data preparatory meeting of stock assessment for North Pacific shortfin mako in Yokohama, Japan

November 29-30, December 1-2, 4-7 2023 (Western Pacific)
Meeting Hours: 09:00 – 16:00 (Japan and Korea time)
Meeting Hours: 08:00 – 15:00 (Chinese Taipei and China time)
November 28-30, December 1, 3-6 2023 (Eastern Pacific)
Meeting Hours: 14:00 – 21:00 (Hawaii time)
Meeting Hours: 16:00 – 23:00 (LaJolla, US and Nanaimo, Canada time)
Meeting Hours: 18:00 – 25:00 (Nayarit Mexico time)

DRAFT

1. Opening of SHARKWG Workshop
   a. Opening remarks (SHARK WG Chair)
   b. Introductions
   c. Meeting arrangements
2. Distribution of documents and numbering of Working Papers
3. Review and approval of agenda
4. Appointment of rapporteurs
5. Report of the SHARKWG Chair
   a. Summary of last stock assessment of NP shortfin mako
   b. Summary of recommendations determined in the WCPFC-SC
   c. Current meeting objectives
6. Review conceptual model for NP shortfin mako
7. Biological information for NP shortfin mako stock assessment
   a. Review of shortfin mako biological data for the assessment
   b. Update of shortfin mako biological data for the assessment including discussion on meta-analysis of growth curve
8. Review CPUE indices for NP shortfin mako stock assessment
9. Review catch data, discard data and total catch estimation procedures for NP shortfin mako stock assessment
10. Review size data for NP shortfin mako stock assessment
11. Discussion of key assessment topics using the conceptual model framework
    a. Stock structure (possible scenarios)

    b. Fleet structure (informed by the stock structure)
    c. Use of CPUE indices
    d. Model time period (when to start the model)
    e. Biology/Growth (several scenarios based on meta-analysis as well as fleet and stock structure)
12. Create a modeling straw-man based on the above key assessment topics
    a. Decide on broad modeling approach (e.g. single base case, ensemble…)
    b. Decide on diagnostic methods
    c. Decide on future projection method and scenarios
13. Establish work plan for the pre-assessment and final data submission deadline
14. Other matters
15. Future SHARKWG meetings
    a. Pre-stock assessment meeting for shortfin mako（La Jolla FEB in 2024）
    b. Stock assessment meeting for shortfin mako (Honolulu /May in 2024)
    c. ISC Plenary (Canada, JUNE in 2024)
16. Clearing of report
17. Adjournment

APPENDIX 4.

From Hutchinson et al. 2021 with updated numbers of tags deployed and rates. Shortfin mako shark (SMA)

High post-release survival rates and low at-vessel mortality rates were observed for SMA in the Hawaii Deep-set Longline Fishery (HIDS). This species is generally discarded in the HIDS, in 2019 total discards in the US Pacific longline fisheries was 4,522 animals with ~ 11% retained (PIFSC 2020).

At-vessel mortality rates (26%) for this species in the Pacific Island Region Observer Program (PIROP) data set were low compared to other studies in longline fisheries: 100% in the IO (Coelho et al. 2011); 26% (Campana et al. 2016), 35.6% (Coelho et al. 2012), and 75% (Afonso et al. 2012) in the AO; and 35.0% (Beerkircher et al. 2004) and 29.3% (Gallagher et al. 2014) in the US longline fisheries targeting swordfish and tuna in the Western AO and Gulf of Mexico respectively.

Post-release survival rates for SMA that were discarded were estimated to be relatively high (96%) in this study with only 1 mortality observed out of 27 tags that reported (32 animals were tagged in the study, 5 tags did not report, and 1 tag was removed because tagging effects couldn't be ruled out). Other studies with much larger sample sizes also found high post-release survivorship for SMA captured in longline fisheries: in the equatorial western Pacific Ocean, 88.4% in uninjured SMA out to 60 days, this estimate dropped to 36.8% if the SMA were injured (Francis et al. 2019). In this study survivorship was greater in large (>150 cm fork length) uninjured sharks and sharks released with shorter lengths of trailing gear (Francis et al. 2023). At 30 days, survival was estimated at 90.2% for SMA (CI: 82.3–98.9%). By 50 days, the proportion of sharks surviving was 84.8% for SMA (CI: 74.7–96.1%; Francis et al. 2023). A study on SMA post-release survival in the AO also noted that condition was a factor where 70% of healthy SMA survived while 67% of injured SMA survived (Campana et al. 2016). The disparity in post-release survival estimates across these studies are also influenced by handling and gear configurations.

The figure A1 below shows the size range from the animals tagged in the US survival study (Hutchinson et al. 2021). Lengths are approximate total length measured in feet from the observers. Vertical axis is number of individuals in the bin.

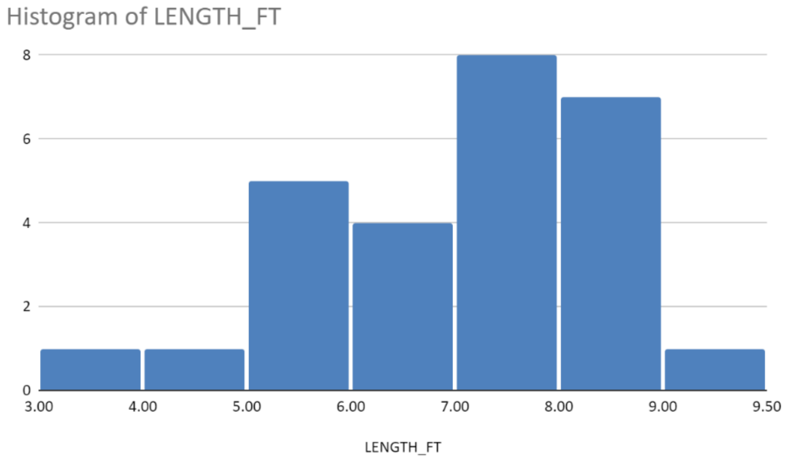

Figure A1. Size range from the animals tagged in the US survival study.

***Table A1**. Summary of at vessel status and fishery interactions with study species. The number of sharks that are alive, dead, percent alive, and average trailing gear length in meters (range in parentheses) for discarded sharks captured in the American Samoa longline (ASLL) and the Hawaii deep-set longline (HIDS). All observations came from observers on-board the vessels that were participating in this study.*

	Alive		Dead		% Dead		Trailing gear length	
Species	ASLL	HIDS	ASLL	HIDS	ASLL	HIDS	ASLL	HIDS
C. falciformis	311	137	176	76	36%	36%	2.86 (0-13)	5.59 (1-15)
C. longimanus	108	177	63	77	37%	30%	1.92 (0-7)	5.05 (1-16)
P. glauca	1,211	16,288	74	1,250	6%	7%	3.68 (0-15)	8.34 (1-16)
A. superciliosus	49	924	24	349	33%	27%	2.84 (1-10)	6.01 (1-16)
I. oxyrinchus	29	946	39	334	57%	26%	1.67 (1-2)	6.7 (0-16)

Just including the table above because I think it's an important consideration – these data are from the HIDS longline fishery before they switched to mono leaders (ASLL uses mono). So I am making the assumption that a higher proportion of SMA were able to free themselves in ASLL by biting through the line – and there is then a higher proportion of SMA in poor condition at the vessel. It is interesting how large the difference in at vessel mortality is for SMA compared to other species.

*Table 2. Survival tag deployment details. The total number of tags deployed by species, along with the number of mortalities, number of sharks surviving during tag deployment, number of tags that did not report data (non-reporters) and the number of tags that were removed from the analyses due to possible effects on survival from tagging. Values in superscript are the number of tags that were removed from the analysis due to tagging effects. *Total number of tags by fate do not include the tags that were removed from the analysis.*

Species	Total tags deployed	Died	Survived	Non – reporters	Removed	Proportion surviving (%)
I. oxyrinchus	32	1	26^{1}	5	1	96.2