FINAL

ISC/24/ANNEX/06

ANNEX 06

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 SHARK WORKING GROUP WORKSHOP SECOND DATA PREPARATORY MEETING OF STOCK ASSESSMENT FOR NORTH PACIFIC SHORTFIN MAKO

June 2024

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ANNEX 06

REPORT OF THE SHARK WORKING GROUP WORKSHOP SECOND 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)

January 23-25, 2024
Virtual Meeting

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 a 3-day web meeting from January 23 to 25 for western Pacific (from 22 to 24 for eastern Pacific), 2024. The primary goal of the workshop was to complete 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 procedure of the conditioning of Stock Synthesis (SS) model at the pre-assessment meeting in February 2024. Mikihiko Kai, SHARKWG Chair, opened the meeting at 9:00 am on January 23, 2023 (western Pacific time). Participants included members from Canada, China, Chinese Taipei, The Inter-American Tropical Tuna Commission (IATTC), Japan, Mexico, and United States of America (USA) (**APPENDIX 1**). SHARKWG Chair welcomed all participants.

1.2. Distribution of Documents and Numbering of Working Papers

Three WG papers were distributed and numbered (**APPENDIX 2**). All WG papers except for Document-No 1 were approved for posting on the ISC website (http://isc.fra.go.jp/) where they will be available to the public after ISC Plenary in June 2024.

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.	J. King (Lead), M. Hutchinson
7.	M. Kinney (Lead), M. Kanaiwa
8.	S. Teo (Lead), K.M. Liu
9.	M. Kinney (Lead), Y, Semba
10.	N. Duchrme-Barth (Lead), J. Tovar-Ávila
11-14.	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 mentioned that the current main meeting objective is to prepare completely for all available biological parameters and fishery data for the stock assessment of NP SMA in 2024.

3. BIOLOGICAL INFORMATION FOR NP SMA STOCK ASSESSMENT

3.1. Update of SMA Biological Data for the Assessment Including Discussion on Meta Analysis of Growth Curve, Maximum Age, Natural Mortality, and Steepness.

Mako Age and Growth, Meta-analysis Revisited. Michael Kinney, Nicholas D. Ducharme-Barth, Norio Takahashi, Mikihiko Kai, Yasuko Semba, Minoru Kanaiwa, Kwang-Ming Liu, José Alberto Rodríguez-Madrigal, Javier Tovar-Ávila (ISC/24/SHARKWG-1/1)

Accurate age estimation is a key component for the assessment of any species. Errors in age and growth parameters can have severe consequences both in the accuracy and stability of an assessment model, and in the subsequent management of the species. This is especially true when the species in question is data limited in other ways (catch, effort, etc.) such as with North Pacific SMA shark (shortfin mako). Since 2011 members of the ISC Shark WG have been seeking to improve our understanding of SMA growth by holding growth workshops and collaborating on meta-analysis approaches to best use what data is available. Here we seek to review and better document the information gained, and decisions made surrounding the three age and growth workshops held by ISC Shark WG members between 2011 and 2017. Additionally, we provide an updated age and growth meta-analysis that utilizes laboratory calibration factors for the combination of age data, an updated parametrization of the von Bertalanffy growth model (*Schnute*), and a more statistically appropriate means of combining age readings with length frequency data for an improved ability to estimate key growth parameters. Ultimately our analysis suggests that North Pacific SMA are larger at age zero ($L1_{2024}$=65.2; $L1_{2018}$=60) grow slightly slower (k_{2024} female=0.128, male=0.141; k_{2018} female=0.128, male=0.174) and reach a smaller size ($L2_{2024}$ female=272.2, male=225.4; $L2_{2018}$ female=293.1, male=232.8) than what was estimated for the 2018 assessment of North Pacific SMA (ISC 2018).

Discussion

The WG provided an overview of the historical context of age and growth estimation efforts for the NP SMA. The WG noted that details on the vertebra reference collection were provided along with efforts of standardization and calibration across regional methodologies and datasets. The WG expressed interest in updating the analysis, the intention was how to translate reference collection and how to make a calibration of readings across the methods (60 individuals with shared vertebra across multiple labs for readings from same samples) age and growth info across studies. Calibration would allow an update of the information that was available in 2018. The uncertainty in the LF data was already a concern – where sensitivity analysis showed the model was very sensitive to the data set. The data set was truncated to keep it from overriding all the other data in the model – which weakened the dataset – and the approach also used an outside growth function and converted LF to ages – which also biased. The WG also noted that this working paper provides the methods and the rationale behind the integration and calibration factors and a better use of the LF data. The improvements aren't a complete shift for how the data is handled but a few tweaks that improve the model. The WG invited to take the historical nuances of age and growth parameter estimation into account.

The WG discussed the large uncertainty in the approach used in the 2017 analysis where the best approach was to combine analyses (2 band pairs up to age 5 for the Eastern Pacific and 1 bad pair for Western Pacific) and how to proceed for this assessment – use the meta-analysis or change the growth curve?

The WG also presented the modeling approach on the updated growth analysis. The WG provided explanations on the revised analyses where the WG member replicated the results from Takahashi et al. (2017) using STAN instead of JAGS, estimated the lab calibration factors, applied calibration factors to standardize the vertebral aging data and estimated VBG parameters, reparametrized the Takahashi et al.(2017) model to be more consistent with assumptions in SS and also added length frequency likelihood component to estimate growth parameters using both standardized vertebral aging data and length frequency data.

The WG discussed the approaches used in this presentation, nuances in the datasets used and problems with the fits for larger individuals. There was some discussion about the L_{inf} parameter estimated using this approach and potential underestimation. The WG also discussed how the Length Frequency data was handled and noted that, without the benefit of the Japanese LF dataset age estimation, the Runcie et al. (2016) LF dataset was integrated, and the effect is watered down mixture model with down weighted age data.

The WG focused discussion on the two recommended growth curve estimation procedures: Japan age method with 1 band per year, without length frequency data (JP-1-noLF; Table 4 of ISC/24/SHARKWG-1/1) and US age method with 2 bands per year, with length frequency data (US-2-LF; Table 8 of ISC/24/SHARKWG-1/1). An attribute of the JP-1-noLF approach is that it produces similar growth curve parameter estimates to the Takahashi et al. (2017) approach used in the previous SFM assessment, providing consistency. An attribute of the US-2-LF approach is that it represents a validated ageing methodology for younger fish, providing accurateness.

The WG concerns regarding the lack of fit of the US-2-LF approach to the Taiwan size data for older fish, specifically an underestimation of size at older ages. The WG noted that this same lack of fit was observed in Takahashi et al. (2017) which was the approach for estimating the growth curve used in the SFM 2018 assessment, i.e. that approach also underestimated the size of the oldest ages. The WG also raised the concern that if the US-2-LF approach is used to estimate the growth curve for the assessment model, an underestimation will be applied to a large portion of the annual catch (i.e. Taiwanese fleets). However, the lack of fit only applies to older fish typically >300 cm PCL, and there are only 4 fisheries in the assessment with SFM >300 cm and with very small numbers of observations, i.e. only 0.08% of all observations. Therefore, the US-2-LF approach for estimating a growth curve in fact represents most observations. The WG noted that it is important that the uncertainty due to process error in the growth curve estimated by the US-2-LF approach does include the rare observations of large fish. Additionally, the WG noted that the US-2-LF approach provides a better fit to the Japan, US and Mexico size data than the JP-1-noLF approach, and that these nations' fleets together also comprise a large portion of annual catch.

The WG discussed applying the US-2-LF approach to eastern SFM and the JP-1-noLF to western SFM. The WG emphasized that the two growth curve estimation procedures represented differences in ageing methodology and not necessarily differences in growth rates of SFM between the eastern and western Pacific. Additionally, the stock assessment model is not a spatial model and there is no movement parameterization. The WG noted that a lack of genetic information on population structure does not support easy demarcation of fisheries data, and many fisheries straddle or fish in both regions. Additionally, within SS when fish move between regions the model does not retain the early-life growth curve and switches, so fish can actually shrink in size within the model.

Some of the WG members were concerned that the L_{inf} estimated by the US-2-LF approach was too low, particularly compared to the Takahashi et al. (2017) results and to L_{max} reported in the literature. The WG clarified that L_{inf} is not L_{max}, but rather the mean L of older fish. The lower L_{inf} reflects the lower L_{max} observed in our fisheries compared to the literature, for example L_{max} for US fisheries is 325 cm PCL, for Taiwan fisheries is 330 cm PCL, for Japan fisheries is 315 cm PCL and for Mexico fisheries is 305 cm PCL. All these observations are lower than reported in the literature, e.g. 340 cm PCL. Despite a lower L_{inf} estimated by the US-2-LF approach, the WG noted that the k estimated is very close to the Takahashi et al. (2017) approach used in the last SFM stock assessment. The WG noted that it is not unusual in other growth curve estimations that the L_{inf} is lower than the observed L_{max}.

Some WG members (Japan and Chinese Taipei) expressed concern that they did not have enough opportunity to read and fully comprehend the analyses undertaken in the Working Paper, since the paper was provided close to the meeting date. Of particular note was the method to convert age estimates from Takahashi et al. (2017) back to band counts in order to conduct the new analyses in the Working Paper. The method used in Takahashi et al (2017) used an externally derived equation based on band counts and the months of birth and of band formation to estimate a fractional age (e.g., age 0.25 vs. age 0). The WG member clarified that information on when the samples were collected were not available, and Takahashi et al. (2017) did not explicitly outline the relationship that was used to convert to fractional age. So that conversion was not used in the current new analyses. Ideally, the underlying raw band-pair counts used in Takahashi et al. (2017) could be made available for inclusion in the new analyses, but it is uncertain if these data are available. The WG noted that the new analyses therefore did have to take the age estimates from Takahashi et al. (2017) to estimate band counts to conduct the lab standardization. For Japan and Taiwan ages, the authors assumed a 1 band-pair per year hypothesis by taking the function of floor () of each age (rounding to the greatest integer less than or equal to the age). For the US and Mexico which assumed the 2 band pairs for the first 5 years with a transition to 1 band pair per year after that, for ages greater than or equal to 5, added 5 to the age before taking the floor () and converting back to band counts. For ages less than 5, the age was multiplied by 2 before taking the floor (). This provided estimates of raw band pair counts from each lab that could be standardized using the estimated calibration factor (Phase 2). Next the standardized band-pair counts were converted to a standardized age by applying the band-pair deposition hypothesis (e.g., multiplying by 1 for Japan or dividing by 2 for US for counts up to 10, and subtracting 5 to US counts after 10). Additionally, the WG concerns regarding the small sample size for US origin samples, specifically for the impact it has on the calibration factor used for the US-2-LF approach. The WG clarified that the calibration factor was derived from the ISC vertebrae reference collection ($n \approx 60$), and applied for all labs so the sample size for US calibration is no more of an issue than it is for other countries.

The WG discussed five options for estimating the growth curve in the stock assessment model: 1) retain the growth curve estimation approach of Takahasi et al. (2017); 2) use the mean parameters between the JP-1-noLF and the US-2-LF approaches; 3) use the JP-1-noLF approach as the base model and the US-2-LF approach as a sensitivity run; 4) use both the JP-1-noLF approach and US-2-LF approach as separate scenarios, but downweight the US-2-LF approach; 5) use both the JP-1-noLF approach and US-2-LF approach as equally weighted scenarios in an ensemble modeling approach. The WG noted that the JP-1-noLF approach and US-2-LF approach will each result in different estimates of M, steepness, and reproductive cycle.

The WG noted that retaining the growth curve estimation approach of Takahasi et al. (2017) is not appropriate since it did not account for difference in ageing methodology between labs. The differences in ageing methodology produce different age estimates, therefore it is not good practice to combine ages without standardization. The WG noted that the US-2-LF approach is based on an OTC validated age (up to 5 years) and is also a plausible method to standardize ages. The WG also noted that the use of mean parameters between the JP-1-noLF and the US-2-LF approaches is also not appropriate since these two approaches are both results from meta-analyses. So, using the mean of the two approaches will result in the loss of the uncertainty in the growth hypotheses. The WG mentioned that the growth curve estimates resulting from the JP-1-noLF approach and the US-2-LF approach should remain separate growth curve estimates and should not be combined.

The WG noted that Canada, Mexico, and US members did not support using the JP-1-noLF approach as the base model and assigning the US-2-LF approach as a sensitivity run. This sensitivity run would require separate steepness and M estimates. Assigning the US-2-LF approach downplays the plausibility of the underlying age determination method, and it was emphasized that it was an OTC validated method.

The WG did not support using both the JP-1-noLF approach and US-2-LF approach as separate scenarios and down-weighting the US-2-LF approach because of the similar rationale to assigning the US-2-LF approach as a sensitivity run. The WG argued that since both age determination methods are plausible, there is no objective rationale to a priori down-weight the US-2-LF approach.

The WG reached consensus that both the JP-1-noLF and US-2-LF growth curve estimations will be used as equally weighted scenarios in an ensemble modeling approach. The WG could not fully agree on using one approach over the other: The JP-1-noLF approach produces estimates similar to the those used in the previous SFM assessment, but has a poorer fit for Japan, US and Mexico data and is based on unvalidated age determination method. The US-2-LF approach is based on an OTC validated age determination method, but it estimates a much lower L_{inf} than L_{max} observed or reported in the literature and has a poorer fit to the Taiwan data. If both approaches are utilized as two plausible scenarios, then the stock assessment will encompass the full views of the WG. However, there remains outstanding concerns from Japan and Chinese Taipei WG members regarding the conversion of age to band count data for the calibration component and with the lower L_{inf} estimated by the US-2-LF. As such, **the WG agreed that the stock assessment model fits will be assessed at the pre-assessment meeting (February in 2024) to determine if equal weighting of the JP-1-noLF and US-2-LF is appropriate or whether there is validity to adopting only one approach as a base case.**

Developing Natural Mortality Priors for North Pacific Shortfin Mako Sharks. Steven L. H. Teo, Nicholas D. Ducharme-Barth, and Michael J. Kinney (ISC/24/SHARKWG-1/2)

In the previous stock assessment of north Pacific SMA sharks in 2018, the instantaneous natural mortality rate (M) was assumed to be 0.128 y^{-1} for both sexes and all ages. This study re-examined the assumptions for M of this stock in preparation for the next assessment in 2024. Following the recommendations for "best" practices, this study developed probability distributions for M that could be used as priors for the assessment. Meta-analytical methods were first used to estimate a range of probability distributions of M for this stock, based on empirical relationships between M and life history parameters. These probability distributions were subsequently combined into a single probability distribution that could be used as a prior for M in the upcoming assessment. We used three empirical relationships between life history and M: 1) Maximum age (AgeMax); 2) Growth (Lk); and Age at maturity (AgeMat). This study found severe problems with a publicly available data with Ms and life history parameters with sharks and instead focused on another dataset with primarily teleosts, which may result in M priors that would be biased high for sharks. This study used the results from previous studies to calculate prediction intervals for each estimated M (in log-scale), using appropriate empirical data sets and life history parameters for this stock. We combined the priors from each empirical relationship using weights based on the variance of the logM distribution (i.e., inverse variance weighting) and the degree of overlap in the data sets used for the meta-analyses (data independence weights). In general, the predicted Ms from the AgeMax relationship was relatively high compared to the the Lk and AgeMat relationships. The exception appeared to be the predicted Ms from the AgeMat relationship or male SMA sharks, which was due to the young AgeMax for male sharks. It was noted that the results from the two growth curve methodologies were relatively similar, and averaging all three growth curves may have overweighted the US-based growth methodologies. The overall predicted M distributions also appear to be similar to the range of M point estimates from shark-based relationships. It would be recommended that these M distributions be used as priors for the upcoming stock assessment, if possible. Even if a fixed M point estimate is preferred due to model specification problems, it would be recommended to use the priors to specify the limits of sensitivity runs. This would allow the upcoming assessment to follow current "best" practices to the extent possible. However, it is noted that these predicted M distributions are based on datasets largely derived from teleosts, but these datasets appear to be the currently best available datasets for this work.

<u>Discussion</u>

The WG re-examined the assumptions for M made in the 2018 assessment and presented an alternative approach following best practices to develop probability distributions for M that could be used as priors of the 2024 stock assessment.

The WG discussed the pros and cons to the empirical approach from Hoenig (1983) used in the last assessment versus the ensemble approach presented in this paper, particularly in relation to the uncertainty around the growth model and maximum age.

The WG mentioned that it was valid to assume that age-0 SFM are more vulnerable (i.e. higher M) than age1+ individuals and discussed how age-specific M could be accommodated in the stock assessment model. The 2018 stock assessment illustrated that the use of the Lorenzen relationship (Lorenzen, 1996) to estimate age-specific M (Kai and Yokoi, 2017) was not appropriate for SFM. The 2024 stock assessment could adjust age 0 M to the higher values in a prior range to account for likely higher age-0 M.

The WG also mentioned that sex-specific differences in M is a reasonable assumption, but asked for clarification on how it could be accommodated in the stock assessment. The main assessment biologist suggested two possible approaches: 1) to estimate within the model, independent M parameters for males and females, or; 2) have a base model for one sex, but then scale differences between sexes (scaled up or scaled down) to model male and females. The second approach would be able to accommodate catch data that does not have sex-specific data.

The WG noted that the methodology to estimate M priors for the stock assessment model should be based on an agreed upon growth curve. For now, the WG suggested that a candidate M be used, and reassessed on suitability at the pre-assessment meeting once discussion on whether an ensemble approach or a best parameter approach will be used. The candidate M could be used as priors to estimate M internally, or the median value of the prior could be used as a point estimate with uncertainty. The WG noted that the estimation of steepness will need to match the M and growth curves used.

The WG discussed whether the same M values for males and females were appropriate. The WG noted that there is strong evidence that SMA have different growth rates between sexes so it follows that M would also be different between the sexes.

The WG noted that SMA are vulnerable to the fishery when they are juveniles and M could be the same for this life stage. The WG decided to set up M scenarios, to test models and that good practice would include a bridging analysis to the previous assessment. **The WG agreed to explore an age structured M where (1) the age-0 M is different from the Ms of the other age classes; (2) the early life stages (ages 1-2) have the same M between male and female, and then it splits by sex.**

The WG finally agreed to use four natural mortalities (Table 3; Estimated values for male and females from growth curves of JP approach:JP1_noLF and US approach: US2_LF) for the stock assessment.

3.2. Review of Biological Parameters Used in the Stock Assessment.

The WG reviewed the tables of life history parameters and discussed the best practice biological parameters.

Discussion

The WG decided on 4 good baseline scenarios (two growth curves and two natural mortalities corresponding to the growth curves) to start from. The WG mentioned that there is quite a bit of uncertainty around M and growth. So, while we may start with 4 scenarios it is imperative that uncertainty gets perpetuated throughout the models, and it is very likely that we will end up with more than 4 scenarios.

The WG also discussed steepness and agreed the point estimate needs to be based on biological parameters and assumptions need to be consistent with the natural mortality, growth, and the other biological parameters (i.e., mean/median and CV scenarios) used in the assessment.

The WG also agreed to use both 2- and 3-year reproductive cycles.

The **Table 1** of **APPENDIX 4** contains the summary of the biological parameters, references, and decisions made for each parameter.

4. REVIEW CPUE INDICES OF US FOR NORTH PACIFIC SHORTFIN MAKO STOCK ASSESSMENT

Catch, Length-Frequency and Standardized CPUE of Shortfin Mako from the US Hawai'i's Longline Fisheries Through 2022. Nicholas Duchrme-Barth, Michael J. Kinney, Steven L. H. Teo, Felipe Carvalho. (ISC/24/SHARKWG-1/3)

The VAST spatiotemporal modelling package was used to develop a standardized CPUE index from Q3 deep-set observer data (2000-2020) as this was felt to be most representative of sub-adult/adult individuals. The final model indicated a generally increasing trend up through 2017, after which the model either declined or bounced back to 2017 levels depending on if possibly anomalous predictions were used in the strata used for the index calculation. As a result, both indices are put forward for further investigation within the stock assessment model.

Discussion

The WG indicated that the Japan Kinkai shallow CPUE index had a continuous sharp increasing trend in 2018 assessment, and there was some concern expressed during the WCPFC SC meeting in whether the sharp increase of the JP_Kinkai_shallow index was reasonable or a data quality problem, and finally the index was not used in the base case model in 2018 assessment.

The WG concerned that the US deep-set also looks to have an increasing trend since 2000 (over a 20-year period a 300% increase). The WG noted that this will need to be looked at more closely when these indices are placed in the model (how they fit in the model). Once that is done, we can decide what to do with these datasets (weighting, etc.). The WG indicated that the Japan Kinkai shallow index and the US index are both showing an increasing (reasonably consistent) trend, which is a good thing (adds confidence to using the indices in the assessment) and will be looked at further in the model. The WG indicated however, that the increasing trend in the Kinkai shallow is now starting to decline. The WG mentioned that based on how the data is looking it does seem like the SMA stock is showing signs of rebuilding from a previous low point, which is a good sign. The WG indicated however that while these two indices are showing the same kind of trend, it is not universal across all indices (such as Mexico) so this will need to be looked at closely in the model. The WG indicated that more than one index from the Hawaii longline data will be tired in the model as it seems like there were some sets that had very high catch. During the pre-assessment meeting, the author plans on developing models with consistent indices, potentially as part of an ensemble of models.

The WG noted that generally, the two indices from the Hawaii longline data to be tested will be one that uses data from all areas, and one that uses a subset of areas (core area where most catch comes from) that does not include the anomalous sets.

5. REVIEW CATCHES OF US, AND DISCARD DATA OF EACH COUNTRY FOR NP SHORTFIN MAKO STOCK ASSESSMENT

Catch, Length-Frequency and Standardized CPUE of Shortfin Mako from the US Hawai'i's Longline Fisheries Through 2022. Nicholas Duchrme-Barth, Michael J. Kinney, Steven L. H. Teo, Felipe Carvalho. (ISC/24/SHARKWG-1/3) [**Catch**]

The US presented catch for the US Hawai'i deep-set and shallow-set longline where the input catch for the assessment was defined, based on observer data, as the sum of retained catch, dead discards, and individuals discarded alive that experience post-release mortality. A design-based catch reconstruction was used for the deep-set for the years 2005-2022 given the lack of complete observer coverage. Catch was similarly extended back to 1971. Shallow-set catch was highest in the early 1990s and remained high prior to a fishery closure in the early 2000s. Catch for the shallow-set remained low. Deep-set catches increase through 2017, after which a combination of gear changes by the fishery causes catch to go down.

Discussion

The WG asked if the increase in SMA interactions in the Hawaii longline (deep-set) was possibly due to an increase in the population. It was responded that yes, even in the CPUE, there is an increase, and so this may indicate more SMAs. The drop in interactions seen in the shallow set is likely the result of a change in bait.

Estimation of Discard of North Pacific Shortfin Mako Caught by Japanese Kinkai-Shallow and Coastal Longline Fisheries (No Working Paper)

Rate of release and mortality rate of released sharks for Kinkai-Shallow longline fleet was calculated based on observer data compiled between 2014 and 2019. Average rate of release was 23.6% and 76.4% of catch was retained. For the released shark, 25.5% was dead and 74.5% was alive. Dead discard at release and post-release mortality were calculated as follows;

Dead discard at release: (catch number * 0.236/0.764) * 0.255

Post-release mortality: (catch number * 0.236/0.764) * 0.745 * 0.038

Discard is sum of dead discard at release and post-release mortality. 0.038 was cited from Table2 in the **APPENDIX 4** of Meeting report of Data preparatory meeting for the North Pacific SMA stock assessment held in November-December 2023.

Discussion

No discussion.

Summary of the Estimation of Fishery Data Methodology, MEXICO

Mexico provided detailed explanation for the estimation methods of catch (**APPENDIX 5**).

6. REVIEW SIZE DATA OF US, AND SIZE DATA RAISED BY CATCH FOR NP SHORTFIN MAKO STOCK ASSESSMENT

Catch, Length-Frequency and Standardized CPUE of Shortfin Mako from the US Hawai'i's Longline Fisheries Through 2022. Nicholas Duchrme-Barth, Michael J. Kinney, Steven L. H. Teo, Felipe Carvalho. (ISC/24/SHARKWG-1/3) [**Size Data**]

Length-frequency observations for the deep-set and shallow-set longline were taken from observer data. Only records with lengths given as TL, FL, and PCL were retained. These lengths were then all converted to PCL where appropriate. The aggregate deep-set distribution was unimodal while the shallow-set distribution was bimodal. Separating the distribution by sex and month indicated seasonal patterns where larger individuals were typically encountered in the summer months (e.g., Q3).

Discussion

The WG indicated that quarter three is perhaps when large females are gathering around Hawaii based on the US deep-set size data and that larger sizes of both males and females are caught at that time of year. The WG asked about the exclusion of animals less than 35cm PCL in the analysis, it was answered that no animals of that size were recorded, and the limit was a carryover from code designed for blue sharks. The WG asked why small females were captured in the shallow-set in the winter quarter of the year but there were very few small males (i.e., female-biased sex ratio). It was answered that this could be a result of the wide spread nature of the shallow-set and those small females may be captured closer to the HI islands. The WG indicated that typically the sex ratio for makos is 1:1 in juvenile stage, but the split in the data looks different. **The WG agreed that this should be looked into and the data will be examined by space and time to see what is going on (if there is sex specific separation around Hawaii).**

The US mentioned that size data is complete for the US, for this assessment but it is not raised to the catch as there is no spatial data so it can't be done.

Estimation of Catch at Length for the North Pacific Shortfin Mako Caught by Japanese Kinkai-Shallow fleets and Japanese Research and Training Vessels (RTV)

Size data collected from port sampling for Japanese Kinkai-Shallow fleet and RTV was extracted and 10 (latitude) by 20 (longitude) block was assigned for each size data, based on the location of catch (grid for port sampling data and set by set for RTV). Based on this, size data was converted to frequency table with 1 cm bin for each Block, Year, and sex in each fleet. For the unsexed size data, half of the number in each bin was added to the number of female and male in the same bin within the same Block and Year, under the assumption of even sex ratio for unsexed individuals.

To calculate the catch at length, following approach was adopted.

Step 1. The percentage of frequency of each bin (sex aggregated) per total number of size data in each stratum (i.e., Block (10-20 latitude and 140-160 longitude) in 2005) was calculated.

Step 2. Sex ratio of each bin was also calculated for each stratum.

Catch number by size class and sex was calculated by multiplying catch number in each stratum by the percentage of each bin (in Step1) and sex ratio of each bin (in Step2) for the corresponding stratum. This procedure was applied to the catch (in number) and size data for two fleets, separately.

<u>Discussion</u>

The WG asked if Japan Kinkai shallow discard data will be provided, it was answered that that would be observer data and can be provided and should be included in the size meta-database reviewed at the meeting (Japan costal longline length data from discards should also be reviewed and added in the same way).

6.1. Review of Other Size Data

<u>Discussion</u>

TWN small-scale longline does not need to be raised to the catch as they measure every fish (census).

7. ESTABLISH WORK PLAN FOR THE PRE-ASSESSMENT

The WG discussed a workplan for the upcoming pre-assessment meeting. The WG noted that the main modeler has already updated the model to new version of SS. Pre-assessment meeting participants can then proceed to checking the input data and control file to ensure there are no mistakes with initial model settings. Following a verification of the inputs then the conditioning of the model can begin after a discussion of the most appropriate series of steps to take within the bridging analysis to reach the 2024 diagnostic case model.

The WG noted that the estimation of steepness will be finished by the beginning of the preassessment meeting and will submit a document paper, but the working paper will be focused on the main outcomes because the estimation model is the same as those used in the literature (Kai, 2020).

The WG confirmed that the table of fishery data (Catch, CPUE, and size data) will be completed by the beginning of the preassessment meeting and will share with the WG members.

Following the pre-assessment meeting the WG suggested to hold online meetings every 2-3 weeks so that WG members could be kept up to date on progress and could provide feedback where necessary. Additionally, the WG noted that the model files will be made available to WG members who are interested (e.g., Google Drive or Github).

The WG also discussed the sensitivity analyses, and it was proposed that many of these sensitivity analyses would be rolled up within the model ensemble. However, important model changes would be presented as steps within the bridging analysis or as distinct one of sensitivities from the diagnostic model in the model ensemble.

The WG confirmed the participants of the pre-assessment meeting from the outside countries.

8. OTHER MATTERS

The WG strongly requested to submit the working paper earlier and then distribute to the WG members at least one week before the meeting, otherwise it is difficult to understand the contents of the working paper. The ISC SHARKWG Chair agreed and mentioned that it is vital to keep the rule of the submission of working paper.

9. FUTURE SHARKWG MEETINGS

a. Pre-stock assessment meeting for SMA（La Jolla/ FEB 5-9 in 2024）

b. Stock assessment meeting for SMA (Honolulu /April 29-May 3 in 2024)

The WG discussed the time schedule of the meeting and confirmed the available time of the meeting room (until 3:45 pm), so the WG decided that the ISC SHARKWG Chair will arrange the meeting schedule including whether we will do the hybrid meeting.

c. ISC Plenary (Canada, JUNE in 2024)

The ISC SHARKWG Chair announced that the election of ISC SHARK WG Chair and Vice Chair will be held at the upcoming ISC Plenary meeting, June in 2024.

10. 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.

11. ADJOURNMENT

The WG Chair thanked everyone for a productive meeting! The meeting was adjourned at 12:35 on Thursday January 25, 2024 (Japan time).

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APPENDIX 1: LIST OF PARTICIPANTS

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APPENDIX 2: MEETING DOCUMENTS AND INFORMATION PAPERS

WORKING PAPERS

ISC/24/SHARKWG-1/1	Mako Age and Growth, Meta-analysis Revisited. **Michael Kinney ,Nicholas D. Ducharme-Barth, Norio Takahashi, Mikihiko Kai, Yasuko Semba, Minoru Kanaiwa, Kwang-Ming Liu, José Alberto Rodríguez-Madrigal, Javier Tovar-Ávila** (michael.kinney@noaa.gov)
ISC/24/SHARKWG-1/2	Developing natural mortality priors for North Pacific shortfin mako sharks. **Steven L. H. Teo, Nicholas D. Ducharme-Barth, and Michael J. Kinney** (steve.teo@noaa.gov)
ISC/24/SHARKWG-1/3	Catch, length-frequency and standardized CPUE of shortfin mako from the US hawai's longline fisheries through 2022. **Nicholas Duchrme-Barth, Michael J. Kinney, Steven L. H. Teo, Felipe Carvalho** (nicholas.ducharme-barth@noaa.gov)

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

January 23-25, 2024 (Western Pacific)
Meeting Hours: 09:00 – 13:00 (Japan and Korea time)
Meeting Hours: 08:00 – 12:00 (Chinese Taipei and China time)
January 22-24, 2024 (Eastern Pacific)
Meeting Hours: 14:00 – 18:00 (Hawaii time)
Meeting Hours: 16:00 – 20:00 (La Jolla, US and Nanaimo, Canada time)
Meeting Hours: 18:00 – 22:00 (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. Current meeting objectives
6. Biological information for NP shortfin mako stock assessment
   a. Update of shortfin mako biological data for the assessment including discussion on meta-analysis of growth curve, maximum age, natural mortality, and steepness.
7. Review CPUE indices of US for NP shortfin mako stock assessment
8. Review catches of US, and discard data of each country for NP shortfin mako stock assessment
9. Review size data of US, and size data raised by catch for NP shortfin mako stock assessment
10. Establish work plan for the pre-assessment
11. Other matters
12. 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)
13. Clearing of report
14. Adjournment

APPENDIX 4

Table 1. Summary of biological parameters determined to use in the stock assessment of North pacific shortfin mako in 2024.

Parameter	Value of Male	Value of Female	Reference	Remarks
Natural mortality	0.197 y^{-1} (Median), 0.326 (SD of logM)	0.139 y-1 (Median), 0.326 (SD of logM)	Teo et al. (2024)	Maximu age + Growth parmeter (Linf, K) based on JP approach without length frequency data
	0.204 y^{-1} (Median), 0.326 (SD of logM)	0.133 y-1 (Median), 0.326 (SD of logM)		Maximu age + Growth parmeter (Linf, K) based on US approach with length frequency data
Max age	29 years	32 years	Natanson et al. (2006)	Observed age based on the study on the vertebrae
Growth	Linf: 236.901 cm PCL (Median) , k: 0.119 $year^{-1}$(Median), L0: 65.109 cm PCL(Median)	Linf: 305.524 cm PCL (Median) , k: 0.101 $year^{-1}$(Median), L0: 65.109 cm PCL(Median)	Kinney et al. (2024)	JP approach (1 band per year)
	Linf: 224.864 cm PCL (Median) , k: 0.142 $year^{-1}$(Median), L0: 65.209 cm PCL(Median)	Linf: 272.387 cm PCL (Median) , k: 0.128 $year^{-1}$(Median), L0: 65.209 cm PCL(Median)		US approach (2 band per year until 5 years old and then 1 band per year)
Length-weight	a: 4.62×10^{-5}, b: 2.77,	a: 3.40×10^{-5}, b: 2.84	Su et al. (2017)	Combined Taiwanese data with Japanese data
Length at maturity (L50 and slope)	L50: 166 cm PCL (a:-25.06, b:0.0137)	L50: 233 cm PCL(a: -34.23, b: 0.146)	Semba et al. (2017)	The WG noted that the relationship did not include estimated uncertainty in the relationship (e.g., 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.
Fecundity	12 pups per litter		Mollet et al. (2000)	3 relationships: 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 and 3 years		Semba et al. (2011), Joung and Hsu (2005)	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.

APPENDIX 5: *SUMMARY OF THE ESTIMATION OF FISHERY DATA METHODOLOGY, MEXICO*

1) The SMA shark catch data that the Mexican Delegation has delivered to the ISC Shark WG comes from two sources:

From the document presented at the Shark WG meeting that took place in Puerto Vallarta, Jalisco, Mexico in November 2014 by Sosa et al, later updated for the period 1976-2016.

In those WPs past SMA shark catches were estimated using different sources of information, assuming different proportions of the species in total catches that have been published in the scientific literature or estimated using more detailed local statistics. The aforementioned working document presents estimates for the SMA shark catches landed at four states from northwestern Mexico, Baja California, BC, Baja California Sur, BCS, Sinaloa, Sin, Nayarit, Nay. The SMA sharks are caught mainly by the artisanal and mid-size longline fisheries that target pelagic sharks or swordfish. Catches that were landed in the past by the large size vessel long-line fisheries and the drift gill net fisheries were taken into consideration to construct the historical series.

Aggregated shark catches from Mexico's Pacific waters were provided by the Mexican National Institute of Fisheries and Aquaculture (INAPESCA, based in its name in Spanish) for each state in the Mexican Pacific, from 1976-2013. Because SMA shark is mainly landed at the Baja California, Baja California Sur, Sinaloa, Nayarit and Colima states, the estimation is based on their reported total shark catches. For the period of 2008 to 2013 SMA shark catches for each state are here reported as they have been reported by CONAPESCA (Fishing Commission) in its web page. The estimated catches for each of the states followed different assumptions for the proportion that SMA sharks represented in the total shark catch reported, following the Sosa-Nishizaki et al. (2014) approach.

For the period 2014 to 2016 catches were submitted by CONAPESCA directly to INAPESCA.

<u>Baja California</u>

In Baja California sharks are target by the artisanal fishery that catch mainly sharks (Holts et al. 1998). Since 1986 middle sizes vessels (10-17 m size) drift gillnet fishery started targeting sharks and swordfish, where SMA was an important target species because its value and the demand in USA. This fishery was banned by federal regulations in 2010. Some of the drift gill net fishing vessels started to switch fishing gear to long-lines in the middle of the 1990s, and kept targeting swordfish, but also pelagic sharks, mainly blue shark and SMA shark (Holts et al. 1998; Sosa-Nishizaki et al. 2008). Shark landings statistics were obtained from the Mexican fisheries agency office at the port of Ensenada. Because Baja California state has two coasts, one facing the Pacific Ocean and the other the Gulf of California, for some periods in the statistics for each coast had to be estimated. Reported shark landings are sorted by coast for the period of 1992 to 2010, and since 2002 SMA shark landings, in weight, are specified for some of the years. SMA shark is only landed in the Pacific side, so first we estimated the proportion of the total shark landings that come from the Pacific coast and obtained the Pacific shark catch for each year. Based in the information reported in Sosa-Nishizaki et al. (2002), Sosa-Nishizaki et al. 2008, and Cartamil et al. (2011), the proportion of SMA shark caught by the artisanal fishery was estimated to be 2% of the total yearly catch of sharks caught in the Pacific side. During the 1976 to 1989 period the total SMA shark catches were assumed to be landed by the artisanal fishery only, and yearly shark catches were estimated using this proportion.

By 1990 the number of artisanal boats targeting blue and SMA shark increased, and the middle size boats started to land SMA shark, instead of finning them at sea. For the period of 1990 to 1992, in order to reflect this increment, we assumed a proportion of 12% of the shark catches were represented by SMA shark catch. Since 1993, most of the middle size vessels started to land blue shark and SMA, and local landing statistics started to by classified, including both species catches. However, there was a high increment in the blue shark catches representing 55% of the total shark catches in the Pacific for the period of 1993 to 2007, and a decrease of the proportion of the SMA was seen, so we assumed a proportion of 10% during the period of the middle of 1980s to middle 2000s. For the period of 2008 to 2016, based on observations at port, SMA shark landings have decreased to represent only the 7% of the state catches.

Baja California Sur

In this state, most of the SMA shark catches come from the artisanal long-line fishery at both Pacific side and Gulf of California coasts (Bizzarro et al. 2009b; Ramirez-Amano 2011). Nevertheless, at Puerto San Carlos in Magdalena Bay of the Pacific coast, a middle size fleet of small number of vessels (4-8 depending on the year), have been fishing with drift gillnet and long-line since the middle of 1990s (Ramirez-Gonzales 2002), and switch to long-lines after 2010. During 2015 and 2016 landings at this port increased substantially to 957 t in 2016, to decrease in the following year to around 300 t level.

The proportion of SMA shark catches in the total shark catches of the state were estimated for different periods. From 1976 to 1984, 2 % was the proportion in the state catches, based on the information reported by Bizzarro et al. (2009b), and considering that fishing in the Pacific coast was less developed. From 1985 to 1989, 4% was used considering the development of the artisanal fishery in the Pacific coast and the continuation of the fishery in the Gulf of California (Bizzarro et al. 2009b; Ramirez-Amano 2011). For the period of 1990 to 2000, the proportion was raised to 6 % to include the participation of the middle side vessels based in Puerto San Carlos. And for the period 2001 to 2006 the proportion was raised to 8 % to reflect a continuity of the increment of the pelagic shark catches in recent years, suggested by Ramirez-Amano (2011).

Sinaloa

Bizzarro et al. (2009a) described the artisanal catches of elasmobranch in the state of Sinaloa and found very few shortfin sharks among 2,390 sharks analyzed during 1998-1999. Today in the port of Mazatlán pelagic sharks are usually landed by the middle size vessel long-line fishery that is based there. This fishery is one of the less known shark fisheries in the country. The SMA shark catches estimations for this state were done, first, considering the proportion of the total sharks landed in Mazatlan. For the period of 1976 to 1993, because of the lack of information, we assumed that 50% of the sharks landed in Sinaloa were landed in Mazatlan. For the period of 1994 to 2011 we have access to data reporting the proportion of sharks landed in Mazatlan in yearly bases, with values varying from 47% to 94%. These values were used to estimate shark catches landed at Mazatlan.

Knowing the total shark catches landed in Mazatlan, for the period of 1976 to 1992 a 1% value was used as the proportion of SMA sharks caught by the local fishery, taking into consideration local artisanal catches observations (Corro-Espinosa unpublished data). To estimate the following years catches, we used a 5.5 % value based on observer on board reports and landing reports.

Nayarit

Since 2003 the Nayarit state has almost double its "tiburón" and "cazón" landings from a level of 843 t to 1,594 t in 2011 (CONAPESCA 2011). In this state, sharks are landed only by the artisanal fishery. Pérez Jiménez et al. (2005) and Mondragon-Sanchez (2011) estimated that blue shark represented 1% of the catches in the most important fishing areas of Nayarit. We used this proportion to estimate the blue shark catches for this state during the period of 1976 to 2013, because the fishery has not changed significantly during the whole period (Mondragon-Sanchez, 2011).

Colima

SMA shark catches in the state of Colima are landed mainly in the port of Manzanillo, where a large size vessel long-line fishery operated during the period of 1986 to 2002 (Mendizabal y Oriza et al., 2002). Before that period most of the fishing was carried out by the artisanal fishery, and we assumed a 0.1% of SMA for this fishery. Since 2003, a long line fishery using middle size vessels (10-14 m long), started to operate targeting sharks in costal pelagic waters (Vögler et al., 2012). Yearly blue shark catches for the state were estimated, for the period of 1976 to 1986, assuming artisanal operations only, with a proportion of 1% similar to Nayarit. Then for the period of 1986 to 2002, I used the yearly proportions of blue shark reported by Mendizabal y Oriza et al., (2002). Then a proportion of 1% was used to reflect the catches of SMA shark by the coastal middle size vessels (Santana-Hernández personal communication), for the 2003 to 2006 period. Finally, we used SMA shark catches reported for the state by CONAPESCA.

1) from the official catch statistics that the National Fisheries and Aquaculture Commission obtains from the "arrival notices" that permit holders of both large and small vessels are required to report after each fishing operation.

However, Mexican shark catch statistics by species were not available until recently (2023) and for a limited range of years.

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