FINAL

ISC/20/ANNEX/06

ANNEX 06

20th Meeting of the
International Scientific Committee for Tuna
and Tuna-Like Species in the North Pacific Ocean
Held Virtually
July 15-20, 2020

REPORT OF THE SHARK WORKING GROUP WORKSHOP

July 2020

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ANNEX 06

REPORT OF THE SHARK WORKING GROUP WORKSHOP

International Scientific Committee for Tuna and Tuna-like Species

December 4-10, 2019
Shimizu, Shizuoka, Japan

1. OPENING OF THE WORKSHOP

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 7-day meeting (with a Monday break) at the National Research Institute of Far Seas Fisheries (NRIFSF) in Shimizu, Shizuoka from December 4-10, 2019. The primary goal of the workshop was to complete an update stock assessment for blue shark, *Prionace glauca*, in the north Pacific (BSH). A secondary objective was to review biological parameters and fishery data of the BSH and to discuss work plans for the upcoming benchmark stock assessment for the BSH.

Mikihiko Kai, SHARKWG Chair, opened the meeting. Participants included members from Chinese Taipei, Japan, Mexico, and United States of America (USA or US). Participants are listed in **Attachment 1**. SHARKWG Chair, Mikihiko Kai, and Division Director of the Project Management Department of NRIFSF, Toshihide Iwasaki, welcomed SHARKWG participants and wished everyone a successful meeting and pleasant visit to Shimizu.

1.2 DISTRIBUTION OF MEETING DOCUMENTS

Eight working papers and four information paper were distributed and numbered (**Attachment 2**). Eleven oral presentations were also made during the meeting and numbered. All working papers were approved for posting on the ISC website where they will be available to the public.

1.3 REVIEW AND APPROVAL OF AGENDA

The draft meeting agenda was reviewed and adopted with a minor change (**Attachment 3**).

1.4 APPOINTMENT OF RAPPORTEURS

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

Item	Rapporteurs
1-7.	M. Kai
8a.	M. Kinney, Y, Fujinami
8b.	M. Kanaiwa, W.P.,Tsai
8c.	Y. Semba, K.M., Liu
9.	Y. Semba, K.M., Liu, A., Yamamoto, A., Kurashima
10.	M. Kinney, M., Kanaiwa
11.	M. Kai, Y. Fujinami
12-15.	M. Kai

2.0 SUMMARY OF CURRENT MEETING OBJECTIVES

The Chair of the SHARKWG reviewed the current meeting objectives and the desired outcomes. They included: 1) summarize the outcomes of webinar in Nov., 2019 and benchmark stock assessment in 2017 for the BSH; 2) update the annual catch of the BSH caught by each fleet until 2018 (2016-2018); 3) review the progress of size data analysis as well as CPUE standardization methods for the BSH; 4) review the progress of biological study of the BSH and shortfin mako, *Isurus oxyrinchus*, in the north Pacific (SFM); 5) propose a future work plan in the collaboration with ISC member countries; 6) conduct the future projection to put forward to represent the stock dynamics of the BSH; 7) summarize the stock status; 8) draft conservation information; 9) develop an outline of the update stock assessment report and a plan to complete the report before the ISC Plenary; and 10) develop plans for conducting the intermediate stock assessment for the SFM in 2020.

3.0 SUMMARY NOVEMBER WEBINER AND OUTCOMES

An intersessional webinar of the SHARKWG was convened via Google hangout in Nov. 6, 2019. Meeting participants included six members from Japan, Mexico, USA and the Inter American Tropical Tuna Commission (IATTC) (**Attachment 4**). The draft meeting agenda of webinar was reviewed and adopted (**Attachment 5**).

The primary goal of the webinar was to discuss a proposal, change in the stock assessment cycle for BSH and SFM from 3 years to 5 years, raised by some member countries (Japan, Chinese Taipei and USA) of the SHARKWG at ISC plenary meeting in Chinese Taipei (ISC, 2019). SHARKWG Chair explained the background of the proposal. In the meeting, there was no objection about the proposal from all participants (Canada, ISC, Japan, Korea, Chinese Taipei and USA). ISC Chair, however, requested to conduct an update stock assessment for both species if the assessment cycle was prolonged. The motivation of the 5 years cycle was a recommendation that was first proposed by the Western and Central Pacific Fisheries Commission (WCPFC).

The advantages were that; (1) it will reduce the burden of the stock assessment scientists, especially for the main modeler of Stock Synthesis (SS); (2) there is no urgent request to assess the stock

status for BSH and SFM because the WG has already finished benchmark assessments for both stocks and the stock status is healthy in the green zone of Kobe plot that means the stock is not overfished and overfishing is not occurring; (3) It will allow biologists more time to work on issues related to the estimation of biological parameters (e.g., growth curve of SFM), and (4) it will help stagger the assessment schedule of highly migratory species to allow greater collaboration with other ISC WG assessment scientist. The disadvantage was that if the spawning biomass declines sharply due to overfishing, management reactions could be delayed. After thorough discussion, **the WG agreed to change the assessment cycle from 3 years to 5 years for BSH and SFM, and the WG also accepted the 5-year time schedule (Table 1).**

The WG discussed a way of conducting the update stock assessment. **The WG agreed to conduct the update stock assessment using the future projection of SS with updated catch data in the years following the last benchmark stock assessment.**

The WG established a work plan for the next stock assessment and final data submission deadline. Annual catch data of BSH caught by all fleets is to be updated until 2018 and to be sent to the SHARKWG Chair by Nov. 21, 2019 (two weeks before the meeting). Japanese modeler will take the lead on the future projection of SS in cooperation with USA modeler and conduct the projections in advance of the update assessment workshop. The future projection will be conducted based on the deterministic way for the process error.

Table 1. Stock assessment schedule (5 years cycle) accepted by SHARKWG.

Year	Seasons/ Month	Contents	Species	Meeting	Cycle
2019	December	Update stock assessment	BSH	SHARKWG	1st year
2020	July	Report the new stock status	BSH	ISC Plenary	2nd year
2020	Fall	Update stock assessment	SFM	SHARKWG	
2021	July	Report the new stock status	SFM	ISC plenary	3rd year
2021	Fall	Data prep. meeting	BSH	SHARKWG	
2022	Spring	Full stock assessment	BSH	SHARKWG	
2022	July	Report the new stock status	BSH	ISC Plenary	4th year
2022	Fall	No assessment meeting to make an interval between full stock assessments of both species			
2023	July	No report the new stock status		ISC Plenary	5th year
2023	Fall	Data prep. meeting	SFM	SHARKWG	
2024	Spring	Full stock assessment	SFM	SHARKWG	
2024	July	Report the new stock status	SFM	ISC Plenary	1st year
2024	Fall	Update stock assessment	BSH	SHARKWG	
2025	July	Report the new stock status	BSH	ISC Plenary	2nd year
2025	Fall	Update stock assessment	SFM	SHARKWG	
2026	July	Report the new stock status	SFM	ISC Plenary	3rd year
2026	Fall	Data prep. meeting	BSH	SHARKWG	
2027	Spring	Full stock assessment	BSH	SHARKWG	
2027	July	Report the new stock status	BSH	ISC Plenary	4th year
2027	Fall	No assessment meeting			
2028	July	No report the new stock status		ISC Plenary	5th year

Discussion

The WG clarified the approval of WCPFC as for the change in the assessment cycle from 3 years to 5 years and SHARKWG Chair responded that the stock assessment for sharks and billfish in the WCPFC is commonly carried out every 5-years and the change will definitely be accepted.

4.0 SUMMARY PREVIOUS STOCK ASSESSMENT IN 2017

SHARKWG Chair reviewed the previous benchmark stock assessment and future projection of the BSH in 2017 (WCPFC, 2017).

This paper presents the preliminary SS stock assessment of the BSH. The assessment consisted of running a SS with newly available catch, abundance index, and length and size composition data for 1971-2015. The results indicated that biomass (age 1 and older) for the BSH fluctuated around 316,896 mt from 1971 until 1981, thereafter exhibited a decline to the lowest level of 202,135 mt in 1993, and then increased to around 302,171 mt for the last three years (2013-2015). Estimated fishing mortality gradually increased from the early 1970s to the late-1980s, peaked at 0.84 $year^{-1}$ in 1989 in response to higher catches, and declined to 0.11 $year^{-1}$ in the most recent years (2013-2015). Compared to MSY-based reference points, the current spawning biomass (average for 2013-2015) was 68% above SSB_{MSY} and the current fishing mortality (average for 2013-2015) was 67% below F_{MSY}. The base case model indicated that the BSH stock was not overfished and was not subject to overfishing relative to MSY-based reference points.

Discussion

No discussion.

5.0 REVIEW FISHERY DATA FOR NORTH PACIFIC BLUE SHARK UPDATE STOCK ASSESSMENT

5.1 CATCH AND DISCARD DATA

SHARKWG Chair reviewed the updated annual catch data of other countries (China, IATTC, Mexico, non-ISC countries and USA-Hawaii) (**Table 2**). The annual catch of China for 2016-2018 was updated by SHARKWG Chair using the average catch for 2011 -2015 because submission of the catch was not made. The annual catch of IATTC, Mexico and USA-Hawaii for 2016-2018 was updated by each country/organization using the same method as that used in the previous assessment in 2017. The annual catch of non-ISC countries (Federated States of Micronesia, Kiribati, Marshall Islands, Papua New Gunia, Palau, Solomon Islands, and Vanuatu) were simply summed up the annual catches provided by Secretariat of the Pacific Community (SPC).

Discussion

The WG agreed that in the update stock assessment, the annual catches of IATTC, Mexico, non-ISC countries and USA-Hawaii will be used, however, the average catch weight (2011-2015) will be used for China. The WG also suggested looking at the effort data from China if possible, to try and understand if a substantial drop in effort was apparent from the data of SPC, which may help explain the drop in reported catch. The WG generally encouraged that each nation should provide information on discard and discard mortality so that a more accurate idea of total dead removals can be provided.

Blue shark (Prionace glauca) bycatch statistics in Canadian fisheries. **J.R. King and A.M. Surry. (*ISC/19/SHARKWG-1/06*)**

We update the catch statistics for 2016- 2018 for blue shark in Canadian waters. The blue shark catch in several Canadian fisheries are recorded as pieces and are expanded using a mean weight recorded in the groundfish hook and line fishery to provide catch statistics in weight. Previously, a mean weight of 21.07 kg was used for this expansion, but erroneous records in the database were discovered and removed. We also provide corrected catch statistics for 1979-2015 using a corrected mean weight of 24.57 kg per piece.

Discussion

The WG discussed if the discard rate was used as the total dead removals in the Canada catch. Based on the catch table provided it seems that 100% discard mortality was applied and so discards were equal to total dead removals. The WG suggested that with the availability of observer data, a discard mortality should be easily calculable and should be used to produce total dead removals that are some percentage of discards. The WG asked Canada to provide information on discard mortality so that the WG knows how total dead removals where calculated. The WG also suggested that in the future (next benchmark assessment) average weight of BSH not be applied to convert catch from number of BSH caught, and instead data should simply be provided in numbers. The WG further proposed doing some sensitivities in the current assessment update that include some different assumptions of discard mortality.

Estimation of blue shark catch by Korean tuna longline fishery in the North Pacific Ocean. **Sung-Il Lee, Doo-Nam Kim, Mi-Kyung Lee and Youjung Kwon. (*ISC/19/SHARKWG-1/08*)**

Annual catches of BSH by Korean tuna longline fishery operated in the north Pacific Ocean from 1982 to 2018 were estimated using logbook and observer data. Although the logbook data have been collected since 1971, the data prior to 1982 were not used in this study due to low spatial coverage and sample size. In addition, shark catch by species has been collected through logbook since 2009. First, shark catch from logbook was aggregated by year and raised based on the data coverage to represent the actual total catch, and then the BSH catch was estimated from the raised total catch. In the estimation of the BSH catch, the time period was divided into two parts that one is the period (from 1982-2012) when there was no or less information about the catch for identified sharks and the other is the period (2013-2018) when there was reasonable information about the catch for identified sharks by species. In the former case, the BSH catch was estimated using total shark catch and the ratio (0.52) of BSH catch to total shark catch came from observer data in recent years for 2013-2018. In the latter case, the BSH catch was directly calculated from the total catch without any processing.

Discussion

The WG noted that no discard information was provided for the Korean catch. The WG suggested that in the future Korea should include an estimate of discard mortality in their calculation of total dead removals. The WG also noted that the assumption that 52% of unidentified shark catch was BSH is different from the identified percent of BSH compared to unknown/other shark in the most recent catch. It is possible that this was due to a decrease in shark catch across the fishery in recent years, regardless, this should be explored more thoroughly. The WG expressed concern that some

misidentification of BSH was happening and would like Korea to further investigate its estimate of BSH from unidentified shark catch.

Update of Japanese annual catches for blue shark caught by Japanese offshore and distant - water longliner in the North Pacific Ocean from 1994 to 2018. **Mikihiko Kai.** (***ISC/19/SHARKWG-1/03***)

This working paper provides update of Japanese annual catches of BSH caught by Japanese offshore and distant-water longline fishery in the western and central north Pacific during 1994 and 2018. 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 including retained and discard/released catches were estimated using a product of standardized annual CPUEs and the fishing effort. The methods were almost the same as those used in the previous analyses. The results showed that the total estimated catches of BSH caught by Japanese offshore and distant-water longline fishery had been decreasing since 1995 until 2018 due to the reduction in the total fishing effort. The total estimated catches in recent five years were varied between 10,498 and 14,232 tons.

Discussion

The WG discussed an issue of target shift in the CPUE standardization for the Japanese offshore and distant water longline fishery. The WG noted that the Japanese shallow-set longline fishery usually targets BSH in the northern area in summer and swordfish (*Xiphias gladius*) in the southern area in winter-spring. The WG noted that the main reason of the insignificant effect of the target effect based on the 10th percentile of swordfish CPUE on the results is that the explanatory variables of season and area are enough to explain the annual catch rates. The WG noted that Japan had started to develop another method to improve the modeling of the target effect using a finite mixture model.

The WG also noted that the large-scale longline fishery in Chinese Taipei frequently changes the target species, but it is possible to easily identify the target species using the information about the depth of hooks (i.e. hooks per basket) because the main target species are bigeye tuna (*Thunus obesus*) and albacore tuna (*Thunnus alalunga*).

Update of annual catches for blue shark caught by Japanese coastal fisheries in the North Pacific Ocean from 1994 to 2017. **Mikihiko Kai, and Toshikazu Yano.** (***ISC/19/SHARKWG-1/04***)

This working paper provides update of Japanese annual catches of BSH caught by Japanese coastal fisheries in the north Pacific Ocean during 1994 and 2017. Since Japanese official coastal landing data have no information about the species for pelagic sharks, the annual catches of coastal fisheries are estimated using the available other shark's species-specific data from other data sources such as sales record (i.e. a ratio of the BSH to sharks). The estimated annual catches showed that the proportion of total annual catches of the BSH caught by Japanese longline fisheries as well as large mesh drift net fishery were accounted for more than 97%. The estimated annual catches had declined from 1994 to 1997, and then gradually increased and reached to the maximum value at 4,064 tons in 2007. Thereafter, the estimated annual catches have been decreasing due to

the decrease of the catches by longline fisheries, while the catches of large mesh drift net fishery had significantly increased in 2016 and 2017.

Discussion
No discussion.

Updated catch of blue shark in US West coast fisheries. **Michael J Kinney.** (***ISC/19/SHARKWG-1/P04***)
The US provided updated catch of BSH for the west coast drift gillnet as well as recreational fisheries (e.g. private fishing boats and commercial passenger fishing vessels). The calculation of past catch for each fishery was maintained for the approaching BSH assessment update, and previous methods for catch calculation were followed in producing estimates for 2016-2018. Past working papers where unclear about the method used to estimate BSH catch for California and Washington recreational fishing, since neither state identifies BSH in its catch, only unidentified shark. The current update used the ratio of BSH to unidentified shark caught in Oregon to establish a ratio that was then applied to the unidentified shark catch in California and Washington.

Discussion
The WG suggested that the methods for obtaining US west coast catch be kept as is for the current assessment update, but that when the next benchmark assessment is undertaken, catch should be recalculated to deal with some of the past discrepancies apparent in WG papers, and to clearly outline decisions that were made, such as what to do with recreational catch in California and Washington which did not record BSH specie catch. The WG also asked about the method of estimating the discard mortality. It was answered that was estimated based on the previous study (live discarded shark ×post release mortality factor). For the drift gillnet fishery, post-release survivorship was assumed to be 0 (every animal caught was dead). For the albacore troll and the recreational fisheries 6.3% post release mortality was assumed (Musyl et al. 2011).

5.2 CPUE INDICES

Update on standardized catch rates for blue shark (Prionace glauca) in the 2006-2018 Mexican Pacific longline fishery based upon a shark scientific observer program. **José Ignacio Fernández-Méndez, José Leonardo Castillo-Géniz, Horacio Haro-Ávalos, Georgina Ramírez-Soberón, and Luis Vicente González-Ania.** (***ISC/19/SHARKWG-1/p10***)
The results of a previous analysis made in the Mexican Pacific showed a reduction in the standardized abundance indices of BSH in a ten-year period (2006 – 2015). However, it was noted that most of this decrease happened in the last two years of the series, when an ENSO event occurred, so it was proposed that the results of the analysis should be considered within the context of biology of the species and the concurrent oceanographic events in the area. Population structure of BSH is known to be complex, with different life history and habitat preferences by size class and sex. The longline fishery for sharks in the northwestern Mexican Pacific operates in two regions with different oceanographic and biogeographical characteristics: The temperate California Current System at the north and tropical waters southward. Size and sex composition of the BSH is quite different in those areas.

In view of this, the work aims at updating the standardized abundance indices of the BSH in the 2006-2018 Mexican Pacific longline fishery, modeling relative abundance indices trends for the northern (temperate) and southern (tropical) zones separately, to assess the relative importance of the concurrent ocean warming episode to explain variations in the abundance indices of both zones. Several predictor variables (related to environmental factors and fishing strategies), not included in the previous analysis, were considered as having a possible influence on the variation of the response variable. Three different GLMs (with Gamma, Negative-binomial and Log-normal error structures) were set for each zone as a function of these factors. The proportion of zero-catch sets is around 3 % in the northern zone and 10% in the southern zone.

In the preliminary results, the inclusion of the additional variables (to the ones used in the previous standardization) results in more stable standardized abundance indices. Recommendations made by members of the Working Group, regarding methods of model selection will be incorporated in coming analysis.

Discussion

The WG noted that different dependent variables were used in CPUE standardization with the three models, which may cause a problem for AIC-based model selection. The WG suggested that the authors may use cross validation to overcome this issue. The WG also suggested that the authors may use the AIC and/or BIC as the selection criteria of the most suitable explanatory variables. The WG pointed out, based on the statistical theory that the use of a discrete model such as Poison and Negative binomial is generally more appropriate than a continuous model such as Gamma and lognormal for count data such as catch number. The WG, however, encouraged continuing the lognormal and gamma models because the mean catch per number of hooks is very high for these fisheries which means there is small effect on the results of CPUE standardization. The WG further suggested that the authors include the zero catch in their analysis as this has been shown to have a significant effect in the results of the CPUE standardization, in general.

The WG noted that the oceanographic variables such as SST commonly may have an impact on the catchability or availability of the BSH in the fishing operation. The WG suggested that the use of average SST is reasonable if the oceanographic events directly impact on the catch ratio. The authors replied that the oceanographic variables affected the catchability in this area. The WG also discussed the disparity in the number of significant explanatory variables between northern and southern zone. The WG noted that the number of hooks per basket for the shallow-set longline fishery is between 4 and 7. The WG also noted that the proportion of night-set has increased in the northern area since 2011 which suggests partial target shift from BSH to swordfish. The WG noted that the percent of moon illuminated seems to have an effect on BSH catch in the southern zone.

Update information on standardized CPUE and catch estimation of the blue shark from Taiwanese large-scale tuna longline fishery in the North Pacific Ocean. **Wen-Pei Tsai and Kwang-Ming Liu. (*ISC/19/SHARKWG-1/05*)**

In the present study, the BSH catch and effort data from observers' records of Taiwanese large-scale longline fishing vessels operating in the north Pacific Ocean from 2004-2018 were analyzed. Due to the large percentage of zero shark catch, the catch per unit effort (CPUE) of the BSH, as

the number of fishes caught per 1,000 hooks, was standardized using delta lognormal approach. The analysis of standardized CPUE showed a stable increasing trend for BSH. The results suggested that the BSH stock seems at the level of optimum utilization. The BSH by-catch was estimated using the area-specific standardized CPUE multiplying the fishing effort and accounting for the coverage rate. Estimated BSH by-catch in weight ranged from 1 ton in 1973 to 1,315 tons in 2002.

Discussion

The WG encouraged continuing this analysis to provide updates on annual catch and CPUE standardization information from the Taiwanese large-scale tuna longline fishery. The WG suggested that the authors apply the Zero-inflated negative binomial model because the use of a discrete model is more suitable for count data (i.e. catch number). The WG pointed out that the residual plot of the binomial parts does not make sense and suggested that authors apply the randomized quantile residuals (RQR; Dunn and Smyth, 1996; Feng *et al*., 2017) because Pearson and deviance residuals have an issue regarding non-normal regression models where residuals are far from normality.

5.3 SIZE DATA

Review of size data of North Pacific blue shark (Prionace glauca) provided from each CPCs. **Yasuko Semba.** (***ISC/19/SHARKWG-1/p07***)

Based on the BSH size data compiled, comparison of number of size data between previous and current dataset and among fishery were conducted. Also, mean, CV (coefficient of variation), and standard deviation for annual PCL (pre-caudal length) for sex-combined, male, female, unknown sex was compared among fishery. Compared to previous dataset, "old" data before 1990 and "latest" data between 2016 and 2018 were newly added. Regarding the amount of total size data, it increased rapidly since 2012, which was caused by the start of port sampling in "Kesennuma". Among fishery, between 1992 and 2005, size data from Research and Training Vessel (Japan) dominated, then that from Mexico middle scale longline dominated between 2006 and 2012 and "Kinkai-Shallow" (Japan) dominated after 2012. Regarding the comparison of annual trend of PCL among fishery, decreasing and increasing trends were observed in Hawaii shallow-set longline, but there was no clear annual trend.

Discussion

The WG discussed the current coverage of size data from the spatio-temporal viewpoint. In general, the coverage is strongly affected by operation of each fleet. The WG noted that the current spatial coverage is enough from the view of stock assessment because it covers operation area of each fishery, however, the coverage in high- and low-latitude may not be sufficient from the purpose of understanding the whole picture of distribution (i.e., biological distribution pattern) by size and sex. The WG discussed difference of mean length by fishery. The WG pointed out that the mean PCL of BSH caught by Taiwanese large-scale longline fishery was large due to that their operation area was the tropical area where tropical tuna has been targeted. The WG noted that the decreasing trend of mean PCL in Hawaii shallow-set longline fishery may be explained by the shift of operation area from south to north. The WG confirmed that some continuous trend which

may reflects the change in the population structure was not observed from the size data of each fleet since the last stock assessment.

Clustering analysis of size data for blue shark (Prionace glauca). **Minoru Kanaiwa, Yasuko Semba, Mikihiko Kai, Castillo-Geniz, Jose Leonardo, Haro-Avalos, Horacio and Carrillo-Colin, Luis Daniel, Kwang-Ming Liu, Wen-Pei Tsai, Michael Kinney, Steven L. H. Teo, and Felipe Carvalho. (*ISC/19/SHARKWG-1/01*)**

The spatiotemporal pattern of size distribution is the key information to understand the biological characteristics, and investigation of various fishery data is required to cover all of the habitat for blue shark in north Pacific Ocean. We conducted mixture model to clarify the spatiotemporal pattern of size distribution. As a result, there is a smaller cluster in northern area and larger clusters of female in southern area through all seasons. Large clusters of male in southern area existed in quarters 2 and 4. Further consideration was required to understand the phenomenon.

Discussion

The WG confirmed that redefinition of fleet in the SS is the main purpose of this work. The WG discussed how to interpret the result of this analysis regarding the redefinition of fleet because the current analysis treated the size data quarterly while size data was treated as combined annual-based dataset (i.e., all season aggregated) in the SS. The WG recommended to continue this work considering that removal of seasonal effect and then to discuss the availability of the result for the original purpose. The WG suggested that the author should refine/reconsider the fishery definition of original data used in this study and modify the fleet definition because the number of fishery definition used in this analysis is larger than that used in the SS, and thus the parts of fishery definition are not overlapped with those in the SS. The WG also discussed the treatment of annual effect in the analysis. The WG noted that the model diagnostics is necessary to check the effect of each explanatory variable on the result. The WG also pointed out that there is a lack of data in the tropical area of the north Pacific.

Preliminary results of redefining fleet definitions of North Pacific fisheries with spatiotemporal consideration of blue shark size and sex data. **Michael J Kinney, Felipe Carvalho, Mikihiko Kai, Yasuko Semba, Kwang-Ming Liu, Wen-Pei Tsai, Castillo-Geniz, Jose Leonardo, Haro-Avalos, Horacio, Carrillo-Colin, Luis Daniel, Steven L. H. Teo. (*ISC/19/SHARKWG-1/03*)**

Following on from the last SHARKWG meeting in which the author presented findings from a cluster analysis of Hawaiian longline data, the author gave a presentation outlining the progress of expanding this project to include all the fleets currently in the ISC BSH assessment. The author outlined how the data was reformatted to break length data into categories based on sex and size at maturity, and that these categories where then turned into proportions to standardize within and across grid-cells. The author discussed the use of k-means clustering in order to determine the optimal number of clusters to use in the analysis, and then the use of a hierarchical clustering approach taking into account, season, sex, and size category. At the moment, the author has not completed this analysis and more work is needed, for instance, running a model where year is included, where season is not, and perhaps one where raw numbers of individuals in length categories are used instead of proportions. The author is also working to determine a way of drawing boundaries between the identified clusters which could ultimately be used to determine a fleet structure that could be used in the next benchmark assessment.

Discussion

The WG discussed the use of k-means clustering as an approach for determining the appropriate number of clusters. The WG noted that the k-means approach may diminish the sum of squares between observation and the cluster center to identify the optimal number of clusters, however, the sum of squares was reduced as the number of clusters increased. The WG discussed how the number of clusters (4) was decided and the author responded that it was decided taking into consideration of the visual inspection of the outputs. Members of the WG have also used this approach for the other species and expressed they could share code with the author which they used to determine the appropriate number of clusters from a k-means approach. The WG also suggested that more models with different combinations of factors need to be investigated, which the author agrees to and plans on. The WG determined that this work should continue and be discussed again.

6.0 REVIEW BIOLOGICAL DATA FOR NORTH PACIFIC BLUE SHARK AND OTHER SHARKS

The evaluation of the accuracy to estimate the body length by using several meseared parts for blue shark. **Atsuya Yamamoto, Yuki Fujinami, Yasuko Semba and Minoru Kanaiwa. (*ISC/19/SHARKWG-1/02*)**

Summary

In this study, we searched for an alternative best available and accurate measurement part for estimating the body length in limited situations, such as in the fish auction market. It was considered that it is effective to use log-transformed DL (Dorsal fin length), IDS (Inter dorsal space), PCA (Pectoral fin anterior margin), and CPH (Caudal fin peduncle height) to estimate the body length under limited situations. The average range of 95% confidence interval of DL and PCA were narrower than other body parts. Especially, PCA seemed to be convenient because it is possible to estimate the body length by using either the right or the left.

Discussion

The WG discussed the applicability of alternative conversion factor for future stock assessment. The WG noted that the analysis was conducted in sex-aggregated dataset. The WG encouraged to conduct similar analysis for each sex separately. The WG also noted that comparison of variability between past and current length-weight relationship would be useful and PCA may be useful if the pectoral fin is not damaged during the processing of shark.

Seasonal migrations of pregnant blue shark, Prionace glauca, in the northwestern Pacific. **Yuki Fujinami, Ko Shiozaki, Yuko Hiraoka, Yasuko Semba, Seiji Ohshimo, and Mikihiko Kai. (*ISC/19/SHARKWG-1/P01*)**

Information on the movements of highly migratory species is important for understanding their ecology including habitat use, population connectivity and stock structure, and thus implementing management and conservation measures. The BSH is highly migratory with a global distribution and exhibits complex movement patterns throughout the global ocean. Although the previous telemetry studies of this species revealed their seasonal migration, diel vertical movements, and sex- and ontogenetic segregations, no reports exist about the movement patterns of pregnant BSH. This study used pop-up satellite archival tags (PSATs) to elucidate seasonal migration by pregnant BSHs in the northwestern Pacific. Twenty-four adult females were tagged, and archival data were subsequently obtained for 21 females (141.1–243.3 cm precaudal length). Of these, 17 were confirmed to be pregnant at the time of release, using ultrasonography or analysis of sex steroid hormones. Females with small embryos had all moved in a northeasterly direction, from subtropical (10–30° N) into temperate (30–40° N) waters, during autumn and the next spring; two of these females had returned to subtropical waters during spring and summer. In contrast, females with large embryos had moved in a southwesterly direction, from temperate into subtropical waters, during spring and autumn. The tagged sharks also showed regional differences in their diving behavior, reflecting thermal habits in the ocean environment. Our findings indicated that pregnant BSHs undergo a seasonal northeast–southwest migration in a year so as to give birth to their pups in productive temperate waters.

Discussion

The WG discussed the unit of kernel density in the hot spot analysis. The WG encouraged to include the effect of latitude and longitude for the spatial analysis in the cluster analysis of future work because the Habitat B had two different waters; tropical waters near Chinese Taipei and around Kuroshio Current. The WG also suggested that the authors attempt to identify the mating ground and elucidate the horizontal movement of male BSH in future work. The WG discussed the research of SPOT-tag, the definition of death, and how to differentiate between natural mortality and tag malfunction.

Age determination and growth of the blue shark (Prionace glauca) in the western North Pacific Ocean. Yuki Fujinami, Yasuko Semba, and Sho Tanaka. (***ISC/19/SHARKWG-1/INFO02***)

Accurate estimation of growth parameters is vital for stock assessments and management of exploited species. To determine if changes in sex-specific growth parameters of the BSH have occurred in the north Pacific Ocean following population declines in the 1980s and 1990s, we analyzed data obtained from the vertebrae of 659 male and 620 female sharks that had precaudal lengths (PCLs) of 33.4–258.3 cm and were captured over a wide geographic area between 2010 and 2016. Maximum counts of growth bands were 18 for males and 17 for females. Significant ($P<0.001$) between sex differences were detected in growth parameters. We estimated parameters of the von Bertalanffy growth function: for males, the theoretical asymptotic length ($L\infty$) was 284.9 cm PCL, the growth coefficient (k) was 0.117/year, and the theoretical age at zero length (t0) was −1.35 years, and, for females, $L\infty$ was 257.2 cm PCL, k was 0.146/year, and t0 was −0.97 years. Sexual discrepancies in growth rates are likely a function of differences in energy allocation

relating to reproduction between sexes. Given that no remarkable change in growth parameters was observed over three decades, life history parameters of this population do not appear to have been affected by shifts in stock abundance or environmental fluctuation.

Discussion

The WG agreed to use the new growth parameter for the next benchmark assessment for BSH. The WG discussed the estimates of asymptotic length (L_{inf}) and maximum age between Nakano (1994) and current study because there was a large difference about the maximum age between two studies, despite similar size range of specimen used in this study.

Introduction of population genetic structure of blue shark (Prionace glauca). **Kenji Nohara, and Yasuko Semba. (*ISC/19/SHARKWG-1/P08*)**

As the background of this work, past two studies which investigated genetic population structure by mitochondrial DNA (mtDNA; Taguchi *et al*. 2013) and microsatellite DNA (King *et al*. 2015) identified no population structure between north and south Pacific and within north Pacific, respectively. They used traditional approach with limited information of genome, however, current innovation of molecular analysis enabled analysis with big data. In this context, authors applied next generation sequencer (NGS) to obtain genome data from mtDNA and nuclear DNA, respectively. Regarding mtDNA, an approach by Tilak *et al*. (2015) was applied and preparation of library, mapping on *Prionace glauca* reference mitogenome and annotation of mitogenome were successfully conducted. As a result, mitogenome was constructed for 6 individuals. As a next step, analysis for several individuals from each sampling area will be conducted to collect information to draw conclusion about genetic structure between north and south Pacific Ocean based on mtDNA.

Discussion

The WG noted that population boundary of Atlantic bluefin tuna (*Thunnus thynnus*) is complex because of the mixing between western and eastern stocks, despite a clear difference of genetic structure was observed between them. The WG suggested that several integrated approaches including tagging study and comparison of seasonality of reproductive activity such as ovulation, mating and pupping between north and south Pacific are also important to discuss the "northern stock issue". The WG recognized that the development of strategy including sampling method is important to address this issue because the samples used in this study are mainly collected from Japanese observer program.

Preliminary result of Parasite fauna of Blue Shark living in the North-west Pacific. **Akira Kurashima, and Yasuko Semba. (*ISC/19/SHARKWG-1/P06*)**

Parasite have a potential as a biological tag. Although it had already reported that the BSH had many parasite species; 52 species of 40 genera belonging to three phyla, we do not have enough biological knowledge about taxonomy, prevalence and intensity for these parasites. In this study, we investigated the parasite fauna of BSH living in the north-west Pacific to explore the possibility of the parasites as a biological tag. In addition, as a preliminary analysis, we compared the parasites between the west Pacific and the north Atlantic using the published papers (Mendez and Galvan-Magana, 2016; Henderson *et al*., 2002) and examined the difference of the parasites among growth-stages using the collected data.

A total of 42 individuals of BSH were investigated and 21 species of 14 genera belonging to 4 phyla were collected in this study. In comparison among locations, the different congener species were parasitic between the Pacific and the Atlantic. The following congener species of three genera; *Anrhobothrium*, *Prosobothrium* and *Kroyeria* showed a different distribution (i.e., *A. caseyi* in the Pacific and *A. laciniatum* in the Atlantic, *P. japonicum* and *P. armigerum*, and *K. carchariaeglauci* and *K. lineata*). Trypanoryncha species were found in adult BSH but not in juveniles. It was considered that some parasite species may have a potential as a biological tag. However, parasite information is not enough to elucidate the differences of the localities. In future study, it needs to accumulate the data about parasite fauna including the spatiotemporal distribution of parasites.

Discussion

The WG recognized the potential of parasites as a tool to investigate the population structure and trophic aspects such as ontogenetic diet shift. The WG noted that the author reiterated that it is important to continue the basic work such as description of parasite fauna from shark collected in various area and time in order to obtain supplementary information about biological theme described above.

Introduction of ongoing work of elemental analysis for North Pacific shortfin mako (Isurus oxyrinchus) and proposal of collaborative study for the improvement of growth estimate.

Yasuko Semba. (***ISC/19/SHARKWG-1/P09***)

In this presentation, author proposed to summarize previous cross-reading dataset to show that different enhancement methodology leads to different band count in the SFM. Next, author showed the results of observation of corpuls calcareum (CC) and centrum surface (CS) by SEM (Scanning Electron Microscope) and backscattered electron image and indicated difference of microstructure between CC and CS. Correspondence of growth band and peak of calcium (Ca) was partially indicated but different level of chemical treatment affected the concentration of Ca and phosphorus (P). As preliminary result, difference of trajectory of Ca and P depending on analytical approach (i.e., EPMA; Electron Probe Micro Analyzer, LA-ICP-MS; Laser Ablation Inductively Coupled Plasma Mass Spectrometry) was introduced.

Discussion

The WG discussed the effect of chemical treatment on the element trajectories. The WG asked the reason for the analysis of CS. The WG noted that the element trajectory of CS is subject to the chemical analysis compared to CC without any connective tissue. The WG also noted that the purpose of this work is to compare the peak of element with growth band observed by shadowing method used in Semba *et al*. 2009 and to investigate the usefulness of verification of band count. The WG pointed out that the trajectory may become similar between CC and CS if the effect of chemical treatment was removed. The WG noted the assumption of chemical analysis that elemental component may be different between the type of growth band due to environmental change that may be worth to be revisited. The WG suggested that in the analysis of CC, the sampling should be done along the side of the vertebra section, since this is the part of the CC that is the most frequently used for aging.

The WG also indicated that the elemental analysis seemed to be disrupted by connective tissue, and that without connective tissue, little pattern could be discerned. The WG suggested that, as different theme using elemental analysis, the comparison of element near the core may be useful to infer the population structure if element composition in the environment is unique depending on the area. The WG indicated the future perspective of this work, including the investigation of the temporal change of elements on the periphery and application of surface analysis as well as line analysis adopted in this experiment.

7.0 FUTURE PROJECTION OF STOCK SYNTHESIS (SS) FOR NORTH PACIFIC BLUE SHARK

7.1 REVIEW AND DISCUSS FUTURE PROJECTION SCENARIOS

Preliminary results of stock synthesis projections of blue shark in the North Pacific Ocean through 2025. **Mikihiko Kai and Felipe Carvalho.** ***(ISC/19/SHARKWG-1/07)***

Stock Synthesis projections were conducted from 2016 to 2025 at pre-specified three constant harvest policies ($C_{status\ quo}$; Status quo, $C_{+20\%}$; 20% increase of catch, $C_{-20\%}$; 20% decrease of catch) and a deterministic recruitment after updating the annual catch data of the BSH caught in the north Pacific Ocean through 2018 to assess not only the stock status in recent three years but also future trajectories of the spawning stock biomass through 2025. The biological parameters, the other fisheries data such as CPUE and size composition data and the specifications of the model such as data weighting were the same as those used in the reference-run of previous benchmark stock assessment in 2017. The future projections with status-quo showed that the spawning stock biomass (SSB) in 2018 exceeded the MSY level (SSB_{2018}/SSB_{MSY}=1.67) and the mean current fishing mortality (F) from 2015 to 2017 was below MSY level ($F_{2015\text{-}2017}/F_{MSY}$=0.33), and the future trajectories of spawning stock biomass gradually increased because current catch is much lower than MSY level. These results continuously suggested that the stock status is not overfished, and overfishing is not occurring.

Discussion

The WG discussed the SS settings for the data and control files of SS for the update stock assessment. The WG suggested that the modeler should use the same data as well as parameters as those used in the previous assessment for the time period from 1971 to 2015 and to update only the recent annual catch data for 2016-2018 because of the consistency of input data that it makes possible to compare directly the outputs with those of previous assessment in 2017.

The WG also discussed the scenario of future projection. The WG suggested that the mean fishing mortality rate is more appropriate than mean annual catch because the annual catch is strongly influenced by the changes in the population biomass. **The WG recommended a use of catch number in SS in the next benchmark stock assessment for BSH to reduce the uncertainty because the current catch weight data in SS contains large uncertainties in the process of conversion from number to weight**.

The WG agreed to use the same data and parameters as those used in the assessment in 2017 with updated catch data for 2016-2018 and to conduct the future projection based on the F-scenarios (F_{MSY}, $F_{2012\text{-}2014}$, $F_{2015\text{-}2017}$, $F_{20\%\ plus}$, and $F_{20\%minus}$).

The WG discussed the conflicting methodology as to estimate or fix R0 (unfished recruitment), however, the WG could not reach a conclusion. Following the meeting, the WG will ask Dr. Rick Methot for advice and then the WG will determine the methodology in an upcoming webinar.

The WG had not finished the update stock assessment due to the constraint of time. **The WG will discuss the results of future projection scenarios at the upcoming webinar in Mar. 3 (JP time). The summaries of the webinar were described in Attachment 6.**

7.2 FINALIZE THE RESULTS OF FUTURE PROJECTION SCENARIOS

No discussion.

7.3 FORMULATE CONSERVATION INFORMATION CONSIDERING MODEL UNCERTAINTY

No discussion.

7.4 DEVELOP/FINALIZE UPDATE ASSESSMENT REPORT

The WG noted that the SHARKWG chair will develop the draft of update stock assessment reports for the BSH and distributed it to the WG by April 30, 2020.

The WG agreed that the SHARKWG chair will finalize the report and submit to the ISC Chair by the deadline as of June 15, 2020.

8.0 REVIEW COLLABORATIVE STUDIES AND ESTABLISH WORK PLAN FOR THE ASSESSMENT

SHARKWG Chair reviewed collaborative study on biological parameters and fishery data for BSH and SFM. The WG discussed each item and finalized a list of collaborative study (**Table 2**). The WG noted that the US is willing to conduct the tagging study for BSH and SFM near the waters off Hawaii Islands where currently there is an unknown amount of information about the migration of these sharks. The WG acknowledged that Chinese Taipei has no ongoing tagging project for these sharks, but it is possible for the observer to tag these sharks using the pole from the gangway after identifying the size and sex if the tags are provided from other member countries. The WG noted that the adult BSH and SFM are frequently caught by Taiwanese longline fishery operated in the temperate and tropical waters. The WG also noted that the tagging study for these adult sharks might provide useful information about the transboundary movement of these species in the tropical zone. The WG also discussed that the Japan will be able to share the knowhow of tagging study with the observer in Chinese Taipei. **The WG (Chinese Taipei, Japan and US) agreed to conduct the tagging study to examine the spatial distribution of BSH and SFM by sex and growth stages as well as stock boundary**.

Table 2. A list of collaborative study among ISC member countries.

No	Species	Category	Methods	Objective	Materials	Data collection	Participants	Lead/Status	Priority
1	Blue shark	Biology	Isotope analysis	Spatial distribution by sex and grwoth stages	Frozen muscle tissue	Location, Date, Species, Sex, Length	JP, MX, TW, US	Yuki (JP)/ Waiting	High
	Shortfin mako							Yasuko (JP)/Waiting	Low
2	Blue shark	Biology	Tagging with chemical injection	Age validation	Vertebrae	Location, Date, Species, Sex, Length	JP, US	JP will confirm whetehr $SrCl_2$ is applicable	Low
	Shortfin mako								High
3	Blue shark	Biology	Tagging for migration and stock boundary	Spatial distribution by sex and grwoth stages and stock boundary	normal tag, PAT	Location, Date, Species, Sex, Length	JP,US, TW	Yuki (JP)/ Mike (US)/ Ongoing	High
	Shortfin mako								High
4	Shortfin mako	Biology	Cross-reading	Age and growth	dataset		JP, MX, US	US will check the dataset	High
5	Blue shark	Size data	Cluster analysis	Redefinition of fleets with spatiotemporal consideration	Size data of each fleets	Location, Date, Species, Sex, Length	JP, MX, TW, US	Michael Kinney (US)/Ongoing	High
	Shortfin mako							Yasuko Semba (JP)/Ongoing	Low
6	Blue shark	Modeling	Finite mixture model	Application of optimal clusterizing analyze for area definition by using Catch, effort and size informations.	Catch, effort and size data	Location, Date, Species, Sex, Length	JP, MX, TW, US	Minoru Kanaiwa (JP)/Ongoing	High
	Shortfin mako							Minoru Kanaiwa (JP)/Waiting	Low
7	Blue shark	CPUE	VAST	CPUE prediction in the entire north Pacific	Catch and size data	Location, Date, Species, Sex, Gear, etc.	JP, MX, TW, US	Mikihiko Kai (JP)/Waiting	Low
	Shortfin mako								Low
8	Blue shark	Biology	Study on parasite	Spatial distribution by sex and growth stage	Parasite	Location, Date, Species, Sex, Length	JP, TW, US	Taiwan/ Waiting	Low
	Shortfin mako								Low

Stable isotope analysis to investigate spatial distribution of the blue shark in the North Pacific Ocean. **Yuki Fujinami, Yasuko Semba, and Seiji Ohshimo. (*ISC/19/SHARKWG-1/P02)***
Stable isotope ratio has been used to infer trajectory of diet, tropical level, and movement of various animals. Migration of pelagic sharks has been investigated mainly based on development of electronic tags. Although the tags provide novel insight, into fine scale movements, behavior, and ecology of animals, it is difficult to know the whole movement patterns of the population. On the other hands, stable isotope ratio has ability to reconstruct retrospective histories of animal movement and generate extensive and rigorous information with low costs although this method is rough scale data resolution. We analyzed the stable carbon and nitrogen isotope ratio ($\delta^{13}C$ and $\delta^{15}N$) to complement the results investigated by electronic tagging and to elucidate spatial distribution and movement pattern of the BSH in the northwestern Pacific. The $\delta^{13}C$ showed higher values in the lower latitude with decreasing as increasing latitude. In addition, the $\delta^{13}C$ tend to be high in the coastal area and the trends slightly differed between sexes. The $\delta^{15}N$ showed higher values in the eastern Pacific than in the western Pacific for both sexes. In future, we will conduct the "Isoscapes" analysis based on the $\delta^{13}C$ and $\delta^{15}N$ values of the BSH.

Discussion
The WG (Chinese Taipei, Japan, Mexico and USA) agreed to start the collaborative study on the isotope analysis next year and Japan will lead the project. It was noted that Mexico had collected frozen tissue samples of BSH in 2018 and will provide to Japan. Noting that Mexico also has a plan to collect the other tissue samples of the BSH in 2020, so Mexico will provide the samples to Japan as well. **The WG also agreed that Japan will prepare for the document paper in relation to the sharing methods of the sampled data (e.g., transportation, cost, details in the necessary data etc.).**

The WG discussed the issue of ABS (Access to genetic resources and benefit sharing, https://absch.cbd.int/) because Japan and Mexico ratified the Nagoya Protocol, but the US had not ratified yet and have no effect on the protocol.

Potential collaborative biology projects for North Pacific sharks. **Michael J Kinney. (*ISC/19/SHARKWG-1/P05)***
Noting the lack of validated age information in the western Pacific, due to an inability to utilize OTC (oxytetracycline), a new approach using a naturally occurring marker, Strontium chloride ($SrCl_2$), is proposed. Much like OTC, $SrCl_2$ can be injected into live animals in order to produce a mark on their calcified structures which can be examined upon recapture to validate band pair deposition rates. This method has yet to be tested on sharks, however, a direct validation method to help clarify the current issues with aging SFM across the Pacific is an important step in improving the understanding of this species biology.

With the current collection of tissue samples for various projects around the Pacific, we propose the storage of genetic samples from BSH and SFM in order to facilitate future projects which will undoubtedly benefit from such Pacific wide sampling. This collection is not meant to be a stand along project, but simply an added collection tied to other ongoing projects. The suggested collection process is simple and only requires tissue samples to be collected and stored in ethanol, along with basic information such as sex, size, and location of sampling. A suggested use for such

samples could be close kin mark recapture, but additionally such samples could help in identifying stock structure or levels of population mixing.

Discussion

The WG discussed the plausibility of the $SrCl_2$. The WG noted that Japan will ask the government about the applicability of the new marker to the aging study of pelagic sharks. The WG confirmed that OTC injection for pelagic sharks is available to Chinese Taipei as well as US.

The WG discussed the issue of Convention on International Trade in Endangered Species in Wild Fauna and Flora (CITES) listing for the SFM. The WG informed that Japanese offshore shallow-set longline fishery will continue to land the SFM, but the Japanese distant water longline fishery will discard the SFM. Regarding this matter, it was confirmed that the WG will continue to progress the work for the publication of the statement about the stock status of the SFM. The WG concerned about the collection of tissue samples for the SFM because of the CITES listing.

The WG noted that the tissue sample stored in ethanol is better than frozen for genetic analysis. The WG also noted that the main objective of the US-proposal is creating the genetic catalogue in order to accelerate the data sharing among ISC member countries. The WG further noted that the sampling of muscle tissue is better than that of fin-tips because the fins of pelagic shark are more valuable than meat.

The WG noted that the close-kin approach may estimate the population abundance and elucidate the stock structure. The WG asked to clarify the objectives of the approach for the BSH and SFM because (1) the population dynamics of these stocks were assessed well using the integrated model (SS) with enough data; (2) the research of the stock structure has a limitation because of the jurisdiction of ISC. The WG also noted that the genetic study of the BSH is ongoing in Japan with the professor of Tokai University using the data collected from north and south Pacific Ocean. The WG pointed out that the age-specific fecundity is required to conduct the close-kin approach and it was responded that the WG had already had such information for BSH and SFM. The WG noted that the presence of meta-population could complicate the analysis.

The WG recognized that the storage of genetic samples for BSH and SFM is important to share the data, however, the WG concerned the issue of the maintenance of the samples without any concrete objectives as well as sample's manager in the ISC. **The WG agreed not to include the project of the genetic samples in the future work plan of SHARKWG.**

Dealing with CITES. **Michael J Kinney. (*ISC/19/SHARKWG-1/P11)***

With the recent listing of SFM as a CITES Appendix II species, there are concerns within the SHARKWG regarding the sharing of biological samples for international projects. This presentation outlined the three ways in which US scientist have gone about sharing biological samples for CITES listed species. The most promising of the three approaches is for each interested institution to obtain a CIETS Certificate of Scientific Exchange, or COSE permit. This permit allows registered institutions to share samples of CITES listed species with a minimal (albeit not negligible) amount of paperwork. The catch is that an institution has so go through the process of obtaining the COSE permit in the first place. At the moment, both NOAA labs, SWFSC

(Southwest Fisheries Science Center) and PIFSC (Pacific Islands Fisheries Science Center) have COSE permits. Several Canadian and Mexican institutions also have such permits, however the author was unable to find any institutions in Japan or Chinese Taipei that had COSE permit. It was suggested that each nation needs to look into the possibility of obtaining such a permit to ease the sharing of SFM samples in the future. The other two methods the author mentions were one off permits, and hand carrying samples into the country. Each of these ways requires a signification amount of planning and paperwork, and needs to be repeated anytime more samples are shipped. None of these processes look particularly desirable, however, one such avenue will be necessary in order to insure continued scientific collaboration on this highly migratory species.

Discussion

The WG noted that the Japan inquired about the COSE to get a certificate of the transportation of tissue samples for the SFM, but Japan Fisheries Research and Education Agency has not registered as COSE and it was unknown how and when it can be registered, so that it might be difficult to get the certificate. US suggested that information regarding obtaining COSE status may be available from the groups within NOAA. Such information will be relayed to the WG following meeting. The WG also noted that ICCAT consulted CITES Secretariat and also attempted to obtain protocol to exchange biological samples particularly for SFM only for research purpose, however this task requires excessive work and more time.

Future Work Plan

The WG discussed that discard mortality was treated in many ways by each country's fisheries. The WG suggested that each nation clearly outline how discard mortality was dealt with in the calculation of total dead removals.

The WG agreed that, for the next update assessment meeting for SFM, each ISC member country or relevant organization should submit their size data 3 months before the Nov. meeting in 2020 (August), and catch data should be submitted 1 month before the meeting (October).

9.0 FUTURE SHARKWG MEETINGS

A tentative schedule for upcoming WG meetings was adopted:

March, 3rd 2020 10:00 AM (JP time) 1 day webinar	Review and finalize the results of future projection for BSH; Formulate conservation information
July 15-20, 2020 Hawaii, USA	Finalize BSH update stock assessment information for the Plenary; conduct work for the Plenary
November, 1st -2nd week, 2020 Honolulu, USA	SFM update stock assessment

10.0 OTHER MATTERS

No discussion.

11.0 CLEARING OF REPORT

The Report was reviewed and the content provisionally approved by all present. The Chair will make minor non-substantive editorial revisions and circulate a revised version to all WG members before finalization.

12.0 ADJOURNMENT

The Chair thanked all participants for attending and for their hard work resulting in a carefully conducted, collaborative assessment. He indicated that he will be in touch regularly over the coming months to finalize the update assessment report and looks forward to seeing many of the participants in July at the SHARKWG and Plenary meetings in Hawaii, USA.
The meeting was adjourned at 15:58 on December 10, 2019.

13.0 LITERATURE CITED

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Attachment 1 - List of Participants

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Attachment 2 - Meeting Documents, Presentations and Information Papers

WORKING PAPERS

ISC/19/SHARKWG-1/01	Clustering analysis of size data for blue shark (Prionace glauca). **Minoru Kanaiwa, Yasuko Semba, Mikihiko Kai, Castillo-Geniz J. Leonardo, Haro-Avalos Horacio, Carrillo-Colin L. Daniel, Kwang-Ming Liu, Wen-Pei Tsai, Michael Kinney, Steven L. H. Teo, and Felipe Carvalho** (kanaiwa@bio.mie-u.ac.jp)
ISC/19/SHARKWG-1/02	The evaluation of the accuracy to estimate the body length by using several meseared parts for blue shark. **Atushi Yamamoto, Yuki Fujinami, Yasuko Semba, and Minoru Kanaiwa** (a_yamamoto@bio.mie-u.ac.jp)
ISC/19/SHARKWG-1/03	Update of Japanese annual catches for blue shark caught by Japanese offshore and distant -water longliner in the North Pacific Ocean from 1994 to 2018. **Mikihiko Kai** (kaim@affrc.go.jp)
ISC/19/SHARKWG-1/04	Update of annual catches for blue shark caught by Japanese coastal fisheries in the North Pacific Ocean from 1994 to 2017. **Mikihiko Kai, and Toshikazu Yano** (kaim@affrc.go.jp)
ISC/19/SHARKWG-1/05	Updated information on standardized CPUE and catch estimation of the blue shark from Taiwanese large scale tuna longline fishery in the North Pacific Ocean. **Wen-Pei Tsai, and Kwang-Ming Liu** (wptsai@nkust.edu.tw)
ISC/19/SHARKWG-1/06	Blue shark (*Prionace glauca*) bycatch statistics in Canadian fisheries. **J.R. King, and A.M. Surry** (*jackie.king@dfo-mpo.gc.ca*)
ISC/19/SHARKWG-1/07	Preliminary results of stock synthesis projections of blue shark in the North Pacific Ocean through 2025. **Mikihiko Kai and Felipe Carvalho** (kaim@affrc.go.jp)
ISC/19/SHARKWG-1/ 08	Estimation of blue shark catch by Korean tuna longline fishery in the North Pacific Ocean. **Sung-Il Lee, Doo-Nam Kim, Mi-Kyung Lee and Youjung Kwon (**k.sungillee@gmail.com**)**

PRESENTATIONS

ISC/19/SHARKWG-1/P01	Seasonal migrations of pregnant blue shark, *Prionace glauca*, in the northwestern Pacific. **Yuki Fujinami, Ko Shiozaki, Yuko Hiraoka, Yasuko Semba, Seiji Ohshimo, and Mikihiko Kai** (fuji925@affrc.go.jp)
ISC/19/SHARKWG-1/P02	Stable isotope analysis to investigate spatial distribution of the blue shark in the North Pacific Ocean. **Yuki Fujinami, Yasuko Semba, and Seiji Ohshimo** (fuji925@affrc.go.jp)
ISC/19/SHARKWG-1/P03	Preliminary results of redefining fleet definitions of North Pacific fisheries with spatiotemporal consideration of blue shark size and sex data. **Michael J Kinney, Felipe Carvalho, Mikihiko Kai, Yasuko Semba, Kwang-Ming Liu, Wen-Pei Tsai, Castillo-Geniz J. Leonardo, Haro-Avalos Horacio, Carrillo-Colin L. Daniel, and Steven L. H. Teo.** (michael.kinney@noaa.gov)
ISC/19/SHARKWG-1/P04	Updated catch of blue shark in US West coast fisheries. **Michael J Kinney** (michael.kinney@noaa.gov)
ISC/19/SHARKWG-1/P05	Potential collaborative biology projects for North Pacific sharks. **Michael J Kinney** (michael.kinney@noaa.gov)
ISC/19/SHARKWG-1/P06	Preliminary result of Parasite fauna of Blue Shark living in the North-west Pacific. **Kurashima Akira, and Yasuko Semba.** (akura@affrc.go.jp)
ISC/19/SHARKWG-1/P07	Review of size data of North Pacific blue shark (Prionace glauca) provided from each CPCs. **Yasuko Semba.** (senbamak@affrc.go.jp)
ISC/19/SHARKWG-1/P08	Introduction of population genetic structure of blue shark (Prionace glauca). **Kenji Nohara, and Yasuko Semba.** (knohara@tokai-u.jp)
ISC/19/SHARKWG-1/P09	Introduction of ongoing work of elemental analysis for North Pacific shortfin mako (Isurus oxyrinchus) and proposal of collaborative study for the improvement of growth estimate. **Yasuko Semba.** (senbamak@affrc.go.jp)

ISC/19/SHARKWG-1/P10	Update on standardized catch rates for blue shark (*Prionace glauca*) in the 2006-2018 Mexican Pacific longline fishery based upon a shark scientific observer program. **José Ignacio Fernández-Méndez, José Leonardo Castillo-Géniz, Horacio Haro-Ávalos, Georgina Ramírez-Soberón, and Luis Vicente González-Ania** (leonardo.castillo@inapesca.gob.mx)
ISC/19/SHARKWG-1/P11	Dealing with CITES. **Michael J Kinney** (michael.kinney@noaa.gov)

INFORMATION PAPERS

ISC/19/SHARKWG-1/ INFO-01	Spatio-temporal changes in catch rates of pelagic sharks caught by Japanese research and training vessels in the western and central North Pacific. **Mikihiko Kai.** 2019. Fisheries Research, 216; 177-195.
ISC/19/SHARKWG-1/ INFO-02	Age determination and growth of the blue shark (*Prionace glauca*) in the western North Pacific Ocean. **Yuki Fujinami, Yasuko Semba, and Sho Tanaka**. 2019. Fisheries Bulletin, 117: 107-120.
ISC/19/SHARKWG-1/ INFO-03	Stock assessment and future projections of blue shark in the North Pacific Ocean through 2015 (Report of the Shark Working Group; ISC17-Annex13). **WCPFC. 2017**. WCPFC-NC13-2017/IP06.
ISC/19/SHARKWG-1/ INFO-04	Pattern recognition of population dynamics for North Pacific swordfish (Xiphias gladius): the operational data analysis of Japanese longline fishery using the finite mixture model. **Hirotaka Ijima and Minoru Kanaiwa**. ISC/18/BILLWG-01/09.

FINAL

Attachment 3 – Meeting Agenda
SHARK WORKING GROUP (SHARKWG)

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

BLUE SHARK UPDATE STOCK ASSESSMENT WORKSHOP AGENDA

December 4-10, 2019

National Research Institute of Far Seas Fisheries
Shimizu Shizuoka

DRAFT

Meeting Hours: 10:00-17:00 (Wednesday, 4 December)
09:30-17:00 (Thursday, 5 through Tuesday, 10 December)
9:30-10:30 (Friday, 6) Webiner
We will work Saturday and Sunday and take day off on Monday.

1. Opening of SHARKWG Workshop
   a. Welcoming remarks
   b. Introductions
   c. Meeting arrangements
2. Confirmation of document paper and presentation with numbering
3. Review and approval of agenda
4. Appointment of rapporteurs
5. Meeting objectives
6. Summary November webinar and outcomes
7. Summary previous stock assessment in 2017
8. Review fishery data for north Pacific blue shark update stock assessment
   a. Catch and discard data
   b. CPUE indices
   c. Size data
9. Review biological data for north Pacific blue shark and other sharks
10. Future projection of Stock Synthesis (SS) for north Pacific blue shark
    a. Review and discuss future projection scenarios
    b. Finalize the results of future projections
    c. Formulate conservation information considering model uncertainty
    d. Develop/finalize update assessment report (Report deadline June 15)
11. Review collaborative studies and establish work plan for the future assessment
12. Future SHARKWG meetings
13. Other matters
14. Clearing of report
15. Adjournment

Attachment 4 - List of Participants for webinar in November 2019

Japan

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Attachment 5 –Draft Agenda of webinar in November 2019

SHARK WORKING GROUP (SHARKWG)
INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC
WEBINER AGENDA
6 November 2019
DRAFT
Meeting begins at 9:00 am Wednesday November 6th (Japan time).

1. Opening of SHARKWG Webiner
    - Confirmation of internet-access via google hangout for all participants
    - Adoption of draft agenda
2. Background explanation (ISC shark WG chair)
    - Proposed change to the stock assessment cycle
    - Pros and Cons
    - Responses from ISC plenary
3. Discuss the proposal
    - Decide whether we change the stock assessment cycle
    - Discuss how to conduct the update stock assessment if we change
4. Establish work plan for the next assessment of blue shark and final data submission deadline

    Plan A (3 year schedule):
    1) Data preparatory meeting in December.
    2) Stock assessment meeting in Spring.
    3) Report of benchmark assessment to Plenary in July.

    Plan B (5 year schedule):
    1) Update stock assessment meeting in December
    2) Report of update assessment to Plenary in July
5. Future SHARKWG meetings
    - December 4-10 Shimizu, Japan (WG meeting)
6. Other matters
7. Adjournment

Attachment 6 –Summary March webinar and outcomes

After the blue shark update stock assessment workshop in December 2019, an additional intersessional webinar of the ISC SHARKWG was convened using google hangout on March 5th, 2020. Meeting participants included 11 members from Japan, Mexico, Taiwan and USA (**Attachment 7**). The main objective of the webinar was to complete the update stock assessment for north Pacific blue shark. A remaining controversial issue from the December meeting was the initial setting of unfished biomass/recruitment in the future projection of stock synthesis (SS). More specifically, whether R0 should be fixed or estimated in the model after fixing the remaining parameters. At the webinar, the WG members explained reasons why SS experts recommend estimating R0 in the model. The main reason was that R0 had never been fixed in future projection before because most of the future projections were conducted using the original code made by the designer of SS. Thereafter, the SHARK WG Chair presented the outcomes of the future projection with R0 estimated. The SS future projections were conducted from 2019 to 2028 at previously specified constant-F scenarios (F_{MSY}, $F_{2012\text{-}2014}$, $F_{2015\text{-}2017}$, $F_{20\%plus}$, $F_{20\%minus}$) and a deterministic recruitment after updating the three years' annual catch data of blue shark caught in the North Pacific through 2018. The specifications of the SS model were the same as those used in the previous benchmark stock assessment in 2017. All the parameters of SS were fixed except for R0 and the recruitment deviations. The future projections with status-quo showed that the spawning stock biomass (SSB) in 2018 exceeded the MSY level (SSB_{2018}/SSB_{MSY}=1.65) and the mean current fishing mortality (F) from 2015 to 2017 was below MSY level ($F_{2015\text{-}2017}/F_{MSY}$=0.29), and the future trajectories of spawning stock biomass gradually increased because current catch is much lower than MSY level. These results consistently suggested that the stock status is not overfished, and overfishing is not occurring. The details of the future projections are described in the working paper (ISC/19/SHARKWG-2/1) and update stock assessment report. In the discussion, the WG member asked to compare the results when R0 was fixed and only initial F was estimated. The results showed inconsistent trajectories of SSB and F during assessment period due to the differences of the trajectories of recruitment deviations. Since it was difficult to accept the inconsistent results, the WG determined to estimate R0 and accepted the update stock assessment results.

Attachment 7 - List of Participants

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