FINAL

ISC/22/ANNEX/04

# ANNEX 04

*22nd Meeting of the*
*International Scientific Committee for Tuna*
*and Tuna-Like Species in the North Pacific Ocean*
*Kona, Hawai'i, U.S.A.*
*July 12-18, 2022*

# REPORT OF THE SHARK WORKING GROUP WORKSHOP

**July 2022**

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*ANNEX 04*

# *REPORT OF THE SHARK WORKING GROUP WORKSHOP*

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

**November 9-12, 16-17, and 19 2021**
**Online meeting**

## 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 online meeting from November 9-19, 2021. The primary goal of the workshop was to prepare for the fishery data as well as biological parameters for the stock assessment of North Pacific blue shark (*Prionace glauca*) in 2022. Also, the WG need to discuss the configurations of Stock Synthesis (SS) model for the base case model as well as sensitivity analyses, methods of the model diagnostics and future projections, and future work plans by the pre stock assessment meeting in 2022.

Mikihiko Kai, SHARKWG Chair, opened the meeting at 9:00 am on November 9, 2021 (Japan time). Participants included members from Canada, Chinese Taipei, Japan, Mexico, and United States of America (USA) (**Attachment 1**). SHARKWG Chair welcomed all participants. He wished for all to stay safe and keep healthy conditions during COVID-19 pandemic and to have a productive meeting and for good work on the data preparation for the stock assessment of North Pacific blue shark.

## 2. DISTRIBUTION OF DOCUMENTS AND NUMBERING OF WORKING PAPERS

Fifteen working group papers and eight information papers were distributed and numbered (**Attachment 2**). Also, one presentation file (US fishery data) was provided without working paper. All WG papers were approved for posting on the ISC website (http://isc.fra.go.jp/) where they will be available to the public.

## 3. REVIEW AND APPROVAL OF AGENDA

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

## 4. APPOINTMENT OF RAPPORTEURS

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

| Item | Rapporteurs |
|---|---|
| 1-5. | M. Kai |
| 6. | N. Ducharme-B (Lead), M. Kanaiwa, L.V. González-Ania |
| 7. | J. King (Lead), Y. Semba, C. P. Chin, A. Yamamoto |
| 8. | M. Kinney (Lead), G. Ramírez-Soberón, J. I. F Méndez |
| 9. | K.M., Liu (Lead), J.L. Castillo-Geniz, Y. Fujinami |
| 10. | N. Ducharme-B (Lead), F. Carvalho |
| 11. | J. King (Lead), M. Kinney |
| 12-15. | M. Kai |

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

## 5. REPORT OF THE SHARKWG CHAIR

The WG Chair presented the summary of the last stock assessment for North Pacific blue shark in 2017. Specifically, the WG Chair explained about the fishery data, biological data, model configurations, model outputs, model diagnostics, and future projection of SS. In addition, the WG Chair presented the limitations and research needs for the stock assessment in 2017. Further, the WG Chair shortly reported the outcomes of alternative model (Bayesian surplus production model).

## 6. REVIEW CPUE INDICES FOR BLUE SHARK STOCK ASSESSMENT

***Spatio-Temporal Model for CPUE Standardization: Application to Blue Shark Caught by Japanese offshore and Distant Water Shallow-Set Longliner in the Western North Pacific. (ISC/21/SHARKWG-2/01)***

This working paper provides a standardized catch per unit of effort (CPUE) of blue shark caught by Japanese offshore and distant-water shallow-set longline fishery from 1994 to 2020 in the western North Pacific Ocean. Since the catch data of sharks caught by commercial tuna longline fishery is usually underreported due to discard of sharks, the author filtered the logbook data using the similar filtering methods applied in the previous analysis. The nominal CPUE of filtered shallow-set data was then standardized using the spatio-temporal generalized linear mixed model (GLMM) to provide the annual changes in the abundance of blue sharks in the northwestern Pacific. This working paper focused on seasonal and interannual variations of the density in the model to account for spatially and seasonally changes in the fishing location due to the target changes between blue shark and swordfish. The estimated annual changes in the CPUE of blue shark revealed an upward trend from 1994 to 2005 and then downward trend until 2008. Thereafter the CPUE gradually increased until 2015 and then slightly decreased in recent years. The estimated CPUE trends from the spatio-temporal model with a large amount of data collected in the most abundant waters in the North Pacific Ocean is a very useful information about the abundance of North Pacific blue shark.

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

The WG raised concerns about the data filtering that may remove much information about the population dynamics and trends, particularly on the fringes of the distribution. Additionally, the data filtering could limit the data coming from sets that are able to maintain higher catches of blue sharks despite potential changes in the population. The WG noted that the data filtering process was conducted to exclude discarding and non-reporting information, and it only extracts the shallow-set longline operation in these areas which target blue shark and swordfish. The WG also noted that longliners in the temperate water catch pelagic sharks using a long longline with 3000-4000 hooks in one operation, so that there is a doubt of reporting or discarding, if there is no shark's catch in such an operation. Further, the WG noted that it is possible to evaluate the CPUE trends in comparison with those of the Japanese research and training vessel (JRTV) because such a data filtering was not applied to the JRTV data.

The WG noted that there is a strong seasonality in the predicted CPUE and speculated on several causes such as the physical movement of the fleet, the movement of the fish, or perhaps un-modeled changes in targeting (bait, light stick, and time of day). The WG responded that the year-season spatio-temporal model can capture the seasonal change of the movement of the fish and the fisherman, and the spatial maps clearly showed the higher CPUE in qt2 and qt3 at the higher latitudes that is considered as the distributional pattern of the blue sharks. The WG considered that fishers move to these waters in these quarters, and VAST can explain this difference, however, it would be good to explore including additional covariates for targeting in the future. The WG also considered that females move to more tropical water in winter when there is lower predicted density at temperate water. Further the WG considered that fishers change their target from blue shark to swordfish and they move to the lower latitudes in the temperate water, where a lower density of blue shark compared to the higher latitude.

The WG asked about the possibility of changes in the operational area and their gear configuration when the fishers change their targeting to swordfish. The WG responded that the Japanese shallow set longliner seasonally changes their operational area and does not change the gear configuration such as the number of hooks between floats and fishing bait. It is however unclear whether they used the light sticks, where swordfish are attracted to light, for targeting the swordfish because the data of light stick is only available after 2013-2014 for the logbook data. Although it is impossible to estimate the standardized CPUE for entire period in consideration with the effect of light stick, it is necessary to examine the effect of light stick on the CPUE trends. However, it is questionable that it would make a big difference given the VAST model configuration had already accounted for the area-seasonal effects.

The WG confirmed the number of set-by-set data after filtering because there is a slight difference (400 datasets) with that used in the *ISC/21/SHARKWG-2/02* because the same Japanese longline data and filtering methods were used in the analysis. The WG noted that the difference might be caused by the minor changes of filtering method such as an actual value of reporting rates. The WG also noted that it will be checked during the meeting.

***The Preliminary Analysis of Standardized CPUE for the Catch Data of Blue Shark by Japanese Longliner Using the Finite Mixture Model. (ISC/21/SHARKWG-2/02)***

The target effect, which is a problem in CPUE standardization, was addressed in latent variable estimation using a finite mixture model, and the abundance indices of blue shark in the Northwest Pacific Ocean were estimated from Japanese longline fishery data. Consequently, the models with latent variables 2-8 converged, and the trends of the estimated abundance indices were similar among them in terms with the peaks in 2005, 2017 and 2018, although minor differences of the trends were observed among the models.

**Discussion**

The WG asked about this CPUE index as a candidate of base case model for the stock assessment because of the preliminary analysis. The WG raised a concern about the convergence issue for the model of larger cluster number more than 8, which made it difficult to find the most parsimonious model using the Bayesian Information Criterion (BIC). Additionally, the standard deviation/error of CPUE index was not estimated for the three models due to the lack of machine power.

The WG confirmed that the model structure includes the quarter, fishing gear, and area as the latent variables. The WG also confirmed that the fishing effort was treated as offset term in the model.

The WG pointed out the seasonal inconsistency of the targeting (higher CPUE) for blue sharks between this and previous analysis (*ISC/21/SHARKWG-2/01*), but the WG confirmed that there is no inconsistency between them.

The WG explained the details of the cluster for the best model, however, there is still considerable confusion regarding the method. The WG requested to improve the analysis, documentation and description of the method in the working paper so that the WG can make an informed consideration of this index. **The WG agreed that this index will not use in the stock assessment in 2022.**

***Spatio-Temporal Model for CPUE Standardization: Application to Blue Shark Caught by Longline of Japanese Research and Training Vessels in the Western and Central North Pacific. (ISC/21/SHARKWG-2/03)***

This working paper provides a standardized CPUE of blue shark caught by JRTVs longline fishery for 1994-2020 in the western and central North Pacific. A statistical filtering method was used to remove unreliable set-by-set data after 2000s collected by JRTVs. The nominal CPUE of the JRTVs was then standardized using the spatio-temporal GLMM to provide the annual changes in the abundance indices in the North Pacific Ocean. The predicted abundance indices of blue shark revealed a downward trend until 2008 and an upward trend thereafter with a stable trend in recent years. The CPUE trends predicted from the fishery-independent data widely collected in the North Pacific Ocean is a very useful information about the abundance in this region.

**Discussion**

The WG noted that the CPUE trend after 2004 for Japanese deep set longline index is very similar to that of the US Hawaii deep set longline, and it is considered that this index should be used in the stock assessment. Additionally, since it does not explicitly target blue shark, it may be more representative of the natural background variation in the blue shark abundance. The WG also noted that there are pros and cons to the CPUE from this fishery independent data. Most of this data come from the sub-tropical area, and one disadvantage is that the blue shark is mainly distributed with higher density in temperate waters. Meanwhile, the advantage of this standardized CPUE is that these data are collected from the dominated area of adult blue shark and could track the adult abundance. Further, the WG noted that more discussion is necessary for the decision of the base case model on the inclusion of this index next week.

**General Discussion**

The WG discussed the possible factors of Japan's CPUE declines in 2020 for both the shallow and deep sets longliner because these fishing efforts (number of hooks) did not show a remarkable decline in 2020. The WG informed that it occurred the CPUE decline in the Eastern Pacific Ocean (EPO) in recent years due to a combination of short term El Niño and blob effects. The WG also informed that the target changes from blue shark to swordfish indicated after 2012 had significant effect on the lower CPUE of blue shark in the EPO. Further the WG informed that it could happened two consecutive warming events for 2013-2016, but the effect was superimposed on the target shift towards swordfish in the EPO for the same period.

The WG noted that modelling of the environmental effects in the CPUE standardization for Japanese deep set longline might resolve the issue.

***Updated Standardized CPUE and Catch Estimation of the Blue Shark from the Taiwanese Large Scale Tuna Longline Fishery in the North Pacific Ocean. (ISC/21/SHARKWG-2/14)***

This working paper analyzed the blue shark catch and effort data from observers' records of the Taiwanese large-scale longline fishing vessels operating in the North Pacific Ocean during the period of 2004-2018. The CPUE of blue shark, as the number of fish caught per 1,000 hooks, was standardized using delta lognormal approach. The standardized CPUE of blue shark showed a stable increasing trend. The results suggested that the blue shark stock in the North Pacific Ocean seems at the level of optimum utilization. The blue shark by-catch was estimated using the area-specific nominal CPUE multiplying the fishing effort and accounting for the coverage rate. Estimated blue shark by-catch in weight ranged from 1 ton in 1973 to 1,247 tons in 2020.

**Discussion**

The WG noted that the annual CPUE of area A in 2010 had no data because observer was not deployed in this area during that year. The WG also noted that Chinese Taipei can provide the catch number of blue sharks caught by large-scale longline fleet because the CPUE of this fleet is estimated from observer data, which includes both catch number and weight. Further, the WG noted that it is impossible to provide the catch number for small-scale longline fleet at this time because the catch is based on the landing data, which is just weight. Additionally, the WG noted that the Chinese Taipei might provide CPUE of small scale longline and can use this to produce the catch number in future. The WG suggested to use the catch weight as a basis for the stock assessment in 2022.

The WG noted that the use of lognormal model for the count data with a small number of catches can cause a bias of estimates. The WG also noted that some misfit in Fig. 5 might be caused by the lognormal error distribution. The WG suggested to use a Poisson/Negative binomial model in the CPUE standardization in future work. In addition, the WG elaborated the method to change the model from continuous to discrete type model as follows. The dependent variable is changed from CPUE (catch/effort) to catch, and the fishing effort is given as an offset term in the explanatory variables.

The WG noted that the CPUE trends with a decrease from 2005 to 2008 and a general increase thereafter is very similar to those of deep-set longline fleets for JRTV and US Hawaii. The WG also asked about the reason that the standardized CPUEs after 2015 were much lower than the nominal CPUEs of the same period. The WG responded that the factor affected on the reduced CPUEs have not been checked yet and noted that the Chinese Taipei would use the logbook data to improve the estimation for this analysis in future work.

The WG noted that the CPUEs in 2004 and 2005 are unstable due to the preliminary data collected in the beginning of the observer program, and **the Chinese Taipei agreed to remove these data in the stock assessment if necessary**.

***Update on Standardized Catch Rates for Blue Shark (Prionace glauca) in the 2006-2020 Mexican Pacific Longline Fishery Based Upon a Shark Scientific Observer Program. (ISC/21/SHARKWG-2/15)***

Abundance indices for blue shark (*Prionace glauca*) in the northwest Mexican Pacific for the period 2006-2020 were estimated using data obtained through a pelagic longline observer program. Individual longline set CPUE data, collected by scientific observers, were analyzed to assess effects of environmental factors such as sea surface temperature (SST), distance to the nearest point on the coast and time-area factors. Standardized catch rates were estimated by applying generalized linear models (GLM). Sea surface temperature, mean SST anomalies, distance to the coast, year, area fished, quarter and fraction of night hours in the fishing set were all significant factors included in the model. The results of this analysis show a relatively stable trend with a sharp descent in the last year of the time series in the standardized abundance index in the period considered. This trend could be explained in terms of recent oceanographic events and possible recent changes in fishing strategy of the fleets involved.

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

The WG asked about the potential mechanism for high CPUE at low temperatures and low CPUE at high temperatures. The WG noted that the SST remained higher in the waters after the high 2015/2016 ENSO anomaly. The decrease of the CPUE due to the warming event could be caused by the blue shark moving farther north (up to waters off Washington State and British Columbia) or diving deeper, that might result in changes in local availability and vulnerability rather than in abundance. The northern area, and part of the central one, are characterized by relatively lower temperatures, with upwelling being present along the coast. The southern area has warmer temperatures. This can result in differences in population structure among these areas. Older mature females are found in the north while smaller, immature, males are found in the south. The WG also noted that a separate analysis of these fishing areas during these warming events could shed light on the availability problem.

The WG asked how the fishing technique is different between the blue shark/swordfish targeting and whether the covariates included in the model can account for these differences. The WG noted that the characteristics vary among the vessels with different tonnages, engine, and storage capacities. In the southern area, many Mazatlán's vessels are converted shrimpers that operate in the shrimp fishery during at least a part of the year. The WG also noted that the interaction between area and proportion of night hours in the fishing set (LATF:PNH) was introduced in the model because the current available data set had no specific information on those differences among vessels, though it might be possible to investigate the current situation using the observer data, complementing it with other information that was made available recently. Further, the WG noted that the target shift does not necessarily occurs seasonally, like in the Japanese shallow-set longline fleet in the western North Pacific Ocean, but rather the target shift of Mexican fleets seemed occur on an annual basis, rather than a seasonal target shift. At least during the years after 2013, warming events have occurred together with the observed target shifting and maybe could be difficult to distinguish clearly their separate effect.

The WG noted that there could be a change of gear configuration allowing the shift towards swordfish (e.g., number of hooks between floats/fishing depth), because the increase in catch rate for swordfish was observed in the past years (from 2012-2015 onwards). It seems that some vessels from Ensenada, in the north, tended to move to the area where Mazatlán fleet operates to capture more swordfish in the South. The WG also noted that the Ensenada fleet has been historically more inclined to catch swordfish, together with sharks, but swordfish is also abundant in southern areas, with different oceanographic conditions, where Mazatlán fleet operates. Although the shift in target species seems to be occurring in both areas, it seems to be more marked in the south. Further, the WG noted that it is necessary to analyze the data more deeply because blue shark is very sensitive to sea temperature. Additionally, the WG noted that it is interesting to see a change in the species composition during the Blob's years. Blue shark usually dominates the catch, relative to mako sharks in Central Baja, during the normal years. However, the catch ratio of both species changed completely during years when the Blob occurred. Shortfin mako is one of the few endothermic sharks and is less sensitive to changes in temperature.

The WG noted that it seems clear that there is a targeting change to swordfish. The WG suggested to improve the CPUE standardization method and suggested to use a spatio-temporal model because that kind of model can consider a density covariate for the SST at each location, with an interaction term with space and time.

***2021 ISC North Pacific Blue Shark Stock Assessment: US Domestic Fishery Data Updates: Catch, CPUE and Length Frequency. (ISC/21/SHARKWG-2/P-01)***

Catch, CPUE, and length frequency for the United States (US) domestic fisheries (Hawaii longline & mainland mixed gears) were updated according to the protocols used in the 2017 stock assessment. In the US Hawaii longline, there are two main sectors (deep and shallow) which target bigeye tuna and swordfish, respectively. CPUE was standardized from the observer data using a delta-lognormal GLM for each sector in the US Hawaii longline. The updated standardized CPUE was similar to the previous CPUE for the overlapping years. It was noted that future work should consider using a spatiotemporal approach, evaluate the inclusion of additional covariates, and consider modelling both sectors jointly in a combined analysis.

US Hawaii longline catch was updated using the previous protocol. This catch was the sum of 3 components: observer catch, logbook catch from reliable sets, and generalized additive model (GAM) predicted catch from unreliable logbook sets. Additionally, catch was adjusted to account for discard mortality and converted to metric tons. The current update also showed the variability in total catch when different discard mortality values were assumed. Future work should include a complete reconstruction of the US Hawaii longline catch time series, by sector.

Length frequency values for the US Hawaii longline were compiled by sector from observer records. For the US domestic mainland fisheries, drift gillnet and recreational, catch was also updated using the accepted protocols. For the US drift gill net, catch was estimated as a multiple of annual nominal CPUE from observer records and total effort from logbook data. For the US recreational fisheries, catch estimates were derived from the RecFIN database and charter boats logbooks. In both cases catch was converted to metric tons. Length frequency values for the US drift gillnet were compiled by sector from observer records.

Future work should include a catch reconstruction and an investigation in the sensitivity of catch estimates to the assumed level of discard mortality.

**Discussion**

The WG discussed the parameter used to estimate the catch (i.e., dead discard) for 0% retention of Hawaiian longline fishery. The WG showed several estimates with confidence interval using 1) estimates of post release mortality (PRM) from "Alive" individual from Campana et al. (2016) (9.8% for "live" sharks or 23.1% as "non-landed" fishing mortality), 2) Total PRM from Campana et al. 2016, 3) PRM within 30 days (27%) from Hutchinson et al. (2021) and 4) PRM within 360 days (79%) from Hutchinson et al. (2021). The WG noted that most of the mortality occurs within first month in both studies after the interaction with fishing gear. The WG also noted that estimates based on 4) was much larger than other estimates and raised concern for its use because the PRM at 360 days after release was extrapolated estimate since tags used in the study had a maximum operational period of 120 days. **The WG agreed to use of PRM within 30 days by Hutchinson et al. (2021) for the estimate of US longline catch, given larger sample size (about 60) and its relevancy to the current fleet. The WG also agreed to use the upper limit of the catch (PRM within 30 days by Hutchinson et al., 2021) as a sensitivity analysis in the stock assessment in 2022.**

The WG confirmed the operational area of longline fleets for the shallow-set and deep-set fisheries. The WG noted that only the CPUE for the deep-set fishery was used in the previous stock assessment in 2017 because the CPUE data for the shallow-set fishery was shorter period of time. The WG also noted the CPUE for the shallow-set fishery might have an issue of the estimation bias due to the implementation of seasonal closure for the shallow-set fishery after 2015. **The WG agreed to use the only US deep-set index in the stock assessment in 2022.**

## 7. CATCH

### 7.1. Working Papers/Presentations

***Update of Japanese Annual Catches for Blue Shark Caught by Japanese Offshore And Distant Water Longliner in the North Pacific Ocean from 1994 to 2020. (ISC/21/SHARKWG-2/04)***

This working paper provides update of Japanese annual catches of blue shark (*Prionace glauca*) caught by Japanese offshore and distant-water longline fisheries in the North Pacific Ocean for 1994-2020. 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 total fishing efforts. The estimation methods of catches were substantially changed due to the changes in the CPUE standardization methods. Since the spatio-temporal models provide only the CPUEs scaled by the mean value, the scaled CPUEs was converted to absolute CPUEs using an average value of nominal CPUE. Then the catch number was estimated using the CPUEs and fishing effort. The calculations were separated by the shallow- and deep- sets longline fisheries. The annual catch number for shallow-set longline fishery was estimated using the season-year CPUEs of Japanese offshore and distant water shallow-set longline fishery with the fishing efforts of the shallow-set fishery, while those for deep-set longline fishery was estimated using the annual CPUEs of JRTVs with the fishing efforts of the deep-set fishery. Further, the annual catch number for each fishery was converted to annual catch weight using an average weight of blue sharks caught by the fishery. The estimated annual catch weight showed a continuous decreasing trend in a gradual decline of the total fishing effort. The total catches in recent five years were varied between 6,674 and 9,240 MT.

**Discussion**

The WG noted that the SS model can treat directly catch number, instead of weight, so perhaps the next stock assessment should use catch numbers instead of converting with uncertain weight data. This would be good to use for all fleets where catch is recorded in numbers (e.g., all longline fisheries) because SS can convert numbers using length-weight relationship. The WG also noted that Japan can provide the catch in numbers of blue shark caught by offshore and distant water longline for 1994-2020, however, all the catch prior to 1994 is in weight. Further, the WG noted that SS cannot deal with different units for the same fleet, however, it is possible to separate the fishery into two with different catch units within the SS model. The WG requested to provide catch number instead of catch weight for major longline fleets such as Japanese and Taiwanese longline fleets in future assessment, while the fleets such as Canada and Mexico are not required to provide the catch number due to the difficulty in the reconstruction of historical catch number data.

***Updated Annual Catches of Blue Shark Caught by Japanese Coastal Fisheries in the North Pacific Ocean from 1994 to 2019. (ISC/21/SHARKWG-2/05)***

This working paper provides update of Japanese annual catch of blue shark (BSH), *Prionace glauca*, caught by Japanese coastal fisheries in the North Pacific Ocean for 1994-2019. This working paper used the same estimation methods as those used in the previous analysis in 2016. Since the species-specific shark's data was not included in Japanese official coastal landing data, the catch amounts of BSH caught by multiple coastal fisheries were estimated using several available species-specific data. The proportion of estimated total catch of BSH for both longline fisheries and large-mesh driftnet fishery accounted for more than 97 % of annual total catch amounts. The annual total catch of BSH had increased in 2000s and reached at peak in 2007, and then it gradually decreased until 2019 due to the reduction of catch amounts for longline fisheries. The total catch amounts of BSH were largely fluctuated between 1041 and 4064 MT during 1994 and 2019. The annual trends of catch amounts of BSH were almost similar between previous and updated analyses.

**Discussion**

The WG discussed the reporting rate of the yearbook data, and it was clarified that they are landing data obtained from sales slip in the fishing market and thus discard is not included in the analysis. The WG noted that, however, these yearbook data are more reliable than the logbook data, because not all of the vessels may report the logbook data. The WG also noted that it could be possible to estimate the standardized CPUE using logbook data for coastal longline fishery, and then estimate the catch using the fishing effort data and to compare those estimates with yearbook catch estimates.

***Updated (2020) Blue Shark (Prionace glauca) Bycatch Statistics in Canadian Fisheries. (ISC/21/SHARKWG-2/06)***

This working paper updates the catch statistics for 2019-2020 for Blue Shark in Canadian waters. There are no targeted fisheries for blue shark, and almost all of the catch are bycatch, discarded at sea. A dramatic increase in catch was observed in the groundfish line fisheries (discarded) and salmon fisheries (discarded). Increases were also observed in the groundfish trawl fisheries (landed and discarded) and the tuna troll fisheries (discarded), but these catches remain very low. Given the increase in catches across all fisheries, the increase is unlikely to reflect misidentification or a fishery management impact. Preliminary data for salmon troll fisheries in 2021 suggest that this increase in bycatch is not sustained.

**Discussion**

The WG discussed the reason for the recent increase (2018-2020) of bycatch in several fisheries and the author confirmed that change of water temperature was the most likely factor. The WG also discussed the treatment of the spike in last two years and its impact in the result of stock assessment. The WG raised a concern about it for the stock assessment that despite still being a small value, the spike may pose a difficulty for the model to deal with depending on the selectivity used. The WG informed that the selectivity applied to Mexican fisheries was also applied to the Canadian bycatch estimates in the previous stock assessment in 2017. The WG noted that a fuller discussion on how to treat the dramatic increase in the Canadian bycatch will be addressed in later discussion on the stock assessment model.

***Estimation of Annual Catch for Blue Shark Caught by Japanese High Seas Squid Driftnet Fishery in the North Pacific Ocean from 1981 to 1992. (ISC/21/SHARKWG-2/07)***

This working paper provided annual catches of blue shark (*Prionace glauca*) caught by Japanese high seas squid driftnet fishery in the North Pacific Ocean for 1981-1992. Since the logbook data from 1981 to 1992 have no species-specific information about sharks, the annual catches of blue shark were predicted using statistical model (GLM and GAM) with scientific observer data in 1990 and 1991 as well as the information about the logbook data from 1981 to 1992. The coefficients of explanatory variables estimated from four models (different model structures from simple to complex) with scientific observer data, and then the relevant information about factors of logbook data were used to predict the catches. The predicted catches in number of blue sharks by different models were aggregated to calculate the annual catches. The annual catches had increased since the early 1980s and peaked in 1988, and subsequently decreased sharply. Annual catches in weight converted from the catch in number using an average weight of individuals were widely ranged from 645 to 20,268 MT. The authors recommend that the estimated catches will be used for the upcoming stock assessment of blue sharks in the North Pacific Ocean because the estimated catches are more reasonable from the view of the annual changes in the trends compared to the unaccountable constant catches used in the previous stock assessment.

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

The WG discussed the standard errors (e.g., confidence intervals) of the catch estimates. The WG noted that bootstrapping method can provide the standard error while they have not been calculated for this analysis. The WG also noted that such uncertainties could be calculated for future stock assessment, and this should be something calculated for all catches estimated by a model, not just this analysis. Further, the WG noted that the uncertainty in catch estimates can be translated into sources of uncertainty in the stock assessment, and previous assessments used +/-20% uncertainty for all fleets, based on observed CVs typically less than 0.2. Additionally, the WG noted that it is possible to provide the catch number instead of catch weight because catch weight was estimated using the mean body weight of 7 kg. The WG suggested to use catch number for the stock assessment in 2022.

***Blue Shark Catches in the Japanese Large-Mesh Driftnet Fishery in the North Pacific Ocean from 1974 to 1993. (ISC/21/SHARKWG-2/08)***

This working paper updated annual catches of blue shark (*Prionace glauca*) caught by Japanese large-mesh driftnet fishery in the North Pacific Ocean during 1973 and 1993 because the annual catch data contains the same constant value, and the calculation/estimation method is not described in the previous literatures. Since Japanese logbook data contains extremely high zero-catch for sharks caught by Japanese large-mesh driftnet fisheries, this working paper estimated the annual catches of blue sharks using the catches in weight of all sharks reported by Japanese statistical yearbook ("Norin-toukei"). Then, Japanese scientific observer data was used to calculate the ratio of blue shark to all sharks because the species-specific shark's data is not included in the statistical yearbook. The estimated catches in weight of blue shark sharply increased from 1975 to 1977, and subsequently decreased with fluctuations until 1993. Amount of annual catch in weight had a wide range between 1,236.0 and 10,580.7 MT for 1973-1993. The authors recommend using the estimated catches in this paper for the upcoming stock assessment of blue sharks in the North Pacific Ocean because the values are more reasonable from the view of the annual changes in the trends compared with the unaccountable constant values.

**Discussion**

The WG discussed the new catch estimates for the large-mesh driftnet fishery since they are quite different from previous estimates, and the updated catch showed a sharp increase in 1977. The WG noted that the fishing effort based on logbook data was constant in 1977 compared to 1978 and 1979, so the increase in catch is not due to effort. The WG conducted additional spatial-temporal analyses of fishing effort and the results showed higher fishing effort in 1977 in East China Sea and coastal water of Japan (esp. qt4), but the higher fishing effort mainly appeared in the coastal water of Japan in 1978 and 1979 (esp. qt3). The WG therefore concluded that the dramatic increase of catch in 1977 is likely due to a change in spatial pattern of fishing effort among year and quarter, but large uncertainty in the catch estimates is still remained.

The WG noted that switch of the operational area from the coastal and offshore waters to far seas was seen in the late 1980s as the driftnet fisheries changed the target from swordfish/billfish to albacore that would have resulted in lower catches of blue shark. The WG also noted that the spatial expansion of the operational area can support the decline observed in the new catch estimates from 1986 onwards, and these estimates are likely more reliable than the previous. Further, the WG noted that these data are only available as catch weight because the statistical yearbook data is on a basis of weight. The WG suggested to remain the catch of this fishery as catch weight in the stock assessment in 2022.

### 7.2. Other Catches (No working paper and presentation)

*Inter-American Tropical Tuna Commission (IATTC)*

The WG noted that IATTC updated the catch data from 2016 to 2020, and the annual catches were a very small amount, less than 10 metric tons.

*Non-ISC countries*

The WG noted that Secretariat of the Pacific Community (SPC) provided the observed catch data for blue sharks caught by longline and purse seine fishery in the North Pacific Ocean from 2015 to 2020. The WG also noted that the annual catches were estimated by the WG using the average CPUE between 2000 to 2010 multiplying by the annual total fishing effort of longline vessels for Non-ISC countries. Further, the WG also noted that there were large differences between the observed and estimated catch. The WG concerned that the estimated catch after 2015 had increased sharply and reached around 20,000 metric tons in 2018, while the observed catch prior to 2017 are remarkably low and less than 1000 metric tons. The WG discussed the need to check the observed data as it is very low compared to the estimated values. **The WG agreed that the catch level (around 2000 metric tons) in 2010 will be used in the test run of assessment model until the WG is available for the reasonable catch.** The WG noted to revisit this topic at the pre-assessment meeting. The WG decided to request the WCPFC Commission to provide the nominal annual CPUE by flag and the fishing effort (number of observed hooks).

*Republic of Korea*
The WG informed that the Republic of Korea provided historical catch data at the 2019 WG meeting. The WG also informed that the Republic of Korea updated the last two years data at this meeting, and those catches were very small amount.

*China*
The WG noted that China provided the catch number data from 2016 to 2020, while the catch data prior to 2015 used in the previous stock assessment was catch weight. The WG converted the catch number to the catch weight (after getting the permission from the contact person of China) using an average body weight (50 kg) estimated from the sex-specific size frequency data for 2009-2014 with weight-length equations (Nakano, 1994). **The WG agreed to use this converted catch data in the stock assessment.**

## 8. REVIEW SIZE DATA

### 8.1. Working Papers/Presentations

***Catch, Size and Distribution Pattern of the Blue Shark Caught by the Taiwanese Small-Scale Longline Fishery in the North Pacific. (ISC/21/SHARKWG-2/12)***

This working paper presented the catch, size, and distribution pattern of the blue shark by the Taiwanese small-scale tuna longline (STLL) fishery in the North Pacific. Catch estimates were based on the landing data from the three major fishing ports for the STLL fishery. The estimated annual catch of blue sharks by the Taiwanese STLL fisheries ranged from 6,983 MT in 2013 to 16,082 MT in 2009, with a mean of 11,685 MT in 2001-2020. The mean sizes were estimated to be 183 cm and 185 cm FL for females and males, respectively. Juvenile females were found in the tropical and subtropical areas, but adults were more often found in the temperate area. The smallest mean sizes for both sexes were found in season 2. The sex ratio was significantly different from 0.5 for every season except season 4.

**Discussion**
The WG noted that the annual catch in 2020 had decreased from 2019. This trend was similar in the Japanese and Mexican catches and wondered if environmental effects caused it. The WG also noted that environmental changes were observed in 2020 in the operational area of the fleet and that catches of some species increased while that of others decreased. No particular factor has been singled out as the cause for these changes.

The WG asked if fishing effort changed during the same time (2019-2020). The WG responded that the fishing effort decreased somewhat, but not much bit due to a good control of the pandemic in Chinese Taipei. It is unlikely that this reduction in effort entirely explains the drop in catch. The WG also asked if observer records and market records differed much, given the observer coverage. The WG responded that this discrepancy could be calculated from the data, but it has not been conducted yet. The WG indicated that such information could be provided in future

The WG asked about the span of lengths observed in area A (temperate water) and area B (tropical water) which seemed to indicate similar sized animals in both areas. The WG asked why the means of body length were so similar despite larger sharks being thought to be more present in tropical waters. The WG responded that this is likely due to fishing area and operating depth which differed between the two areas. This could explain the difference between what is typically thought about size compositions in the two areas, and what was presented. The WG noted that observers are not deployed in a regular and consistent manner which may account for some of the variation in the length compositions.

***Size and Spatial Distribution of the Blue Shark, Prionace glauca, Caught by the Taiwanese Large-Scale Longline Fishery in the North Pacific Ocean. (ISC/21/SHARKWG-2/13)***

This working paper presented the size and spatial distribution of the blue shark based on 5,897 specimens, that were collected by scientific observers on-board the Taiwanese LTLL vessels in the North Pacific Ocean between June 2004 and December 2020. Size segregation was found, and the mean size of blue sharks in area B (0-25°N) was significantly smaller than that in area A (north of 25°N). No significant sex segregation was found. Males predominated in the size range of 170-280 cm and 170-200 cm TL in area A and B, respectively.

**Discussion**

The WG asked about the size difference between the two areas, area A (temperate water) and area B (tropical water). The WG responded that fisher in area A targets albacore and so the sets are shallower, while the fisher in area B targets bigeye tuna and so the sets are deeper (>15 hooks between floats). The WG noted that the consideration of the gear effect in the CPUE standardization would reflect the size difference between areas. The WG suggested that this investigation should be done in the future work. The WG also noted that the bulk of the fleet operated in the north of Hawaii, where larger sharks are expected to be found, so that the finding of larger sharks in this fleet is not surprising.

***Size Distribution of Blue Shark (Prionace glauca) Collected by Japanese Fleet and Research Program in the North Pacific. (ISC/21/SHARKWG-2/11)***

This working paper summaried the size distribution of blue shark caught by Japanese fishery and research cruise, based on the several sources. Totally, 894,060 size data was collected between 1967 and 2020. 67% of them was from commercial Kinkai-shallow longline (port sampling), followed by research data with deep-set longline (23%) and the ratio of other type of fishery was less than 5%. Generally, blue shark caught by deep-set longline (median and mode: larger than 160 cm precaudal length: PCL) tends to be larger than that of other type of fishery (median and mode: smaller than 150 cm PCL). From the perspective of ontogenetic composition, ratio of juvenile was different depending on the type of fishery. Generally, juvenile ratio in coastal fishery (longline and driftnet) was higher than deep-set longline operated in the offshore/distant water for both sexes, while juvenile rate in deep-set longline for males was lower than females.

**Discussion**

The WG noted that the LTLL and the Japanese deep set longline are similar in that they both catch similar sized animals and have a similar sex ratio. The WG also noted that in the coastal areas in Japan, the sex ratio in catch is more or less even while males predominate in catches of the offshore commercial fishery.

The WG noted that the depth range of the deep-set fishery is 200 or 300 meters, and it is interesting weather the larger sharks are being caught at deeper depths. The WG also noted that the seasonal change in the mean body size of blue sharks caught by the deep set would need to be investigated in the future work.

The WG noted that the catch in Mexico is predominantly immature, and it is of interest to the WG at what deep the larger animals are found at.

### 8.2. Other Size Data (No working paper and presentation)

***Size Data of Republic of Korea***

The size data was not provided.

***Size Data of Non-ISC countries***

The WG clarified the meaning of "UF" which was "upper jaw fork length". The WG decided to convert all size data to PCL using conversion equation provided by SPC. The WG noted that sex specific size data from non-ISC countries is available this year, and there should be a discussion about whether or not to include it in the stock assessment in 2022.

## 9. BIOLOGICAL INFORMATION

### 9.1. Review of Blue Shark Biological Data for the Assessment

***Progress Report of Collaborative Study on the Migration Pattern of Blue Shark (Prionace glauca) in the Central North Pacific Ocean. (ISC/21/SHARKWG-2/09)***

This working paper presented a collaborative study to investigate the migration patterns of blue shark in the central North Pacific Ocean that was launched between Japan and the US in 2020. Ten pop-up satellite archival tags (PSATs) provided by Japan were distributed to US longline observers onboard commercial Hawaiian longline fishery vessels between 2020 and 2021 in association with US scientists. As of the end of October 2021, all PSATs had been successfully attached to blue sharks. Among the ten PSATs, three had troubles with their depth sensor and/or archival of data, and two had no data transmissions after the preset pop-off date. The data was obtained from one adult female consisting of 226 days-at-liberty, the adult female exhibited a clockwise movement pattern (from the southwestern waters off Hawaii towards the US mainland) between January and August 2021 with spatiotemporal variation of vertical behavior. The remaining four PSATs currently still attached to sharks are programmed to detach from February to June in 2022.

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

The WG discussed the sample size of electronic tagging data required for study on the stock structure and migration ratio. The WG noted that it is difficult to directly use the electronic tagging data in the stock assessment in 2022 because the sample size is insufficient at this time. The WG informed that only 10 tags have been deployed in the central North Pacific Ocean that is not enough to estimate the migration ratio and to define the stock structure. Combining with other information such as conventional tagging and genetic analysis are needed. The WG however raised issues on the less quality of conventional tag data and higher cost of electronics tags.

The WG noted that it is difficult to directly incorporate the seasonal movement effect in the SS model for North Pacific blue shark as the model structure is annual basis. The WG also noted that the recent study (Fujinami et al. 2021) provided information on seasonal migration in the northwestern Pacific that will help incorporate the area effect explicitly in the assessment model in future work.

The WG informed that satellite electronic tagging data (16 tags) used to estimate the selectivity in the South Atlantic blue shark stock assessment as a case study for validation (Carvalho et al. 2015). The WG noted that the well experimental design is needed to obtain useful information for stock assessment and the required sample size of tagging depends on the quality of the data. The WG proposed to conduct a collaborative study between Japan and US to estimate the selectivity for the validation.

The WG concerned about the elaborating on a spatial explicit model without enough tagging information. The WG noted that size composition data is available for the estimation of movement patterns, however, it is usually difficult to accurately estimate them from only the size composition data, so that the information from tagging study is needed for such area-specific model in future work.

### 9.2. Update of Blue Shark Biological Data for the Assessment Including Discussion on Stock-Recruitment Relationships (LFSR)

***Review and Proposal of Key Life History Parameters for North Pacific Blue Shark Stock Assessment. (ISC/21/SHARKWG-2/10)***

This working paper provides a review of key life history parameters of North Pacific blue shark used in the previous stock assessment and a proposal of new biological parameters to be used in the next stock assessment. The authors recommend updating the following parameters: updated sex-specific growth parameters, sex-specific natural mortality at age, and parameters of stock-recruitment relationships. For the parameters of low-fecundity stock recruitment (LFSR) relationships, the authors recommend discussing the estimation method of the parameters in the upcoming meeting.

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

**The WG agreed to use a suite of updated biological parameters of SS such as sex-specific growth and maturity parameters, and steepness in the stock assessment in 2022.**

The WG confirmed that the updated sex-specific natural mortality (M) at age were almost the same as those used in the previous stock assessment in 2017. The WG pointed out that it is necessary to compare the updated M-schedules with those used in the stock assessments of other regions (i.e., the Atlantic, the Indian, and the South Pacific) because M is one of the key parameters in the stock assessment model. The WG compared the updated M-schedules with those used in the stock assessments in other regions. The WG noted that the updated M-schedules in juveniles are much higher and cumulative survival rates are lower than those in the other tuna-RFMOs. The WG suggested to use the lower M-schedules as sensitivity analyses. The WG also noted that the use of updated M-schedules estimated from the region-specific growth curves (Fujinami et al., 2019) and age-at maturity (Fujinami et al., 2017) are more appropriate in the stock assessment, and not necessarily to use those estimates from other regions with the different demographic rates. Further, the WG noted that the blue shark has a high productivity because that the reproductive cycle is one year, the fecundity is around 35 with the maximum of approximately 100, and maturity at age is 4-5 years. By contrast, other pelagic shark such as a shortfin mako (*Isurus oxyrinchus*) has lower productivity with that the reproductive cycle is 2-3 years, the fecundity is around 10, and maturity at age of female is more than 10 years and ICCAT used the 18 years of maturity at ages for the latest stock assessment. The WG noted that the blue shark is a unique pelagic shark, and they chose r type strategy while other pelagic sharks chose k type strategy.

The WG noted that the updated M-schedules seem high in younger sharks because the Ms of age 2 are almost the same with that used for small pelagic fish such as a sardine (approximately a constant value of 0.4). The WG therefore decided to investigate whether the updated Ms for North Pacific blue sharks are reasonable from biological and ecological perspective. The WG reviewed a suite of Ms for North Pacific blue sharks using multiple empirical equations with key biological parameters (http://barefootecologist.com.au/shiny_m.html). The estimates of Ms were substantially different among the estimator and it was very difficult to verify the suitability of the updated Ms from the comparisons of the estimates. The WG noted that we had already discussed the suitability of the M-schedules estimated from the constant value (0.23) of meta-analysis (Campana et al., 2016) in the previous assessment in 2017 (Semba and Yokoi, 2016) and in the published paper (Kai and Fujinami, 2018). The WG also noted that the higher Ms are used in the stock assessment for Pacific bluefin tuna and the M of age 0 (1.6) was directly estimated from the tagging study. Therefore, the updated M-schedules does not seem high in younger sharks.

**The WG agreed to use the updated M-schedules in this working paper for the stock assessment in 2022 because those are the scientifically best available estimates at this moment.**

The WG estimated alternative sex-specific M-schedules using the empirical estimators (Then et al., 2015; Hamel and Copes, in press) recommended by Mark Maunder (In press) in combination with an allocation method based on the growth (Lorenzen, 2000), which is incorporated in the SS. The WG also estimated the confidence intervals of the M-schedules using the uncertainty in the estimator. The estimates of alternative M-schedules based on the von-Bertalanffy growth curve (Then et al., 2015) showed similar to the updated M-schedules. The estimates of alternative M-schedules based on the three maximum ages (17, 18 and 24 years) (Hamel and Copes, in press) showed higher M-schedules compared to the updated M-schedules. **The WG agreed that the lower range of estimates from the Then et al. (2015) and upper range of estimates from Hamel and Copes (in press) with the maximum age of 24 are used as the sensitivity analyses in the stock assessment in 2022.**

## 10. DISCUSS STOCK SYNTHESIS (SS) MODELING APPROACHES INCLUDING THE CHOICE OF INPUT PARAMETERS AND PRIORS

<u>Annotated agenda of item 10</u>

**a. Decide on the version of SS**

・Update the version of SS from 3.24 f to 3.3

**b. Decide on base case configurations**

・Population and fishery structure

- ➢ Stock assessment period (1971-2020)
- ➢ Annual (Jan-Dec)
- ➢ Two-sex model
- ➢ Age classes 1-24 +
- ➢ Sex-specific selectivity (double normal selectivity)
- ➢ Initial catch is fixed at 40,000 MT

・Fleet definitions (Catch: 18 fleets, CPUE 7 fleets, Size data 10 fleets)

- ➢ Annual catch in weight and size data by fleets

F1_MEX;
F2_CAN; (no size data; mirroring of F1)
F3_CHINA;
F4_JPN_KK_SH;
F5_JPN_KK_DP;
F6_JPN_ENY_SH; (no size data; mirroring of F4)
F7_JPN_ENY_DP;
F8_JPN_LG_MESH;
F9_JPN_CST_Oth; (no size data; mirroring of F8)

F10_JPN_SM_MESH;
F11_IATTC; (no size data; mirroring of F1)
F12_KOREA; (no size data; mirroring of F3)
F13_NON_ISC; (New size data)
F14_USA_GILL;
F15_USA_SPORT; (no size data; mirroring of F14)
F16_USA_Lonline;
F17_TAIW_LG;
F18_TAIW_SM; (no size data; mirroring of F17)

- Annual CPUE by fleets
  S1_HW_DP
  S2_ TAIW_LG
  S3_ JPN_SH_EARLY
  S4_ JPN_SH_LATE
  S5_SPC_OBS
  S6_ MEX_OBS
  S7_ JPN_RTV(New)

・Biological parameters

- Use the updated biological parameters by Yuki et al. (2021); **ISC/21/SHARKWG-2/09**

・Model weighting

- Francis (2011) Method

**c. Decide on tentative sensitivity analyses**

・Natural mortality schedule

・Initial catch

・Alternative late CPUE series or all CPUEs

・SS (mimic 2017 blue shark SS model)

・Assumptions of spawner-recruit relationships

・Alternative of annual catch (US Hawaii LL)

**d. Decide on diagnostic methods**

・Joint residual plots

・Likelihood (R0) profiles

・Age-structured production model (ASPM)

・Retrospective analysis

・Hindcast Cross-validation

・Jitter analysis

**e. Decide on future projection method and scenarios**

・Same method as those used in the 2017 assessment

- Four scenarios (Average F+ 20% Fmsy, Fmsy, Average F-20%, Average F-2017-2019)

- Projection period (2020-2029)
- Recruitment from the S-R relationships
- Fixed selectivity

・MCMC (as a challenge, newly updated function of SS; Monnahan et al., 2019; Kai 2021)

**Discussion**

The WG discussed the modeling approach and choice of input parameters for the base case and sensitivity analyses. Most of the model settings that were listed in the annotated agenda (see above) were adopted with consensus though there was short discussion on a few topics.

The WG discussed the assumption of double normal selectivity for all fisheries. The WG noted that it is necessary to test the use of a logistic/asymptotic selectivity for at least one fishery to guard against cryptic biomass. The WG informed that this was applied to the Taiwanese large-scale longline fishery in the previous stock assessment in 2017 since the fleet captured the largest individuals. The WG suggested to incorporate the logistic/asymptotic selectivity into the sensitivity analysis based on the testing.

**The WG agreed to use the same fleet definitions as in the previous stock assessment in 2017.**

The WG suggested that in the next assessment the US HI longline should be split into two fisheries, deep-set and shallow-set, as these sectors catch has different amounts and sizes of individuals and would be expected to have different F-at-age. The WG noted that splitting the US HI longline would require a complete reconstruction of the catches for each sector which is why this change is recommended for the next assessment in 2022. If time allows, US will provide catch by different longline sector.

The WG discussed the choice of stock recruitment relationship. The WG noted that the estimated scale of the population seems to be too high when placed in the context of other regional assessments, WCPO bigeye tuna and SWPO blue shark. The WG also noted that there needs to be careful consideration about the LFSR and it is needed to determine if it is appropriate to apply in this case.

The WG discussed an appropriate level of Sigma-R in the stock assessment. The WG noted that the value (0.3) used in the previous assessment was a subjective choice and this could perhaps be estimated internally but this is an area of the model development that needs more careful thought.

The WG discussed model diagnostics and proposed diagnostics centered on the use of the ss3diags package which is the application of the "cookbook" proposed by Carvalho et al. (2021). The WG noted that application of all of the diagnostics in that paper is relatively easy and straightforward to do using that package. These diagnostics should be consulted throughout the model development process and not just reported for the final model. The WG discussed the different configurations of the hindcast cross-validation diagnostic including the "model-free" approach proposed by Kell et al. (2021). The WG also discussed the implementation of hindcasting in SS, and how it is based off of the retrospective analysis and assumes the same model assumptions.

The WG noted that in terms of the model sensitivity and the presentation of the uncertainty there is a major decision that needs to be made. The WG discussed the way of presenting the assessment results based on a "small" model ensemble of 2-20 models, while the ISC traditionally identify the best available model configurations and parameterization. The WG also noted that the idea was supported by some WG members as there are a number of key sensitivities that were identified, which should be incorporated into the management advice.

**The WG agreed to keep the minimum number of future projection scenarios used in the previous assessment in 2017 at this stage but to keep an open mind for alternatives.** A final decision can come later at the pre-stock assessment meeting.

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

The WG noted that the Japan shallow- and deep-set longline fishery and the Taiwanese large-scale longline fishery catch estimates will be provided in numbers for sensitivity analyses and the deadline is the end of November 2021.

The WG noted that the US will reconstruct the complete Hawaiian longline catch time series with the recommendations provided, and with an improved discard mortality rate. The WG also noted that the catch can be provided in numbers for sensitivity analyses and the deadline is by the pre-assessment meeting.

The WG indicated that upgrading from SS version 3.2 to 3.3 would need to be done as soon as possible and will be discussed at the small modelers meeting. The WG also noted that Japan indicated the data file and control file for SS will be provided for the modeler's meeting after the SS version is updated.

**The WG agreed to use established values for Ms and steepness provided in last week's WG paper.** The WG noted that the stock assessment team will meet the week of November 22 (24$^{th}$ JP time), 2021 to outline modeling tasks, assignments and workplans. The WG confirmed that the tasks below to be completed by the assessment team and the deadline is by the pre-assessment meeting.

- Update the version of SS
- Parameterizations (mainly size-selectivity and time block)
- Model diagnostics and selection of base case model.

The WG noted that the application of the LFSR to North Pacific blue shark will need to be discussed by the assessment team, but the deadline to complete this will likely be one-month prior to the pre-assessment meeting.

## 12. OTHER MATTERS

No discussion.

## 13. FUTURE SHARKWG MEETINGS

### a. Pre-stock assessment meeting for blue shark（FEB/MAR in 2022）

**The WG agreed that the online pre-stock assessment meeting will be held at the end of the February and/or the beginning of the March.**

### b. Stock assessment meeting for blue shark (APR/May in 2022)

**The WG agreed that the online/in-person stock assessment meeting will be held in April and May except for the beginning of the April (pre-assessment of SC of WCPFC).**

### c. ISC Plenary (Hawaii, JULY in 2022)

## 14. 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.

## 15. ADJOURNMENT

The WG Chair thanked everyone for a productive meeting! The meeting was adjourned at 12:37 on Friday November 19, 2021 (Japan time).

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## ATTACHMENT 2. MEETING DOCUMENTS AND INFORMATION PAPERS

**WORKING PAPERS**

| | |
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| ISC/21/SHARKWG-2/01 | Spatio-temporal model for CPUE standardization: Application to blue shark caught by Japanese offshore and distant water shallow-set longliner in the western North Pacific. **Mikihiko Kai** (kaim@affrc.go.jp) |
| ISC/21/SHARKWG-2/02 | The preliminary analysis of standardized CPUE for the catch data of blue shark by Japanese longliner using the finite mixture model. **Minoru Kanaiwa, Atsuya Yamamoto, and Mikihiko Kai** (kanaiwa@bio.mie-u.ac.jp) |
| ISC/21/SHARKWG-2/03 | Spatio-temporal model for CPUE standardization: Application to blue shark caught by longline of Japanese research and training vessels in the western and central North Pacific. **Mikihiko Kai** (kaim@affrc.go.jp) |
| ISC/21/SHARKWG-2/04 | Update of Japanese annual catches for blue shark caught by Japanese offshore and distant water longliner in the North Pacific Ocean from 1994 to 2020. **Mikihiko Kai** (kaim@affrc.go.jp) |
| ISC/21/SHARKWG-2/05 | Updated annual catches of blue shark caught by Japanese coastal fisheries in the North Pacific Ocean from 1994 to 2019. **Mikihiko Kai and Toshikazu Yano** (kaim@affrc.go.jp) |
| ISC/21/SHARKWG-2/06 | Updated (2020) blue Shark (*Prionace glauca*) bycatch statistics in Canadian fisheries. **Jackie. R. King (Jackie.King@dfo-mpo.gc.ca)** |
| ISC/21/SHARKWG-2/07 | Estimation of annual catch for blue shark caught by Japanese high seas squid driftnet fishery in the North Pacific Ocean from 1981 to 1992. **Yuki Fujinami, Minoru Kanaiwa, and Mikihiko Kai** (fuji925@affrc.go.jp) |
| ISC/21/SHARKWG-2/08 | Blue shark catches in the Japanese large-mesh driftnet fishery in the North Pacific Ocean from 1974 to 1993. **Yuki Fujinami, Minoru Kanaiwa, and Mikihiko Kai** (fuji925@affrc.go.jp) |
| ISC/21/SHARKWG-2/09 | Progress report of collaborative study on the migration pattern of blue shark (*Prionace glauca*) in the central North Pacific Ocean. **Yasuko Semba, Yuki Fujinami, Melanie Hutchinson, Michael Kinney, and Mikihiko Kai** (senbamak@affrc.go.jp) |
| ISC/21/SHARKWG-2/10 | Review and proposal of key life history parameters for North Pacific blue shark stock assessment. **Yuki Fujinami, Yasuko Semba, and Mikihiko Kai** (fuji925@affrc.go.jp) |

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| ISC/21/SHARKWG-2/ 11 | Size distribution of blue shark (Prionace glauca) collected by Japanese fleet and research program in the North Pacific. **Yasuko Semba** (senbamak@affrc.go.jp) |
| ISC/21/SHARKWG-2/ 12 | Catch, size and distribution pattern of the blue shark caught by the Taiwanese small-scale longline fishery in the North Pacific. **Kwang-Ming Liu, Kuan-Yu Su,Wen-Pei Tsai, and Chieng-Pang Chin** (kmliu@mail.ntou.edu.tw) |
| ISC/21/SHARKWG-2/ 13 | Size and spatial distribution of the blue shark, Prionace glauca, caught by the Taiwanese large-scale longline fishery in the North Pacific Ocean. **Kwang-Ming Liu, Kuan-Yu Su, Wen-Pei Tsai, and Chieng-Pang Chin** (kmliu@mail.ntou.edu.tw) |
| ISC/21/SHARKWG-2/ 14 | Updated standardized CPUE and catch estimation of the blue shark from the Taiwanese large scale tuna longline fishery in the North Pacific Ocean. **Kwang-Ming Liu, Kuan-Yu Su, Wen-Pei Tsai, and Chieng-Pang Chin** (kmliu@mail.ntou.edu.tw) |
| ISC/21/SHARKWG-2/ 15 | Update on standardized catch rates for blue shark (*Prionace glauca*) in the 2006-2020 Mexican Pacific longline fishery based upon a shark scientific observer program. **José Ignacio Fernández-Méndez, José Leonardo Castillo-Géniz, Georgina Ramírez-Soberón, Horacio Haro-Ávalos, and Luis Vicente González-Ania (ignacio.fernandez@inapesca.gob.mx)** |
| **PRESENTATIONS** | |
| ISC/21/SHARKWG-2/ P-01 | 2021 ISC North Pacific blue shark stock assessment: US domestic fishery data updates: Catch, CPUE and length frequency. **Nicholas Duchrme-Barth, Michael Kinney, and Felipe Carvalho** (Nicholas.ducharme-barth@noaa.gov) |
| **INFORMATION PAPERS** | |
| ISC/21/SHARKWG-2/ INFO-01 | Cluster analysis used to reexamine fleet definitions of North Pacific fisheries with spatiotemporal consideration of blue shark size and sex data. Kinney M. J., F. Carvalho, M. Kai, Y. Semba, K.-M. Liu, W.-P. Tsai, C.-G. J. Leonardo, H.-A. Horacio, C.-C. L. Daniel, and S. L. H. Teo. (michael.kinney@noaa.go) |
| ISC/21/SHARKWG-2/ INFO-02 | Performance of a finite mixture model in CPUE standardization for a longline fishery with target change. 2021. Fish. Sci. 87: 465-477. **Ayumi Shibano, Minoru Kanaiwa, and Mikihiko Kai** |
| ISC/21/SHARKWG-2/ INFO-03 | Stock Assessment and Future Projections of Blue Shark in the North Pacific Ocean through 2015. WCPFC-SC13-2017/SA-WP-10 |

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| ISC/21/SHARKWG-2/ INFO-04 | Seasonal migrations of pregnant blue sharks *Prionace glauca* in the northwestern Pacific. 2021. Mar. Ecol. Prog. Ser. 658: 163-179. **Yuki Fujinami, Ko Shiozaki, Yuko Hiraoka, Yasuko Semba, Seiji Ohshimo, and Mikihiko Kai** |
| ISC/21/SHARKWG-2/ INFO-05 | Spatio-temporal changes in catch rates of pelagic sharks caught by Japanese research and training vessels in the western and central North Pacific. 2019. Fish. Res. 216: 177-195. **Mikihiko Kai.** |
| ISC/21/SHARKWG-2/ INFO-06 | Stock-recruitment relationships in elasmobranchs: Application to the North Pacific blue shark. 2018. 200: 104-115. **Mikihiko Kai and Yuki Fujinami.** |
| ISC/21/SHARKWG-2/ INFO-07 | Reproductive biology of the blue shark (Prionace glauca) in the western North Pacific Ocean. 2017. Mar. Freshwater. Res. 68: 1-10. **Yuki Fujinami, Yasuko Semba, Hiroaki Okamoto, Seiji Ohshimo and Sho Tanaka** |
| ISC/21/SHARKWG-2/ INFO-08 | Age determination and growth of the blue shark (*Prionace glauca*) in the western North Pacific Ocean. Fish. Bull. 2019. 117: 107-120. **Yuki Fujinami, Yasuko Semba, and Sho Tanaka.** |

## ATTACHMENT 3. DRAFT AGENDA27

**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 blue shark**

**November 9-12, 16-17, 19 2021 (Japan and Korea time)**

**Meeting Hours: 08:30 – 12:30 (Japan and Korea time)**

**November 9-12, 16-17, 19 2021 (Taiwan time)**

**Meeting Hours: 07:30 – 11:30 (Taiwan time)**

**November 8-11, 15-16, 18 2021 (Hawaii time)**

**Meeting Hours: 13:30 - 17:30 (Hawaii time)**

**November 8-11, 15-16, 18 2021 (Mexico and Canada time)**

**Meeting Hours: 15:30 - 19:30 (Mexico and Canada time)**

***DRAFT***

**Meeting begins at 08:30 am Tuesday JST (07:30 Taiwan and Korea, 13:30 Hawaii, and 15:30 Mexico and Canada)**

1. Opening of SHARKWG Workshop
    a. Opening remarks (SHARK WG Chair)
    b. Introductions
    c. Meeting arrangements
2. Distribution of documents and numbering of Working Papers
3. Review and approval of agenda
4. Appointment of rapporteurs
5. Report of the SHARKWG Chair
    a. Summary of last stock assessment of NP blue shark
    b. Current meeting objectives
6. Review CPUE indices for blue shark stock assessment
7. Review catch data, discard data and total catch estimation procedures
8. Review size data
9. Biological information
    a. Review of blue shark biological data for the assessment

   b. Update of blue shark biological data for the assessment including discussion on stock-recruitment relationships (LFSR)

10. Discuss Stock Synthesis (SS) modeling approaches including the choice of input parameters and priors
    a. Decide on the version of SS
    b. Decide on base case configurations
    c. Decide on tentative sensitivity analyses
    d. Decide on diagnostic methods
    e. Decide on future projection method and scenarios
11. Establish work plan for the pre-assessment and final data submission deadline
12. Other matters
13. Future SHARKWG meetings
    a. Pre-stock assessment meeting for blue shark（FEB/MAR in 2022）
    b. Stock assessment meeting for blue shark (APR/May in 2022)
    c. ISC Plenary (Hawaii, JULY in 2022)
14. Clearing of report
15. Adjournment