Annex 7

REPORT OF THE SHARK WORKING GROUP WORKSHOP

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

March 9-17, 2015
Shizuoka, Japan

1.0 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 9-day meeting in Shimizu, Shizuoka, Japan, March 9-17, 2015. The primary goal of the workshop was to prepare the indicator based assessment of the north Pacific shortfin mako shark stock.

Suzanne Kohin, SHARKWG Chair, opened the meeting at 9:00 on 9 March, 2015. Participants included members from Chinese Taipei, Japan, United States of America (USA) and the Western and Central Pacific Fisheries Commission (WCPFC) (Attachment 1). Dr. Miki Ogura, Director of the Tuna and Skipjack Division of the National Research Institute of Far Seas Fisheries (NRIFSF), on behalf of the Director General of the NRIFSF, welcomed all participants. He wished for all to have a productive meeting and for good work on the north Pacific shortfin mako shark assessment.

2.0 Distribution of documents and numbering of working papers

Eight working papers and 6 information papers were distributed and numbered (Attachment 2). Several oral presentations were also made during the meeting. All working group papers were approved for posting on the ISC website where they will be available to the public with the exception of papers 03, 05, and 08.

3.0 Review and approval of agenda

The draft meeting agenda was reviewed. Additional agenda items were suggested and the agenda was adopted with minor revisions (Attachment 3).

4.0 Appointment of rapporteurs

Rapporteuring duties were assigned to Kotaro Yokawa, Minoru Kanaiwa, Seiji Ohshimo, Kwang-Ming Liu, Mioko Taguchi and Norio Takahashi for the meeting report. The approved agenda (Attachment 3) indicates the rapporteurs for each item in parentheses. The Chair also assigned Kevin Piner, Hui-Hua Lee, Felipe Carvalho, Tim Sippel, Mikihiko Kai, Suzy Kohin and Kwang-Ming Liu to lead the writing on various sections of the stock assessment report of the north Pacific shortfin mako shark.

5.0 Report of the SHARKWG Chair

The SHARKWG Chair summarized the outcomes of the last SHARKWG meeting, held in November 2014, in Puerto Vallarta Mexico. At that meeting, members reviewed the fishery information available for shortfin mako shark in the North Pacific including catch, catch-per-unit-effort (CPUE), and size data. While many members have made significant progress on developing catch, CPUE and size time series, there remain a number of data gaps.

The working group discussed the types of assessment models that can be used to determine stock status when different types of data are available. For example, fully integrated age-structured models require size data, abundance indices, and catch, whereas a production model can be conducted when size data are lacking. Catch-free models and fishery indicators have also been used for data poor analyses. The Working Group reviewed preliminary work on simulations that demonstrates how informative various fishery time series are to providing conclusions about stock status, when using an indicator analysis approach in the absence of a full assessment.

In addition to reviewing fishery data, the group reviewed the status of knowledge on the life history of shortfin mako sharks. There is uncertainty in ageing shortfin makos due to conflicting information regarding the vertebral band pair deposition rates. An oxytetracycline (OTC) tagging study has shown that in the northeast Pacific, juvenile shortfin makos (up to age 4 to 5) deposit two band pairs in their vertebrae per year, however it is unknown whether that pattern persists throughout life or in all regions of the north Pacific. A working group paper described a recent recapture of an OTC tagged adult male shortfin mako shark after 6 years at liberty and provides the first data to support an ontogenetic shift in banding pattern from two to one band pair per year at about age 5 in male shortfin mako sharks in the northeast Pacific. The ISC shark age and growth specialists have a work plan to help reduce uncertainty in the understanding of both blue and shortfin mako age and growth. There is also a lack of understanding on the breeding periodicity of shortfin mako sharks. Past studies report that gestation period may be anywhere from 9-24 months, and that the breeding periodicity could be once every 2 or 3 years. The Working group agreed to begin metadata analyses that combine raw data from age and growth and reproductive studies to help draw the most parsimonious conclusions regarding those biological parameters for use in stock assessments. Templates were developed and circulated to members to collect data for the metadata analyses.

Given the incomplete fishery data and the uncertainties regarding life history parameters, the working group settled on using an indicator approach to provide the ISC Plenary with information on the status of north Pacific shortfin mako sharks. Members were asked to provide finalized time series data in advance of this meeting and those will be reviewed and included in the indicator analyses. Members were reminded to provide data for the metadata analyses as not all members had done so.

6. Review of outstanding shortfin mako data

6.a CPUE

6.a.1 *CPUE and catch of shortfin mako caught by Japanese shallow-set longliner in the western North Pacific (ISC/15/SHARKWG-1/02)*

<u>Summary</u>

This working paper provides estimation of catch per unit of effort (CPUE) and catch of shortfin mako, *Isurus oxyrinchus*, caught by Japanese shallow-set longliners during 1994 to 2013 in the western North Pacific. Two filtering methods were applied to choose the reliable vessels using the data in 2000s. Filtering (I) was conducted based on the AIC estimated from CPUE standardization, comparing longline research vessels and commercial vessels. Filtering (II) is conducted based on the visual observations of the positive catch of shortfin mako for each vessel. The fishery area was separated into four areas using GLM tree. A negative binomial model was used to standardize the CPUE for filtered data from 1994 to 2013. Four different models (three area model, four area model, five area model, and no area model) were applied, and the four area model was selected by AIC. The estimated abundance indices showed an increasing trend. These CPUE series represent the abundance indices of juvenile and sub-adults (60-200 cm PCL) in the western North Pacific (25-45 N and 137 E-160 W). Also, the catch number was estimated by multiplication of the CPUE by total effort of Japanese shallow-set fishery in the western North Pacific. The number was converted to tonnage by the average weight. The estimated and retained catch weight (tons) had slightly increased until around 2006 and has been slightly decreasing since due to a decline in effort.

Discussion

It was explained that research vessels used to verify the fishery data in this study are chartered boats which use the same fishing gear and same operational patterns as Japanese commercial surface longliners. The reliability of estimates in the 1990s was questioned as the research data is only available since 2000. It was answered that because the 2nd filtering step to select data of vessels with higher reporting ratios is more problematic for shortfin mako sharks because of the relatively low catch ratios of shortfin mako shark compared to blue sharks, so there may be more uncertainty for the 1990s. A more complex stochastic approach may be necessary to obtain reliable estimates in the 1990s. The ratio between blue and mako shark in 2000s for the estimation in 1990s could be used, but that is an uncertain assumption.

The WG noted that the increase in CPUE from 1994 to present is particularly high and unlikely given the low productivity of shortfin makos. Some participants asked about whether this could be a reflection of the fleet shift in targeting from swordfish to blue shark. The spatial pattern of the catch of blue, shortfin mako and swordfish was shown and there is not as clear a distinction by time and area in the catch ratios (swordfish:shortfin mako and blue shark:shortfin mako) as was seen for blue sharks. The authors recalculated the standardization by including the CPUE ranking of swordfish (i.e. blue shark targeting factor), as well as by removing the quarter and area factors in order to see the effect of the quarter and area factors and the swordfish CPUE ranking. The quarter and area factors were significant and included in the full model based on the model selection presented, but the trends in the reduced model without the quarter and area and with the swordfish CPUE ranking included did not affect the CPUE trend. No significant differences were found in comparison to the full model, so the WG concluded that there is no apparent effect based on the change in targeting, at least based on the factors explored. **The WG recommended that work continue on improving the index for this fishery in order to help identify the reason for the trend that seems inconsistent with the productivity of the shark.**

For the use of reported indices, it was indicated the results of this study at least indicate no large decrease in the abundance indices of shortfin mako in the juvenile areas (2 and 4) and areas where larger sharks are found (1 and 3) in the 1990s, and an apparent increasing trend since. The trends observed in areas 2 and 4 are consistent with the trend in the research survey index (*ISC/14/SHARKWG-3/04*).

6.a.2 *Revised standardized catch rates and catch estimate of shortfin mako shark by Taiwanese large-scale tuna longline fishery in the North Pacific Ocean (ISC/15/SHARKWG-1/07)*

Summary

In the present study, the shortfin mako shark catch and effort data from the logbook records of Taiwanese large-scale tuna longline fishing vessels operating in the North Pacific Ocean from

2005-2012 were analyzed. Due to the large percentage of zero shortfin mako shark catch, the catch per unit effort (CPUE) of shortfin mako shark, as the number of fish caught per 1,000 hooks, was standardized using a delta lognormal model. Both nominal and standardized CPUE of shortfin mako sharks showed stable but slightly decreasing trends. Estimated shortfin mako shark by-catch in weight from the Taiwanese large-scale tuna longline fishery ranged from 0 metric tons (MT) in 1973 to 154 MT in 2006, and it decreased thereafter. The results obtained in this study can be improved if longer time logbook data are available and environmental factors are included in the model.

<u>Discussion</u>

The data and fishery cover a wide area; however, the annual availability of data vary and for some years and regions, sample numbers are rather low. This might affect the estimated annual trend of standardized CPUE. The WG requested the authors check the area specific data availability, nominal CPUE trends and residual patterns. The nominal CPUE trends were provided and showed some differences among the areas. Also, concerns were raised regarding the skewed residual patterns for both negative binominal and log-normal parts. **One solution could be to use only those areas where the data are continuously available and recalculate the standardized CPUE. It was also suggested that methods be used to correct for differences in effort and CPUE across space and time.** Because the annual trend of standardized CPUE by the Taiwanese distant-water longliners shows a different pattern from those by other fisheries, the data should be further explored in order to provide an explanation.

The WG asked about the results of the comparison between logbook data and observer data. The author explained the CPUE trends calculated by logbook and observer data are similar. **The results of the comparison should be documented in order to support the reliability of the reported abundance index.**

6.b Catch

6.b.1 *Preliminary comparision of the Hawaii deepset longline and Japan training vessel longline CPUEs (oral presentation)*

At the November 2014 meeting, the CPUE of the Japan RTV fishery was prepared using the same model as used for the Hawaii deepset longline fishery that is believed to operate in an overlapping area and with similar fishing conditions. There was a suggestion that these data be further explored in order to see if the RTV data set can provide additional information on relative abundance for that area and population sector (larger sharks) farther back in time. A preliminary comparison of the set by set data for the two fisheries was presented. Although there do not appear to be large differences in the times and areas fished, the WG did not agree that the data should be combined at this time to use in a single standardization model given that some operational details may differ. **There also is no need to combine the data; the two indices can both be used in either an indicator analysis or a full assessment and still provide information independently on the relative abundance trends. Work will continue to further understand how these data sets can be used together for future analyses.**

The RTV data set is considered to be quite reliable for the 1990s. Since 2000, there is concern that reporting accuracy may have changed and there needs to be further verification and explanation of the problem in order to understand the best use of these data.

6.c Size/sex

6.c.1 *Spatial and temporal patterns of shortfin mako shark size and sex in the North Pacific Ocean (ISC/15/SHARKWG-1/04)*

A single stock is assumed within the North Pacific Ocean based on evidence from genetics and tagging data. However, regional differences in sex-specific size distribution have been identified based on analyses of size data from individual nations. Spatially explicit size and sex data from all nations and regions have not yet been investigated together. This analysis combines data from multiple fisheries distributed across most of the North Pacific to identify population substructure and then looks at temporal patterns in size and sex ratio by region. This information can become part of an evaluation of stock status indicators and provide a basis for research towards a better understanding of population movement.

<u>Discussion</u>

A previous study near Taiwan suggested the pupping season is Dec – July. The pupping season is around winter, Dec – Jan in the northwest and central Pacific based on the analysis of Kai et al. 2014 (ISC/14/SHARKWG-3/INFO01). **The WG suggested that a next step may be to use modeling approaches, such as GAM, to explore the locations of pupping grounds or presumed mating grounds and seasons.** GAM may help to explain length distributions and sex ratios. Subsequent analyses should also look for possible multi-modal distributions (histograms) to determine if a statistic such as the median would be more appropriate than the mean for representing central tendency. At the request of the WG, maps of shortfin makos from 50-70 (PCL) were added to show age zero animals.

6.d Inventory of all data for analysis

<u>CPUE</u>

After reviewing newly reported CPUE documents, the WG updated the CPUE selection table which was created during the last meeting. The table will be used for summarizing the reliability of the available abundance/biomass indices for use in the indicator analysis.

<u>Catch</u>

The WG had a quick review of the catch table and a figure was prepared to show the current partial catch data available. These data will be used in the indicator analysis to help explain the current knowledge of recent trends in fishing effort and catch. There are still large gaps in the catch data and **the WG members were requested to continue to work on estimating catch of shortfin mako by all their fleets for as far back as possible.** These data will be needed in order to conduct a full assessment of shortfin mako shark.

7.0 Indicator analysis simulations

<u>Summary</u>

Fishery indicator analysis is one of several data-poor methods used to provide general stock status advice when the data needed to produce traditional population dynamics models are unavailable. We define fishery indicators to be simple metrics characterizing a temporal change in the data stream (CPUE and length compositions). For pelagic sharks, fishery indicators should consider spatial aspects of life history and fisheries from which the indicator information is drawn. This working paper used simulation methods to evaluate the reliability of CPUE and size indictors' prediction of stock status by comparing indictors against spawning stock biomass and fishing mortality. We simulate synthetic populations of a variety of life histories and exploitation scenarios that are consistent with the biological and fisheries properties of mako-like sharks. We further evaluate which potential indicators (CPUE and average size) provide the most reliable information about the stock status. The simulation results suggest that (1) indices of CPUE are better indicators for representing the stock status (in terms of both biomass status and fishing status) than average length; (2) longer or close to virgin CPUE series are better indicators than shorter series; (3) precise CPUE indices are better indicators than imprecise indices; (4) adult CPUE indices are better indicators than recruit indices; and (5) conclusions about not overexploited status ($B/B_{MSY} > 1$) are more robust to the length and precision of CPUE indices than conclusions about crashed population ($B/B_{MSY} < 0.2$).

Discussion

The group asked for more details about the biological and fisheries parameters used to construct the simulation model, and how well the model represents the species under study. Given current limited information on shortfin mako shark population dynamics in the North Pacific, probability distributions were assigned to model parameters to reflect uncertainty. The biological parameters such as growth and reproduction were used from information provided at the ISC SHARKWG meeting in November 2014. A three area model was assumed (1) for juveniles, and (2) for subadult and adult sharks, and movement rates between each area were optionally set. The natural mortality (M) assumed was derived by Jensen's method, but simulations can be run using alternative methods for estimating M.

The group discussed the use of lambda (which takes into account only the difference between the start and end point of the time series) as a measure of the trend in CPUE and size data. The authors agreed that other alternatives, such as time series analyses, must be explored in order to better understand and evaluate the overall trend of these data. A point was raised about the relationship between stock status and lambda CPUE (i.e. the difference between the CPUE estimated for the first and final years in the time series). If a relatively low productivity shark was caught at F_{MSY} (equilibrium level), lambda CPUE would be 0, therefore stock status cannot be estimated. It was also recommended to use the combination of CPUE and size. The group suggested making use of information from other tuna and tuna-like stocks which have longer time series to understand the historical F pattern. Overall, the group agreed that the results of this study were valuable, but the authors were requested to apply the simulation framework with some of the actual CPUE data available in order to assist the WG with understanding the stock status. The use of some different indicators was raised, for example actual values of the standardized CPUEs, average annual lengths and/or likelihood of length distributions between virgin and current stock status.

The WG picked 6 indices to calculate the probability of stock status. The likelihood for each simulated CPUE versus observed CPUE and stock status was calculated for all combinations of biological and fishery assumptions used in the simulation study. The results were consistent with the original simulation results.

8. Conduct indicator analyses

The WG carefully reviewed all available data. The group decided upon which indicators provide the most information of stock status based on the quality of the data as well as the value of differing types and lengths of data sets. The decision was based in part on the simulation analyses. The consensus was that the CPUE indices are most informative about stock status and that of the indices, the Japan longline, Hawaii deepset longline and Hawaii shallowset longline indices provide the best information due the quality of the standardizations and their relatively larger coverage in areas where the greatest number of adult sharks are caught. Details on the contributions of each indicator and the conclusions drawn will be in the stock status report.

9. Shortfin mako biological studies: progress and plans

9.a Age and growth

The Chair presented a summary of progress and ongoing activities of age and growth study (See Attachment 4).

Discussion

The WG discussed whether a growth curve estimated based on length frequency (Kai et al. 2014 ISC/14/SHARKWG-3/INFO01) should be used for younger ages in an assessment model because of the variation in band pair counts among ageing studies. For older ages, the growth parameters could be estimated by meta-analysis. The WG recognized that whether one or two pairs of band are formed annually across all age classes and sexes is still unresolved.

9.b Reproductive biology/productivity

9.b.1 *Re-analysis of reproduction cycle of shortfin mako using Taiwanese and Japanese data (oral presentation)*

Summary

The reproductive cycle of shortfin mako was thought to be 3 years (Mollet et al. 2000; Joung and Hsu 2005) or 2 years (Semba et al. 2011). To overcome this contradiction, the data from Taiwan and Japan were pooled, and linear and von Bertalanffy's growth curves were applied for fitting. Both results indicate the pregnancy duration is most likely 1 year, but more detailed data are need in the future.

Discussion

Although the study shows a direct observation of pup growth (i.e., reproduction cycle), it was noted that the data used were limited and raw data were from only one study (Semba et al. 2011). The WG recommended that more raw data be provided from published studies, and that all nations need to continue to collect data from large reproductive shortfin mako sharks and provide the data for the WG meta-analysis. Appropriate results for use in an assessment have not yet been obtained.

There was general discussion on how to use information from incomplete biological studies for modeling purposes in an assessment and how biologists and modelers should work collaboratively.

9.b.2 *Estimation of productivity of blue shark and shortfin mako under the different biological parameters based on the matrix model (ISC/15/SHARKWG-1/08)*

Summary

The productivity (intrinsic rate of increase of the population) of blue shark and shortfin mako was estimated based on a two-sex matrix model, and was analyzed using the different biological parameters, such as growth coefficient, reproductive periodicity, first maturation age, natural mortality and longevity. The results indicated that the first maturation age and growth coefficient drastically influence to the productivity of the both species. e.g., lower first maturation age and higher growth coefficient increase the productivity. Reproductive periodicity also affects productivity, longer periodicity decreases the productivity. Those results indicate that the productivity should be largely affected by the revision of biological parameters. Biological parameters should be revised when the productivity and population trends from the stock assessment contradict, and a model based analysis is available to revise the biological parameters.

Discussion

A question was raised regarding how the number of mature males can affect the stock productivity (*r*). It was answered that the model assumes a one to one relationship between mature males and females, but little is known about shark mating systems. It was noted that as this study showed the effects of various biological parameters on *r* the biological parameters must be reliably determined, and that productivity can be compared with trends in CPUE to see if conclusions are realistic.

It was agreed that this type of approach which examines the effects of a range of parameters on *r,* be considered when the WG discusses further sensitivity analyses with respect to uncertain parameters.

9.c Spatial distribution

Spatial and temporal patterns of shortfin mako shark size and sex in the North Pacific Ocean (ISC/15/SHARKWG-1/04) was presented and discussed under the agenda item **6.c** (shortfin mako data – size and sex).

9.d Genetics

9.d.1 *Genetic stock structure of shortfin mako (Isurus oxyrinchus) in the Pacific Ocean (ISC/15/SHARKWG-1/05)*

Summary

Genetic stock structure of the Pacific shortfin mako was inferred from the mitochondrial and microsatellite DNA variations in shortfin makos collected from seven sampling locations across the Pacific. The mitochondrial genetic diversities in each sampling location were similar to each other (h, 0.79-0.91; π, 0.004-0.005). Pairwise FST and AMOVA analysis using mitochondrial DNA indicated the three genetic stocks of shortfin mako in the eastern and western South Pacific and the North Pacific. The microsatellite analysis showed that mean allelic richness (5.33-5.52) and expected heterozygosity (0.70-0.75) were quite similar among sampling locations. The pairwise FST and AMOVA analysis using microsatellite DNA suggested a lack of genetic differentiation of the shortfin mako in the entire Pacific, which was in contrast to the results from the mitochondrial analyses. We could not make a final conclusion for the observed discrepancy between markers in the present working paper; nevertheless considering the observed clear mitochondrial differentiation between the North and South Pacific, the North Pacific shortfin mako should be regarded as a single stock separately from the South Pacific in the stock assessment.

Discussion

The author clarified that the number of microsatellite loci used in this study was eleven compared to only four in Schrey and Heist (2003). It was also clarified that difference in sample size between mitochondrial and microsatellite DNA was caused by a different number of failures of PCR-amplification in each marker. It was noted that this study may have the same technical problem as Schrey and Heist (2003) that detected no stock differentiation by using microsatellite DNA. In addition, differences in results from different mitochondrial markers (i.e., whole gene, cytochrome b gene and control region) should be interpreted carefully because these markers show different timing of divergence in evolutionary history. It was pointed out that the haplotype diversity for Chile was lower than those for other locations. The reason of low haplotype diversity for Chile is unknown; however, **the conclusion that the shortfin mako in the North Pacific is a single stock separately from the south Pacific did not change**, considering the mitochondrial divergence between north and south Pacific comes from both Chilean and Tasman samples. The WG also recognized that there is a significant difference between Chile and Tasman samples based on the mitochondrial genome. The WG discussed the possibility of using information from tagging along with results from genetic analysis. The tagging data available now only provides partial information on the stock because they do not cover all areas and size classes by sex. Because tag-recapture areas depends on fishery effort, they could be biased, so it is difficult to distinguish whether tagging results reflect stock differentiation or reflect merely changes in fishing areas. The need for consideration of different migration patterns between sexes, which could cause the different results between mitochondrial and microsatellite DNA markers, should be discussed when deciding on the appropriate stock structure for an assessment model.

9.e Tagging

Summary

Both the U.S. and Japan have been conducting conventional and electronic tagging of shortfin makos in the North Pacific. Japan presented results of some tagging surveys for PSAT and conventional tagging. Japan will continue those tagging surveys for understanding the migration and distribution pattern of sharks in the Western North Pacific. Stable isotope ratios were also presented to examine spatial distribution and migration and it was suggested that ISC member countries conduct collaborative stable isotope analyses. The U.S. also showed some results of conventional and electronic tagging. A large number of PSAT tags have been deployed off California, primarily on juvenile and subadult sharks. All sharks have remained in the eastern Pacific Ocean moving as far west and south as Hawaii. The data are being analyzed now for vertical and horizontal movement patterns.

Discussion

Some members of the WG emphasized the importance of an appropriate tagging study design to investigate exchange rates, detect movement patterns of juveniles, natural mortality and other aspects of population dynamics. The WG agrees that a well-designed, collaborative tagging program for shortfin mako sharks is a good idea. The tagging data obtained through the Japan and U.S. programs already provides valuable information regarding stock boundaries and movements.

While a well-designed stock-wide tagging program could provide very valuable information, it is important to consider the challenges in implementation, as has been seen of the ISC's north Pacific-wide biological sampling plan to address uncertainties in growth and reproductive biology. Funding and multinational agreements need to be obtained. This could become more possible with a PICES-ISC collaboration. The Chair will discuss this with the ISC Chair and maybe it should be brought up at the ISC Plenary.

Interestingly, the higher stable isotope ratios observed in the eastern north Pacific (NP) were also observed in western NP blue sharks whereas the shortfin makos showed a gradient in the ratio longitudinally. This may indicate a higher inter-mixing rate for blue shark than for shortfin mako. The use of vertebrae for stable isotope analysis should also be possible, and collaborative research among U.S., Taiwan and Japan was recommended.

10. Work plan for coming year

The WG has several options for the coming year which include: continuing work on shortfin mako sharks with the goal of improving the indicator analyses or performing a full stock assessment; shifting the focus back to blue sharks with the goal of conducting a new blue shark assessment; shifting the focus to another shark species in the North Pacific important to the ISC; and spending the year working on advancing biological and scientific studies that will improve our knowledge of blue and shortfin mako sharks and conducting an assessment in 2017. In November the Chair had asked members to begin to compile information on the other species caught in high numbers in their tuna and HMS fisheries in order to decide if there should be a shift in focus to another species. The following paper was presented.

10.c Size and standardized CPUE of two pelagic sharks in the North Pacific based on salmon driftnet surveys (ISC/15/SHARKWG-1/01)

<u>Summary</u>

Catch and effort data of two pelagic sharks, salmon shark and blue shark, caught in the salmon driftnet surveys conducted by Hokkaido University and Fisheries Research Agency in the period between 1978 and 2012 in the North Pacific Ocean were analyzed to investigate their distribution pattern in association with environmental factors such as sea surface temperature as well as their trends in population in the survey area. Likewise, the catch composition of Japanese surface longliners in the offshore area of the northeastern Japan was examined, and blue shark is dominant in number in the subarctic-subtropical transition zone throughout the period analyzed. Salmon shark widely appears in the survey area including the Sea of Japan and the Bering Sea. Its standardized CPUE was apparently at a higher level in the period after the early 1990s, when the high seas driftnet fishery moratorium was put in place, than in the 1980s.

<u>Discussion</u>

The presenter showed that larger size salmon sharks are found in low latitudes (south of 32 N) but the survey was primarily conducted north of 33 N. The question of whether salmon sharks are caught by the Japanese shallow longline fishery was raised. This survey operated in cold waters (Oyashio Current) where salmon sharks can be caught but the shallow longliners operate in warmer waters where few salmon sharks are found. In contrast, few shortfin mako sharks are caught in the colder Oyashio current, than in the warmer Kuroshio Current waters. The group noted that these data can be useful for the next blue shark assessment and further suggested that a comparison of blue shark CPUE from the longline fishery and drift net survey could be based on overlapping seasons to look for consistency in trends. A retrospective analysis of both salmon and blue sharks for early years was also suggested by the group.

After a general discussion of the research and assessment needs, the WG tentatively decided upon the following priorities, depending upon the outcome of the ISC Plenary and WCPFC SC meetings:

1) Continued development and improvement of catch and CPUE time series for blue and shortfin

mako shark

2) Spawner-recruit research (meta-analysis)

3) Advancing biological studies (age and growth, reproductive biology, spatial structure, etc.)

4) Work toward completing a full assessment in 2017 (species TBD but preference for shortfin mako shark)

11. Routine assignments for the ISC Plenary

The WG Chair reminded all members to provide total official catch data on blue and shortfin mako sharks for the Plenary tables. A template will be circulated by the Chair in advance of the Plenary meeting.

12. Future SHARKWG meetings

The WG decided to plan for two intercessional meetings before Plenary 16, one in the fall of 2015 and one in the late winter/spring of 2016. Because the work plan for the coming year has not been finalized and may emphasize biological work rather than assessment work, the WG may decide to convene meetings of smaller subgroups, or webinars (e.g. to work on age and growth, reproductive biology, the spawner-recruitment relationship, spatial structure, tagging, time series development or other topics) rather than have meetings of the full workgroup. The final schedule of workgroup meetings will be made after the WCPFC Science Committee meeting in August 2015.

13. Other matters

Shark species/stocks to consider as northern stocks:

The Chair was informed that the NC would like the ISC to provide information to the NC in regards to whether blue shark in the North Pacific should be considered a northern stock. The Chair will discuss this assignment with the ISC Chair. Japan is moving forward with analyses to inform the NC about this matter.

14. Clearing of report

A draft of the report was reviewed by WG members 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 and wonderful hospitality and food!

The meeting was adjourned at 14:36 on March 17, 2015.

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Attachment 1: List of Participants

Chinese Taipei
Kwang-Ming Liu
National Taiwan Ocean University
2 Pei-Ning Road
Keelung, 20224 Taiwan
kmliu@ntou.edu.tw

Japan
Yuki Fujinami
Natl. Res. Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
fuji925@affrc.go.jp

Hirotaka Ijima
Natl. Res. Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
ijima@affrc.go.jp

Mikihiko Kai
Natl. Res. Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
81-54-336-6045, 81-54-335-9642 (fax)
kaim@affrc.go.jp

Minoru Kanaiwa
Tokyo University of Agriculture
196 Yasaka, Abashiri
Hokkaido, Japan 099-2493
81-152-48-3906, 81-152-48-2940 (fax)
m3kanaiw@bioindustry.nodai.ac.jp

Seiji Ohshimo
Natl. Res. Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
oshimo@affrc.go.jp

Hiroaki Okamoto
Natl. Res. Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
okamoto@affrc.go.jp

Ko Shiozaki
Natl. Res. Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
salt0@affrc.go.jp

Mioko Taguchi
Natl. Res. Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
tagu305@affrc.go.jp

Norio Takahashi
Natl. Res. Inst. of Far Seas Fisheries
2-12-4 Fukuura, Kanazawa, Yokohama
Kanagawa, Japan 236-8648
81-45-788- 7517, 81-45-788-5004 (fax)
norio@affrc.go.jp

Kotaro Yokawa
Natl. Res. Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
81-54-336-6016, 81-54-335-9642 (fax)
Yokawa@fra.affrc.go.jp

Hiroki Yokoi
Natl. Res. Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
yokoih@affrc.go.jp

United States
Felipe Carvalho
NMFS/PIFSC
1845 Wasp Blvd.
Honolulu, HI 96818
808-725-5605
Felilpe.Carvalho@noaa.gov

Suzanne Kohin
NMFS/SWFSC
8901 La Jolla Shores Drive
La Jolla, CA 92037
858-546-7104, 858-546-7003 (fax)
Suzanne.Kohin@noaa.gov

Hui-Hua Lee
NMFS/SWFSC
2570 Dole St.
Honolulu, HI 96822-2396
808-725-5352, 808-983-2902 (fax)
Huihua.Lee@noaa.gov

Kevin Piner
NMFS/SWFSC
8901 La Jolla Shores Drive
La Jolla, CA 92037
858-334-2887, 858-546-7003 (fax)
kevin.piner@noaa.gov

Tim Sippel
NMFS/SWFSC
8901 La Jolla Shores Drive
La Jolla, CA 92037
858-546-7070, 858-546-7003 (fax)
Tim.Sippel@noaa.gov

WCPFC
Shelly Clarke
Western and Central Pacific Fisheries Commission
Kolonia, Pohnpei State
96941, Federated States of Micronesia
shelley.clarke@wcpfc.int

Attachment 2. Meeting Documents

WORKING PAPERS		Available on Web?
ISC/15/SHARKWG-1/01	Size and standardized CPUE of two pelagic sharks in the North Pacific based on salmon driftnet surveys. Seiji Ohshimo, Ko Shiozaki and Kotaro Yokawa (oshimo@affrc.go.jp)	Y
ISC/15/SHARKWG-1/02	CPUE and catch of shortfin mako caught by Japanese shallow-set longliner in the western North Pacific. Mikihiko Kai, Ko Shiozaki, Seiji Ohshimo, Kotaro Yokawa, Norio Takahashi and Minoru Kanaiwa (kaim@affrc.go.jp)	Y
ISC/15/SHARKWG-1/03	Use of Geostatistical modelling for CPUE of Japanese shallow-set longline for Shortfin mako shark. Mikihiko Kai, Kevin Piner and Mark N. Maunder (kaim@affrc.go.jp)	N
ISC/15/SHARKWG-1/04	Spatial and temporal patterns of shortfin mako shark size and sex in the North Pacific Ocean. Tim Sippel, Seiji Ohshimo, Kotaro Yokawa, Mikihiko Kai, Felipe Carvalho, Kwang-Ming Liu, Jose Leonardo Castillo-Geniz, and Suzanne Kohin (tim.sippel@noaa.gov)	Y
ISC/15/SHARKWG-1/05	Genetic stock structure of shortfin mako (*Isurus oxyrinchus*) in the Pacific Ocean. Taguchi, M. Ohshimo, S. and Yokawa, K. (tagu305@affrc.go.jp)	N
ISC/15/SHARKWG-1/06	Simulation testing of Stock Indicators. Hui-Hua Lee, Felipe Carvalho, and Kevin R. Piner (huihua.lee@noaa.gov)	Y
ISC/15/SHARKWG-1/07	Revised standardized catch rates and catch estimate of shortfin mako shark by Taiwanese large-scale tuna longline fishery in the North Pacific Ocean. Wen-Pei Tsai and Kwang-Ming Liu (kmliu@mail.ntou.edu.tw)	Y
ISC/15/SHARKWG-1/08	Estimation of productivity of blue shark and shortfin mako under the different biological parameters based on the matrix model. Hiroki Yokoi, Seiji Ohshimo and Kotaro Yokawa (yokoih@fra.affrc.go.jp)	N

INFORMATION PAPERS	
ISC/15/SHARKWG-1/INFO-01	Assessing the potential biases of ignoring sexual dimorphism and mating mechanism in using a single-sex demographic model: the shortfin mako shark as a case study. Wen-Pei Tsai, Kwang-Ming Liu, Andre E. Punt, and Chi-Lu Sun (chilu@ntu.edu.tw)
ISC/15/SHARKWG-1/INFO-02	Indicator based analysis of the status of New Zealand blue, mako and porbeagle sharks. M.P. Francis, S.C. Clarke, L.H. Griggs, S.D. Hoyle
ISC/15/SHARKWG-1/INFO-03	Stock status indicators for silky sharks in the eastern Pacific Ocean. Alexandre Aires-da-Silva, Cleridy Lennert-Cody, Mark N. Maunder and Marlon Román-Verdesoto
ISC/15/SHARKWG-1/INFO-04	Satellite Tagging and Cardiac Physiology Reveal Niche Expansion in Salmon Sharks. Kevin C. Weng, Pedro C. Castilho, Jeffery M. Morrissette, Ana M. Landeira-Fernandez, David B. Holts, Robert J. Schallert, Kenneth J. Goldman, Barbara A. Block
ISC/15/SHARKWG-1/INFO-05	Using pop-up satellite archival tags to inform selectivity in fisheries stock assessment models: a case study for the blue shark in the South Atlantic Ocean. Felipe Carvalho, Robert Ahrens, Debra Murie, Keith Bigelow, Alexandre Aires-da-Silva, Mark N. Maunder, and Fabio Hazin
ISC/15/SHARKWG-1/INFO-06	Using movement data from electronic tags in fisheries stock assessment: A review of models, technology and experimental design. Tim Sippel, J. Paige Eveson, Benjamin Galuardi, Chi Lam, Simon Hoyle,Mark Maunder, Pierre Kleiber, Felipe Carvalho, Vardis Tsontos, Steven L.H. Teo, Alexandre Aires-da-Silva, Simon Nicol

Attachment 3. Meeting Agenda

SHARK WORKING GROUP (SHARKWG)

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

INTERCESSIONAL WORKSHOP AGENDA

March 9-17, 2015
National Research Institute of Far Seas Fisheries
Shizuoka, Japan

Meeting Hours: 09:00-17:00

1. Opening of SHARKWG Workshop
    a. Welcoming remarks – Dr. Miki Ogura
    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: Summary of the November 2014 Workshop, February 2015 Webinar and current meeting objectives
6. Review of outstanding shortfin mako data (*Yokawa, Kanaiwa*)

    WPs 02, 03, 07, 04

    a. CPUE
    b. Catch
    c. Size/sex
    d. Inventory of all data for analyses
7. Indicator analysis simulations (*Ohshimo*)

    WP 06
8. Conduct indicator analyses

a. develop model(s)
b. model sensitivities
c. formulate conservation information considering model uncertainty
d. recommendations/research needs for improvements
e. draft analysis report (Report deadline of May 1)
Piner (editor and conservation advice), Kai and Sippel (data), Lee and Carvalho (data poor analyses and simulations), Liu and Kohin (shortfin mako life history)
    i. develop outline
    ii. individuals work on report sections
f. finalize all supporting WG papers for analysis time series

9. Shortfin mako biological studies: progress and plans (*Takahashi, Taguchi*)

WPs 05, 08

a. age and growth
b. reproductive biology
c. spatial distribution
d. genetics
e. tagging

10. Work plan for coming year (*Kohin*)

WP 01

a. blue shark
b. shortfin mako
c. other species
d. advance research on scientific topics

11. Routine assignments for the ISC Plenary

a. catch tables

12. Future SHARKWG meetings

13. Other matters

a. shark species/stocks to consider as northern stocks

14. Clearing of report

15. Adjournment

Attachment 4: Progress on shortfin mako age and growth

During the January 2014 meeting, age and growth specialists from all participating nations established a work plan to address continued uncertainty in mako age and growth.

1) Each nation was to age images provided by the US of an OTC validated reference collection taken from the Wells et al. 2013 study and fill in the template accepted during the January 2014 age and growth meeting.
    - China – Reading completed; template filled in
    - Japan – Readings not yet completed
    - Mexico – Reading completed; template not fully filled in, some info on readings still missing (i.e. confidence score, edge reading)
    - Taiwan – Reading completed; template not fully filled in, some info on readings still missing (i.e. confidence score, edge reading)
    - USA – Reading completed; template filled in

2) OTC validated image counts from each nation were to be reviewed by the US and if count discrepancies warranted, a short meeting to discuss variations in counts would be held.
    - China – Counts reviewed; meeting held; counts redone following meeting
    - Japan – Readings not yet completed
    - Mexico – Counts reviewed; meeting held; counts not yet redone following meeting
    - Taiwan – Counts reviewed; meeting not yet held

    Next step: Continue to compare readings among labs and try to understand differences in counts. US will help explain how the validated vertebrae were read so that all readers can read the images again in hopes that the readings will be more similar and corroborate each other. Instruction and corroboration webinar to be planned.

3) The US was to process and share images of the larger ISC mako reference collection made up of verts shared from each nation that cover the whole size range of makos captured in the Pacific.
    - All vertebra have been processed, and images have been shared.

4) Each nation was to age the ISC reference collection xrays processed by the US and fill in the templates accepted during the January 2014 age and growth meeting. (Note: none of

the nations have read the ISC reference collection images post discussion of OTC verts so recounts would be beneficial from all nations.)

- China – Readings not yet completed
- Japan – Readings completed; template filled in
- Mexico – Readings completed; template filled in
- Taiwan – Readings not yet completed
- USA – Readings completed; template filled in

Next steps: complete step 2, corroboration of readings of Wells et al. x-rays. None of the nations have read the ISC reference collection images post discussion of OTC verts so recounts would be beneficial from all nations. Once all are reading the same band pairs on the Wells et al. 2013 images, re-read the reference collection xrays and compare them across labs.

5) At the ISC meeting in November 2014 a template was provided in order to fill in data from studies made by each member nation looking at mako shark length vs band pair counts. This template was meant to be filled in and returned to the meeting chair by January 2015.
   - China – Template not yet filled in
   - Japan – Template not yet filled in
   - Mexico – Template filled in
   - Taiwan – Template not yet filled in
   - USA – Template filled in