FINAL

ISC/19/ANNEX/04

ANNEX 4

19th Meeting of the
International Scientific Committee for Tuna
and Tuna-Like Species in the North Pacific Ocean
Taipei, Taiwan
July 11-15, 2019

REPORT OF THE SHARK WORKING GROUP WORKSHOP

July 2019

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Annex 04

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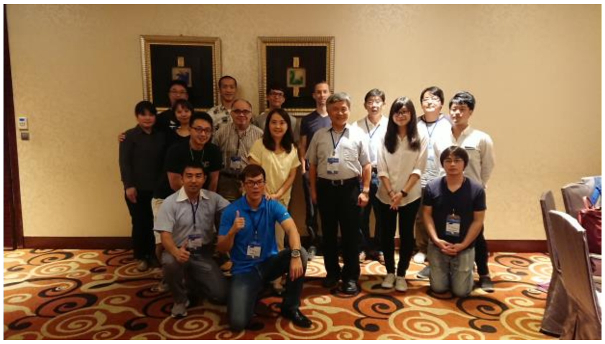
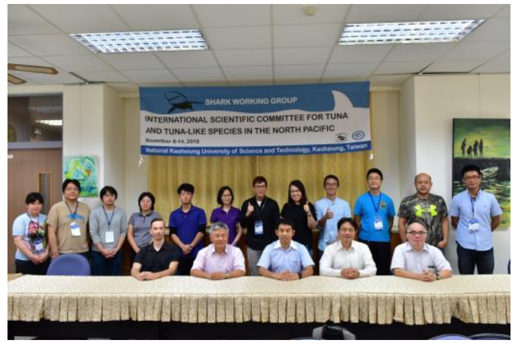
International Scientific Committee for Tuna and Tuna-like Species
in the North Pacific Ocean

November 8-14, 2018
Kaohsiung, Taiwan

1. OPENING OF THE WORKSHOP

1.1 Welcome and Introduction

The Shark Working Group (SHARKWG or WG) of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) held a seven-day meeting (with a Tuesday break) at the National Kaohsiung University of Science and Technology in Kaohsiung, Taiwan, from November 8-14, 2018. The main goal of the workshop was to improve the fishery data, biological parameters and modelling approach for key shark species such as blue shark (BSH) and shortfin mako (SFM) in the North Pacific. In addition, the discussions of the future work plans and a proposal of new modeling approaches are required to improve the next stock assessments for BSH and SFM in the North Pacific.

Mikihiko Kai, SHARKWG Chair, opened the meeting. Participants included members from Chinese Taipei, Japan, Mexico and United States of America (USA). Participants are listed in Attachment 1A. SHARKWG Chair, Mikihiko Kai, and assistant professor, department of Fisheries Production and Management, National Kaohsiung University of Science and Technology, Wen-Pei Tsai, welcomed SHARKWG participants and wished everyone a productive meeting and pleasant visit to Kaohsiung.

1.2 Review and Approval of Agenda

The WG reviewed and adopted the draft meeting agenda with minor revisions (Attachment 2).

1.3 Distribution of Meeting Documents

Six working papers were distributed and numbered (Attachment 3). Several oral presentations were made during the meeting. Papers no.1 and 3 were approved for posting on the ISC website where they will be available to the public. Paper no. 2 is pending. All other documents will not be posted.

1.4 Appointment of Rapporteurs

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

Item	Rapporteurs (P is for presentation only)
1-4.	M. Kai
5.	Y.J, Chang, W.P, Tsai (WP-01)
6.	M. Kai (P-01)
	C.P. Chin, M. Kinney (P-02)
	M. Kanaiwa, H. Katahira (WP-02)
7.	M.Kinney, C.P, Chin (WP-03)
8.	M. Kanaiwa, M. Kinney (WP-04)
	Y. Fujinami, H. Katahira (WP-05)
	W.P. Tsai, A. Yamamoto (WP-06)
	M. Kinney, S.H. Sue (P-03)
	M. Kinney, Y. Fujinami (P-04)
	M. Kanaiwa, S.H. Sue (P-05)
	M. Kai (P-06)
9.	M.Kinney, C.P, Chin
10-13.	M. Kai

2 REVIEW OF NEW CATCH, NEW CPUE, AND NEW SIZE DATA FOR PELAGIC SHARKS

Preliminary analysis of BSH catches in the Japanese high seas squid driftnet fishery in the North Pacific. Yuki Fujinami and Mikihiko Kai (ISC/18/SHARKWG-3/01)

This working paper estimated annual catch of BSH (*Prionace glauca*) caught by Japanese high seas squid driftnet fishery in the North Pacific from 1981 to 1992. Since the logbook data from 1981 to 1992 has no species-specific information about sharks, the annual catch of BSH was predicted using a generalized linear model and generalized additive model with scientific observer data in 1990 and 1991, as well as the corresponding logbook data. Four models were conducted and the best model was selected based on the model selection criterions. The estimated coefficients of explanatory variables from the best model using scientific observer data and logbook data were used to predict the catches. The predicted catches of BSH by factors were aggregated to calculate the annual catch. The predicted annual catch of BSH tended to increase during the early 1980s, peaked around 1988-1989, and subsequently decreased.

<u>Discussion</u>

The WG discussed the issue of misreporting zero catch which may potentially bias the result of the catch estimation. It was indicated that the zero-catch ratio varied by year. The WG proposed to add a new covariate (total catch or zero-catch ratio) into the model to improve the catch estimation. The WG discussed the diagnostics of the residuals for the two stage model versus the one stage model and **recommended to conduct k-folds cross-validation to evaluate the model performance in future work**. The WG discussed the availability of catch number, size information and gear selectivity of the observer dataset and that there is no size information. The WG also discussed the potential size variation among spatial areas and seasons. The WG suggested that species composition of sharks be included in the report (**Table 1**) to describe that the ratios of BSH are stable. The WG noted the vessel license numbers were available in the study of McKinnell and Seki (1998; INFO-01). This may be useful for the estimation of the total catch of BSH in the North Pacific Ocean.

Table 1. Elasmobranch species composition (in numbers observed) in the Japanese squid driftnet fishery of the North Pacific Ocean in 1990 and 1991(upper left), in qt2 and qt3 (upper right) and in each month (lower).

Sharks	species rate		
	1990	1991	Total
Blue shark	92.5	95.2	93.9
Salmon shark	6.2	4.1	5.1
Shortfin mako shark	0.1	0.1	0.1
Cookie cutter	0.0	0.0	0.0
Spiny dogfish	0.0	0.1	0.0
Green eye shark	0.0	0.0	0.0
Pygmy shark	0.0	0.0	0.0
White shark	0.0	0.0	0.0
Basking shark	0.0	0.0	0.0
Common thresher shark	0.0	0.0	0.0
Unidentified shark	1.2	0.5	0.8

Sharks	species rate		
	qt 2(MAY-JUN)	qt 3(JUL-DEC)	Total
Blue shark	95.7	92.5	93.9
Salmon shark	2.6	7.0	5.1
Shortfin mako shark	0.1	0.1	0.1
Cookie cutter	0.0	0.0	0.0
Spiny dogfish	0.0	0.1	0.0
Green eye shark	0.0	0.0	0.0
Pygmy shark	0.0	0.0	0.0
White shark	0.0	0.0	0.0
Basking shark	0.0	0.0	0.0
Common thresher shark	0.0	0.0	0.0
Unidentified shark	1.5	0.3	0.8

Sharks	species rate							
	May	June	July	August	September	October	November	December
Blue shark	99.1	95.1	92.9	87.3	93.8	96.4	97.7	99.6
Salmon shark	0.7	3.0	6.5	12.2	5.5	3.3	2.1	0.4
Shortfin mako shark	0.2	0.1	0.0	0.1	0.1	0.0	0.0	0.0
Cookie cutter	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0
Spiny dogfish	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0
Green eye shark	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pygmy shark	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White shark	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Basking shark	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Common thresher shark	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0
Unidentified shark	0.0	1.8	0.5	0.1	0.2	0.1	0.0	0.0

3. REVIEW OF SPATIAL ISSUES AND APPROACHES FOR DEALING WITH THEM

***Introduction of Vector Autoregressive Spatio-Temporal (VAST) package. Mikihiko Kai (ISC/18/SHARKWG-3/P01*)**

The WG introduced an R-package, "VAST" (Thorson 2018; INFO-02), to give motivation to members to apply the spatiotemporal model to the catch and effort data for pelagic sharks in the North Pacific.

Discussion

The WG had no discussions.

***Evaluation of spatio-temporal distributions and abundance index of Pacific saury by using geostatistical delta-generalized linear mixed models. Jhen Hsu, Yi-Jay Chang and Mikihiko kai (ISC/18/SHARKWG-3/P02*)**

In this study, we analyzed the spatio-temporal distribution and abundance trend of Pacific saury in the Western North Pacific Ocean using fleet-aggregated catch rate data of stick-held dip-net fisheries by a generalized linear mixed model with spatio-temporal effects. Various candidate models were evaluated using AIC and residual diagnostics. The results from the best-fitting model indicated that the area of high predicted catch rate was distributed in the 40° - 45°N and 140° - 150°E in nearby coastal Japanese waters, but the range of that area has declined since 2013. Standardized CPUE of Pacific saury fluctuated during 2005-2014 and then dramatically decreased from 2014 to 2017. We recommended further investigations into the impact of environmental variation on the recent changes of habitat area and population abundance of Pacific saury.

Discussion

The WG discussed why the trends in the annual CPUE estimated from the four models (M1-4) were not largely different from one another. The WG speculated that the high spatial and temporal coverage of the data might cause similar trends. The WG suggested that the effects of vessel and country (i.e., fleets) on the CPUE should be taken into consideration. The WG asked if there were any changes in body size of the catch between years, seasons and sampling stations. It was responded that the catch sizes were larger in August than in November and their distributional areas were different between seasons. In addition, it was mentioned that a clear decreasing trend in CPUE was observed from 2015 to 2017. The WG suggested that the number of "knots" should be given using the "mesh" method rather than the "grid" method because the "mesh" method can give the "knot" based on the balance of the sampling locations and a boundary effects, something that is taken into account using the additional points around the boundary (the variances of extrapolation area are twice as large as that of interpolation). The WG noted that it is possible to interpolate and extrapolate the "knots" using dummy variables but it might not make sense if the given explanatory variables have a small impact on the response variables. The WG discussed the suitability of the geostatistical model for the Pacific saury abundance indices estimation. The WG pointed out that the assumption of multivariate normal distribution (correlation) at the station might be appropriate because of the schooling behavior of Pacific saury. The WG reviewed the preliminary results of the application of the method discussed here to BSHs caught by Taiwanese large-scale longline fishing vessels. **The WG recommended investigating the use of the geostatistical model (VAST) to standardize the CPUE of BSH and SFM in future work.**

Preliminary results of redefining of Hawaiian longline fisheries with spatiotemporal consideration of BSH size data. Michael J. Kinney, Felipe Carvalho, Steven L.H. Teo (ISC/18/SHARKWG-3/02)

Our study looks at redefining the Hawaiian longline fleets that have been used for previous assessments by investigating the size composition data from observer records in greater detail. Our goal is to reduce model misspecification by allowing the working group to produce indices and size compositions that more appropriately consider the spatiotemporal characteristics of the catch. This analysis divided the eastern North Pacific Ocean into 80 5x5° areas with available size composition data. A clustering approach was taken to discern areas with relatively consistent size compositions. The results suggested three distinct clusters. A core adult cluster (areas 38, 47, 48, 49, 50, 60, 70) which primarily consisted of individuals over 150cm PCL, a core juvenile cluster (areas 20, 21, 31, 32, 33) with individuals less than 100 cm PCL, and an intermediate area linking the two which has a mixture of sub-adult individuals greater than 100cm but less than 150cm PCL (areas 3, 8, 16, 18, 19, 26, 27, 28, 29, 30). This is preliminary work and catch in the proposed clusters will need to be investigated before fully committing to the identified fleet structure in upcoming assessments. Beyond this, we suggest to use this clustering approach on an expanded set of fisheries data in order to improve the fleet definitions currently used in the assessment of BSHs with spatiotemporal consideration of size and sex data for future assessments.

Discussion

The WG clarified the interpretation of size distribution for each cluster, the characteristic of seasonal and annual size distribution pattern for each cluster and the definition of the number of the cluster. Model settings were mostly dependent on the limited number of sample sizes because the BSH was not targeted by the Hawaiian longline fisheries. The WG agreed that this is a useful idea and **recommended applying this type of analysis to size and sex data combined from multi-country fishing data** to determine the area stratification of fleets in the future. The WG suggested to improve the model by incorporating more factors such as the spatiotemporal changes in CPUE, sex ratio and gear set into the model. **The WG also recommended investigating the use of the finite mixture model applied to the North Pacific swordfish (**Ijima and Kanaiwa, 2018; INFO-03**)** as a complementary approach to consider the realistic boundaries of clusters and compare to the results of the present cluster analysis.

4. REVIEW OF WORK PLAN AND NEW MODELLING APPROACHE

Lists and proposals of future work plan for the stock assessment of BSH and SFM in the North Pacific. Mikihiko Kai (ISC/18/SHARKWG-3/03)

The author created a list to remind the working group of future plans for BSH AND SFM stock assessments in the North Pacific. The author also proposed a new work plan to improve the accuracy of the stock assessment. In the upcoming WG workshop, ISC SHARKWG will discuss the priority and necessity of the future work plans for upcoming stock assessments.

<u>Discussion</u>

The WG discussed that the upcoming shark assessment include both an update model where catch improvements are included but little else is changed, and a more advanced update where spatial considerations are incorporated (i.e. cluster analysis fleets as areas). This could be a lot of work for the primary modeler but the WG stressed that a successful model is important, so that the update model is needed and the spatial model is more exploratory. The WG also suggested that perhaps the next shark assessments be done using the latest version of SS3.3x. This could help with uncertain parameters such as natural mortality (M) by allowing for the use of priors. The WG proposed a collaborative study along with the large-scale tagging to use OTC, potentially in the Japanese research and training vessel fleet. If it is prohibited to use OTC, the WG will attempt to get a limited permit to perform OTC work to ensure that there is some validated age and growth information from the western Pacific (the US will investigate whether any papers have been published about the safety of OTC when used in food products). This effort will be listed in the collaborative projects table at a future data meeting once it has been determined whether it is allowed. **The WG agreed that in the upcoming assessment, VPA and ASPM for SFM and ASPM for BSH will be used as diagnostics instead of BSPM**. The WG discussed the table of collaborative study among the ISC member countries (Table 2). The WG explained that while the role of the project leader is to summarize data and present the output at the WG meeting and the lead scientist functions as a point of contact for project progression, the WG analysis should be a group effort.

Table 2. Lists of collaborative studies among ISC members.

No	Species	Category	Project name	Participants	Lead scientist	Priority
1*	BSH	Fishery data	Application of optimal clustering analyze for area definition by using Catch, effort and size information.	JP, MX, TW, US, OT	Michael Kinney (US), Minoru Kanaiwa (JP)	High
2	BSH	Biological parameter	Isotope analysis in the North Pacific	JP, MX, TW, US	Yuki Fujinami (JP)	Mid.
3*	BSH	CPUE	Application of VAST to data in the NP	JP, MX, TW, US, OT	Mikihiko Kai (JP)	High
4	BSH	Biological parameter	Study on parasite in the North Pacific	JP, MX, TW, US	Yu-Rong Cheng (TW)	Low
5	SFM	Fishery data	Application of optimal clustering analyze for area definition by using catch, effort and size information.	JP, MX, TW, US, OT	Yasuko Semba (JP), Minoru Kanaiwa (JP)	Low

6	SFM	Biological parameter	Update of meta-analysis for the estimation of growth curve	JP, MX, TW, US	(JP)	Low
7	SFM	Biological parameter	Update of estimation of maturity at length	JP,TW	Yasuko Semba (JP)	Low
8	SFM	Biological parameter	Update of estimation of length-weight relationships	JP,TW	Shan-Hui Su (TW)	Low
9	SFM	Biological parameter	Update of estimation of maternal size- litter size relationships	JP,TW	Yasuko Semba (JP)	Low
10	SFM	Biological parameter	Isotope analysis in the North Pacific	JP, MX, TW, US	Yasuko Semba (JP)	Low
11	SFM	Biological parameter	Study on parasite in the North Pacific	JP, MX, TW, US	Yu-Rong Cheng (TW)	Low
12*	SFM	CPUE	Application of VAST to data in the NP	JP, MX, TW, US, OT	Mikihiko Kai (JP)	Low
13*	SFM	Modelling	VPA analysis	JP, MX, TW, US	Yasuko Semba (JP)	Low

*Each participant (member country) shall provide necessary fishery data to the data manager using the data template of ISC SHARK WG (Appendix).

5. REVIEW OF NEW BIOLOGICAL INFORMATION FOR PELAGIC SHARKS

***Development and Characterization of Polymorphic Microsatellite Markers for the Scalloped Hammerhead Shark (Sphyrna lewini) Using Paired-end Illumina Shotgun Sequencing. Shan-Hui Su, Shang-Yin Vanson Liu , Wen-Pei Tsai and Kwang-Ming Liu (ISC/18/SHARKWG-3/04*)**

The scalloped hammerhead shark (*Sphyrna lewini)* is a migratory shark species, with high commercial value for its meat and fins. Although this species has been listed on the CITES Appendix II, its genetic structure in the Western Pacific has not been well studied. Shotgun sequencing was used to sequence millions of small fragmented DNA sequences simultaneously. Eleven novel polymorphic microsatellite markers were isolated through this sequencing method and tested on 36 individuals collected from fishing harbors of Taiwan. The number of allele detected in each locus ranged from 5 to 16. Observed and expected heterozygosities of these loci were 0.306 to 0.972 and 0.596 to 0.886. These 11 novel polymorphic loci can further be used to reveal genetic connectivity pattern of *S. lewini* in the Western Pacific.

Discussion

The WG suggested that since several of the primer sequences had significant statistical differences between samples they may not be useful as markers. It was explained that the limited sample size of the study may have led to this finding and perhaps this discrepancy would disappear with more samples. The WG clarified several minor points and suggested using the novel analytical method RAD-seq (Restriction-site Associated DNA Sequencing). The WG encouraged continuing the work to determine the population structure for this species.

***Improvement in conversion factors for the body parts of BSH in the Pacific Ocean by considering sexual differences. Atsuya Yamamoto, Ayumi Shibano, Yuki Fujinami, Yasuko Semba and Minoru Kanaiwa (ISC/18/SHARKWG-3/05*)**

In this study, updated conversion factors between several body parts in BSH were provided by considering the sexual differences. In comparisons between sexes, the slope values for females were higher than those for males between body-weight (BW) and measurements, and between the liver weight (LW) and measurements. However, measurements for males were lower than those for females between heart weight (HW) and other measurements. Future work will require further consideration into the impacts of sexual differences on conversion factors.

Discussion

The WG discussed the suitability of model selection using AIC. The WG questioned the likelihood functions of the linear regression model for actual and log-transformed values. It was answered that the likelihood for the log-transformed values is corrected adding the additional value to the likelihood to compare two models using AIC. The WG confirmed the differences of this study from the past study. The authors indicated that the consideration of the sexual differences in this study is the reason for this difference. The WG encouraged using these sex-specific conversion factors, e.g. length-weight relationship, for future stock assessments. The WG suggested considering seasonal effects in the model in future work because body weight will change by seasons. The authors expressed concern about the suggestion because most of the current data were collected during the same season (April to June). The WG mentioned that the measurement of PCA (pectoral fin interior margin) is more accurate than DL (distance between the origin of first and second dorsal fin) when measured in the field.

***Length-length and length-weight relationships in salmon sharks Lamna ditropis Hubbs & Follett, 1947 caught from the northwestern Pacific Ocean. Hirotaka Katahira, Yuki Nakagawa, Akira Kurashima, Yuki Fujinami, Yasuko Semba and Minoru Kanaiwa (ISC/18/SHARKWG-3/06*)**

The salmon shark is caught by small-directed fisheries in the northwestern Pacific Ocean as an edible resource. To prepare for future collections of international catch statistics for this species, the authors have recently started to evaluate length-length and length-weight. For male and female specimens landed at the Kesennuma fishing port, northern Japan, we are currently recording length measurements (i.e., total length [TL], fork length [FL], precaudal length [PCL] length between the front end of the first and second dorsal-fin bases [F1-F2D], length between the front end of the first dorsal-fin base and the rear end of the second one [F1-R2D] and pectoral fin length [PL]) and gutted weight (W). Although the investigation is still ongoing, each measurement has represented high R^2 value (> 0.81) for TL conversions in linear and allometric models (sample size: 40 males and 128 females). For W conversions, TL, FL, SL and PL represented high R^2 values (> 0.83).

Discussion

The WG discussed the differences of statistical meaning for AIC and BIC. The WG encouraged using both information criterions to check the difference of the information criterion. The **WG agreed that the selected conversion factors are the best available information for this species currently**. The WG noted that WCPFC has a planned project to improve conversion factors for key shark species. The WG encouraged the continuation of this type of study and the continued acquisition of more and better data to determine the length-weight conversion equations of this species.

Update of EPMA analysis for the verification of age and growth for juvenile SFM (Isurus oxyrinchus) collected in the western and central North Pacific Ocean. Yasuko Semba (ISC/18/SHARKWG-3/P03)

EPMA (Electron Probe Micro Analyzer) was applied to juvenile SFM (*Isurus oxyrinchus*) to evaluate its effectiveness as the tool of age validation of this species. Corpus calcareum and centrum surfaces with different degrees of chemical treatment were used for the study. Observation of sections and measurement of percent mass of Calcium (Ca) and phosphorus (P) from the edge to the core showed different microstructure and occurrence pattern of the elements, between and among regions analyzed. Preliminary comparison of correspondence between growth band and peaks of calcium was also indicated.

Discussion

The WG asked what total percent mass meant in terms of the measurements of calcium. The presented responded that the author needed to confirm the meaning. The WG suggested that if the absolute value of the chemical of interest could be obtained, it would be possible to more accurately compare amounts of the chemical between treatments since currently it seems the analysis is simply describing the amount of connective tissue that remains on the sample. **The WG recommended that this method be used on BSH.** Since the growth curve of BSH is more settled than for SFM, it may be a way to test the method with an easier ageing structure (e.g. BSH vertebrae). The WG questioned the cost of analysis and it seems the analysis is nearly 450 US dollars per sample.

Introduction of Stable Isotope Analysis to investigate spatial distribution of pelagic shark. Yasuko Semba, Yuki Fujinami and Seiji Ohshimo (ISC/18/SHARKWG-3/P04)

Stable isotope ratio ($\delta^{13}C$ and $\delta^{15}N$) has been used to infer trajectory of diet, trophic level, and feeding ground of various animal species. Migration of pelagic sharks has been investigated mainly based on deployment of tags (mainly pop-up archival tag). The application of biochemical markers to this issue has been limited, especially in the North Pacific. We preliminarily conducted stable isotope analysis of pelagic sharks to investigate the usefulness of this to describe migration. We introduce the variability of $\delta^{13}C$ and $\delta^{15}N$ depending on capture location, shark size, type of organ, and sex of individual for BSH (*Prionace glauca*).

Discussion

The WG asked if it was possible to use bone instead of muscle since it would maintain a longer time series. The author answered that this had been tried in the past but with little success. The WG suggested that the ratio between liver and muscle be reviewed, perhaps with cluster analysis, to see how stable the diet is, possibly allowing more information about the movement to be inferred. The WG also suggested using the cluster analysis approach for stable isotope ratios with consideration of area and season, it was suggested that this might be an interesting and useful step for further analysis. The WG also suggested looking into using compound specific amino acids on a subset of samples in order to help clarify inferences about movement based on the C and N results. It was noted, however, that this method is very expensive. The WG asked if there was a seasonal effect on the difference in the C signal between embryos and mothers. The authors responded that they would look into this in future analysis. The WG suggested the use of parasites as a biomarker because stable isotope ratio analysis is relatively expensive in comparison.

Progress report of spatio-temporal analysis of distribution of SFM (Isurus oxyrinchus) in the North Pacific by size and sex. Yasuko Semba, Michael Kinney, Jose Leonardo Castillo-Geniz and Carlos Godinez-Padilla (ISC/18/SHARKWG-3/P05)

SFM (*Isurus oxyrinchus*) has been known to exhibit segregation by ontogenetic stage and sex. Semba (2011) presented a distribution pattern by ontogenetic stage and sex based on Japanese research data which covered a wide range of the North Pacific. However, size and sex data in the eastern area (i.e., east of the dateline) was relatively limited. Within the ISC SHARKWG, each country submitted size and sex data and Sippel et al. (2014, 2015) conducted a preliminary analysis that suggested spatial structure of SFM by size and sex. In this presentation, the preliminary results of a GAM applied to the same dataset was introduced in order to interpret the spatial structure based on a statistical approach in combination with past results of logistic analysis.

Discussion

The WG made some clarifications of model settings regarding the classification of size. The WG suggested to improve the analysis by incorporating the sex-area, season-area differences into the model. The WG also suggested including random effects for factors such as a gear type.

Summary of ongoing studies for pelagic sharks by Mexico. Jose Leonardo Castillo-Geniz, presented by Chair (ISC/18/SHARKWG-3/P06)

Several ongoing studies operated by the Mexican delegation were summarized to share the information with the ISC Shark WG members. (1) The reproductive study of BSHs has been conducted using samples collected at Ensenada and Mazatlán by longline boats operated in the Mexican Pacific coast since last January. The samples of 300 sharks had already been collected from January to May and August to October in 2018 and they were examined based on the maturity criteria outlined in Fujinami et al (2017). Unfortunately, the samples from mature females and males during June-September are unavailable, so the collection of samples from mature sharks is a high priority in 2019. (2) The growth study of BSHs was conducted using the vertebrae under the guide of Dr. Javier Tover to determine age and growth, with more than 200 vertebrae samples collected. (3) Leonora has been conducting a demographic study of SFM to estimate the intrinsic natural growth rate (*r*). (4) Luis and Nacho gave lectures on R to the staff in INAPESCA, so that they will start the standardization of nominal CPUE for scalloped hammerhead, *Sphyrna lewini*, captured by the longline fleets in Mazatlan. (5) Nacho and Luis at the beginning of this year had already completed the first analysis on the standardization of the abundance index for silky sharks (*Carcharhinus falciformis*) from the longline fleet in Manzanillo.

Discussion

The WG questioned the meaning of "the samples from mature females and males during June-September are unavailable" and the presenters answered that this is in reference to the difficulty of collecting data during this period due to the seasonal closure of commercial fisheries. The WG planned a scientific survey to collect samples from the missing months.

6. ESTABLISH WORK PLAN FOR THE NEXT ASSESSMENT AND DATA SUBMISSION DEADLINE

The WG discussed the collaborative studies on the biological parameters and fishery data. **The WG agreed to combine size, sex and location data for the potential redefinition of fleets**. **The WG also agreed on the importance and continued use of meta-analysis for future shark assessment biological parameters**.

The WG discussed the stable isotope study of sharks in the Pacific. The US stated that it has an ongoing stable isotope collection of sharks and that it may be possible to combine this work with Japan. Mexico also discussed that it has stable isotope samples and has written a paper on this data, this project is ongoing.

The WG questioned the use of two clustering approaches to define the fleets and what the difference would be between these two approaches. It was explained that these studies would be similar but that it would be interesting to compare what each analysis found, one with catch and effort data, and one without. These analyses, however, will be combined into one working paper to better facilitate the definition of fleet areas using all available information.

The Mexican delegation stated that it had started a parasite study in January of 2018. The WG suggested that this study could be combined with the Taiwan study.

The WG suggested that SFM band pair deposition rate samples could be collected from large sharks (vertebra) so that radio bomb carbon dating be applied to see if band pairs are deposited two per year in the Western Pacific as well. The WG asked if this method needs to be applied to BSHs as well but **it was agreed that this was more important for SFM**. The WG also **determined that the targeted sharks need to be more than seven years old**. The WG also indicated that there is no current capacity to collect or analyse such samples since historic samples are likely unavailable for all nations.

The WG discussed concerns of CITES listings for BSH and SFM. The WG expressed concern that the listing is in contrast to what the WG has stated for the stock in the North Pacific. It was also expressed that the listing uses different, more conservative, criteria for endangered than what the ISC uses for overfishing and overfished. The chair will draft a statement to share before the final decision is made by CITES. It was discussed that this statement should focus on the inappropriate nature of combining two stock assessments and data limited areas to come up with a global status that misrepresents the stocks.

7. OTHER MATTERS

The Chinese delegation invited to hold the ISC-SHARKWG meeting in China and the WG discussed the possibility of holding the future data preparatory meeting there. However, the WG decided that Japan would be a more appropriate venue from the perspective of participating key WG members. However, the WG will continue to seek the chance to have a future meeting in China.

8. FUTURE SHARKWG MEETINGS

The WG adopted a tentative schedule for upcoming WG meetings:

July 2019 (date is TBD) Taiwan (city is TBD)	Finalize the schedule of the workshop and data preparatory meeting for the BSH stock assessment
Autumn 2019 (date is TBD) Japan (city is TBD)	Convene a short term workshop before the data preparatory meeting to present and discuss the collaborative studies for BSH and SFM. This is an opportunity to check the progress of the collaborative studies Convene a data preparatory meeting for the BSH stock assessment soon after the workshop. This will help to reduce the cost of travel. Finalize the schedule of the stock assessment for BSH
Spring 2020 (date is TBD) La-Jolla, US	Convene the stock assessment meeting for BSH

9. CLEARING OF REPORT

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

10. ADJOURNMENT

The Chair thanked the participants for attending and for their hard work resulting in an improvement of the data for pelagic sharks and fruitful discussions on future work plans. He indicated that he will be in touch regularly over the coming months to finalize the report and looks forward to seeing many of the participants in July 2019 at the SHARKWG and Plenary meetings in Taiwan. The meeting was adjourned at 17:14 on November 14, 2018.

Appendix

Table A1. Catch and effort data template and examples.

Year	Month	Season/ Quarter	Longitude	Latitude	Location Type	Block Width_Longitude (Degrees)	Block Width_Latitude (Degrees)	Fishery	Trip ID	Set ID	Trip-Set ID	catch number	catch weight	unit weight	weight type	fishing effort	effort unit
1995	5	2	-112.327	35.123		NA	NA		DGN-0123	1	DGN-0123-1	3	30	pd	whole	1000	
1995	5	2	-112.327	35.123		NA	NA		DGN-0123	1	DGN-0123-1	10	100	pd	whole	1000	
1995	5	2	-112.327	35.123	Set level	NA	NA	USA-DGN	DGN-0123	1	DGN-0123-1	5	50	pd	whole	1000	Number of tans
1995	5	2	-113.456	31.456		NA	NA		DGN-0123	2	DGN-0123-2	4	32	pd	whole	1000	
1996	7	3	-117.456	32.001		NA	NA		DGN-4567	6	DGN-4567-6	2	20	pd	whole	1000	
1997	10	4	-113.456	31.123		NA	NA		DGN-7890	4	DGN-7890-4	4	40	pd	whole	1000	
1997	7	3	145.5	31.5		1	1		SSLL-1234	1	SSLL-1234-1	0	0	kg	dress	1000	
1997	7	3	145.5	31.5		1	1		SSLL-1234	1	SSLL-1234-1	17	170	kg	dress	1000	
1997	7	3	145.5	31.5		1	1	Japan-Kinkai shallow	SSLL-1234	1	SSLL-1234-1	4	40	kg	fillet	1000	
1997	7	3	145.5	31.5	Grid centroid	1	1		SSLL-1234	1	SSLL-1234-1	5	50	kg	fillet	1000	Number of hooks
1997	7	3	145.5	31.5		1	1		SSLL-1234	1	SSLL-1234-1	7	70	kg	fillet	1000	
1998	4	2	120.5	32.5		1	1		SSLL-4567	6	SSLL-4567-6	9	90	kg	fillet	1000	
1999	3	1	127.5	31.5		1	1		SSLL-5678	4	SSLL-5678-4	19	190	kg	fillet	1000	
1999	3	1	127.5	31.5		1	1		SSLL-5678	4	SSLL-5678-4	4	40	kg	fillet	1000	

Table A2. Size data template and examples.

Year	Month	Season/ Quarter	Longitude	Latitude	Location Type	Block Width_Longitude (Degrees)	Block Width_Latitude (Degrees)	Fishery	Trip ID	Set ID	Trip-Set ID	Measured length	Measured weight	Measurement Unit of Length	Measurement Unit of Wight	Length Type	Weight Type	Converted Length (cm)	Converted Length Type	Sex
1995	5	2	-112.327	35.123		NA	NA		DGN-0123	1	DGN-0123-1	110	20	cm	pd	TL	whole	81.3	PCL	F
1995	5	2	-112.327	35.123		NA	NA		DGN-0123	1	DGN-0123-1	165	30	cm	pd	TL	whole	123.2	PCL	M
1995	5	2	-112.327	35.123		NA	NA	USA-DGN	DGN-0123	1	DGN-0123-1	151	23	cm	pd	TL	whole	112.6	PCL	M
1995	5	2	-113.456	31.456	Set level	NA	NA		DGN-0123	2	DGN-0123-2	147	22	cm	pd	TL	whole	109.5	PCL	F
1996	7	3	-117.456	32.001		NA	NA		DGN-4567	6	DGN-4567-6	142	21	cm	pd	TL	whole	105.7	PCL	F
1997	10	4	-113.456	31.123		NA	NA		DGN-7890	4	DGN-7890-4	131	20	cm	pd	TL	whole	97.3	PCL	F
1997	7	3	145.5	31.5		1	1		SSLL-1234	1	SSLL-1234-1	136	15	cm	kg	PCL	dress	136	PCL	M
1997	7	3	145.5	31.5		1	1		SSLL-1234	1	SSLL-1234-1	136	15	cm	kg	PCL	dress	136	PCL	M
1997	7	3	145.5	31.5		1	1	Japan-Kinkai shallow	SSLL-1234	1	SSLL-1234-1	136	15	cm	kg	PCL	dress	136	PCL	M
1997	7	3	145.5	31.5	Grid centroid	1	1		SSLL-1234	1	SSLL-1234-1	136	15	cm	kg	PCL	dress	136	PCL	M
1997	7	3	145.5	31.5		1	1		SSLL-1234	1	SSLL-1234-1	136	15	cm	kg	PCL	dress	136	PCL	M
1998	4	2	120.5	32.5		1	1		SSLL-4567	6	SSLL-4567-6	145	18	cm	NA	FL	fillet	131.8	PCL	F
1999	3	1	127.5	31.5		1	1		SSLL-5678	4	SSLL-5678-4	168	19	cm	NA	FL	fillet	152.9	PCL	U
1999	3	1	127.5	31.5		1	1		SSLL-5678	4	SSLL-5678-4	174	23	cm	NA	FL	fillet	158.5	PCL	U

Attachment 1 - List of Participants

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Attachment 2 - Meeting Agenda

SHARK WORKING GROUP (SHARKWG)
INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC

IMPROVEMENT OF DATA AND MODELLING WORKSHOP AGENDA

November 8-14, 2018
National Kaohsiung University of Science and Technology
Kaohsiung, Taiwan

DRAFT

Meeting Hours: 10:00-17:00 (Thursday, 8 November)
09:00-17:00 (Friday, 9 through Monday, 12 November)
Day off (Tuesday, 13 November)
12:00-17:00 (Wednesday, 14 November)

1. Opening of SHARKWG Workshop
   a. Introductions
   b. Meeting arrangements
2. Distribution of documents and numbering of Working Papers
3. Review and approval of agenda
4. Appointment of rapporteurs
5. Review of new catch, new cpue, and new size data for pelagic sharks
6. Review of spatial issues and approaches for dealing with them
7. Review of work plan and new modelling approach
8. Review of new biological information for pelagic sharks
9. Establish work plan for the next assessment and data submission deadline
10. Other matters
11. Future SHARKWG meetings
    a. Blue shark data preparatory meeting in 2019 (Autumn in Japan)
    b. Blue shark stock assessment meeting in 2020 (Spring in La Jolla)
12. Clearing of report
13. Adjournment

Attachment 3 - Meeting Documents

WORKING PAPERS AND PRESENTATIONS	
ISC/18/SHARKWG-3/01	Preliminary analysis of blue shark catches in the Japanese high seas squid driftnet fishery in the North Pacific Ocean from 1981 to 1992. **Yuki Fujinami and Mikihiko Kai** (fuji925@affrc.go.jp)
ISC/18/SHARKWG-3/02	Preliminary results of redefining Hawaiian longline fisheries with spatiotemporal consideration of blue shark size data. **Michael Kinney, Felipe Calvalho and Steven Teo** (michael.kinney@noaa.gov)
ISC/18/SHARKWG-3/03	Lists and proposals of future work plan for the stock assessments of blue shark and shortfin mako in the North Pacific. **Mikihiko Kai** (kaim@affrc.go.jp)
ISC/18/SHARKWG-3/04	Development and Characterization of Polymorphic Microsatellite Markers for the Scalloped Hammerhead Shark (Sphyrna lewini) Using Paired-end Illumina Shotgun Sequencing. **Shan-Hui Su** (Susanzernike@gmail.com)
ISC/18/SHARKWG-3/05	Improvement in conversion factors for the body parts of blue shark in the Pacific Ocean by considering sexual differences. **Atsushi Yamamoto, Ayumi Shibano, Yuki Fujinami, Yasuko Semba and Minoru Kanaiwa** (a_yamamoto@bio.mie-u.ac.jp)
ISC/18/SHARKWG-3/06	Length-length and length-weight relationships in salmon sharks Lamna ditropis Hubbs & Follett, 1947 caught from the northwestern Pacific Ocean. **Hirotaka Katahira, Yuki Nakagawa, Akira Kurashima, Yuki Fujinami, Yasuko Semba and Minoru Kanaiwa** (paraparaparasites@gmail.com)
ISC/18/SHARKWG-3/P01	Evaluation of spatio-temporal distributions and abundance index of Pacific saury by using geostatistical delta-generalized linear mixed models. **Jhen Hsu, Yi-Jay Chang and Mikihiko kai** (winnie122065@gmail.com)
ISC/18/SHARKWG-3/P02	Update of EPMA analysis for the verification of age and growth for juvenile shortfin mako (*Isurus oxyrinchus*) collected in the western and central north Pacific Ocean. **Yasuko Semba** (senbamak@affrc.go.jp)
ISC/18/SHARKWG-3/P03	Introduction of Stable Isotope Analysis to investigate spatial distribution of pelagic shark. **Yasuko Semba, Yuki Fujinami and Seiji Ohshimo** (senbamak@affrc.go.jp)

ISC/18/SHARKWG-3/P04	Progress report of spatio-temporal analysis of distribution of shortfin mako (*Isurus oxyrinchus*) in the North Pacific by size and sex. **Yasuko Semba, Michael Kineey, Jose Leonardo Castillo-Geniz and Carlos Godinez-Padilla** (senbamak@affrc.go.jp)
ISC/18/SHARKWG-3/P05	Summary of ongoing studies for pelagic sharks by Mexico. **Jose Leonardo Castillo-Geniz** (leonardo.castillo@inapesca.gob.mx)

INFORMATION PAPERS

ISC/18/SHARKWG-3/ INFO-01	Guidance for decisions using the Vector Autoregressive Spatio-Temporal (VAST) package in stock, ecosystem, habitat and climate assessments. **James Thorson.** 2019. Fisheries Research, 210; 143-161.
ISC/18/SHARKWG-3/ INFO-02	Shark bycatch in the Japanese high seas squid driftnet fishery in the North Pacific Ocean. **Skip McKinnella and Michael P. Seki**. 1998. Fisheries Research, 39; 127-138.
ISC/18/SHARKWG-3/ INFO-03	Pattern recognition of population dynamics for North Pacific swordfish (*Xiphias gladius*): the operational data analysis of Japanese longline fishery using the finite mixture model. **Hirotaka Ijima and Minoru Kanaiwa**. 2018. ISC-BILLFISHWG-01-09.