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Lists and proposals of future work plan for the stock assessments of blue shark and shortfin mako in the North Pacific[1]

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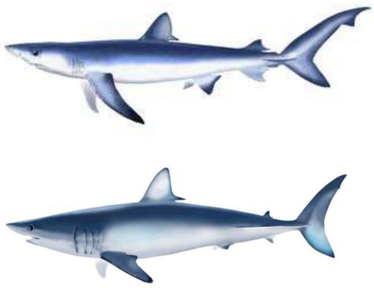

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Abstract

The author made up a list of future work plans for the stock assessment of blue shark and shortfin mako in the North Pacific to remind the working group members of the plans. The author also proposed a new work plan to improve the accuracy of the stock assessment. In the upcoming working group workshop, ISC shark working group discuss the priority, necessity, and imperious need of the future work plans for the next stock assessments.

1. Introduction

ISC SHARK Working Group (WG) conducted a full stock assessment of blue shark (*Prionace glauca*) and shortfin mako (*Isurus oxyrinchus*) in the North Pacific in 2017 and 2018, respectively (ISC 2017, 2018). The results based on the stock synthesis model (SS) were accepted by the scientific committee of WCPFC. However, for both the species, there are still large uncertainties in the fishery data and biological parameters. The improvement of the data as well as the revisit of the specification of SS is needed by the next data preparatory meeting. The objectives of this working paper (WP) are to make a list up the future work plan and to propose a new work plan to improve the accuracy of the stock assessments.

2. Future work plan for blue shark

2.1. Fishery data

2.1.1. Catch

1) Explore whether there are any fisheries that catch blue shark that may not have been identified by the SHARKWG.
2) Improve the methods to estimate blue shark catches.

2.1.2. Abundance indices (CPUE)

1) Improve the data sources and standardization methods.
2) Explore the use of geo-statistical methods (i.e. VAST: https://github.com/James-Thorson/VAST) and compare with the current models for abundance indices
3) Explore further regarding the existing standardization model's explanatory variable（e.g. targeting of Japan's Kinkai shallow fishery data）.

2.1.3. Length and sex composition

1) Collect further composition data including sex from all fleets to clear the substantial size and sex structure patterns through space and time.
2) Continue the collaborative study of data analyses for the composition data.

2.2. Biological parameters

2.2.1. Growth parameters

1) Collect samples of large male and female sharks to estimate more accurately growth parameter.

2) Improve the methods to determine the ages for old sharks

3) Revisit the estimation of other parameters (natural mortality, longevity, intrinsic rate of increase and steepness) if the growth parameter is updated.

2.2.2. Reproductive parameters

1) Collect samples of large female sharks to improve the estimation of litter size

2) Validate the one-year reproductive cycle using other methods such as by monitoring reproductive hormone levels and continue the investigation of the ratio between one- and two- year reproductive cycle because small portion of the samples contains two-year reproductive cycle.

2.2.3. Migration and Distribution (e.g. Large-scale tagging studies)

1) Conduct (collect and analyze the output of) the tagging study throughout the North Pacific to estimate the age-specific natural mortality, fishing mortality and growth parameters, to clear their migration patterns, and to help for the identification of the stock structure.

2) For supplement of the tagging study, investigation on the spatio-temporal distribution of stable-isotope analysis is expected to provide information on the migration or distribution of this species. Collaborative study across the North Pacific will improve the coverage of data

2.2.4. Meta-analysis of the biological parameters

Implement the meta-analysis (e.g. growth, maturity, weight-length relationships, and litter size etc.) among ISC-members to improve accuracy of the estimated biological parameters and to clear the spatio-temporal change of the parameters.

2.2.5. Stock-recruitment relationship

1) Make an attempt to reduce the uncertainty of the natural mortality before and after recruitment using the other estimation methods such as tagging study to improve the accuracy of the estimation.

2) Develop the estimation methods of the steepness parameters based on the equation of low-fecundity stock-recruitment relationships.

2.2.6. Stock structure

Continue the genetic study to identify the stock structure that helps to improve the accuracy of the stock assessment and to solve the "Northern stock's issue of blue shark" (Hampton, 2018)

2.3. Stock assessment model

Bayesian-surplus production model (BSPM) was used in the previous assessment in 2017 to compare the results with those of SS. The results of the stock status were almost the same. Taking into consideration of the situation of the data quality and quantity as well as the model specification for the blue shark, it might be unnecessary to conduct the stock assessment using the BSPM in the next stock assessment.

3. Future work plan for shortfin mako

3.1. Fishery data

3.1.1. Catch

1) Explore whether there are any fisheries that catch shortfin mako that may not have been identified by the SHARKWG (e.g. Korean longline fishery).

2) Improve the methods to estimate shortfin mako catches, especially for the early period from 1971 to 1993 (e.g. Japan drift-net fishery).

3.1.2. Abundance indices (CPUE)

1) Improve the data sources and standardization methods, especially in the early period (1975-1993) and for the drift-net fishery (e.g. Japan drift-net fishery).

2) Explore the use of geo-statistical methods and compare with the current models for abundance indices

3) Explore the reasons for the steep increase trends of the CPUE for Japanese shallow-set longline fishery.

3.1.3. Length and sex composition

1) Improve the quantity and quality of composition data including sex from all fleets to improve the accuracy of the stock assessment and to clear the substantial size and sex structure patterns through space and time.

2) Continue the collaborative study of data analyses for the composition data

3.2. Biological parameters

3.2.1. Growth parameters

1) Collect samples of small and large sharks for both sexes to estimate more accurately growth parameter.

2) Improves the methods to determine the ages for old sharks

3) Evaluate the research of the cross reading of the vertebrae to clear the uncertainty in the estimation method and limitation of the methods.

4) Do research alternative methods for providing aging information using vertebrae, such as bomb radiocarbon, EPMA (Electron Probe Micro Analyzer), SXFM(scanning x-ray fluorescence microscope), Fukushima radionuclide markers, analysis of length composition data, and tagging study, and encourage members to conduct such studies collaboratively.

5) Revisit the estimation of other parameters (natural mortality, longevity, intrinsic rate of increase and steepness) if the growth parameter is updated.

3.2.2. Reproductive parameters

1) Collect samples of large female sharks to improve the estimation of litter size and reproductive cycle (i.e., resting and gestation period).

3.2.3. Migration and Distribution (e.g. Large-scale tagging studies)

1) Conduct (collect and analyze the output of) the tagging study throughout the North Pacific to estimate the age-specific natural mortality, fishing mortality, and growth parameters, to clear their

migration patterns, and to help for the identification of the stock structure.

2) For supplement of the tagging study, investigation on the spatio-temporal distribution of stable-isotope analysis is expected to provide information on the migration or distribution of this species.

3.2.4. Meta-analysis of the biological parameters

Implement the meta-analysis (e.g. growth, maturity, weight-length relationships, and litter size etc.) among ISC-members to improve accuracy of the estimated biological parameters and to clear the spatio-temporal change of the parameters.

3.2.5. Stock-recruitment relationship

1) Make an attempt to reduce the uncertainty of the natural mortality before and after recruitment using the other estimation methods such as tagging study to improve the accuracy of the estimation.

2) Develop the estimation methods of the steepness parameters based on the equation of low-fecundity stock-recruitment relationships.

3.2.6. Stock structure

Continue the genetic study to identify the stock structure that helps to improve the accuracy of the stock assessment.

3.3. Stock assessment model

VPA was used to compare the initial conditions and biomass time series with those of SS. The biomass time series over time was very similar to those found in the SS model. Since the consistency on the results between two models were acknowledged by the WG, it might be unnecessary to conduct the assessment using the VPA.

4. Proposal of new work plan

Taking the spatial and temporal segregation by sex and size classes into consideration is essential for the modelling of the pelagic sharks such as blue sharks and shortfin mako to improve the accuracy of the stock assessment. However, the current SS models for both sharks have no spatial structure explicitly. It is therefore necessary to include the spatial structure into the model and to evaluate the levels of biomass and fishing mortality by time and area. The author expects that it will enhance the accuracy of the stock assessment and it will be useful for the managements as well. In addition, the outputs of the model might give important information to solve the "Northern stock's issue of blue shark".

The SS has a function to treat the explicit spatial structure in the model. To implement the spatial explicit model, the SS requires the fishery data of each fleet with spatial and temporal information. As a first step, the author considers to use the public domain data of tuna-RFMO (i.e. IATTC and WCPFC). The member countries of ISC have an obligation to provide the operational data to the tuna-RFMO. The data includes information about catch of pelagic sharks caught in the North Pacific and fishing effort (number of hooks) by year, and latitude and longitude with 5 x 5 degrees. It is therefore possible to standardize the CPUE of both sharks, and the catch can be estimated multiplying the CPUE by fishing effort. As a tool of the estimation for the CPUE, the geo-statistical model is strongly recommended. For the size composition data, ISC have a large amount of data provided by Japan, US, and Mexico. However, the spatial coverage is insufficient because Taiwan had not provided the size composition data yet. In the near future, the WG expects that Taiwan will provide the size composition data by area and time. With regards to the detailed specification of the spatial SS model such as movement rates and area stratification would be determined based on the objectives of the analysis as well as the outputs of the model.

5. Notification

The ISC SHARK WG Chair (author) raised many future work plans based on the previous stock assessment's reports. As a general rule, the WG member of each country and Tuna-RFMO (IATTC and WCPFC) shall provide the updated (or new) fishery data such as historical catch, cpue, and size composition data to the WG Chair and data manager by the data preparatory meeting in the next stock assessments. If necessary or possible, the WG member should provide the new or updated biological parameters and take a challenge to improve the model specification.

6. Acknowledgements

The author would like to express my gratitude to all the WG members for their hard work and a great contribution to the assessments in the past. The author also hopes that the working group member will help to conduct the next stock assessment and will be successful.

7. References

Hampton, J. 2018. Indicators of the spatial distribution of blue shark (*Prionace glauca*) in the North Pacific. WCPFC-SC14-SA09.
Available at https://www.wcpfc.int/node/30975

ISC., 2017. Stock assessment and future projections of blue shark in the north Pacific Ocean through 2015. ISC 17 Plenary Report and Documents.
Available at http://isc.fra.go.jp/reports/stock_assessments.html

ISC., 2018. Stock assessment of shortfin mako shark in the North Pacific Ocean through 2016., ISC 18 Plenary Report and Documents.
Available at http://isc.fra.go.jp/reports/stock_assessments.html