Plan of trilateral collaborative study among Japan, Korea and Taiwan for producing joint abundance index with longline fisheries data for the tropical tuna species in the Indian Ocean

Toshihide Kitakado[1], Keisuke Satoh[2], Takayuki Matsumoto[3], Hiroki Yokoi[3], Kei Okamoto[3], Sung Il Lee[4], Mi Kyung Lee[4], Jung-Hyun Lim[4], Sheng-Ping Wang[5], Nan-Jay Su[5], Wen-Pei Tsai[6] and Su-Ting Chang[7]

[1] Tokyo University of Marine Science and Technology, 5-7, Konan 4, Minato, Tokyo, 108-8477, Japan (Email: kitakado@kaiyodai.ac.jp)

[2] National Research and Development Agency, Japan Fisheries Research and Education Agency, Fisheries Resources Institute, 2-12-4 Fukuura, Kanazawa-ku, Yokohama-shi, kanagawa-ken, 236-8648, JAPAN

[3] National Research and Development Agency, Japan Fisheries Research and Education Agency, Fisheries Resources Institute, 5-7-1, Orido, Shimizu, Shizuoka-shi, 424-8633, Japan

[4] National Institute of Fisheries Science, 216 Gijanghaean-ro, Gijang-eup, Gijang-gun, 46083 Busan, Korea

[5] National Taiwan Ocean University, No. 2, Beining Rd., Zhongzheng Dist., Keelung City 20224, Taiwan

[6] National Kaohsiung University of Science and Technology, No. 415, Jiangong Rd., Sanmin Dist., Kaohsiung City 80778, Taiwan

[7] Overseas Fisheries Development Council, 3F., No.14, Wenzhou St., Da'an Dist., Taipei City 10648, Taiwan

SUMMARY

Three distant-water tuna longline countries, Japan, Korea and Taiwan, have started a collaborative study for improving the joint abundance index using integrated fishery data of these fleets for tropical tuna species in the Indian and Atlantic Oceans. In addition to some preliminary steps to confirm similarity and dissimilarity of fishery operation, nominal CPUE, length frequency and spatio-temporal coverage, we planned three tasks to produce the joint CPUE; 1) investigation of better approaches to account for changes in target within each country; 2) analyses using conventional regression models with geographical, environmental and fishery (including target) information; and 3) analysis using an advanced spatio-temporal model (e.g. VAST) for developing abundance indices with additional consideration of spatio-temporal correlations. Although we have started with some coding work for bigeye tuna in the Atlantic Ocean, we will also apply the methods to yellowfin tuna in the Indian Ocean in a parallel way. A final set of results on the IO yellowfin tuna will be submitted to the Working Party on Methods and Working Party on Tropical Tuna next year for use as inputs for the update of its stock assessment. The work can also be extended for the IO albacore for its future stock assessment.

KEYWORDS

Catch/effort, yellowfin tuna, joint abundance index, spatio-temporal modelling

INTRODUCTION

Tuna-RFMOs, including the IOTC, recommended that the joint CPUE of longline fisheries be developed to improve the stock assessments for tropical tunas, and thus the IOTC has conducted collaborative works for several years to produce an abundance index by combining CPUEs data from major longline fleets. An ensemble approach of fishery data from multiple longline fleets has been applied to the tropical and temperate tuna species for their stock assessments (e.g. Hoyle et al. 2018, Hoyle et al. 2019a, 2019b).

However, it was found that the fishing technologies, data formats, spatial-temporal coverage were different among the fleets, and therefore it is important to discuss and exchange the information among countries using ample time in order to improve the analysis and index. To this end, three longline countries, Japan, Korea and Taiwan, have been conducting a collaborative study for developing the abundance index since December 2019.

We have started with some coding work for the bigeye tuna in the Atlantic Ocean by the common interest. Currently, a data sharing protocol among the three countries is in a finalization process to ensure data security. In

addition, since the stock status of yellowfin tuna is a matter of concern in the IOTC and its stock assessment is scheduled next year, we will also apply the methods to yellowfin tuna in the Indian Ocean in a parallel way. As a plan, a final set of results on the IO yellowfin tuna will be submitted to the Working Party on Methods and Working Party on Tropical Tuna (data preparatory meeting) next year so that it can consider the results as inputs for the update of its stock assessment.

APPROACHES

In addition to some preliminary steps to confirm similarity and dissimilarity of fishery operation, nominal CPUE, length frequency and spatio-temporal coverage, there are the following three planned tasks to produce the joint CPUE:

1) investigation of better approaches to account for changes in targeting within each country;

2) analyses using conventional regression models (e.g. delta-lognormal model) with geographical, environmental and fishery (including targeting) information for continuity from the previous approaches; and

3) analysis using an advanced spatio-temporal model (e.g. VAST) for developing abundance indices with additional consideration of spatio-temporal correlations and size structure.

PROGRESS SO FAR AND WORKPLAN

As mentioned above, we have started our work for the Atlantic bigeye tuna and submitted a short progress report to the ICCAT species group meeting (Satoh et al. 2020). For that purpose, several common R codes have been developed preliminarily and shared among the members for use

0) in reviewing catch and effort data and species composition data for ease to detect their similarity and difference among fleets;

1) in conducting the cluster analysis to address targeting changes;

2) in developing an abundance index using a traditional delta-lognormal model as well as tools for diagnostics and presentation; and

3) in developing a spatio-temporal model by size (see Figure 1 for illustration).

After the first face-to-face planning meeting in Busan in December 2019, we have been holding only webinar meetings (a total of 5 times so far) because of COVID-19 pandemic. Therefore, the work has been delayed. Nevertheless, after we finalize a data sharing protocol among the three countries, we are planning to hold a collaborative meeting so that we can present a final set of results before the next WPTT meeting for use as inputs for the update of yellowfin tuna stock assessment in 2021.

We also note that the work can be extended for the IO albacore for its future stock assessment

REFERENCES

Hoyle, S.D., Chang, S.T., Fu. D., Kim, D.N., Lee, S.I., Matsumoto, T., Chassot, E. and Yeh, Y.M. (2019a) Collaborative study of bigeye and yellowfin tuna CPUE from multiple Indian Ocean longline fleets in 2019, with consideration of discarding. IOTC-2019-WPM10-16.

Hoyle, S.D., Chassot, E., Fu, D., Kim, D.N., Lee, S.I., Matsumoto, T., Satoh, K., Wang, S.P. and Kitakado, T. (2019b) Collaborative study of albacore tuna CPUE from multiple Indian Ocean longline fleets in 2019. IOTC-2019-WPTmT07(DP)-19.

Hoyle, S.D., Kitakado, T., Yeh, Y.M., Wang, S.P., Wu, R.F., Chang, F.C., Matsumoto, T., Satoh, K., Kim, D.N., Lee, S.I., Chassot, E., and Fu, D. (2018) Report of the Fifth IOTC CPUE Workshop on Longline Fisheries, May 28th–June 1st, 2018. IOTC–2018–CPUEWS05–R. 27 pp.

Satoh K., Matsumoto, T., Yokoi, H., Okamoto, K., Lee, S.I., Lee, M.K., Lim, J.H., Wang, S.P., Su, N.J., Tsai, W.P., Chang, S.T. and Kitakado, T. (2020) Trilateral collaborative study among Japan, Korea and Taiwan for producing joint abundance index by longline fisheries for the tropical tuna species in the Atlantic Ocean. SCRS/2020/143.

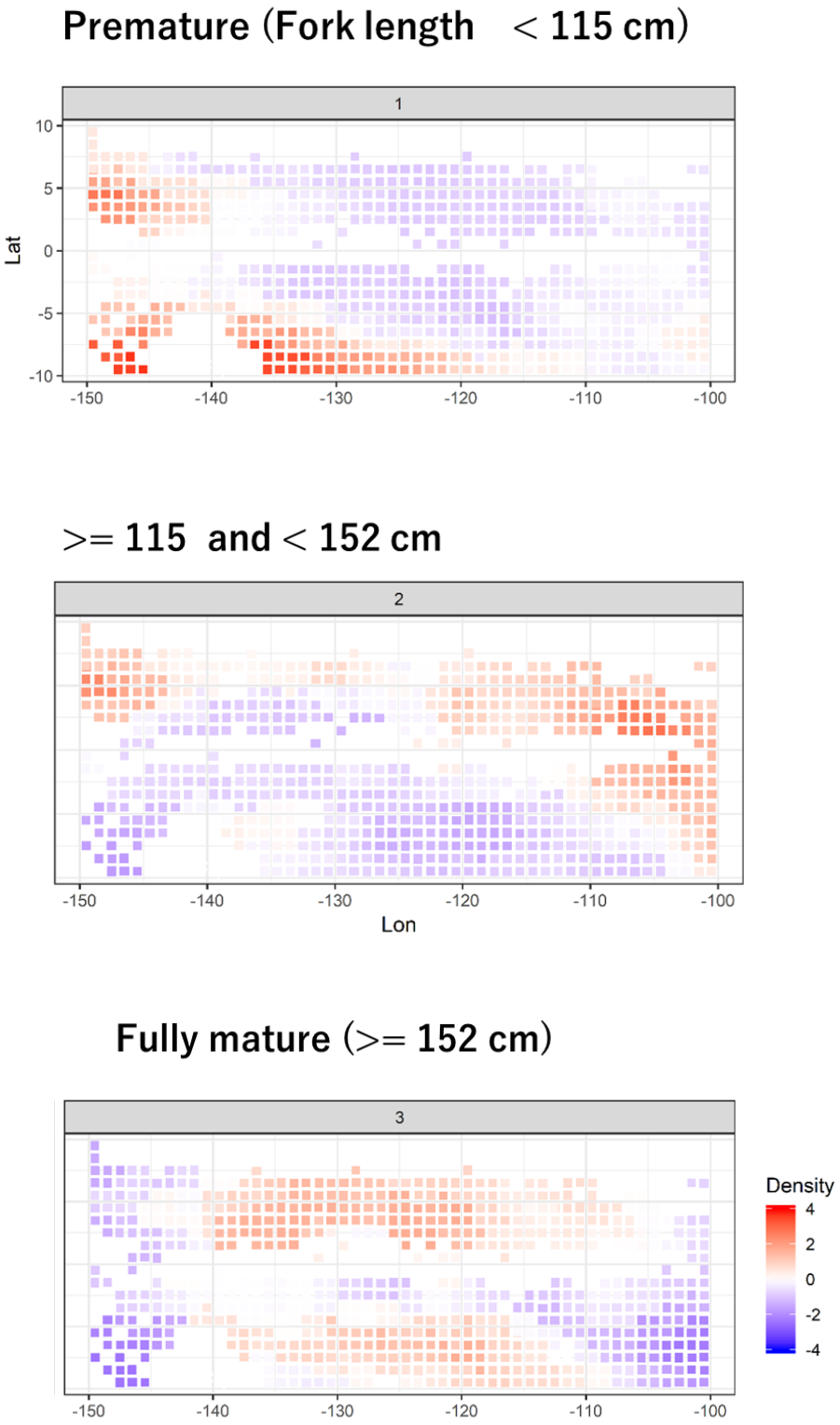

Figure 1: Example outcomes of VAST application for bigeye tuna in EPO. The results clearly indicated clear spatial segregation by bigeye fish body size related to its maturity schedule in the EPO (just an illustrative purpose)