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TRILATERAL COLLABORATIVE STUDY AMONG JAPAN, KOREA AND CHINESE TAIPEI FOR PRODUCING JOINT ABUNDANCE INDEX BY LONGLINE FISHERIES FOR THE TROPICAL TUNA SPECIES IN THE ATLANTIC OCEAN

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SUMMARY

Three distant-water tuna longline countries, Japan, Korea and Chinese Taipei, have started a collaborative study for improving the joint abundance index using integrated fishery data of these fleets for the upcoming stock assessments of tropical tuna species in the Atlantic Ocean. In addition to some preliminary steps to confirm similarity and dissimilarity of fishery operation, nominal CPUE, length frequency and spatio-temporal coverage, there are three planned 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 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. A final set of results will be submitted to the next tropical species group meeting for use as inputs for the update of its stock assessment.

RÉSUMÉ

Trois pays réalisant des activités de pêche thonière palangrière en eaux lointaines, le Japon, la Corée et le Taipei chinois, ont entamé une étude collaborative pour améliorer l'indice d'abondance conjoint en utilisant des données de pêche intégrées de ces flottilles pour les prochaines évaluations des stocks d'espèces de thonidés tropicaux dans l'océan Atlantique. Outre certaines mesures préliminaires visant à confirmer la similitude et la dissimilitude des opérations de pêche, la CPUE nominale, la fréquence des longueurs et la couverture spatio-temporelle, trois tâches sont prévues pour produire la CPUE conjointe : 1) l'étude de meilleures approches pour tenir compte des changements des cibles au sein de chaque pays ; 2) des analyses utilisant des modèles de régression conventionnels avec des informations géographiques, environnementales et halieutiques (y compris les cibles) pour assurer la continuité par rapport aux approches précédentes ; et 3) des analyses utilisant un modèle spatio-temporel avancé (par exemple VAST) pour élaborer des indices d'abondance en prenant les corrélations spatio-temporelles en compte. Un ensemble final de résultats sera soumis à la prochaine réunion du Groupe d'espèces sur les thonidés tropicaux afin de les utiliser comme données d'entrée pour mettre à jour l'évaluation de ces stocks.

RESUMEN

Tres países palangreros dirigidos a los túnidos en aguas distantes, Japón, Corea y Taipei Chino, han iniciado un estudio colaborativo para mejorar el índice de abundancia conjunto utilizando datos pesqueros integrados de estas flotas para las próximas evaluaciones de stock de las especies de túnidos tropicales del Atlántico. Además de algunos pasos preliminares para confirmar la similitud y no similitud de las operaciones pesqueras, la CPUE nominal, la frecuencia de tallas, y la cobertura espacio-temporal, hay tres tareas previstas para elaborar la CPUE conjunta: 1) investigación de los mejores enfoques para tener en cuenta los cambios en

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el objetivo dentro de cada país, 2) análisis usando modelos de regresión convencionales con información geográfica, medioambiental y pesquera (incluido el objetivo) en aras de la continuidad respecto a enfoques anteriores y 3) análisis usando un modelo espacio-temporal avanzado (por ejemplo, VAST) para desarrollar índices de abundancia teniendo una consideración adicional de las correlaciones espacio-temporales. El conjunto final de resultados se presentará en la próxima reunión del Grupo de especies tropicales para que se utilicen como datos de entrada en la actualización de su evaluación de estos stocks.

KEYWORDS

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

Introduction

Tuna-RFMOs, including ICCAT, recommended that the joint CPUE of longline fisheries be developed to improve the stock assessments for tropical tunas, and thus collaborative works have been conducted for several years to produce an abundance index by combining CPUEs data from major longline fleets. However, it was found during the meetings that the fishing technologies and data formats were different among the fleets, and therefore it is important to discuss and exchange the information among countries in order to improve the analysis and index. To this end, three longline countries, Japan, Korea and Chinese Taipei, have started a collaborative study for developing the abundance index.

Regarding longline CPUE standardization processes, an ensemble approach of fishery data from multiple longline fleets has been applied recently to the tropical tuna species stock assessments (Hoyle et al. 2019a, 2019b; Matsumoto et al. 2019). The development of joint abundance index is considered to be successful, but it still has some issues to be solved (Anonymous 2018a, 2018b, 2019a and 2019b, Fernández 2019, Methot 2020). In the Tropical Tuna Species Group Meeting in July, 2020, the WG recommended further analysis including developing the data sharing protocol and developing size-based standardized CPUE as follows;

In Section 9 of bigeye tuna data preparatory meeting report (Anonymous 2018a),

To the SCRS and CPCs:

- *Ask all CPCs to commit to develop a joined longline index for tropical tunas based on combining set by set data as it was attempted for the first time during the data preparatory meeting. This would require:*
    - *finding a mechanism for sharing the data prior to the data preparatory meetings so as to produce an SCRS paper with the combined index;*
    - *agreeing on a procedure to protect the confidentiality of the national data;*
    - *agreeing on a methodology for the combination of data;*
    - *ensuring that the tropical group scientists have the ability to conduct the analysis (during the current meeting an external scientist led the analysis).*

To the Stock Assessment Methods Working Group (WGSAM):

- *To add to the diagnostic section on the guidelines for development of relative abundance indices the production of influence plots for each factor in the model.*
- *To review the following methodological issues associated with combining longline set by set data from different longline fleets for the purposes of standardizing CPUE:*
    - *the use of clustering of longline sets based on species composition within a longline set;*
    - *the use of fishing effort (number of hooks per longline set) as an explanatory variable in standardization models;*
    - *investigate the assumptions (explicit and implicit) related to weights assigned to individual longline sets according to the cell such longline.*

In Section 2.3 of bigeye tuna stock assessment meeting report (Anonymous 2018b), to investigate to ensure similarity of selectivity patterns of multiple fleets.

1. *More careful examination will be pursued to evaluate if the selectivities are reasonably similar;*

2. *The inclusion of time-varying selectivity in the SS3 for a particular fleet should be examined (see proposed guidelines below);*

3. *Use of age/size information for the CPUE standardisation (size or age-based standardized CPUE indices or using the mean size as a covariate) may help reduce or eliminate such a bias.*

Some of these tasks need time to investigate, thus a trilateral framework composed of three longline countries (Japan, Korea and Chinese Taipei) has developed to address these recommendations. Currently, a data sharing protocol among the three countries is in a finalization process to ensure data security. We are planning to jointly work toward production of joint abundance indices for bigeye tuna stock assessment, which will be conducted next summer.

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

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 (see **Figures 1-3** for illustration);

1. in conducting the cluster analysis to address targeting changes (see **Figure 4** for illustration);

2. in developing an abundance index using a traditional delta-lognormal model as well as tools for diagnostics and presentation (see **Figure 5** for illustration); and

3. in developing a spatio-temporal model by size (see **Figure 6** for illustration).

After a face-to-face 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, a data sharing protocol among the three countries is now in a finalization process to ensure data security, and we are planning to present a final set of results before the next tropical tuna species group meeting for use as inputs for the update of bigeye stock assessment in 2021.

References

Anonymous 2018a. Report of the 2018 ICCAT bigeye tuna data preparatory meeting. (Madrid, Spain 23-27 April, 2018). pp. 1-44.

Anonymous 2018b. Report of the 2018 ICCAT bigeye tuna stock assessment meeting. (Pasaia, Spain 16-20 July, 2018). pp. 1-92.

Anonymous 2019a. Report of the 2019 ICCAT yellowfin tuna data preparatory meeting. (Madrid, Spain 22-26 April, 2019). pp. 1-42.

Anonymous 2019b. Report of the 2019 ICCAT yellowfin tuna stock assessment meeting. (Grand-Bassam, Cote d'Ivoire, 8-16 July 2019). pp. 1-118.

Fernández, Camen. 2019. External review of ICCAT bigeye tuna stock assessment. Collect. Vol. Sci. Pap. ICCAT, 75(7): 2247-2258.

Hoyle, S.D., Huang, J. H.W., Kim, D.N., Lee, M.K., Matsumoto, T., Walter, J. 2019a. Collaborative study of bigeye tuna CPUE from multiple Atlantic Ocean longline fleets in 2018. Collect. Vol. Sci. Pap. ICCAT, 75(7): 2033-2080.

Hoyle, S.D., Lauretta, M., Lee, M.K., Matsumoto, T., Sant'Ana, R., Yokoi, H., Su, N.J. 2019b. Collaborative study of yellowfin tuna CPUE from multiple Atlantic Ocean longline fleets in 2019. Collect. Vol. Sci. Pap. ICCAT, 76(6): 241-293.

Matsumoto, T., Satoh, K., Kitakado, T., Wang, S.P., Su, N.J., and Yeh, Y.M. 2019. Comparison of yellowfin tuna CPUE and length composition between the Chinese Taipei and Japanese longline fisheries in the Atlantic Ocean. SCRS/2019/060, ICCAT Yellowfin Tuna Data Preparatory Meeting, 22-26 April 2019, Madrid, Spain.

Methot, R. 2020. (DRAFT) External review of Atlantic yellowfin tuna assessment in 2019. Collect. Vol. Sci. Pap. ICCAT, 76(6): 992-996.

a) Japan

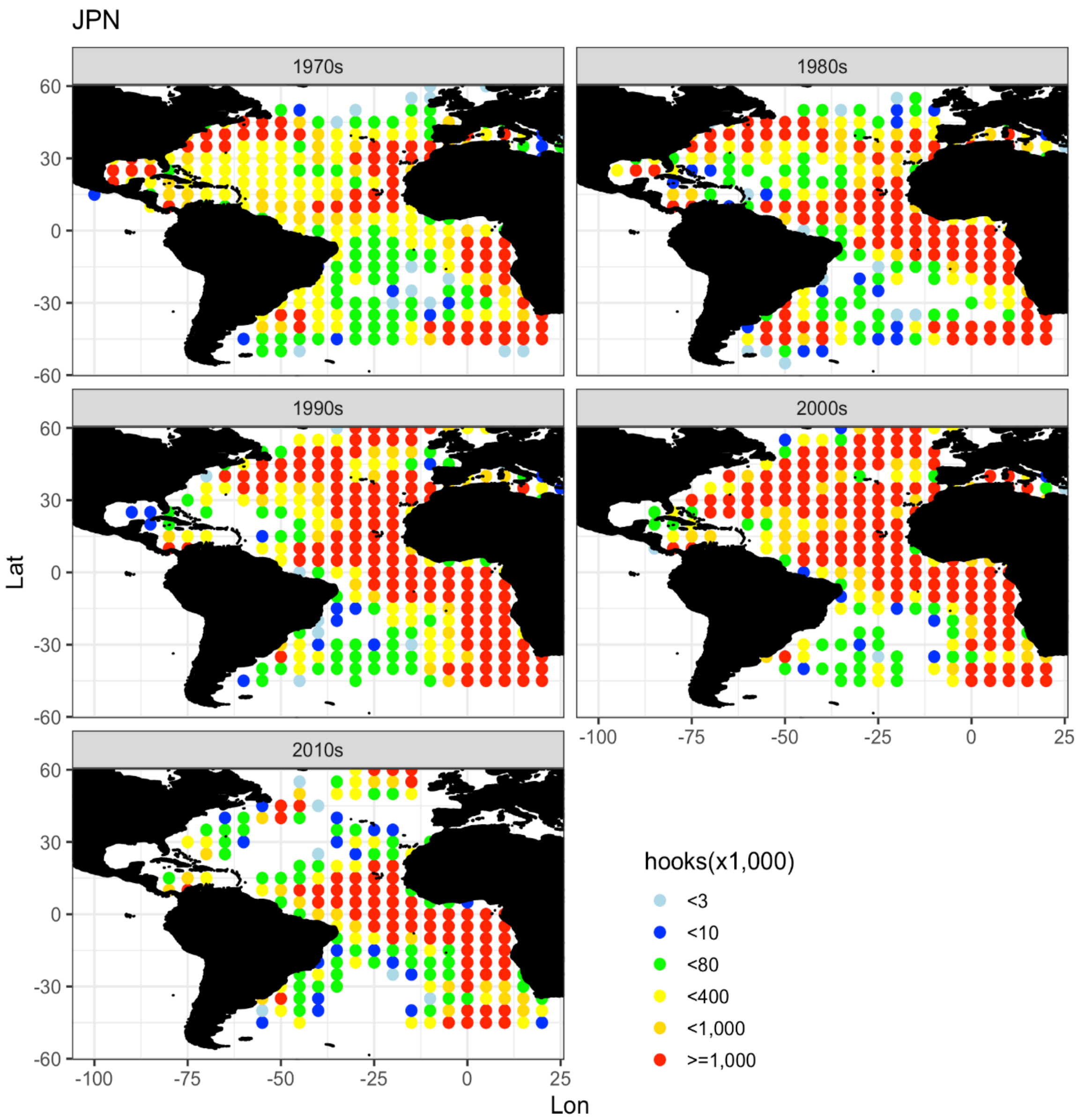


Figure 1. Decadal distributions of fishing efforts (number of hooks) for longline fisheries over the fishing ground in the ICCAT convention area.

b) Korea

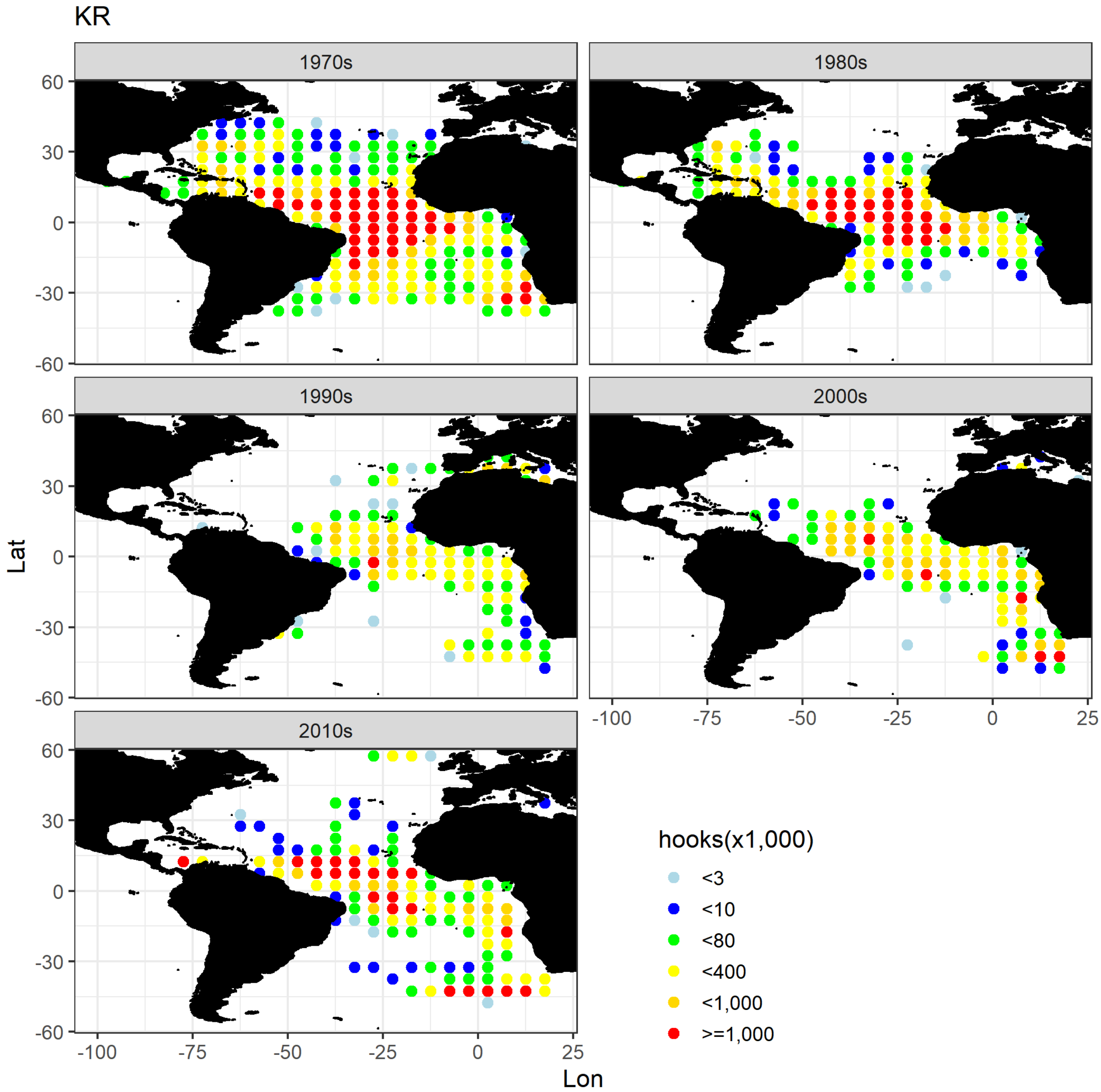


Figure 1 (Continued).

c) Chinese Taipei

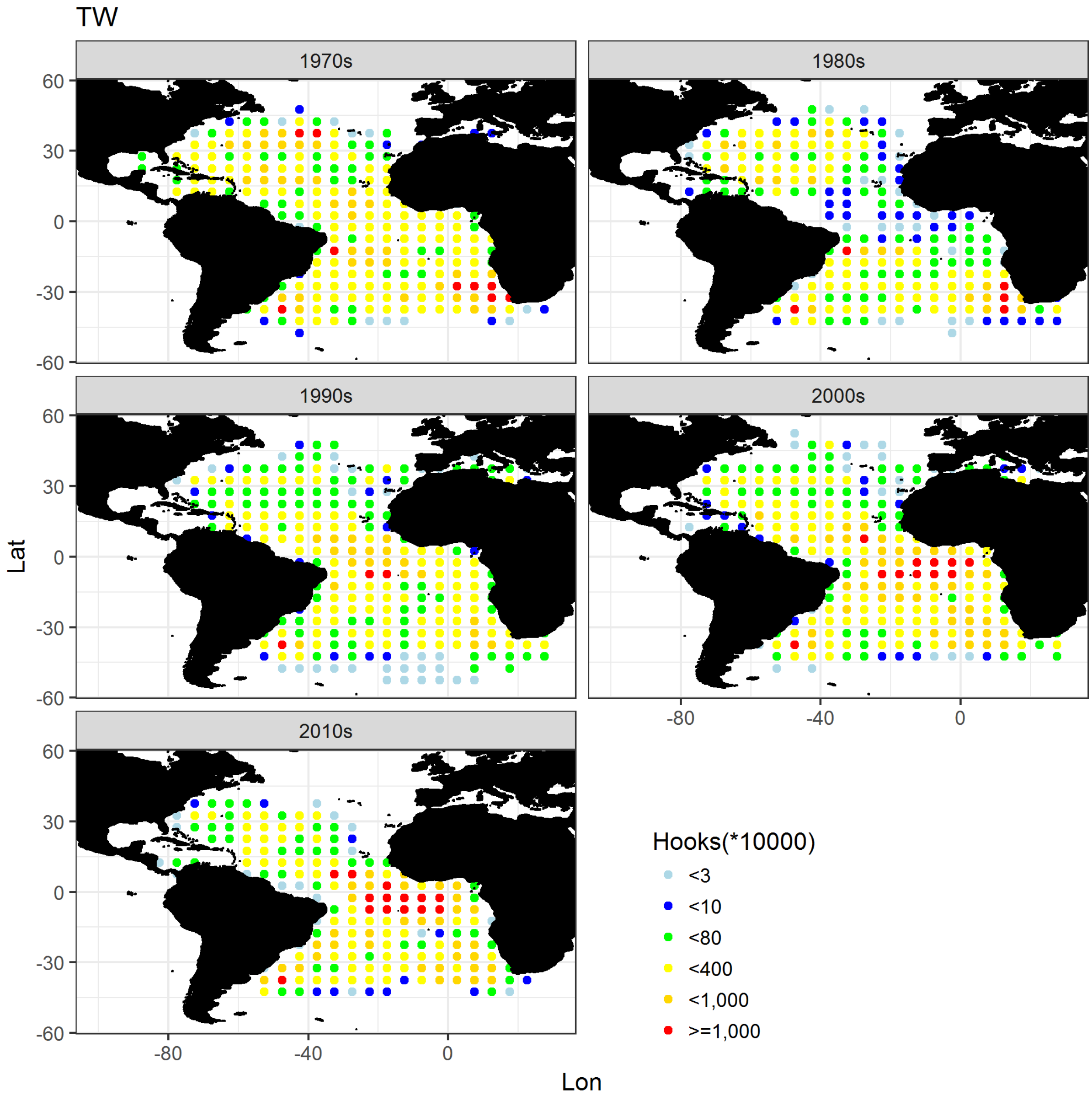


Figure 1 (Continued).

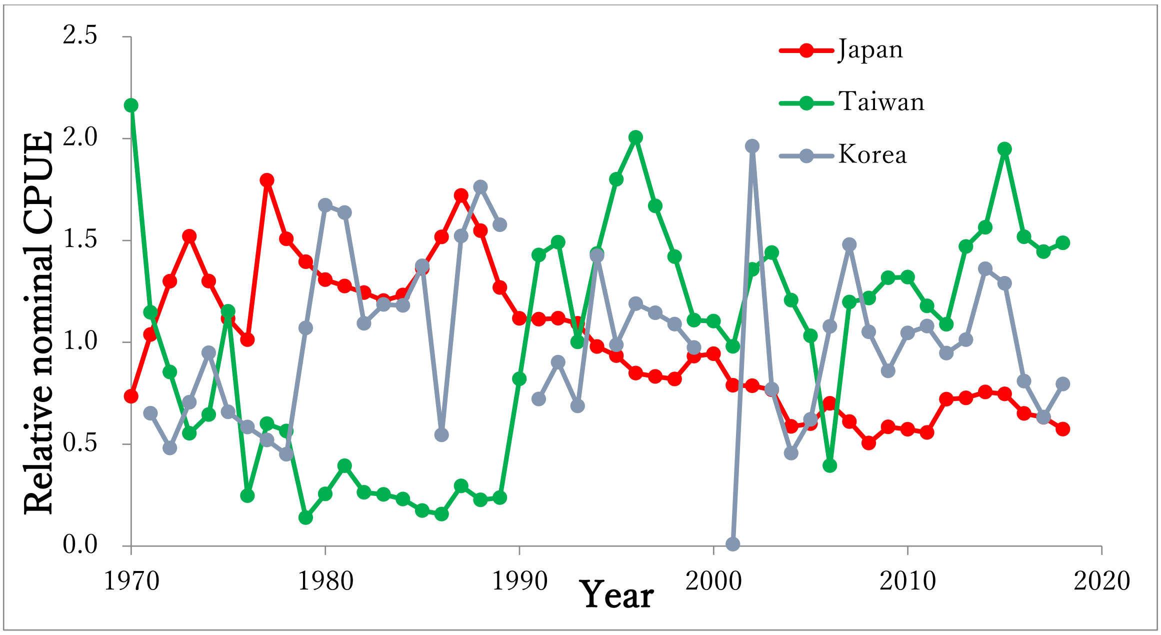
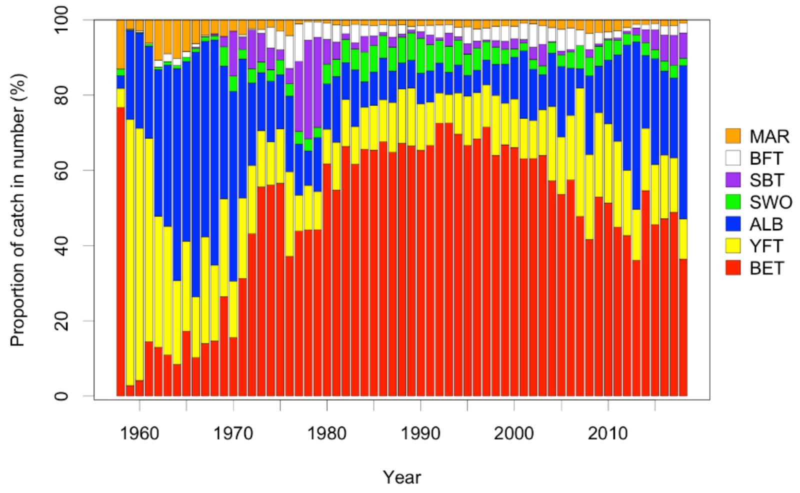
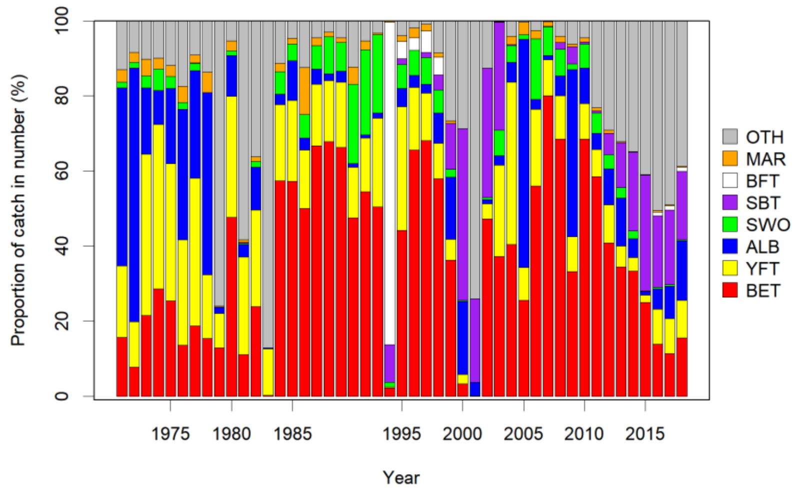


Figure 2. Time series of nominal CPUE of bigeye tuna for longline fisheries in the ICCAT Convention area.

a) Japan



b) Korea



c) Chinese Taipei

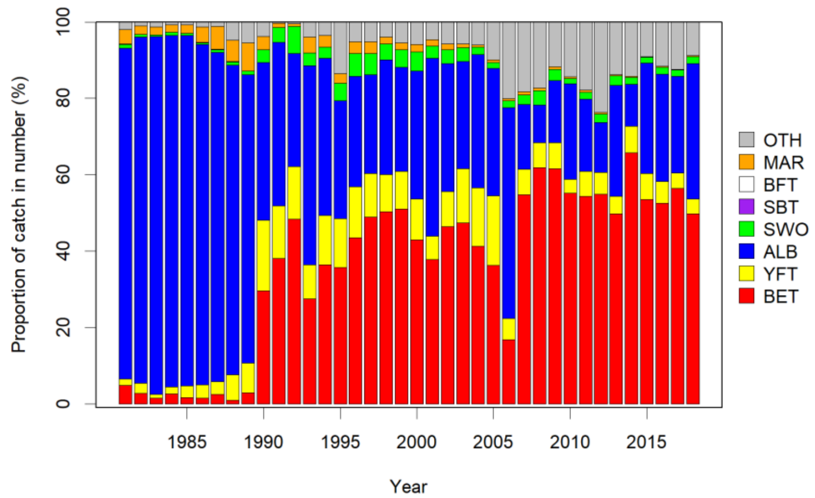


Figure 3. Species compositions for longline fisheries in the ICCAT Conventional area.

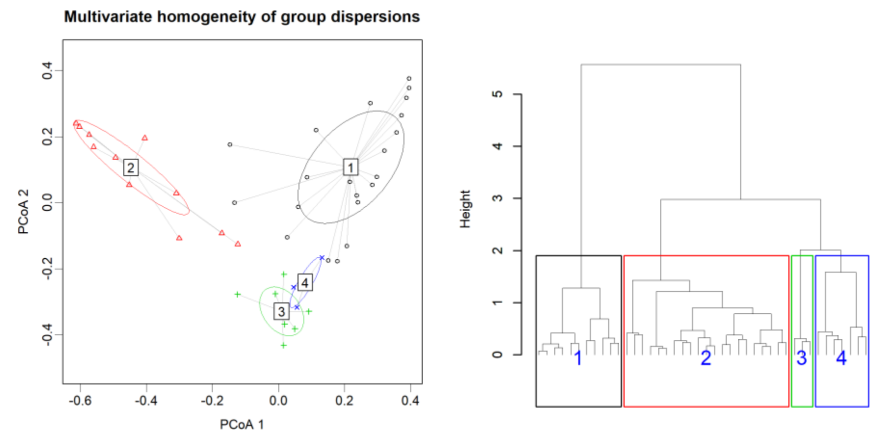


Figure 4. Preliminary analysis for the cluster analysis to detect the targeting of fishing operation (just an illustrative purpose).

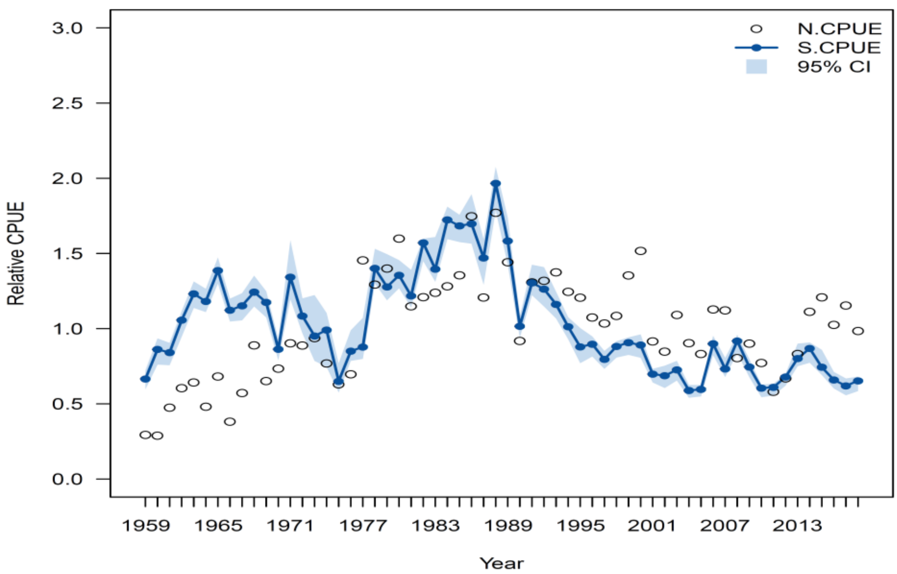


Figure 5. Evaluation of CI and SE by bootstrapping. The confidence intervals of standardized CPUE were estimated using a bootstrap resampling method. The number of bootstrap sub-samples were generated according to the sample size of CPUE in each year (just an illustrative purpose).

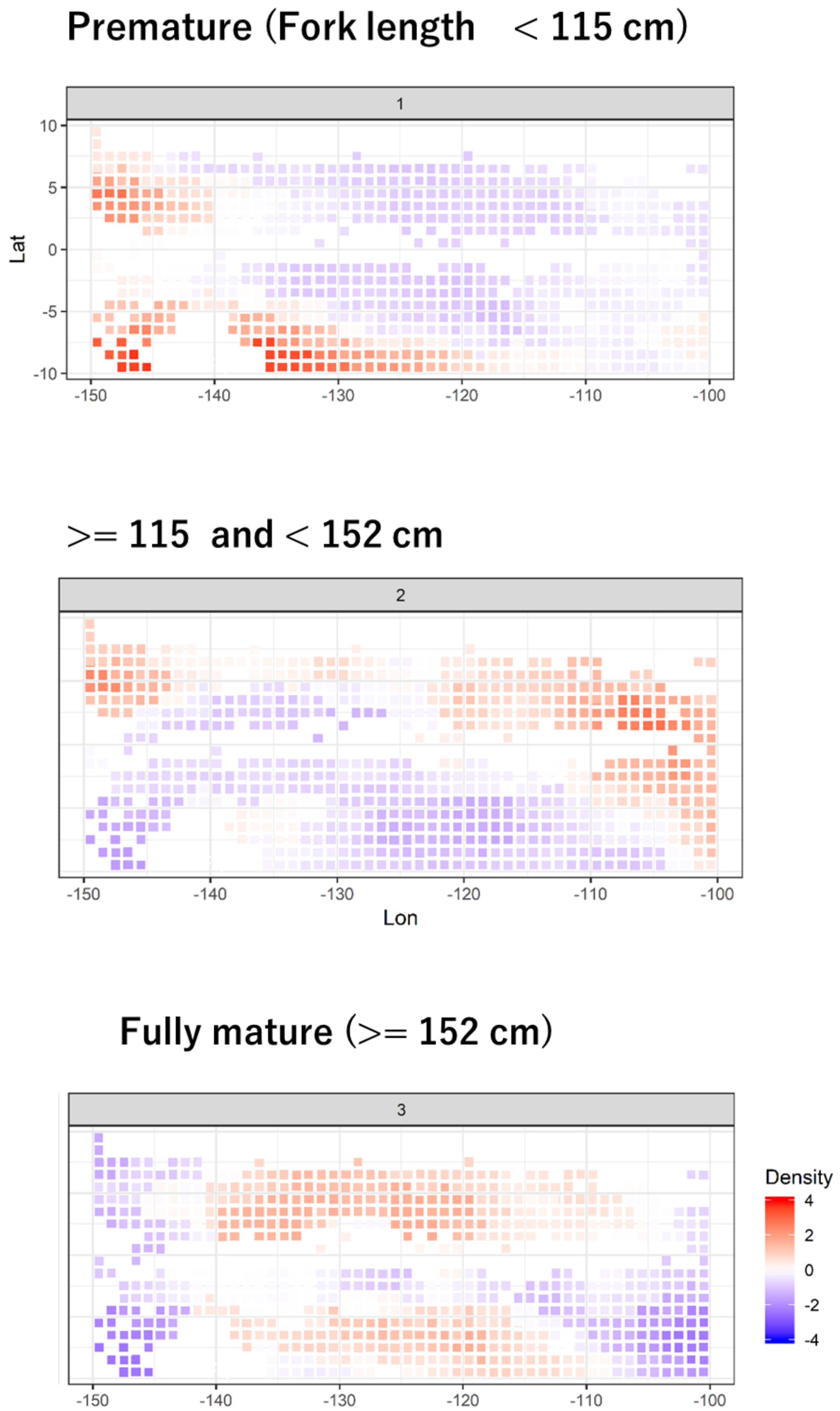


Figure 6. Example VAST outcomes for bigeye tuna in EPO. The results clearly indicated clear spatial segregation by bigeye fish body size related to its maturity schedule in the EPO (just an illustrative purpose).