WCPFC-SC14-2018/SA-WP-04

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Improvements in skipjack (*Katsuwonus pelamis*) abundance index based on the fish size data from Japanese pole-and-line logbook (1972–2017)

Kinoshita, J., Aoki, Y., Ijima, H. and Kiyofuji, H.

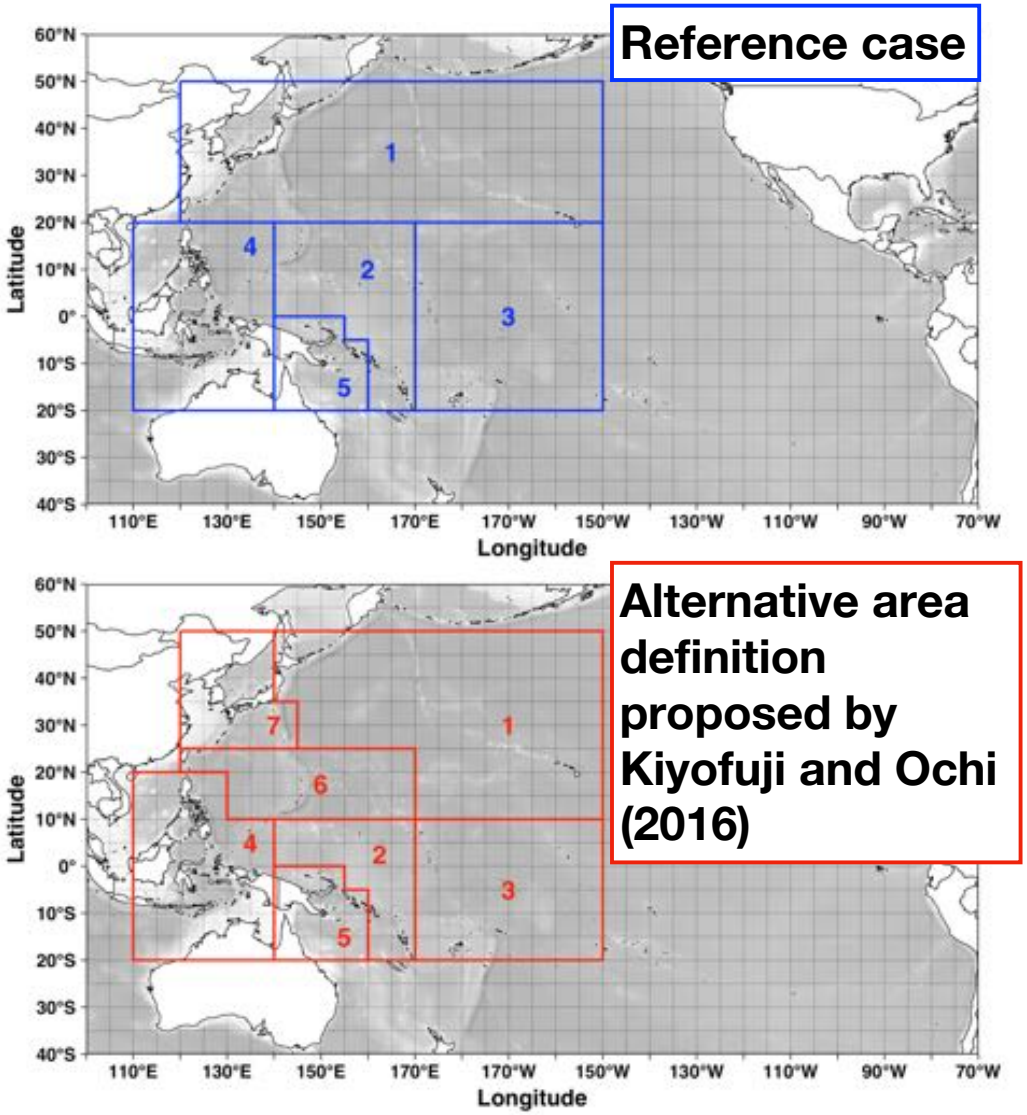
National Research Institute of Far Seas Fisheries, Japan

Brief summary of our study

- When calculating abundance indices, it is ideal that one size group (≃cohort) be distributed in defined area.
- However, it is difficult to distinguish size groups because size data often includes different size and/or age class in the same area. We should reduce size and/or age biases in same area as much as possible.
- We addressed a model-based cluster analysis considering skipjack size (mean body weight) caught by JPNPL and obtained useful result for determining spatial structure.
- Therefore, we recommend that **SC14 to consider a new area definition proposed by this study as the reference case (diagnostic case) in the next skipjack stock assessment**.

Background

- Application of fishery information based on underlying biological characteristics to the stock assessment model is a basic concept to achieve a better assessment.
- Kiyofuji and Ochi (2016, SC12-2016/SA-IP-09) proposed an alternative area definition based on tagging and larvae surveys' data but it has still lacks the evidence in terms of size distribution.
- A wide range of WCPO is covered by Japanese pole-and-line fishery whose logbook data have comprehensive dataset (i.e., operational area, catch amount, mean body weight of skipjack, etc.)



Materials and Methods

Logbook in Japanese pole and line fishery (JPNPL): 1972–2017

1. Resolution: Daily, 1°×1°
2. Items: catch, longitude, latitude, mean body weight (BW), vessel info

Filtering and transformation

1. Removed zero catch or unknown BW (expressed as 0 kg) records
2. Transformed BW into weighted BW at each grid (1°×1° or 5°×5°) by the equation as follows:

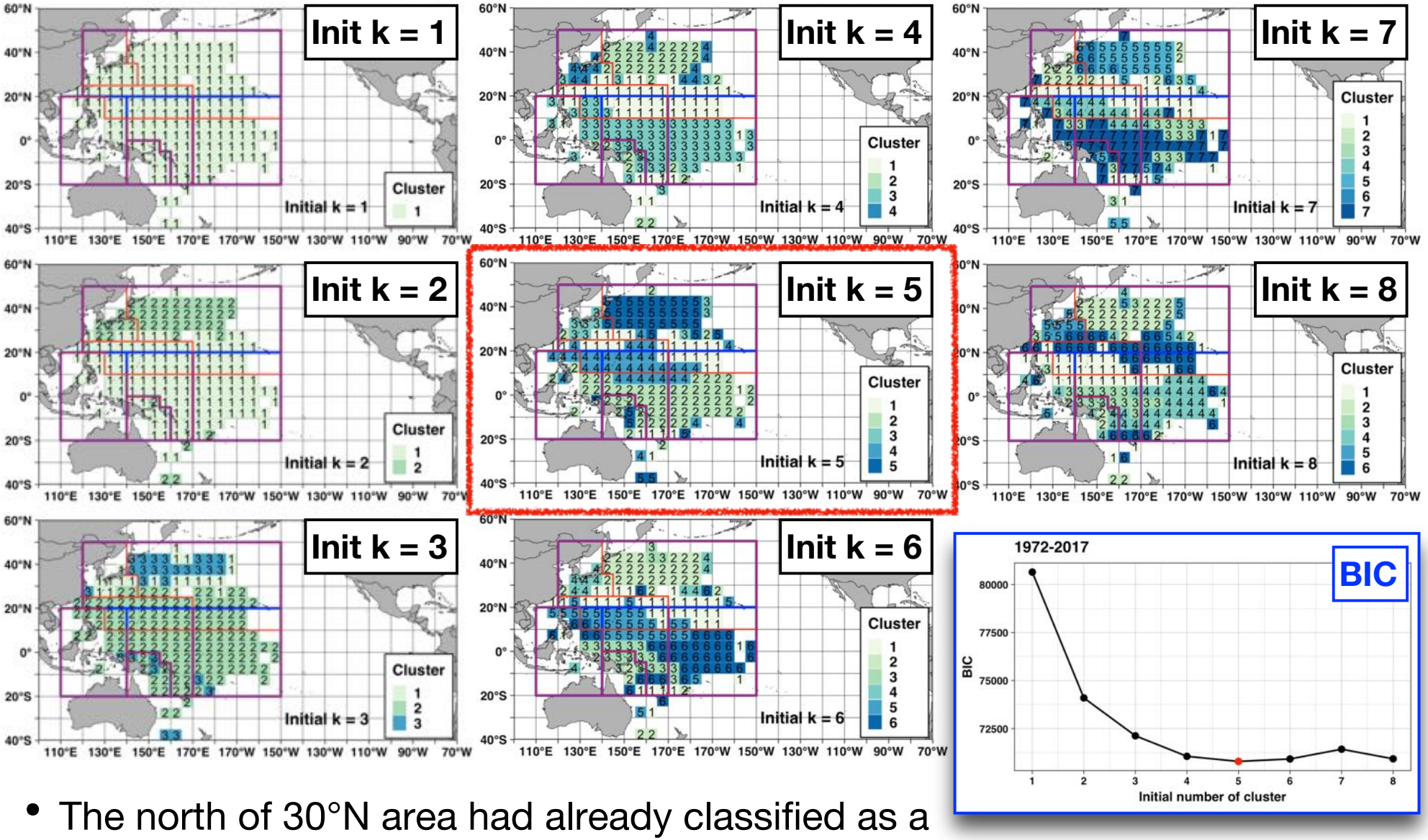
$$weightedBW = \sum_{i=1}^{99} \frac{BW_i \times CatchatBW_i}{Totalcatch}, BW_i = 0.1, 0.2, \cdots, 9.9$$

Finite mixture model

- This model is useful to classify data where observations originate from various groups but the original group structure is unknown.
- In our analysis, a mixture of Gamma and lognormal GLMs was assumed
  1. Response variables: **weighted BW** (Gamma), **CPUE** (lognormal)
  2. Explanatory variables: **year**, quarter (**qtr**), gross register tonnage (**grt**)
- The initial number of latent clusters were assumed from 1 to 8.
- Bayesian information criterion (**BIC**) was used for model selection.

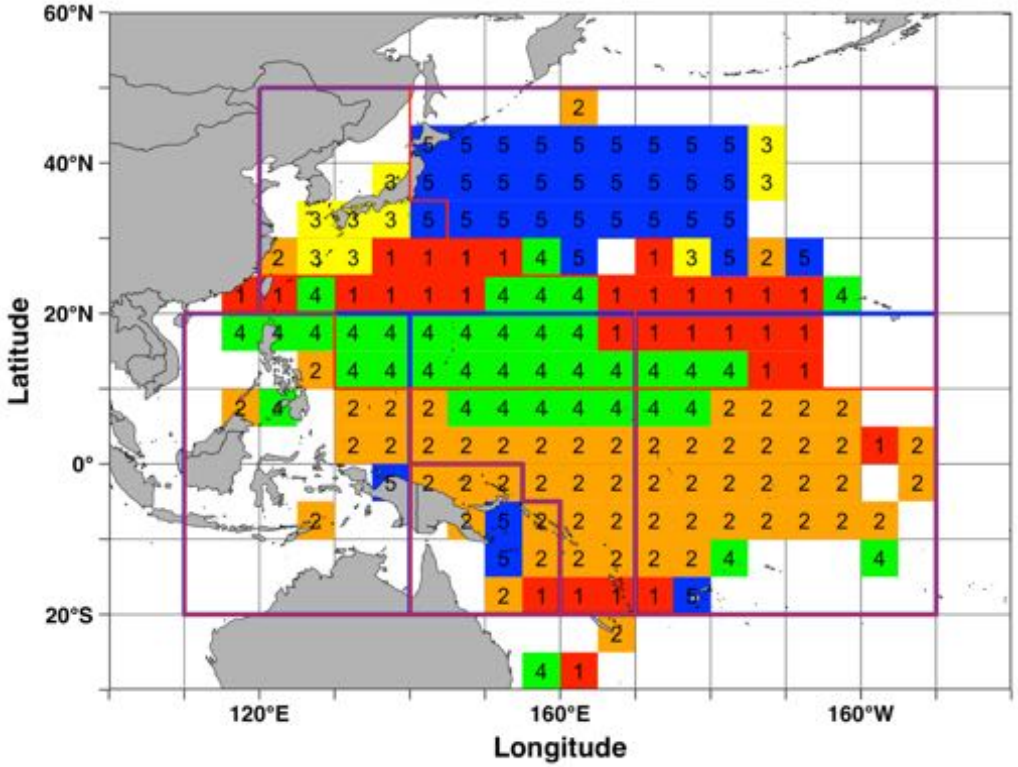
Result

Comparisons of cluster distribution and BIC among different initial clusters

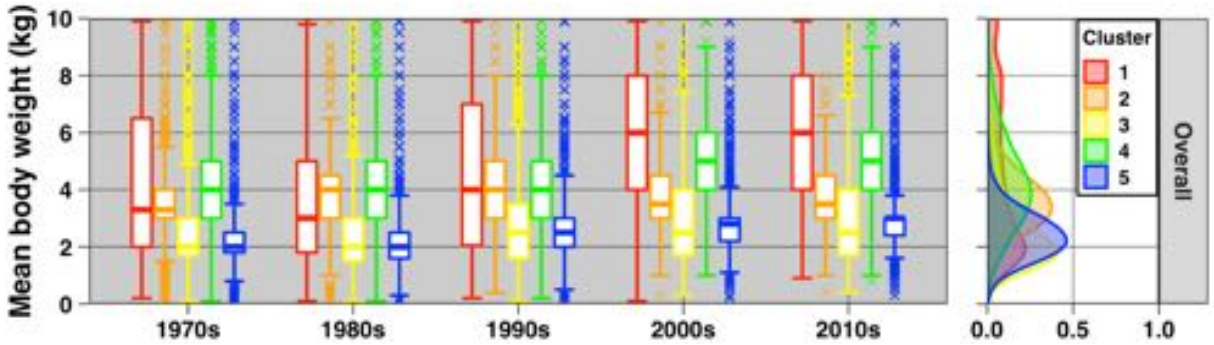


- The north of 30°N area had already classified as a distinct cluster at init k = 2.
- The BIC of **Init k = 5** was the lowest and selected.

Result of cluster analysis and changes mean body weights (kg)

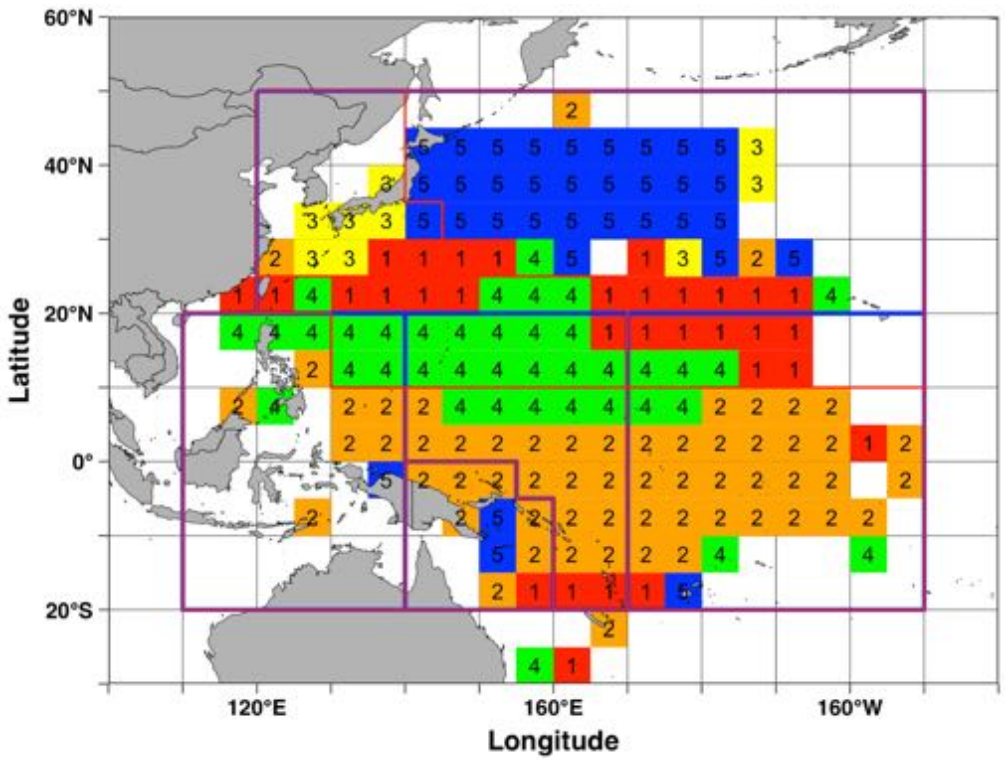


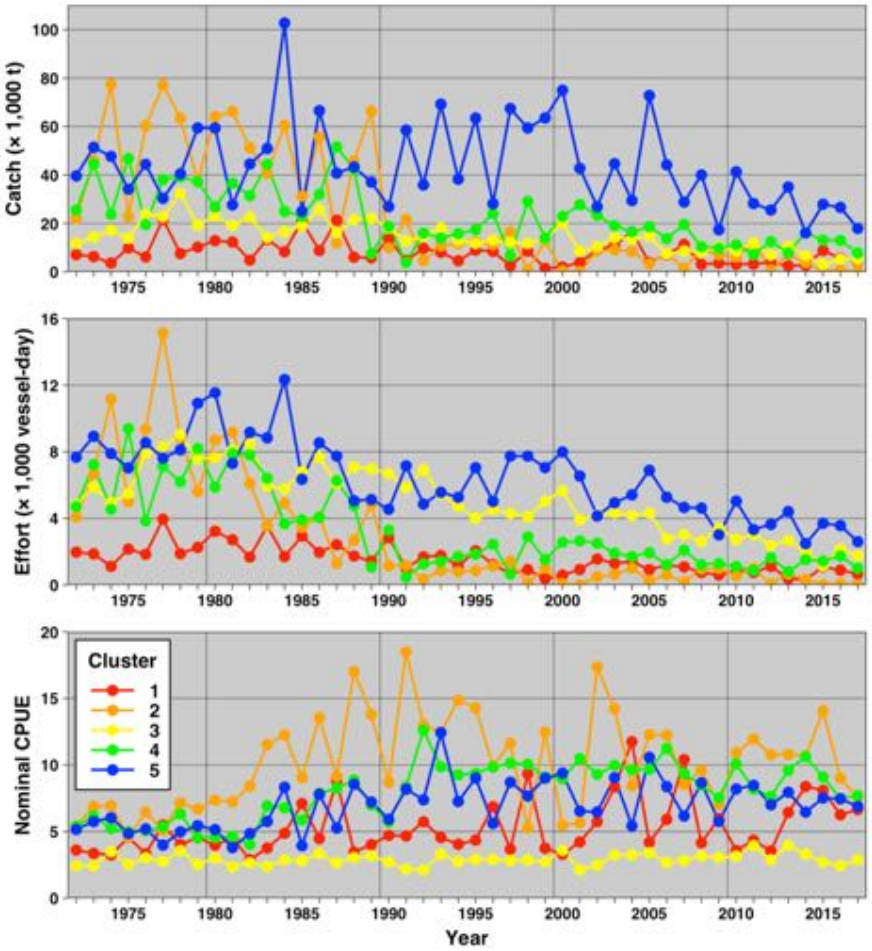
- **Cluster 1 distributes between cluster 4 and 5 and has a peak at 2.2 kg with a large deviation**
- **Cluster 2 distributes tropical area widely and has a peak at 3.4 kg.**
- **Cluster 3 distributes Nansei isl. of Japan and has a peak at 1.8 kg.**
- **Cluster 4 distributes north subtropical area and has a peak at 3.9 kg.**
- **Cluster 5 distributes the northernmost area and has a peak at 2.2 kg of weighted BW**



- The peaks appears around 2 kg and 4 kg.
- Cluster 1 (red) has large variation.

Result of cluster analysis and Catch, Efforts and CPUE

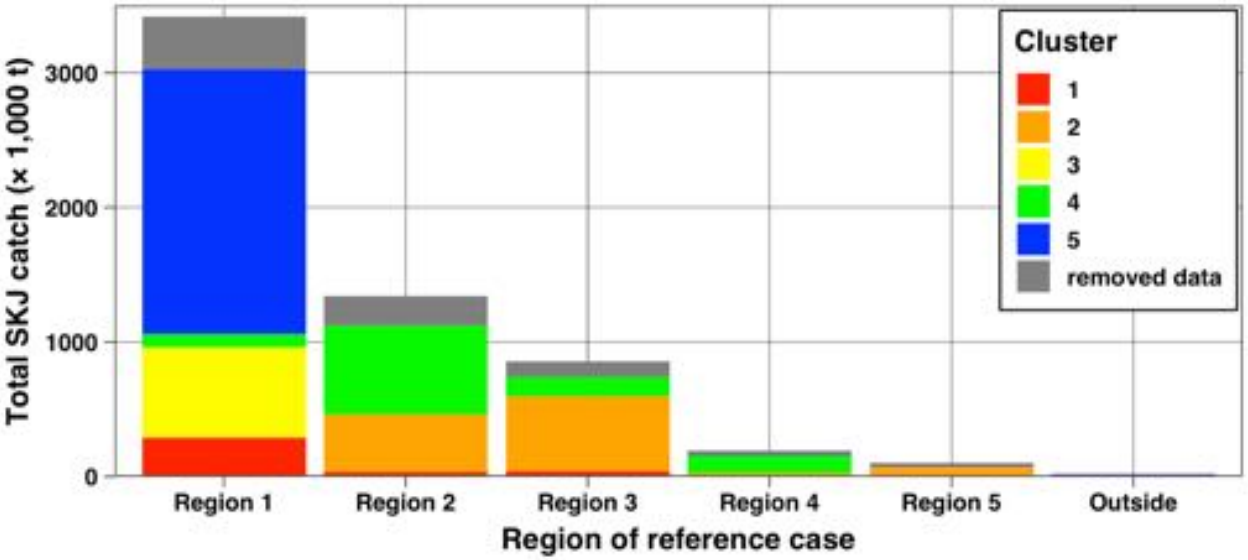




- Catch and Effort (vessel-day) in Cluster 2 (orange) and 4 (green) were drastically decreased from 1980s to 1990s.
- Effort in Cluster 3 (yellow) and 5 (blue) were gradually decreased from 1980s.
- Nominal CPUE varied year by year except for Cluster 3 (yellow).

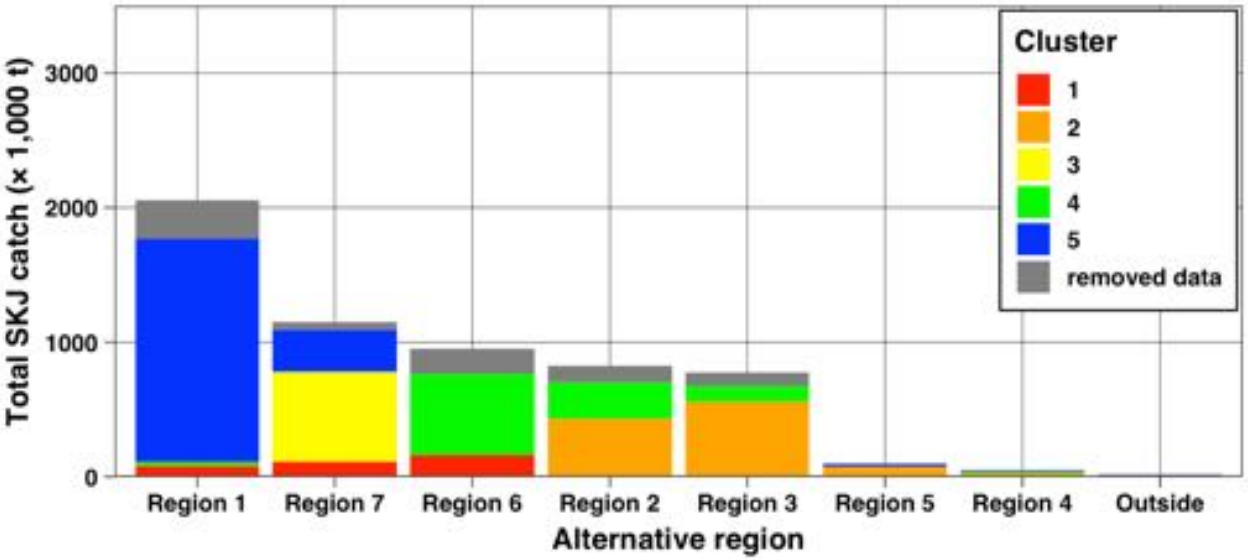
Comparison of total catch between two area definitions

Reference case



- Region 1 contains three clusters.
- Total catch in Region 4 and 5 were low.

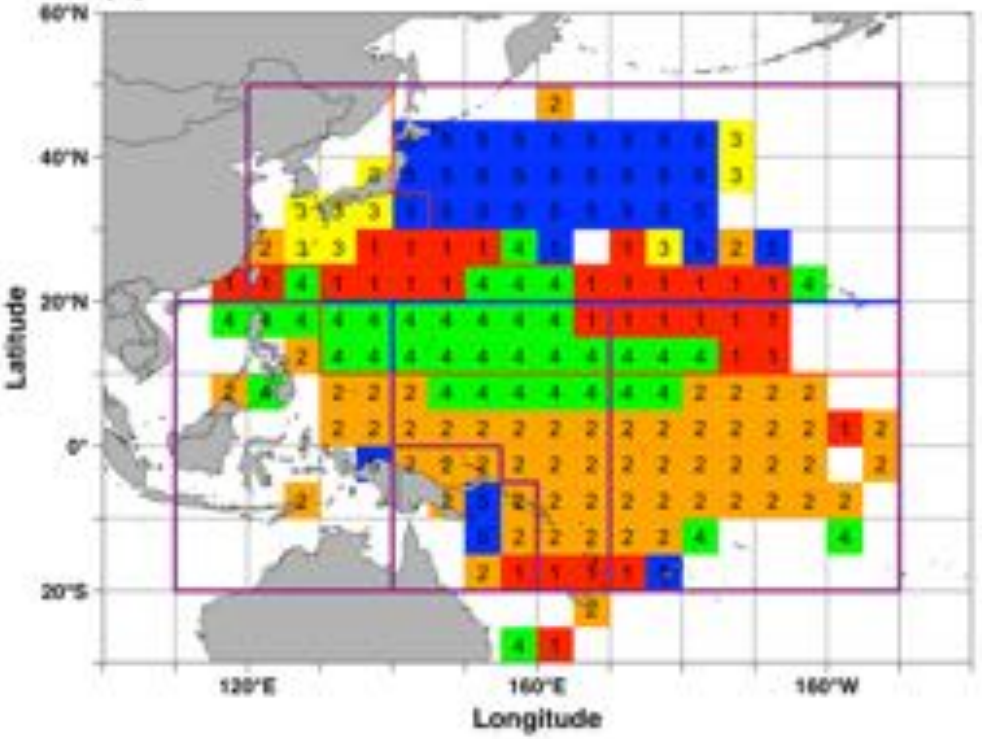
Alternative area proposed by Kiyofuji and Ochi (2016)



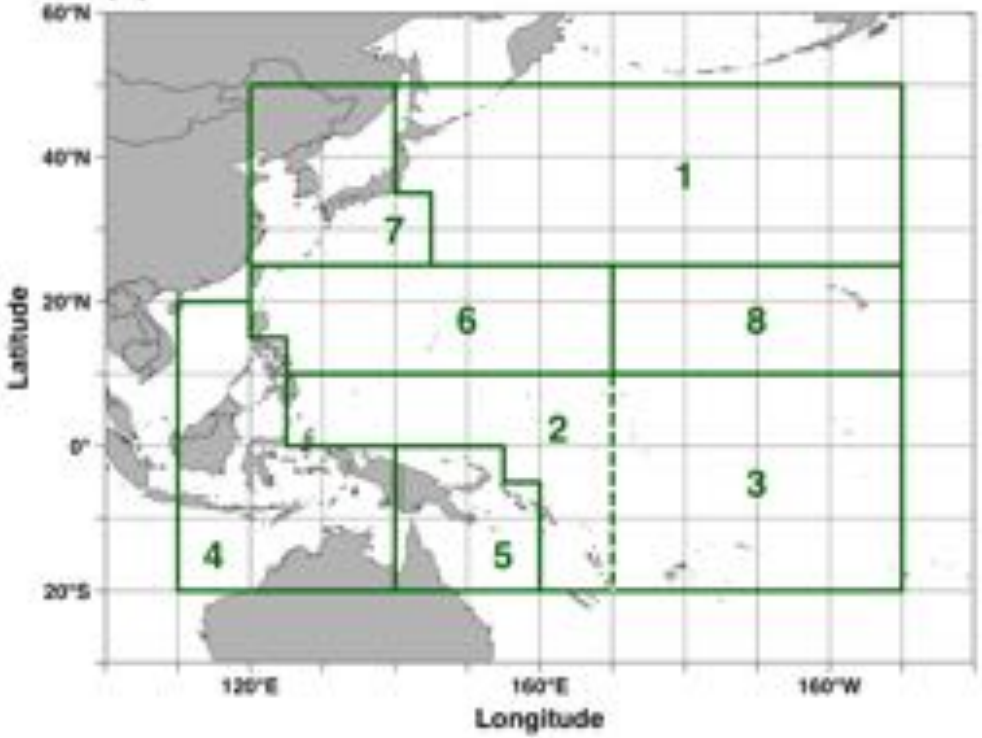
- Region 1 includes almost one cluster, or Cluster 5.
- Region 7 includes mainly one cluster, or Cluster 3.
- Total catch in Region 4 and 5 were low.

A proposal of new area definition

Distribution of five clusters (all year, all qtr)



New area definition



In the new area definition,

- Cluster 1 to the east of 170°E is divided into (→) Region 8, Cluster 2 → Region 2 and 3, Cluster 3 → Region 7, Cluster 4 → Region 6, and Cluster 5 → Region 1.
- It will be more reasonable to combine Region 2 and 3 due to non-separation of Cluster 2.

Summary and Future work plan

Summary

- Model-based cluster analysis using SKJ size (BW) and CPUE provides clearly distinct five latent clusters.

- We propose a new area definition which better explains (or corresponds to) our clustering result.

- Therefore, we recommend that **SC14 to consider a new area definition proposed by this study as the reference case (diagnostic case) in the next skipjack stock assessment**.

Future work plan

1. Mean body weight based on logbook will (should) be converted to actual fork length measured in Japan.
2. Calculation of JPNPL abundance index considering the cluster analysis.