Joint CPUE indices for the bigeye tuna in the Indian Ocean based on Japanese, Korean and Taiwanese longline fisheries for use in MP application in IOTC–2025–SSC01

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ABSTRACT

Joint CPUE standardization for the Indian Ocean bigeye tuna was conducted using longline fisheries data from Japan, Korea, and Taiwan up to 2023. This effort aimed to provide the IOTC Scientific Committee with updated abundance indices for use in the adopted Management Procedure (MP) for this stock. The collaboration sought to enhance the spatial and temporal coverage of fishery data, thereby producing combined indices. To account for inter-annual variations in the target species for each fishery, data on hooks between floats or clustering results were incorporated for each region. Conventional regression models were applied to standardize catch-per-unit-effort data, using shared operational data in each region. Overall, the trend in CPUE was broadly consistent with those used in previous stock assessments and MP applications.

Note: This document provides an overview of the joint CPUE work for the Indian Ocean bigeye tuna. Due to the nature of the paper and time constraints, detailed descriptions of the methodology and results are omitted. The focus is on summarizing the approaches and key findings from the collaborative effort.

Tuna-RFMOs, including the IOTC, have recommended the development of joint CPUE data from longline fisheries to enhance stock assessments for tropical tunas. In response, the IOTC has been conducting collaborative efforts for several years to produce abundance indices by combining CPUE data from major longline fleets. An ensemble approach using fishery data from multiple longline fleets has been applied to tropical and temperate tuna species in their stock assessments. Following these established practices within the IOTC and other RFMOs, we conducted a collaborative study to develop abundance indices for the Indian Ocean bigeye tuna. This study was based on longline fisheries data from Japan, Korea, and Taiwan, up to 2023.

The combined dataset for bigeye tuna CPUE standardization included operational data on catch numbers by species, with spatio-temporal information (daily; 1° latitude and longitude), vessel IDs, number of hooks (as effort), as well as HBF (for R1N, R1S and R2) and clustering outcomes (R3, see Fig 2) to account for changes in the target species during fishing operations. For clustering, as outlined by Wang et al. (2021), the species were classified into albacore (ALB), bigeye tuna (BET), yellowfin tuna (YFT), southern bluefin tuna (SBT), black marlin (BLM), blue marlin (BUM), swordfish (SWO), other billfishes (BIL), sharks (SKX), and others (OTH). The data period for the three fisheries spans 1979-2023 for Japan and Korea, and 2005-2023 for Taiwan.

Vessel ID data is available from 1975 for the Japanese data; however, for consistency with previous analyses, data from 1979 onward were used. For the Taiwanese data, data from 2005 onwards were used due to data quality issues discussed in previous IOTC meetings. Also, we also removed some data of Taiwanese vessels in 2021-2023 because of their sudden operational changes. Regarding vessel screening, only vessels with 10 or more data were included in the CPUE standardization.

For standardizing the catch-per-unit-effort data, the conventional linear models were employed for operational data. We used an adjustment factor (here 10% of mean of CPUE) to the CPUE data to employ conventional log-normal distributions as follows:

$$\log(CPUE + c) = Temporal\ (YrQtr) + Space\ (5° \text{ grid}) + VesselID + HBG/Cluster\ +\ Error$$

The error terms are assumed to be independently and identically distributed as the normal distribution with mean 0 and standard deviation σ. HBF is defined as Shallow (<=7), Medium (8<=HBF<=13) and Deep (14 <= HBF).

The results are shown in Figure 3 and were provided to the secretariat and MP developers. Overall, the trend in CPUE was broadly consistent with those used in previous stock assessments and MP applications.

Item	2019	2022	2025
Data	Operational	Aggregated	Operational
Distribution	Delta lognormal	LN (R1N, R1S, R2) Delta lognormal (R3)	LN
Data screening or sampling	Vessels fish ≥ 100 sets Vessels fish ≥ 5 qtrs Spatial cells ≥ 50 sets Y-Q ≥ 50 sets (all reduced to 3/5 for R3) Subsampling for strata (yr.qtr.ll) with ≥ 15 sets	Vessels with ≥ 20 positive catch data	Vessels with ≥ 10 data
Target	HBF-spline (R1N, R1S, R2) Cluster (R3)	HBF-category (R1N, R1S, R2) Cluster (R3)	HBF-category (R1N, R1S, R2) Cluster (R3)
Methods	Spatial reweighting Binomial rescaling		
Interactions		Lonlat*Qtr	

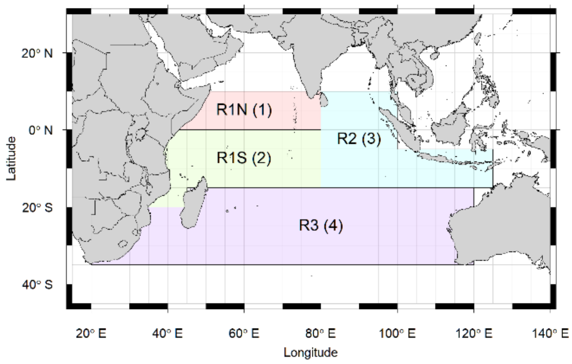

Figure 1. Definition of the regions used in the analysis.

Japan Korea Taiwan

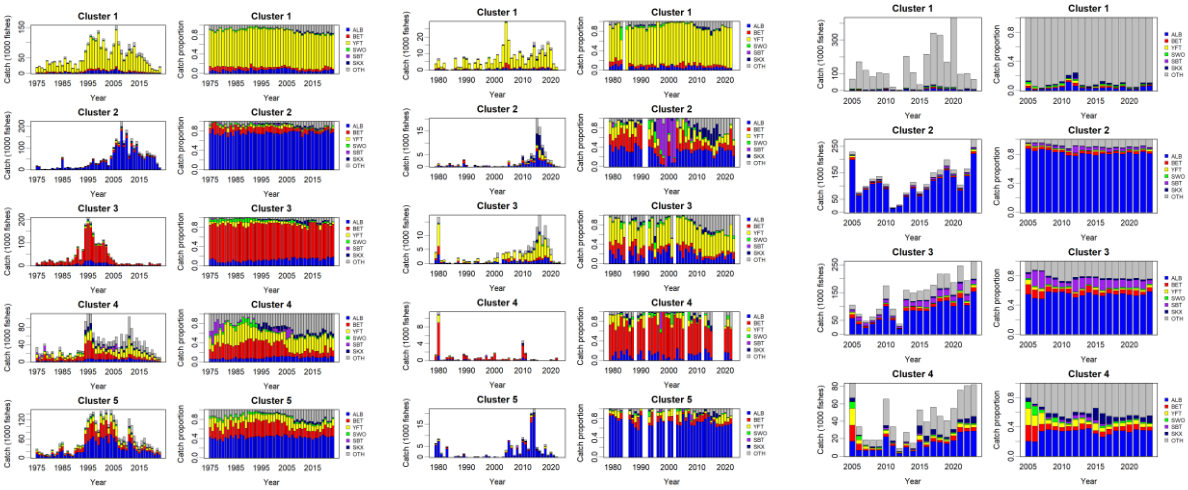

Figure 2: Species composition for each cluster in R3.

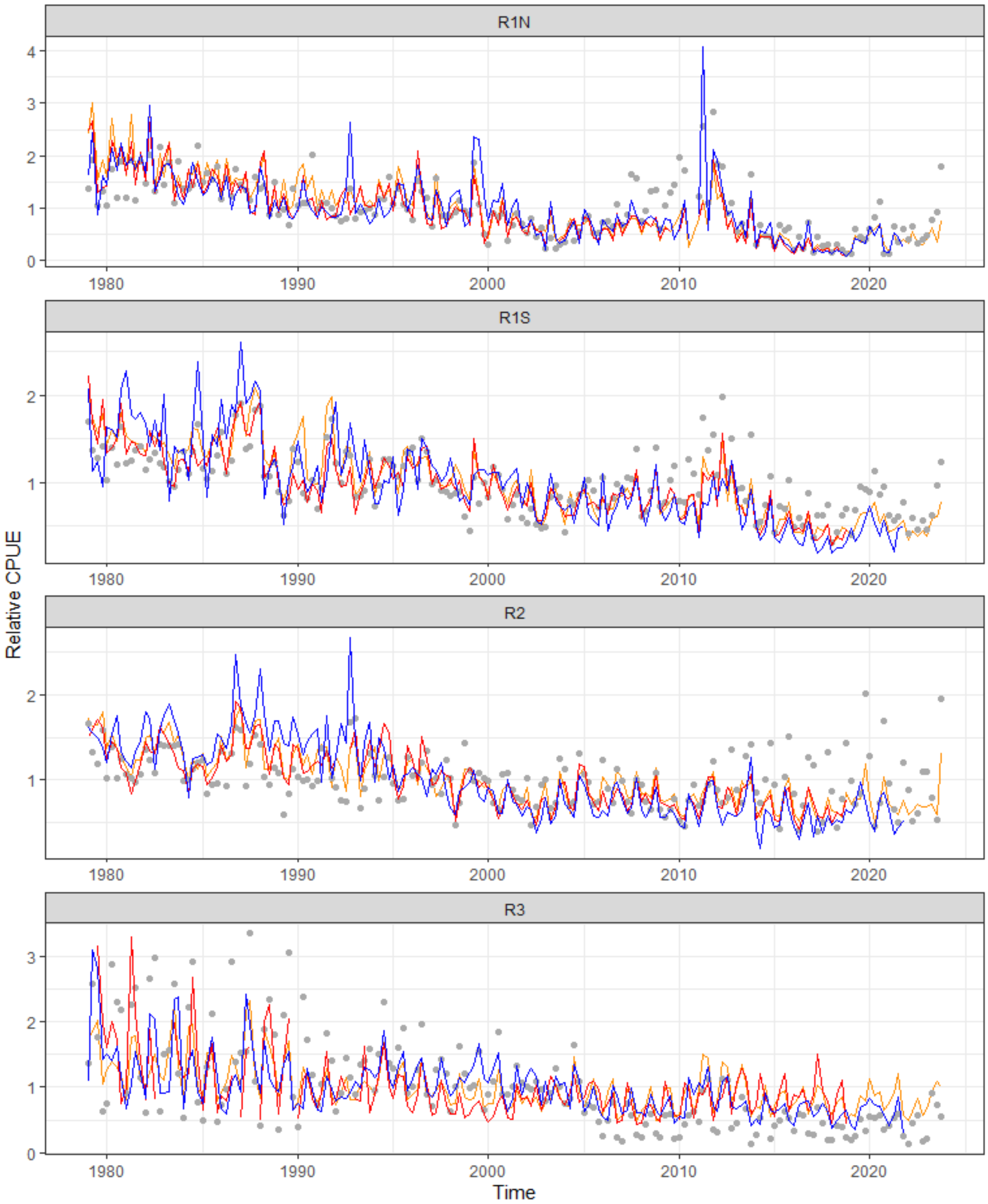

Figure 3. Comparison of quarterly, region-wise standardized CPUEs (with red, blue, and orange lines representing the 2019, 2022, and 2025 analyses, respectively, and dots indicating nominal CPUEs).