Skipjack Management Procedure Estimation Method: Japanese Pole-and-Line (JPPL) CPUE WCPFC-SC21-2025/MI-WP-01

SCIENTIFIC COMMITTEE
TWENTY-FIRST REGULAR SESSION
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Background

- SKJ management procedure (MP) adopted in 2022 (CMM2022-01).
- Regional Japanese Pole-and-Line (JPPL) CPUE: a key input to the estimation method in SKJ MP.
- Key points raised:
  - Differences in JPPL CPUE inputs between 2022 dry run and 2023 MP run.
  - Transition from VAST to sdmTMB for geostatistical CPUE standardisation.
  - Ongoing data degradation due to spatial contraction of the JPPL fishery in equatorial areas.

Objectives

To assess the reliability of the skipjack Management Procedure(MP):

- Discrepancies in JPPL CPUE inputs
  → *Understand and reconcile discrepancies in CPUE time series used in the 2022 dry run and 2023 MP runs.*

- Transition from VAST to sdmTMB
  → *Evaluate its impact on MP performance.*

- Spatial contraction in the equatorial JPPL fishery
  → *Test robustness of the MP to this data degradation in the equatorial regions via simulation analysis.*

Discrepancies in JPPL CPUE inputs

Two main sources of discrepancy were identified:

1. Application of the penalty.
2. Application of sea surface temperature (SST) filter.

Penalty is derived from the time-varying coefficient of variation (*CV*) output of the geostatistical model.

	Catch-Errors Model	Catch-Conditioned Model
Equation	Penalty= 1/(2*CV^2)	Penalty = SE
Relationship	CV ↓ Penalty ↑	CV ↑ Penalty ↑
Model Example	EM in the tested SKJ MP	2022 SKJ stock assessment

Highlights the challenges of conducting a stock assessment and a MP run in the same year.

Discrepancies in JPPL CPUE inputs

Two main sources of discrepancy:

1. Application of the penalty.
2. Application of sea surface temperature (SST) filter.

The tested MP incorporated SST both as **a covariate** and as **a spatial filter**, using only biomass from grid cells with SST ≥18 °C to construct the abundance index.

In contrast, the 2022 dry run applied SST only as **a covariate**.

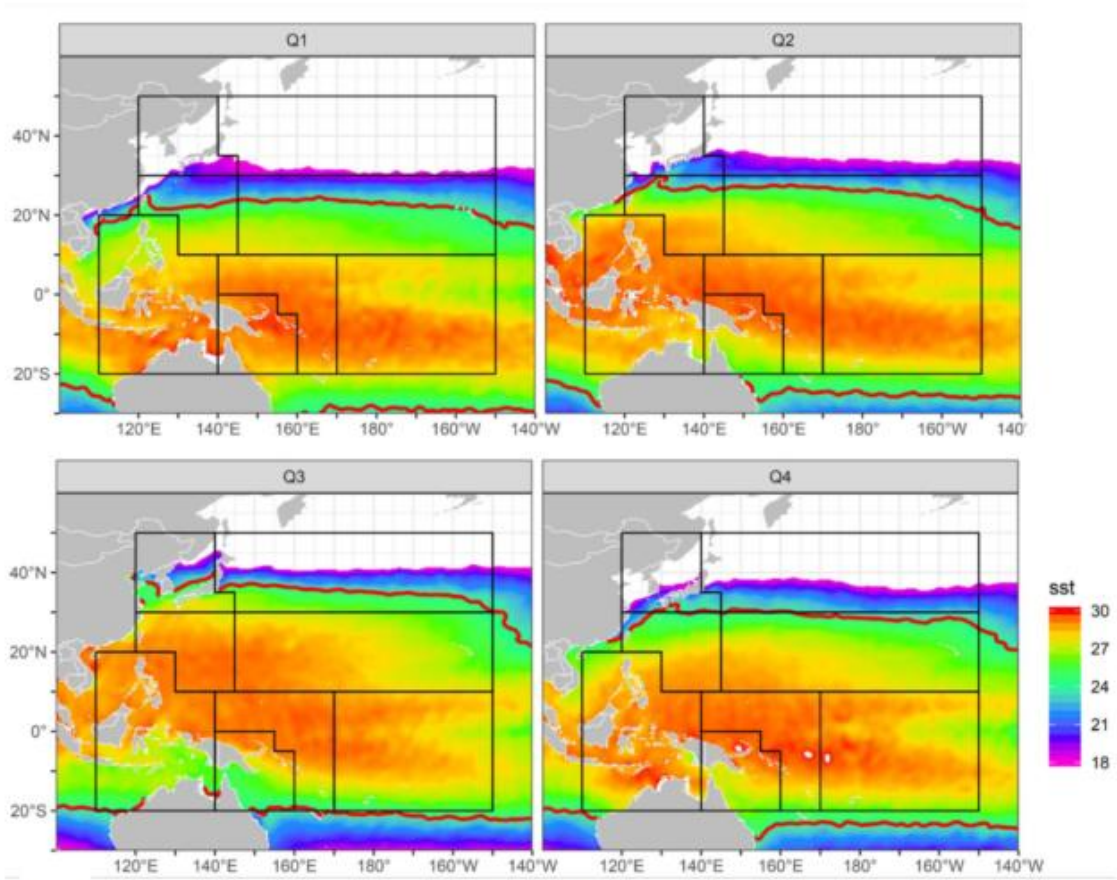
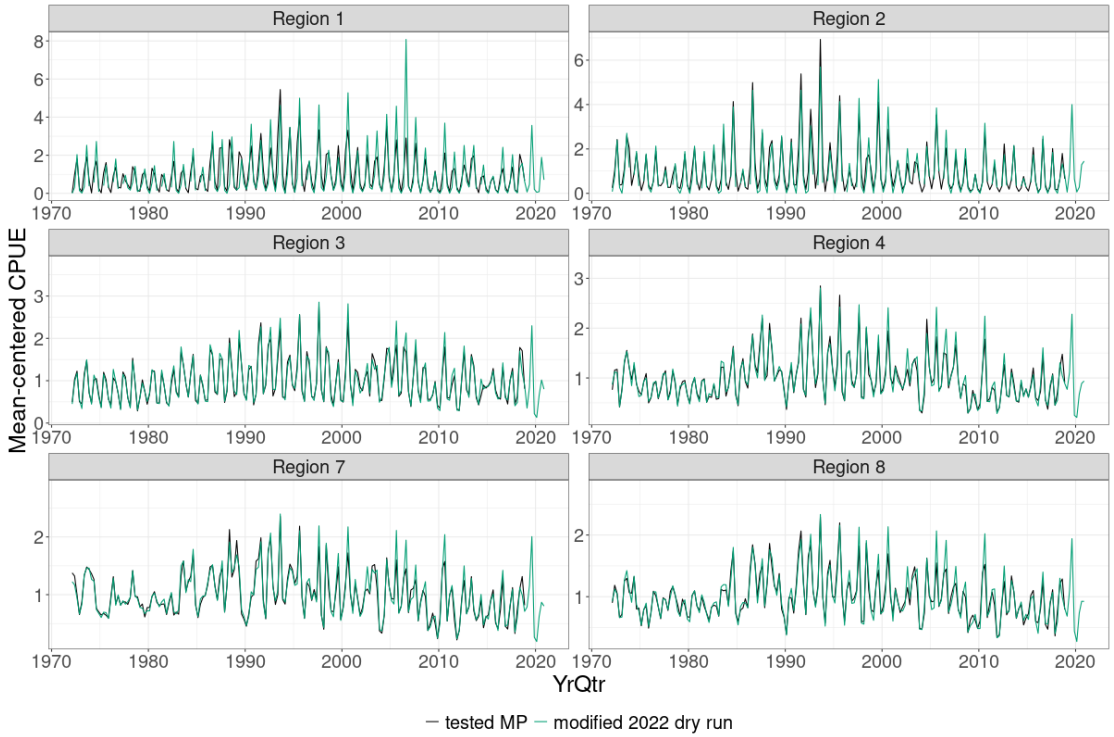
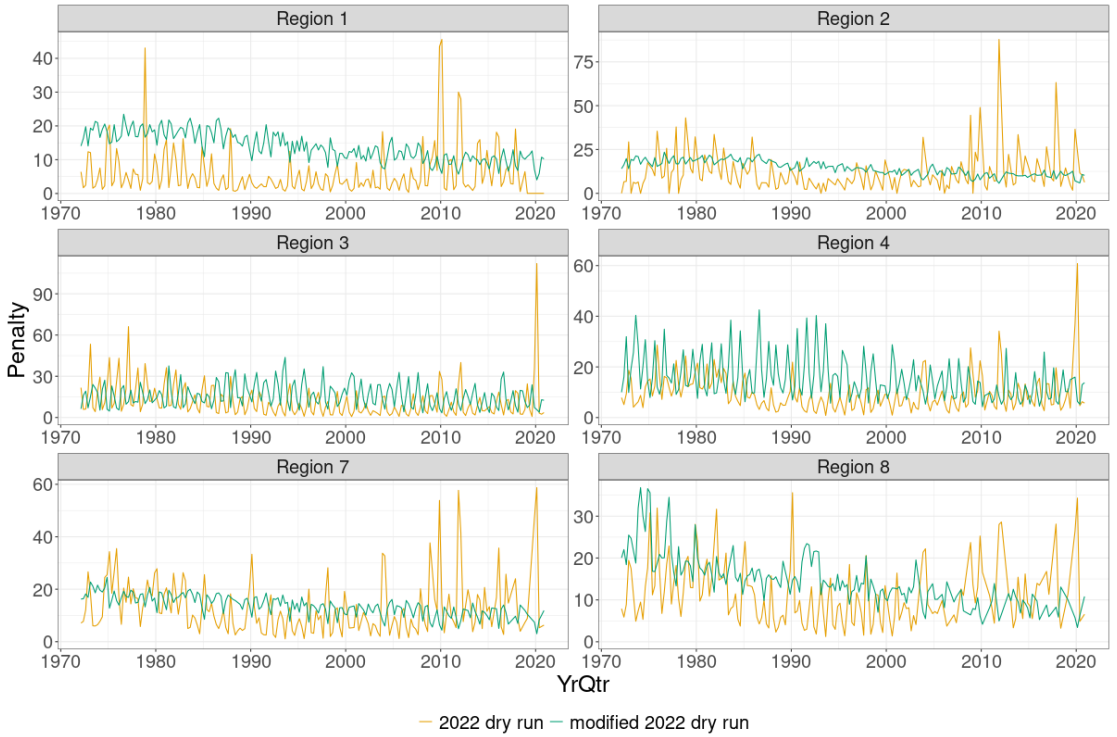


Figure 5: Thermal habitats based on sea-surface temperature (SST, °C) for skipjack by quarter in the Western and Central Pacific Ocean (WCPO).

Discrepancies in JPPL CPUE inputs





Transition to sdmTMB

- Motivation of the transition: VAST limitations (dependencies, reproducibility).
- The **2025 stock assessment** used **sdmTMB** to standardise JPPL CPUE indices.
- **sdmTMB results** were similar to those from VAST (SC21-SA-IP-05).
- However, CPUE standardisation in the MP should remain **consistent** with the method adopted in the **original tested MP**.
- Therefore, it is important to **test the impact of switching to sdmTMB** by running the MP with sdmTMB-based indices.

Transition to sdmTMB

Standardisation settings and post-processing steps for JPPL CPUE used in the skipjack estimation method

Model Setting	Description
Model Type	Spatiotemporal delta-lognormal generalized linear mixed model (delta-GLMM)
Spatial Knot Configuration	A mesh with 285 knots
Model Equations	Encounter probability: $p_i \sim \text{Year} + \text{Month} + \text{VesselID} + \omega_1(x_i) + \phi_1(x_i,t_i) + \text{Class} + \text{NumPoles} + \text{grt} + s(\xi_1)$ Positive catch rate: $c_i \sim \text{Year} + \text{Month} + \text{VesselID} + \omega_2(x_i) + \phi_2(x_i,t_i) + \text{Class} + \text{NumPoles} + \text{grt} + s(\xi_2)$
Implementation Platform	sdmTMB version 0.6.0 (R packages)
Environmental Filtering	SST filtering applied quarterly; retains only grid cells with SST > 18°C.
Normalisation Method	CPUE values mean-centered based on absolute values
CV Rescaling Method	Mean CV set to 0.2; all CVs rescaled relative to this level
Penalty Term Calculation	Penalty terms applied as $2 \times \sqrt{CV}$

Spatial contraction of JPPL

- JPPL effort has contracted in equatorial Regions 7–8 in recent years.

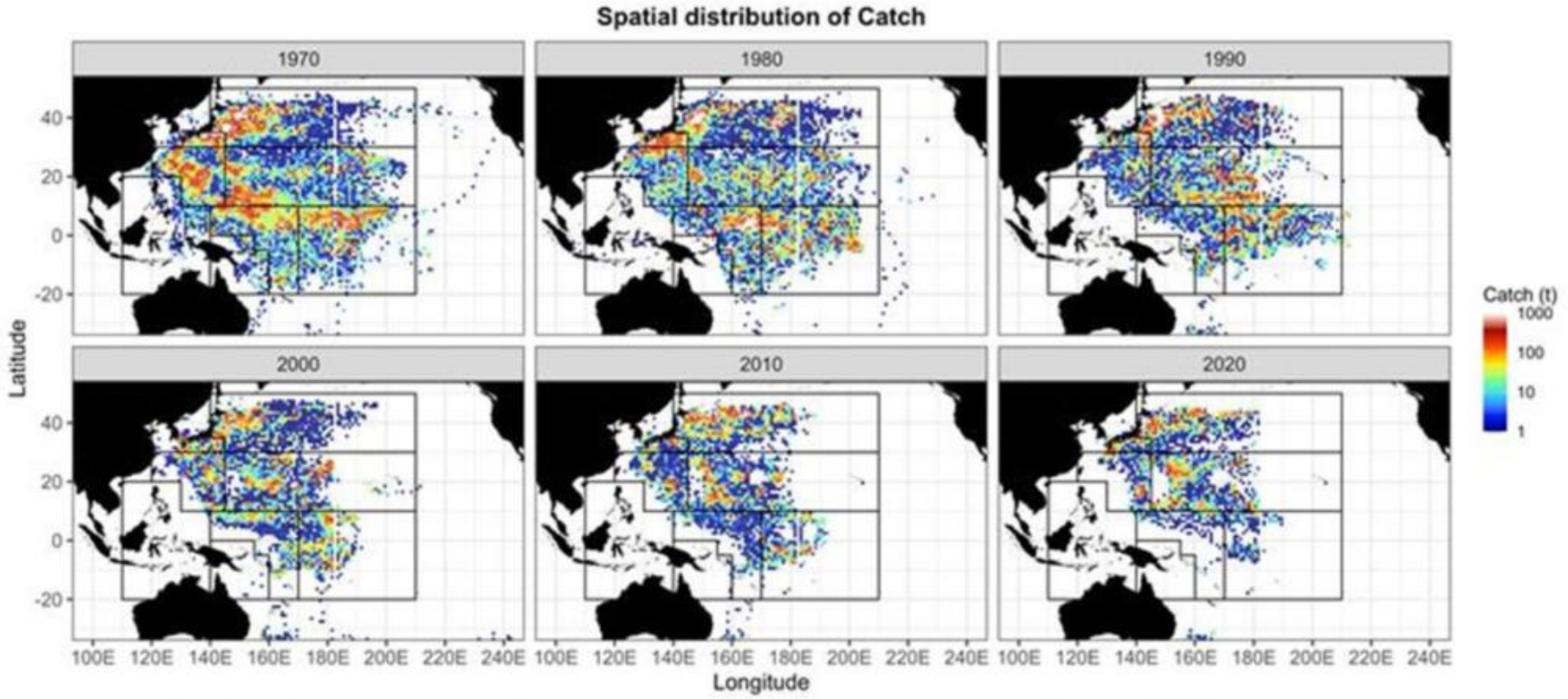
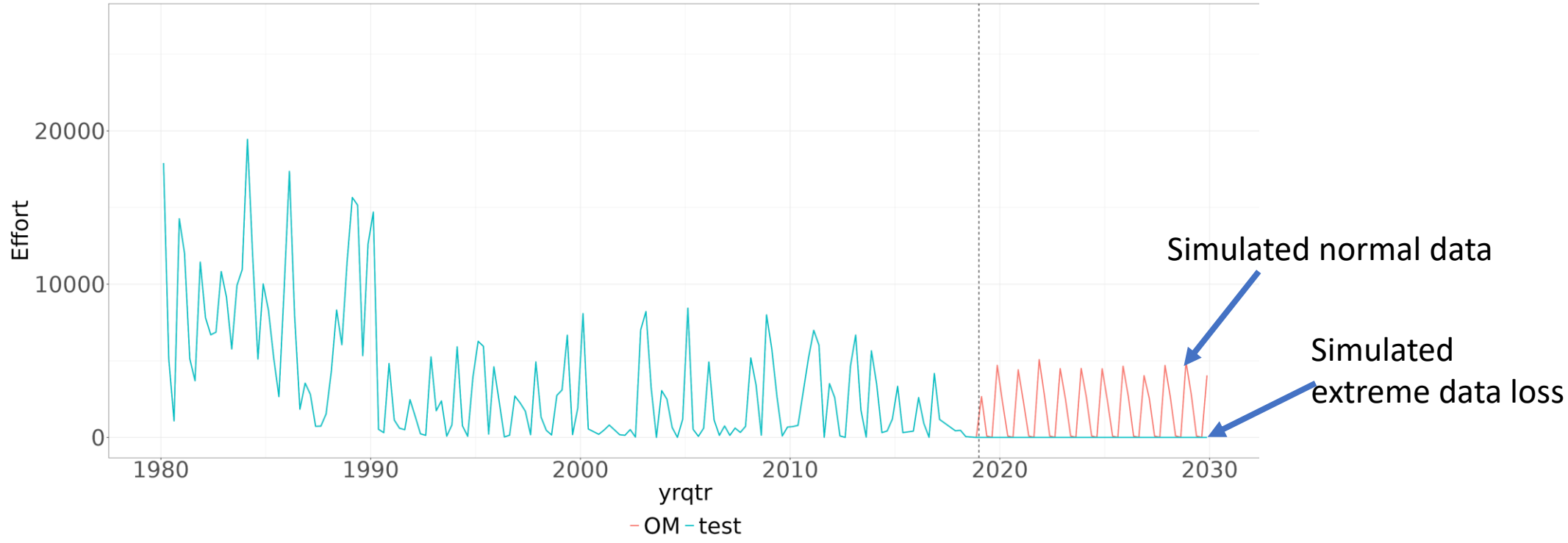


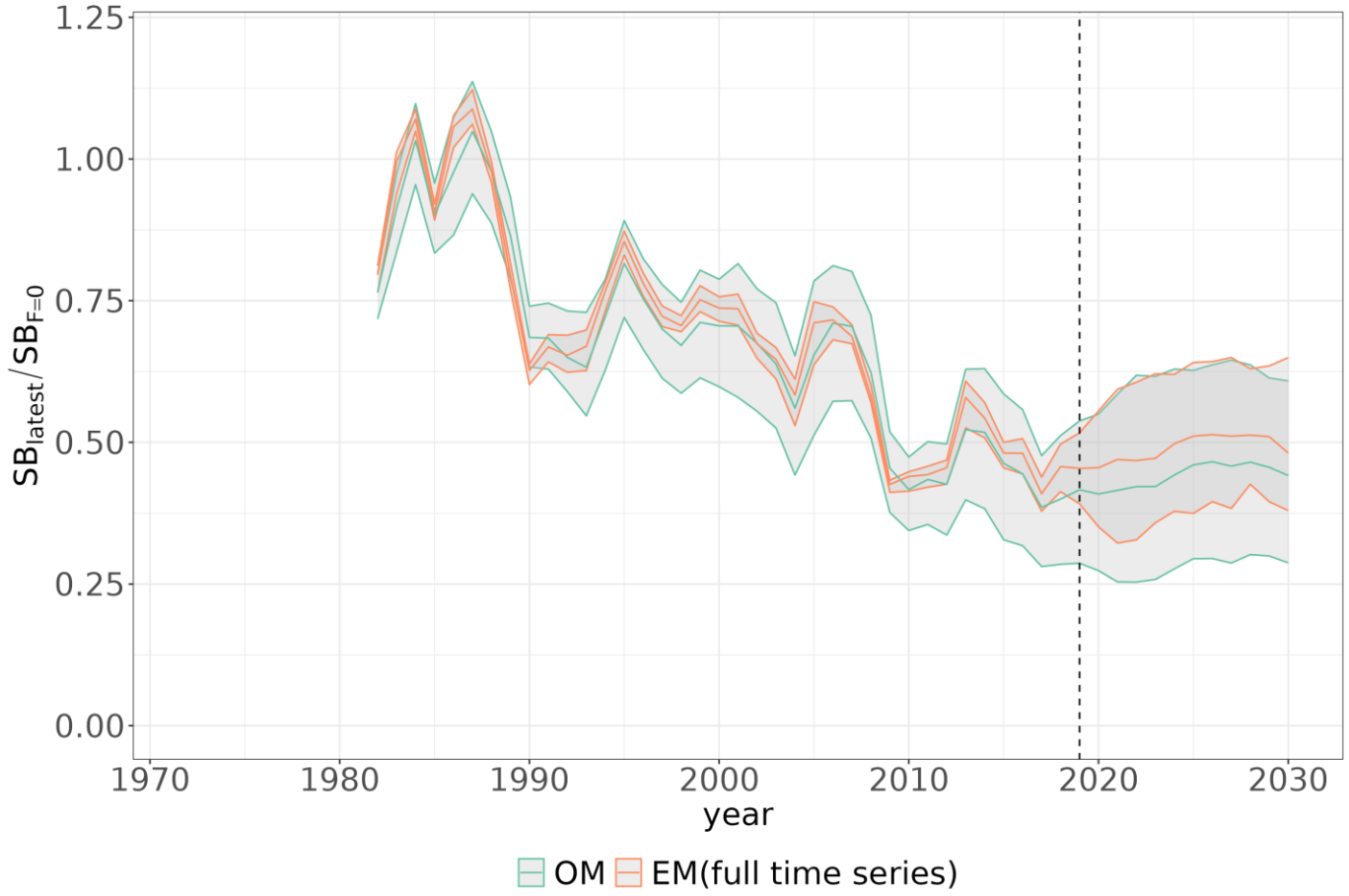
Figure 2. Decadal shifts in spatial distribution of Japanese pole-and-line (JPPL) fishery skipjack catch (metric tons) from 1972 to 2023. Each map shows the catch for each decade.

Spatial contraction of JPPL

- Simulated extreme loss of CPUE data in the future (see example below).
- 3, 6, 9 years of missing data tested.
- Under three fishing level: high (1.5 x sq), status quo (SQ) and low (0.5 x sq)



Simulation Results



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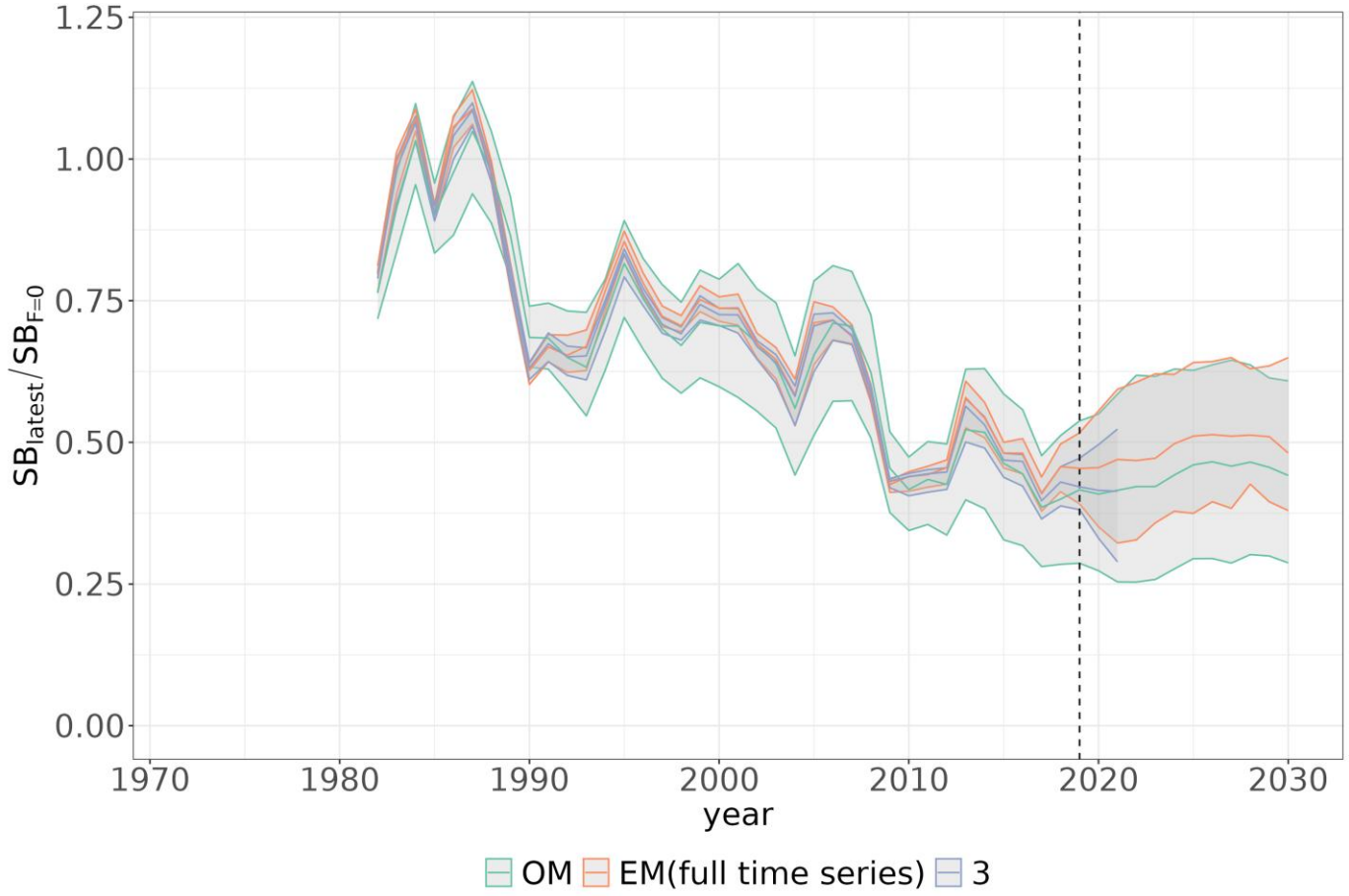

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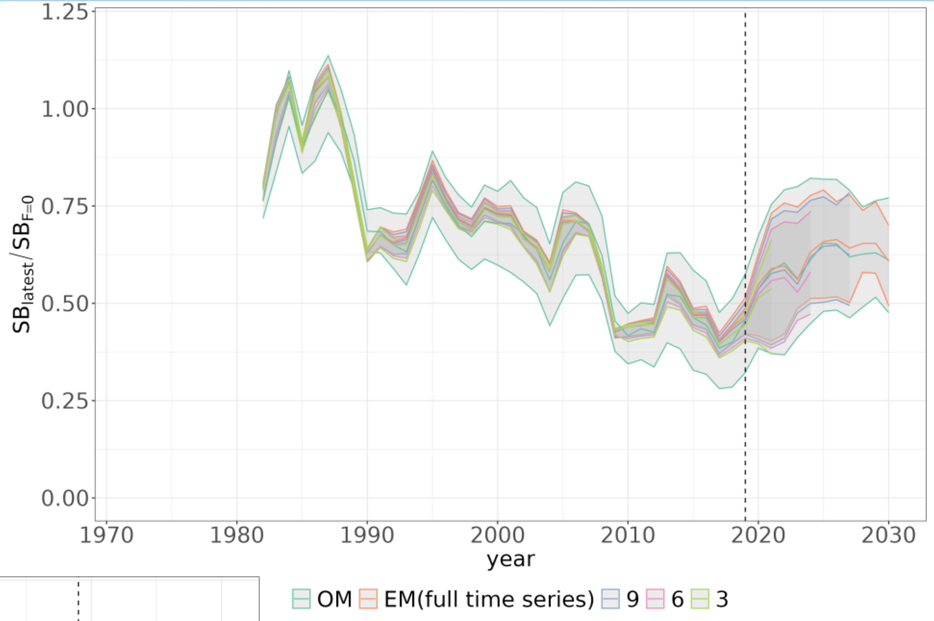

Discussion and Recommendation

- Key discrepancies between the 2022 dry run and the 2023 MP run:
  (1) Incorrected penalty formula, and
  (2) Application of the SST spatial filter.

- Support transition to sdmTMB.
- Recommendation setting for standardise JPPL CPUE for future SKJ MP.

- The MP appears reliable in the short term under JPPL data degradation but presents increased long-term risks.

Future Work & Alternatives

- Consider alternate estimation methods:

- Purse seine (PS) CPUE

- Spatiotemporal tag models

- Ecosystem-based models (SEAPODYM)

- All alternatives will require reconditioning of the MSE framework and extensive testing.

Invite SC to

- Note the results of the investigation of the JPPL CPUE time series.
- Support the continued use of the adopted skipjack MP for the next implementation cycle.
- Note that settings used to develop standardised CPUE indices should be included within MP documentation for all relevant WCPFC management procedures.
- Provide guidance on alternative abundance indices or inputs for longer-term MP development.