

Progress on the Pacific saury SS3 model in 2026

NPFC SWG PS MSE 08

October 2026

Quang Huynh



www.openmse.com

Background

- The seasonal SS3 population model was presented at SSC PS 16 in December 2025 (NPFC-2026-SSC PS16-WP07)
- A table of updated specifications was developed in Annex E of SSC PS 16 report
- At SWG NSAM 2026-02 (July 2026), the working group:
 - Reviewed model specifications
 - Explored sensitivity analyses and various model diagnostics to explore behaviour of the model
 - Updated specifications and diagnostics
- Next step is model update at SSC PS 17 (December 2026) and present revisions at SSC PS 18 in January 2027

Background

The assessment is a reconstruction of the biological population that best explain the fishery and survey data. Potentially, we can also try to estimate productivity and density-dependence to establish MSY reference points.

The model requires a description of:

- Biology of individual cohorts: growth, maturity, natural mortality of cohorts
- Representativeness of data: assumptions about catchability and hyperstability of the CPUE, i.e., whether time series are representative of relative changes in abundance over time

For management use, the model should have also good diagnostic behaviour & predictive ability, with:

- Minimal retrospective patterns
- Hindcast ability to explain out-of-sample data (indices of abundance)

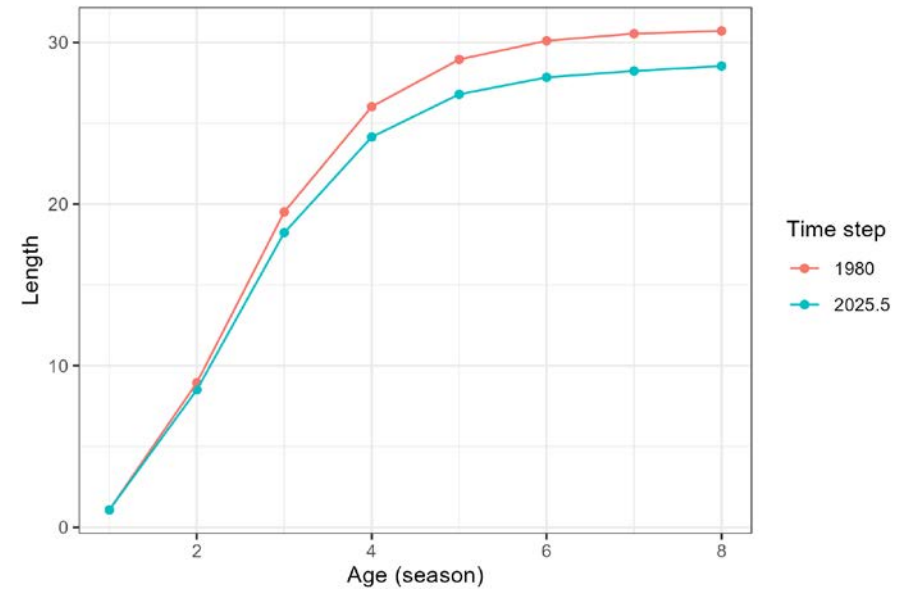
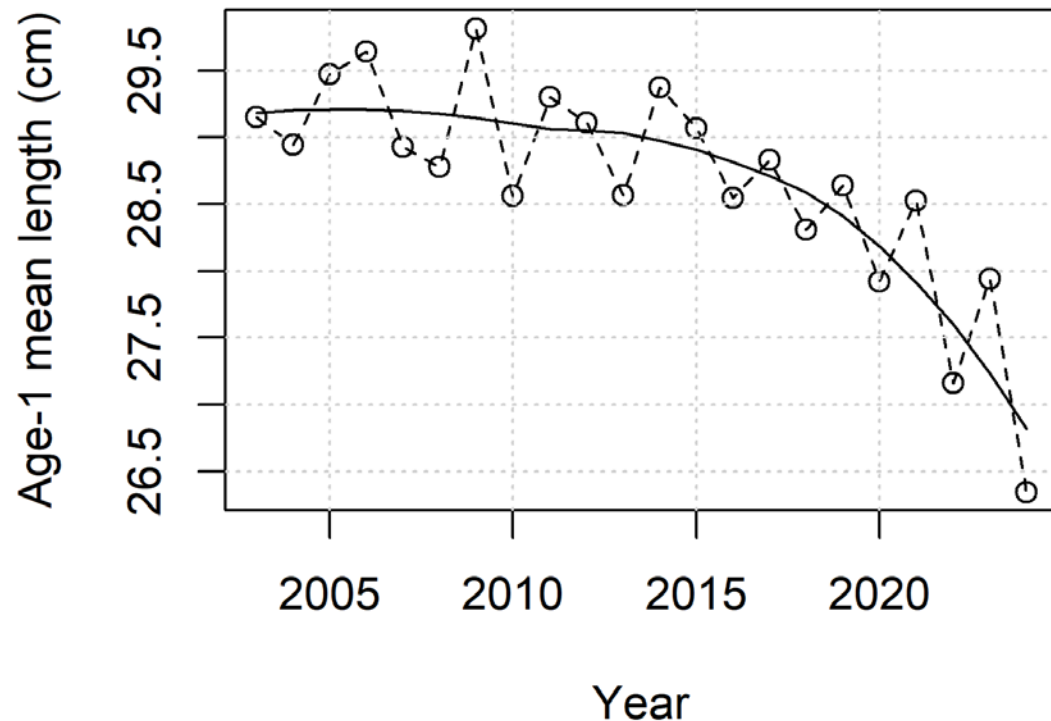
SSC PS 16 – Annex E

Annex E: Summary of SS3 specification for models presented at SSC PS16, and future modeling plans		
Feature	Current Approach	Suggested Changes
Fishery catch	- Members' seasonal catch and seasonal length composition - RUS comps not used, assume JPN selectivity	
Fishery CPUE	- Members' annual standardized CPUE assigned to season 4 - Separate JPN-early (pre-1994) and JPN-late series	- Assign JPN CPUE to season 4 - Assign CHN, CT, RUS, and KOR CPUE to season 3 - Sensitivity model with joint CPUE (selectivity based on historical catch composition by Members)
Surveys	- Age-aggregated fishery-independent index of abundance with length composition	
Spatial considerations	- None, single area model	- Potential fleets as area-seasons approach, lower priority
Selectivity	- Asymptotic function estimated for all fleets and surveys	
Model time step	- Seasonal, model start in 1980	
Catchability (q)	- Linear biomass-index relationship - Catchability prior for biomass scale - Hyper-stability parameter estimated for CPUE - Q walk for JPN-early CPUE	- Q change in CT series in 2011
Variance weighting	- CPUE downweighted ($\lambda = 0.2$) - McAllister-Ianelli method for length composition	
Natural mortality (M)	- $M = 2.18$, sensitivity model with $M = 1$ (both age-independent)	- Sensitivity models with $M = 1, 1.5, \text{ or } 2$ - Age-varying M - Model post-spawning mortality at end of 2 year lifespan

Steepness (h)	- Fixed at 0.82	- Sensitivity models with $h = 0.6, 0.7, 0.8, 0.95$ - Estimate with prior from Hsu et al. (2024)
Recruitment timing	- Beginning of season 1, 2, and 4	
Growth	- Time-varying asymptotic length from survey length-age data	
Growth variability	- Estimated to fit length composition	
Maturity	- Constant ogive (logistic inflection at 25 cm)	- Seasonal maturity ogive
Fecundity	- Proportional to weight	- Update from batch fecundity and spawning frequency data
Environment	- No environmental information in model	- Explore relationships between recruitment, growth with environmental indices outside model

Biology - growth

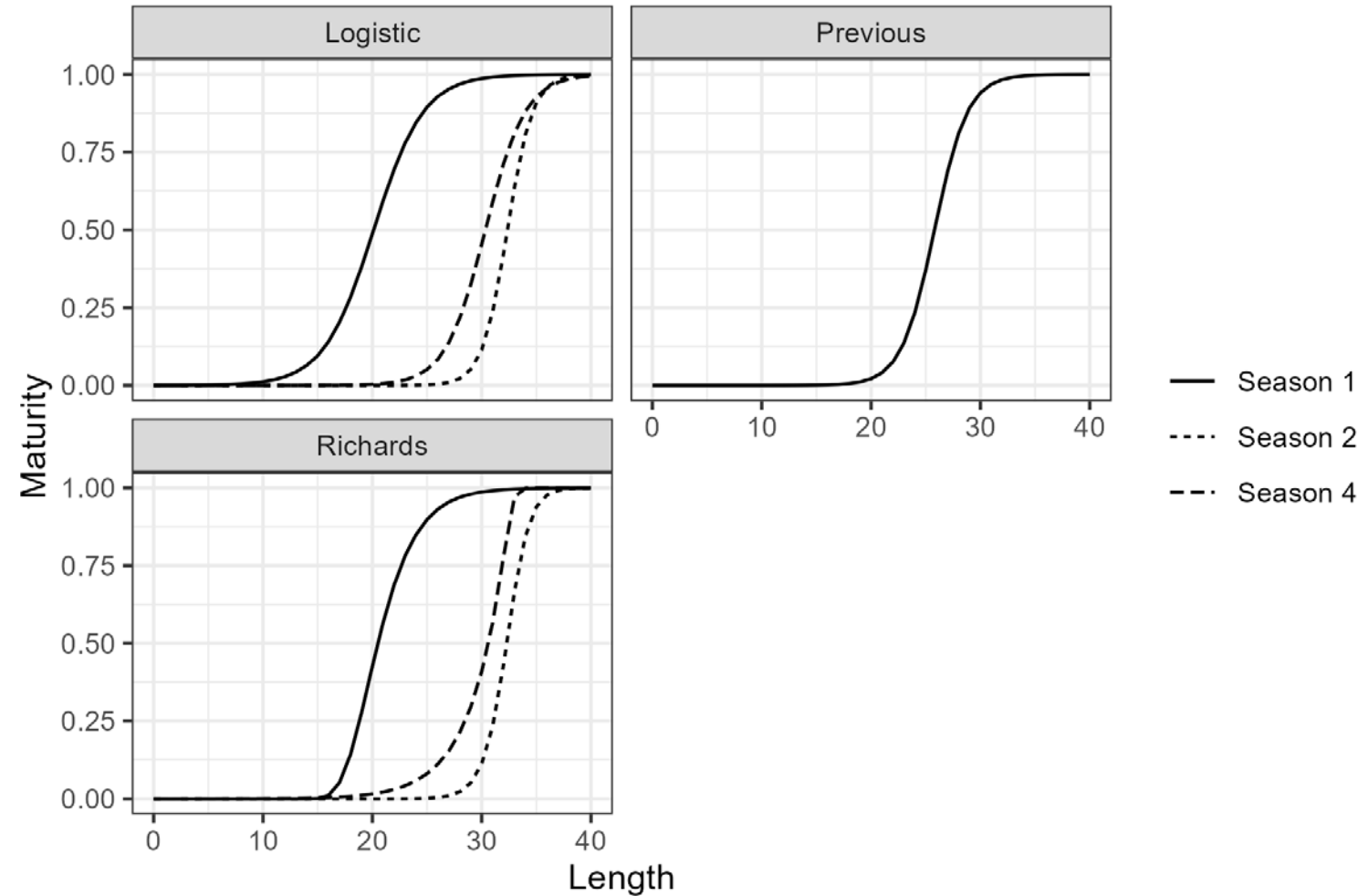
- Growth: Use Gompertz growth function from NPFC-2024-SSC PS14-WP05 (1980-2002)
- Recent change in asymptotic size informed by reduction in average size of age-1 fish in survey (2003-2024)
- Changes in average size were helpful to fit the length composition data



Comparison of growth time series in SS3 version 3.30.25

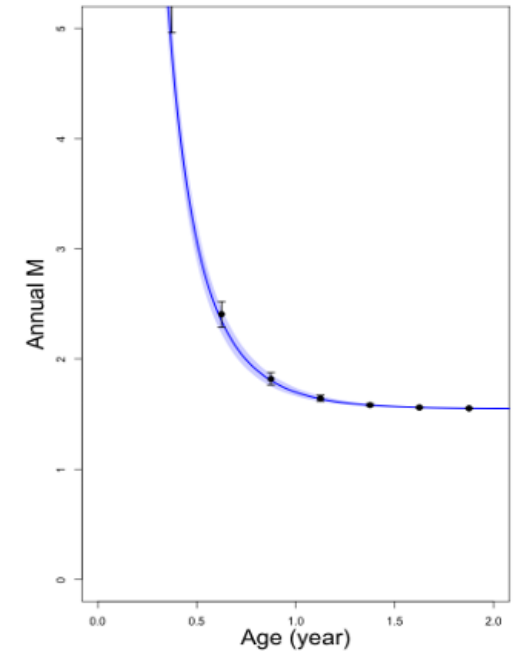
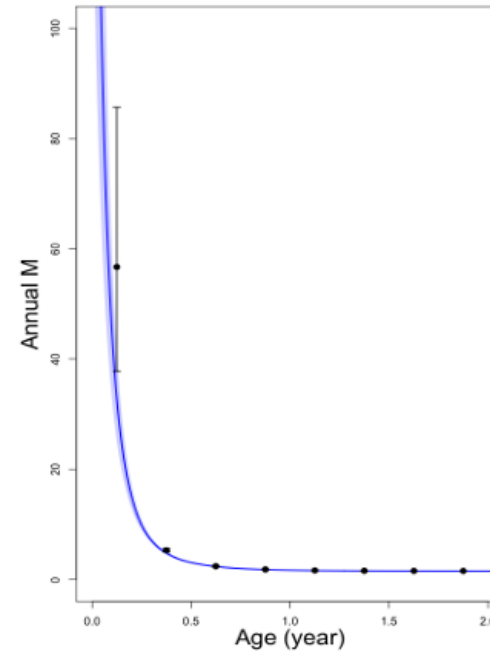
Biology - maturity

- Seasonal maturity parameters provided by Japan at SWG NSAM 01
- Most spawning occurs in season 1 (50% maturity at 20 cm)
- Less spawning in seasons 2, 4
- SWG NSAM determined that SS3 model should have seasonal varying maturity (best fidelity to biological dynamics)
- SS3 supports seasonal logistic maturity parameterization



Biology – natural mortality

- Natural mortality is not estimated directly for Pacific saury (or most species!) but we can use meta-analysis from other species to predict values from other covariates, e.g., longevity or size
- At SWG NSAM 01, we developed an age-dependent relationship for natural mortality predicted from size (Charnov 2013)
- Predictor not used for the first 3 months of cohort lifespan (beyond the observed data used in meta-analysis)
- We model early survival through the stock-recruit relationship
- Post-spawning mortality at end of lifespan



season	Range (year)	M_point estimate	2.5%tile	97.5%tile
1	0–0.25	56.71	37.75	85.69
2	0.25–0.5	5.309	4.96	5.643
3	0.5–0.75	2.407	2.288	2.521
4	0.75–1	1.819	1.765	1.876
5	1–1.25	1.643	1.618	1.671
6	1.25–1.5	1.582	1.571	1.596
7	1.5–1.75	1.561	1.556	1.567
8	1.75–2	1.553	1.551	1.556

Estimability of hyperstability parameters

In previous SS3 models, the hyperstability parameter for Members' CPUE was estimated based on the behaviour of fishing vessels. This describes the extent to which CPUE is resistant to change when population size changes.

However, this is not typical practice, as proportionality of CPUE to population trends is foundational to stock assessment.

High correlations were found in the estimates, indicating that hyperstability could not be estimated well. Sensitivity analysis indicated that the hyperstability parameters had little impact on diagnostic performance.

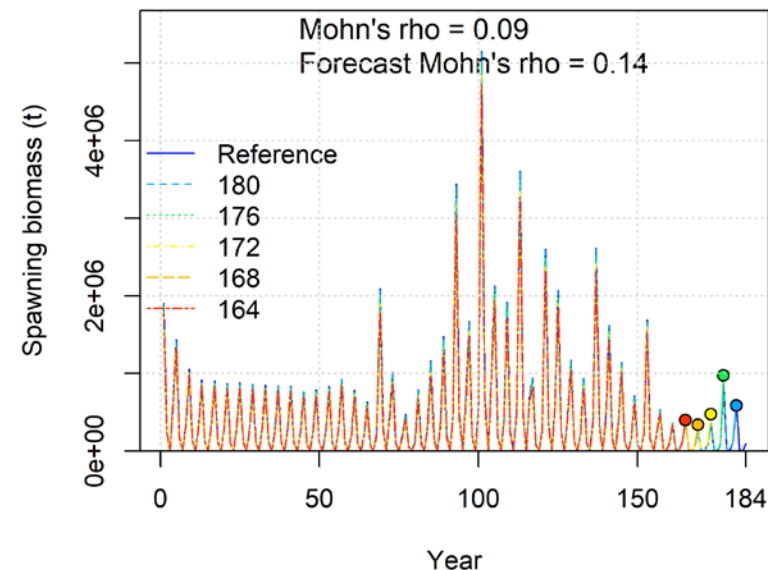
The WG determined that the hyperstable parameter should be fixed ($\beta = 1$)

Uncertainty in the representative of individual CPUE series is addressed through alternative time series, i.e., joint CPUE

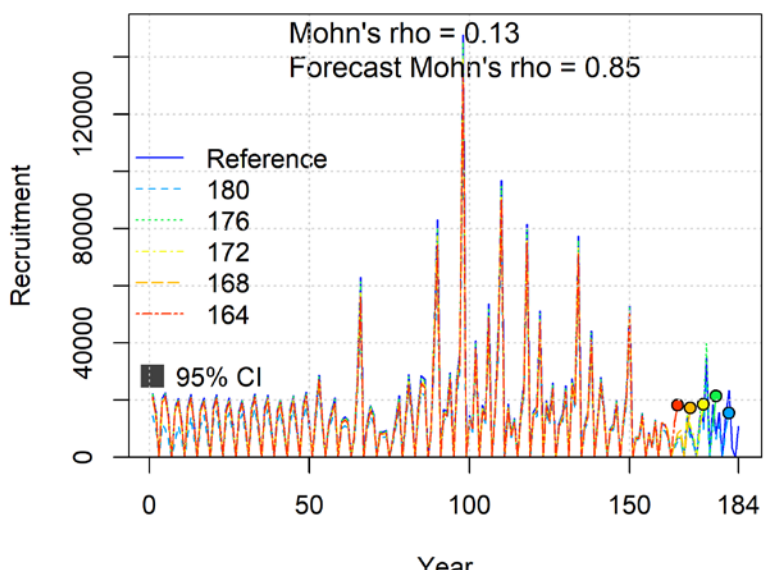
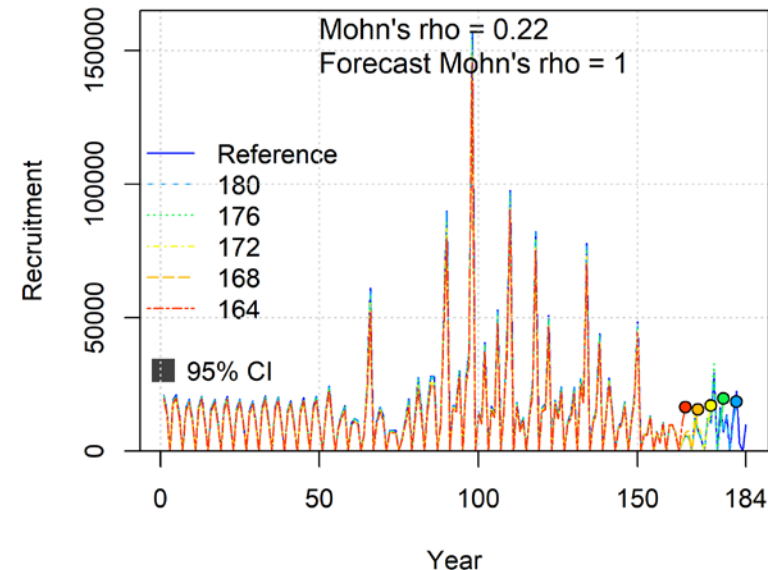
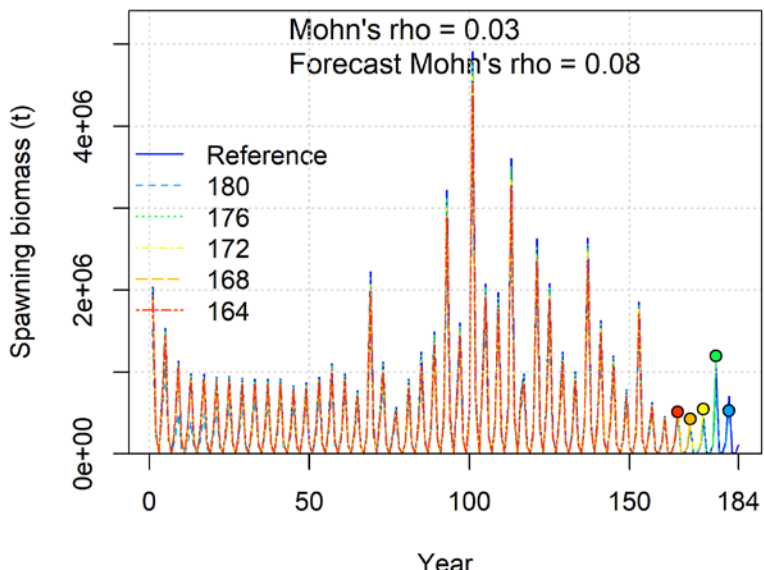
Hyperstability profile

Improved retrospective patterns with seasonal maturity

Beta = 0.7

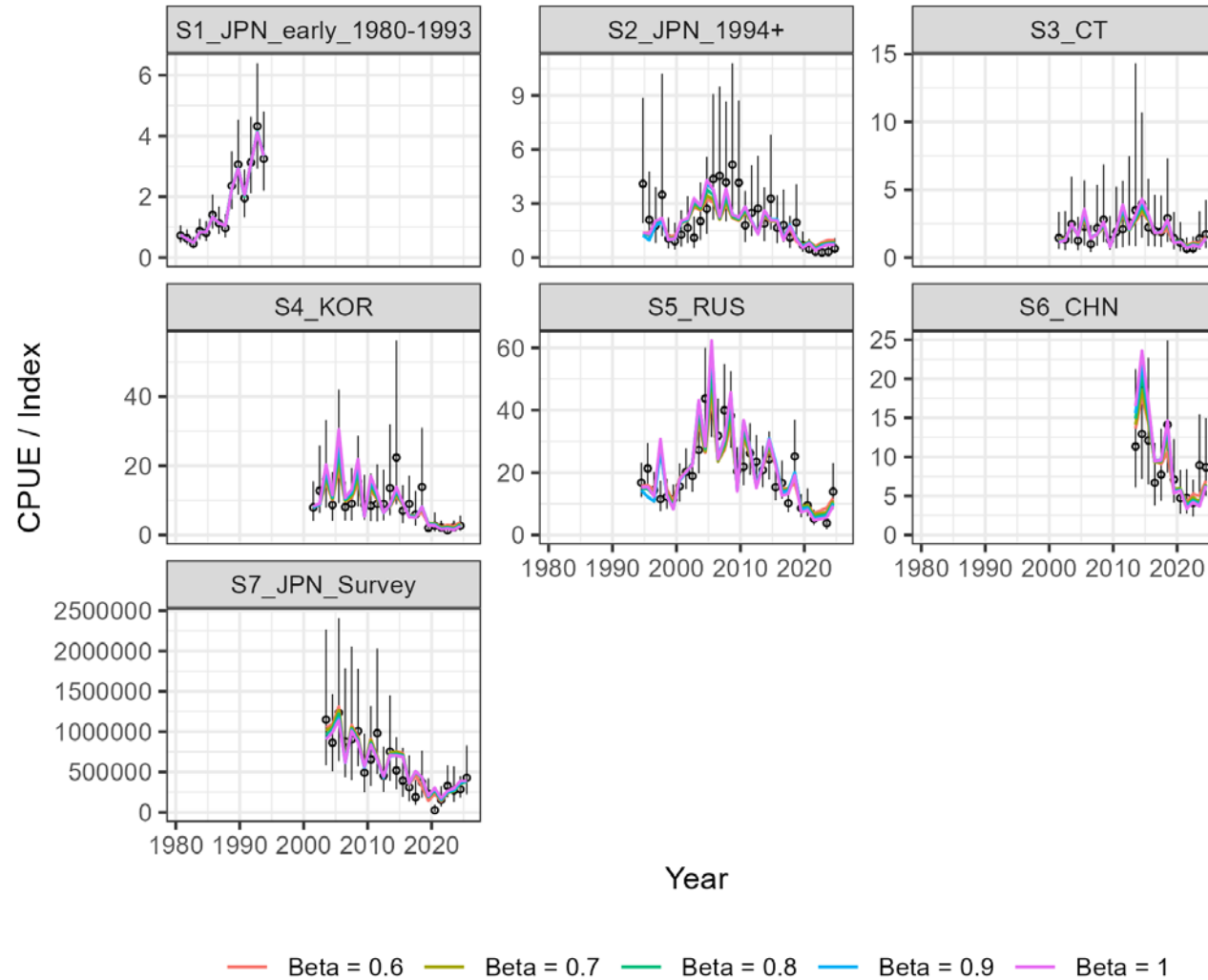


Beta = 1



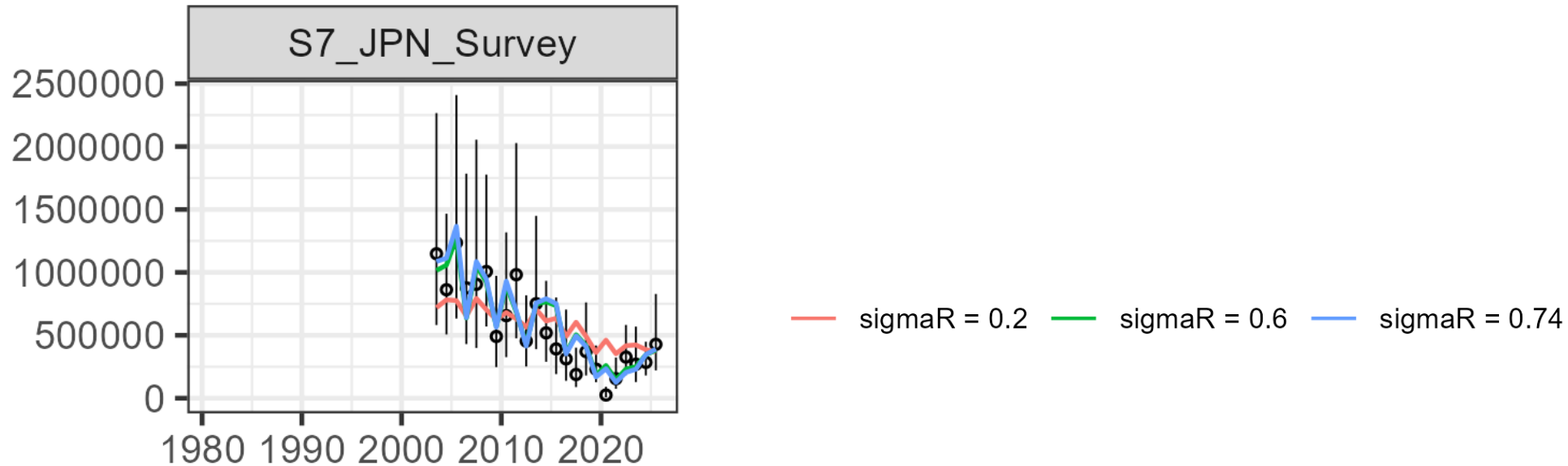
Hyperstability profile

No obvious change in fit to CPUE likely indicates inability to estimate hyperstability



Other model explorations during SWG NSAM 02

- Profile of sigmaR determined that high recruitment variability is needed to explain historical data
- This behaviour is confirmed by the ASPM diagnostic.
- Need high sigmaR to estimate decline in survey (high recruitment to low recruitment cannot be explained by stock recruit relationship)
- Not a surprise, Pacific saury is a recruitment-driven species. WG chose sigmaR = 0.74, based on a meta-analytic prior by Thorson et al. (2014)



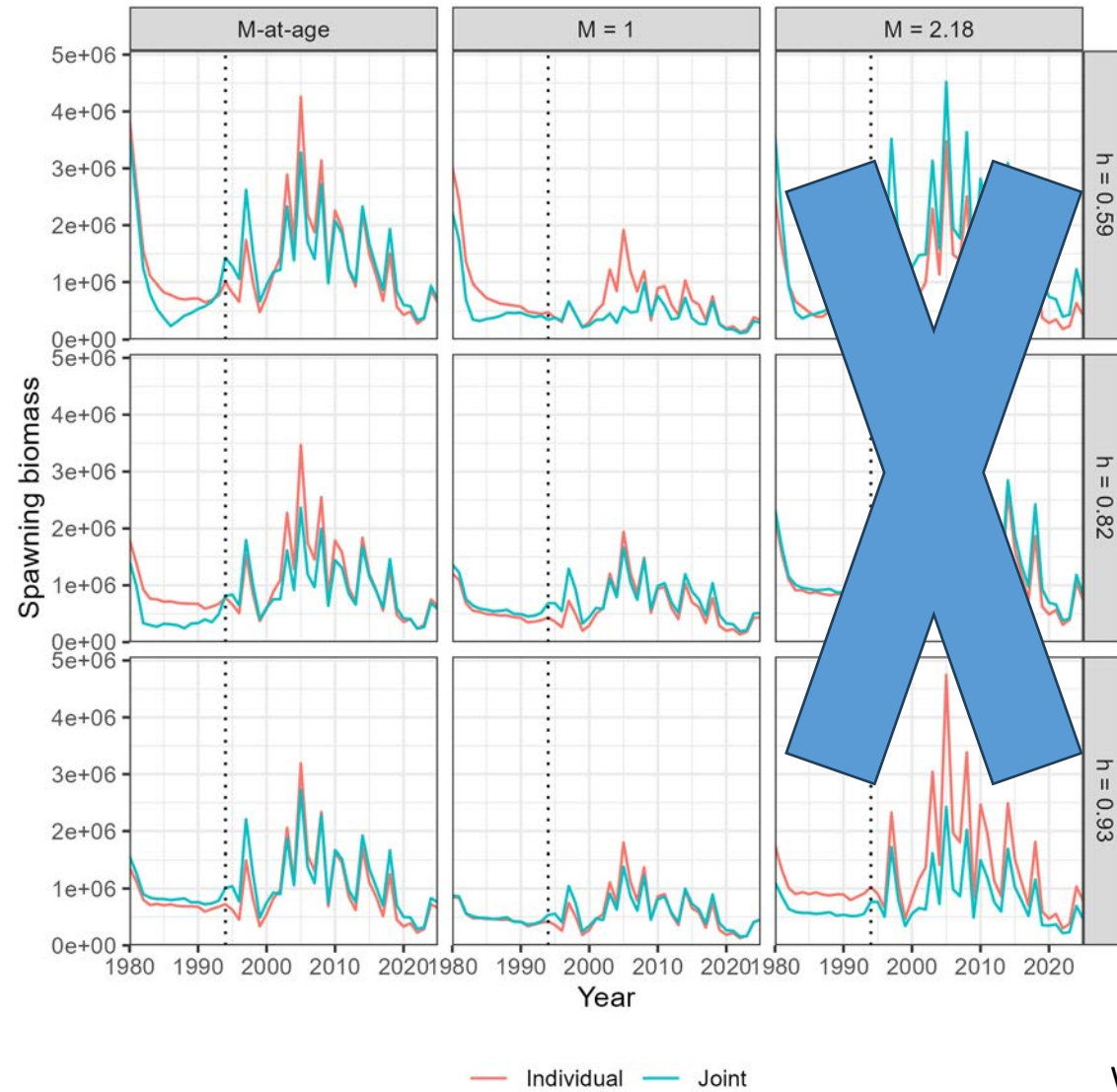
Model grid approach

Important biological parameters such as steepness of the stock-recruit relationship and natural mortality determine productivity of population and reference points but are un-observed and uncertain

Therefore, a multiple model approach is planned to present a grid of models that vary in:

- Steepness (3 levels): $h = 0.59, 0.82, 0.93$
- Natural mortality (2 levels): $M = 1$ and 1.5 (varying with age, other values deemed less plausible)
- Index of abundance (2 levels): Fitted to individual members' CPUE or joint CPUE (single time series using catch & effort of all members)

Model grid approach



WG deemed $M = 2.18$ to be implausible

Next steps

- The seasonal SS3 population model was presented at SSC PS 16 in December 2025 (NPFC-2026-SSC PS16-WP07)
- A table of updated specifications was developed in Annex E of SSC PS 16 report
- At SWG NSAM 2026-02 (July 2026), the working group:
 - Reviewed model specifications
 - Explored sensitivity analyses and various model diagnostics to explore behaviour of the model
 - Updated specifications and diagnostics
- Next step is model update at SSC PS 17 (December 2026) and present revisions at SSC PS 18 in January 2027

Some thoughts for SWG MSE PS

The grid of models developed during SWG NSAM can serve as the first set of operating models for the MSE, to evaluate the robustness of management procedures against alternative states of nature

Best practices with the MSE approach require agreement on one set of data to calculate catch advice. Currently, the model grid uses two sets of indices (individual members and joint CPUE)

I would not recommend use of SS3 in the management procedure right now

- Feasibility: Simulation testing of SS3 in MSE may not be feasible. The simulation may fail when fitting to simulated datasets in the closed-loop projection.
- Automation: MSE evaluates fixed algorithms to calculate catch advice, including the assessment configuration. We don't know if the assessment configuration will change over time
- Communication: Is it possible to succinctly describe the SS3 model? Is it preferable to evaluate simpler procedures to communicate with a broad audience?