Pacific saury SS3 assessment: Exploration and diagnostics after WGNSAM

NPFC SSC PS 15

September 2025

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Agenda

1. Status and follow-up after WGNSAM II
2. Diagnostics (retrospective, profiling, etc.)
3. Forecast for annual TAC calculation in seasonal model
4. Discussion

Status after WGNSAM II

- Conversion to the preferred seasonal model. Annual time step is too large to adequate model lifespan and spawn timing. Seasonal model has better fit to time-aggregated length composition

- Presented suite of model diagnostic tools: retrospective analysis, hindcast, and profiling of stock-recruit parameters (steepness and R0)

- Still need to fit recent declines in mean length in fishery size composition
- Initial speculative models (Step21) were presented
- Length-age data from Japanese survey provide insight to model reduction in growth?

Status after WGNSAM II

Outstanding issues:

We need to:

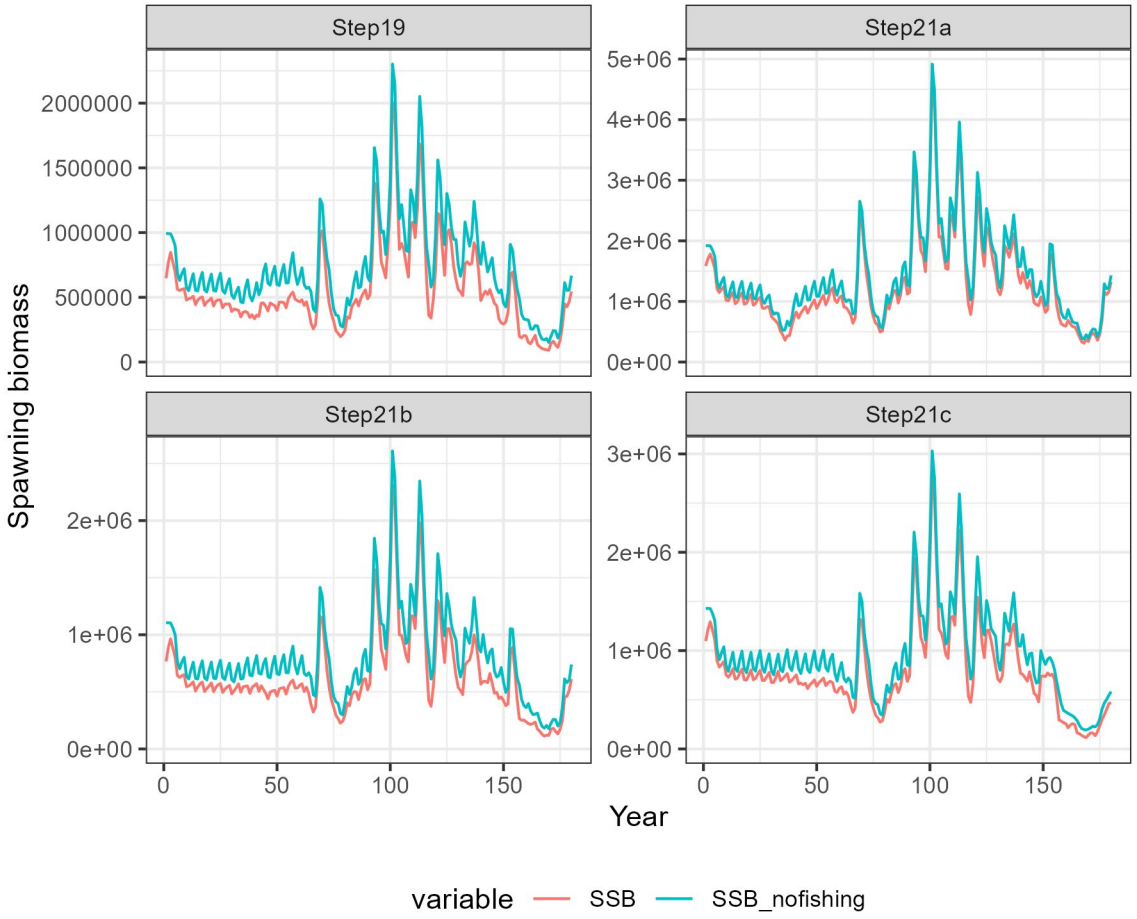
- Understand why the spawning biomass is close to unfished dynamic SSB (implies lightly fished stock)

- Identify model structure with good diagnostic behaviour

- Identify set of reference and sensitivity models
  - Plan is to present these models at SSC 16 in December with data update
  - Including age-aggregated survey index with size data, which informs model on relative catchability of age-0 to age-1 (not available with age-specific index)

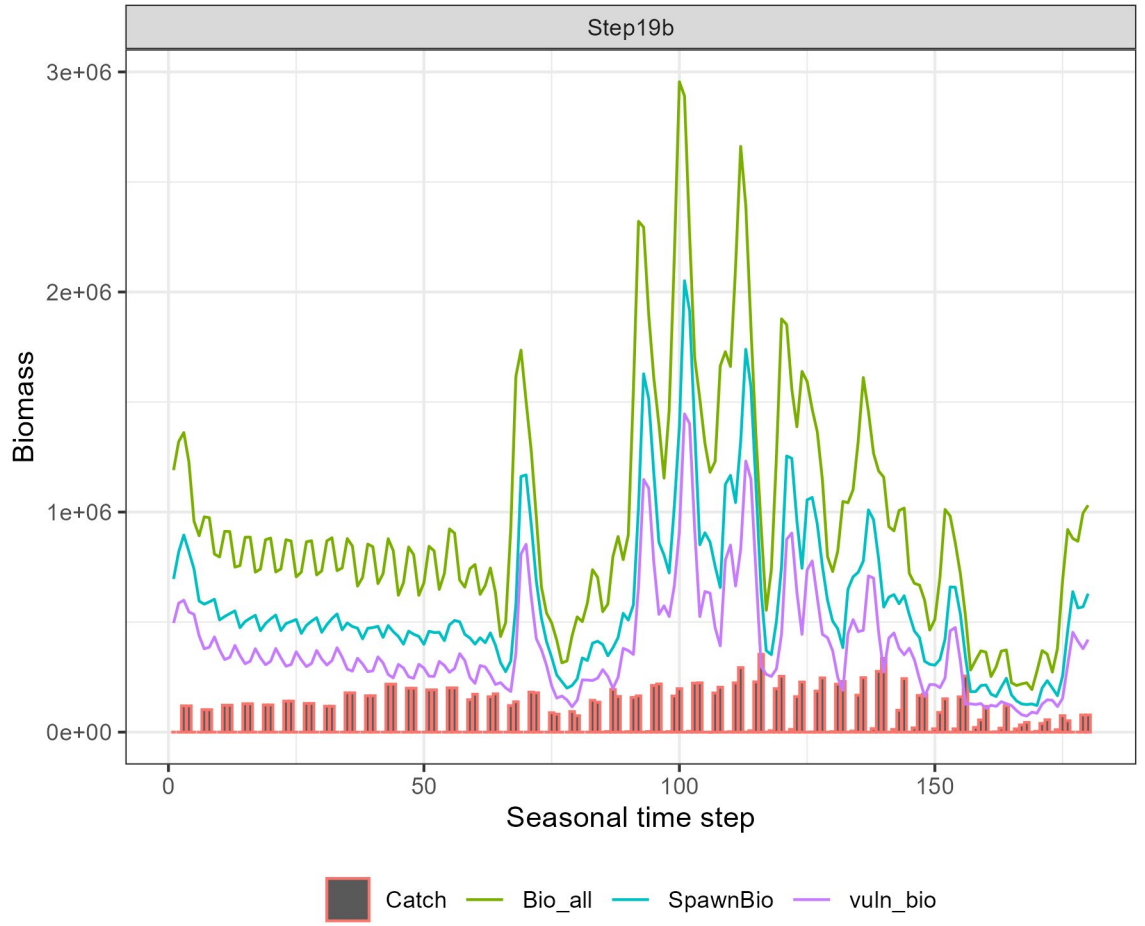
Dynamic unfished spawning biomass

- The estimated spawning biomass (red) is close to the hypothetical reconstructed unfished biomass (blue), implying that the exploitation rate is low



Biomass comparison

- The estimated stock size is large relative to the catches
- With short lifespan, changes in population are predicted by recruitment, not exploitation.
- There is no other information on depletion, e.g., age structure truncation



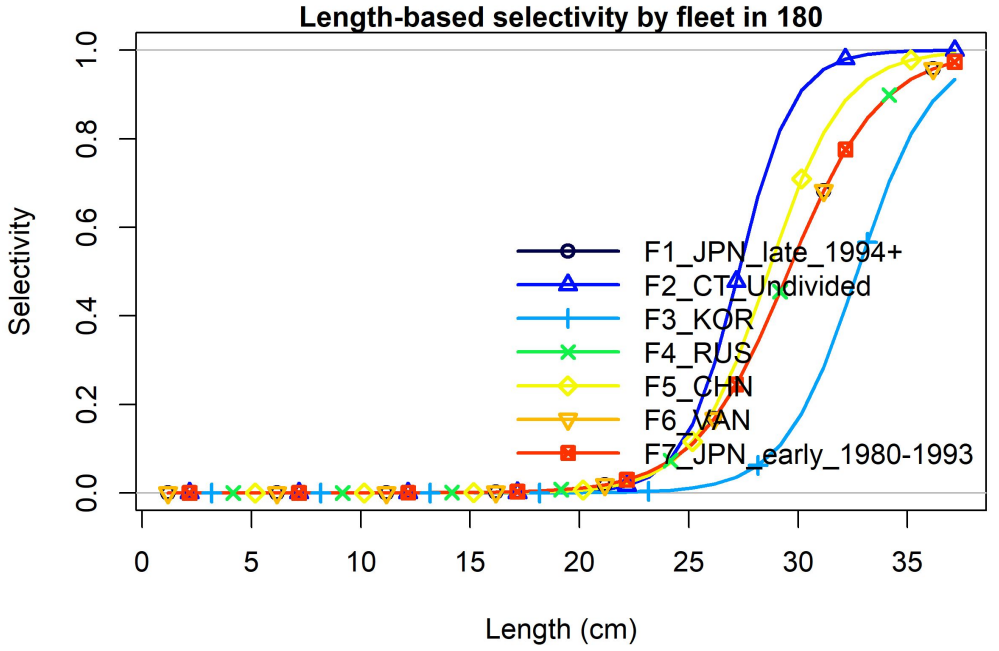
** Vulnerable biomass in the middle of the season
** Total and spawning biomass at the beginning

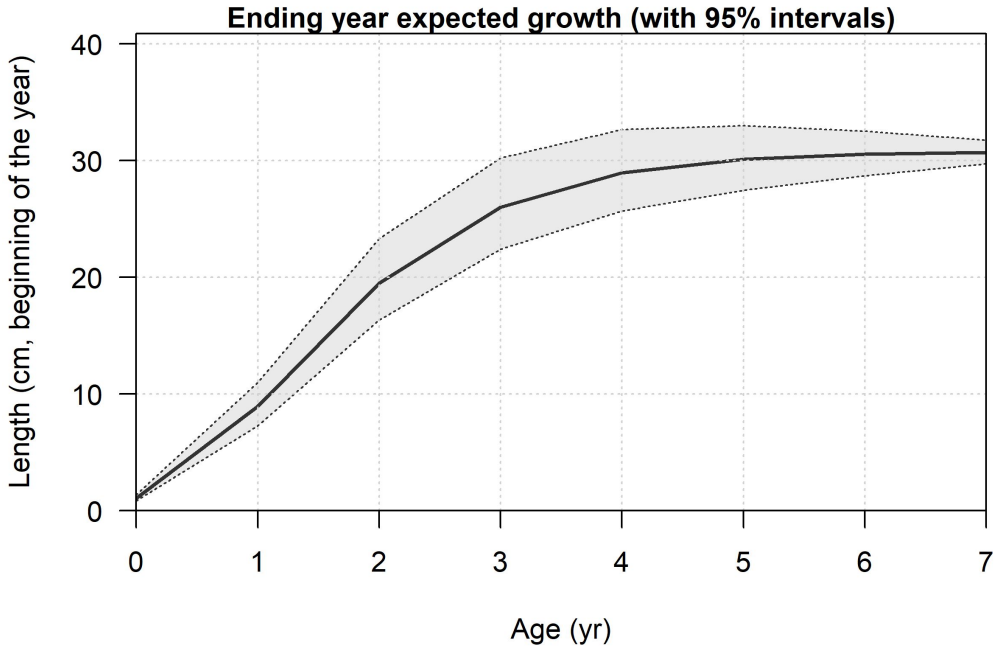
Selectivity

- I believe the model has difficult estimating population scale, because size of full selectivity is close to the asymptotic length

- This behavior will be evident in some of the diagnostics

- The model needs lots of old, large fish to fit to length composition, leading to very large stock size in general





Diagnostics for acceptance of assessment models

1. Can the model reliably estimate parameters?

- **Jitter analysis** explores stability of optimization from different starting values of parameter
- **Bayesian MCMC** integrates over parameters to characterize uncertainty. Do maximum likelihood and Bayesian posterior estimates agree?
- **Likelihood profiling** indicates whether important parameters can be estimated and informed by the data

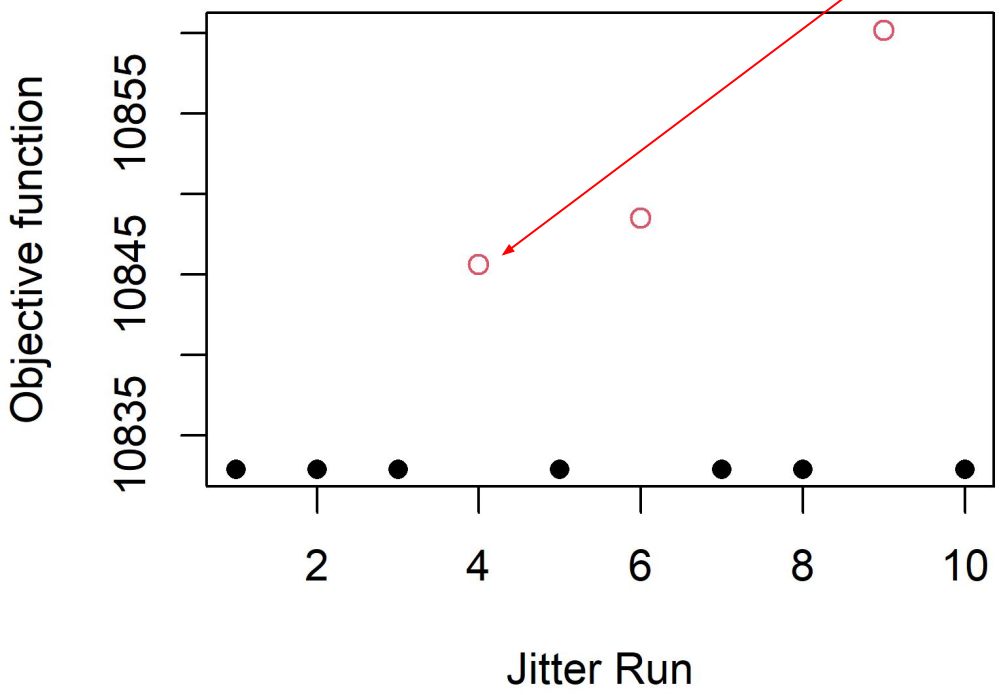
2. Does the model have good predictive ability?

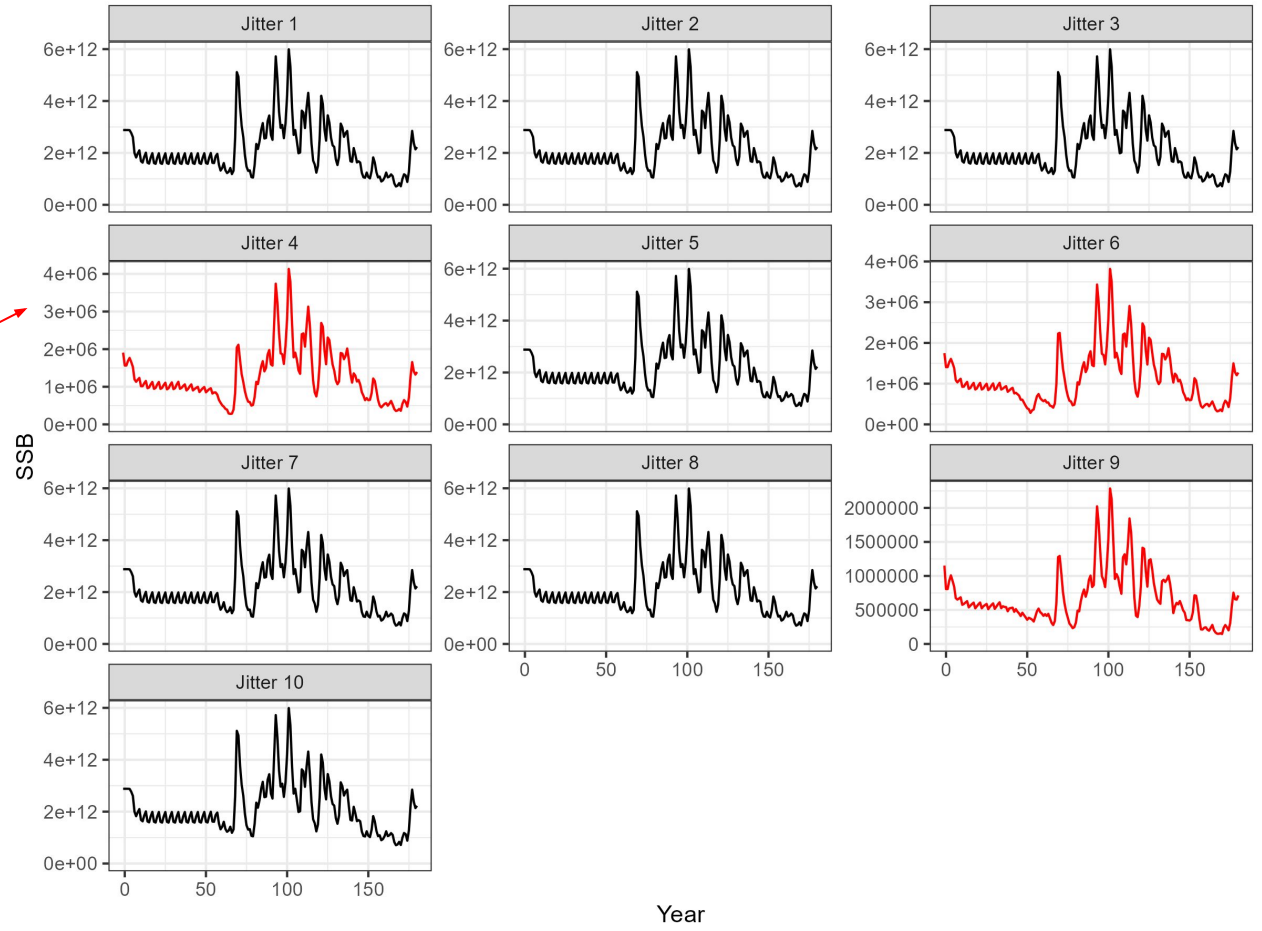
- **Retrospective analysis** indicates whether biomass estimates are stable with new data
- **Hindcasting** complements retrospective analysis to determine whether past projections would have been consistent with real data

Jitter analysis

Step19b model with slight adjustments at WGSNAM, e.g., survey timing, exclude CPUE fits)

- Previous reported magnitude of population is in order of 10^6 t (millions of tonnes)
- Compare with catch (~200,000 t) and index from Japanese survey (up to 500 kt or 500,000 t)
- However, this is not the optimal solution to objective function that fits the data

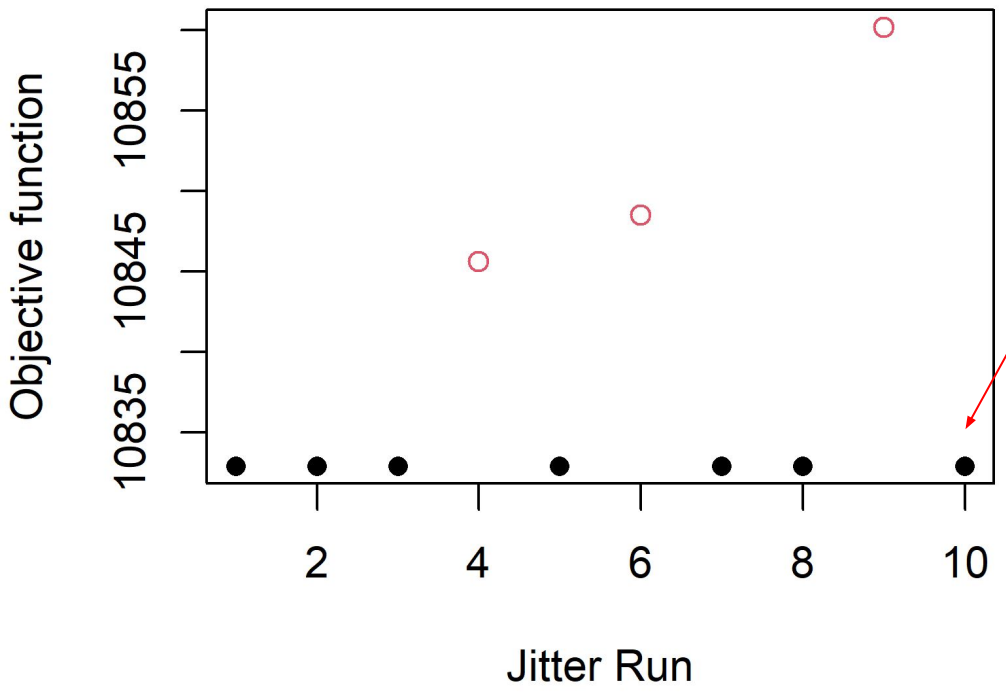


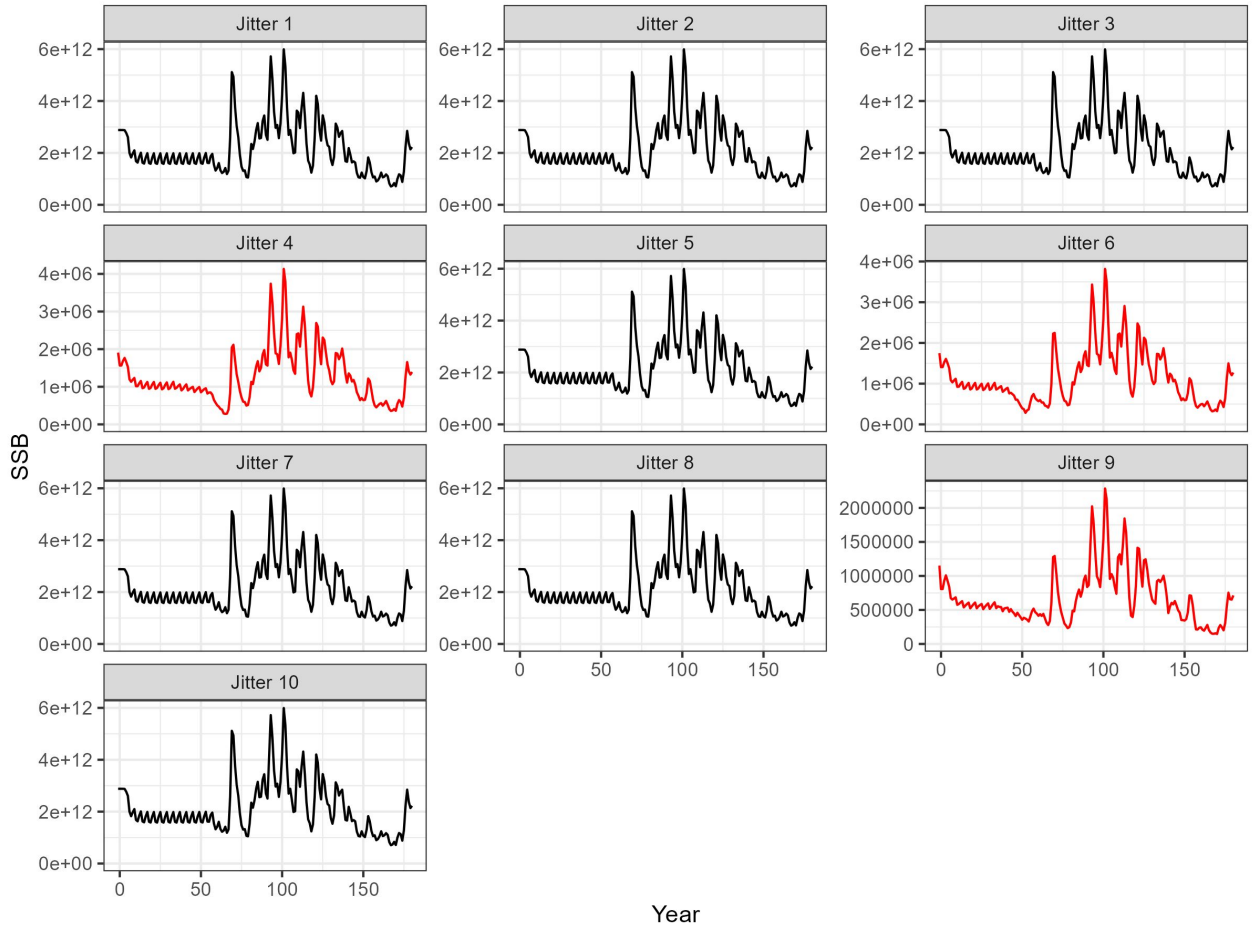


Jitter analysis

Step19b model with slight adjustments at WGSNAM, e.g., survey timing, exclude CPUE fits)

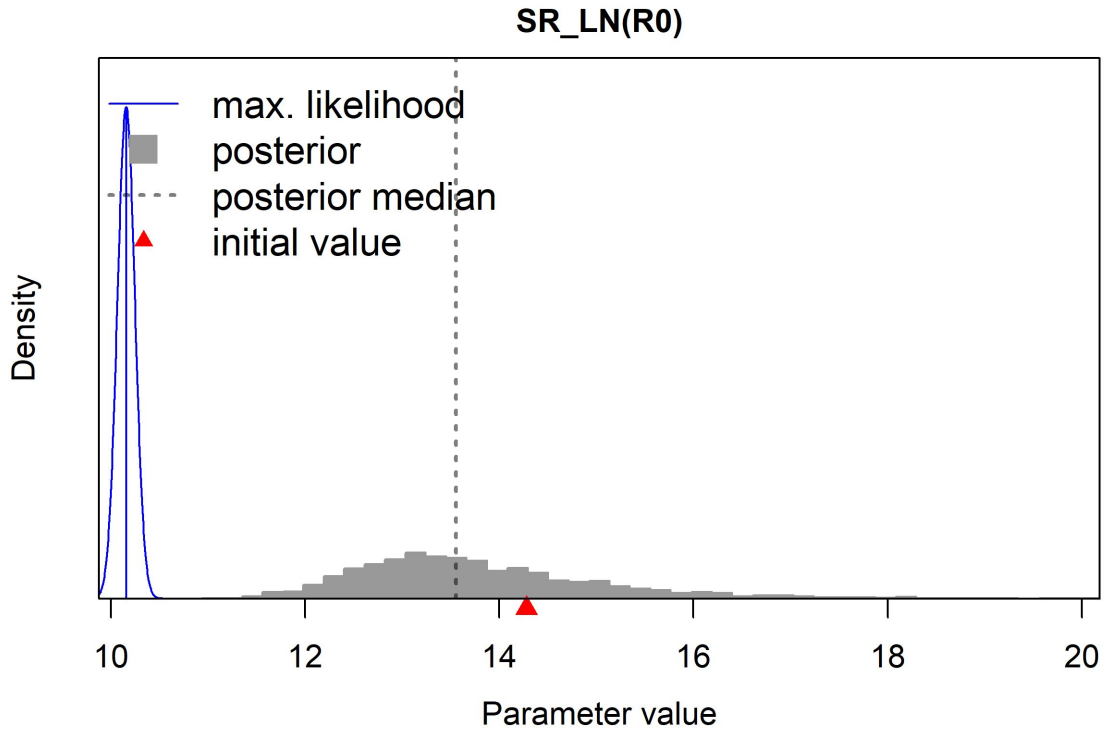
- Minimum objective function estimates population at unreasonable values (10^{12} mt, trillions of tonnes!)
- This model has issues estimating scale

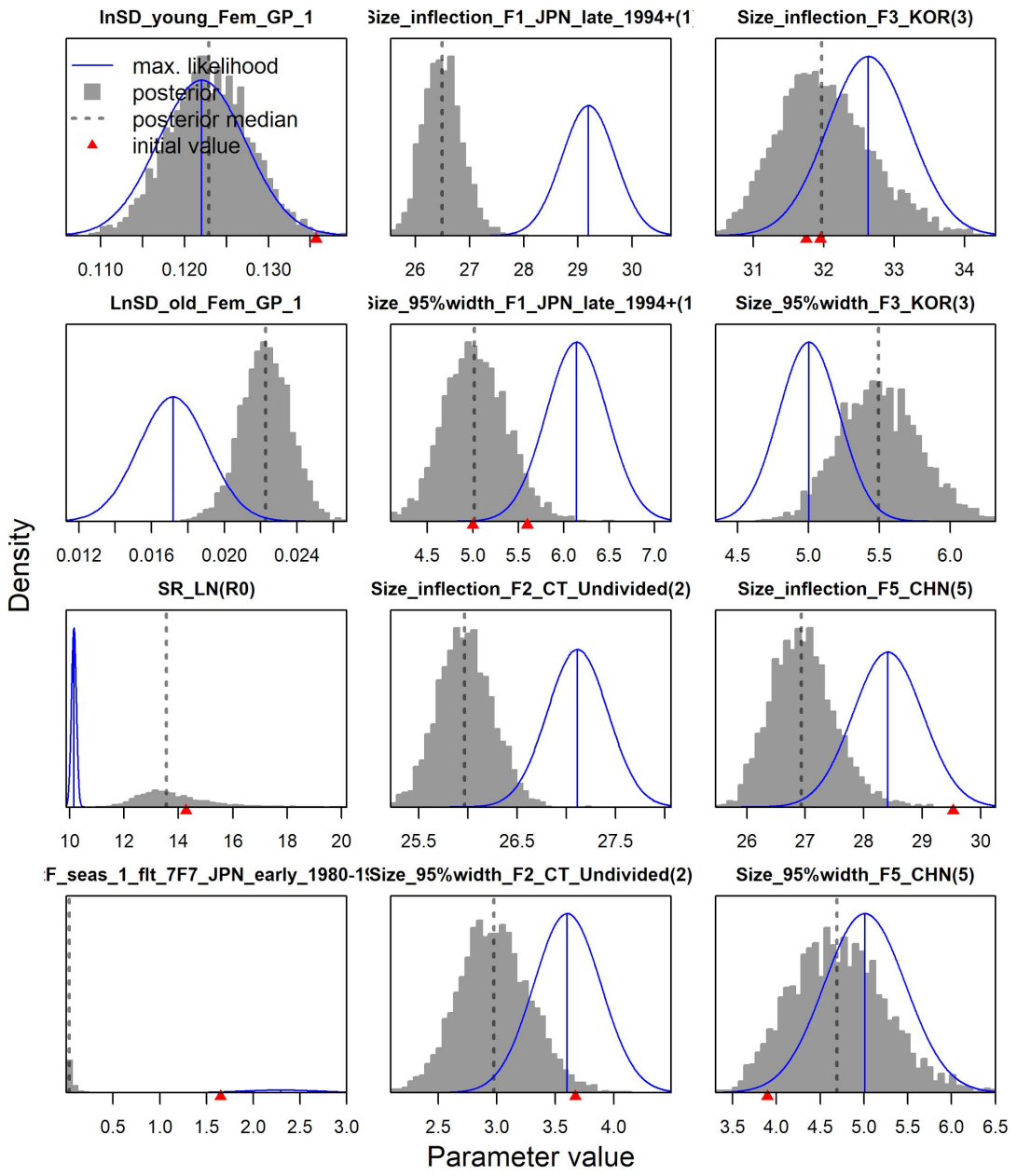




MCMC

In Model 19d, MCMC posterior estimate of R0 is larger compared to the maximum likelihood value, again indicating issues with the estimation





The model has issues estimating size of population

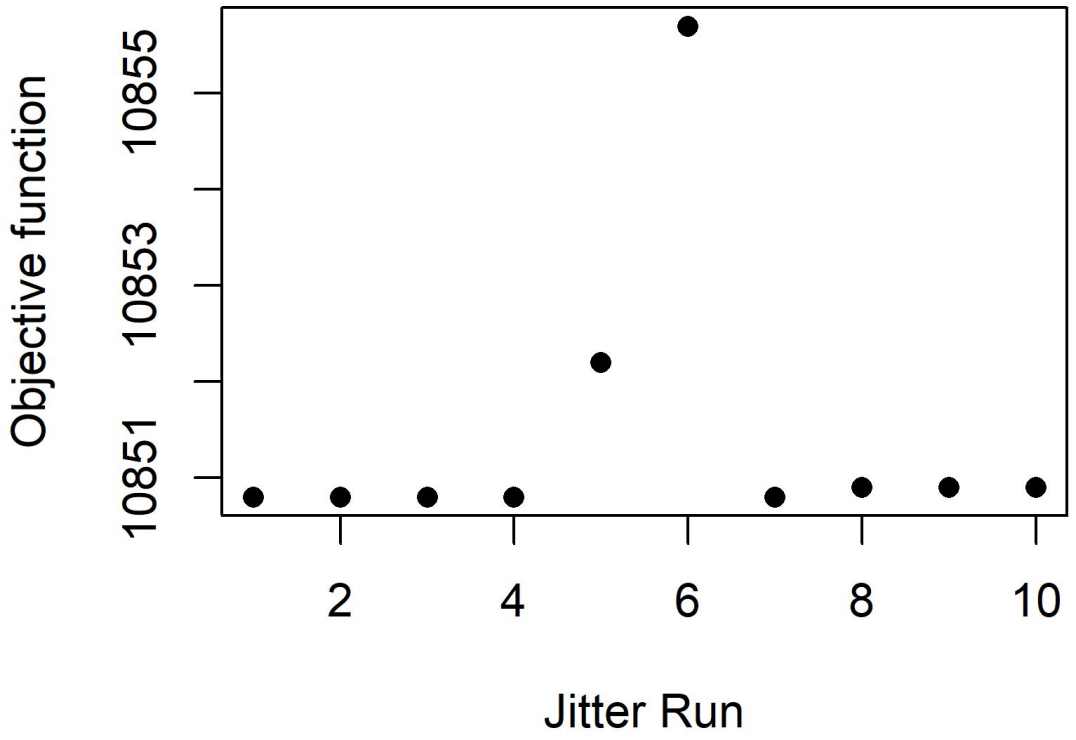
Proposal:
Use a prior on catchability for survey. Index of abundance is calculated from an area-weighted spatiotemporal modeling approach, implying we have some prior information about stock size

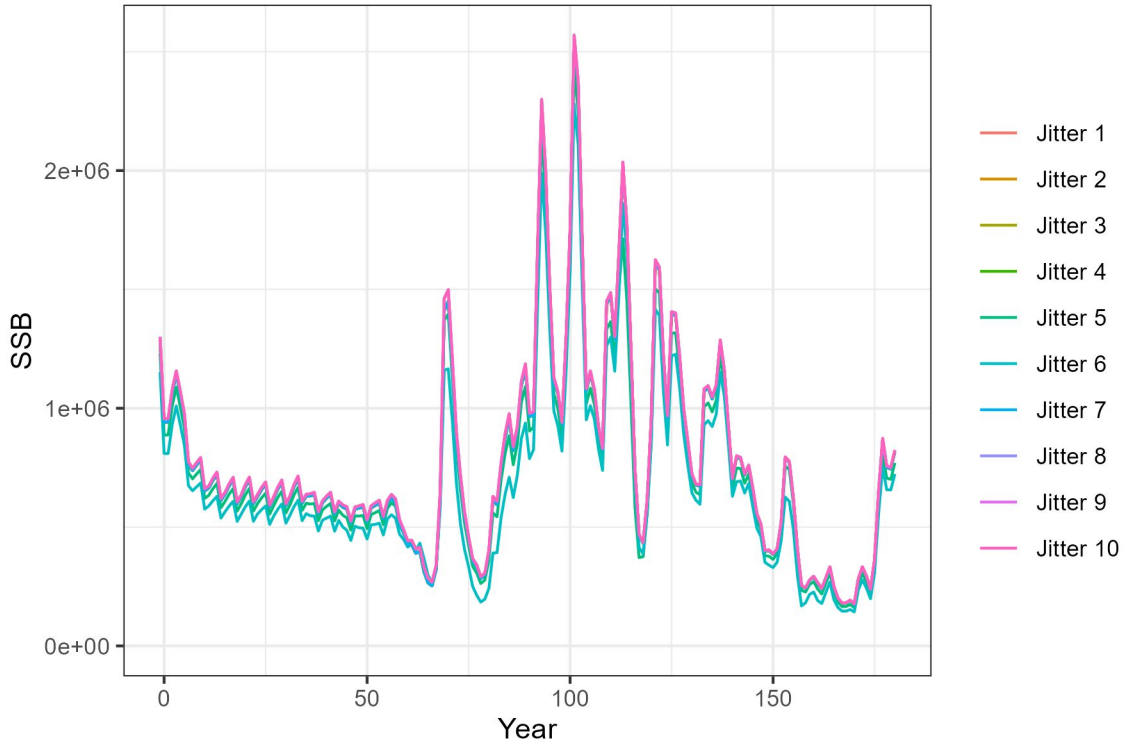
Next: I show improvement in estimation with the prior ("Model 19d")

Example lognormal prior on age-1 survey: $\log(q) \sim N(\log(1), 0.10)$

Model 19d with survey catchability prior has better estimation properties

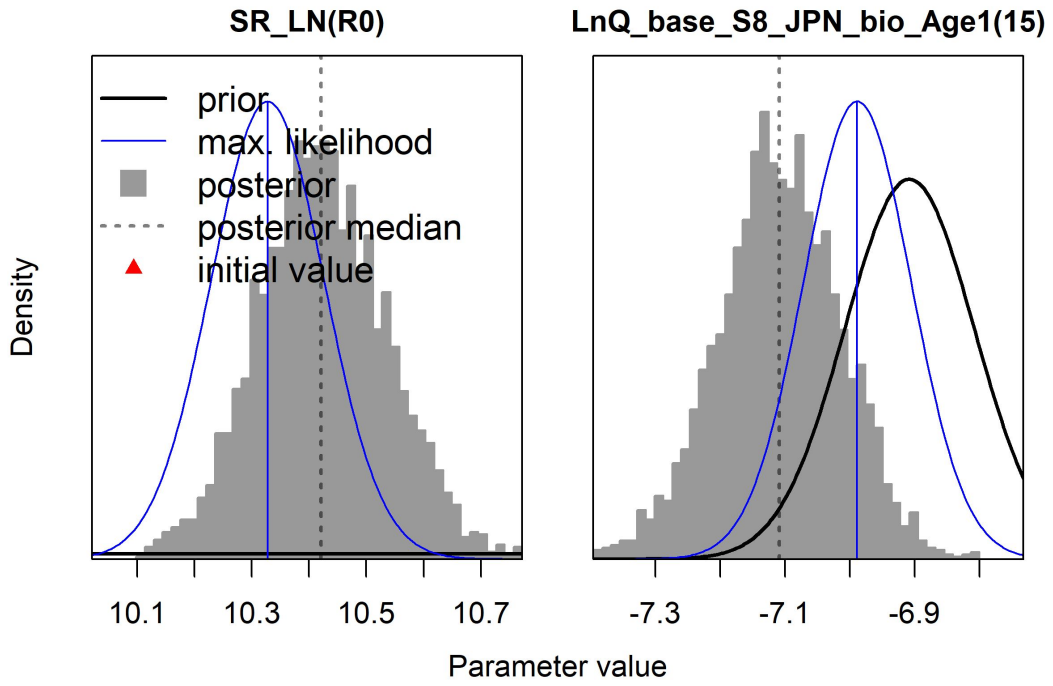
SSB estimates is robust with the jitter analysis when a catchability prior is used

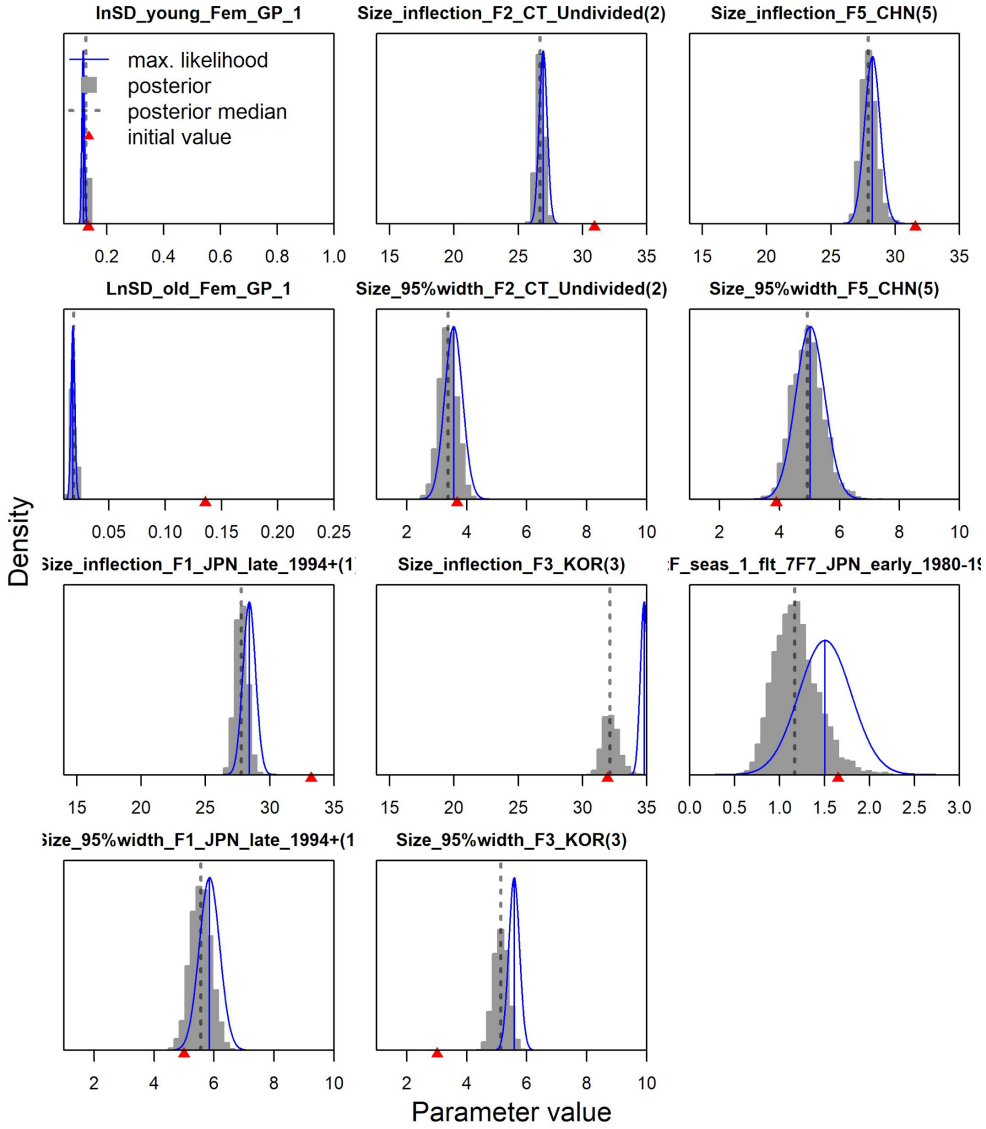




Model 19d with survey catchability prior has better estimation properties

Better agreement between Bayesian MCMC posterior and maximum likelihood estimate approaches





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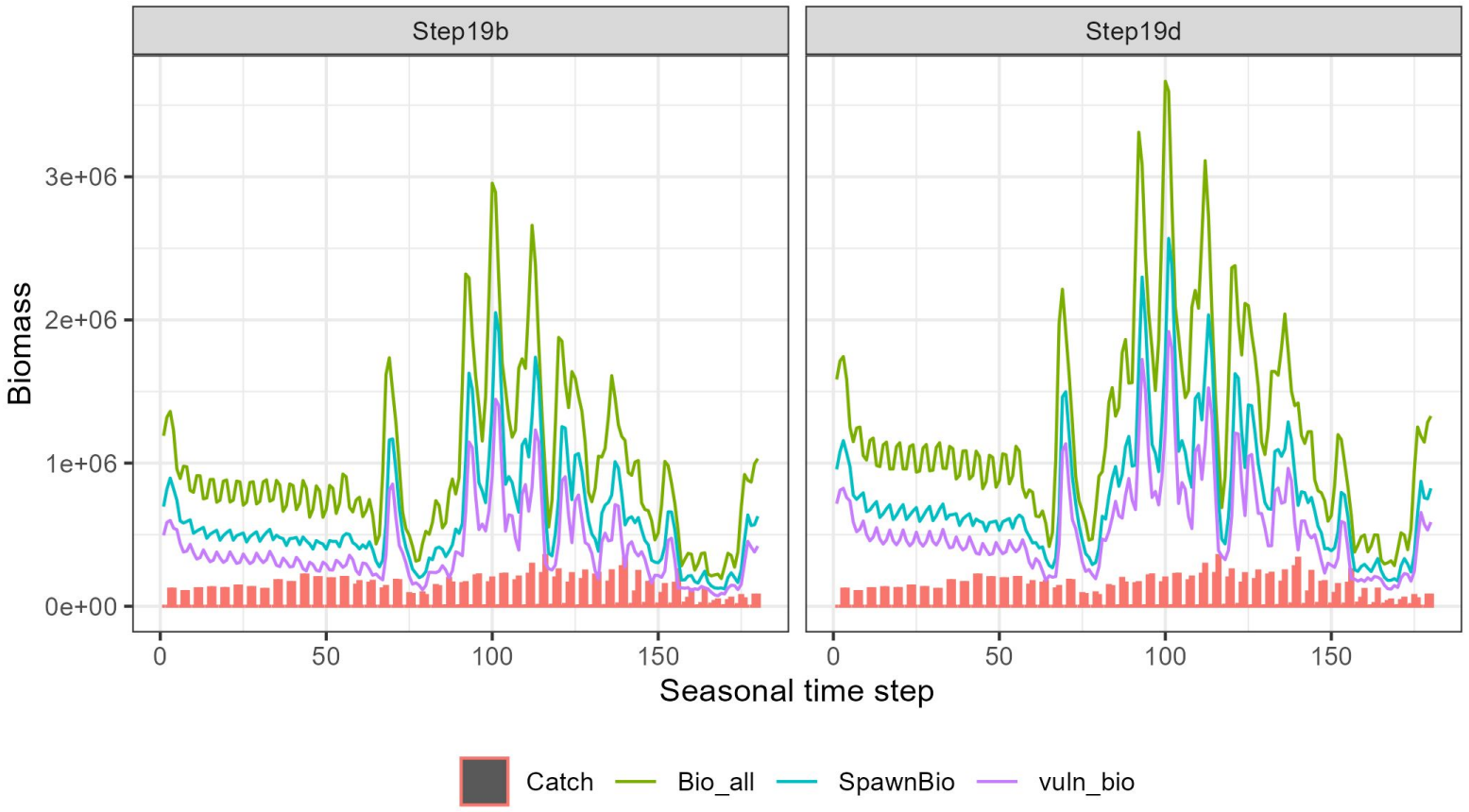
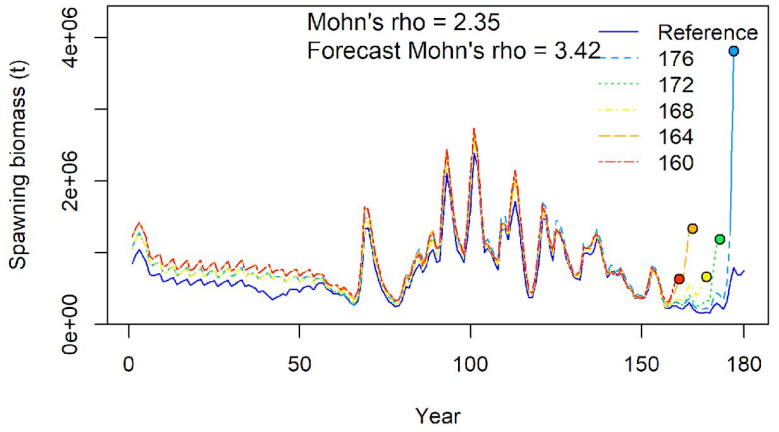


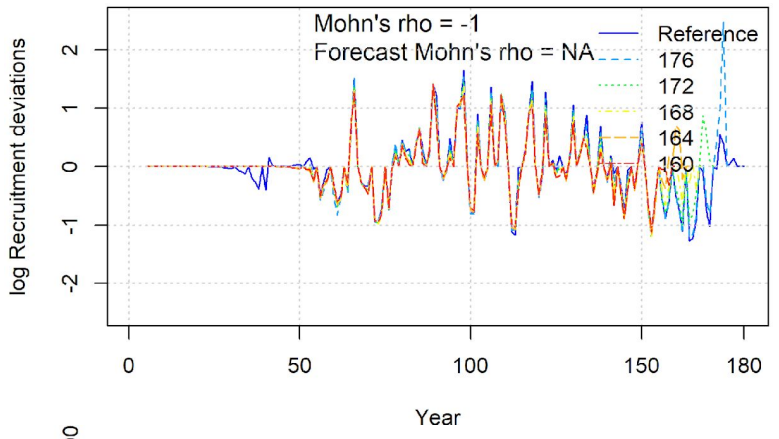
Model 19d – retrospective and hindcast

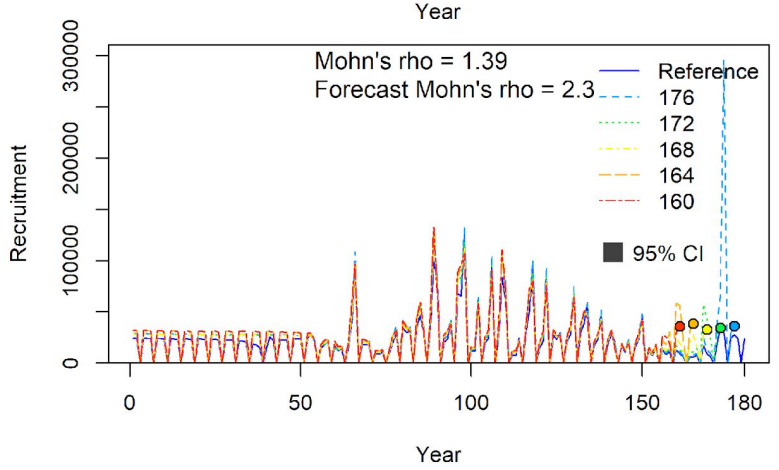
Predictive ability in first projection year is still poor

- Perhaps we need a model with time-varying growth or selectivity for better predictive ability

- Use alternative assumptions about recruitment? (e.g., average, below average scenarios)
- Projection assumes average recruitment from stock-recruit relationship. However, recent historical recruitment is below average (see log rec devs < 0)







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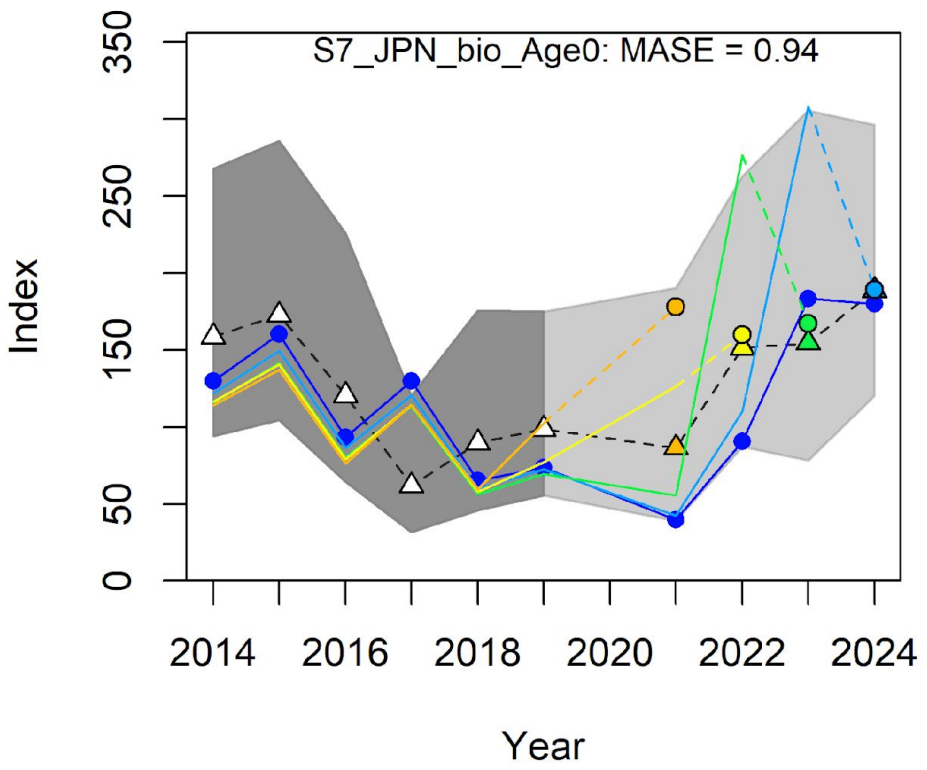
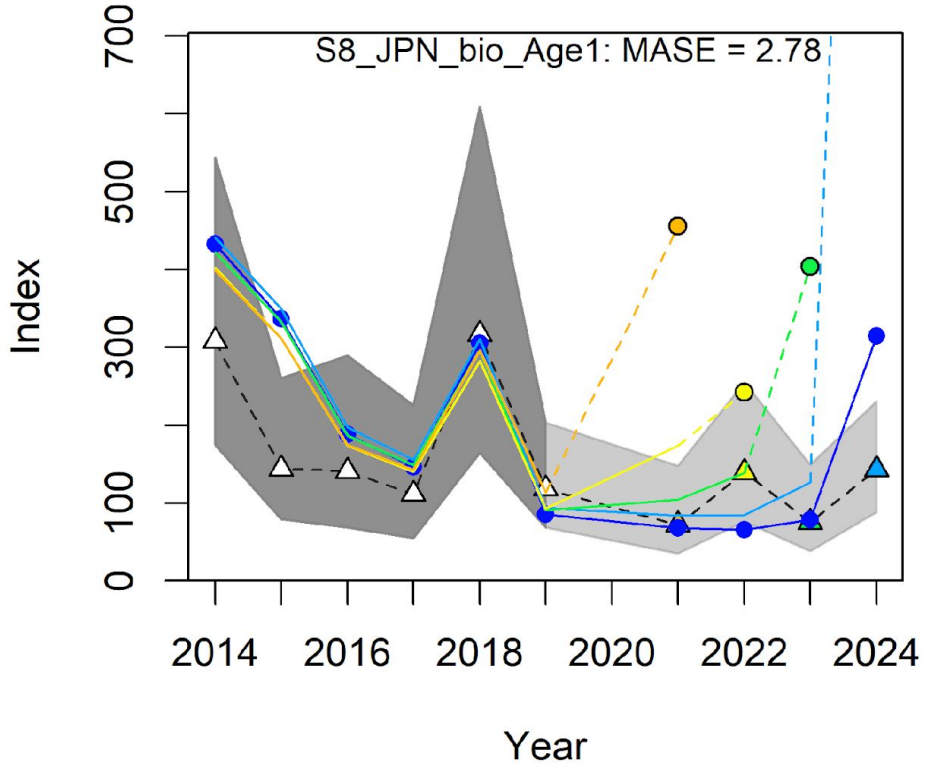




- Model 19d only fitted to survey indices
- One-year prediction is 4 seasonal time steps!

Forecasting

- With seasonal time step model, stock-recruit relationship predicts seasonal recruitment
- Yield curve, FMSY and MSY reference points are based on seasonal exploitation and catch
- To provide annual TAC advice, model must be projected across 4 future time steps

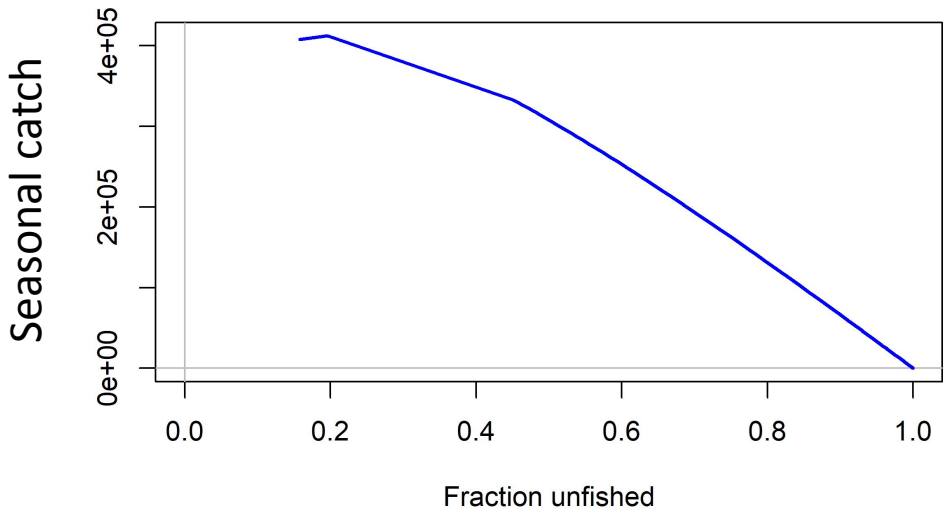
- Such a projection is possible in the SS3 forecast file
- Explicit assumptions needed for seasonality of the fishery (e.g., constant F at third and fourth quarter) and recruitment (e.g., average recruitment except in the third quarter)

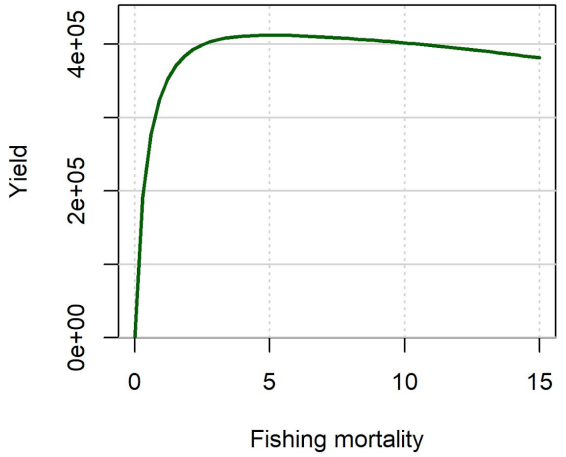
- Note: there is a one-year lag between survey and catch data. What is the best provisional catch to use for the missing year? Currently using previous year's catch

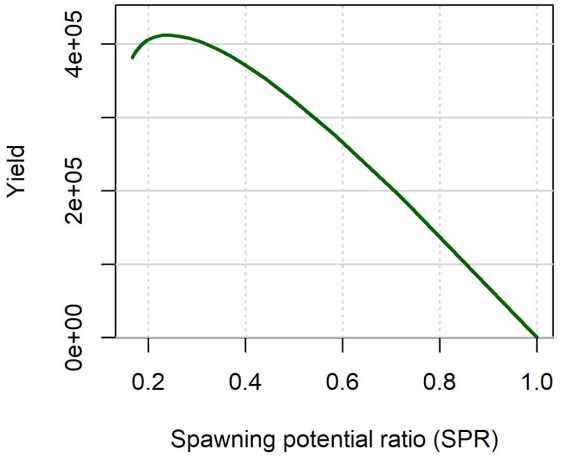
Yield curve

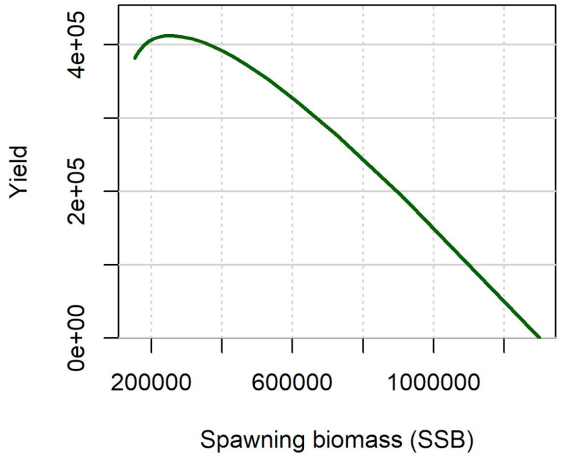
- SS3 has difficulty finding optimum of yield curve
- Needed to confirm outside of the assessment model
- Difficult to estimate dome in yield curve with respect to fishing mortality, potentially due to late selectivity relative to lifespan

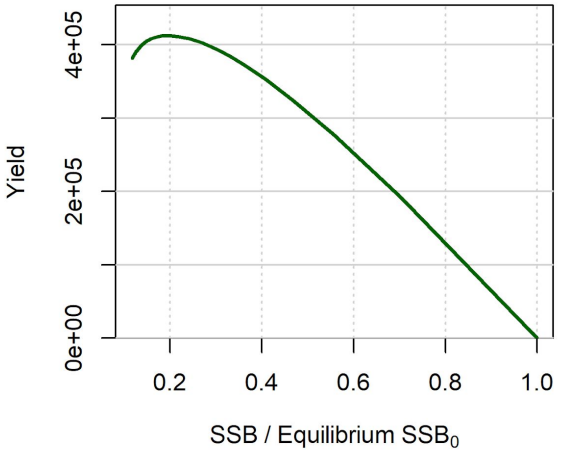
- Are explicit FMSY reference points possible or should we use proxies?
- Note for future: additional assumptions required for reference points if there is time-varying growth











Summary and discussion

Some questions to the group:

- I believe the model cannot reliably estimate stock size unless there is prior information. Can we develop a prior on survey catchability?

- What are the appropriate reference points to use for any potential TAC advice?

- Models will be updated with new data from SSC PS 15, and I plan to use various sensitivity scenarios identified in WGNSAM. Any other new information, or diagnostic figures?

Thank you!