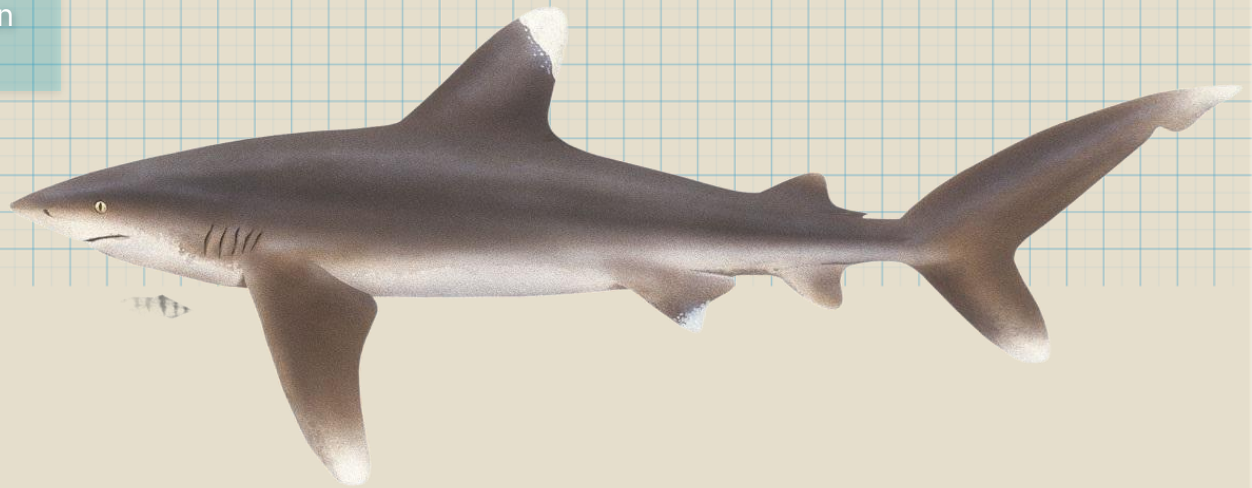
Stock Assessment of Oceanic Whitetip Shark in the Western and Central Pacific Ocean: 2025

Scientific Committee 21st Regular Session
SA-WP-08



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Kath Large

Date:
August 2025

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Data Science

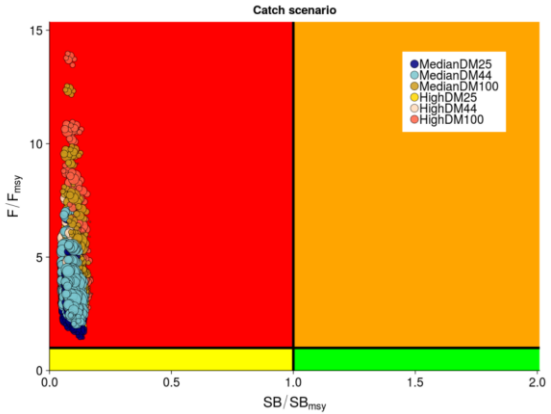
Overview:

- Background
- Assessment inputs
  - Updated catch reconstruction (CR),
  - CPUE, and
  - length compositions
- Assessment models
  - SS model - stepwise updates and Bayesian ensemble for 2025
  - Surplus production model
- Recommendations

Background

2. SC15 conclusions:

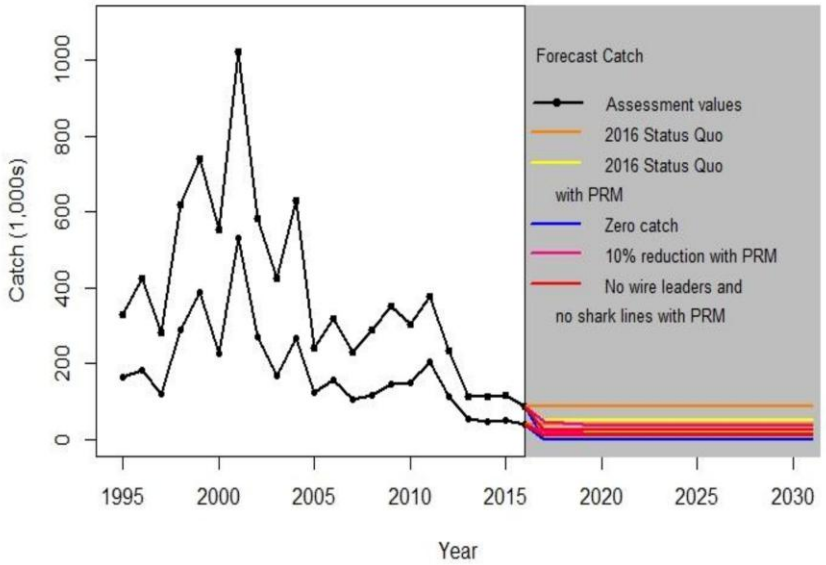
- Stock status: overfished and undergoing overfishing based on depletion and MSY-based reference points
- Very slight recovery in stock biomass in the most recent years (2013-2016)
- Few, if any, target fisheries
    - greatest impact from longline bycatch
    - lesser impact from purse seine



Future stock projections – Bigelow *et al.* (2022)

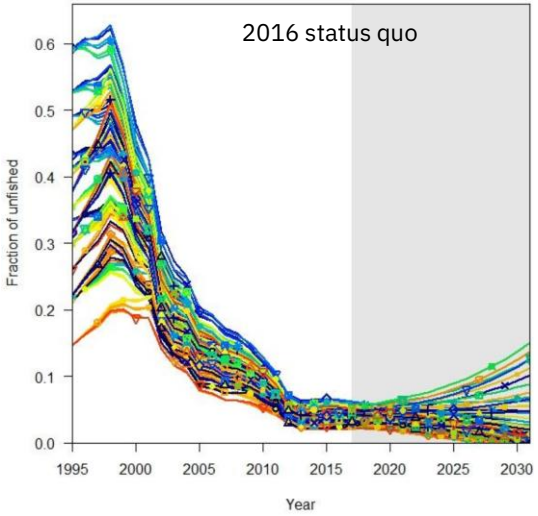
Considered five future catch scenarios forecasted within a 15 year window

- 2019 assessment values projected, with:
  - assumption 43.75% mortality (status quo)
  - status quo with updated estimates of handling & PRM (LL-retrieval M 19.2%, PRM (8%))
  - 10% catch reduction (2017-2020) and updated estimates (LL-retrieval 19.2%, PRM 8%)
  - assumption of reduced mortality from gear-ban (41.2%) and updated estimates (LL-retrieval 19.2%, PRM (3%))
  - zero future catch

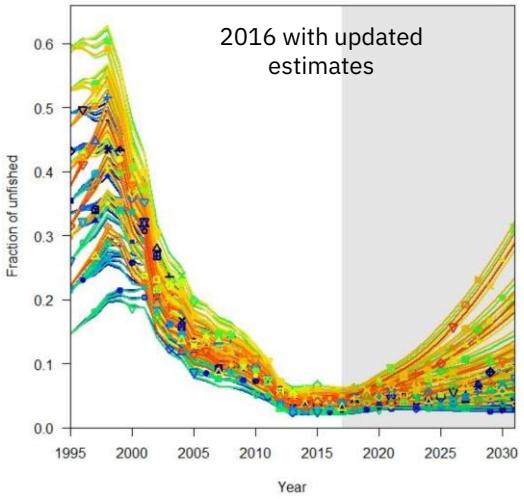


Future stock projections – Bigelow *et al.* (2022)

- Population was projected to increase over the projection period under new mortality scenarios: higher projected SB in 2031 relative to 2016
- Strong dependence of recovery trajectories on mortality levels



mean $SB_{2031}/SB_{F=0}$ = 0.015



mean $SB_{2031}/SB_{F=0}$ = 0.070

Stock, biology & length structure

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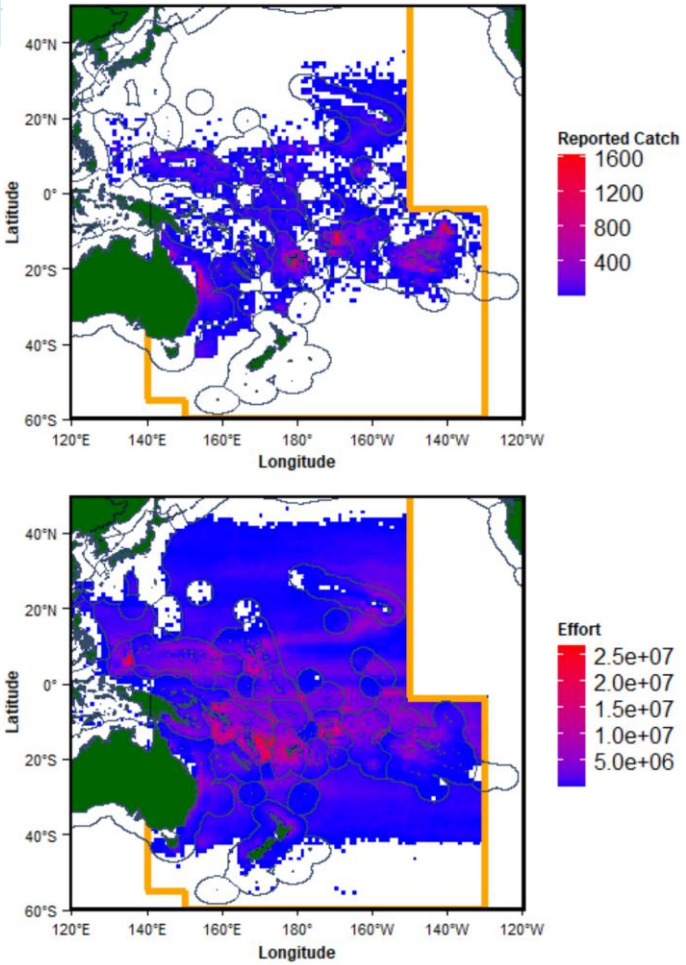
Fishery

- Most reported LL catch is south of the equator to 25° South



Fishery

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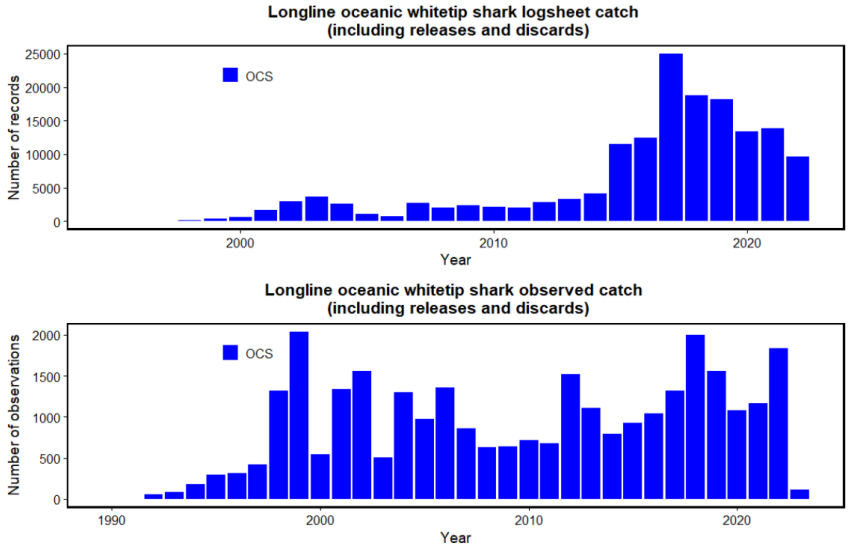
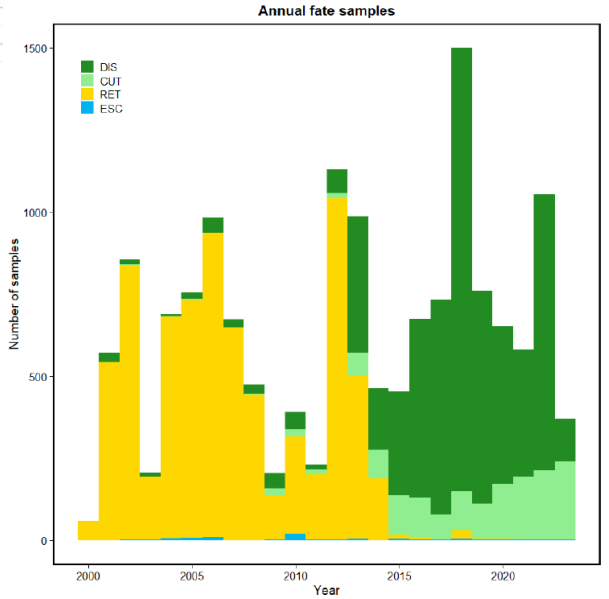
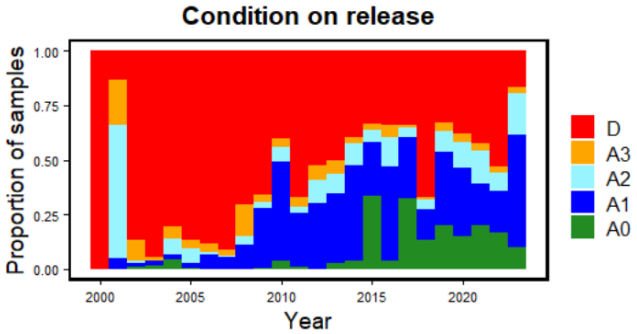
- Probably not well reported in the past



Fishery

- Most reported LL catch is south of the equator to 25° South
- Probably not well reported in the past
- Increasingly cut free, near 100% non-retention in recent years
- Still reasonably high handling mortality





Fishery

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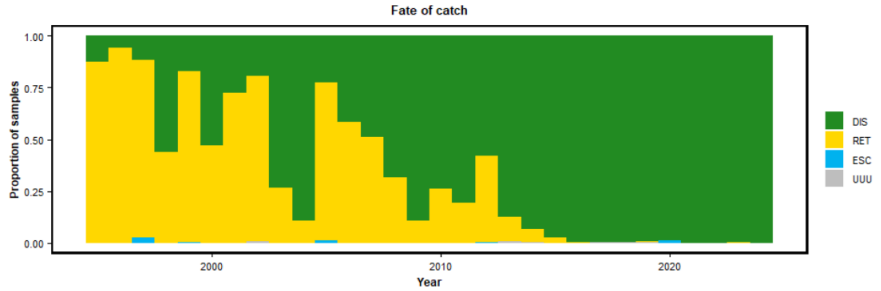
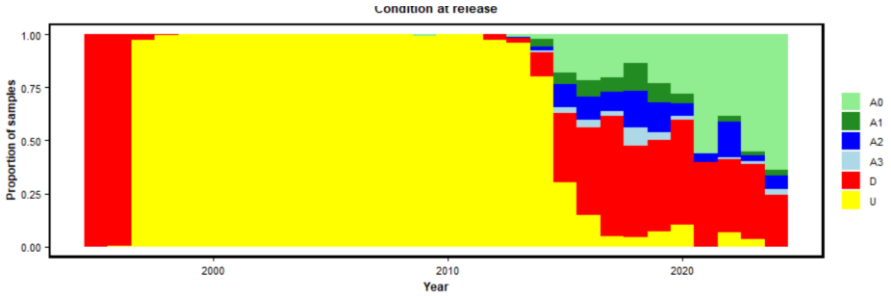
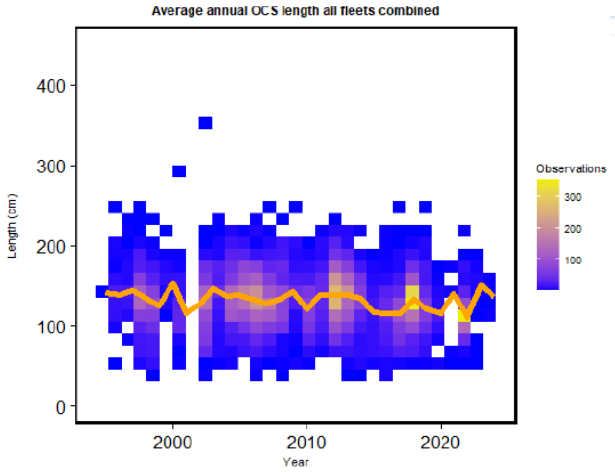
- Increasingly cut free, near 100% non-retention in recent years
- Still reasonably high handling mortality
- Little PS catch; increasingly discarded in good condition.

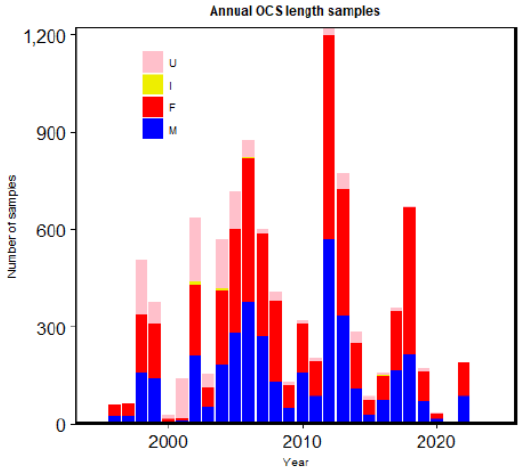




Stock structure

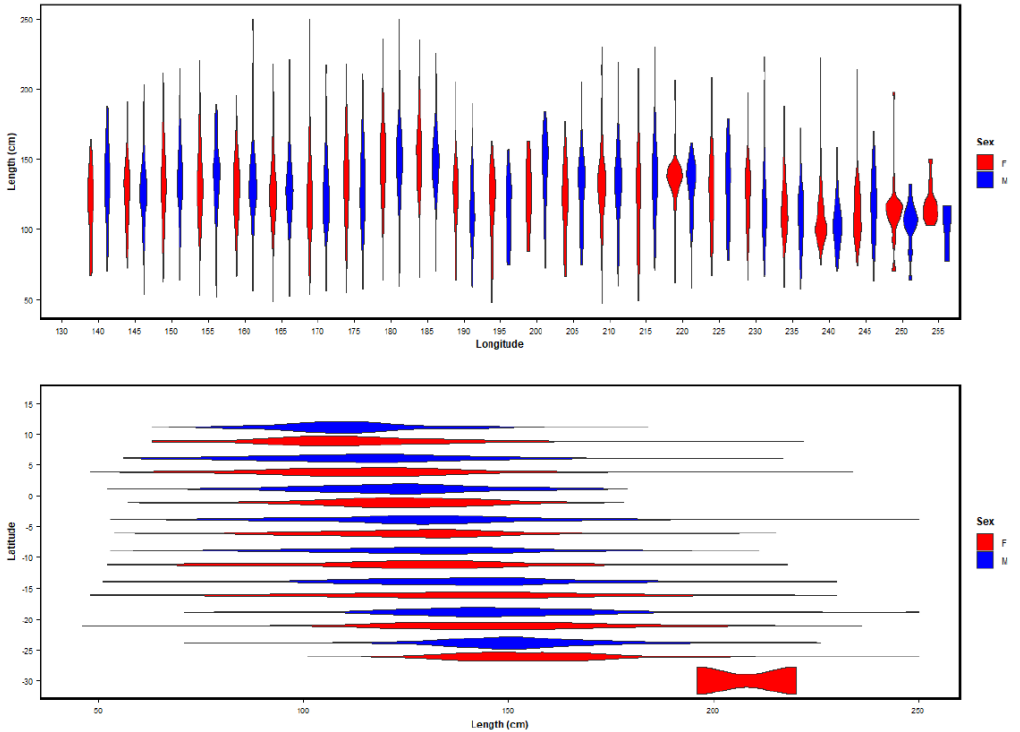
- Reasonable amounts of length data from longline observers





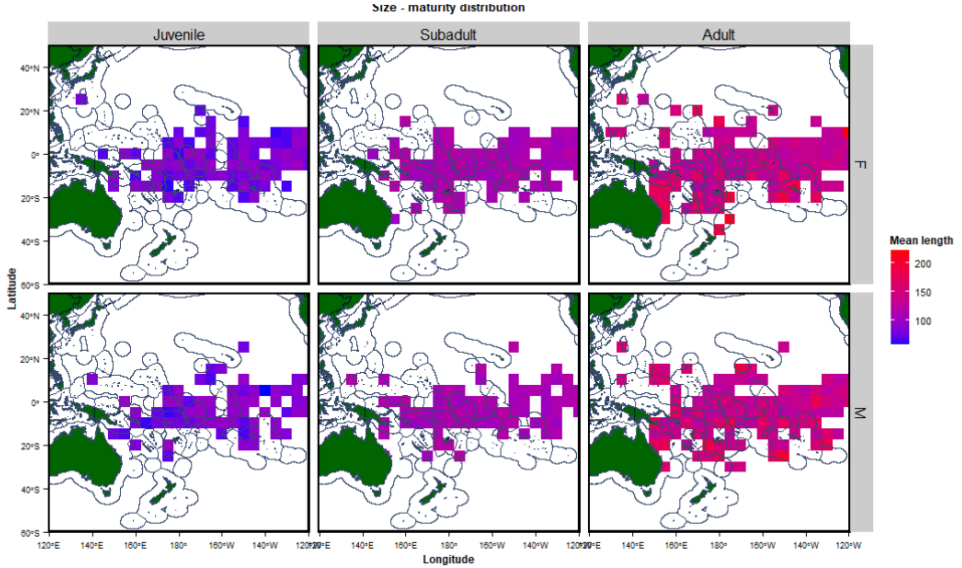
Stock structure

- Reasonable amounts of length data from longline observers
- Larger individuals south of equator



Stock structure

- Reasonable amounts of length data from longline observers
- Larger individuals south of equator
- Unclear about underlying cause - no discernable patterns in maturity in space
- 2025 assessment uses single area model - same as previous assessments



Assessment inputs

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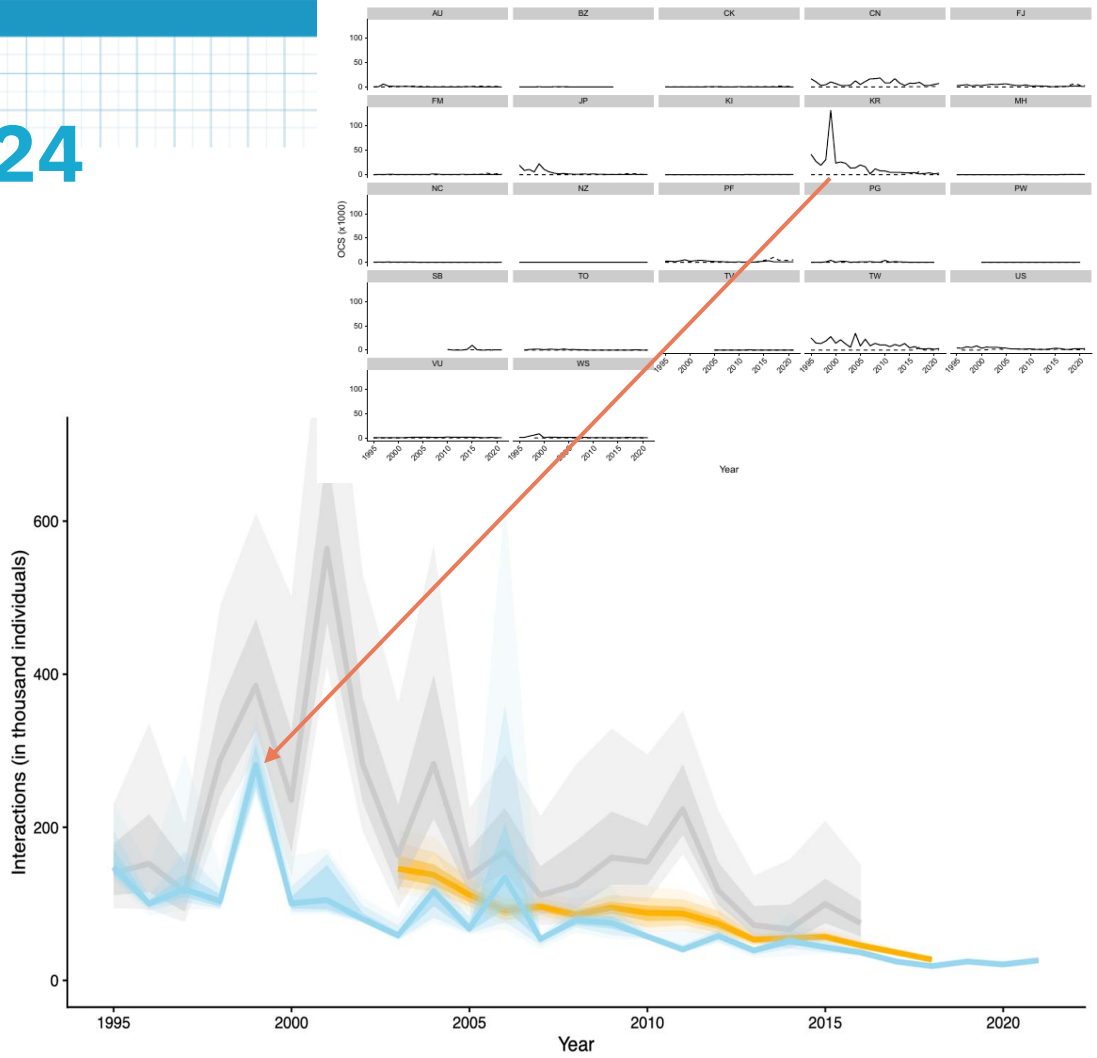
Longline catch - 2024 estimates

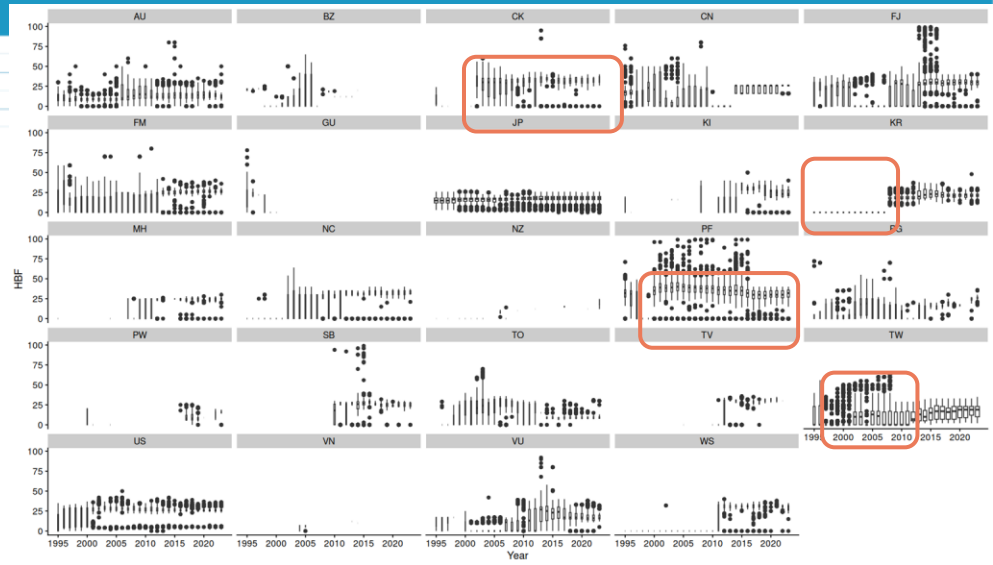
- 2024 Catch reconstruction estimated comparable to predicted values from Peatman et al. (2018), but lower than those predicted by Tremblay-Boyer et al. (2019)
- Trends associated with DW-fleets

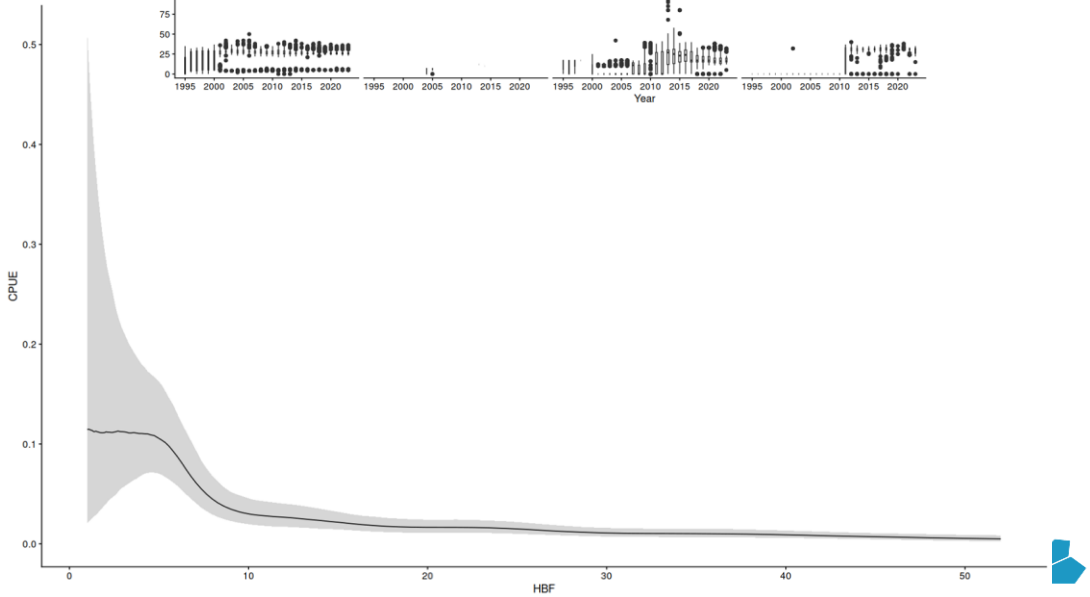
WCPFC-SC20-2024/SA-WP-11-Rev2



Longline catch - 2025 updates

- Key difference with Tremblay-Boyer et al. (2019) was use of HBF to predict catch
- HBF has a strong impact on OCS catch rates in observer CPUE models
- Reported HBF not complete - lots of reported zeros in some fleets; likely not true zeros
- Large impact on predictions





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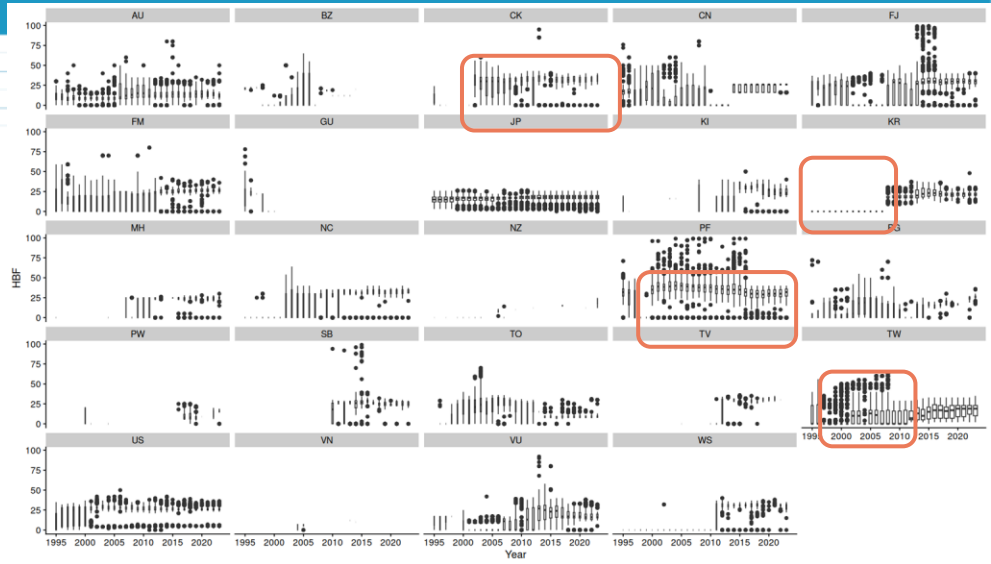

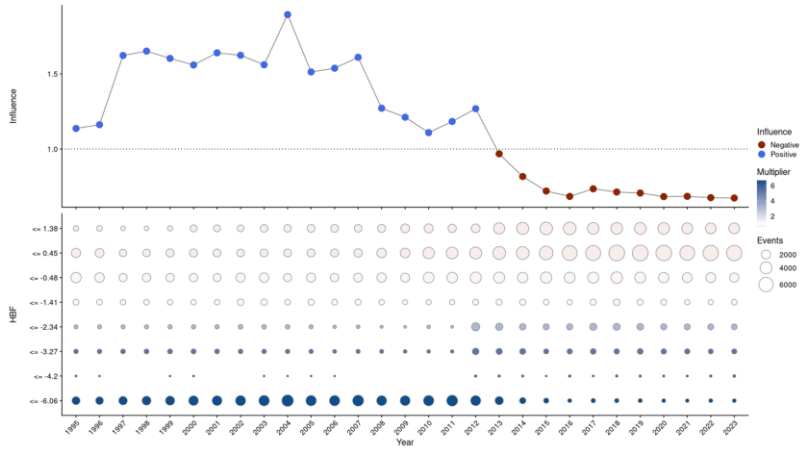

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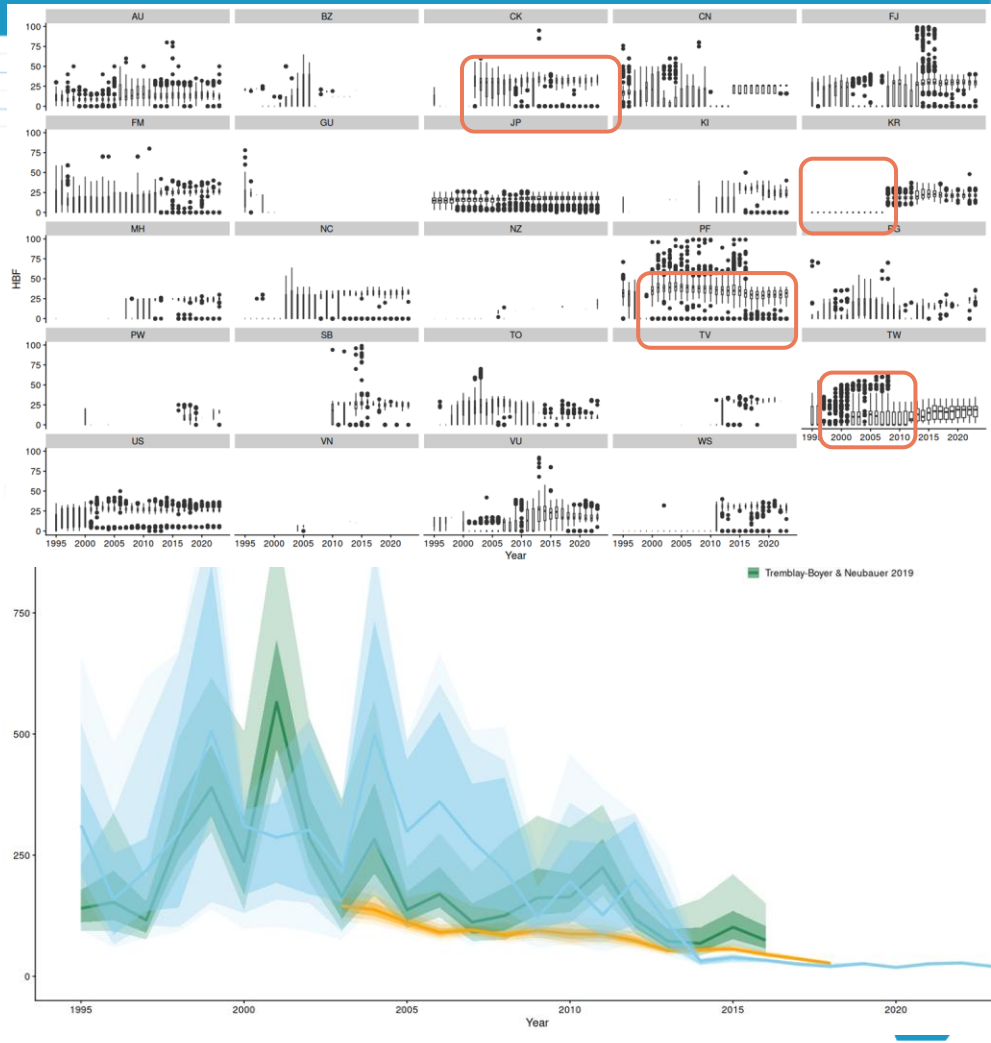

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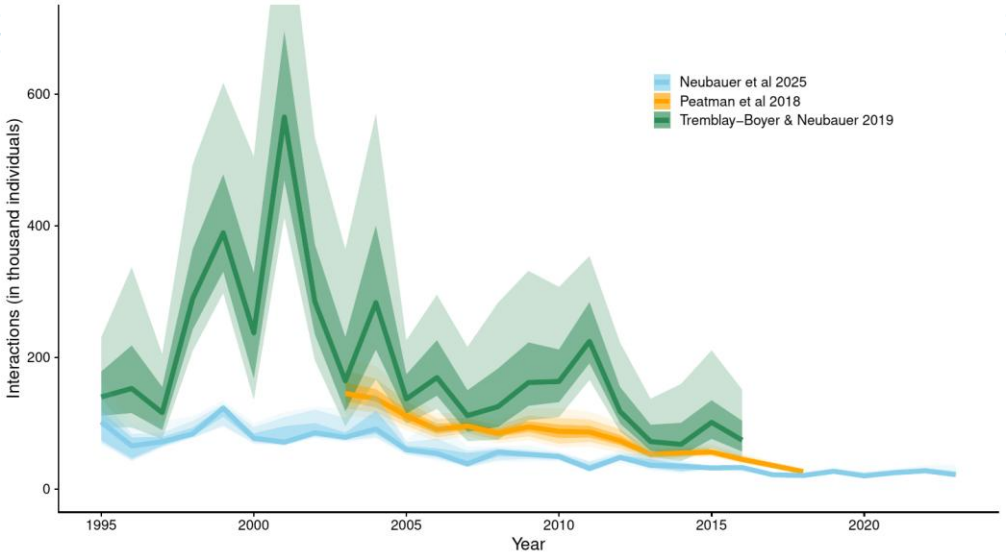

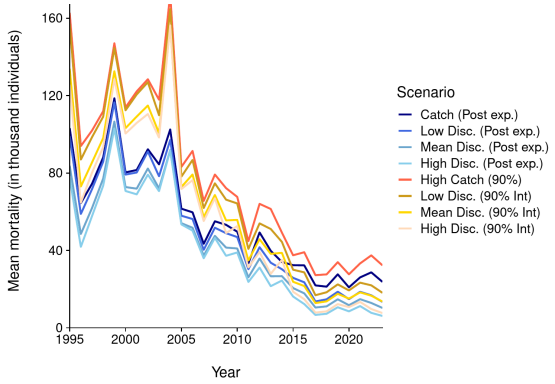

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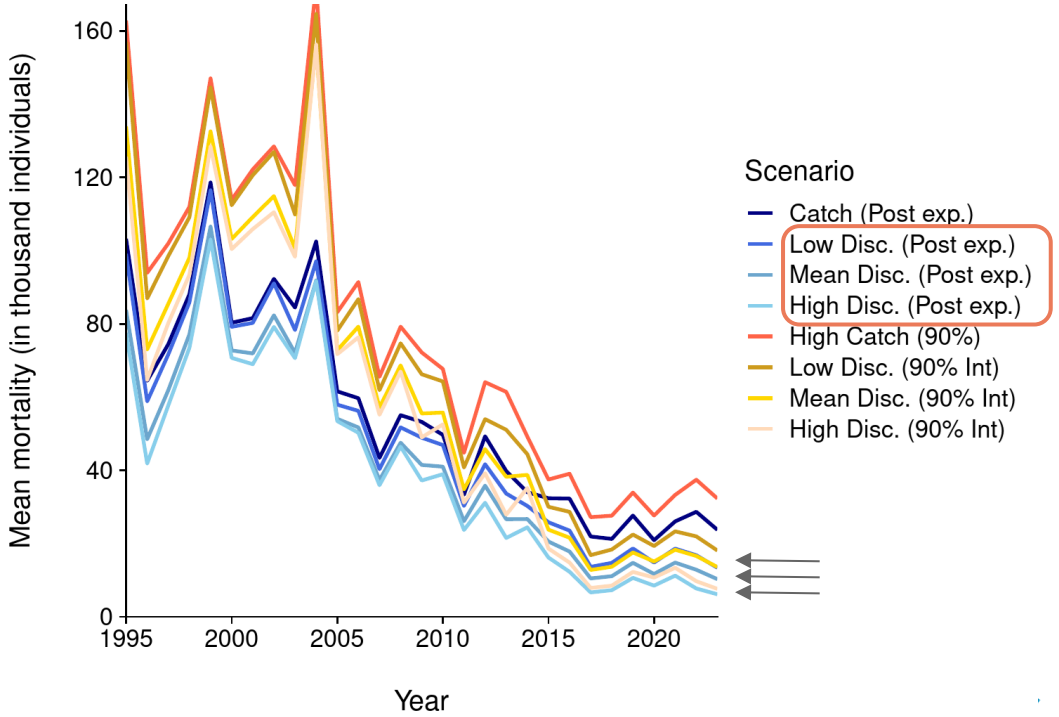
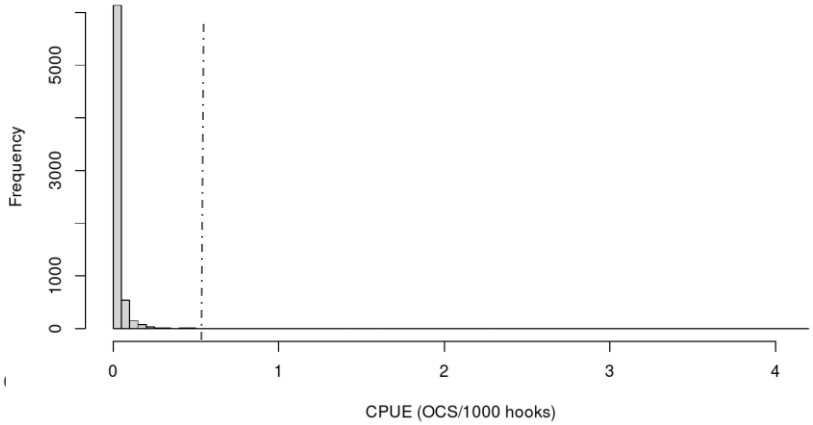
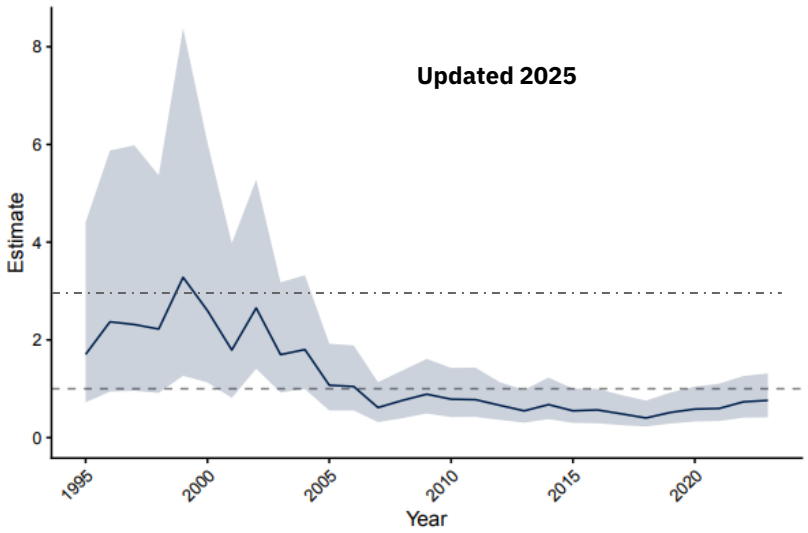
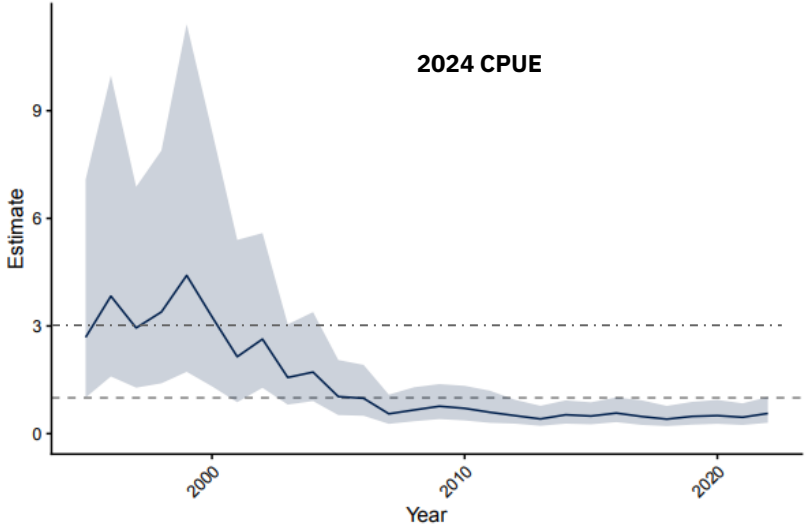


CPUE

- Updated CPUE based on filtered nominal CPUE
- Reduces impact of a few outliers (targeting?) on CPUE

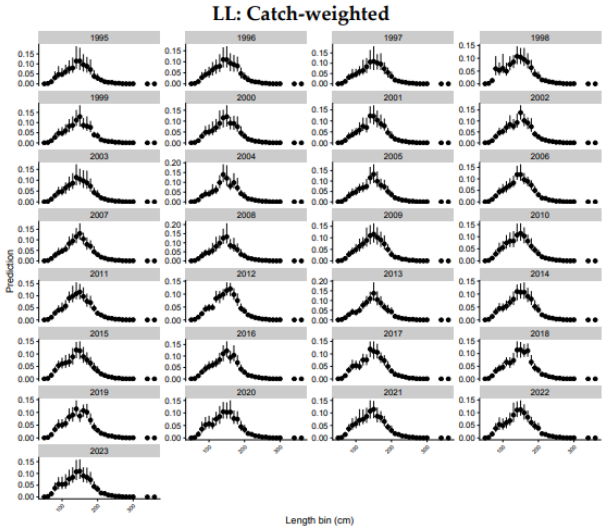


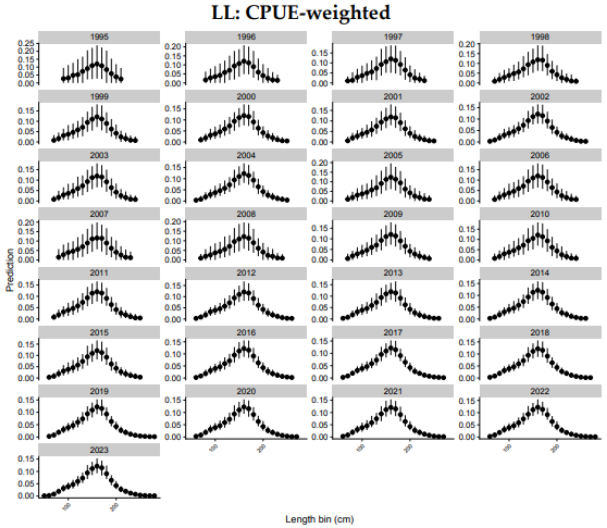




LFs

- Standardised (model-based) and split into
  - Capture fleet LFs: catch weighted
  - Index LFs: CPUE weighted





Stock assessment

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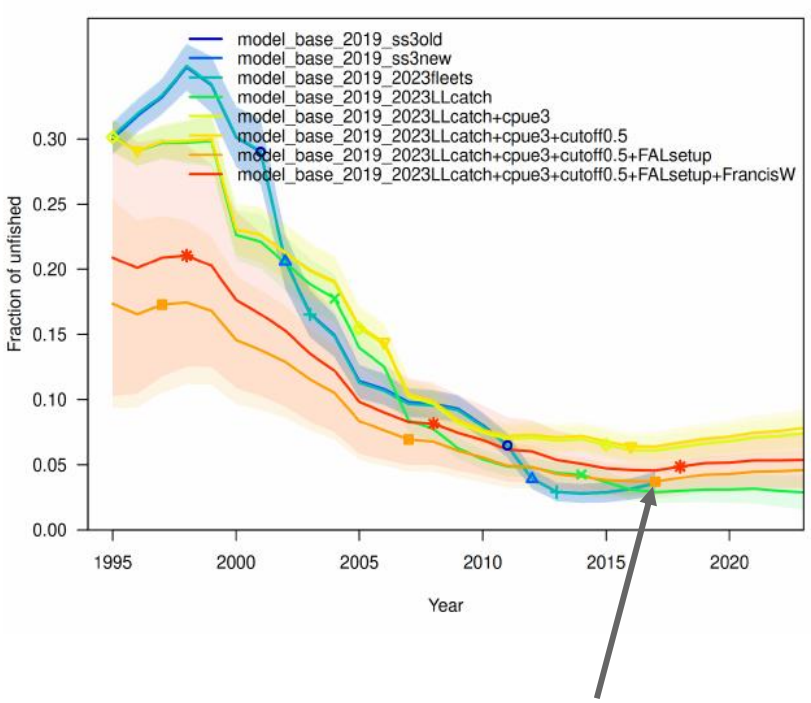
Two alternative assessments

- **SS3** - stepwise updates from previous (2019) assessment
- Surplus production model (BDM): alternative model without length compositions

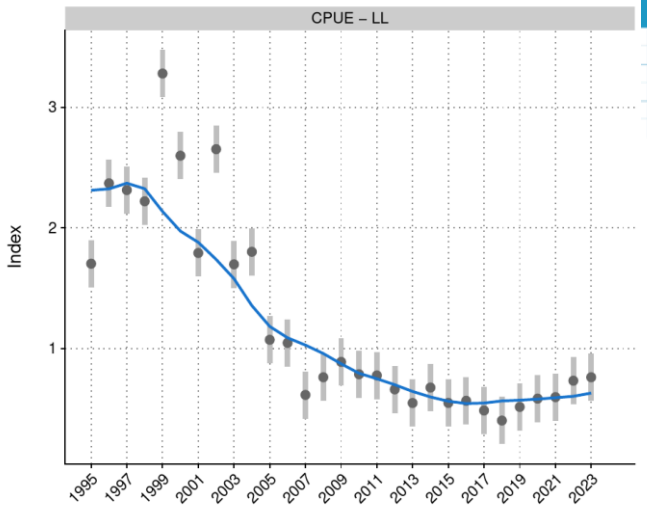
SS3 - 2025 updates

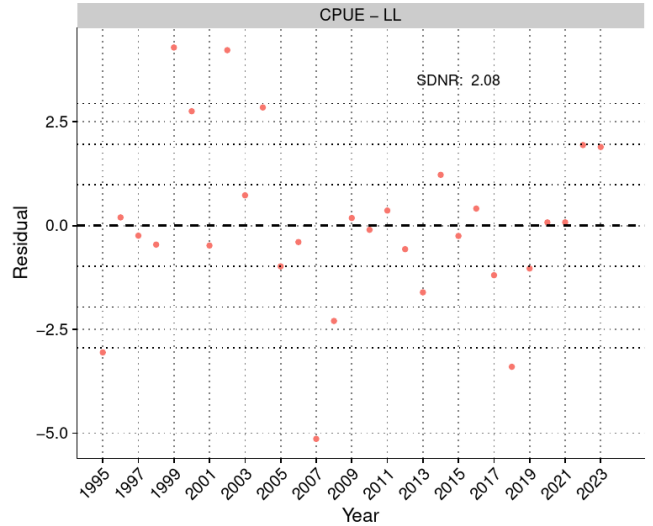
1. Old model
2. Updated SS3 version
3. Remove longline target fleet (catches subsumed in longline catches)
4. Updated catch estimates
5. Updated CPUE
6. CPUE cutoff
7. FAL setup:
    - **Estimated M, initial F**, SR survival fraction
    - LFs split between index and capture fleets
8. Reweighted LFs (no convergence, **not used**)



SS3 - 2025 diagnostics

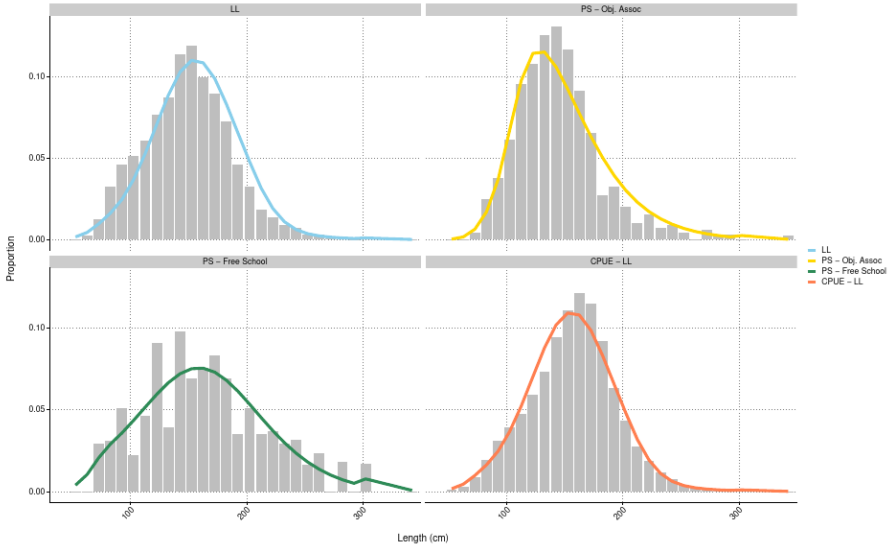
- Joung growth model and associated M prior for diagnostics
- Force fit to CPUE; high residuals early on - noisy data in late 1990s and early 2000s (low observer coverage in tropical waters)





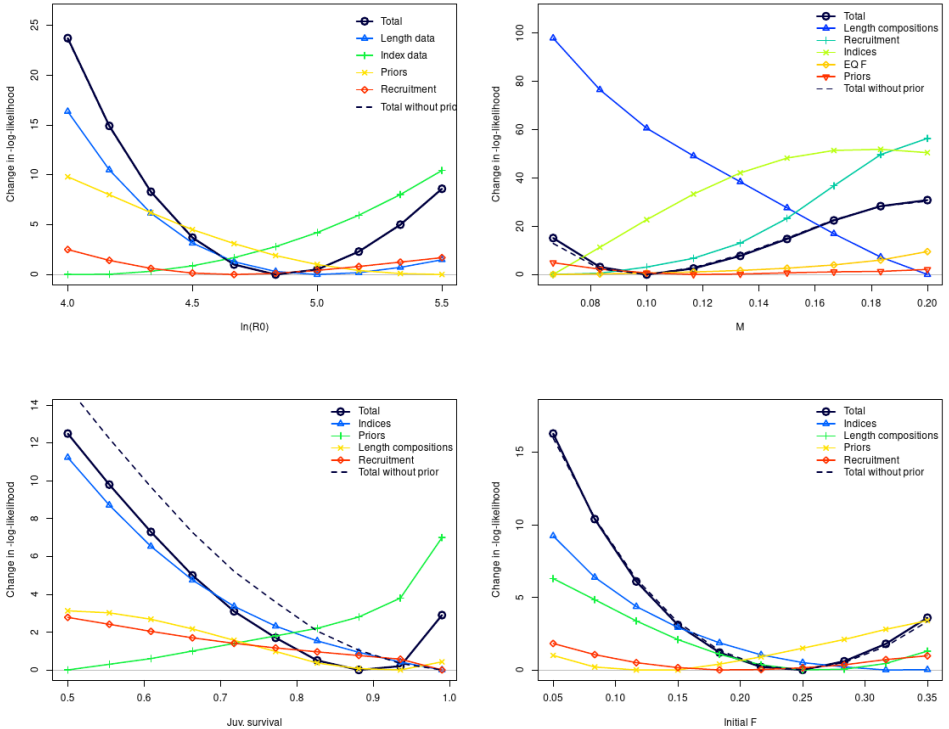
SS3 - 2025 diagnostics

- Joung growth model and associated M prior for diagnostics
- Force fit to CPUE; high residuals early on - noisy data in late 1990s and early 2000s (low observer coverage in tropical waters)
- Reasonable fits to LFs



SS3 - 2025 diagnostics

- Joung growth model and associated M prior for diagnostics
- Force fit to CPUE; high residuals early on - noisy data in late 1990s and early 2000s (low observer coverage in tropical waters)
- Reasonable fits to LFs
- Conflict between CPUE (smaller stock) and LFs (larger stock) - same as 2019.
- Possibly biased by larger sharks not being measured?

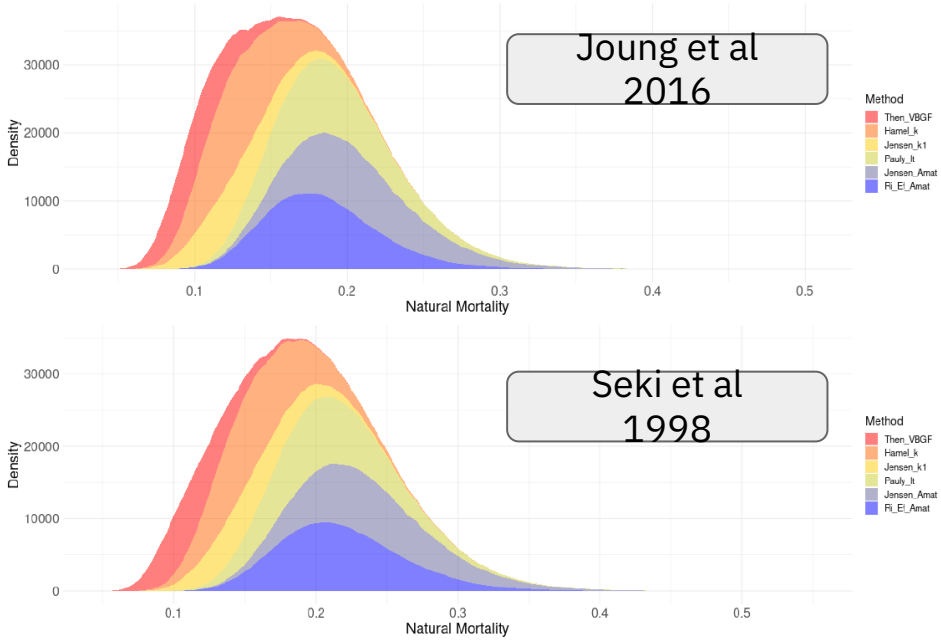


SS3 - Uncertainty

1. Alternative growth (same as 2019) - alternative (matched) M priors
2. Alternative discard assumptions
3. Alternative LF weights (x10 or /10)
4. Alternative stock-recruit settings

Bayesian estimation (full MCMC) across the grid;

Weighted by discard assumption likelihood, all other axes equally weighted



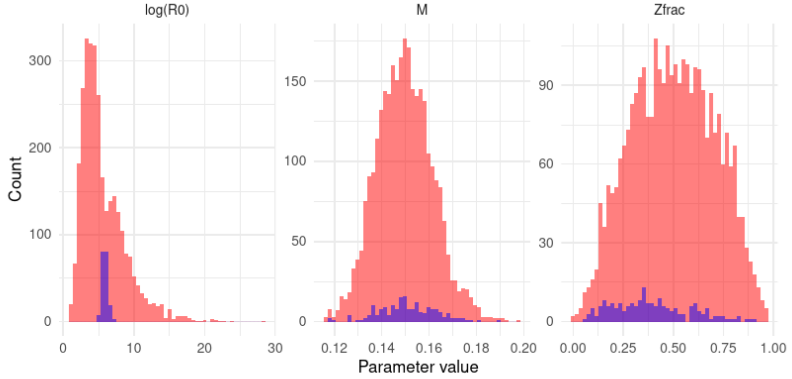
SS3 - Uncertainty

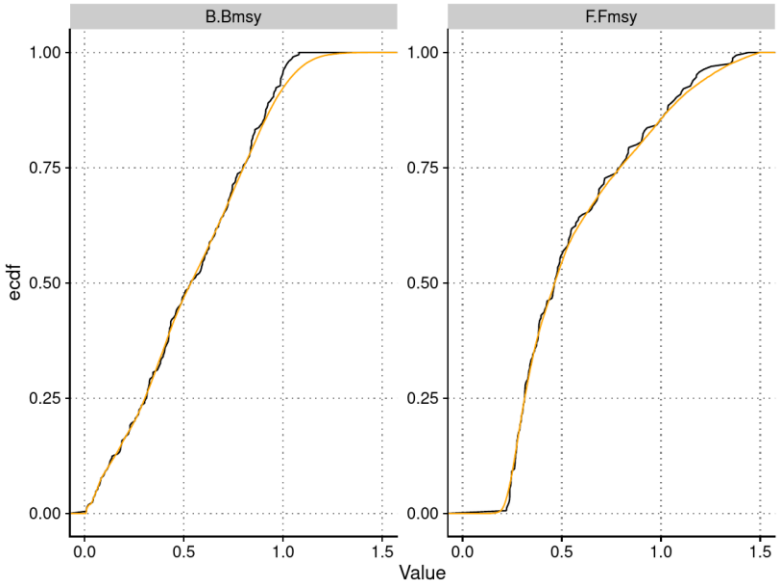
Some divergent transitions across all models - likely due to very low stock status

Avoiding/testing for potential bias (Kim & Neubauer 2025 - Fisheries Research) -

- Priors adjusted using prior predictive (push-forward) checks
- Testing for bias in estimation using simulation-based calibration

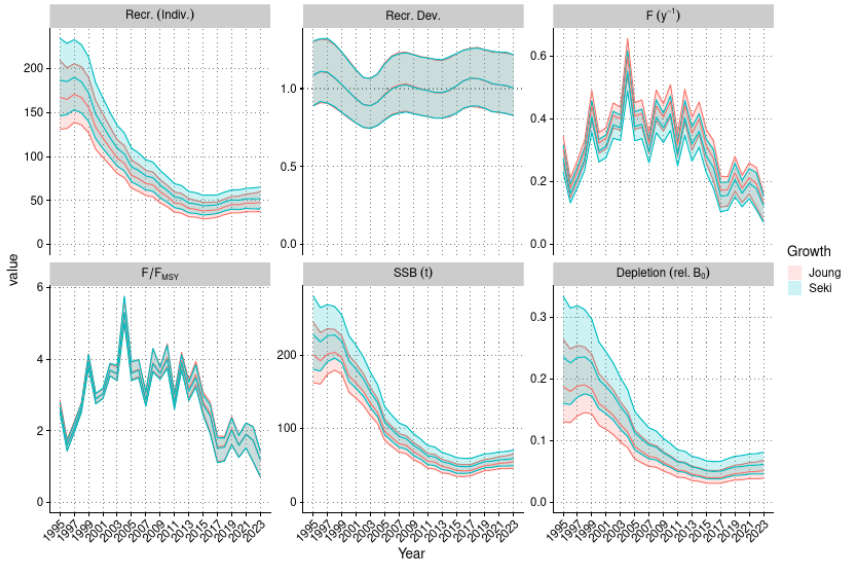
Can show that estimation of management quantities is unbiased over plausible ranges

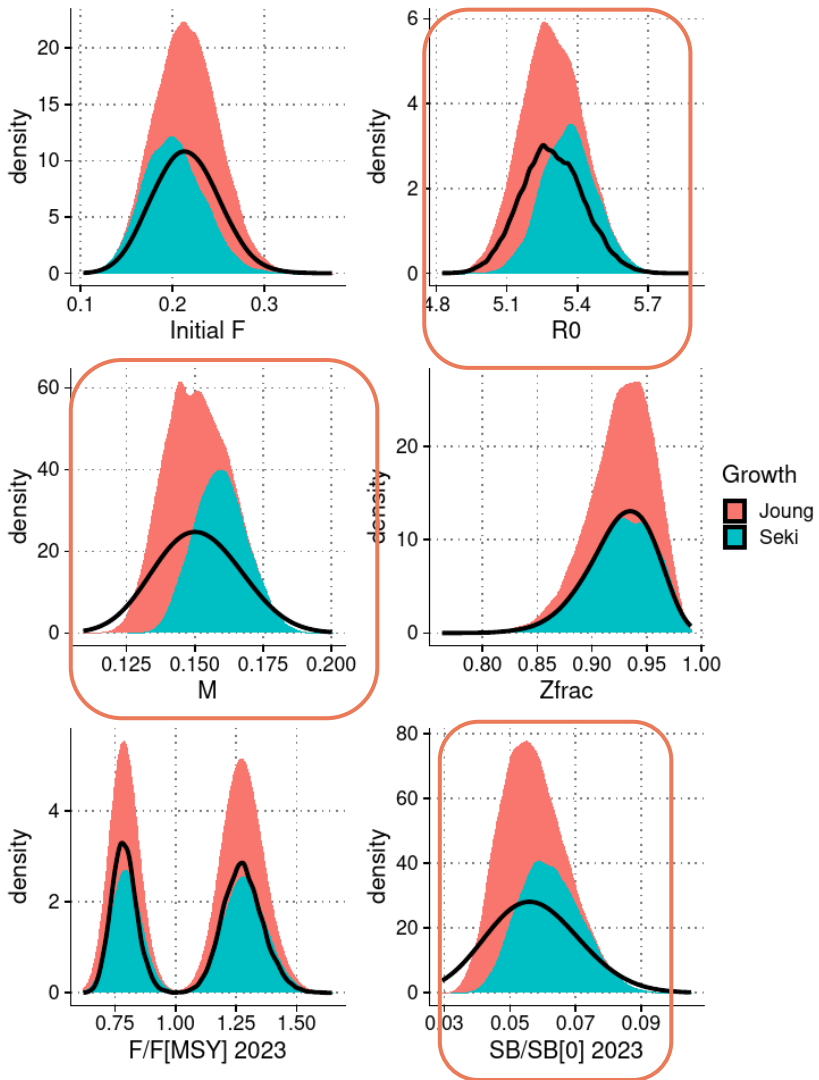




SS3 - Uncertainty

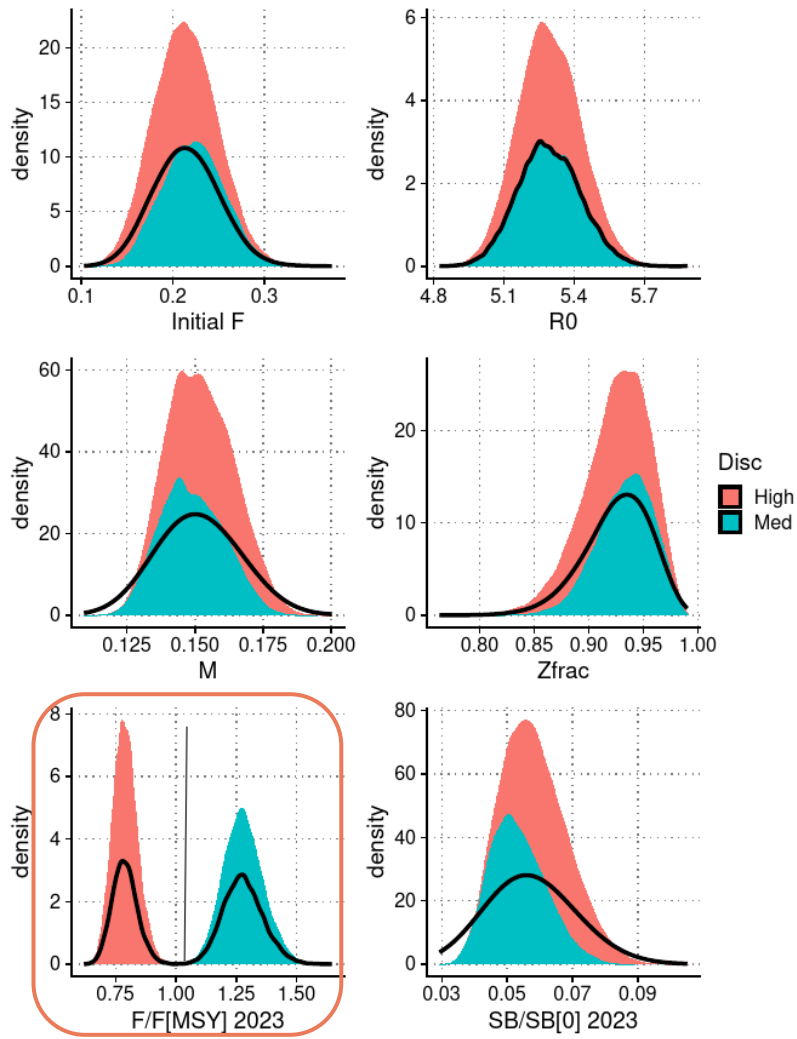
- Growth/M uncertainty key for biomass quantities





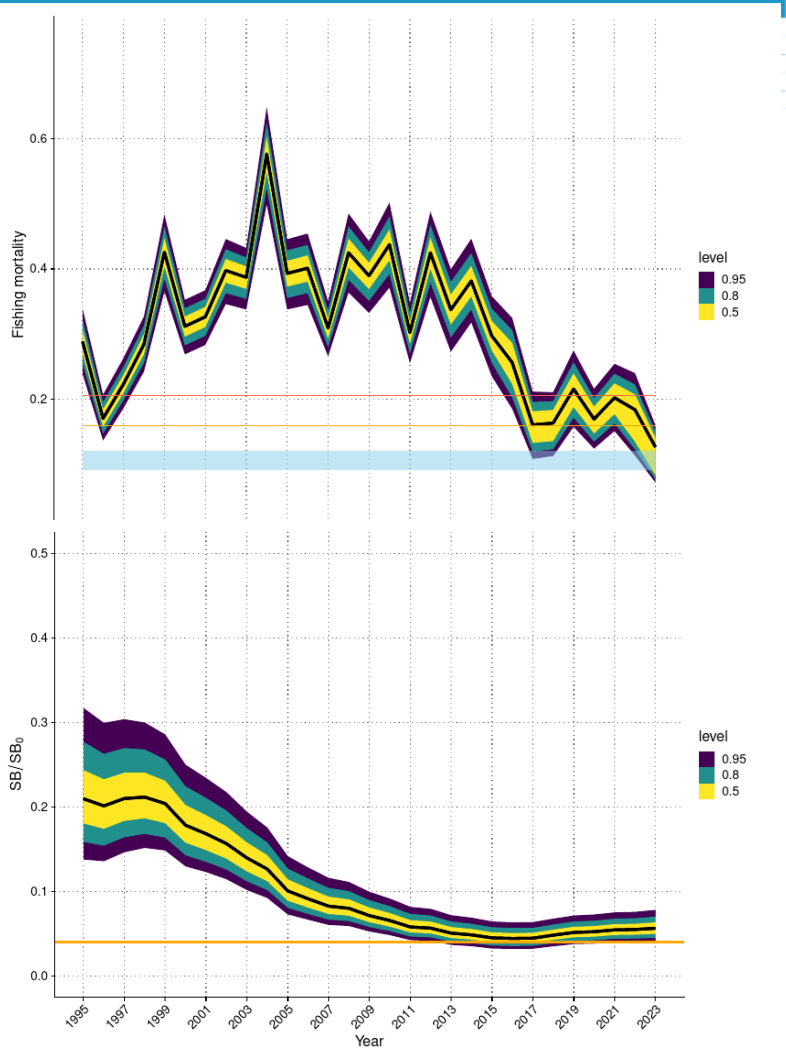
SS3 - Uncertainty

- Growth/M uncertainty key for biomass quantities
- Discard assumptions determine recent F - **low discard models did not work**



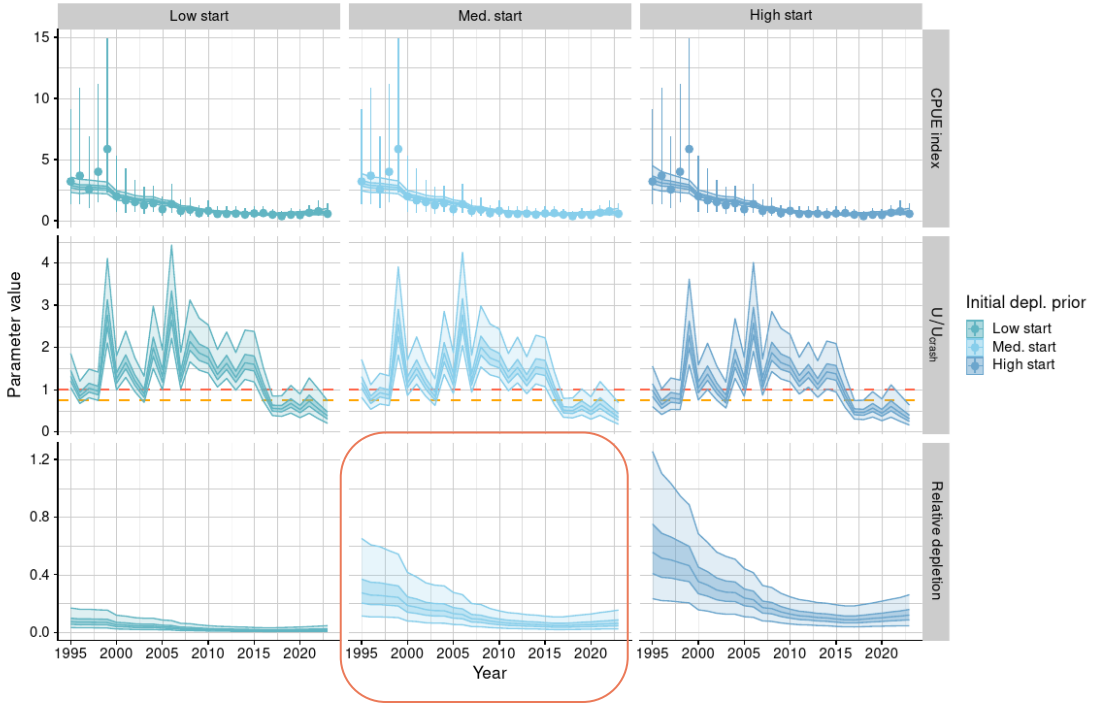
SS3 - trends

- Recent F (2023) likely below suggested limit reference points for F_{lim} , F_{crash}
- Status remains low (6% of unfished SB), but slight increase from low point (4%)



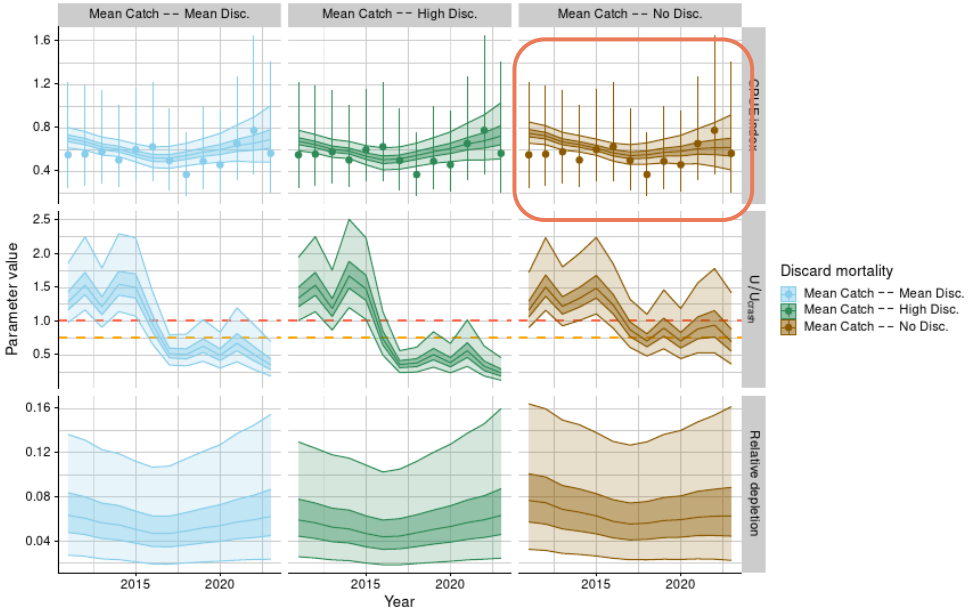
BDM surplus production model

- Cannot estimate initial depletion in BDM - need to make assumptions
- Intermediate initial depletion assumption aligns most closely with SS3



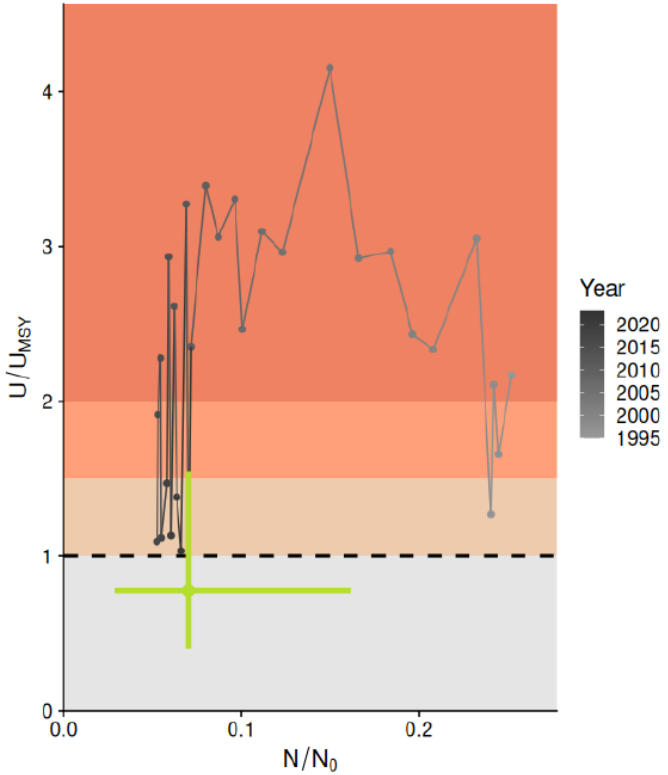
BDM surplus production model

- Cannot estimate initial depletion in BDM - need to make assumptions
- Intermediate initial depletion assumption aligns most closely with SS3
- Poor fit with low discard assumption - not used



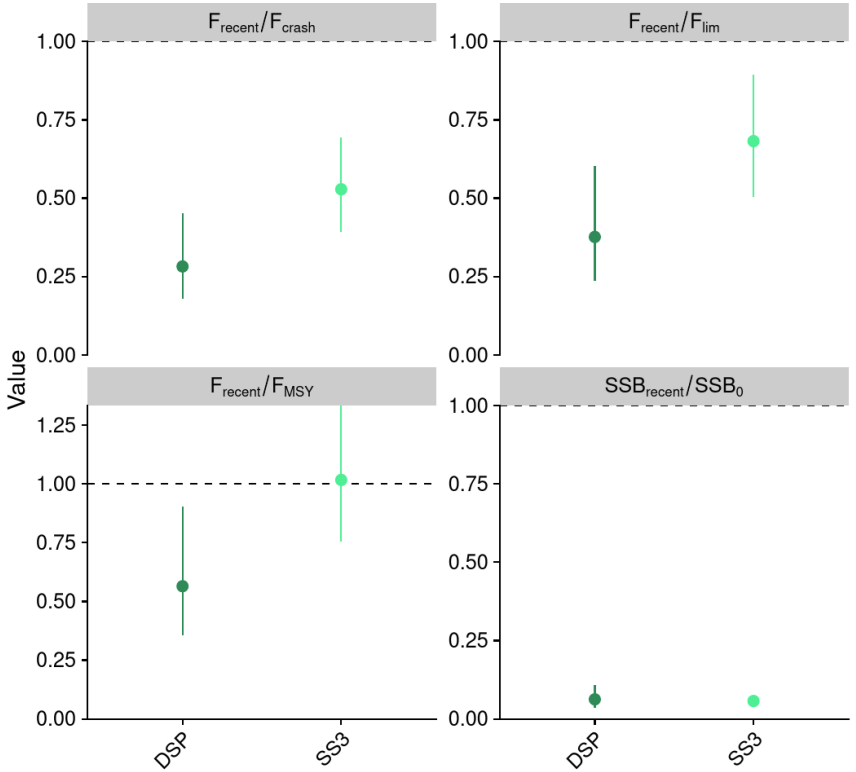
BDM surplus production model

- Cannot estimate initial depletion in BDM - need to make assumptions
- Intermediate initial depletion assumption aligns most closely with SS3
- Poor fit with low discard assumption - not used
- 7% of unfished abundance, fishing mortality more optimistic than SS3



Assessment comparison

- SS3 and BDM have very similar status estimates;
- More optimistic estimates of fishing pressure from BDM



Outcome & Recommendations

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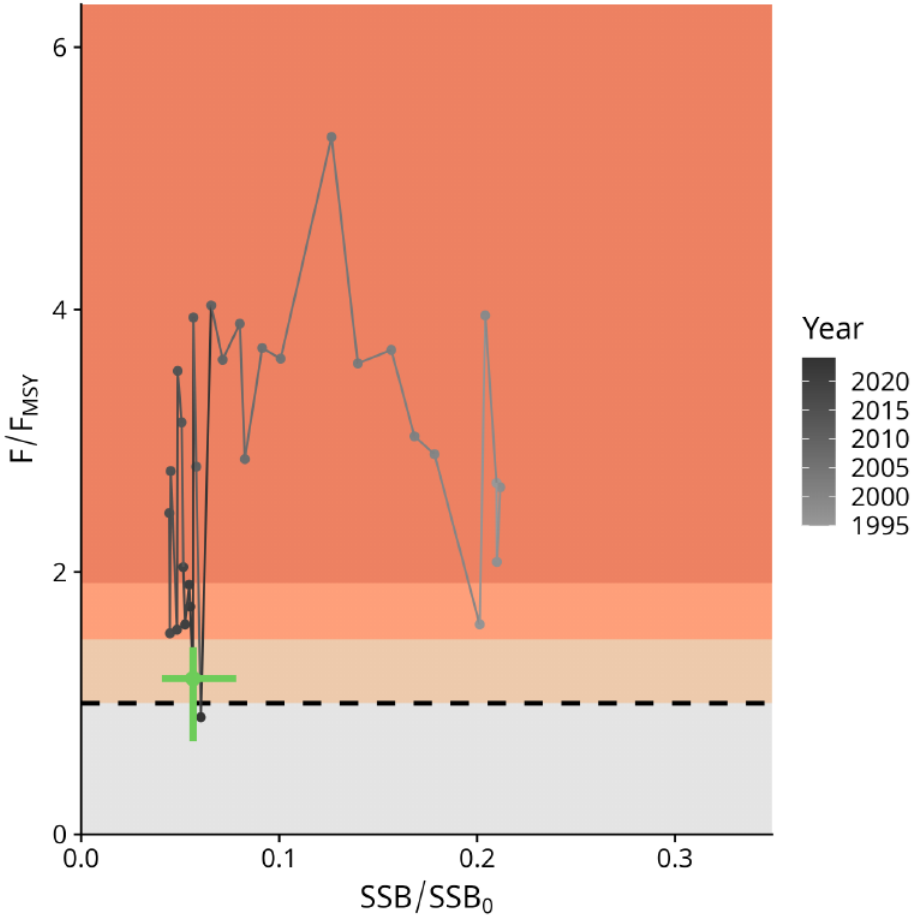
SS3 - key outcomes

- Suggest that the ensemble of SS3 models be used for management advice.
- Recent F (2023) likely below suggested limit reference points for F_{lim} , F_{crash}
- Status remains low (6% of unfished SB), but slight increase from low point (4%)
- Overfishing (wrt MSY) may still be occurring.
- Management measures likely halted declines and have allowed some rebuilding.



Recommendations

- **Improve observer data protocols**: longline observer programmes implement clear and consistent directives for recording all capture events, especially unobserved ”discarded-cut-free” (DCF) individuals.
- **Recording approximate length measurements** for cut-free sharks, a practice already in place in some programmes, should be standardised.
- **Prioritise research on stock structure and connectivity**: Satellite tagging and expanded genetic/genomics studies. **Resolve conflicting life history parameters.**
- **Continue multi-model assessment frameworks**: Given the persistent conflict between CPUE and length data, it is recommended that future assessments continue to use multi-model approaches.
- **Refine historical catch estimates**
- **Review and document recent improvements in shark assessment methodologies (workshop/review)**

Ngā mihi rā.
Thank you for your input!

DRAGONFLY
Data Science

Good with data