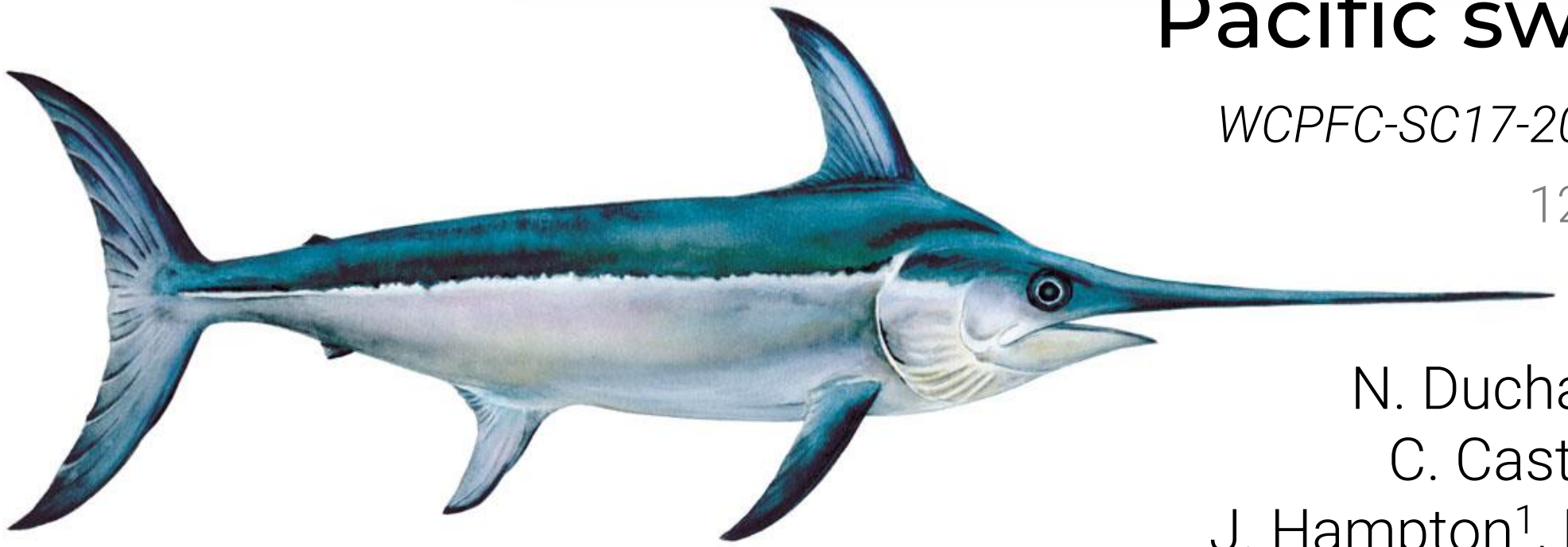
Stock assessment of southwest Pacific swordfish



WCPFC-SC17-2021/SA-WP-04

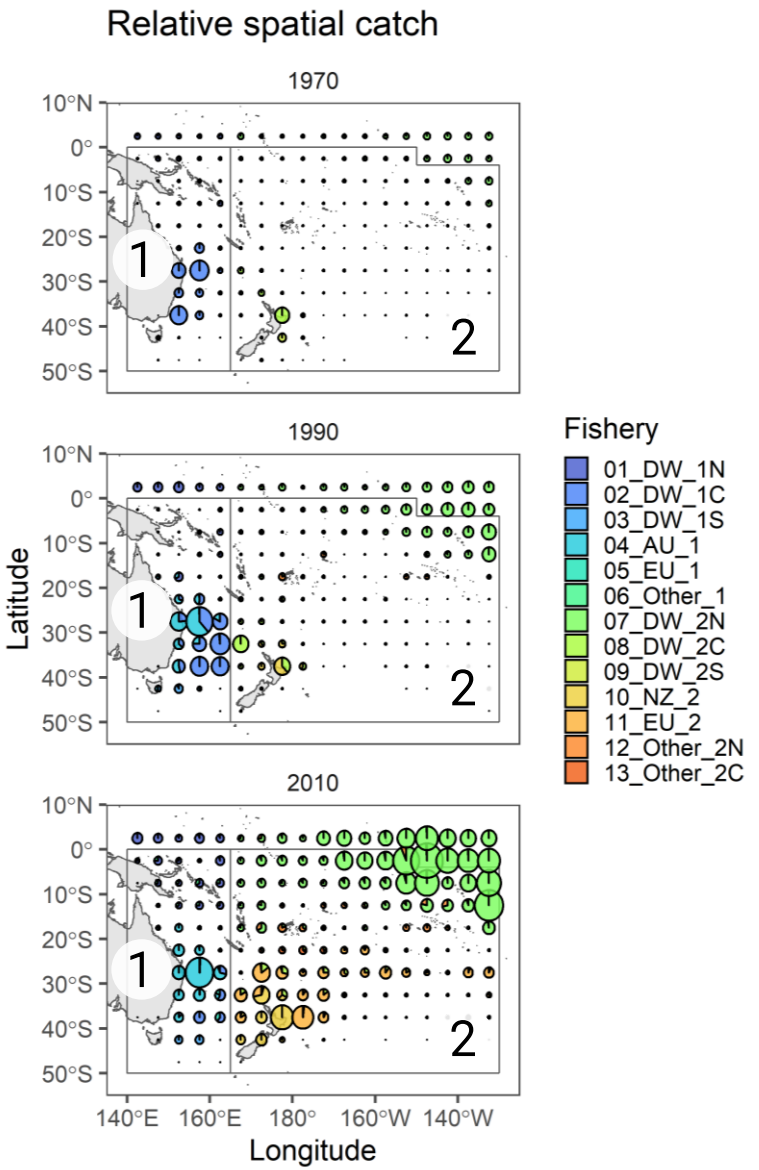
12 August 2021

N. Ducharme-Barth[1], C. Castillo-Jordan[1], J. Hampton[1], P. Williams[1], G. Pilling[1], P. Hamer[1]

1. Pacific Community, Oceanic Fisheries Programme

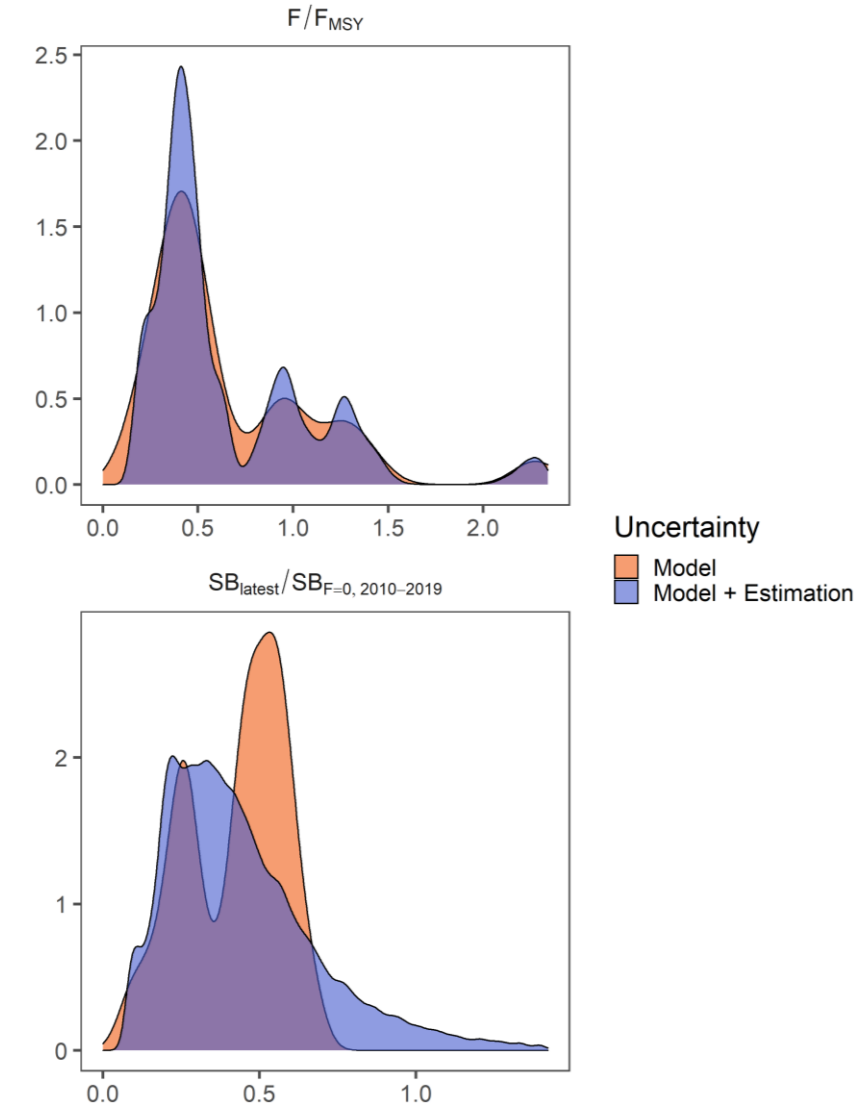
Background

- 2017 assessment indicated non-ignorable risks that the stock was overfished (11%) and undergoing overfishing (32%) according to MSY based reference points ($\frac{SB_{latest}}{SB_{MSY}} < 1$ & $\frac{F_{recent}}{F_{MSY}} > 1$)
- Quarterly fishery and movement dynamics, annual population dynamics: 1952 - 2019
- 2 spatial regions
- 13 extraction fisheries & 2 – 8 index fisheries



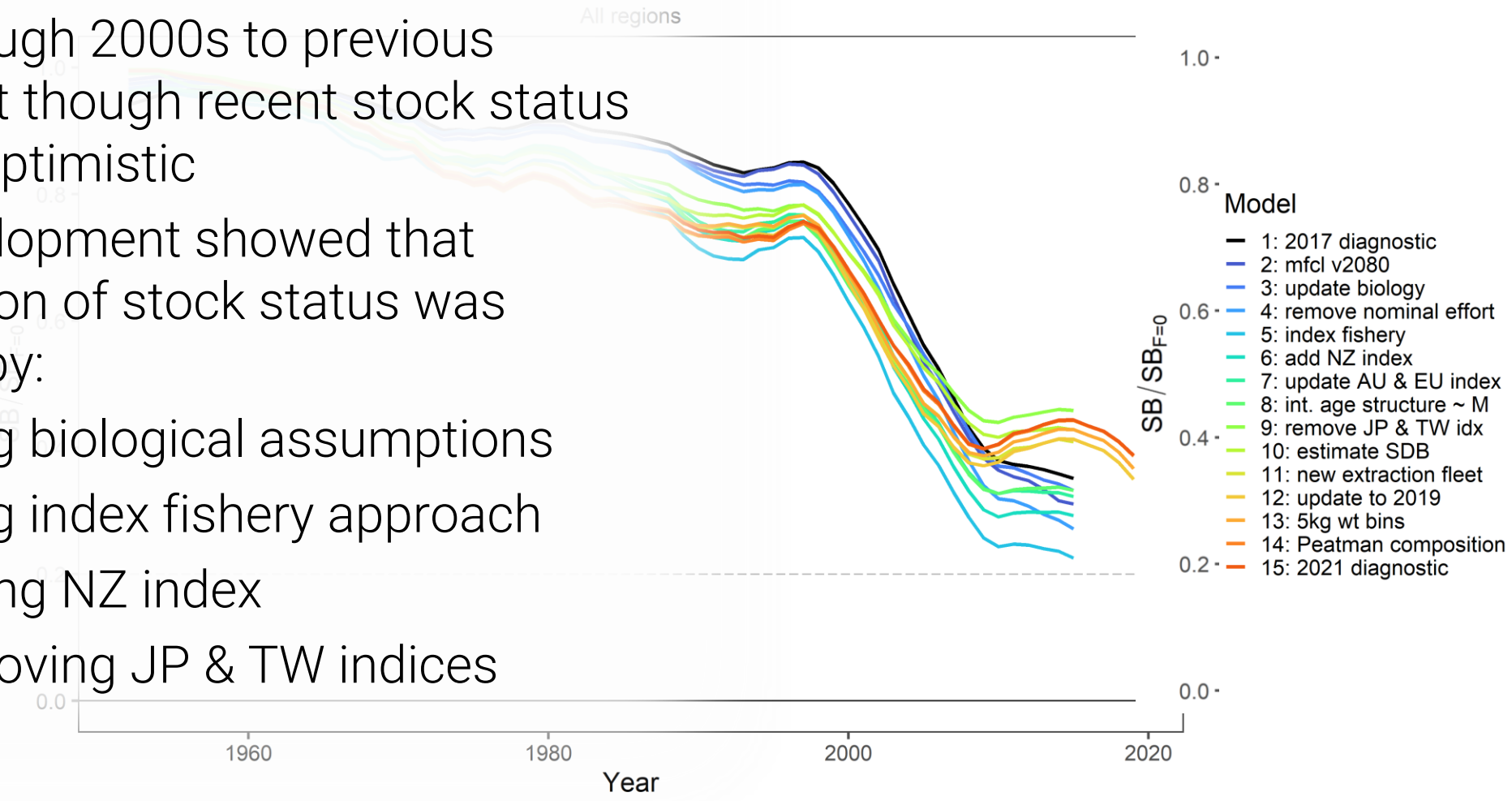
Key developments

- New approach for developing model ensemble & characterizing uncertainty (estimation + model) following *WCPFC-SC17-2021/SA-WP-05*
- Updates biological assumptions and reproductive potential.
- Implementation of index fishery approach & inclusion of NZ index
- All data updated through 2019.
- Development of alternative sex-disaggregated model ensemble



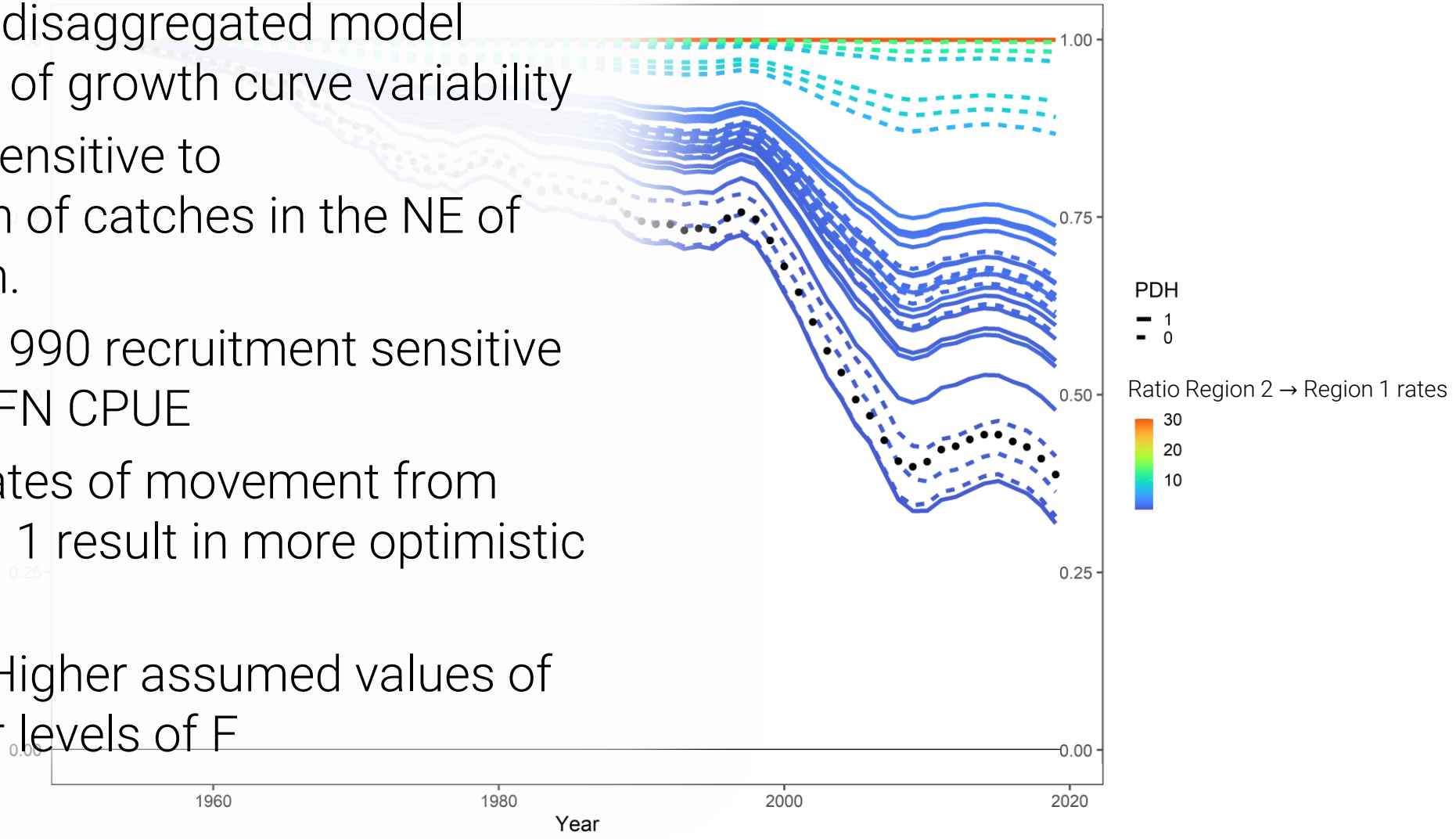
Model development

- 2021 diagnostic case showed similar results through 2000s to previous assessment though recent stock status was more optimistic
- Model development showed that determination of stock status was influenced by:
  - Updating biological assumptions
  - Adopting index fishery approach
    - Adding NZ index
    - Removing JP & TW indices



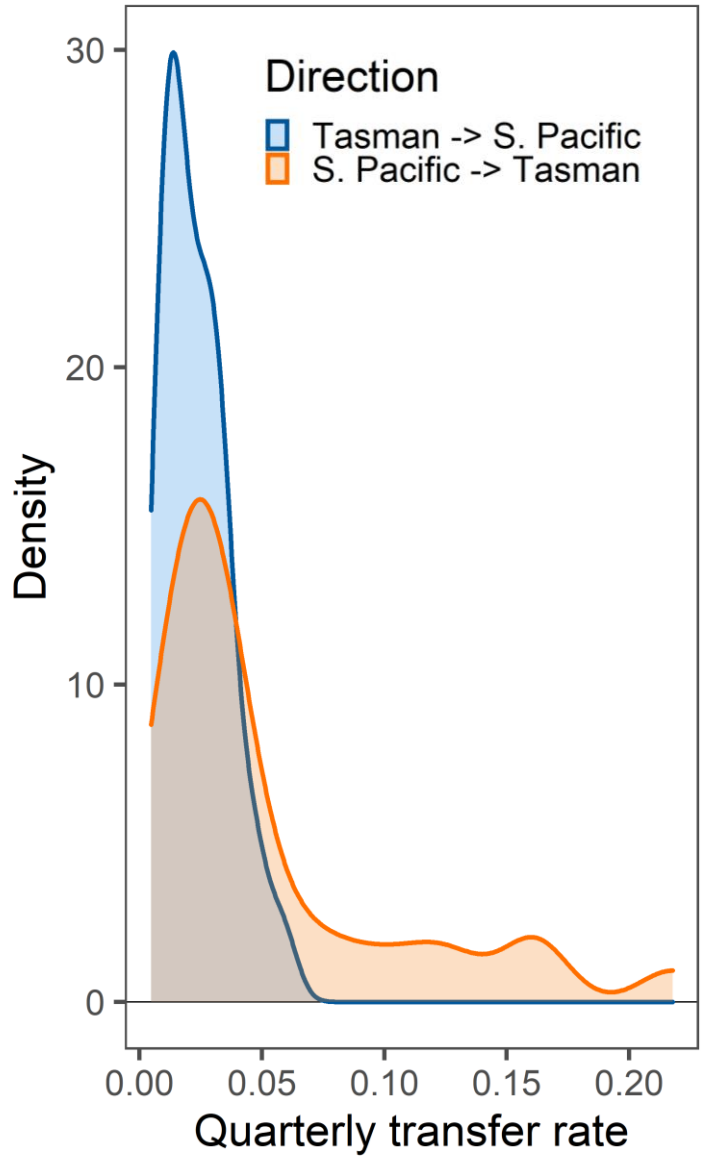
Key sensitivities

- Sex-structure: Sex-disaggregated model sensitive to choice of growth curve variability
- Catch scenarios: Sensitive to inclusion/exclusion of catches in the NE of assessment region.
- DWFN CPUE: Pre-1990 recruitment sensitive to inclusion of DWFN CPUE
- Movement: High rates of movement from Region 2 → Region 1 result in more optimistic stock status.
- Natural mortality: Higher assumed values of M allow for greater levels of F

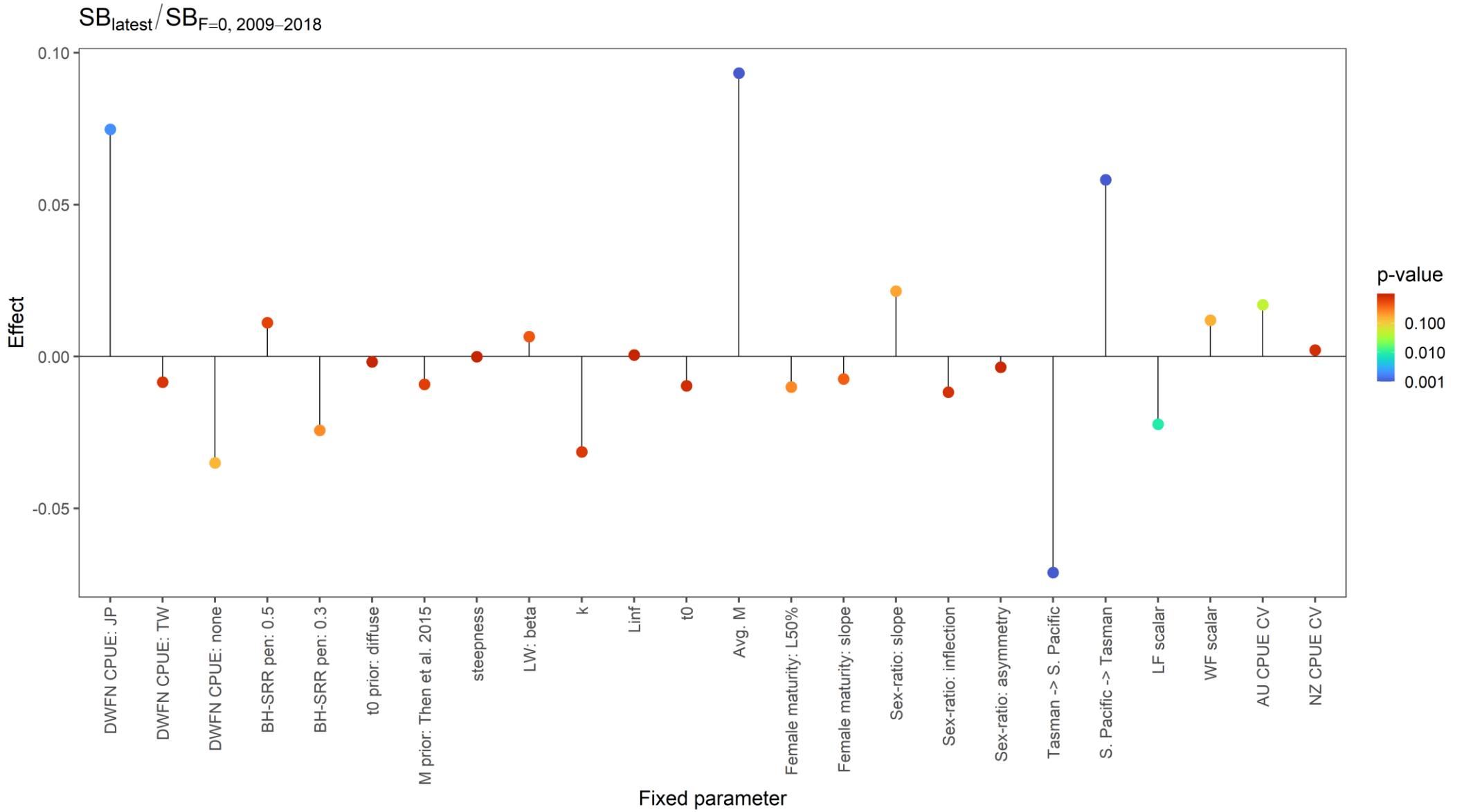


Model ensemble

- Combination of factorial and 'joint prior': 384 total models
- Factorial component: 48 unique combinations, replicated 8 times
  - Choice of DWFN CPUE
    - JP, TW, EU, or none
  - Penalty on recruitment deviations from stock-recruit relationship
    - CV = 0.3, 0.5, 0.7
  - Natural mortality prior
    - Based on VB life-history invariants or maximum-age based
  - Growth – t0 prior
    - Uniformative or informative and centered on 0
- Joint prior: unique parameter combinations for all 384 combinations
  - Biology: Growth, M, movement, steepness, length-weight & reproductive potential
  - Data-weighting: LF scalar, WF scalar & average CPUE CV

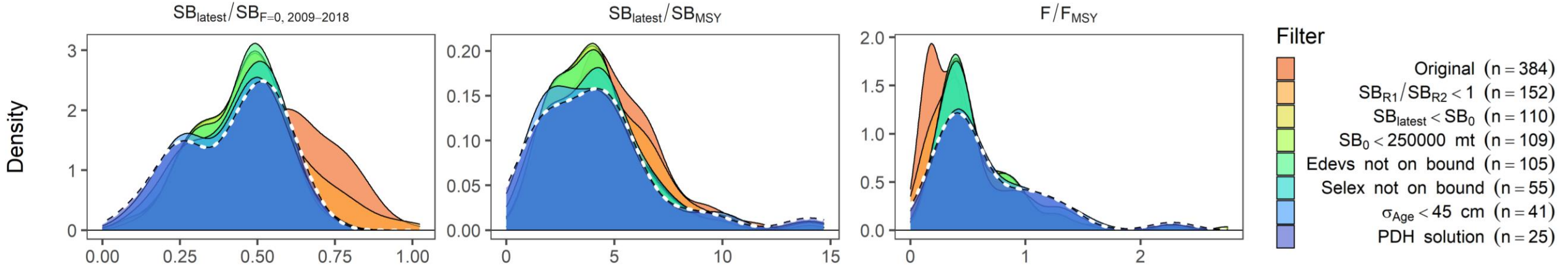


Key sensitivities

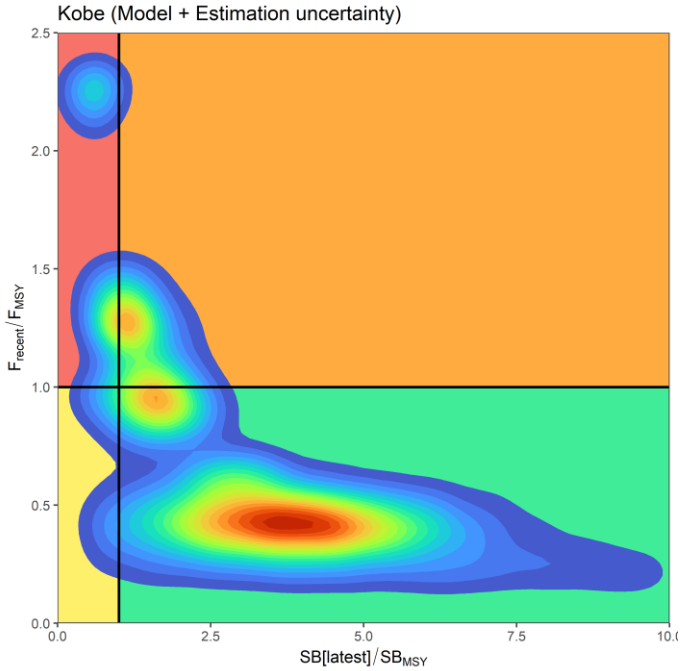


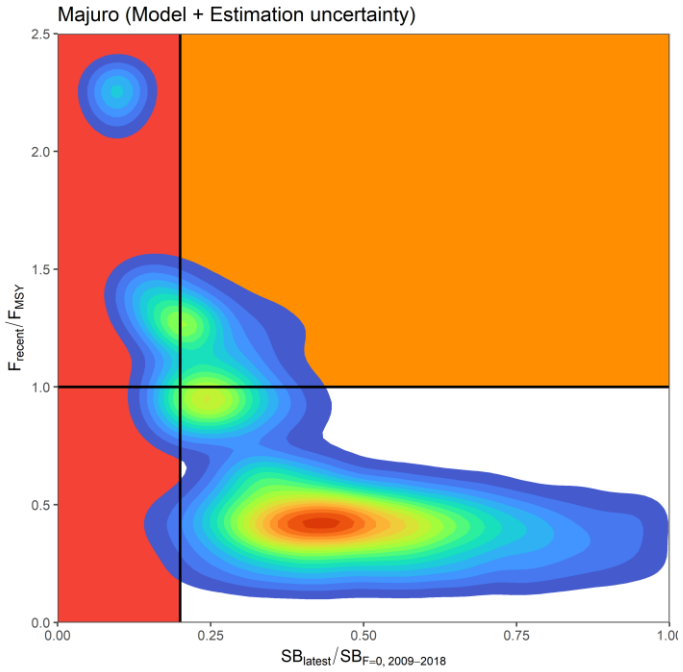
Model retention

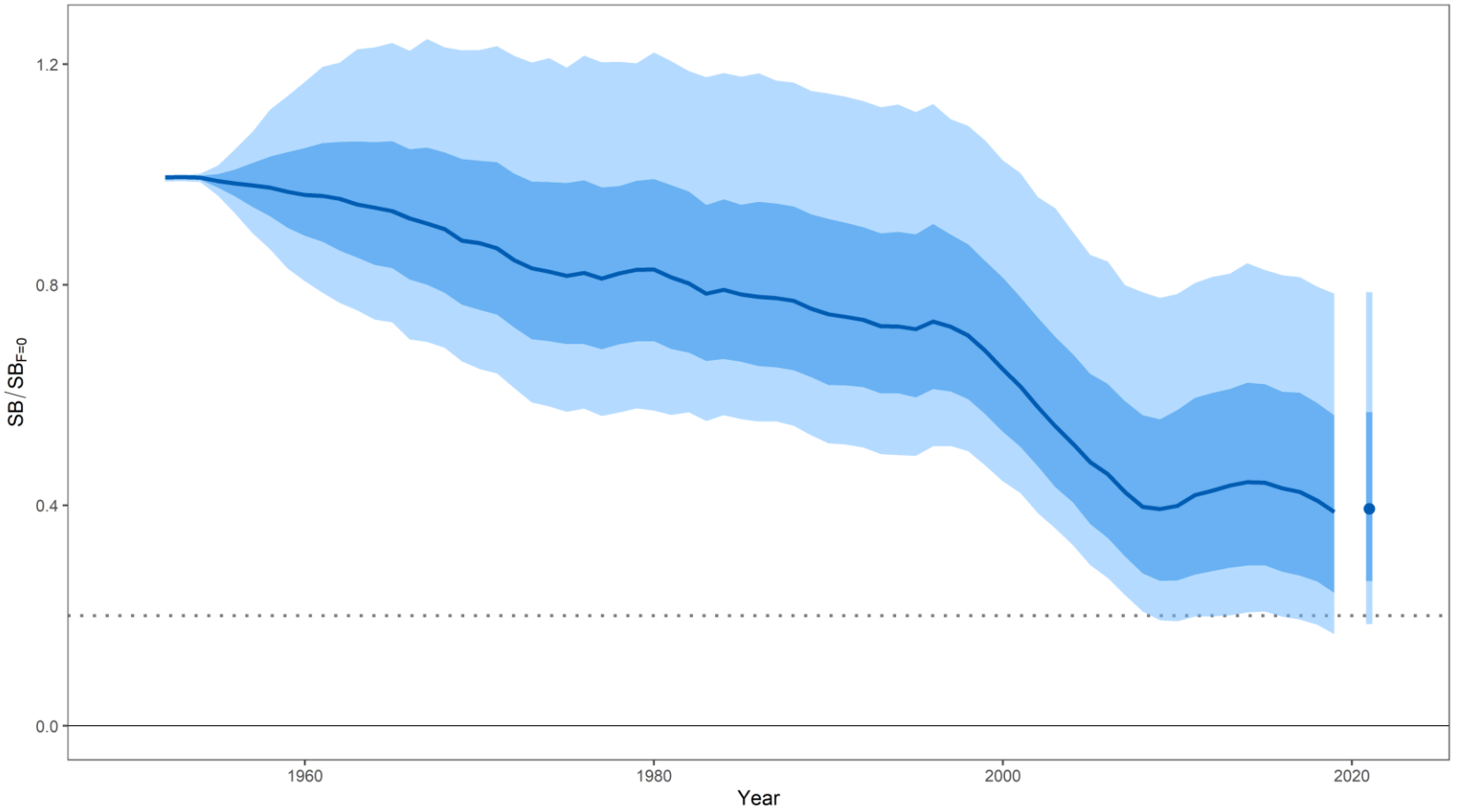
1. Average spawning potential Region 1 (Tasman) < Region 2 (S. Pacific): n = 152
2. Spawning potential 2019 < spawning potential 1952: n = 110
3. Spawning potential 1952 < 250,000 mt: n = 109
4. Effort deviates not estimated on parameter bound: n = 105
5. Selectivity parameters not estimated on bound: n = 55
6. $\sigma_{Age} <$ 45cm: n = 41
7. Model achieves positive definite Hessian solution: n = 25



Stock status







Main conclusions

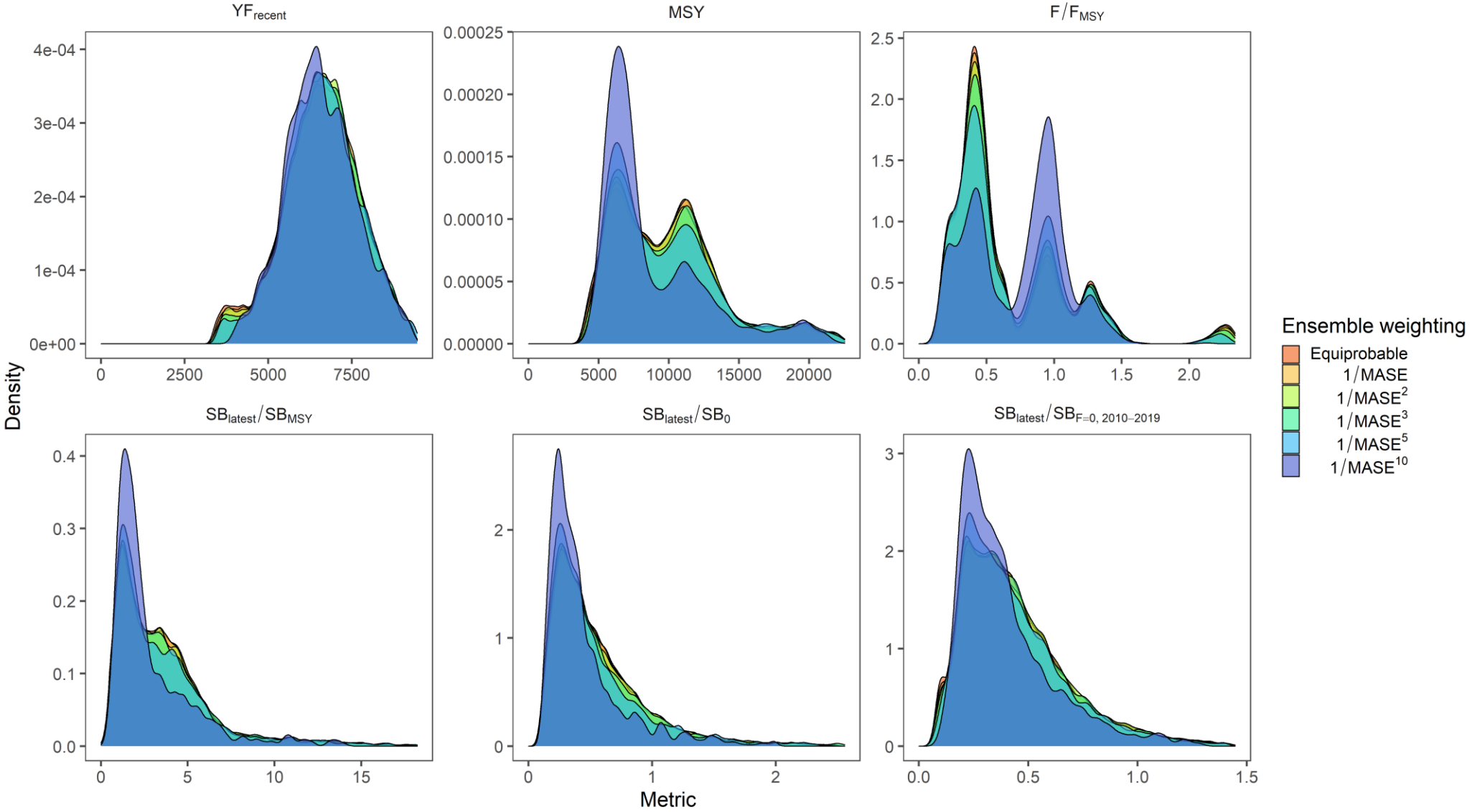
- Relative to 2017 assessment, median estimates of stock status are similar though overall the assessment is less certain. This is expected given the new approach for characterizing uncertainty.
- Uncertainty in the assumed movement rates, and natural mortality are the two predominant contributors to overall assessment uncertainty.
- Model and estimation uncertainty from the final ensemble indicate that the stock is at a 20% risk of undergoing overfishing according to $\frac{F_{recent}}{F_{MSY}} > 1$, and between a 10% - 13% risk of being overfished according to $\frac{SB_{latest}}{SB_{MSY}} < 1$ and $\frac{SB_{latest}}{SB_{F=0}} < 0.2$.
- A sex-disaggregated model ensemble indicated greater uncertainty in stock status with a greater risk (19%) that the stock was overfished according to $\frac{SB_{latest}}{SB_{F=0}} < 0.2$.

Discussion

- Assessment challenges
  - Representativeness of CPUE indices due to restricted spatio-temporal sampling or lack of operational gear covariates for standardization
  - Uncertainty in movement dynamics and population connectivity with high catch regions to the northeast of SWPO
  - Lack of sex-specific data for proper attribution of sex-specific catch/fishing mortality
- Key research recommendations
  - Directed longitudinal tagging of swordfish to reduce movement uncertainty across SWPO & stock structure uncertainty regarding high catch region in NE SWPO
  - Feasibility study to determine if CKMR can improve estimates of total population scale and natural mortality
  - Development of statistical sampling design for biological (sex-specific) samples
  - Expand minimal reporting requirements for longline operational characteristics

Extra slides

Hindcast weighting



Stock structure sensitivity