



SC20-SA-WP-02 South Pacific albacore stock assessment

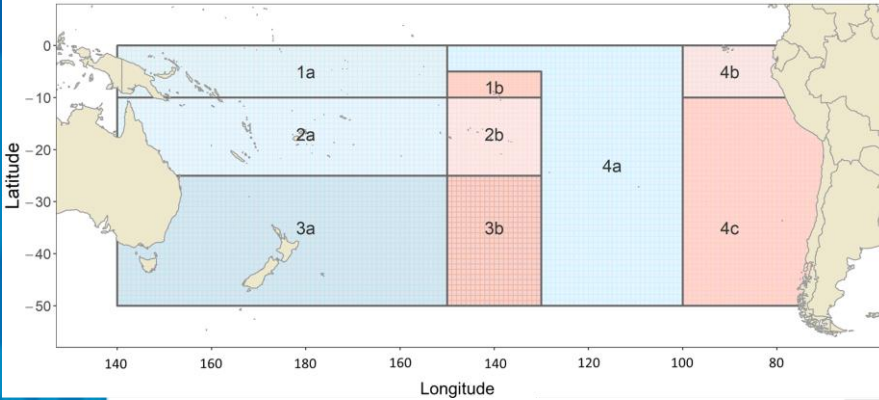
SPC-OFP
August 2024

Model regions

2021

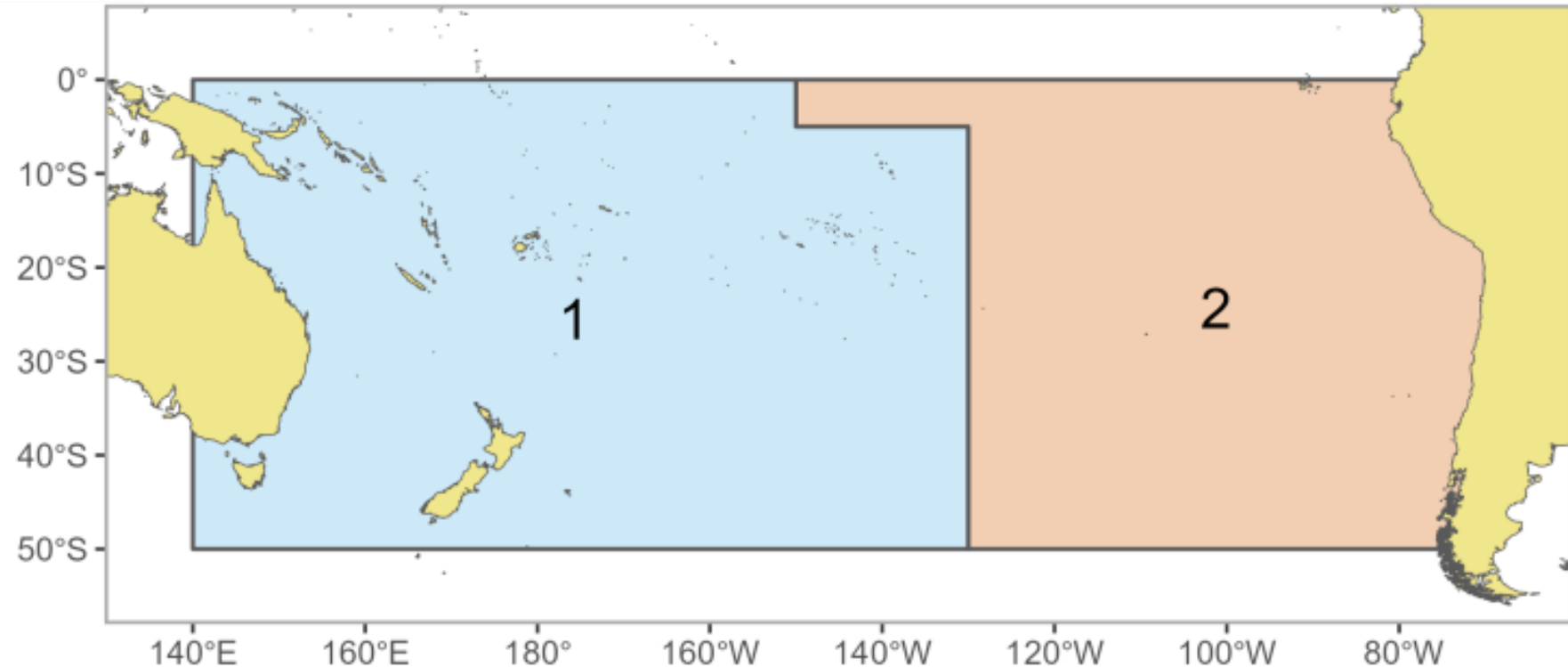
Guidance from:

- Previous SAs
- YFT peer-review (2022)
- CAPAM 'Tuna Stock Assessment Good Practices Workshop' (2023)
- PAW (2024)



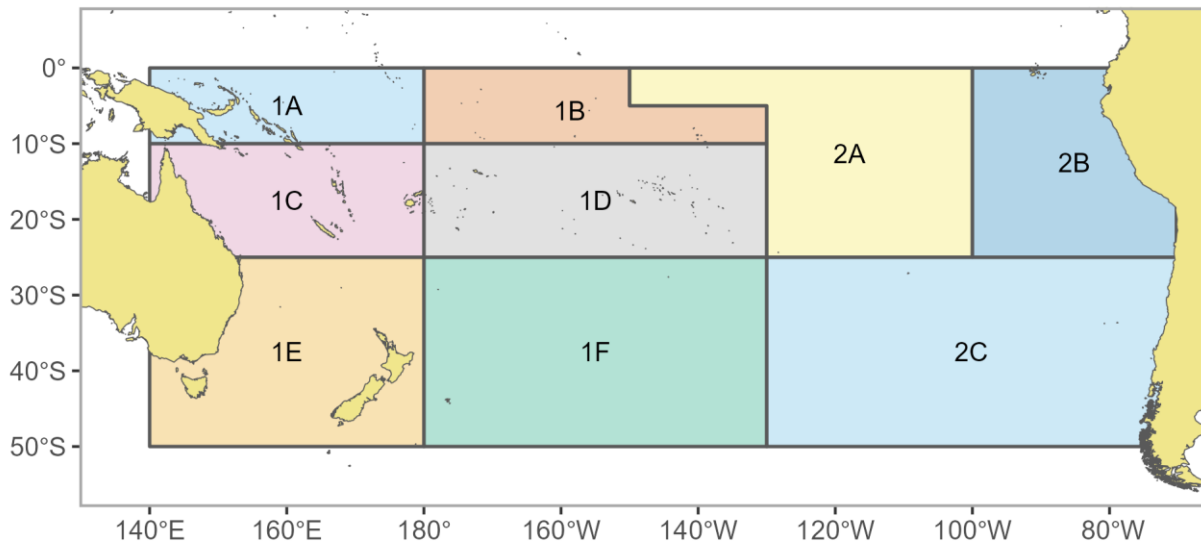
- 3 more years of data
- Simplify the spatial structure to 2 regions

2024



Areas-as-fleets

- Informed by regression tree analysis using longline length data



Fishery Number	Gear	Model Code-Fleets	Flags	Model Region
1	LL	1.LL.DWFN.1a	DWFN	1
2	LL	2.LL.DWFN.1b	DWFN	1
3	LL	3.LL.DWFN.1c	DWFN	1
4	LL	4.LL.DWFN.1d	DWFN	1
5	LL	5.LL.PICT.1ab	PICT	1
6	LL	6.LL.PICT.1cd	PICT	1
7	LL	7.LL.AZ.1abcd	AU/NZ	1
8	LL	8.LL.DWFN.1ef	DWFN	1
9	LL	9.LL.PICT.1ef	PICT	1
10	LL	10.LL.AZ.1ef	AU/NZ	1
11	TR	11.TR.ALL.1e	ALL	1
12	TR	12.TR.ALL.1f	ALL	1
13	DN	13DN.ALL.1ef	ALL	1
14	LL	14.LL.EPO.2a	ALL	2
15	LL	15.LL.EPO.2b	ALL	2
16	LL	16.LL.EPO.2c	ALL	2
17	TR	17.TR.EPO.2abc	ALL	2
18	LL	18.LL.INDEX.1abcd	INDEX	1
19	TR	19.TR.INDEX.1ef	INDEX	1
20	LL	20.LL.INDEX.2abc	INDEX	2

- Annual index of abundance from LL (WCPFC-CA (north 25S) and rest of EPO)
- Juvenile index from WCPFC-CA troll
- Troll data important to 'control' recruitment estimates

Biology

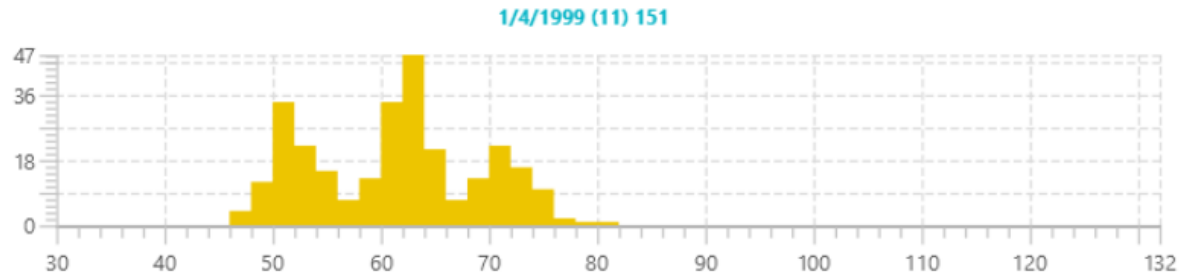
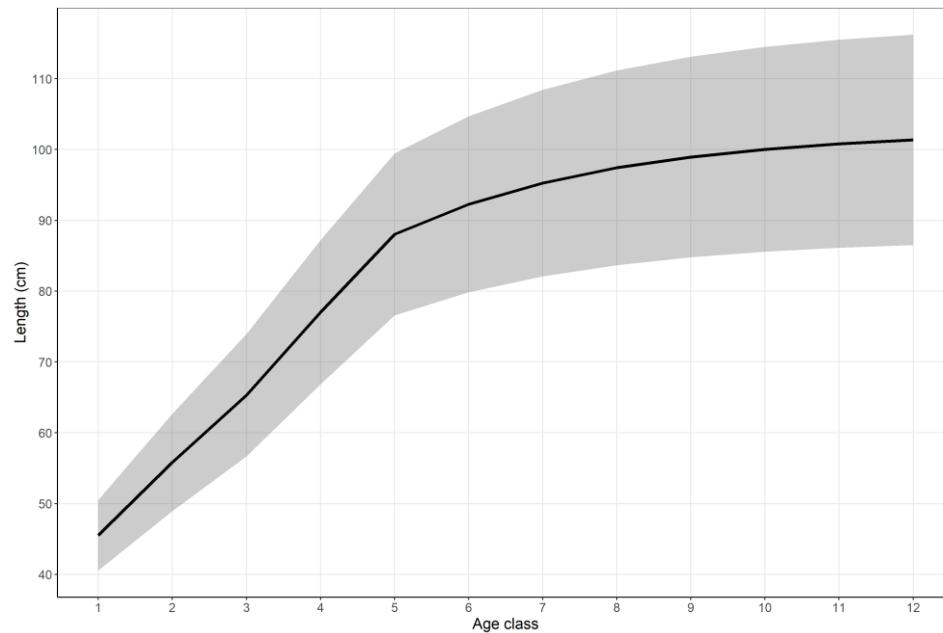
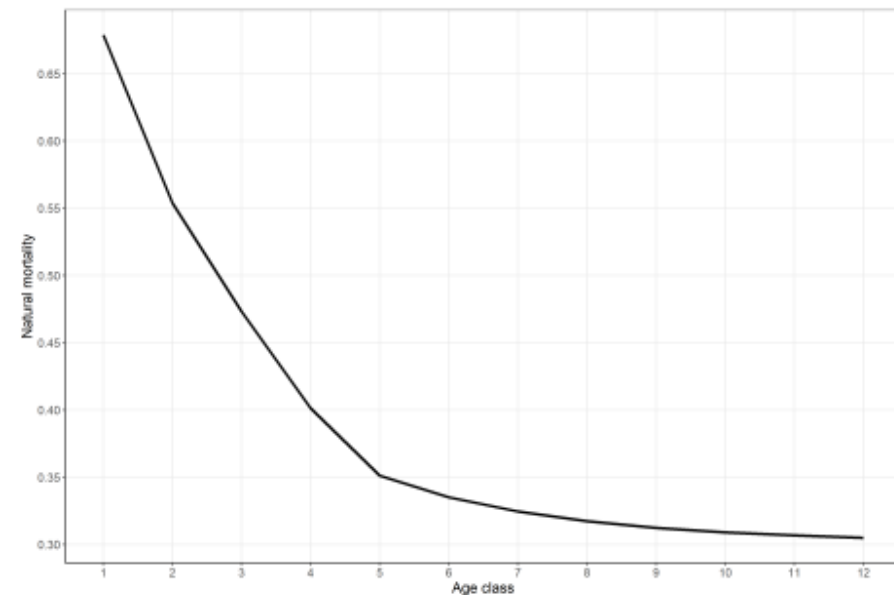


Figure 9: A segment of NZ troll fishery length-frequency data demonstrating strong modal structure representing annual age classes.

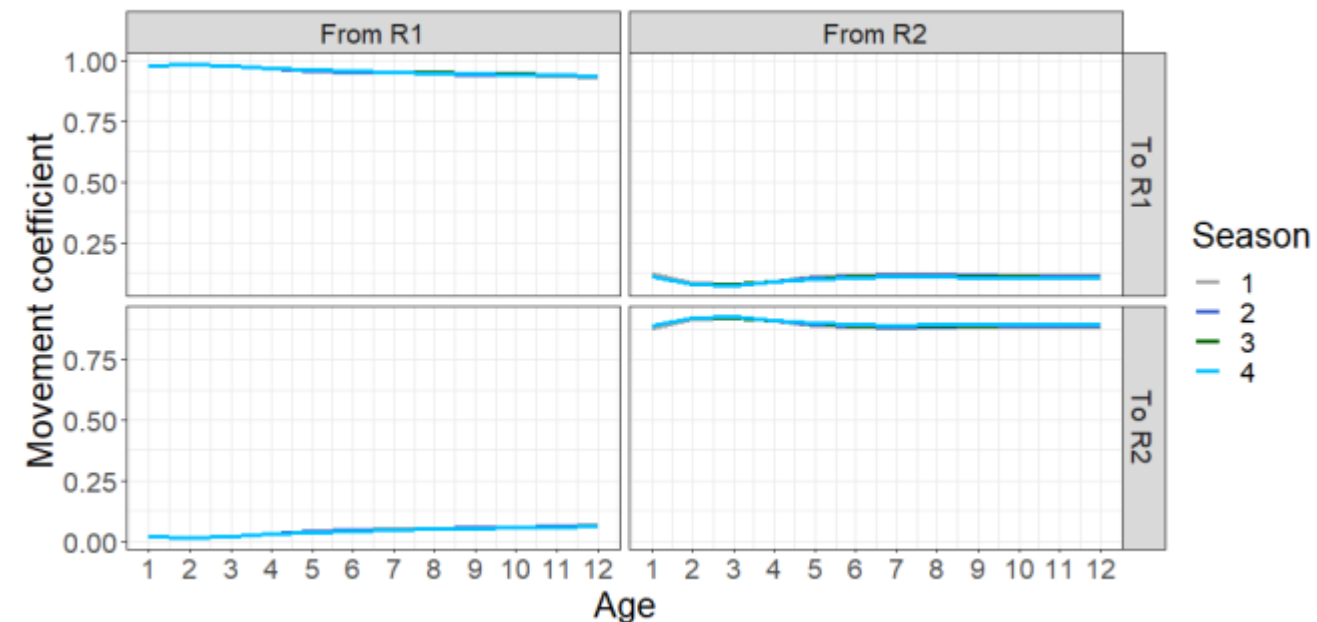
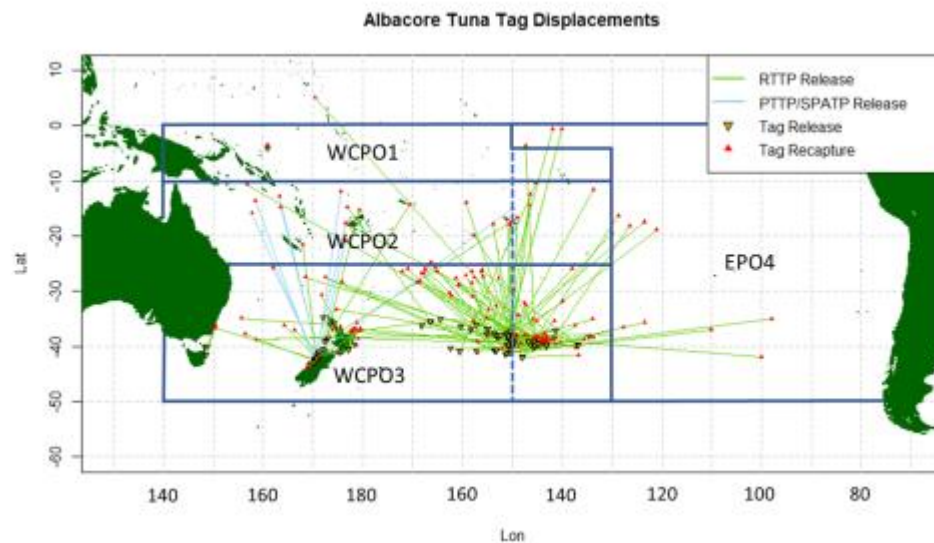


- Growth – informed by conditional age-at-length (otoliths) & size data
 - Know there is growth differences W/E
 - Effort to fit modes in the troll size data
 - VB with 'offsets' to fit ages 2-4 yrs
- M – Based on Lorenzen formulation
 - Avg adult M ~ 0.36 (max-age based; Hamel and Cope 2022)
- L-W relationship updated



Movement/recruitment

- Not really much information from tags (although long times at liberty)
 - Movement generally north/south
- Use SEAPODYM estimated movement between regions
 - Pretty low movement E/W
- SEAPODYM also used to fix recruitment distribution ($\sim 0.82/0.18$)
- Recruitment changed from quarterly to annual (occurring in October)



Fishery data – length data

- Weighted through Francis weighting approach

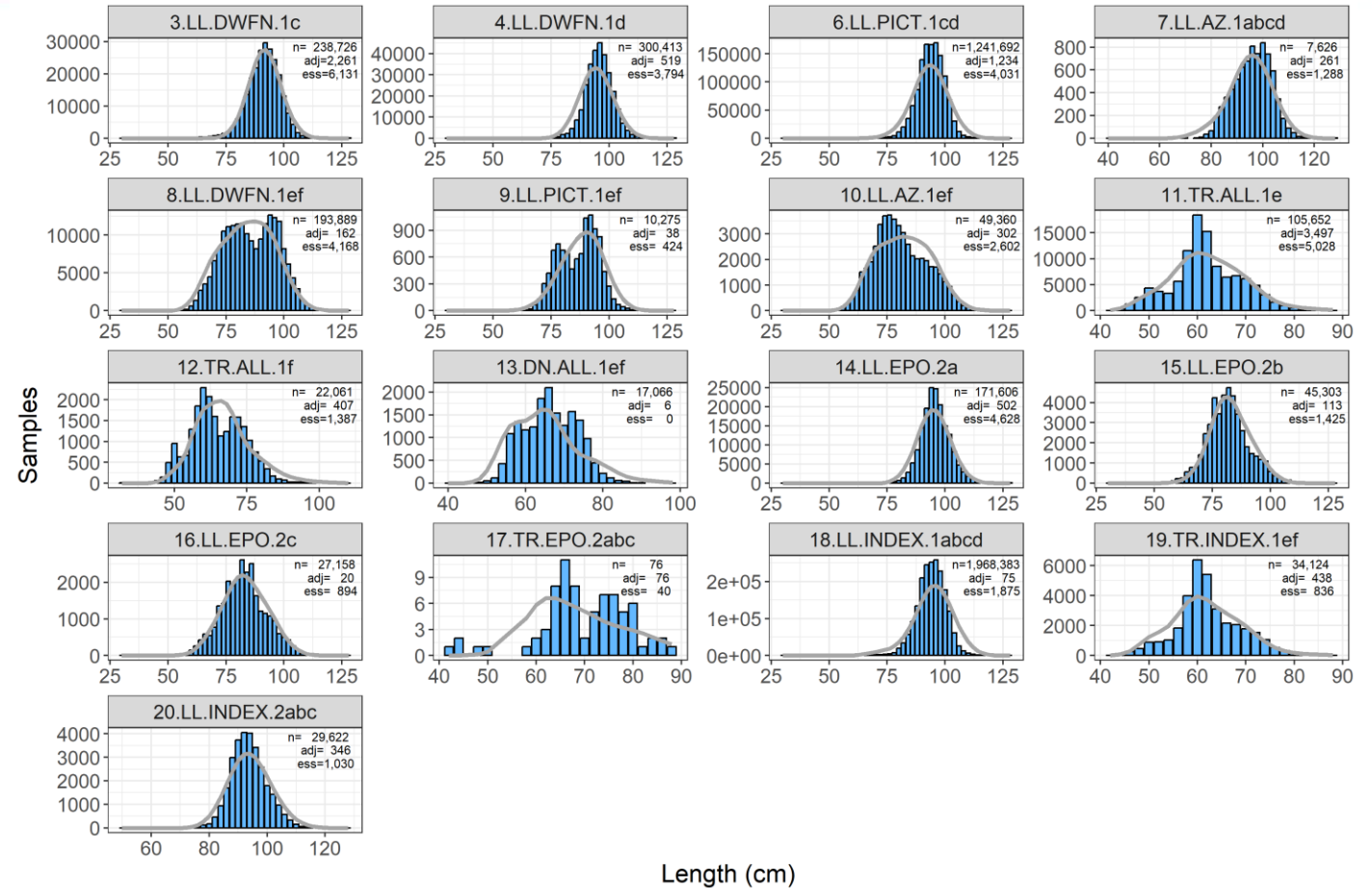
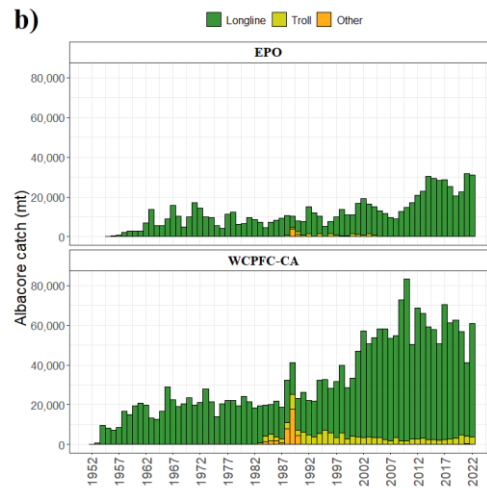
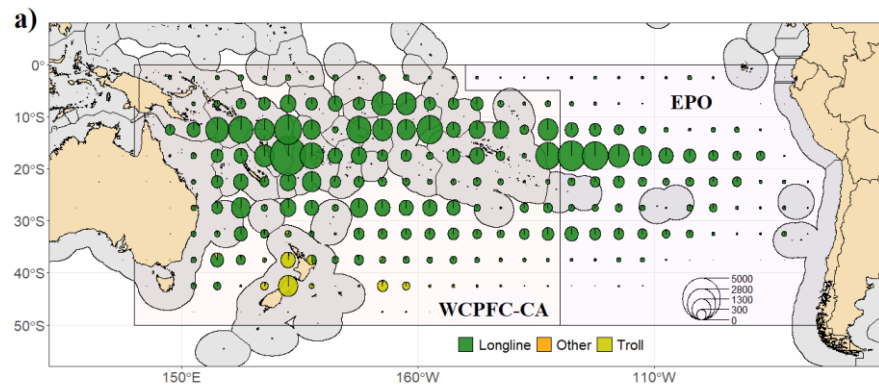
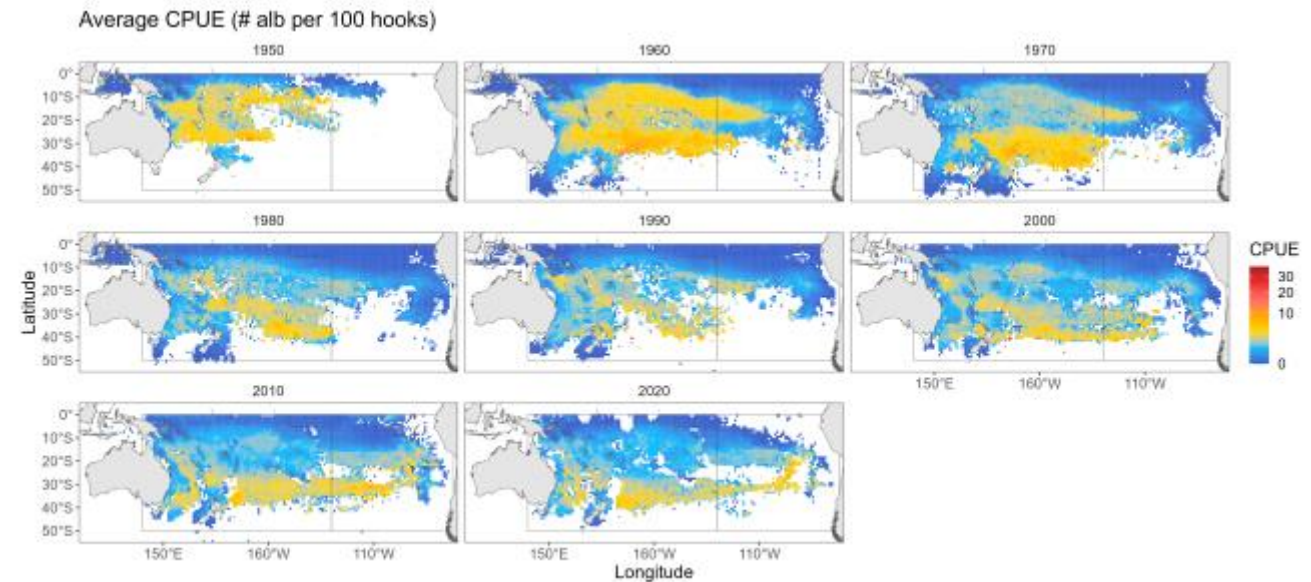
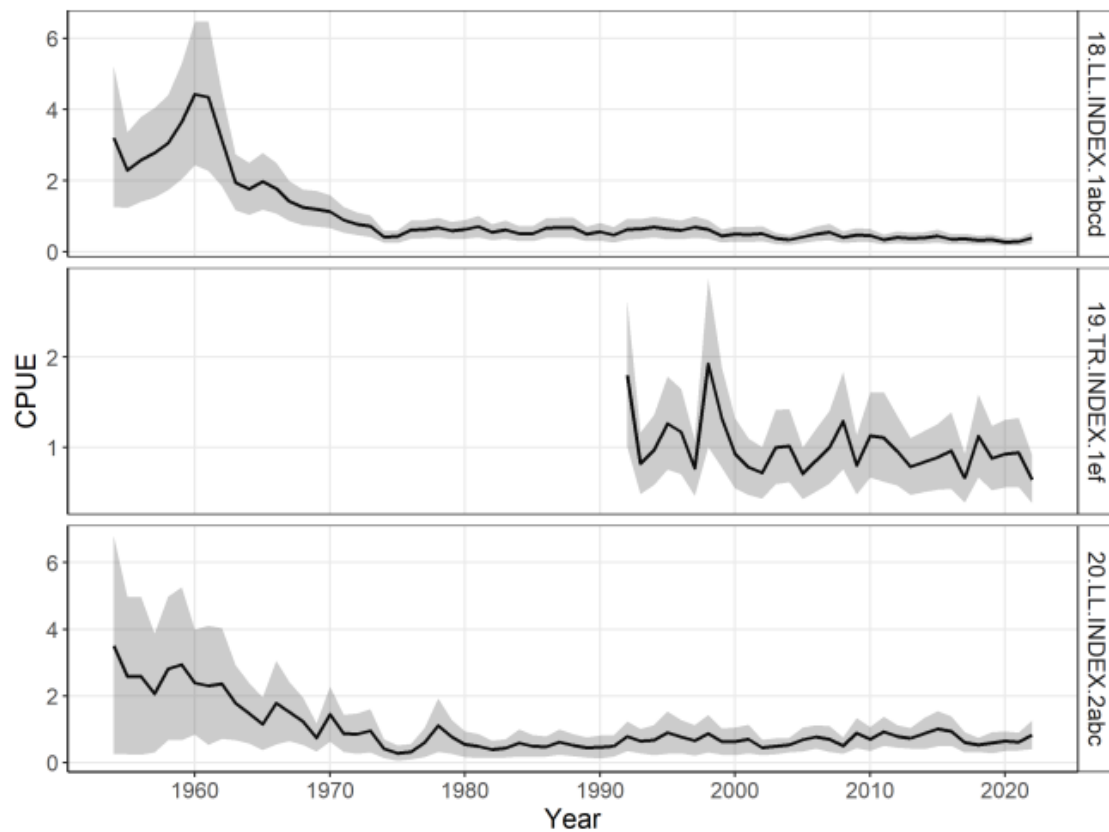


Figure 20: Aggregated (over time) observed (blue histograms) and predicted (grey lines) catch-at-length for longline, troll, and driftnet fisheries with sample sizes for the diagnostic case model. Includes the estimated effective sample size (ess) as derived from the robust normal likelihood, the adjusted input sample size (adj) as scaled by the Francis weighting method, and the observed sample size (n).

Fishery data – CPUE trends

- Time-varying CVs in MFCL

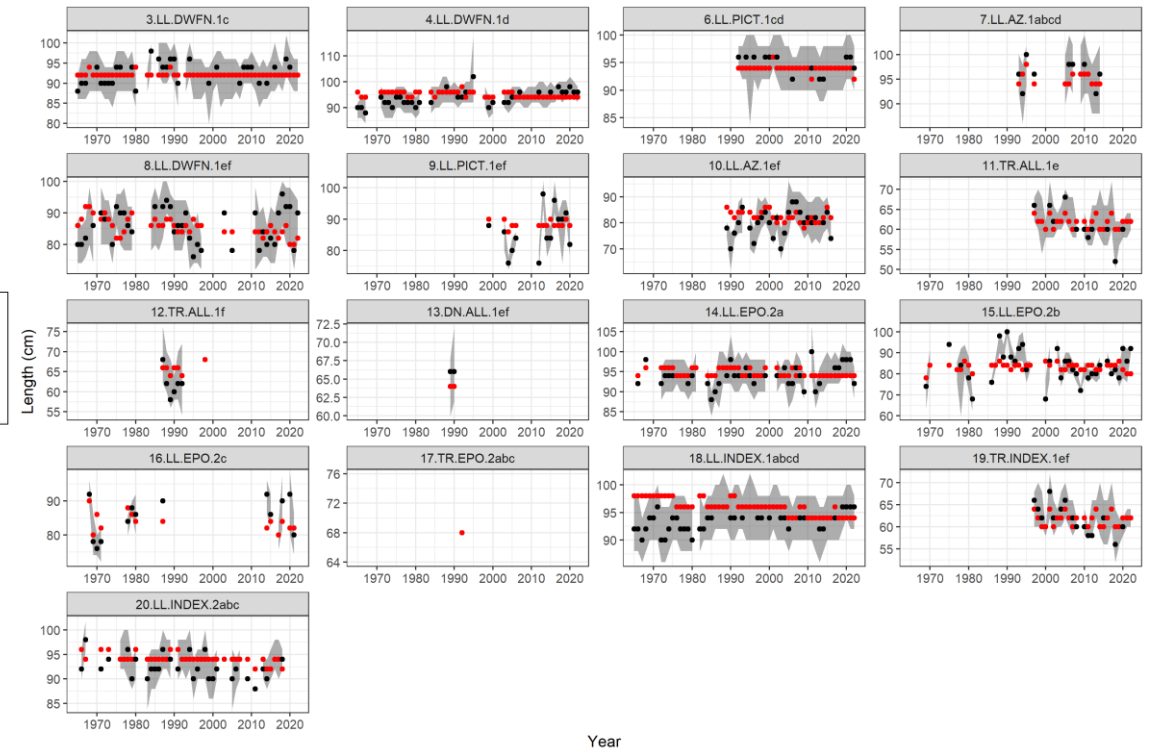
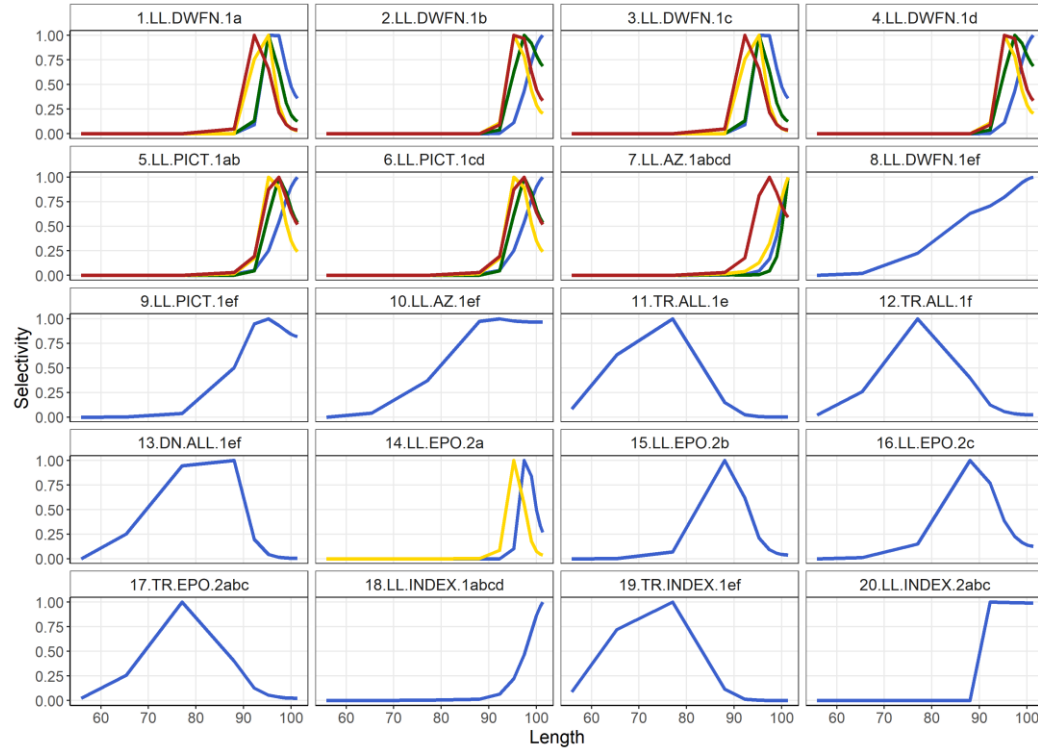


- Model period Q1 1954 to Q3 2022
- CPUE follows an annual time step

The model

- Direction for simpler assessments - simplified region structure, annual model
- ‘Catch-conditioned’ – exact solution of catch equation for fishing mortality – no estimation of effort deviations and catchability
 - Large parameter reductions, aids with positive-definite hessians, and greatly reduce model run times
- Size data – 50 x 2cm size classes
 - Needed considerable work on the data – provision at different size bins
- Initial population (1954) – unexploited
- Stepwise approach to development from previous model
 - Note big step from ‘complex’ to ‘simple’ in early step – not the standard stepwise

Quick diagnostics



Year

Quick diagnostics

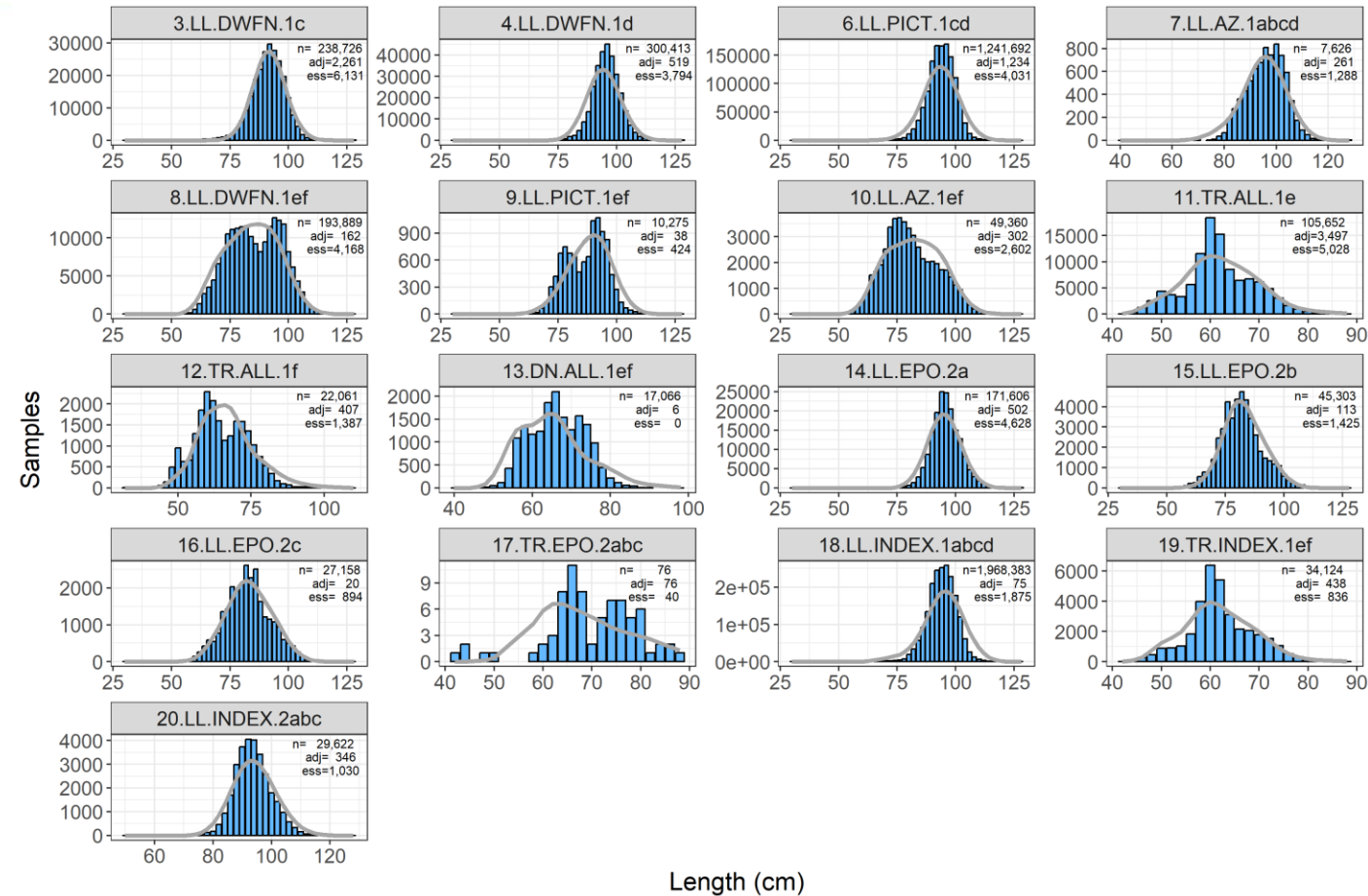
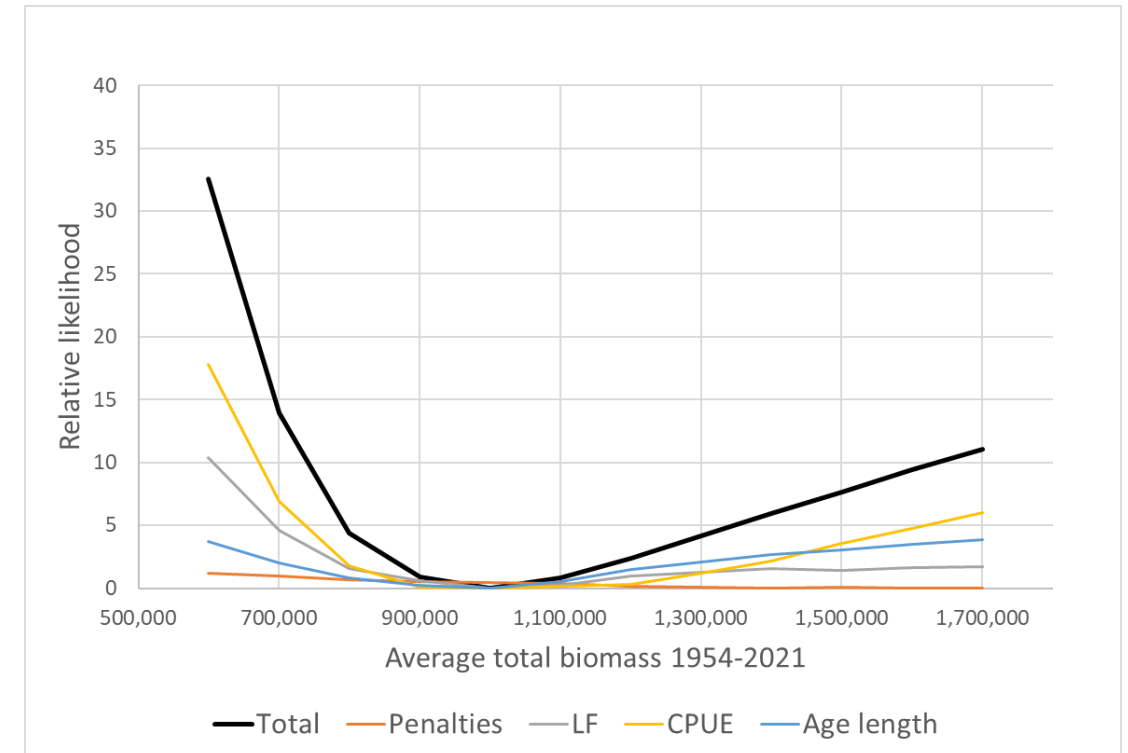
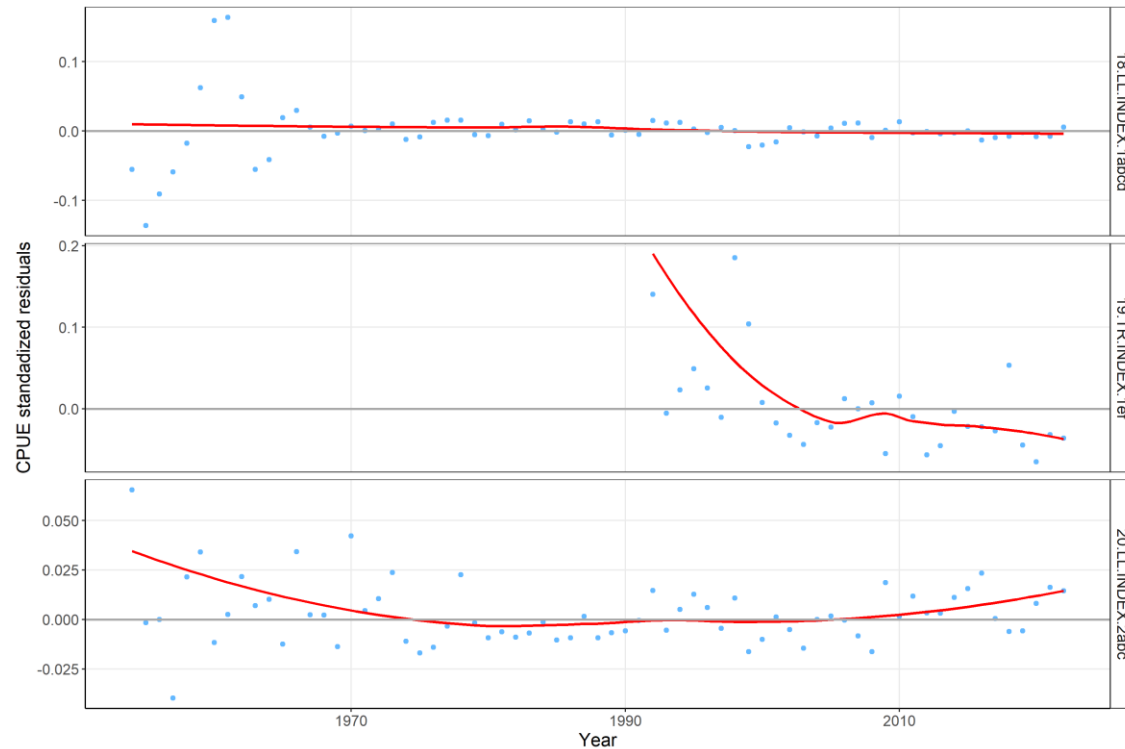


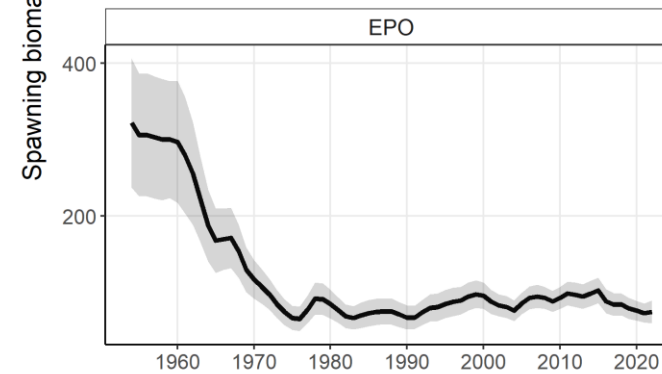
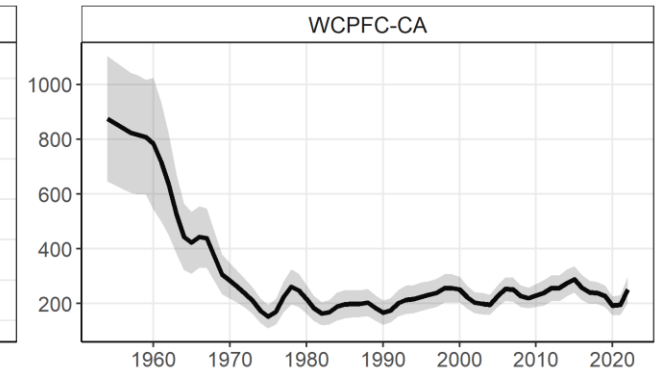
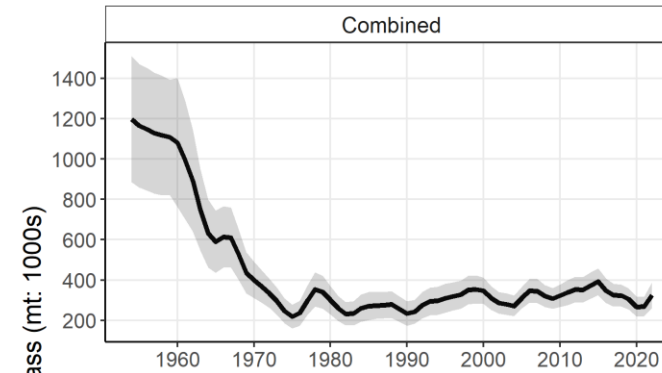
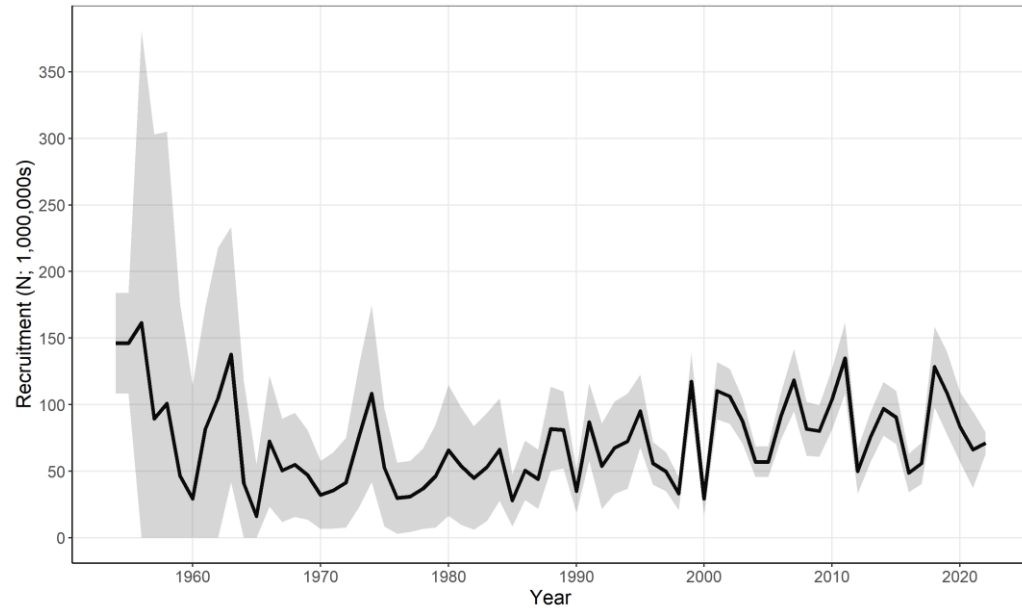
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Quick diagnostics



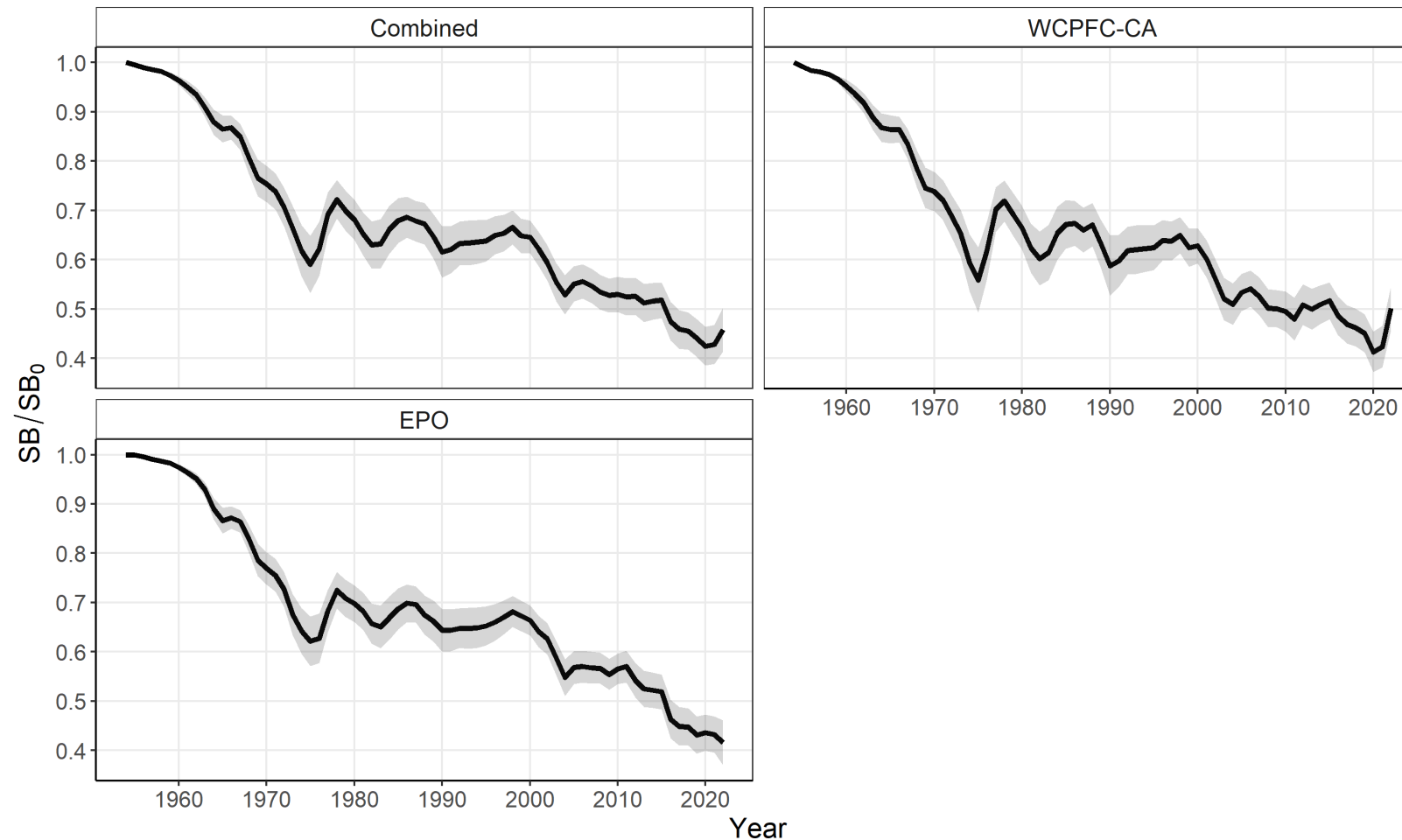
- Retrospectives pretty good too
- Stable to Jittering

Diagnostic model outcomes



Year

Diagnostic model outcomes



- Also looked at alternative assessment approaches as diagnostics - see what is having an impact on the estimation of population scale and trends.

One-off sensitivities

- CPUE series
 - 2 x LL, incl/excl TR
- NZ troll LF data exclusion
- Conditional L@Age data weighting
- Movement
- Effort creep
- Recruitment distribution assumption
- Number age classes
- Selectivity/catchability time blocks - no benefit
- Growth – no benefit
- **M – notable impact on results**
- **Steepness – notable impact on MSY-related results**

Uncertainty grid – model ensemble

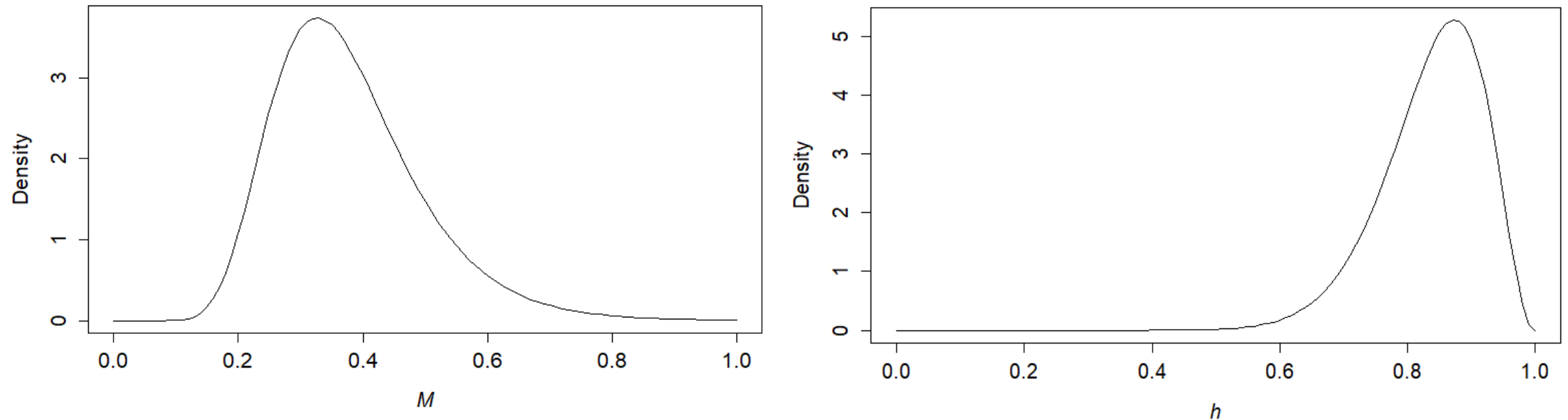


Figure 12: Assumed 'prior' distributions of average M (left) and steepness rates (right) considered in the model ensemble uncertainty characterization

- Grid of 100 model runs in 'uncertainty grid'
- Reviewed PDH/fit to data to ensure convergence was OK and model behaviour OK

Outcomes - depletion

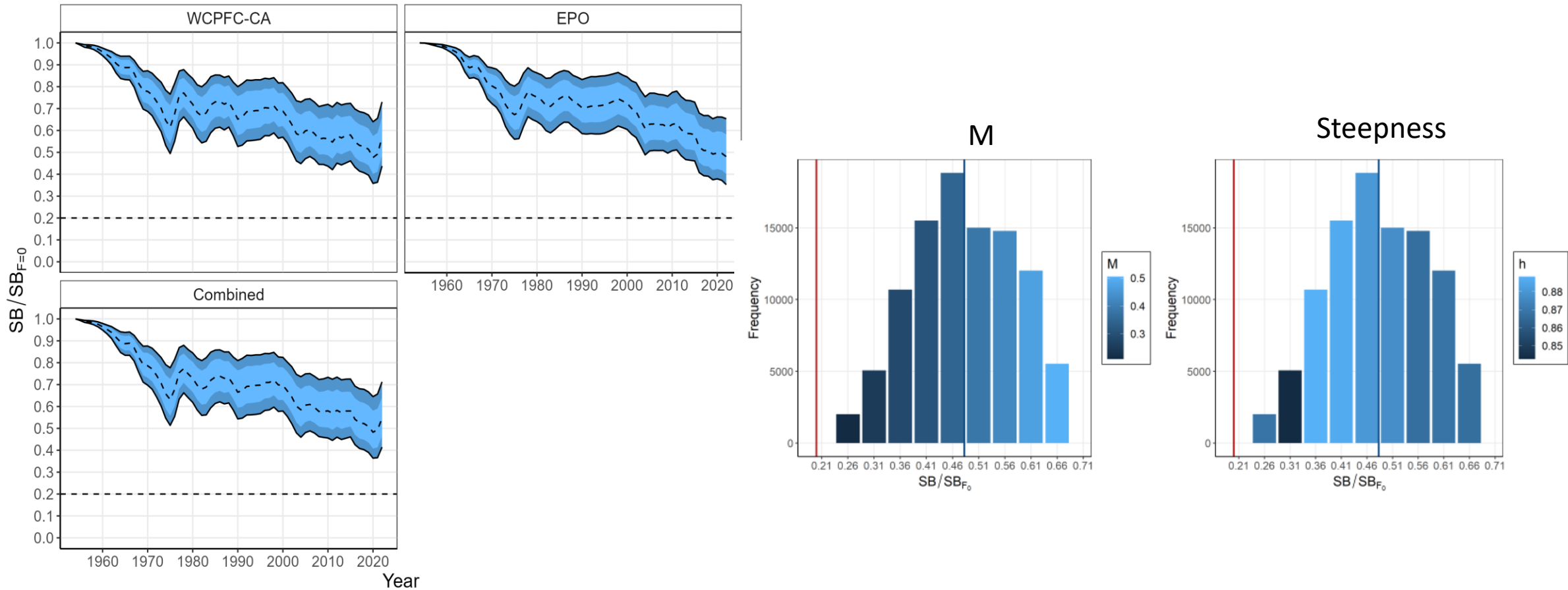
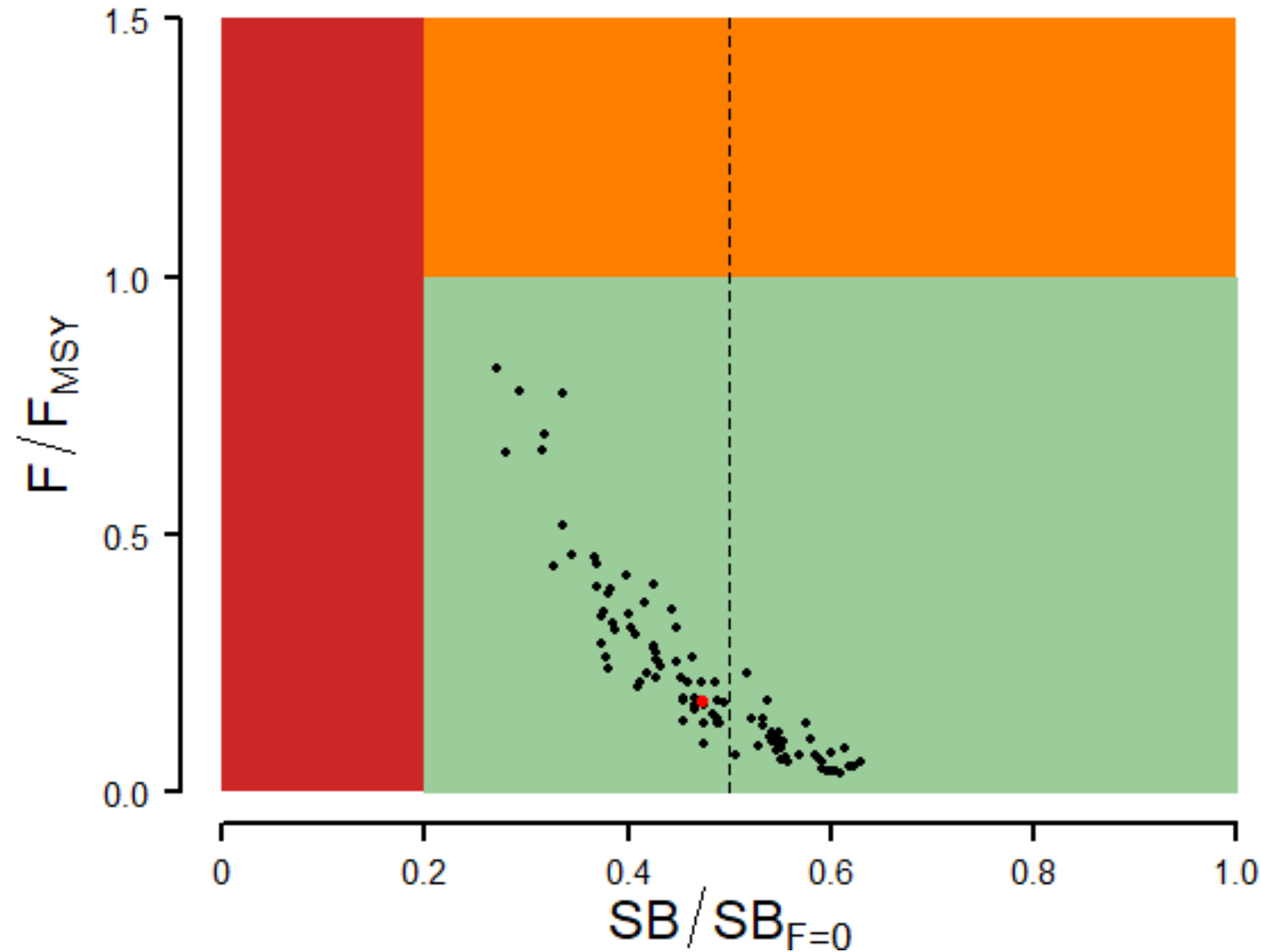


Figure 58: Annual estimated 90% (dark blue) and 75% (light blue) quantiles of $SB_t/SB_{F=0}(t)$ by region from the model ensemble. The dashed line within the interval indicates the median.

SPA stock assessment



SPA stock assessment

Table 9: Summary of reference points over the model ensemble and diagnostic case model (Diag case), along with results incorporating estimation uncertainty. Note that these values do not include estimation uncertainty, unless otherwise indicated.

	Mean	Median	Min	10%	90%	Max
F_{MSY}	0.15	0.16	0.10	0.12	0.18	0.20
f_{mult}	7.95	5.61	1.21	2.27	17.18	27.66
F_{recent}/F_{MSY}	0.22	0.18	0.04	0.06	0.44	0.82
MSY	113,308	101,100	62,120	74,018	176,330	202,400
SB_0	587,089	566,950	529,100	537,100	662,500	749,700
$SB_{F=0}$	724,200	711,059	665,389	674,633	788,312	857,071
SB_{latest}/SB_0	0.66	0.67	0.38	0.53	0.81	0.90
$SB_{latest}/SB_{F=0}$	0.54	0.54	0.29	0.41	0.70	0.78
SB_{latest}/SB_{MSY}	3.71	3.40	1.65	2.32	5.77	7.45
SB_{MSY}	111,738	110,950	65,140	80,350	142,690	172,600
SB_{MSY}/SB_0	0.19	0.20	0.11	0.13	0.24	0.27
$SB_{MSY}/SB_{F=0}$	0.15	0.16	0.10	0.11	0.19	0.22
$SB_{recent}/SB_{F=0}$	0.48	0.48	0.27	0.37	0.62	0.65
SB_{recent}/SB_{MSY}	3.30	3.06	1.54	2.10	5.23	6.34
$Y_{F_{recent}}$	74,531	74,375	61,760	67,731	83,023	86,180
$SB_{latest}/SB_{F=0:iTRP}$	1.065	1.051	0.961	1.015	1.139	1.213
$SB_{recent}/SB_{F=0:iTRP}$	0.952	0.952	0.899	0.924	0.986	1.016
Including estimation uncertainty						
F_{recent}/F_{MSY}	0.23	0.18	0.03	0.06	0.44	1.00
$SB_{recent}/SB_{F=0}$	0.48	0.48	0.23	0.36	0.62	0.77
SB_{recent}/SB_{MSY}	3.32	3.02	1.20	2.04	5.21	8.96

Note: Recalibrated value for $iTRP = 0.50$ (Pilling et al., 2024)

Median – 18% F_{MSY}
(18% with estimation
uncertainty)
Zero risk > F_{MSY}

Median – 48% $SB_{F=0}$
(48% with estimation
uncertainty)
Zero risk < LRP

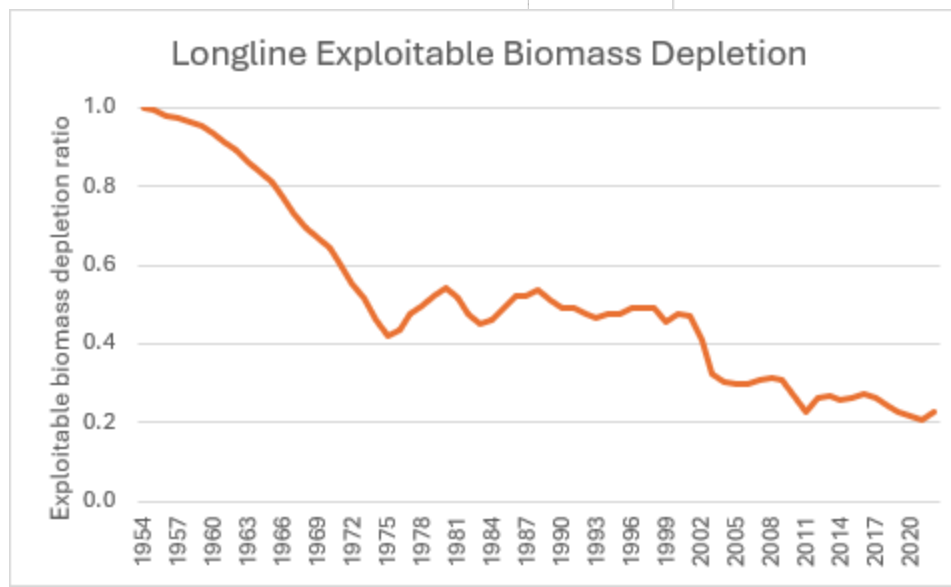
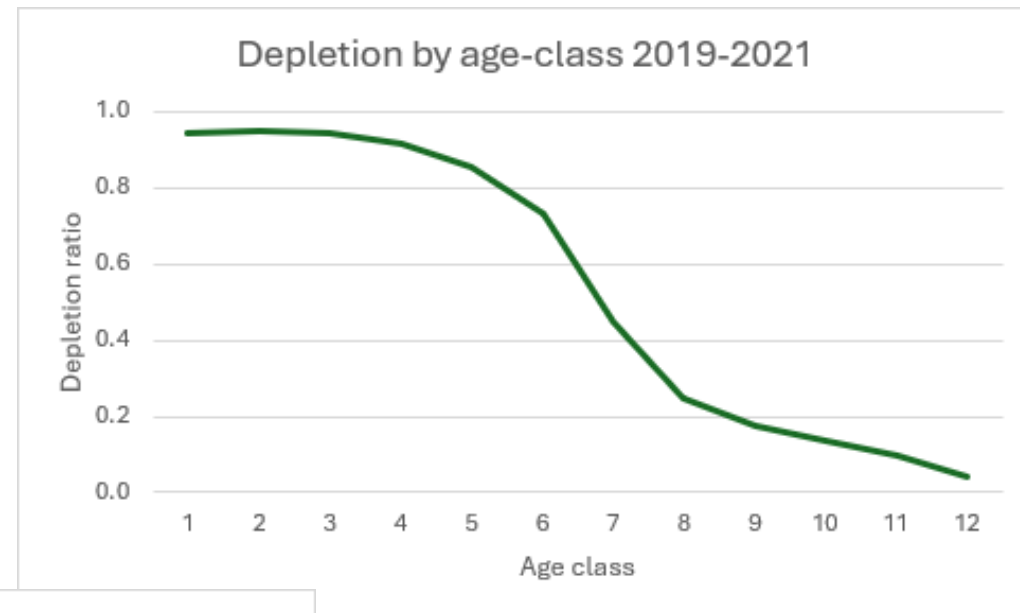
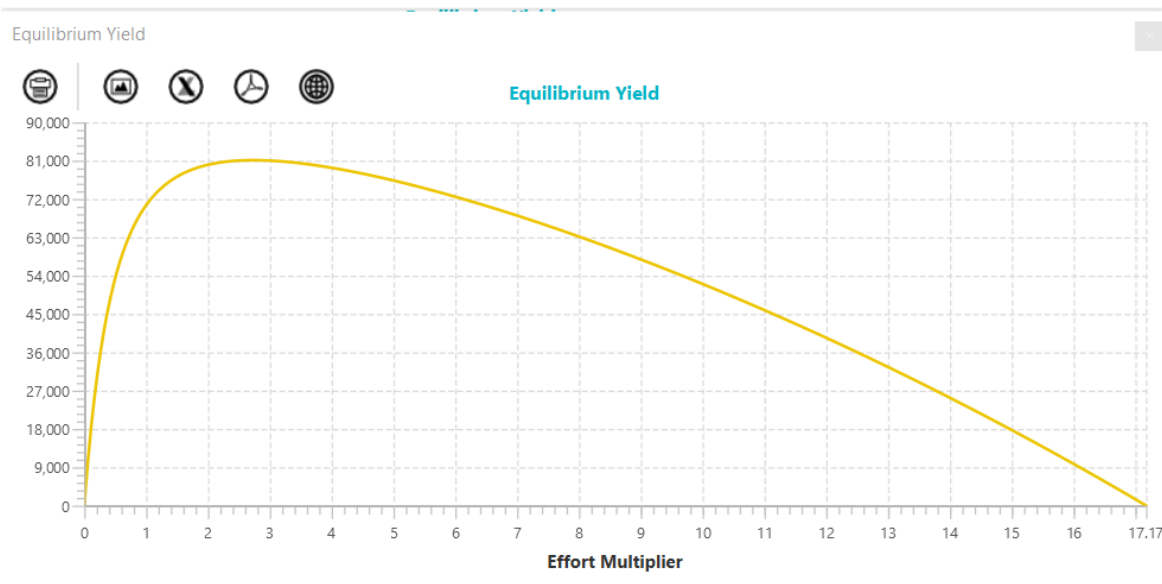
Median – 95% of TRP

Stock not overfished, not undergoing overfishing

Questions

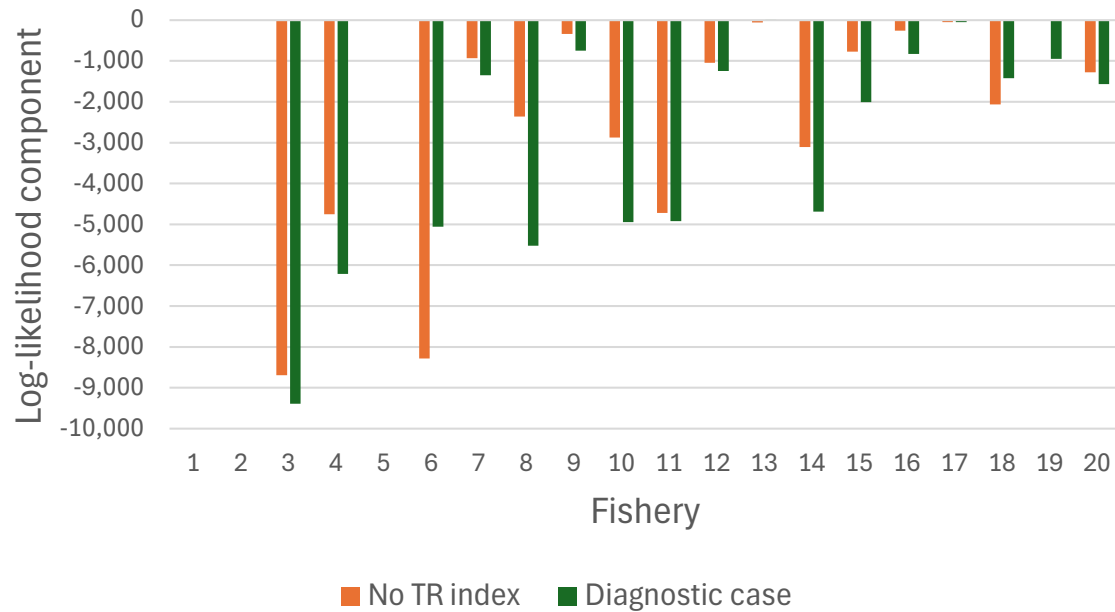


SPA stock assessment

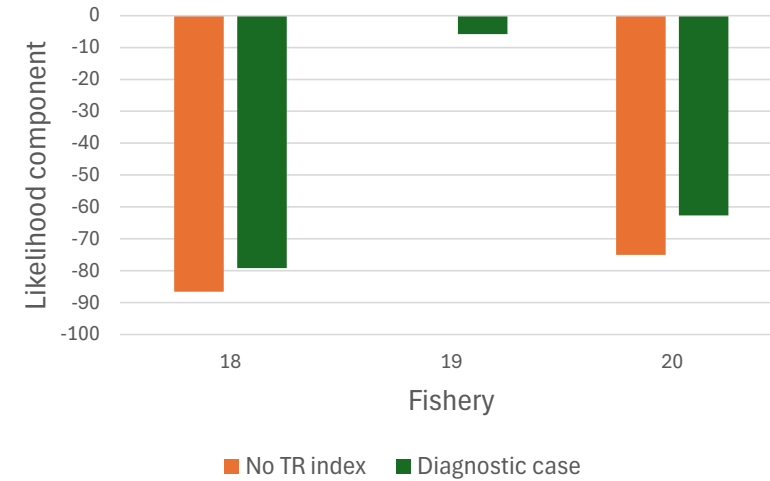


Log likelihood comparisons

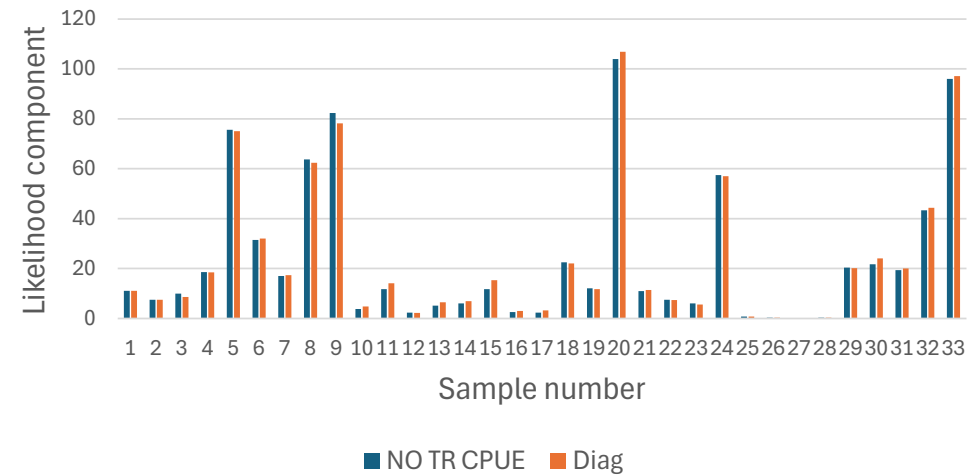
LF Likelihood components



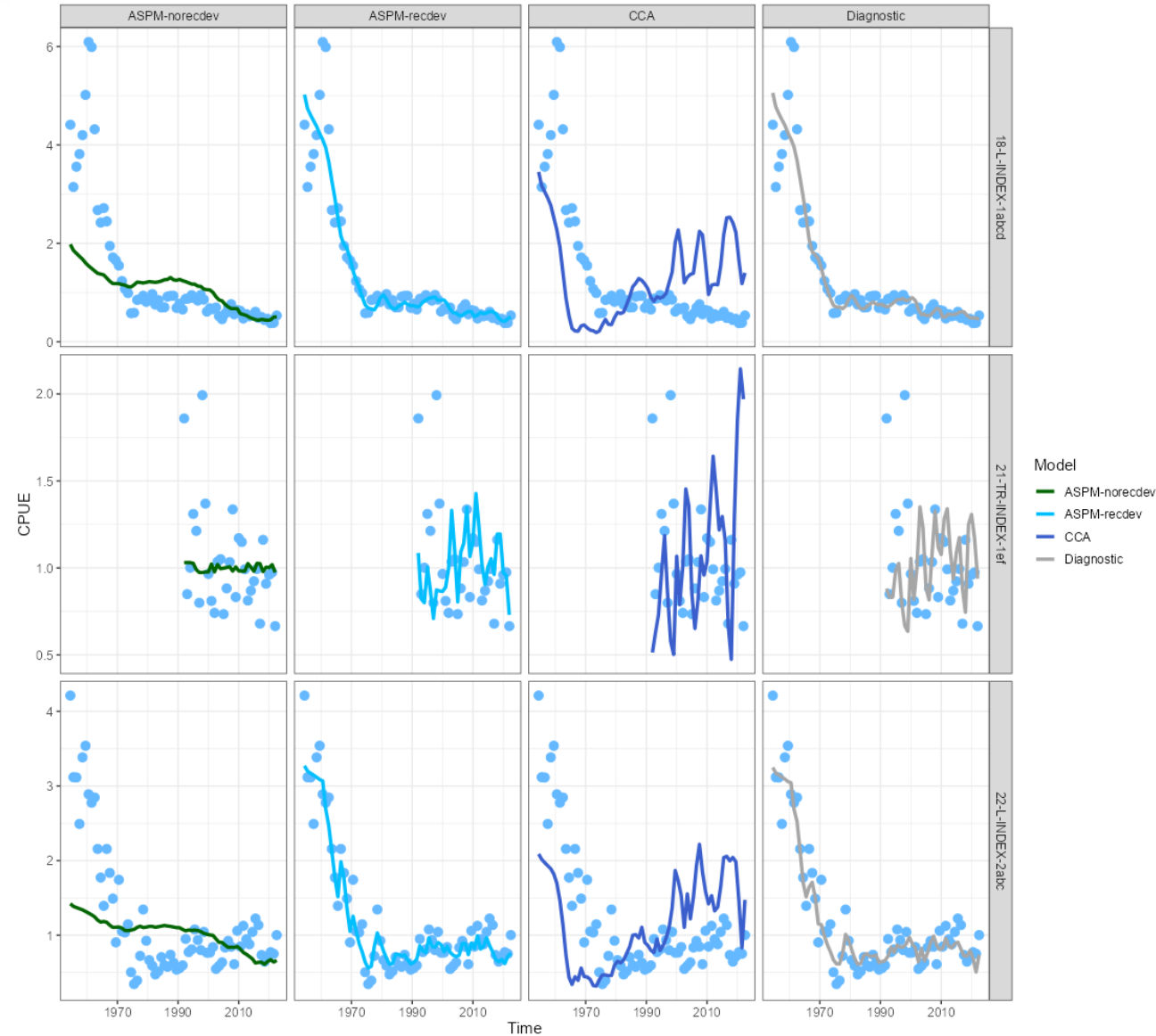
CPUE likelihood components



CAAL Likelihood components



CPUE fits to ASPM & CCA



CPUE residuals to ASPM & CCA

