

Operating Models Summary Report

North Atlantic Swordfish MSE

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Operating Model Scenarios

Base Case Model

Table 1. Key parameter values for the base case analysis. The column names are: Natural mortality (M) - fixed parameter; standard error of recruitment deviations (sigmaR) - fixed parameter; Steepness (h) - estimated in the base case model; Coefficient of variation for the indices (CPUE CV) - varied between indices and years (range of values shown here); Effective sample size of length composition (Len. Comp. Eff. Samp. Size) - fixed; Q Increase assumed for indices (Q increase); Environmental covariate included for some indices (Env. Covariate).

M	sigmaR	h	CPUE CV	Len. Comp. Eff. Samp. Size	Q increase	Env. Covariate
0.2	0.2	0.823509	0.16 - 0.38	20	FALSE	TRUE

Uncertainty Grid

Table 2. The uncertainty grid is a full factorial design with the following 7 factors, resulting in 288 OMs. M and h were fixed in the uncertainty grid. CPUE CV was fixed for all indices.

M	sigmaR	h	CPUE CV	Len. Comp. Eff. Samp. Size	Q increase	Env. Covariate
0.1	0.2	0.60	0.3	2	1	FALSE
0.2	0.6	0.75	0.6	20	1.01	TRUE
0.3		0.90				

Convergence

All 288 OMs in the uncertainty grid converged (invertible hessian).

Check for Parameters at Bounds

73 OMs had parameters that were close to the specified bounds (defined here as within 1% of the bounds). This only occurred for 3 parameters, all related to the size-selectivity parameters of the Japan Early and US fishing fleets.

Table 3. Table of parameters where the estimated values were within 1% of the specified minimum and maximum bounds. Filters at the top of each column can be used to subset the results. The table can be downloaded as a CSV file using the ‘CSV’ button.

NOTE: Dynamic tables are only available in HTML version of this report. Click here¹ to download the table in CSV format (After opening link, right-click and Save As .csv).

¹https://github.com/ICCAT/nsw-mse/raw/master/docs/Reports/OM_Summary/Table3.csv

CSV

Show 10 entries

Search:

OM	Parameter	Value	Min	Max
All	All	All	All	All
3	SizeSel_5P_1_JPN_ERLY_5	316.811	70	317
6	SizeSel_5P_1_JPN_ERLY_5	316.793	70	317
9	SizeSel_5P_1_JPN_ERLY_5	316.894	70	317
12	SizeSel_5P_1_JPN_ERLY_5	316.867	70	317
14	SizeSel_5P_1_JPN_ERLY_5	316.536	70	317
15	SizeSel_5P_1_JPN_ERLY_5	316.914	70	317
17	SizeSel_5P_1_JPN_ERLY_5	316.178	70	317
18	SizeSel_5P_1_JPN_ERLY_5	316.887	70	317
27	SizeSel_5P_1_JPN_ERLY_5	315.158	70	317
33	SizeSel_5P_1_JPN_ERLY_5	316.441	70	317

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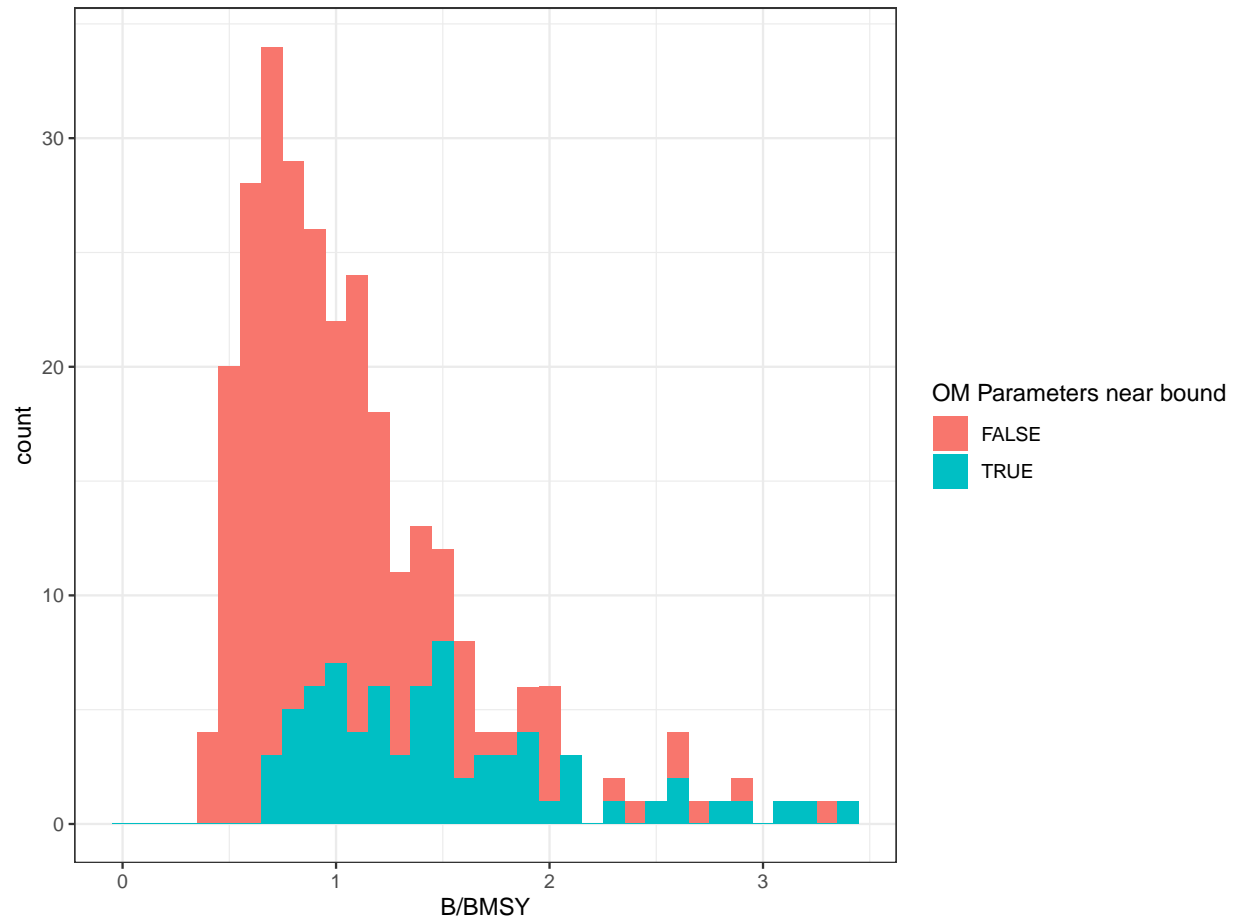


Figure 1. Histogram of the estimated stock status (B/B_{MSY}) in 2017 with colours showing the OMs with some selectivity parameters close to the bounds.

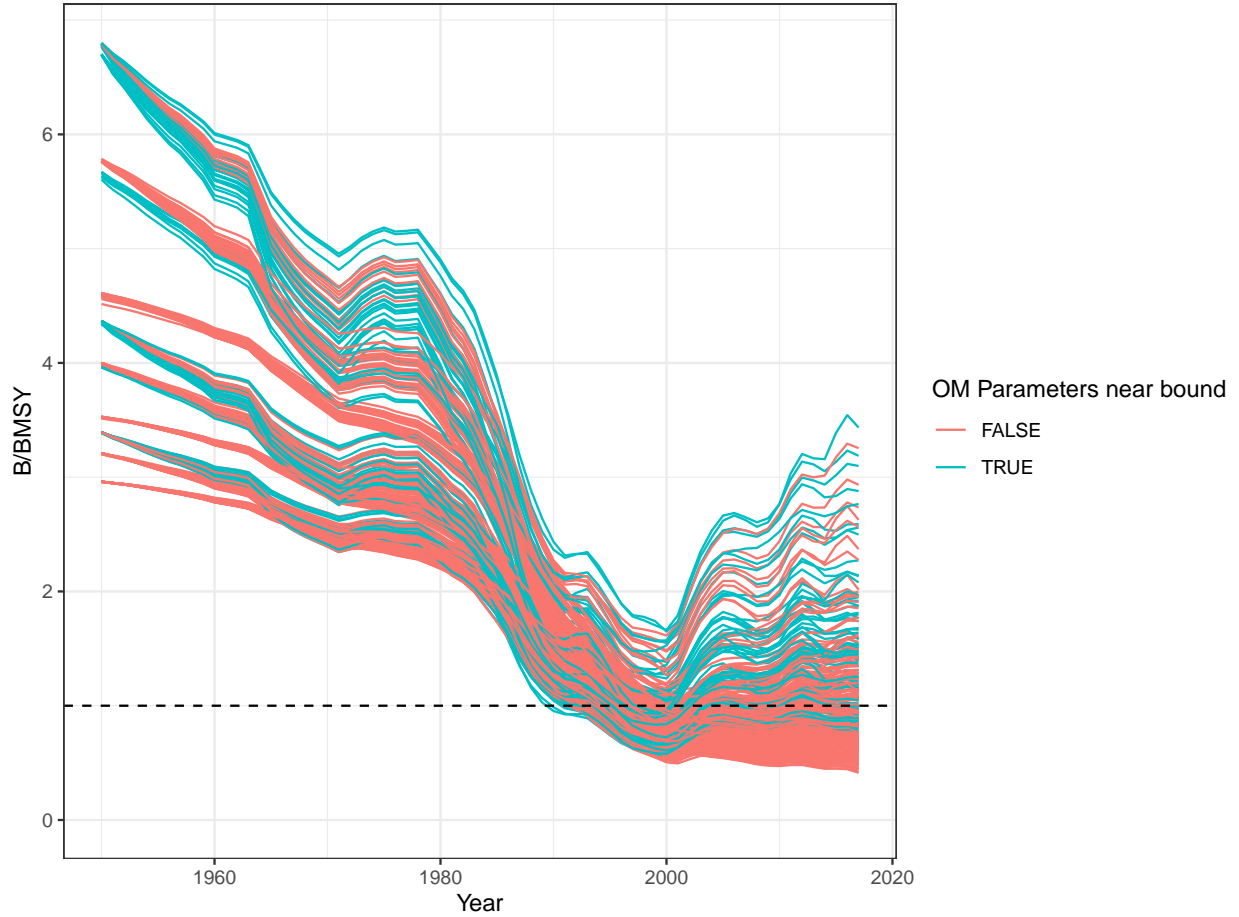


Figure 2. Time-series plot of $B/BMSY$ with colours showing the OMs with some selectivity parameters close to the bounds. $B/BMSY = 1$ is shown as a dashed black line.

Parameter and Likelihood Table

Table 4. The parameters and the total and component negative log-likelihood values for the base case model and the 288 OMs from the uncertainty grid. Filters at the top of each column can be used to subset the results. The table can be downloaded as a CSV file using the ‘CSV’ button.

NOTE: Dynamic tables are only available in HTML version of this report. Click here² to download the table in CSV format (After opening link, right-click and Save As .csv).

²https://github.com/ICCAT/nsw-mse/raw/master/docs/Reports/OM_Summary/Table4.csv

CSV

Show 10 entries

Search:

Parameter Values									Likelihood Values				
OM	M	sigmaR	h	CPUE CV	Len. Comp. Eff. Samp. Size	Q increase	Env. Covariate		Total	Survey	Mean_body_wt	Length_comp	Recruitment
All		All	All	All	All	All	All		All	All	All	All	All
base_case	0.2	0.2	0.823509	0.2701595	20	1	TRUE		379.897	-188.35	122.919	480.688	-37.537
1	0.1	0.2	0.6	0.3	2	1	FALSE		-23.2488	-185.743	123.713	71.9124	-33.1381
2	0.2	0.2	0.6	0.3	2	1	FALSE		-46.1227	-183.918	121.006	52.8787	-36.093
3	0.3	0.2	0.6	0.3	2	1	FALSE		-45.963	-181.251	121.383	51.6647	-37.7726
4	0.1	0.6	0.6	0.3	2	1	FALSE		-3.80535	-190.121	123.429	73.5251	-10.6455
5	0.2	0.6	0.6	0.3	2	1	FALSE		-27.9336	-191.055	121.265	53.8414	-11.9904
6	0.3	0.6	0.6	0.3	2	1	FALSE		-26.6171	-187.491	121.684	51.7292	-12.5492
7	0.1	0.2	0.75	0.3	2	1	FALSE		-31.0563	-187.25	122.27	69.7248	-35.8075
8	0.2	0.2	0.75	0.3	2	1	FALSE		-49.9767	-186.628	121.273	53.1095	-37.7378
9	0.3	0.2	0.75	0.3	2	1	FALSE		-49.2933	-181.448	121.287	50.5191	-39.6651

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Reference Points Table

Table 5. Summary table of the biological reference points for the base case model and the 288 models from the uncertainty grid. Filters at the top of each column can be used to subset the results. The table can be downloaded as a CSV file using the ‘CSV’ button.

NOTE: Dynamic tables are only available in HTML version of this report. Click here³ to download the table in CSV format (After opening link, right-click and Save As .csv).

³https://github.com/ICCAT/nsw-mse/raw/master/docs/Reports/OM_Summary/Table5.csv

CSV

Show 10 entries

Search:

Parameter Values									Reference Points						
OM	M	sigmaR	h	CPUE CV	Len. Comp. Eff. Samp. Size	Q increase	Env. Covariate		MSY	SB _{MSY}	F _{MSY}	F/F _{MSY}	SB/SB _{MSY}	SB _{MSY} /SB ₀	Depletion
<input type="text" value="All"/>	<input type="text" value=""/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>		<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>
base_case	0.2	0.2	0.823509	0.2701595	20	1	TRUE		12303.8	27046.7	0.14	0.85	1.12	0.22	0.24
1	0.1	0.2	0.6	0.3	2	1	FALSE		10546.2	148652	0.04	0.98	1.08	0.34	0.37
2	0.2	0.2	0.6	0.3	2	1	FALSE		12384.6	57655.4	0.08	0.71	1.32	0.31	0.41
3	0.3	0.2	0.6	0.3	2	1	FALSE		13174.6	28709.3	0.11	0.64	1.45	0.3	0.43
4	0.1	0.6	0.6	0.3	2	1	FALSE		11244.6	156292	0.04	1.03	0.98	0.34	0.33
5	0.2	0.6	0.6	0.3	2	1	FALSE		14180.6	65589.4	0.08	0.68	1.2	0.31	0.37
6	0.3	0.6	0.6	0.3	2	1	FALSE		15889.6	34630.6	0.11	0.56	1.37	0.3	0.4
7	0.1	0.2	0.75	0.3	2	1	FALSE		11323.4	105289	0.06	0.87	1.15	0.28	0.33
8	0.2	0.2	0.75	0.3	2	1	FALSE		12784.7	36699	0.12	0.66	1.42	0.25	0.36
9	0.3	0.2	0.75	0.3	2	1	FALSE		13716	17685.5	0.16	0.58	1.68	0.23	0.39

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Negative Log-Likelihood Plots

The negative log-likelihood (NLL) values are not directly comparable across the OMs due to different data and assumptions used in the models.

For example, Figures 3 and 4 show histograms of the Total NLL and NLL of the length composition data for the 288 OMs with colours indicating the effective sample size of the length composition.

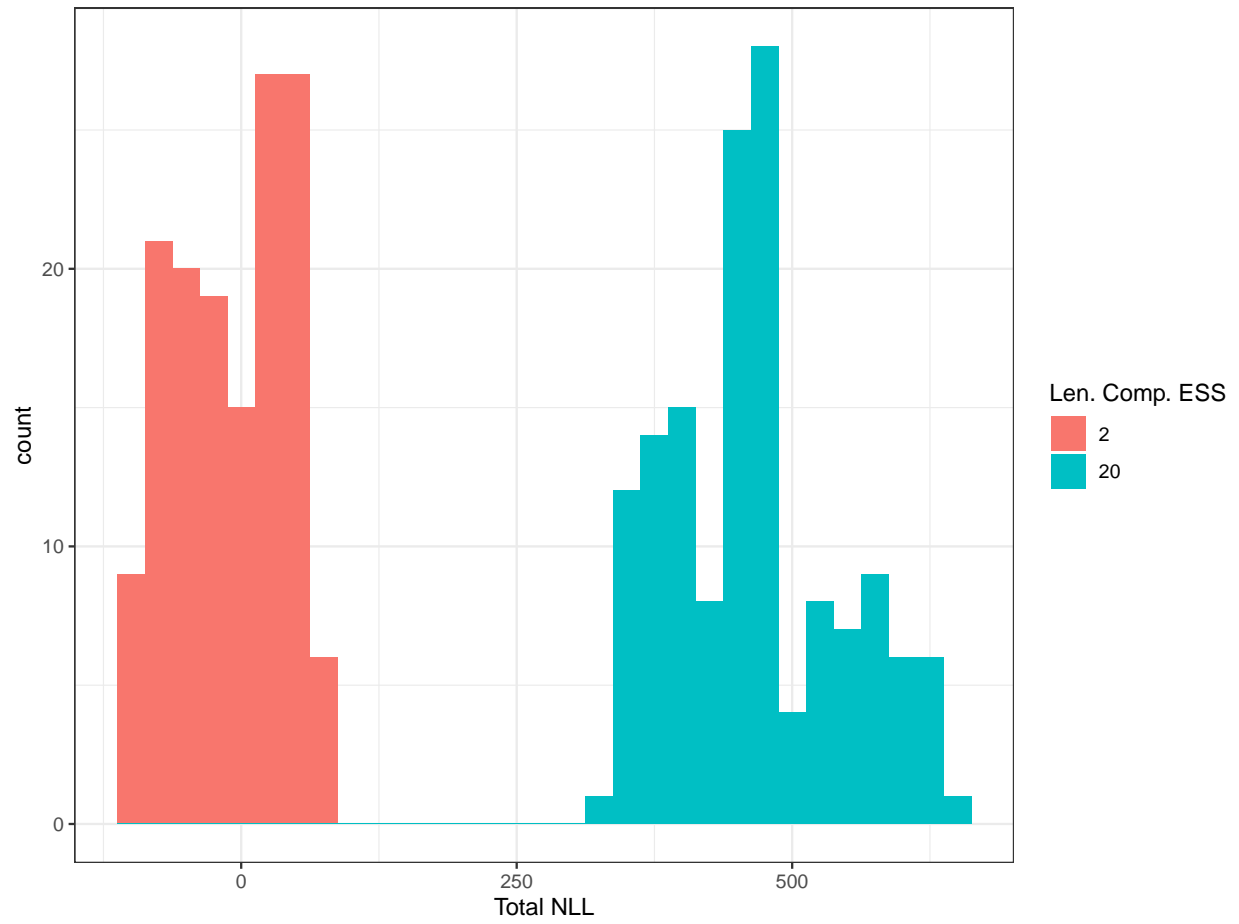


Figure 3. Histogram of the total negative log-likelihood (NLL) with filled colours indicating the two values for the effective sample size for the length composition (Len. Comp. ESS).

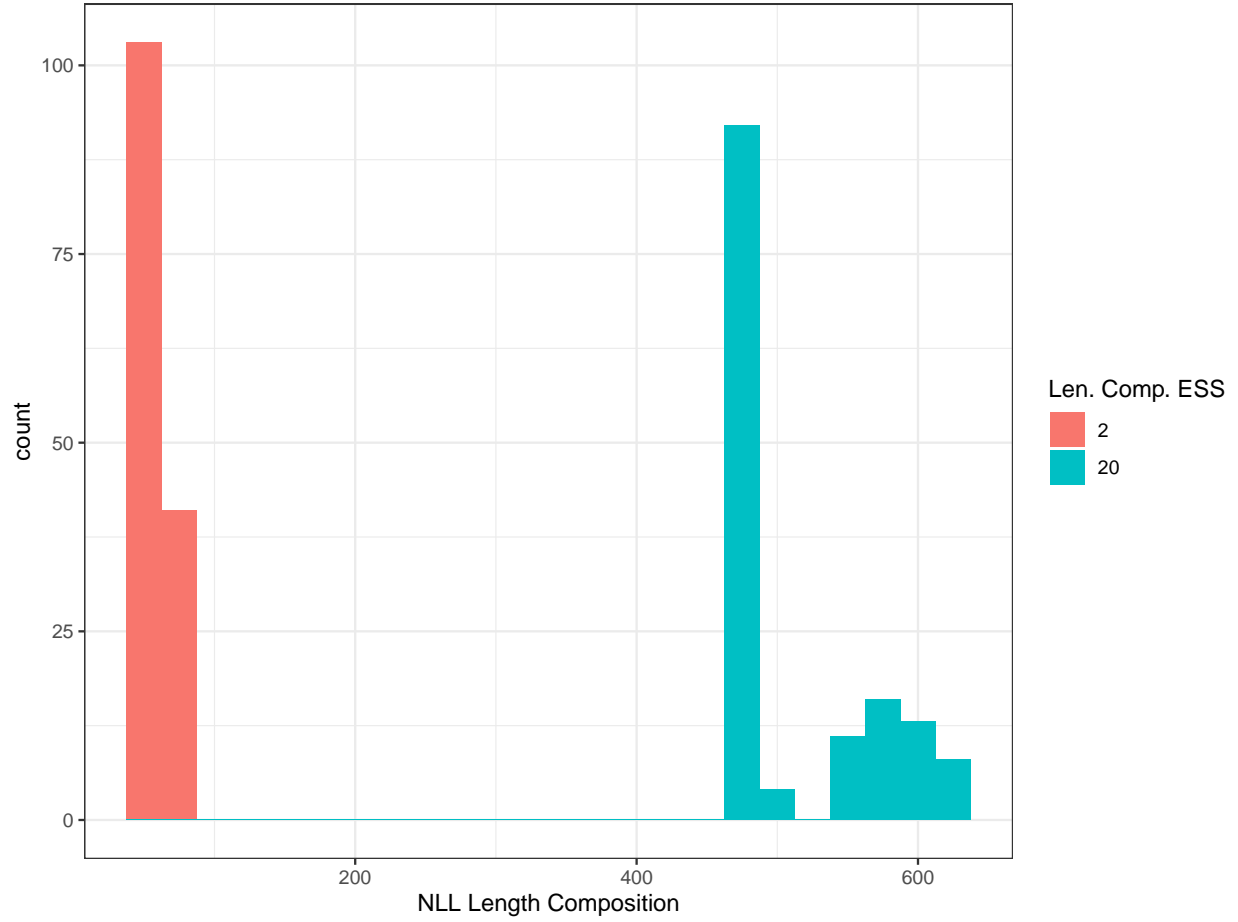


Figure 4. Histogram of the NLL for the length composition data with filled colours indicating the two values for the effective sample size for the length composition (Len. Comp. ESS).

Comparing Model Fits to Length Composition Data

To compare the fits to the length composition data the NLL of the length composition with effective sample size 2 was up-weighted by a factor of 10 (Figure 5). Figure 6 shows a histogram of the estimated 2017 stock status with colours indicating 4 discrete levels of the up-weighted NLL for the length composition.

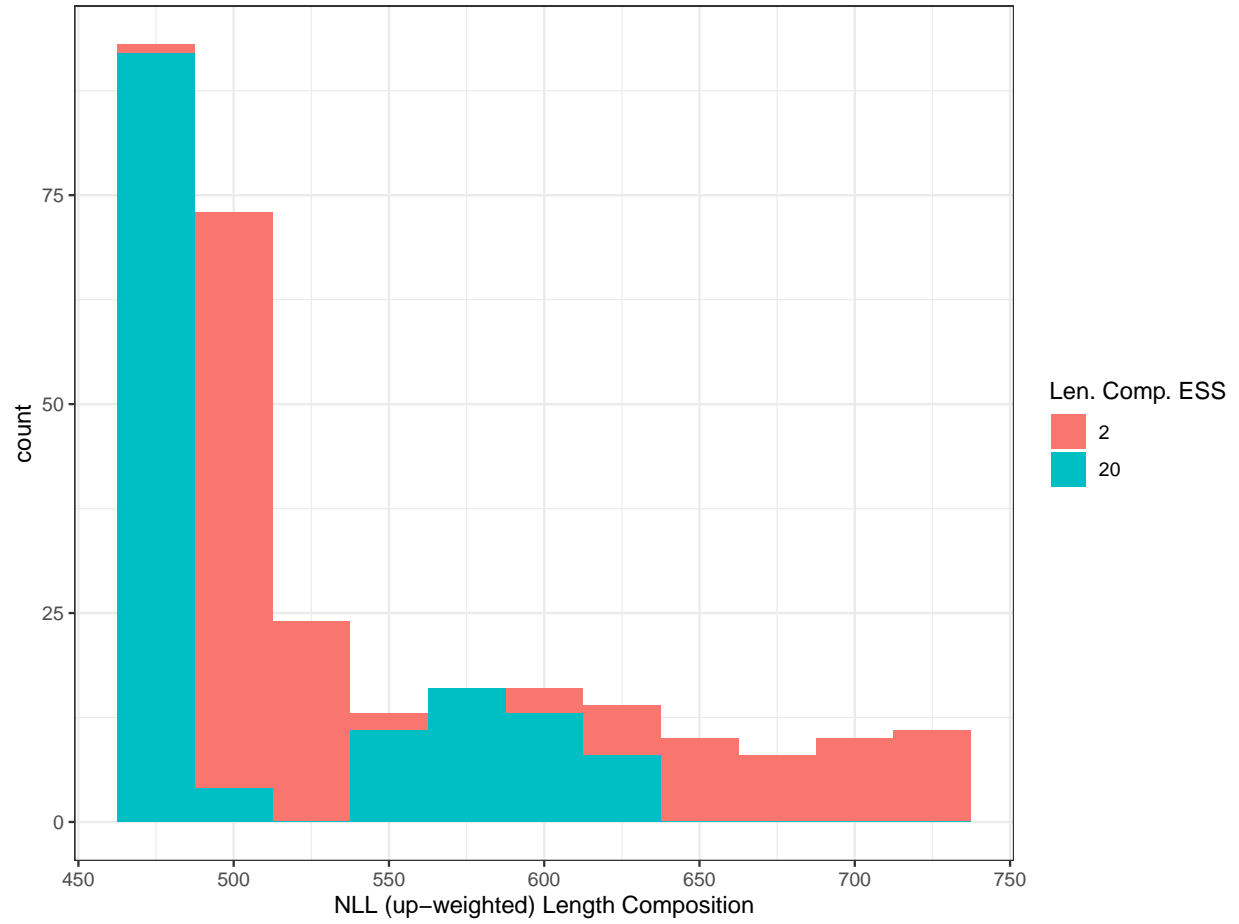


Figure 5. Histogram of the NLL for the length composition data, where NLL for effective sample size 2 was up-weighted by a factor of 10, with filled colours indicating the two values for the effective sample size for the length composition (Len. Comp. ESS).

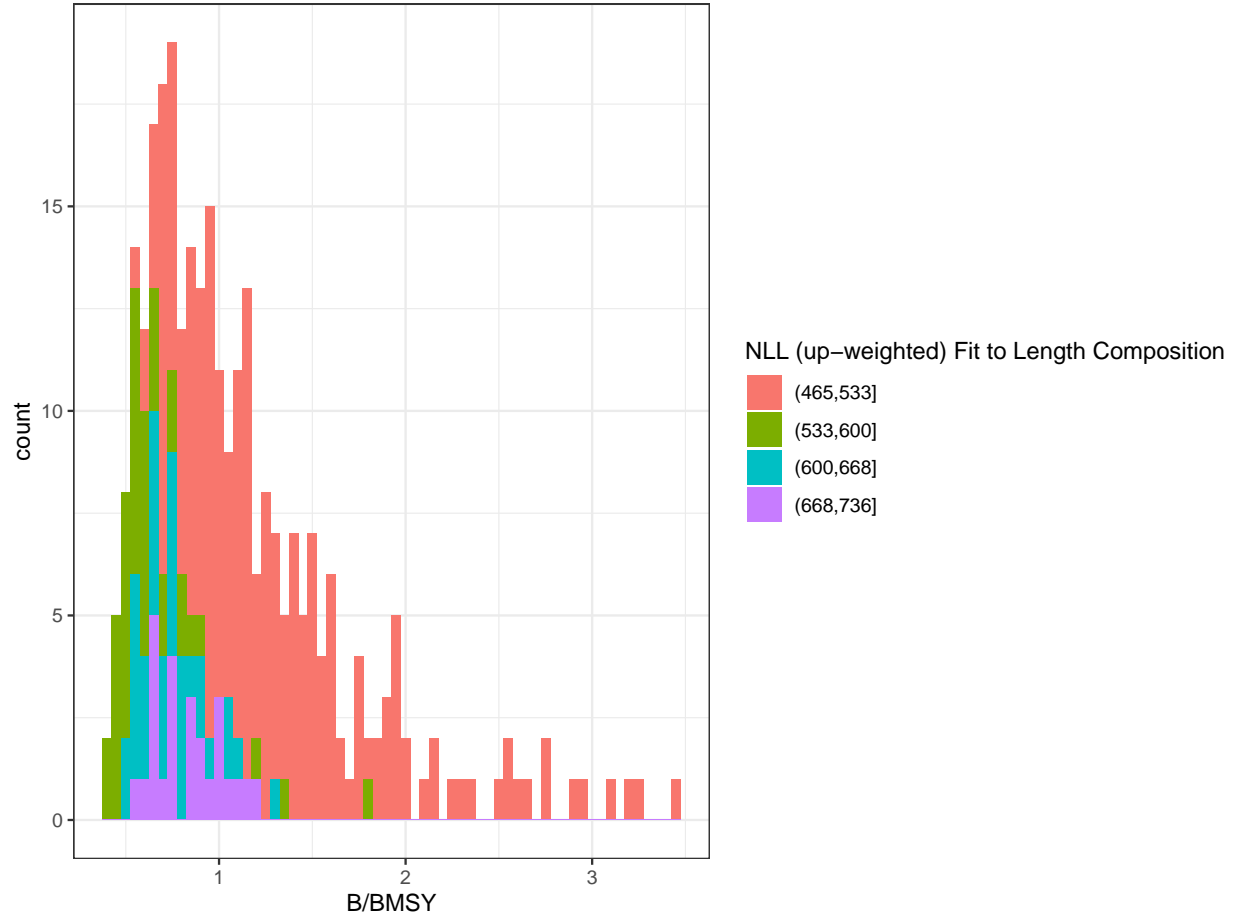


Figure 6. Histogram of estimated stock status (B/B_{MSY}) in 2017 for the length composition data, where NLL for effective sample size 2 was up-weighted by a factor of 10, and NLL values grouped into 4 discrete classes.

SB/ SB_{MSY} Timeseries Plots

Time-series plots of the spawning biomass (SB) relative to spawning biomass corresponding with maximum sustainable yield (SB_{MSY}) for the seven factors examined in the uncertainty grid.

Natural Mortality

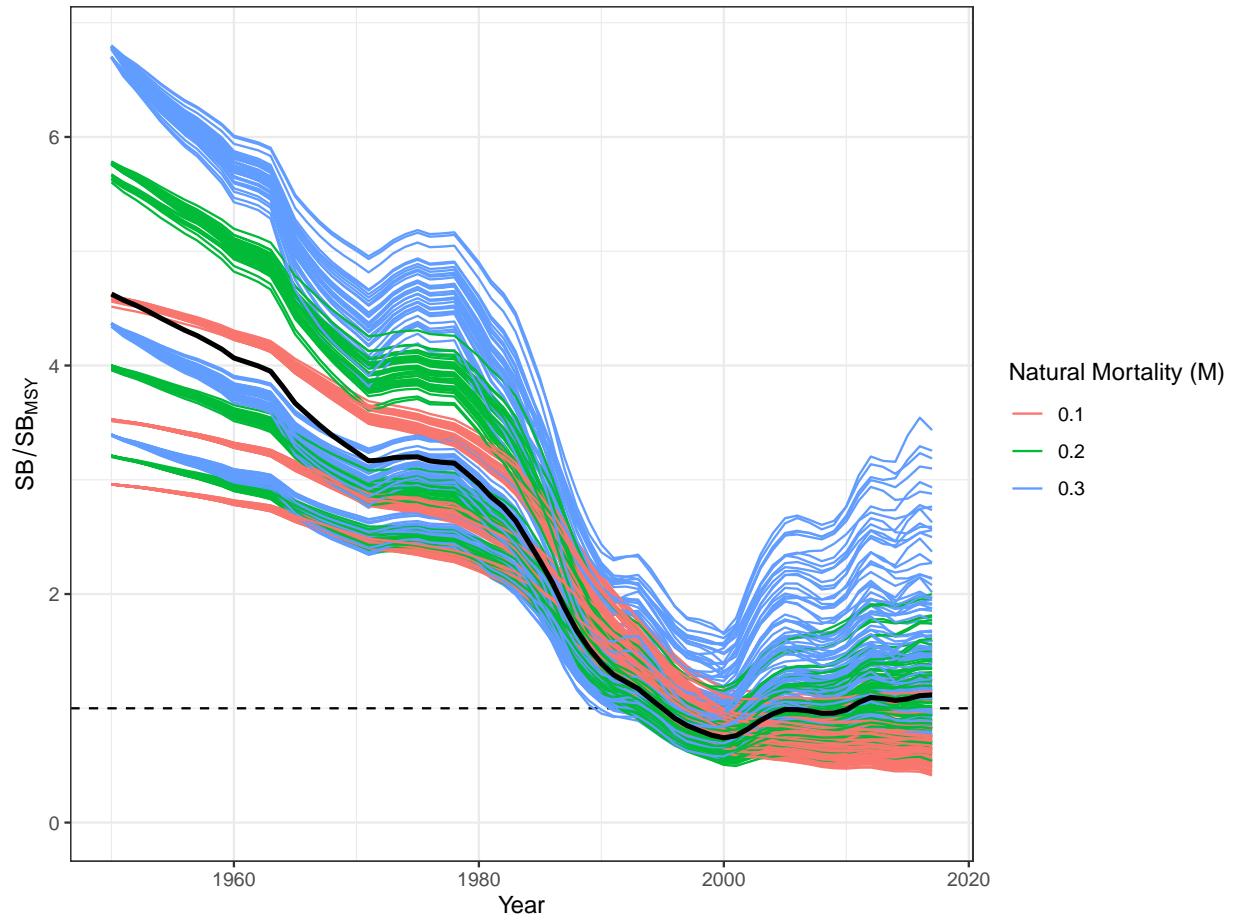


Figure 7. Predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 3 levels of Natural Mortality (M) shown as coloured lines. The base case OM is shown as the thick black line.

Recruitment Variability

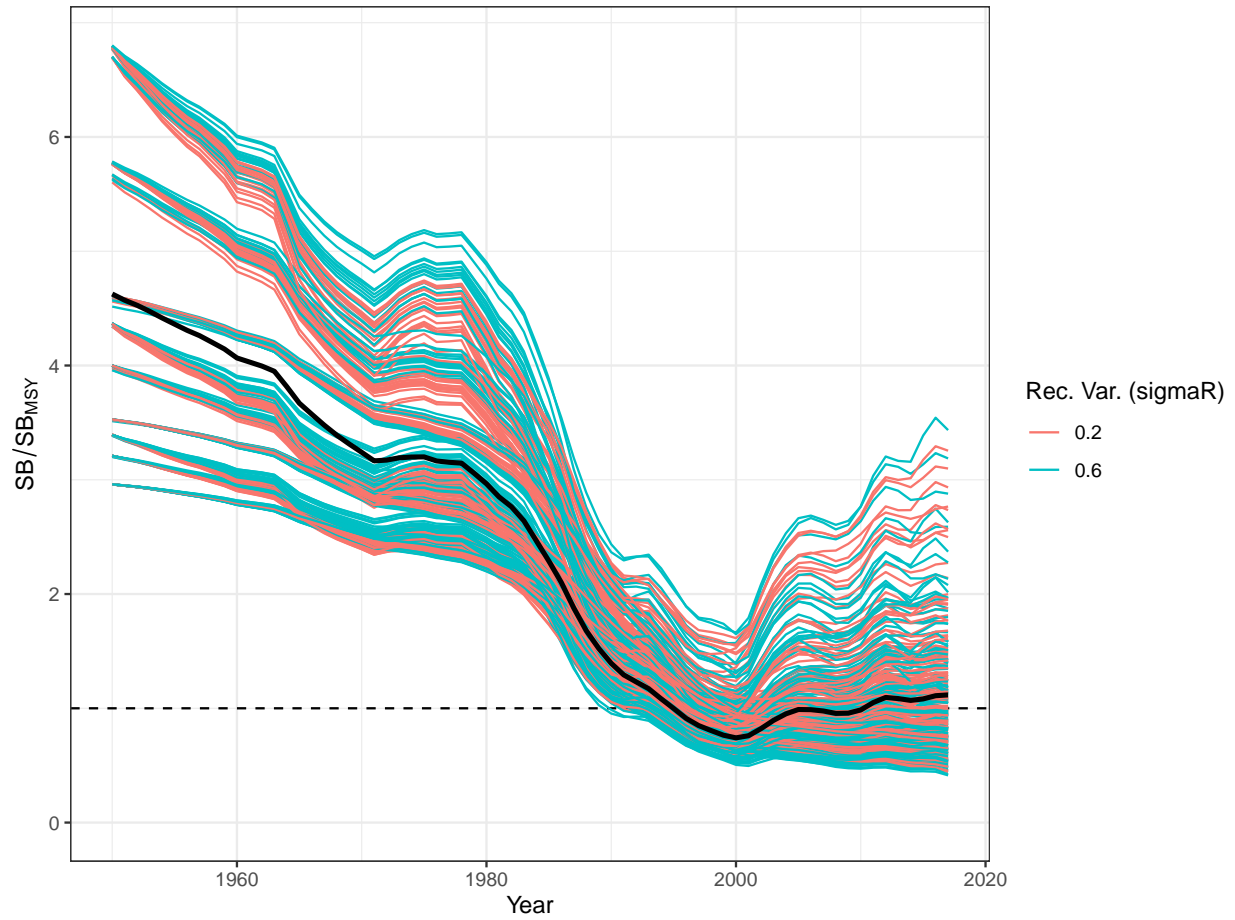


Figure 8. Predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OM from the uncertainty grid with the 2 levels of Rec. Var. (σ_R) shown as coloured lines. The base case OM is shown as the thick black line.

Steepness

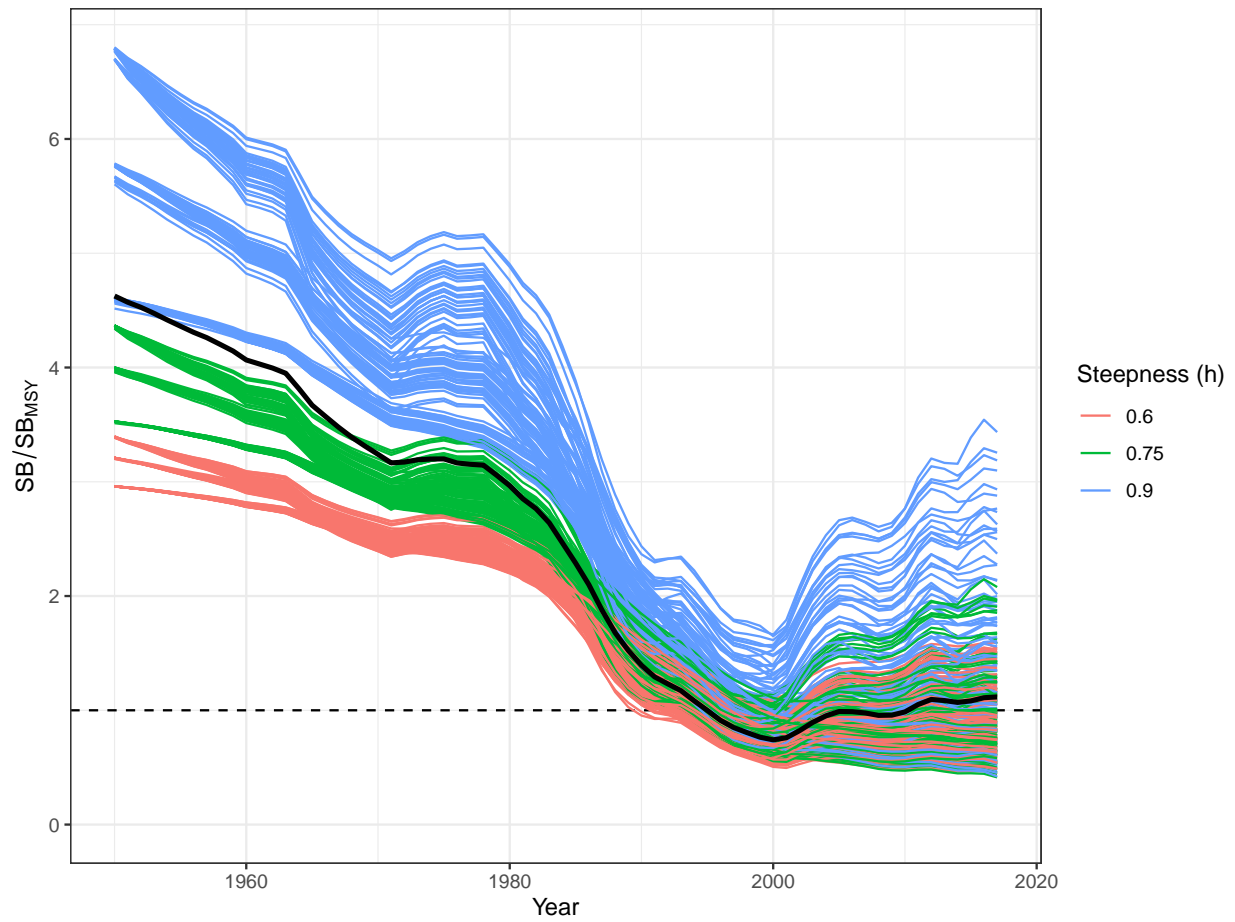


Figure 9. Predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 3 levels of Steepness (h) shown as coloured lines.

CPUE CV

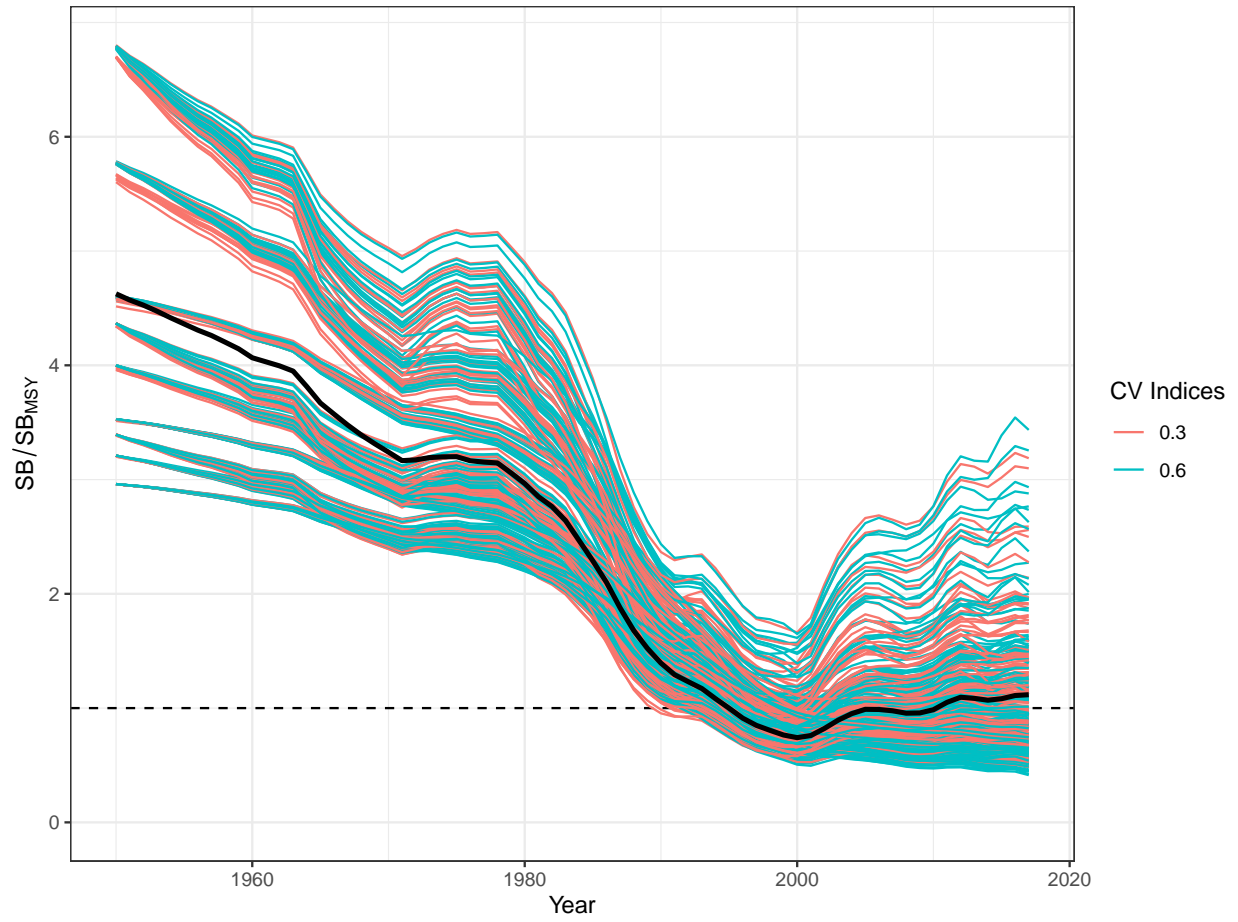


Figure 10. Predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of CV Indices shown as coloured lines. The base case OM is shown as the thick black line.

Length Comp. ESS

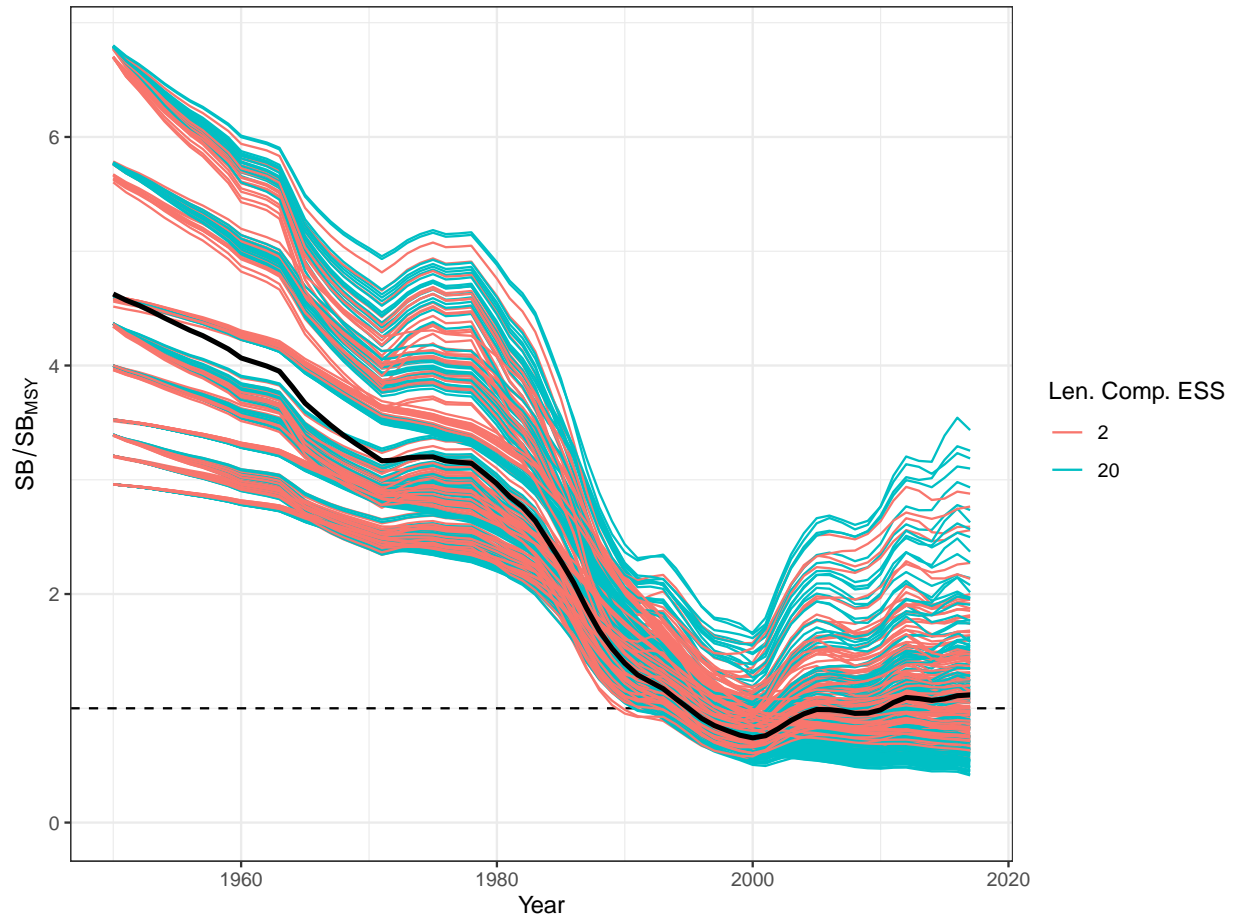


Figure 11. Predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of Len. Comp. ESS shown as coloured lines. The base case OM is shown as the thick black line.

Catchability Increase

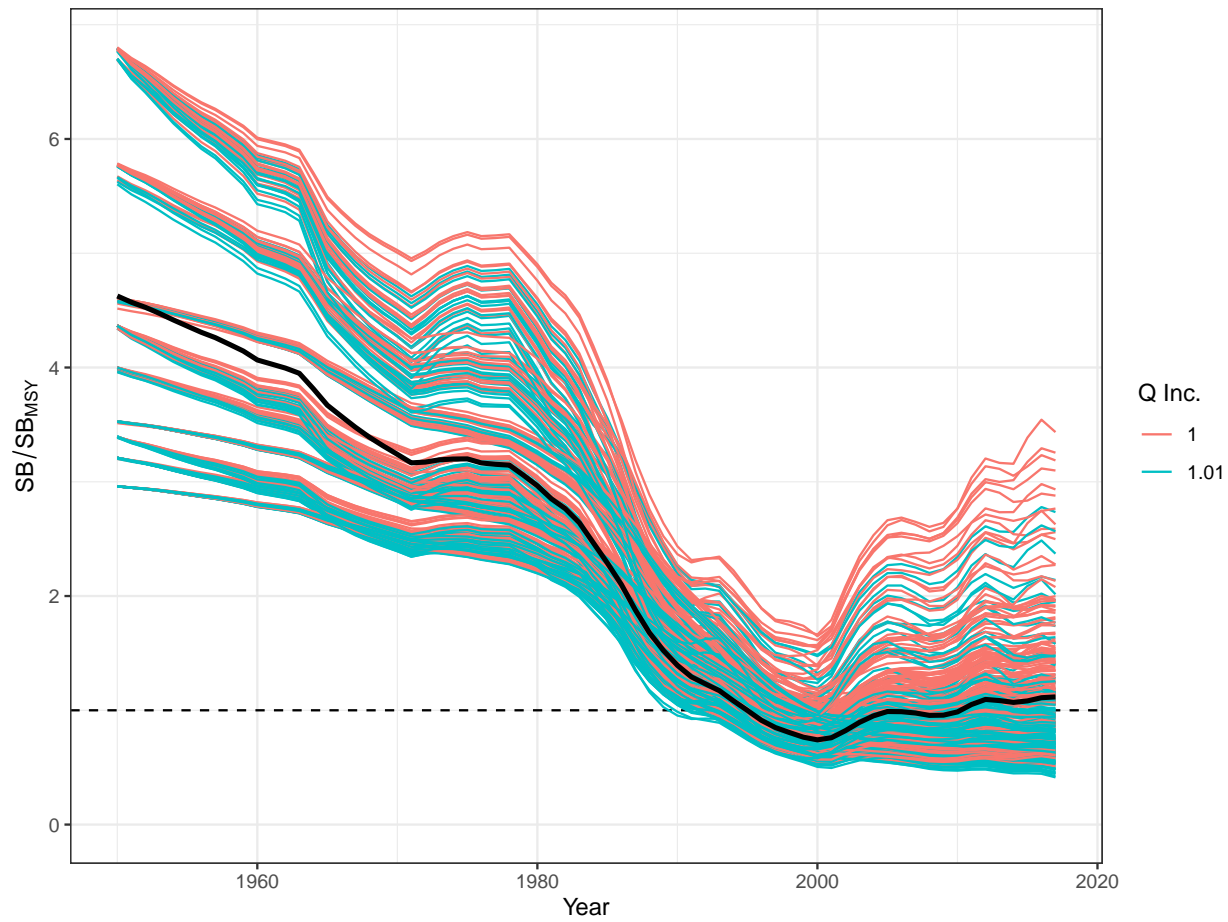


Figure 12. Predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of Q Inc. shown as coloured lines. The base case OM is shown as the thick black line.

Environmental Covariate

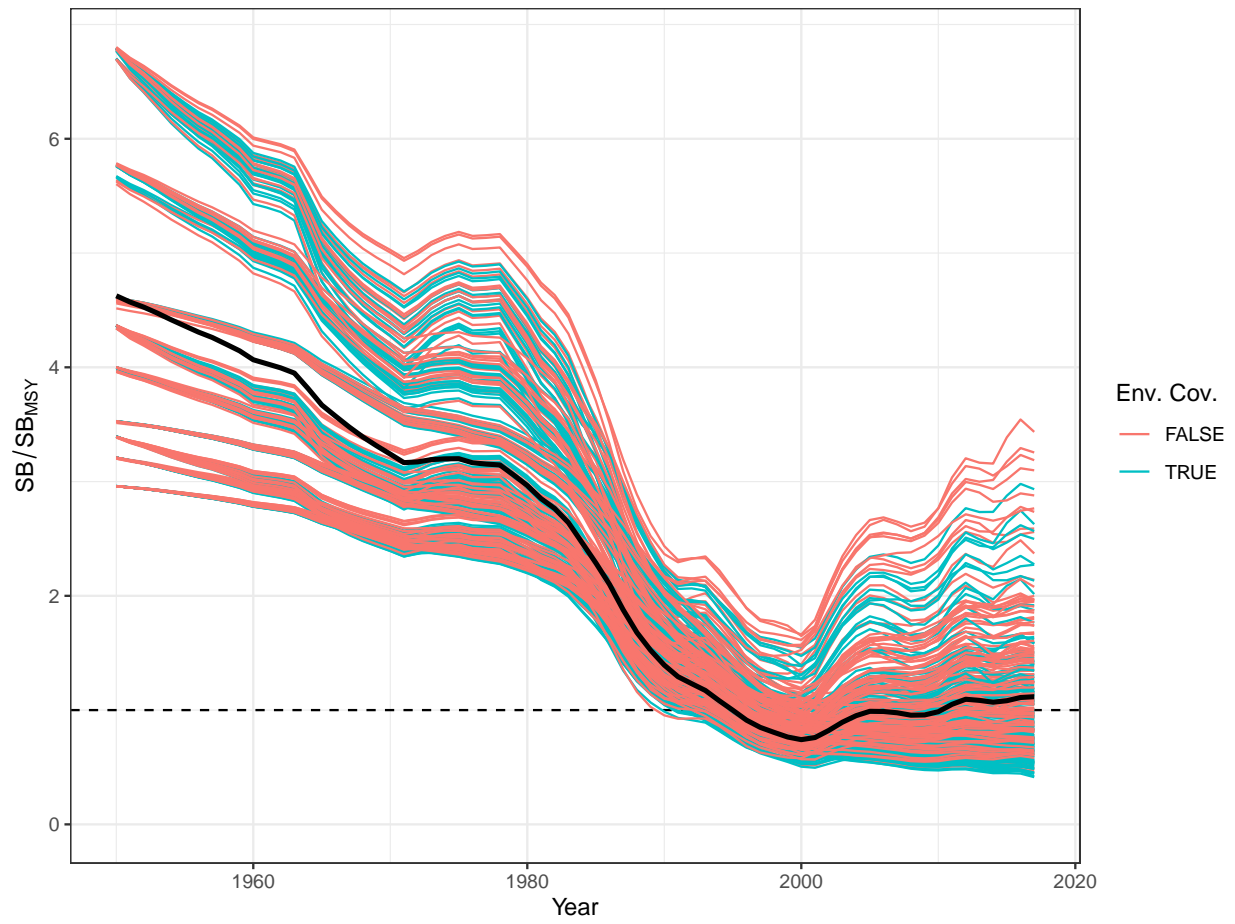


Figure 13. Predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of Env. Cov. shown as coloured lines.

Current SB/SB_{MSY} Histograms

Natural Mortality

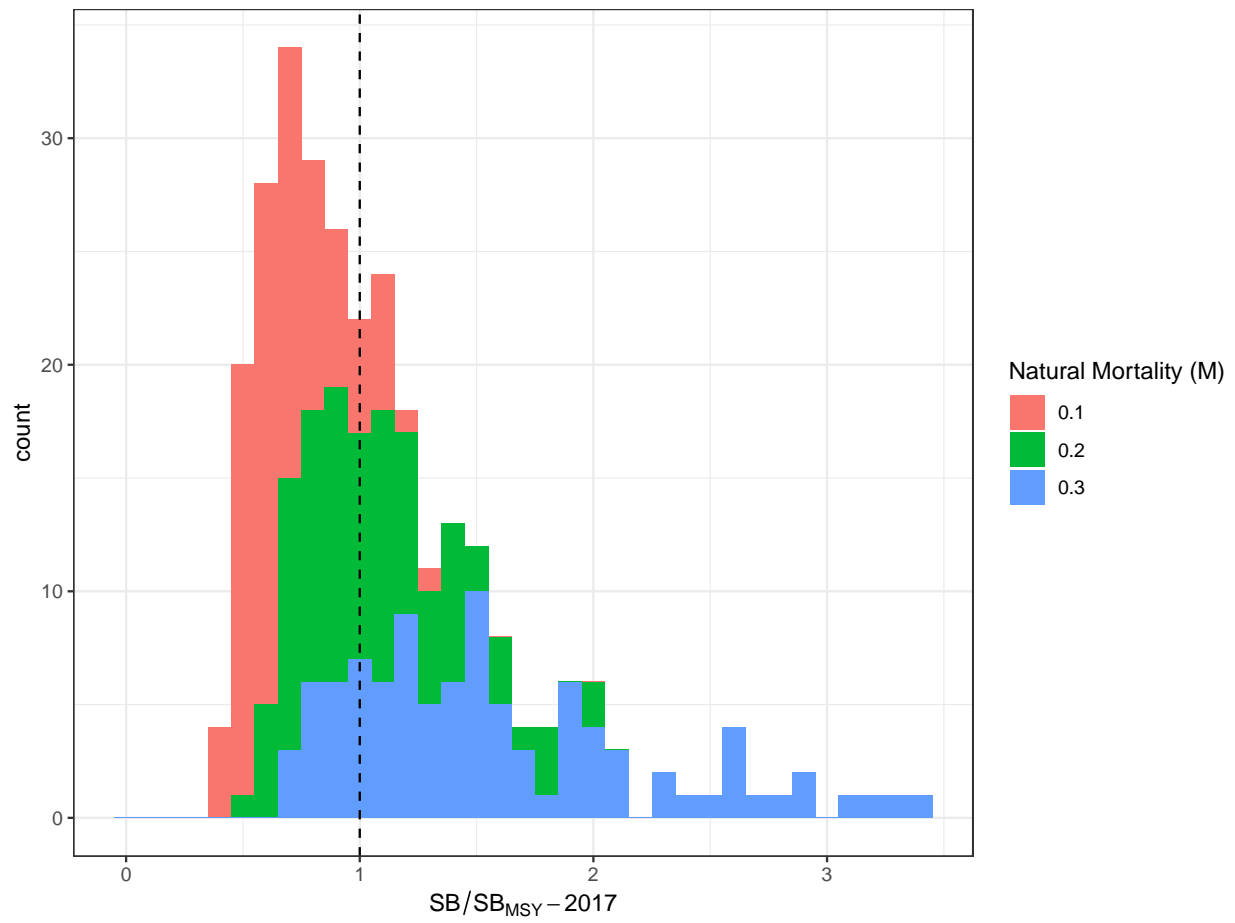


Figure 14. Histogram of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 3 levels of Natural Mortality (M).

Recruitment Variability

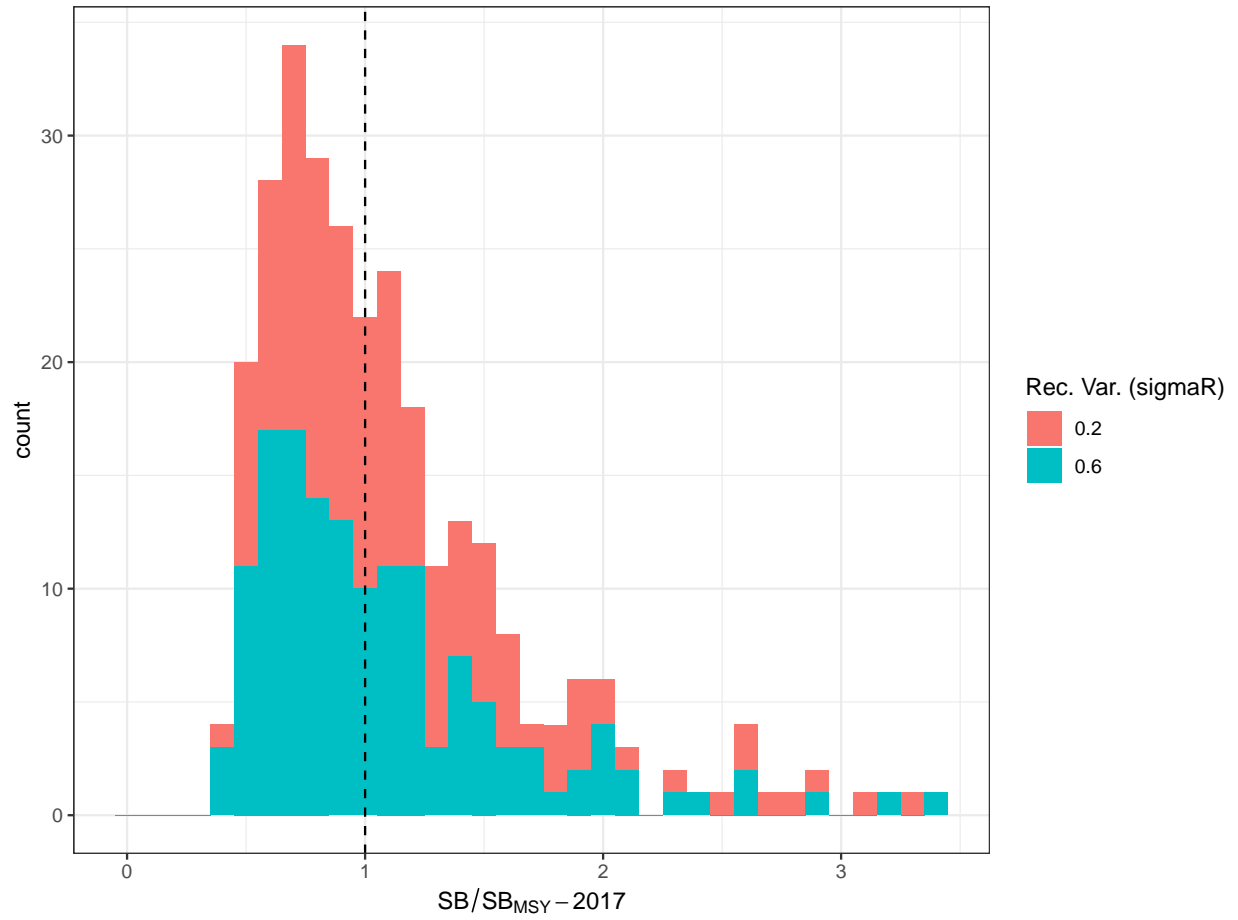


Figure 15. Histogram of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of Rec. Var. (sigmaR).

Steepness

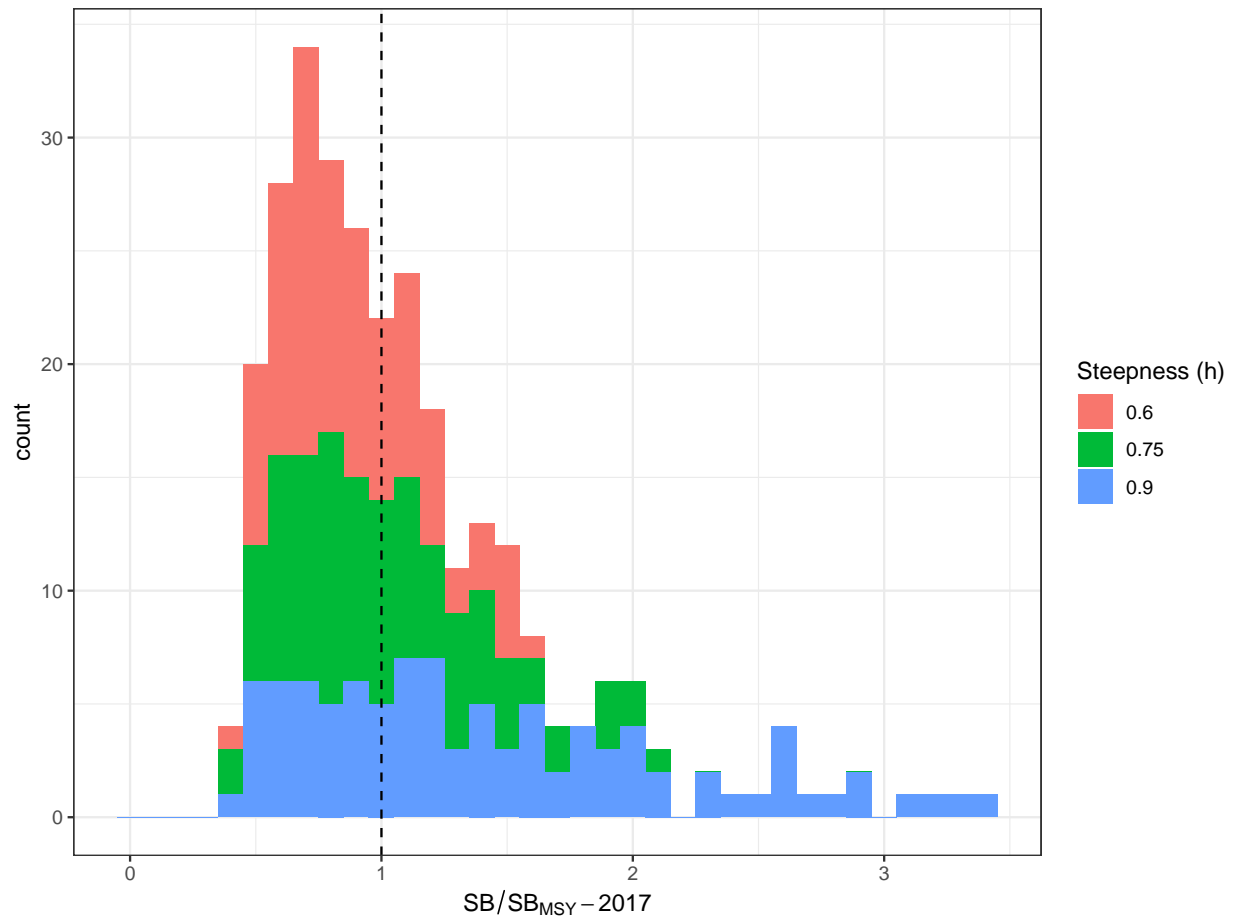


Figure 16. Histogram of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 3 levels of Steepness (h).

CPUE CV

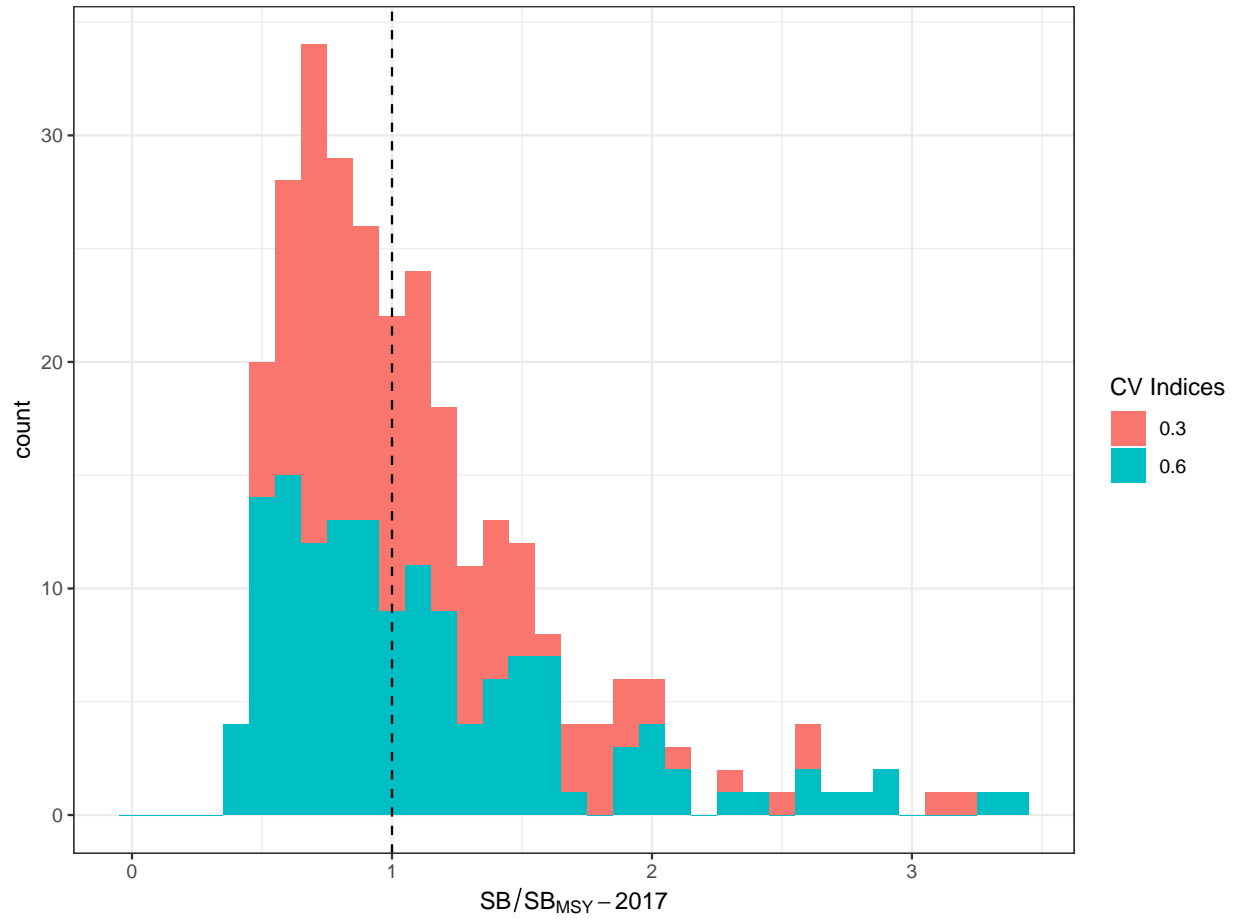


Figure 17. Histogram of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of CV Indices.

Length Comp. ESS

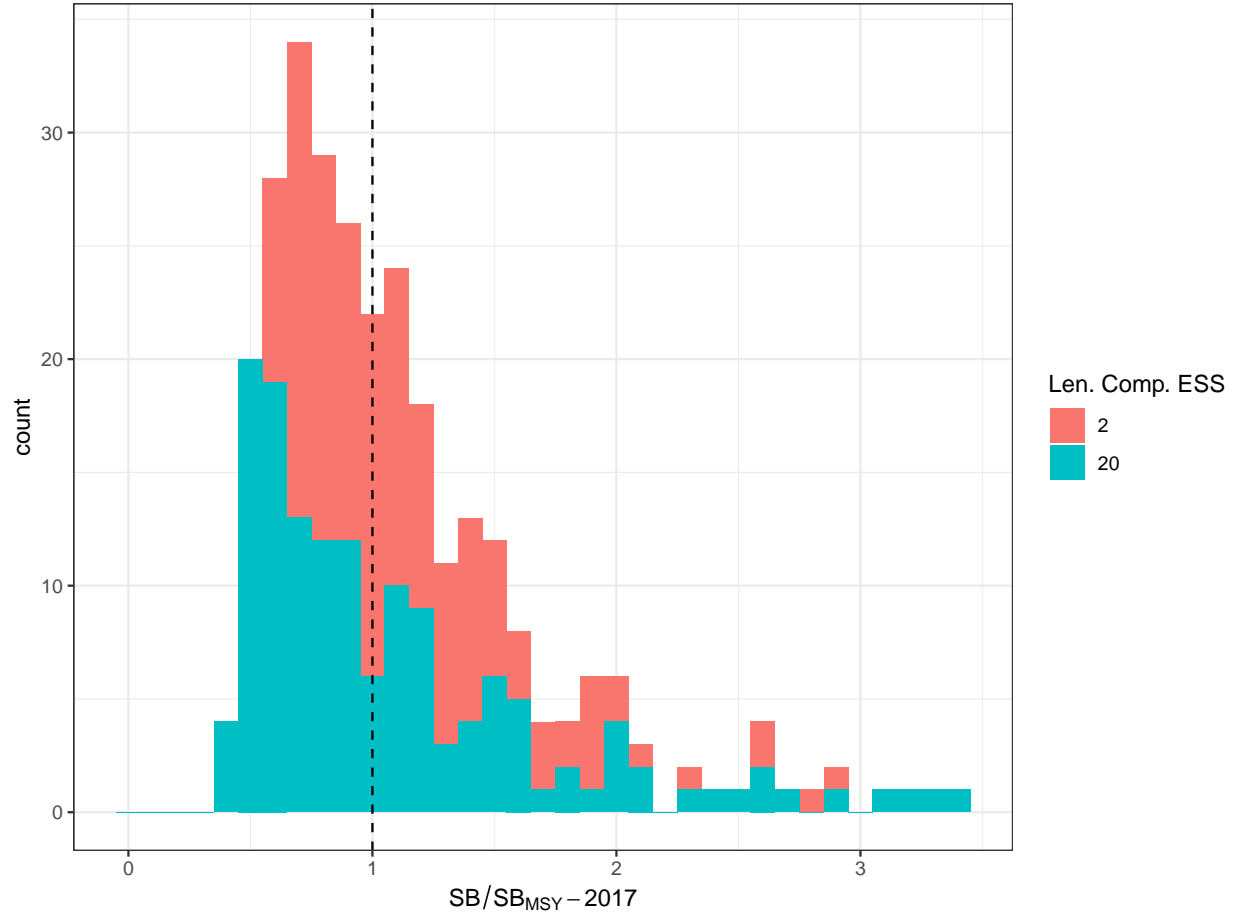


Figure 18. Histogram of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of Len. Comp. ESS.

Catchability Increase

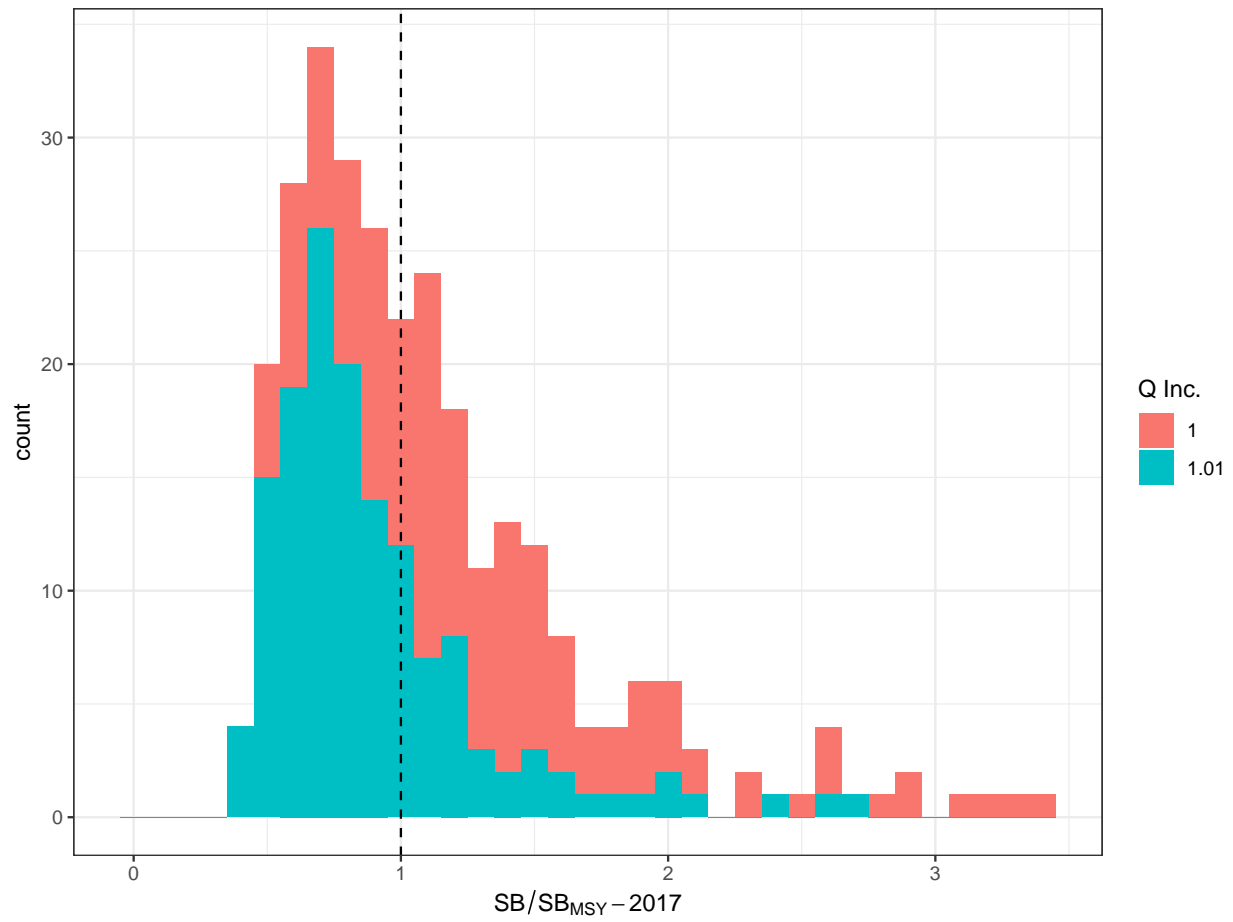


Figure 19. Histogram of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of Q Inc..

Environmental Covariate

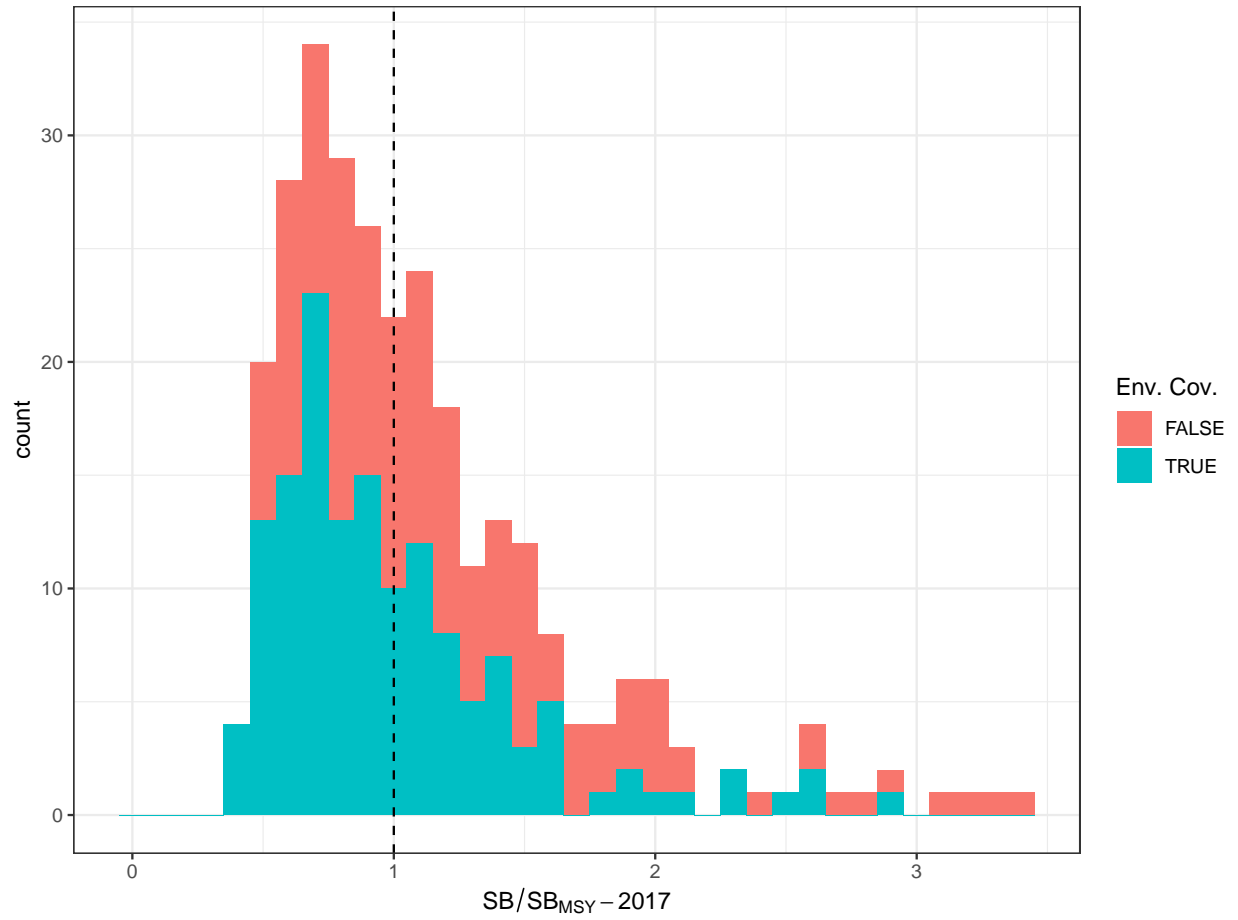


Figure 20. Histogram of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of Env. Cov..

Current SB/SB_{MSY} Bi-Variate Boxplots

Bivariate boxplots of the spawning biomass (SB) relative to spawning biomass corresponding with maximum sustainable yield (SB_{MSY}) for the factors examined in the uncertainty grid.

Natural Mortality

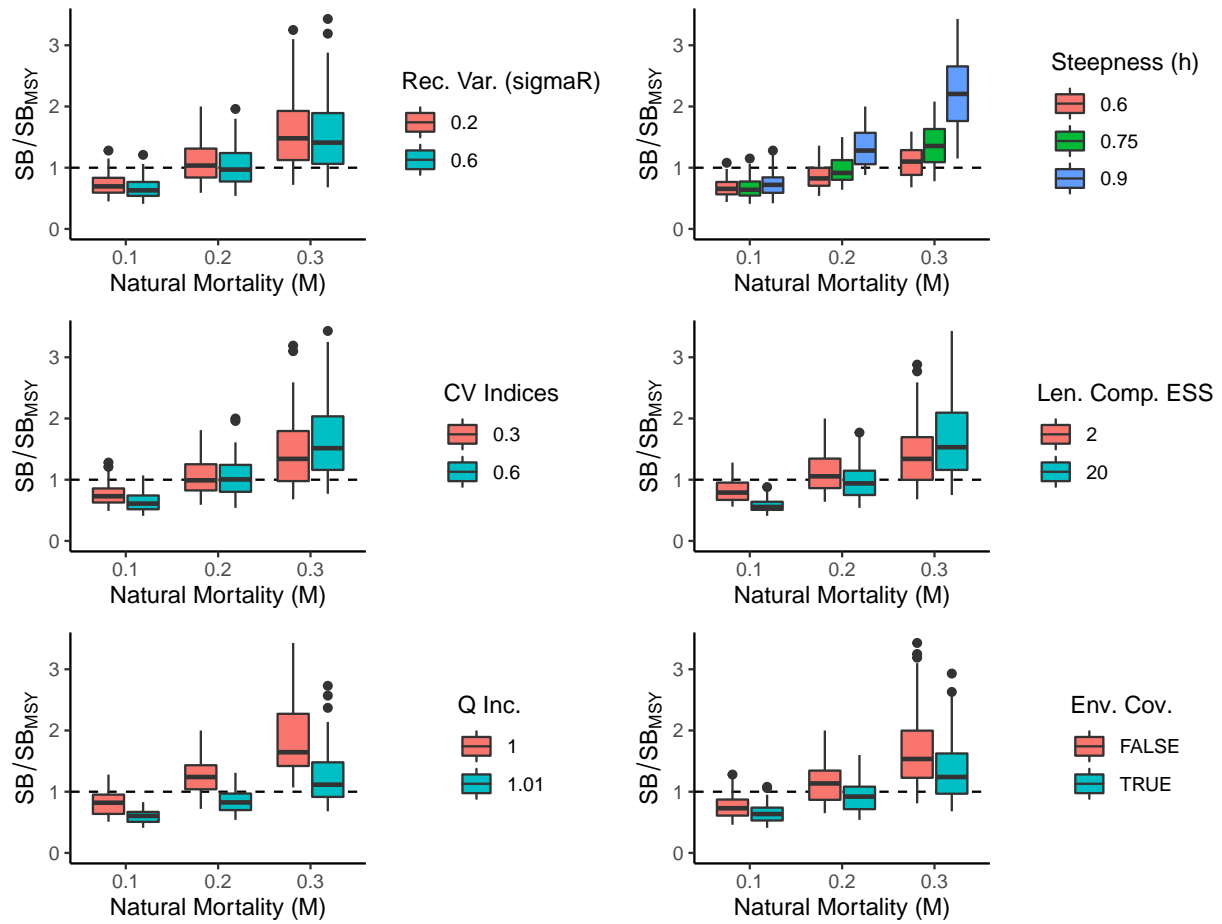


Figure 21. Boxplots of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 3 levels of Natural Mortality shown as factors on the x-axis and colours indicating the other factors.

Recruitment Variability

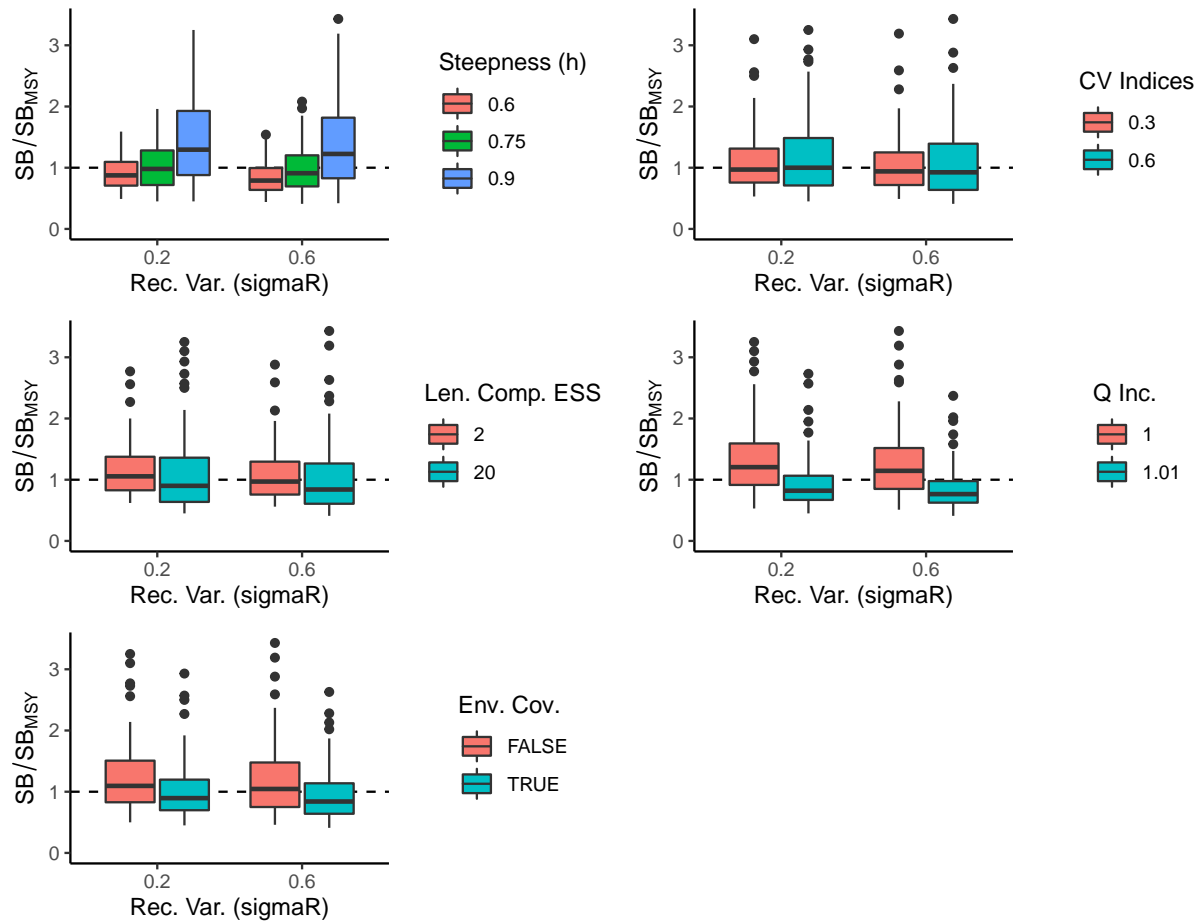


Figure 22. Boxplots of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OM's from the uncertainty grid with the 2 levels of Recruitment Variability shown as factors on the x-axis and colours indicating the other factors.

Steepness

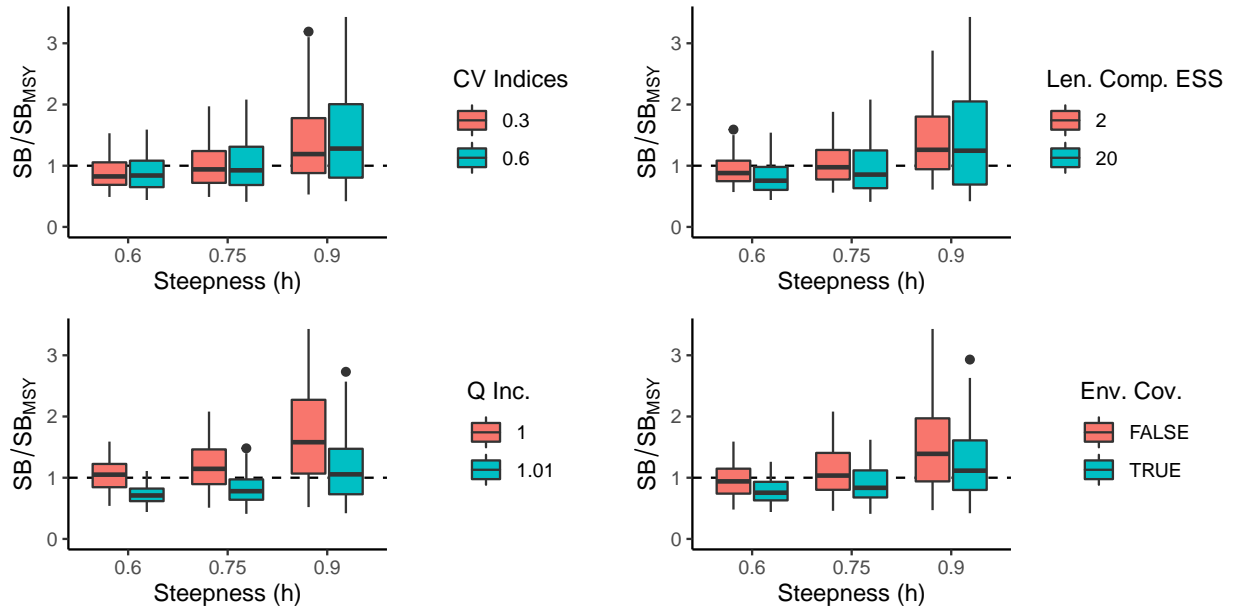


Figure 23. Boxplots of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 3 levels of Steepness shown as factors on the x-axis and colours indicating the other factors.

CPUE CV

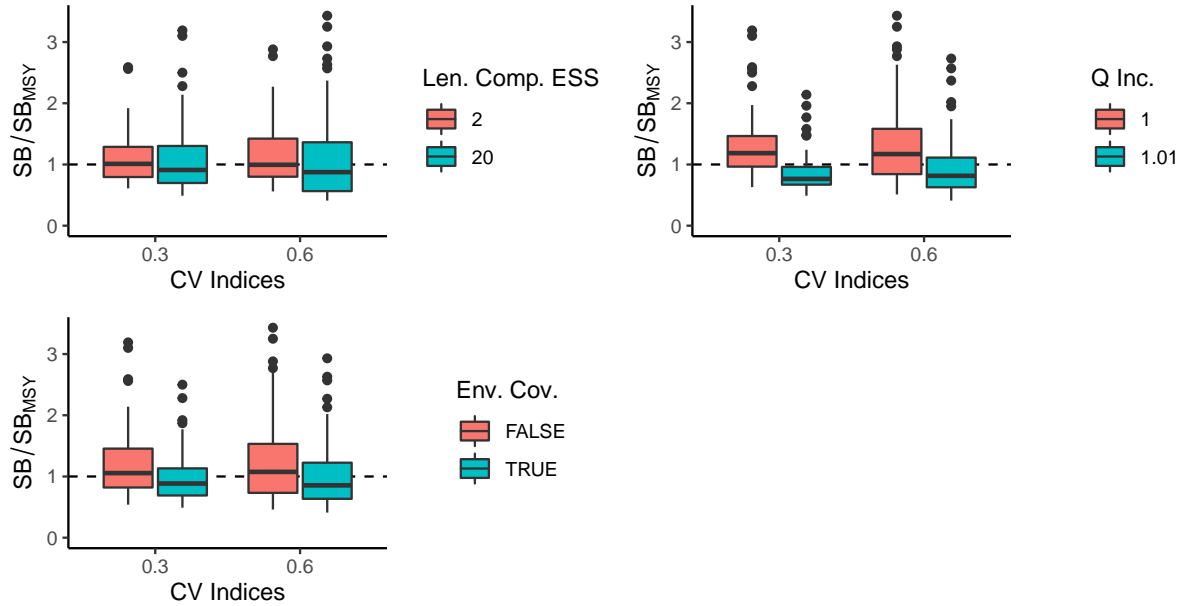


Figure 24. Boxplots of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of CV Indices shown as factors on the x-axis and colours indicating the other factors.

Length Comp. ESS

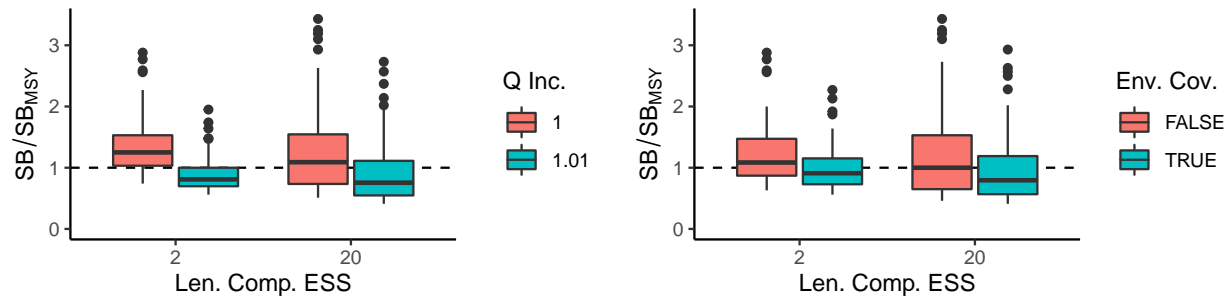


Figure 25. Boxplots of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of Length Composition Effective Sample Size shown as factors on the x-axis and colours indicating the other factors.

Catchability Increase

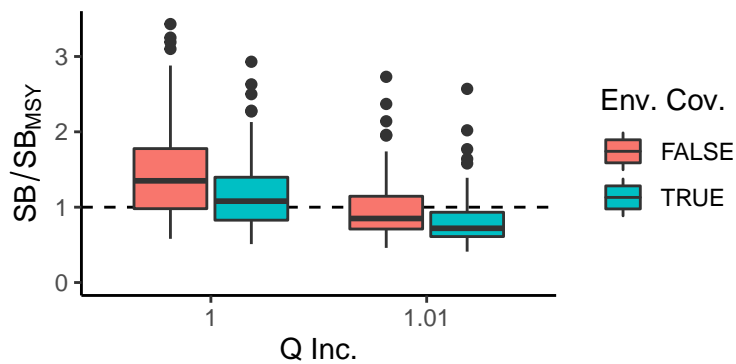


Figure 26. Boxplots of predicted spawning biomass (SB) relative to spawning biomass at maximum sustainable yield (SB_{MSY}) for the 288 OMs from the uncertainty grid with the 2 levels of Q Increase shown as factors on the x-axis and colours indicating the other factors.

Impact of M and h on Estimated Parameters

Unfished Recruitment (R_0)

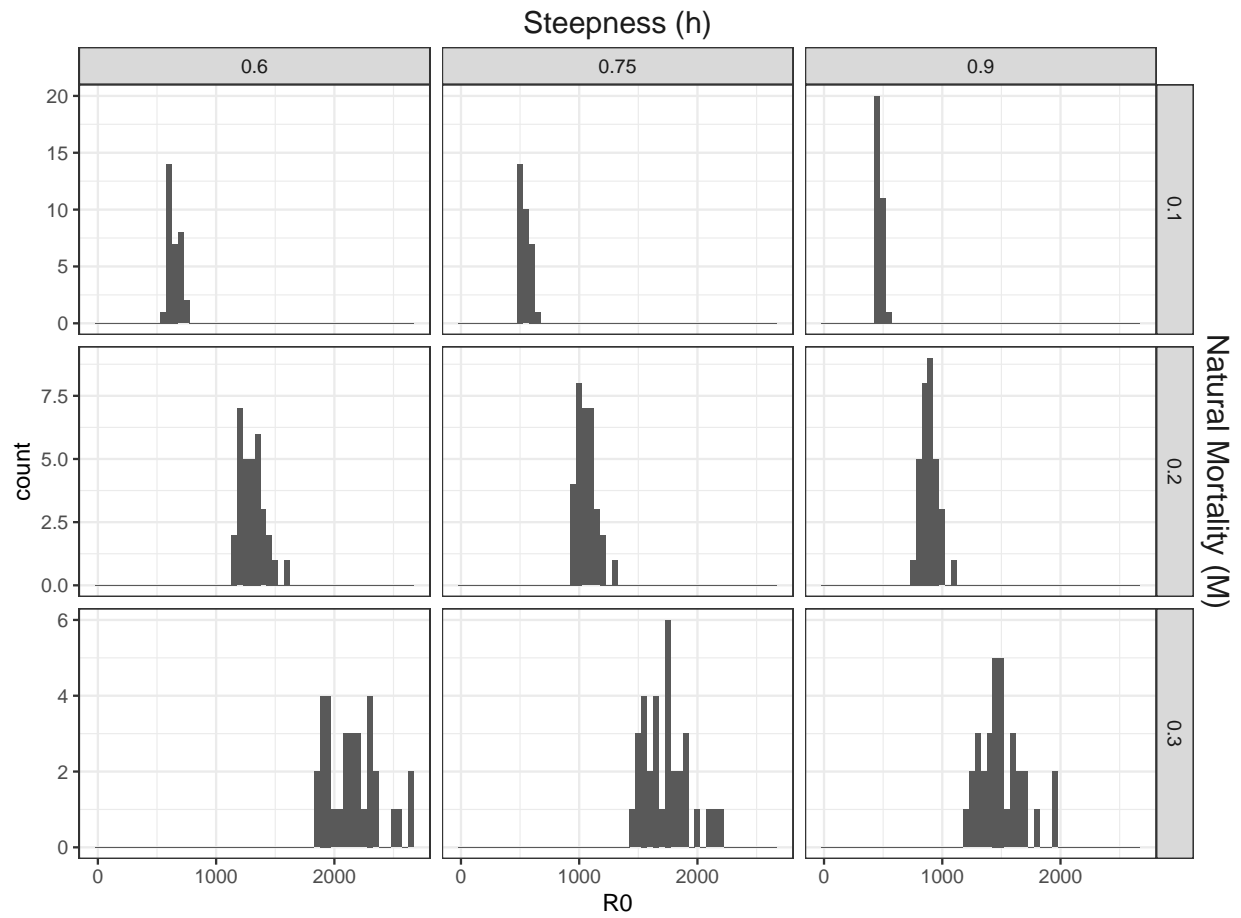


Figure 27. Histograms of estimated unfished recruitment (R_0) faceted by 3 levels of natural mortality (M) and 3 levels of steepness (h).

Depletion

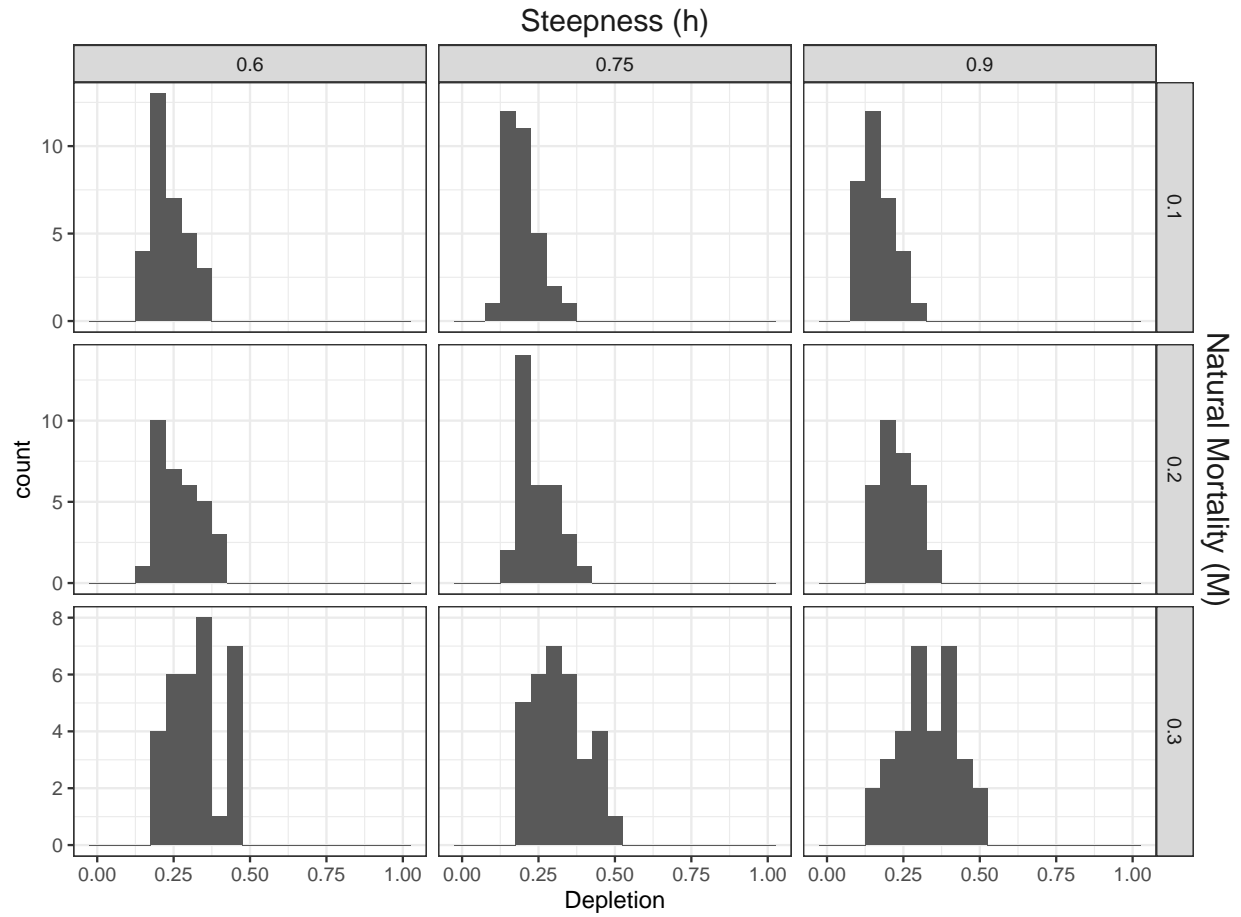


Figure 28. Histograms of estimated depletion (SB/SB_0) faceted by 3 levels of natural mortality (M) and 3 levels of steepness (h).

SB_{MSY}

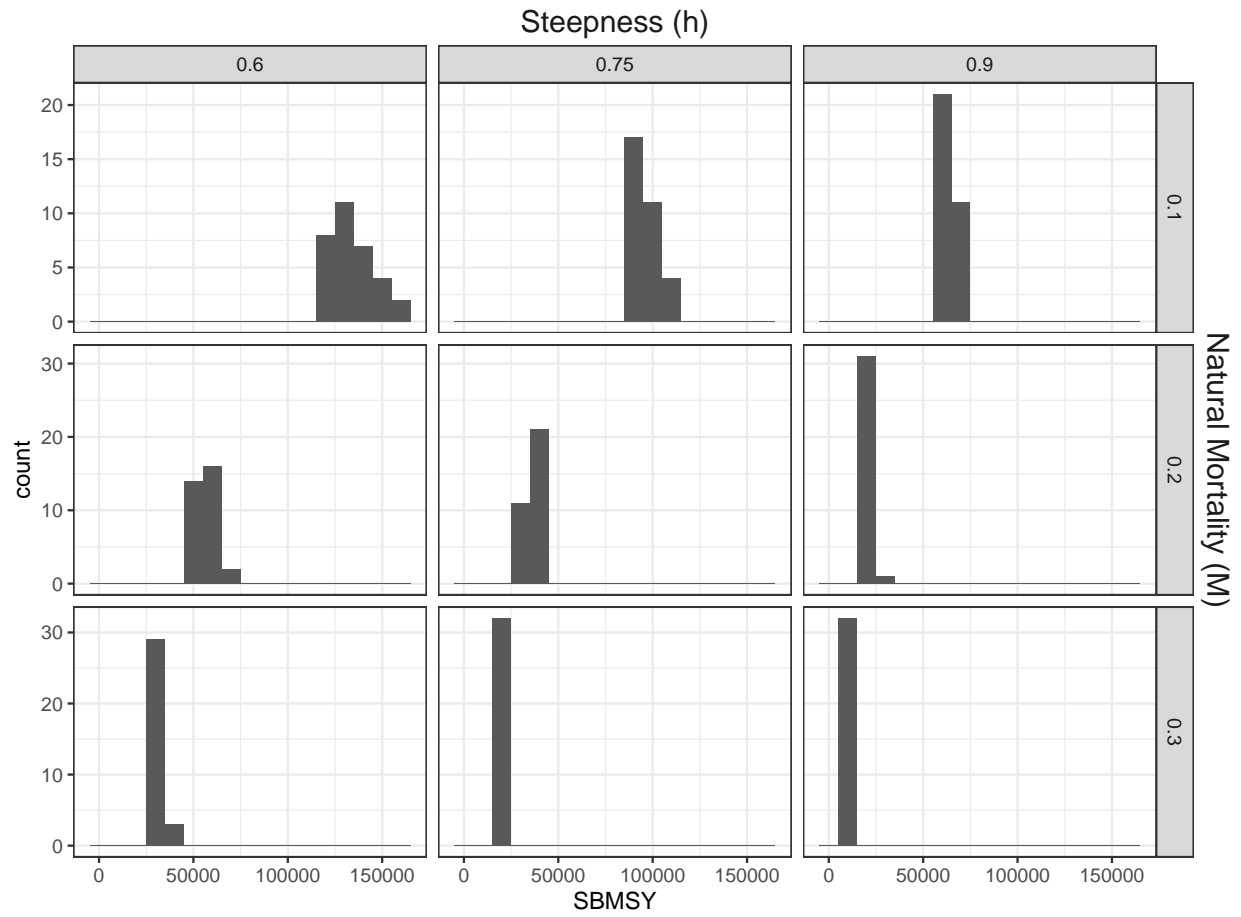


Figure 29. Histograms of estimated SB_{MSY} faceted by 3 levels of natural mortality (M) and 3 levels of steepness (h).

SSB

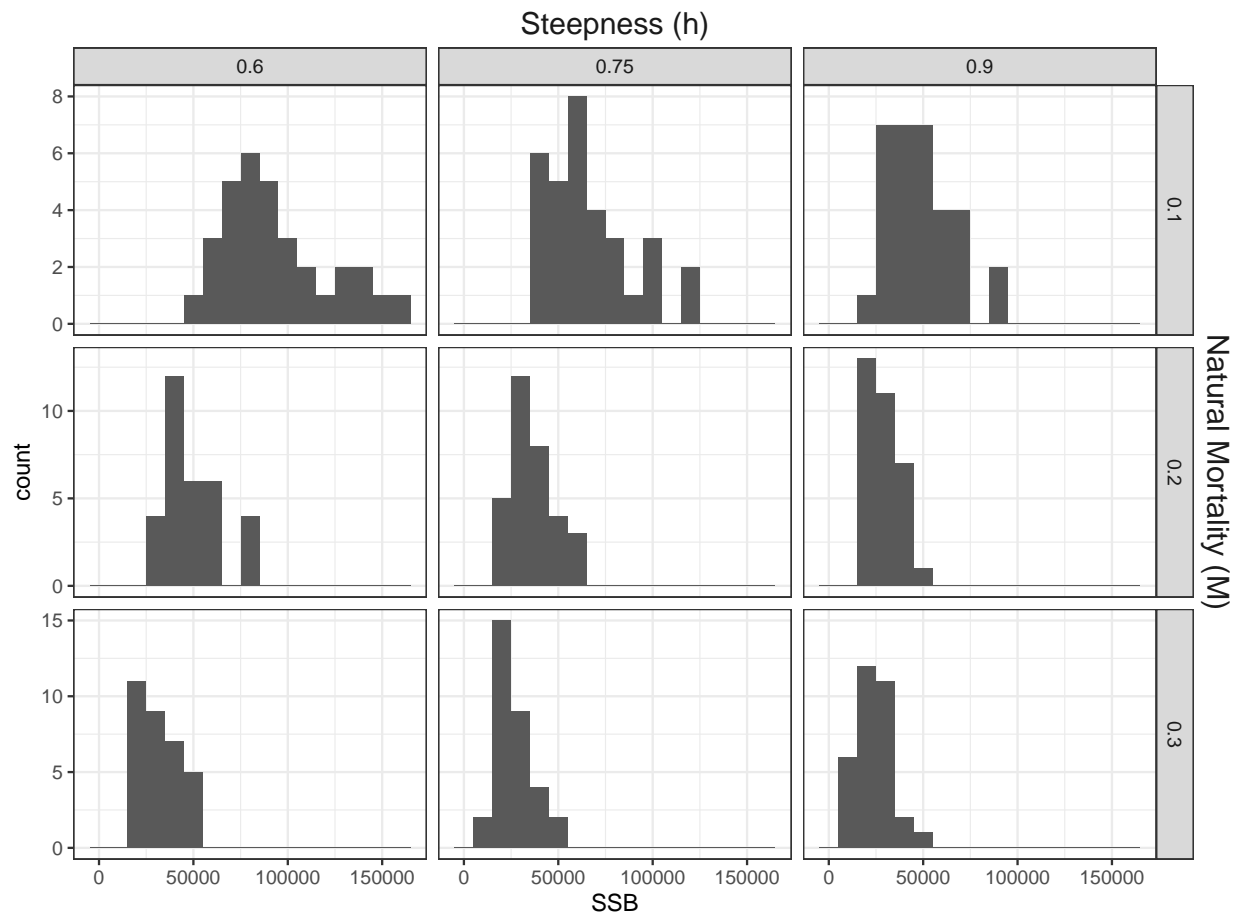


Figure 30. Histograms of estimated SSB faceted by 3 levels of natural mortality (M) and 3 levels of steepness (h).

SB0

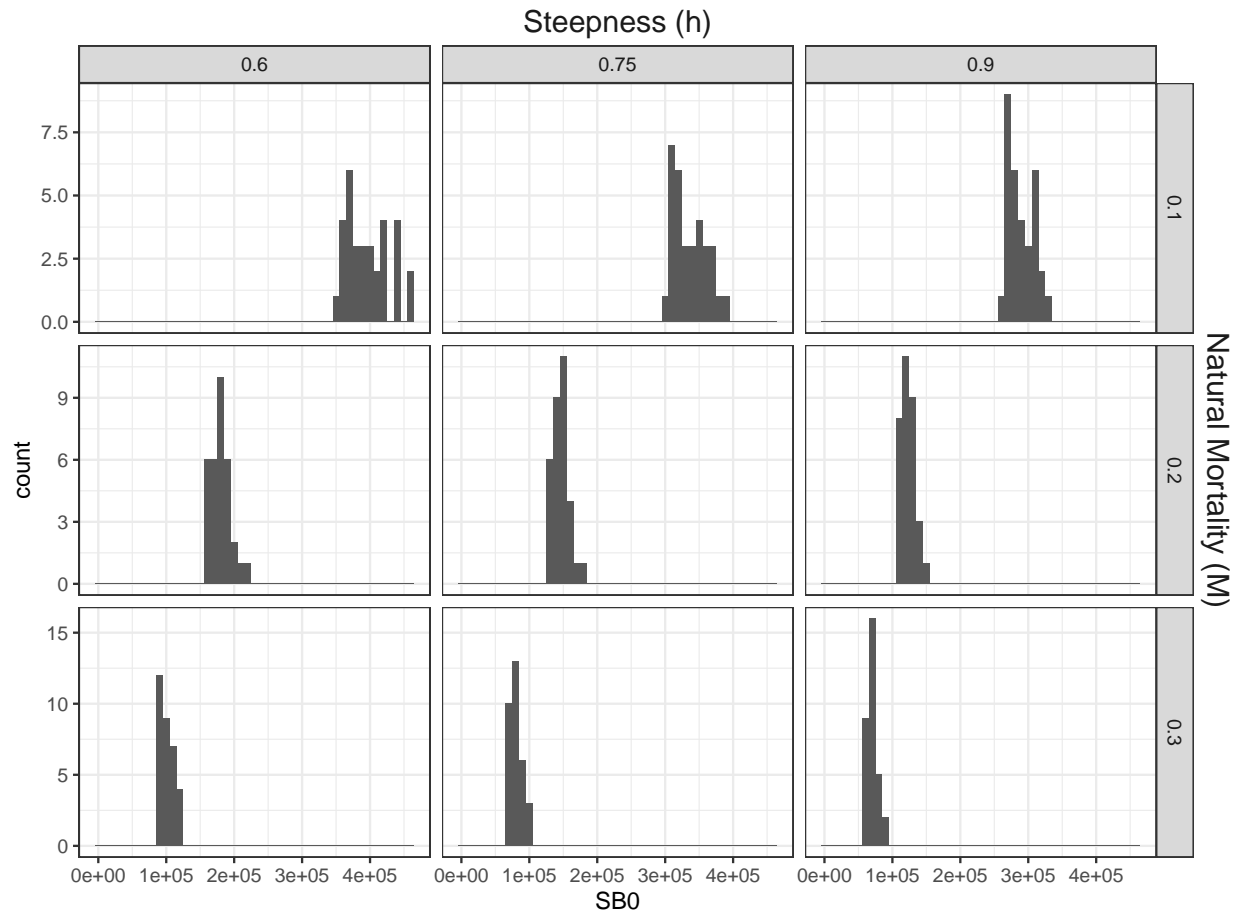


Figure 31. Histograms of estimated SB0 faceted by 3 levels of natural mortality (M) and 3 levels of steepness (h).