Brief examination of conditioning results of the SBT operating model for management procedure evaluation

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Updated conditioning results for the operating model used for evaluation of management procedures are examined briefly. Although no serious problems are found, the examination shows that:

(1) higher steepness is preferred in the grid sampling for the reference set, which leads to slightly more optimistic future projections, and

(2) based on the results of grid sampling for future projections under the current catch level, robustness trials relating to longline CPUE series often show features that differ from those for the reference set.

管理方式評価に使われるオペレーティングモデルの条件付けの結果の検討

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管理方式の評価に用いるオペレーティングモデルの条件付け結果を簡潔に検討した。大きな問題点は見られなかったが、以下のことが明らかになった。

(1) ベースケースにおいて、より高い steepness が選択される傾向にあり、これまでより多少楽観的な将来予測結果が得られた。

(2) グリッドサンプリングと将来予測結果によると、特に延縄 CPUE に関連した頑健性テストでベースケースと異なる結果が得られた。

Introduction

Since the CCSBT Extended Scientific Committee (ESC) meeting held in September 2009, the conditioning process for the Operating Model (OM) to be used for evaluation of candidate SBT Management Procedures (MPs) has been updated for an initial round of MP testing in primarily two respects: (1) the inclusion of Japanese longline CPUE data for 2007 and 2008, and (2) a revision of the aerial survey index for the Great Australian Bight. In addition, the ESC selected 22 scenarios for robustness trials to check the robustness of candidate MPs to a variety of uncertainties that are not included in the reference set. Some of the detailed model assumptions were agreed only through

intersessional web meetings held after the ESC meeting, but their impacts on conditioning results have not as yet been fully examined. In this paper, therefore, we show conditioning and projection results under the current catch level for the updated reference set and the robustness trials, and report in particular on (1) the preference for somewhat higher steepness in the grid sampling and consequently more optimistic projection results, (2) exploration of an alternative range of values for steepness and natural mortalities in the grid, and (3) characteristics of and questionable necessity for some of the robustness trials.

Data and model specification

In this analysis, we use the conditioning program "sbtmod22.exe" (distributed on 21 April 2010) and the projection program "sbtprojv118.exe" (distributed on 19 May 2010). Conditioning results, particularly for robustness trials, were obtained in collaboration with national scientists, the MP consultant and the advisory panel. The default grid specification proposed at the ESC meeting in September 2009 is used (Table 1a). In addition, results for an alternative grid with lower and higher steepness values, a higher M_1 value and a lower M_{10} value are explored (Table 1b). We also examine all the robustness trials that were specified at and after the ESC meeting.

Results and Discussion

New conditioning result for the base case

Compared to the final results obtained at the ESC meeting in September 2009 (Fig. 1), the new grid results for the reference set prefer somewhat higher steepness along with slightly lower M_{10} values (Fig. 2a). Although the likelihood profile does not show a distinct difference between these two results from the conditioning, the higher steepness preference seems to arise as a result of the fit to the catch composition data for LL3 (Japanese LL in Area 2) and Indonesian fisheries, while the catch-at-size data for LL1 supports lower steepness as was also evident for the 2009 ESC results (Fig. 3).

Historical trajectories of recruitment and spawning biomass are not substantially different from previous results (compare Figs 1b and 2b), and projection results under the zero catch scenario appear almost identical (Figs 1c and 2c). However, there is a moderate difference in the replacement yield, which is the catch that maintains the spawning stock biomass at its current level. For the updated model, the replacement yield is estimated at about 14000t, while it was about 12000t previously.

Range of parameter values in the grid

Because the upper limit values for steepness and natural mortality (M_1) were heavily sampled in the

current grid specification, we explored the possibility of expanding the ranges for steepness and natural mortalities (Table 1b). The new upper limit of steepness (0.82) is sampled as much as the current lower limit (0.55) (Fig. 4). New higher M_1 and lower M_{10} values were also sampled moderately with somewhat high correlations among the three parameters. Future projections obtained from this new grid candidate showed slightly more optimistic stock trends at the current catch level (9449t) (i.e., quicker stock rebuilding).

Robustness trials

Projection results for the robustness trials under the current catch scenario indicate that this current set of the trials covers a wide variety from rather pessimistic trials to somewhat optimistic ones. In particular, trials relating to longline CPUE series (such as “highCPUECV”, “Laslett”, “STwin”, “omega75”, and “upq”) often show different features compared to the reference set (Fig. 5). This suggests that the estimates of parameters including those included in the grid (in particular, steepness) and the current stock biomass are rather different (Fig. 6). A trial incorporating the troll index has very high steepness with leads to very optimistic future projections. On the other hand, the “omega75” trial (which assumes a non-linear relationship between CPUE and the exploitable biomass of the stock) results in further stock depletion. Interestingly, the “downearlysize” trial (reducing the weight of early size composition data in the likelihood) results in a lower steepness along with very high recruitments in the late 1950s, but the projection results are similar to those of the reference set. In general, scenarios relating to overcatch do not show any appreciable difference from the reference set. This suggests that it might be possible to drop some of the robustness trials from the current list after an initial examination of performance of candidate MPs for them.

References

CCSBT 2009. Report of the Extended Scientific Committee for the 14th Meeting of the Scientific Committee. 5 - 11 September 2009, Busan, Korea.

Table 1. Grid specifications used for this analysis (note that the shading below indicates specifications that differ from the default).

(a) Default

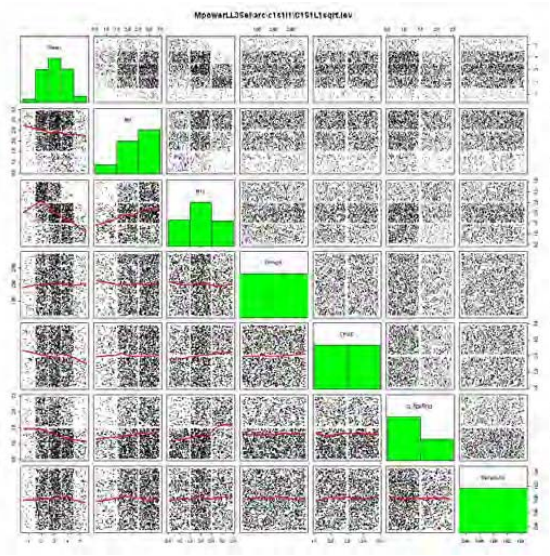
	Levels	Cumul N		Values		Prior	Simulation Weights
Steepness (*h*)	3	3	0.55	0.64	0.73	Uniform	Likelihood
M_1	3	9	0.30	0.35	0.4	Uniform	Likelihood
M_{10}	3	27	0.07	0.1	0.14	Uniform	Likelihood
Omega	1	27		1		NA	NA
CPUE series	2	54		w.5	w.8	Uniform	Prior
q age-range	2	108		4-18	8-12	0.67, 0.33	Prior
Sample Size	1	108		Sqrt		NA	NA

(b) Alternative used for this analysis, with 5 steepnesses and 4 natural mortalities (M_1 and M_{10})

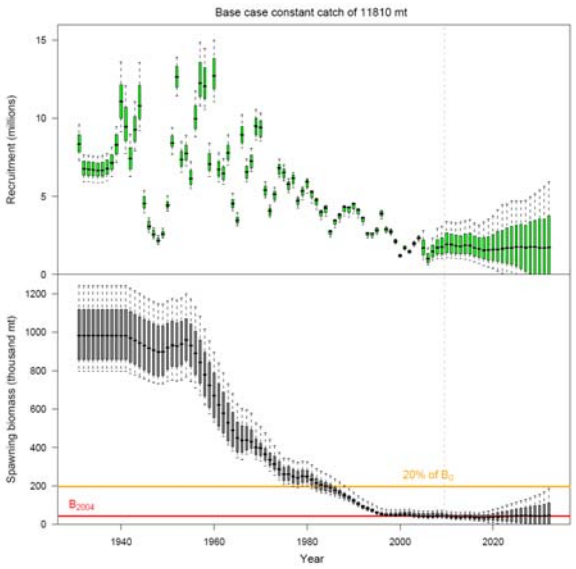
	Levels	Cumul N			Values			Prior	Simulation Weights
Steepness (*h*)	5	5	***0.385***	0.55	0.64	0.73	***0.82***	Uniform	Likelihood
M_1	4	20		0.30	0.35	0.4	***0.45***	Uniform	Likelihood
M_{10}	4	80	***0.04***	0.07	0.1	0.14		Uniform	Likelihood
Omega	1	80			1			NA	NA
CPUE series	2	160			w.5	w.8		Uniform	Prior
q age-range	2	320			4-18	8-12		0.67, 0.33	Prior
Sample Size	1	320			Sqrt			NA	NA

Figure 1. Conditioning results for the base case shown at the Scientific Committee in 2009 (CCSBT 2009). (a) Likelihood-weighted shade plots for the 5 steepness values (0.385, 0.55, 0.64, 0.73, 0.82). (b) Recruitment and spawning stock biomass, showing the medians, quartiles and 90th percentiles. Projections of future spawning stock biomass and recruitments assume a constant catch (***11810t***). (c) Median spawning stock biomass projected for a variety of levels of constant catches.

(a)



(b)



(c)

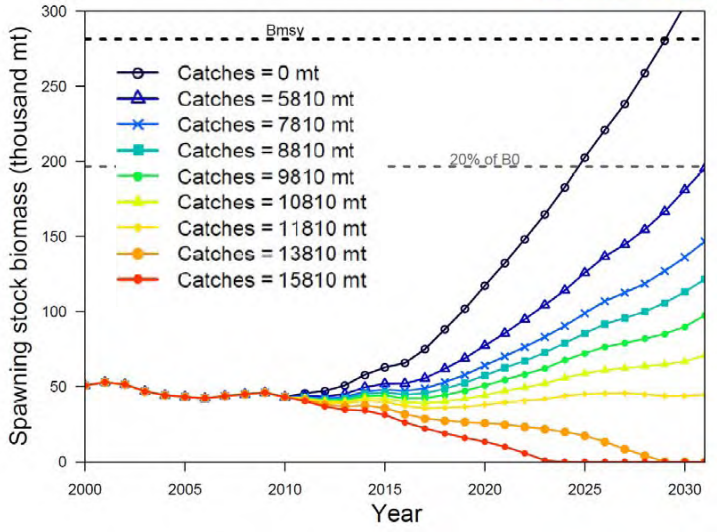
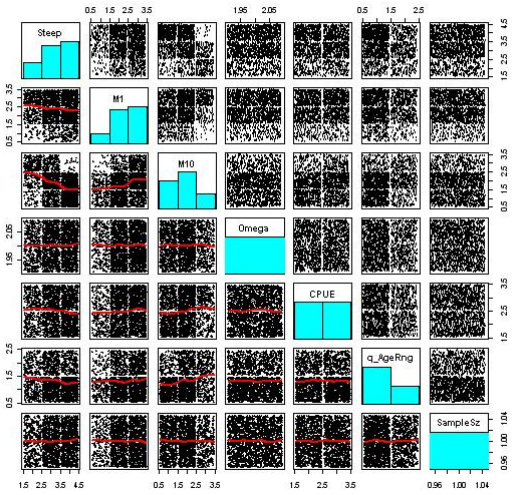
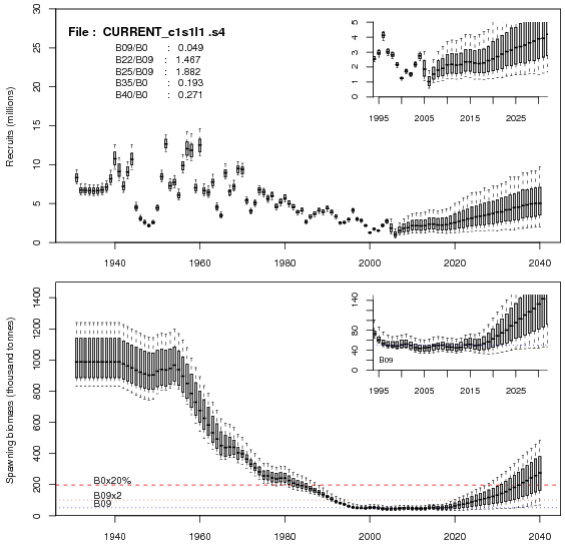


Figure 2. Conditioning results for the base case proposed for the OM/MP technical meeting. (a) Likelihood-weighted shade plots for the 3 steepness values (0.55, 0.64, 0.73). (b) Recruitment and spawning stock biomass. Future projections assume a constant catch at the current level (***9449t***). (c) Median spawning stock biomass projected for a variety of levels of constant catches.

(a)



(b)



(c)

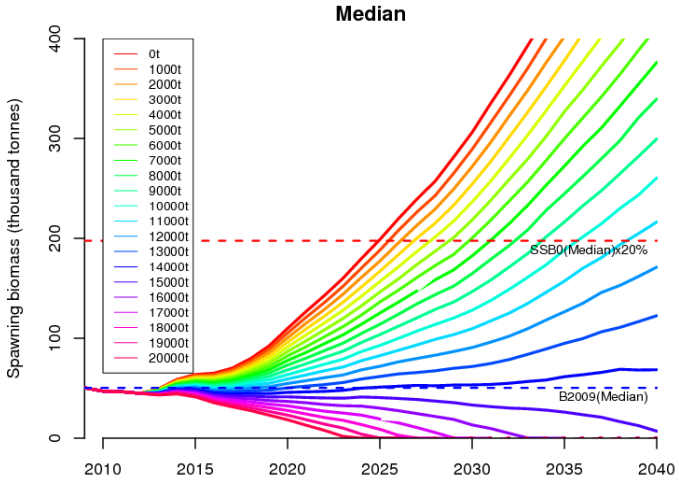
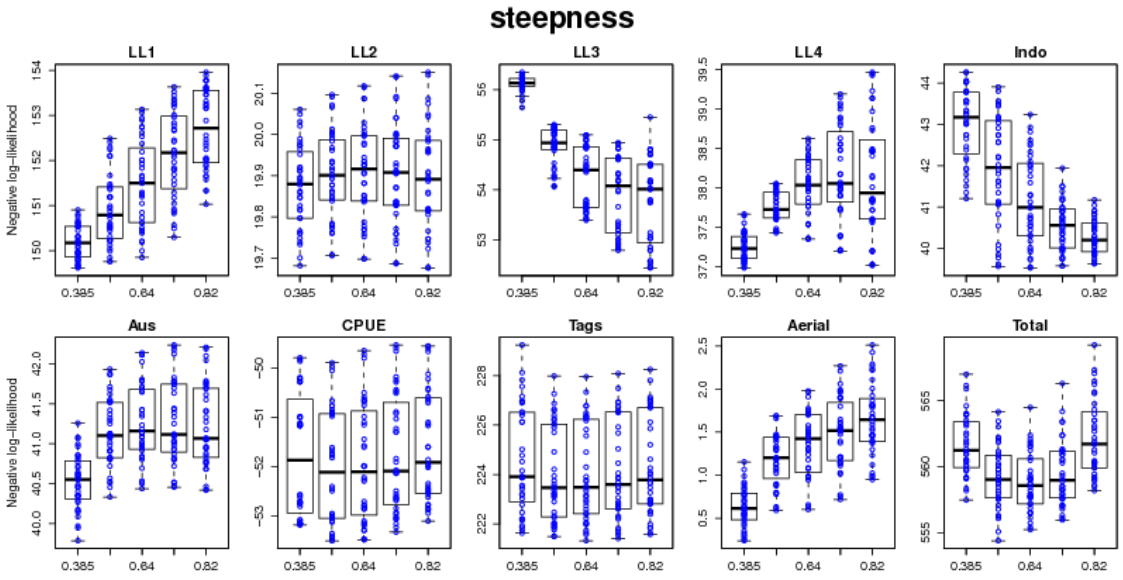


Figure 3. Likelihood profiles for data components and total (lower right) for the reference set of the operating model used for (a) the Scientific Committee in 2009 and (b) the OM/MP Technical Meeting in 2010.

(a) 2009 Scientific Committee



(b) 2010 OM/MP Technical Meeting

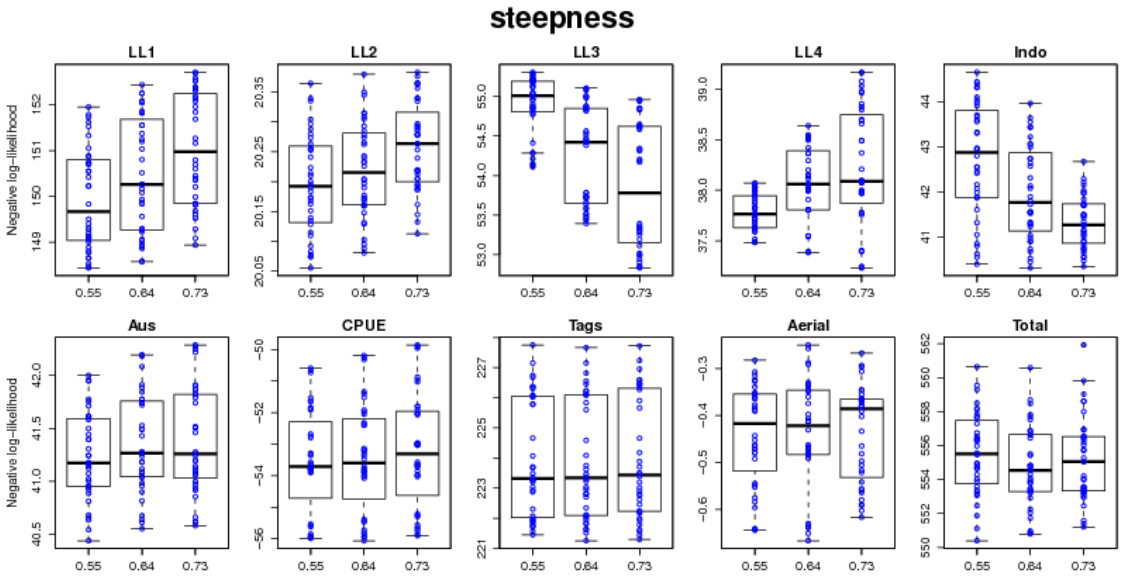


Figure 4. Estimated distributions for each uncertainty axis when grid values for steepness and natural mortalities are expanded as shown in Table 1b.

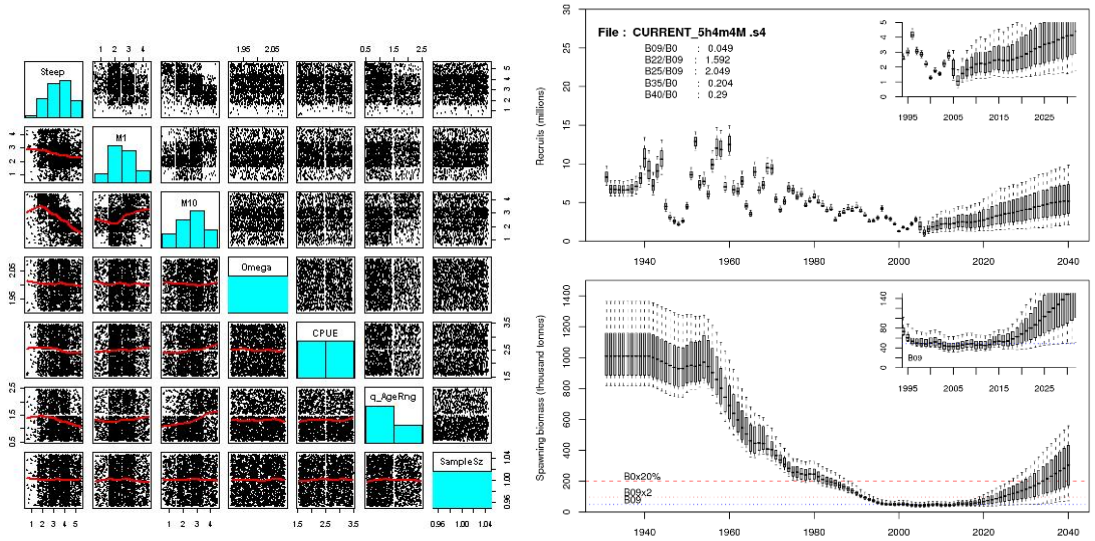


Figure 5. Median spawning stock biomass projected under the current catch level (9449t) for 22 robustness trials.

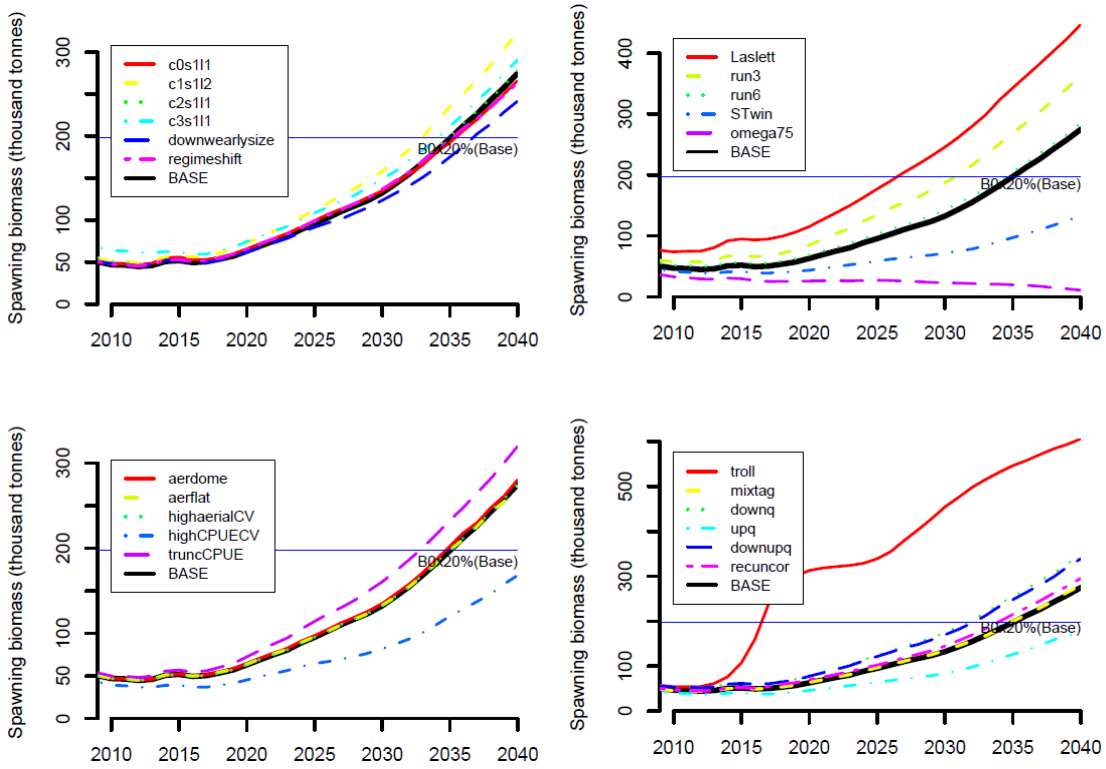
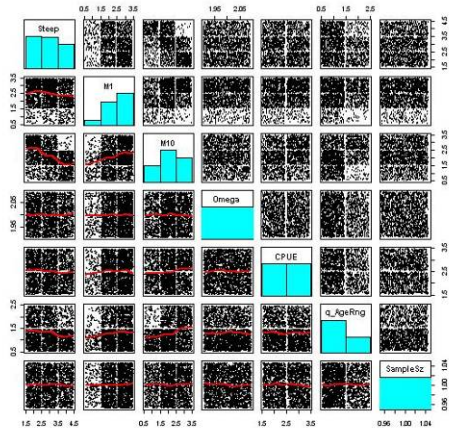
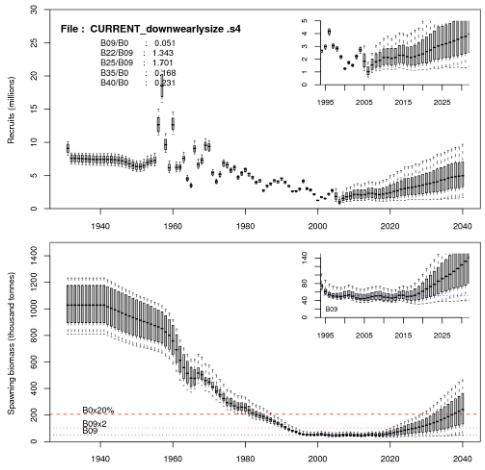


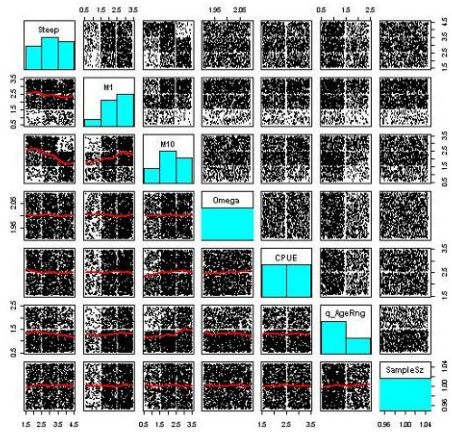
Figure 6. Distributions for each uncertainty axis (left panel) and recruitment and spawning biomass trajectories under the current catch level (right panel) for some of the robustness trials.

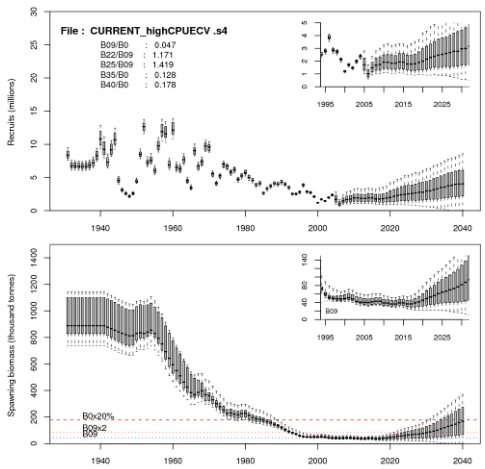
(a) “downearlysize”



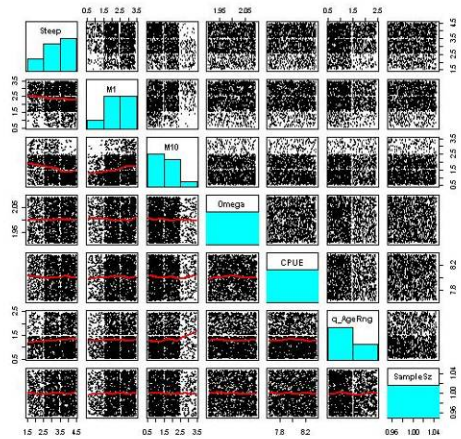


(b) “highCPUECV”





(c) “Laslett”



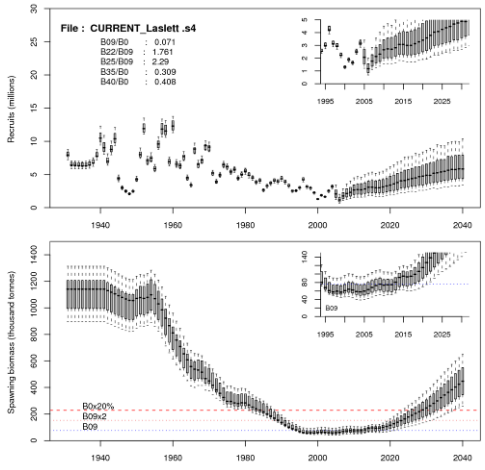
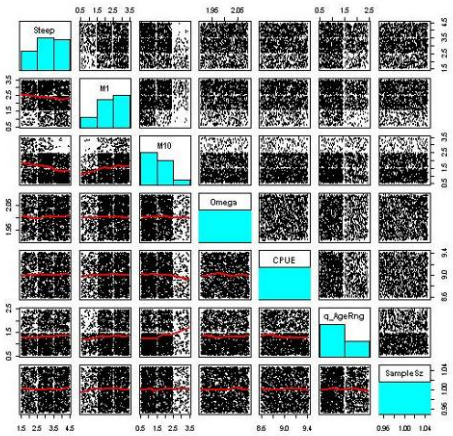
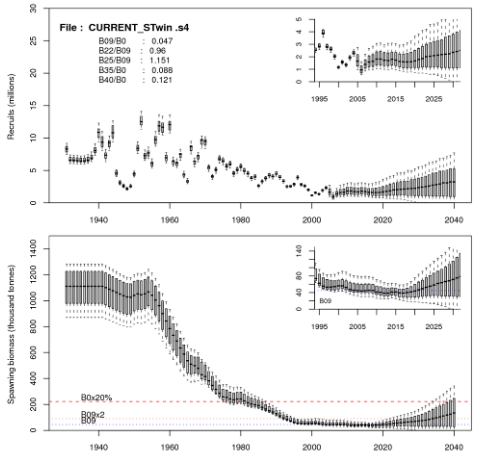


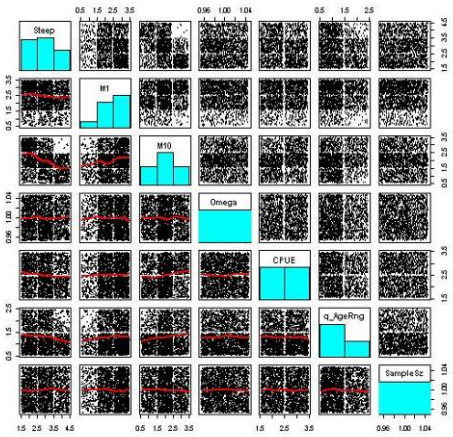
Figure 6. (cont.)

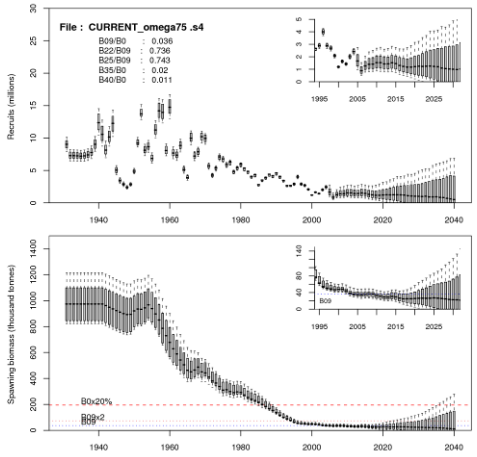
(d) “STwin”



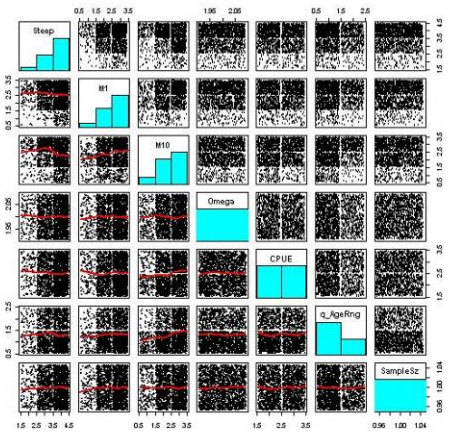


(e) “omega75”





(f) “troll”



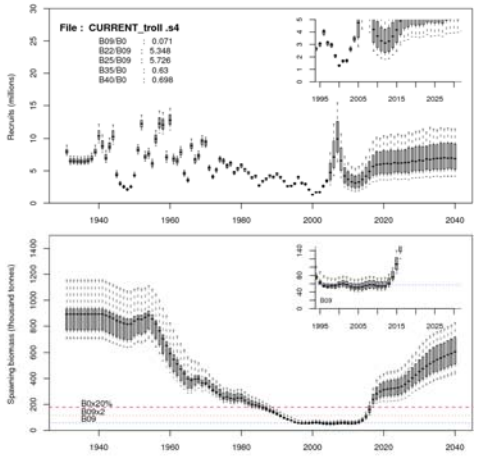


Figure 6. (cont.)

(g) “upq”