SBT Stock Assessment and Projection under Overcatch Scenarios Using the Operating Model

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Stock assessments and constant catch projections under several overcatch scenarios using the operating model developed by CCSBT SC are conducted. The main factors influencing the assessment results are (1) the period over which the longline overcatch took place and (2) assumptions about the extent to which the longline overcatch necessitates CPUE adjustments. We also consider the appropriateness of the criterion used previously by the SC to evaluate short term risk.

CCSBT 科学委員会で開発されたオペレーティングモデルを用いて、いくつかの過剰漁獲シナリオのもとで、資源評価と将来予測を行う。結果に大きな影響を与える要因として、(1)延縄の過剰漁獲の期間と(2)CPUE を補正する際反映させる努力量の大きさに関する仮定が挙げられる。また短期的リスクを評価するために使われた基準の妥当性について議論する。

The Special Meeting of the Commission held in July 2006 provided the CCSBT SAG/SC with several scenarios for overcatch in the longline and surface fisheries, and outlines for the revision of nominal CPUE for Japanese longliners (Attachment 7, CCSBT 2006). In order to specify these more precisely for the purpose of conducting assessments, the SC's Advisory Panel proposed a minimum set of scenarios in August. In the main, we follow this proposal and conduct stock assessments and constant catch projections using the operating model originally developed for the evaluation of management procedures in the CCSBT SAG/SC.

Preliminary runs to find key factors and select base scenarios

Before conducting runs of the full grid, which consists of 1080 parameter combinations, the operating model was run for a specific parameter set with a central choice for each factor (h2m2M2O2C3q1a1_sqrt: h = 0.55, M0 = 0.4, M10 = 0.1, Omega = 1.0, CPUE = Laslett, q age-range = 4-18); this was aimed at guiding a strategy to explore overcatch-related factors with the most influence on results within the limited time available for analysis. This preliminary analysis was conducted with the current nominal catch (14925t) used in projections for an original no-overcatch scenario to serve as a reference, and for all overcatch scenarios combined: surface overcatch options (S0, S1, S2, S3) and longline overcatch options (L1, L2) (for more detailed information on these options see Appendix 1).

Figure 1 indicates that the stock trajectories (both past and projected) are dependent on the overcatch scenarios for both fisheries. However, the impacts of the differences between the longline options are larger than those for the surface options; furthermore the L2 option, which assumes a longline overcatch for a longer period, results in greater current population biomass and more optimistic future projections. Since as the surface overcatch increases, the projection results become slightly more optimistic in a straightforward manner, our sense is that results for the S1 and S2 options can reasonably be interpolated between those for the S0 and S3 options. Accordingly further analyses were restricted to the S0 and S3 options.

Comparison between original no-overcatch scenario and longline overcatch scenario (C0S0L0, C0S0L2)

The C0S0L0 and C0S0L2 scenarios (Case2 1985-2005) are compared to illustrate the major effects of the longline overcatch on stock assessment results. Fig. 2 shows the distributions of parameter values/estimates and assumptions for the grids, which are sampled in terms of the original configuration determined at the MP technical meeting in Seattle (CCSBT, 2005a). Fig. 3 provides a similar plot, but here the sampling for the steepness parameter is based on likelihood, not according to fixed proportions as originally specified, to check the sensitivity of results to this.

Comparison of these results illustrates that the longline overcatch has appreciable impacts on the stock assessment results. Natural mortalities (M0 and M10) shift towards lower values when the overcatch is included (Figs. 2a and 2c). As regards the parameter "omega" (which relates to the linearity of CPUE vs abundance relationship), the proportion of values of 1.0 selected increases to the extent that the 0.75 value hardly ever occurs. Furthermore, when steepness is selected based on likelihood weighting, higher steepness values become more favoured and the distribution becomes similar to that of the fixed proportions chosen for the original specification (Figs. 3a and 3c). As expected from the changes to the natural mortality distributions, virgin spawning biomass (B0) and the current spawning biomass (B2006) become larger, although the estimated current depletion does not change appreciably (Table 1). One should though also note that the rate of decrease in abundance over the past 10 years becomes larger with the overcatch included.

Projections at the current catch level (14925 tons) indicate that the overcatch scenario provides more optimistic projections than the original reference case for both the short- and long-term (Table 1, Figs. 4a1 and 4c1). The TAC for 2007 that would apply in terms of the criterion for short-term risk adopted by the SC at its 2005 meeting (CCSBT, 2005b), namely a median spawning biomass in 2014 no lower than that in 2004, can be computed. If no overcatch is assumed, the TAC reduction would be about 9000 tons, i.e. a TAC of about 6000 tons (Table 1, Fig. 4a2). On the other hand, if L2 overcatch option is assumed, the reduction drops to 5000 tons, i.e. a TAC of 10000 tons (Fig. 4c2).

Longline overcatch scenarios (C0S0L1, C0S0L2, C0S0L3)

Results are slightly different between C0S0L1 (Case1 1996-2005) and C0S0L2, particularly in M10 distribution (Figs. 2b and 2c). Given the similarity between the C0S0L2 and C0S0L3 results (Case3 1985-2005) (Figs. 2c and 2d), it is clear that differences in results across the longline overcatch options are primarily influenced by the periods over which overcatch occurred.

Based on the projection results the, L2 scenario is the more optimistic and the L1 the more pessimistic (Figs. 4b-d). Interestingly, however, TAC in 2007 would be reduced by a near identical amount to about 10000 tons for any of the longline overcatch scenarios in terms of the criterion used at the 2005 SC meeting for short term risk (Table 1).

Surface overcatch scenarios (C0S0L2, C0S3L2)

As stated above, it seems likely that the surface overcatch options have relatively rather less impact on the assessment results, even if the S3 option (the maximum farm anomaly) is assumed (Fig. 2e1). The C0S3L2 scenario provides projections that are more optimistic in the long term, but the TAC reduction required in terms of the criterion adopted at the 2005 SC meeting remains about the same at some 5000 tons (Fig. 2e2).

CPUE adjustment (C0S3L2, C1S3L2, C2S3L2, C3S3L2)

Although many alternative options for CPUE adjustments might be advocated, the two methods that the Advisory Panel proposed (option A and option B) were pursued here. As might have been expected, parameter distributions are highly affected by this adjustment (Figs. 2e-h). As the fraction of existing reported effort that is associated with longline overcatch (so-called "S") becomes larger, the M10 distribution shifts towards smaller values and the proportion of the lower value for omega increases. When steepness parameter selection is based on likelihood weighting, the distribution shifts towards higher steepness values (Figs. 3e-h).

Current depletions (B2006/B0) for the C1 (option A, S=0.5), C2 (option A, S=1), C3 (option B, S=0.5) scenarios are much larger than that for C0 scenarios. Projection results become much more promising. The current catch level is sustainable if viewed in terms of the ratio of spawning biomass in 2032 to that in 2004 (Figs. 4f-h). However, if the criterion of the same spawning biomass in 2014 as in 2004 is to be satisfied, the TAC reduction in 2007 would be 5000 tons. The option B (C3 scenario) is slightly more optimistic than the option A (C1 scenario), but the difference is very small.

Assumptions for 2005-2006 market anomaly (C0S0L1, C0S0L1_reg)

Regarding assumptions for the market anomaly for 2006 and 2007, we suggest that rather than assume this to be the same as for 2005, it is more reasonably based on a linear regression of the anomalies for 2003-2005 for each case concerned extrapolated to 2006 and 2007. This is so that trends in the recent estimates reported are taken into account. This option was not included in the minimum set of scenarios which the Panel proposed due to constraints of time, and without intended inferences as to relative plausibility.

The operating model was refit for the C0S0L1 scenario with this regression assumption. The assessment results are almost identical to those for the original C0S0L1 scenario (so that it was not thought necessary to show the Figure). Future projections are, however, slightly more optimistic and the required TAC reduction to meet the 2005 SC criterion is only 4000 tons (Fig. 4i). Thus assumption has pertinence to TAC recommendations, and we consider it necessary that the SAG/SC meetings give it due attention in their discussions.

Discussion

These analyses illustrate that the key factors influencing stock assessment results are (1) the period over which the longline overcatch occurred, and (2) the so-called S value for the associated adjustment of the Japanese longline CPUE. We consider these results to be reliable, even though based on only the limited extent of investigations that the short time available has allowed. If any overcatch is assumed, it is clear that assessment results become more optimistic than previously estimated. However, as the SAG/SC Chairs and the Panel have recommended, it is necessary first to narrow the range options as much as possible based on other available data and information, to be able to provide more reliable TAC recommendations to the Commission.

Somewhat surprisingly, in all the scenarios investigated in the present study (except for the alternative specification of 2006 and 2007 market anomalies), the TAC reduction required to meet the criterion of the same median spawning biomass in 2014 as in 2004 is a reduction of some 5000 tons. Thus there is no alternative to an appreciable TAC reduction to deal with the consequences of low recruitments in 2000 and 2001 if the spawning stock biomass is to return to at least its current level in the next decade. However, given that the current abundance is estimated to be higher in absolute terms given the overcatch, and that this means that the depletion over the next few years will not be as large as estimated for the no-overcatch scenario, we consider that alternative criteria for short-term risk need discussion. We suggest that the SC recommendations for the 2007 TAC should show options across a range of such criteria, and further take account also of the rate of recovery projected thereafter.

Configuration of the grid integration also may need to be discussed. In the present analysis, we have focused on steepness parameter, one of important parameters in determining stock productivity. The distribution of the estimates of this parameter are considerably influenced by introduction of a longline overcatch and CPUE adjustment, and these have consequences for the natural mortality estimates as well. In particular, if S is high, the distribution is shifts towards higher values (Figs. 3f-h) and future projections show much more optimistic results (Figs. 5f-h). Thus in addition to introduction of new grid axes, there is a need to reconsider the appropriateness of the original specifications for grid integration.

References

CCSBT 2005a. Report of the Special Management Procedure Technical Meeting. 15-18 February 2005, Seattle, USA.

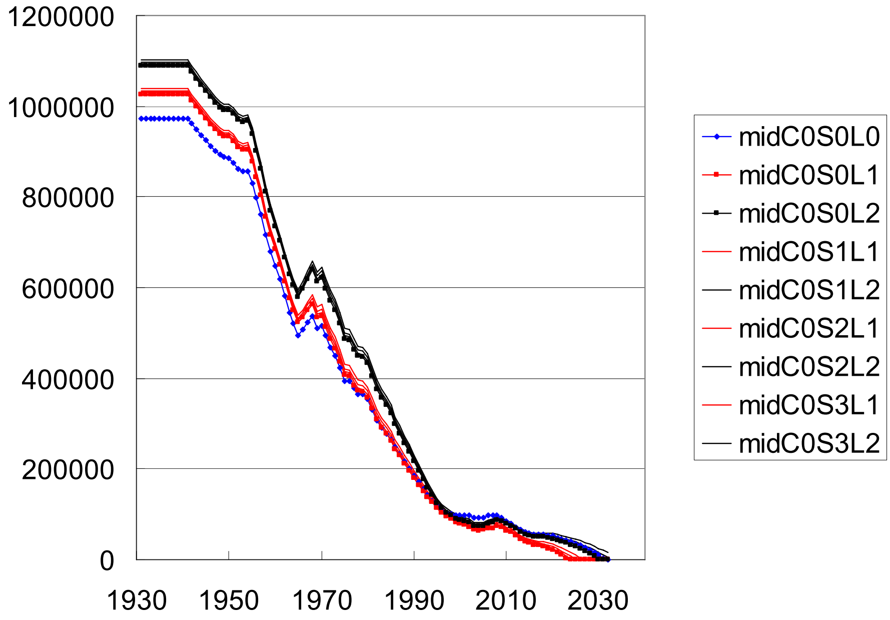
CCSBT 2005b. Report of the Extended Scientific Committee for the Tenth Meeting of the Scientific Committee. 5-8 September 2005, Taipei, Taiwan.

CCSBT 2006. Report of the Special Meeting of the Extended Committee. 18-19 July 2006, Canberra, Australia.

Table 1. Summary of stock assessment and constant projections. Biomass values shown refer to median spawning biomass (in tons).

	catch	B2014/B2004	B2022/B2004	B2032/B2004	B2006/B0	B2006/B1989	B2006/B1996	B2006/B2001	B0	B2006
C0S0L0	0	1.32	3.00	5.35	0.08	0.46	1.03	1.05	725341	59806
C0S0L0	6000	***1.01***	1.90	3.12	0.08	0.46	1.03	1.05	725341	59806
C0S0L0	8000	0.91	1.51	2.29	0.08	0.46	1.03	1.05	725341	59806
C0S0L0	10000	0.81	1.13	1.44	0.08	0.46	1.03	1.05	725341	59806
C0S0L0	11000	0.76	0.95	1.00	0.08	0.46	1.03	1.05	725341	59806
C0S0L0	12000	0.71	0.77	0.55	0.08	0.46	1.03	1.05	725341	59806
C0S0L0	14925	0.57	0.27	0.00	0.08	0.46	1.03	1.05	725341	59806
C0S0L0	16000	0.52	0.10	0.00	0.08	0.46	1.03	1.05	725341	59806
C0S0L1	0	1.58	3.48	6.33	0.07	0.38	0.78	0.97	774889	61397
C0S0L1	6000	1.23	2.24	3.81	0.07	0.38	0.78	0.97	774889	61397
C0S0L1	8000	1.12	1.84	2.87	0.07	0.38	0.78	0.97	774889	61397
C0S0L1	10000	***1.01***	1.44	1.93	0.07	0.38	0.78	0.97	774889	61397
C0S0L1	11000	0.95	1.24	1.44	0.07	0.38	0.78	0.97	774889	61397
C0S0L1	12000	0.89	1.04	0.98	0.07	0.38	0.78	0.97	774889	61397
C0S0L1	14925	0.73	0.47	0.00	0.07	0.38	0.78	0.97	774889	61397
C0S0L1	16000	0.68	0.29	0.00	0.07	0.38	0.78	0.97	774889	61397
C0S0L2	0	1.40	2.77	4.82	0.09	0.36	0.70	0.91	1211860	98958
C0S0L2	6000	1.18	1.95	3.12	0.09	0.36	0.70	0.91	1211860	98958
C0S0L2	8000	1.10	1.67	2.52	0.09	0.36	0.70	0.91	1211860	98958
C0S0L2	10000	1.02	1.40	1.92	0.09	0.36	0.70	0.91	1211860	98958
C0S0L2	11000	***0.99***	1.26	1.62	0.09	0.36	0.70	0.91	1211860	98958
C0S0L2	12000	0.95	1.14	1.31	0.09	0.36	0.70	0.91	1211860	98958
C0S0L2	14925	0.84	0.76	0.43	0.09	0.36	0.70	0.91	1211860	98958
C0S0L2	16000	0.80	0.62	0.12	0.09	0.36	0.70	0.91	1211860	98958
C0S0L3	0	1.42	2.90	4.99	0.09	0.37	0.75	0.95	1184660	96610
C0S0L3	6000	1.18	2.00	3.21	0.09	0.37	0.75	0.95	1184660	96610
C0S0L3	8000	1.10	1.71	2.58	0.09	0.37	0.75	0.95	1184660	96610
C0S0L3	10000	***1.01***	1.41	1.95	0.09	0.37	0.75	0.95	1184660	96610
C0S0L3	11000	0.97	1.27	1.62	0.09	0.37	0.75	0.95	1184660	96610
C0S0L3	12000	0.93	1.12	1.26	0.09	0.37	0.75	0.95	1184660	96610
C0S0L3	14925	0.81	0.70	0.28	0.09	0.37	0.75	0.95	1184660	96610
C0S0L3	16000	0.77	0.55	0.00	0.09	0.37	0.75	0.95	1184660	96610
C0S3L2	0	1.39	2.77	4.70	0.10	0.37	0.74	0.94	1230810	110115
C0S3L2	6000	1.18	2.00	3.19	0.10	0.37	0.74	0.94	1230810	110115
C0S3L2	8000	1.11	1.74	2.65	0.10	0.37	0.74	0.94	1230810	110115
C0S3L2	10000	1.04	1.48	2.11	0.10	0.37	0.74	0.94	1230810	110115
C0S3L2	11000	***1.00***	1.36	1.84	0.10	0.37	0.74	0.94	1230810	110115
C0S3L2	12000	0.96	1.23	1.56	0.10	0.37	0.74	0.94	1230810	110115
C0S3L2	14925	0.86	0.87	0.72	0.10	0.37	0.74	0.94	1230810	110115
C0S3L2	16000	0.82	0.74	0.43	0.10	0.37	0.74	0.94	1230810	110115
C1S3L2	0	1.22	2.28	3.70	0.13	0.50	0.88	0.98	1239820	162234
C1S3L2	6000	1.04	1.65	2.48	0.13	0.49	0.85	0.97	1364420	167477
C1S3L2	8000	1.03	1.58	2.31	0.13	0.50	0.88	0.98	1239820	162234
C1S3L2	10000	***0.99***	1.40	1.94	0.13	0.50	0.88	0.98	1239820	162234
C1S3L2	11000	0.97	1.32	1.77	0.13	0.50	0.88	0.98	1239820	162234
C1S3L2	12000	0.94	1.23	1.57	0.13	0.50	0.88	0.98	1239820	162234
C1S3L2	14925	0.88	0.99	1.07	0.13	0.50	0.88	0.98	1239820	162234
C1S3L2	16000	0.85	0.90	0.87	0.13	0.50	0.88	0.98	1239820	162234
C2S3L2	0	1.17	1.99	2.99	0.17	0.59	0.96	1.01	1619860	297559
C2S3L2	6000	1.08	1.64	2.35	0.17	0.59	0.96	1.01	1619860	297559
C2S3L2	8000	1.05	1.52	2.12	0.17	0.59	0.96	1.01	1619860	297559
C2S3L2	10000	1.02	1.39	1.88	0.17	0.59	0.96	1.01	1619860	297559
C2S3L2	11000	***1.00***	1.34	1.76	0.17	0.59	0.96	1.01	1619860	297559
C2S3L2	12000	0.99	1.28	1.64	0.17	0.59	0.96	1.01	1619860	297559
C2S3L2	14925	0.94	1.10	1.29	0.17	0.59	0.96	1.01	1619860	297559
C2S3L2	16000	0.92	1.03	1.15	0.17	0.59	0.96	1.01	1619860	297559
C3S3L2	0	1.15	2.11	3.35	0.14	0.53	0.92	0.99	1246700	180361
C3S3L2	6000	1.03	1.65	2.46	0.14	0.53	0.92	0.99	1246700	180361
C3S3L2	8000	***0.99***	1.50	2.15	0.14	0.53	0.92	0.99	1246700	180361
C3S3L2	10000	0.96	1.35	1.84	0.14	0.53	0.92	0.99	1246700	180361
C3S3L2	11000	0.94	1.27	1.68	0.14	0.53	0.92	0.99	1246700	180361
C3S3L2	12000	0.92	1.20	1.53	0.14	0.53	0.92	0.99	1246700	180361
C3S3L2	14925	0.86	0.99	1.10	0.14	0.53	0.92	0.99	1246700	180361
C3S3L2	16000	0.84	0.91	0.94	0.14	0.53	0.92	0.99	1246700	180361
C0S0L1_reg	0	1.62	3.57	6.44	0.08	0.40	0.82	1.00	774642	63713
C0S0L1_reg	6000	1.28	2.32	3.95	0.08	0.40	0.82	1.00	774642	63713
C0S0L1_reg	8000	1.17	1.93	3.03	0.08	0.40	0.82	1.00	774642	63713
C0S0L1_reg	10000	1.05	1.53	2.09	0.08	0.40	0.82	1.00	774642	63713
C0S0L1_reg	11000	***1.00***	1.33	1.61	0.08	0.40	0.82	1.00	774642	63713
C0S0L1_reg	12000	0.94	1.13	1.14	0.08	0.40	0.82	1.00	774642	63713
C0S0L1_reg	14925	0.78	0.56	0.00	0.08	0.40	0.82	1.00	774642	63713
C0S0L1_reg	16000	0.70	0.37	0.00	0.08	0.39	0.81	1.00	775801	65545

(a)



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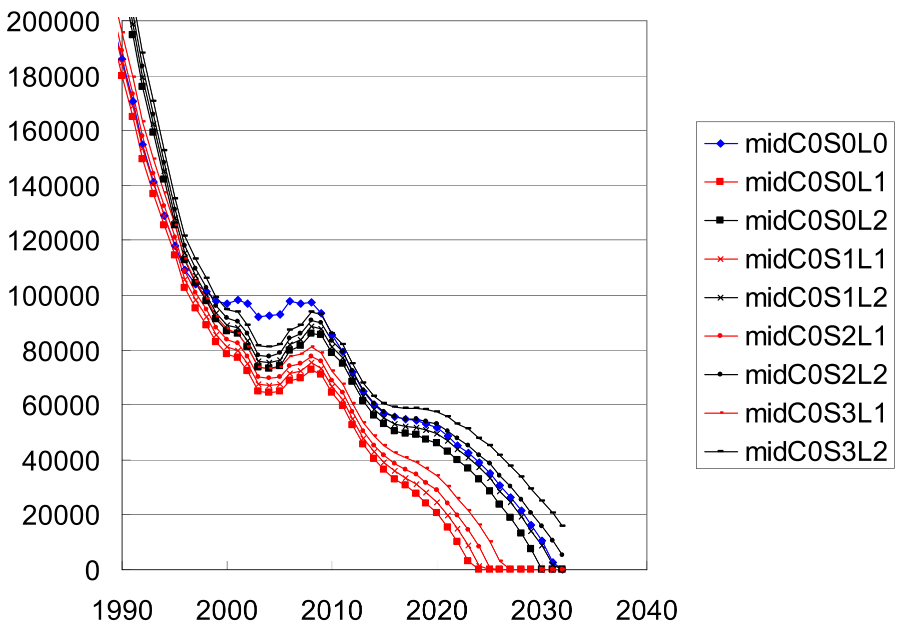


Figure 1. Estimated stock trajectories and constant catch projections (current nominal catch 14925 tons) for a parameter set (h2m2M2O2C3q1a1_sqrt: h=0.55, m0=0.4, m10=0.1, Omega=1.0, CPUE=Laslett, q age-range=4-18). Here and in the Figures that follow, abundances are expressed in tons and refer to spawning biomass.

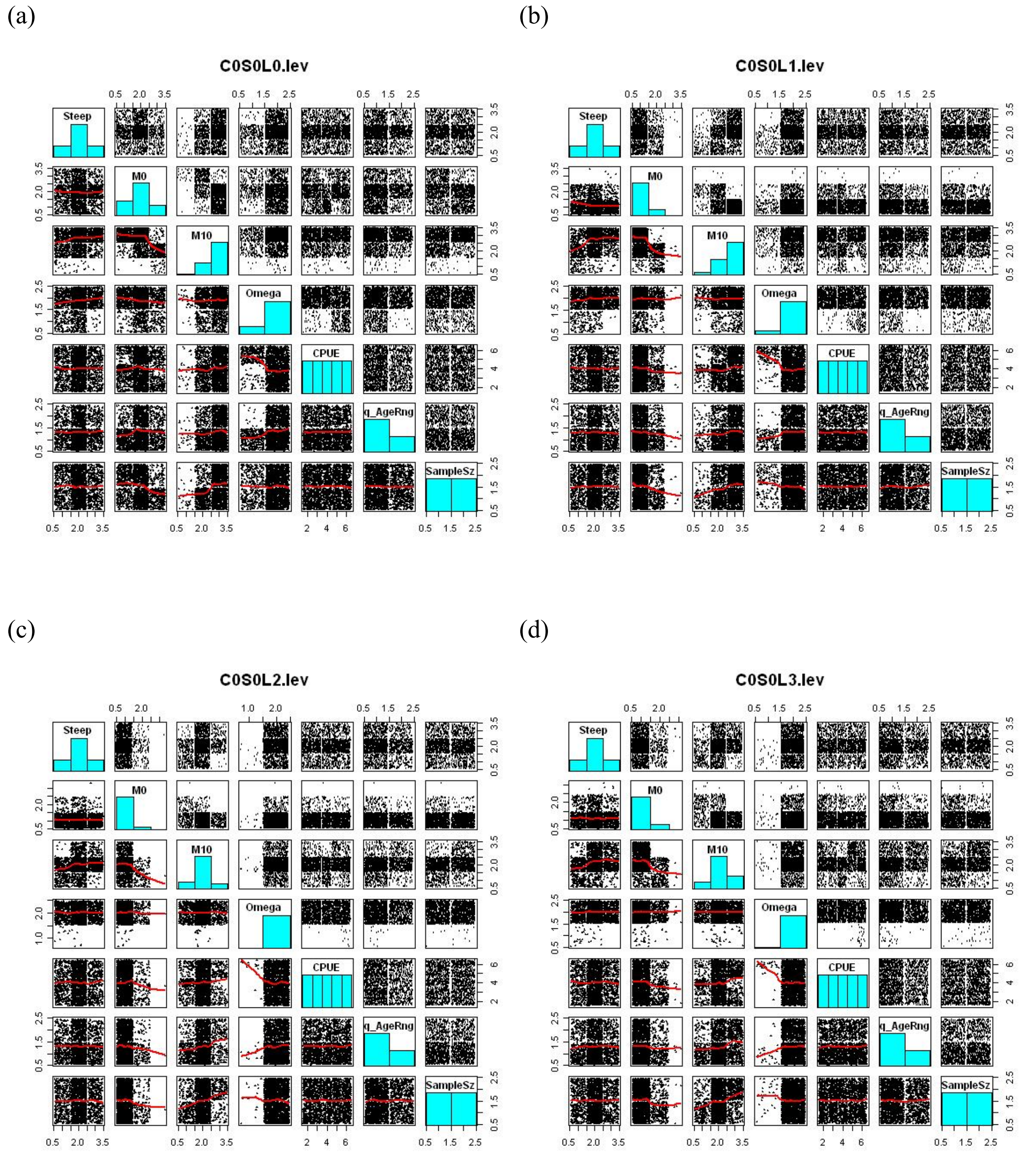
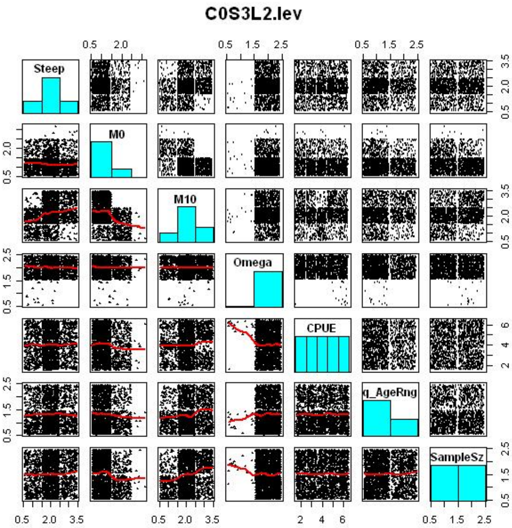
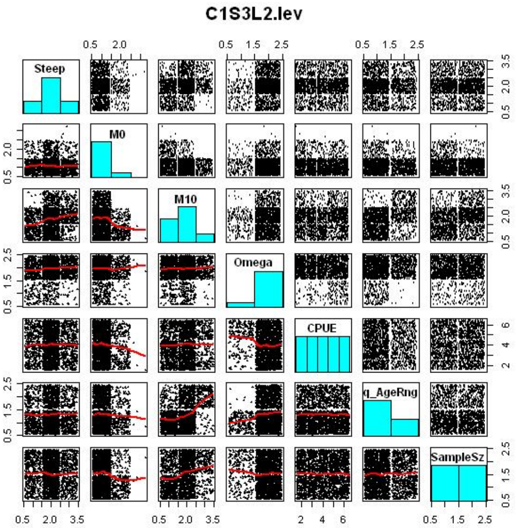


Figure 2. Pairwise plots of 2000 samples drawn from an original MPD grid for different overcatch and CPUE adjustment scenarios

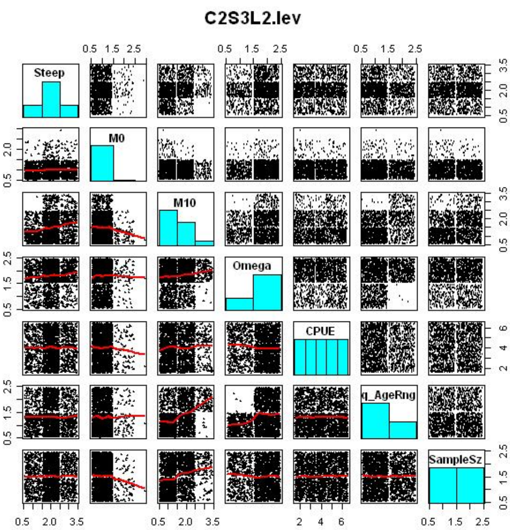
(e)



(f)



(g)



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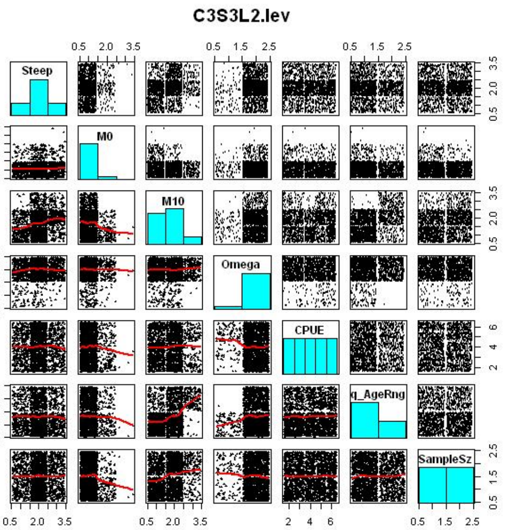


Figure 2. cont.

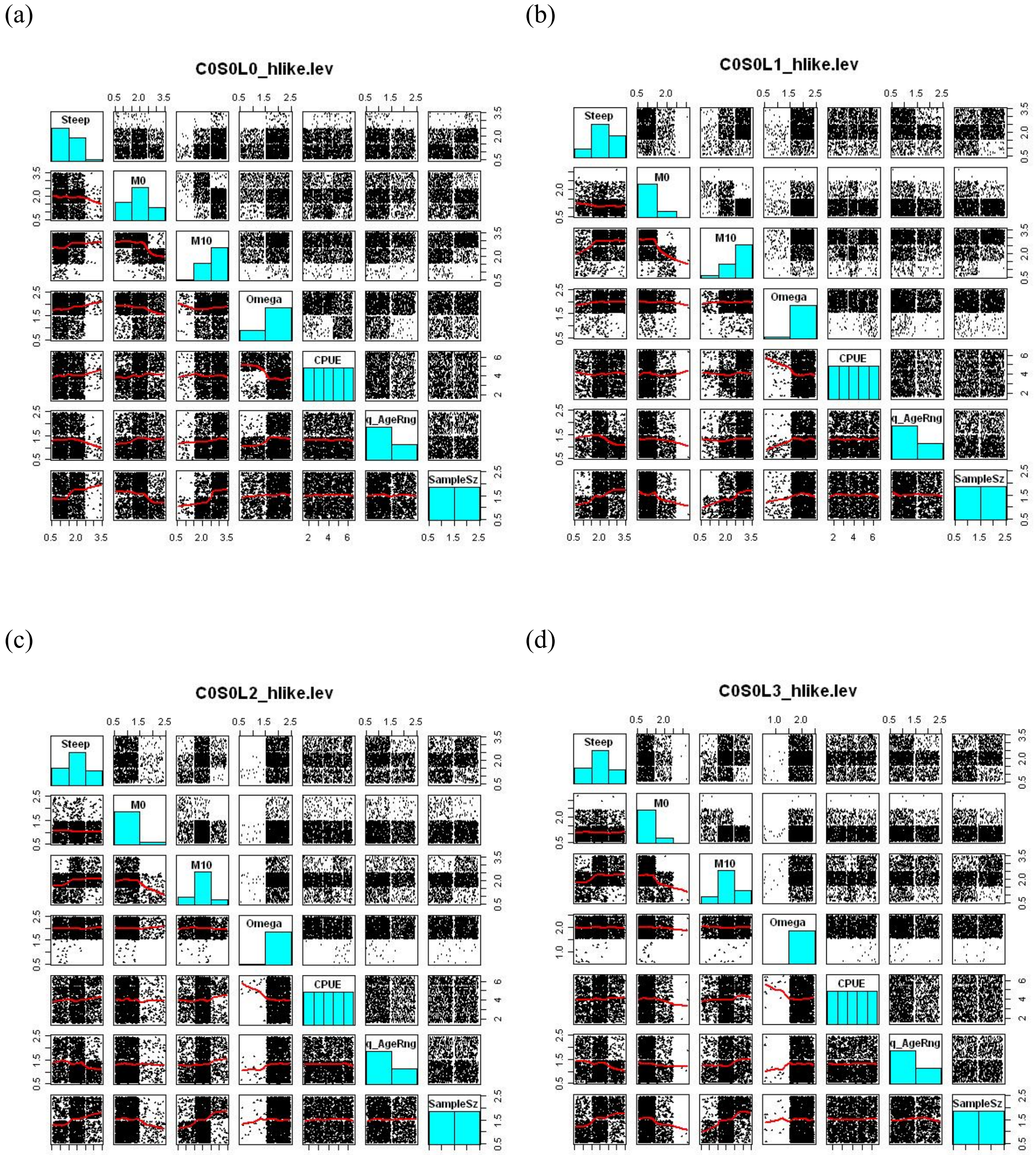
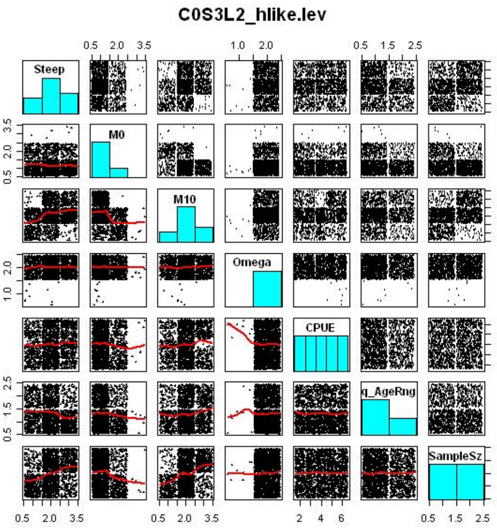


Figure 3. Pairwise plots of 2000 samples drawn from a modified MPD grid (steepness sampling is based on likelihood, not fixed) for different overcatch and CPUE adjustment scenarios

(e)



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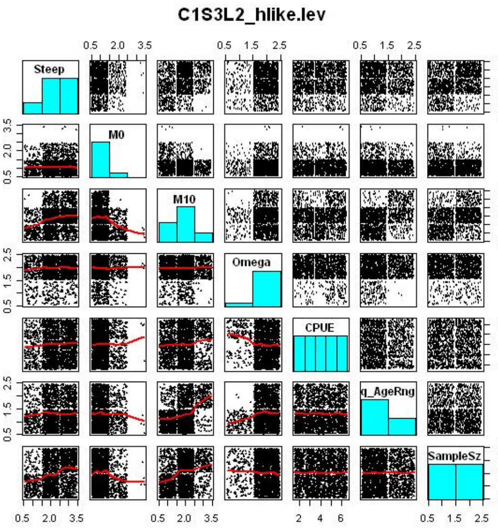

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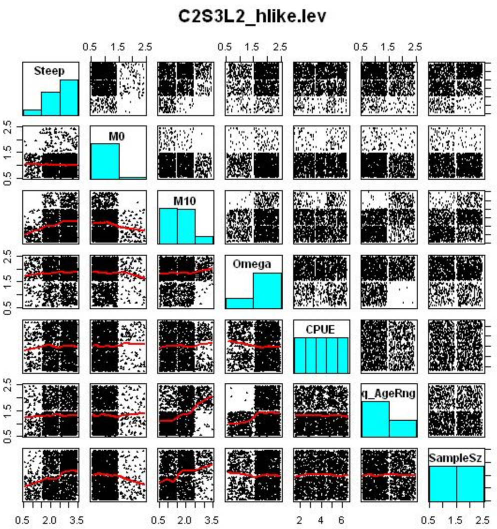

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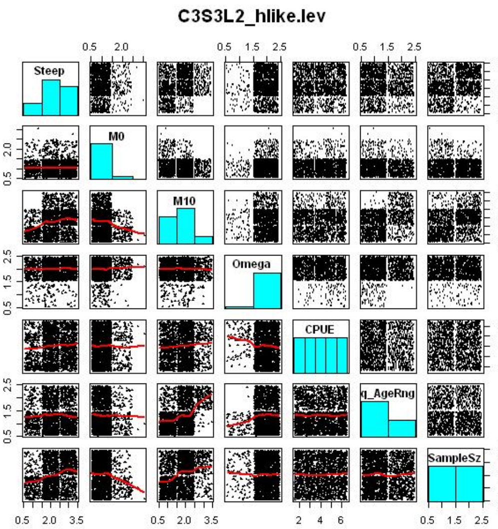
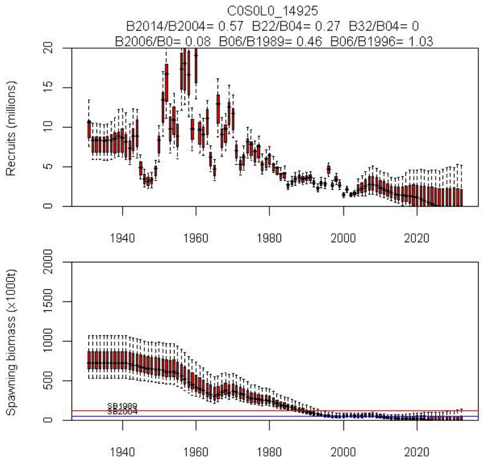
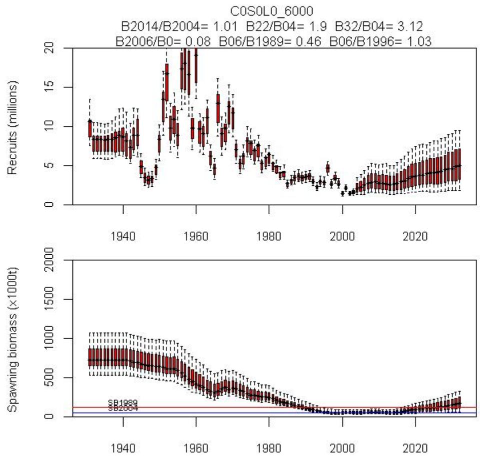


Figure 3. cont.

(a1)



(a2)



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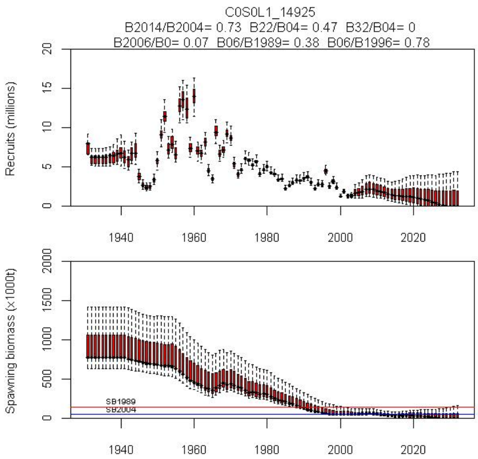

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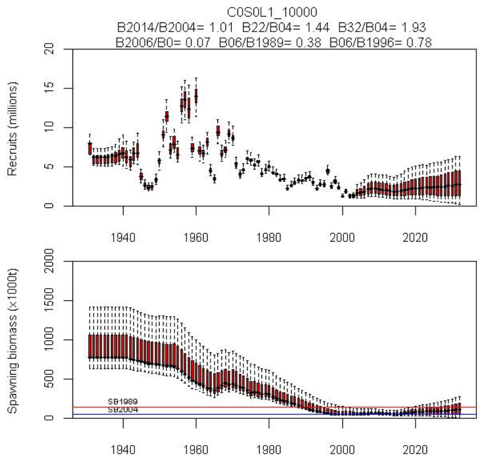
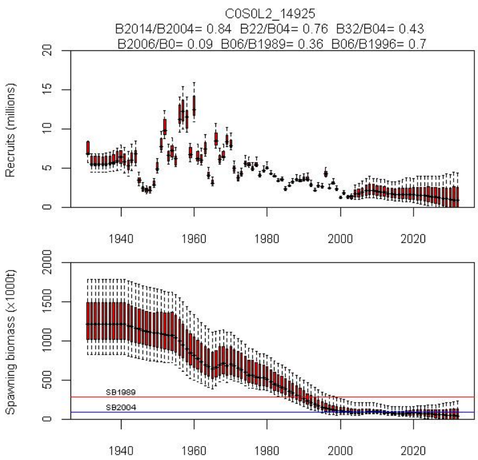


(c1)



(c2)

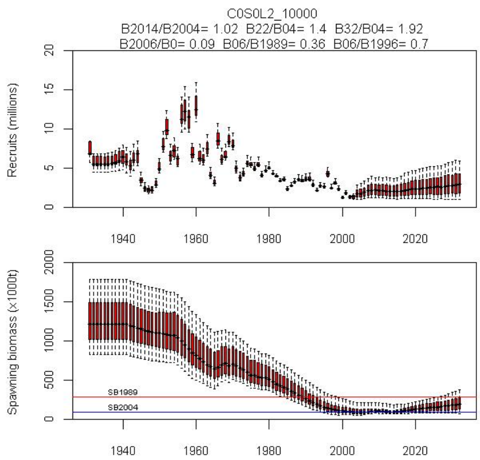
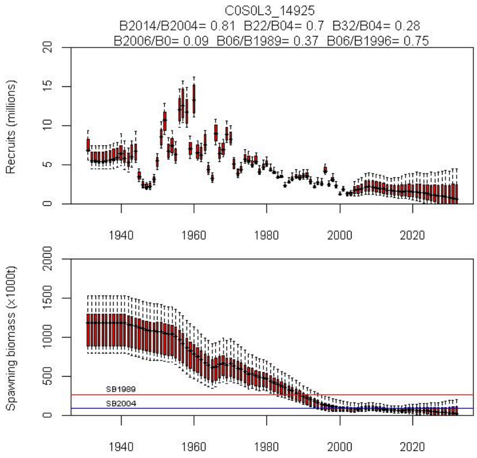
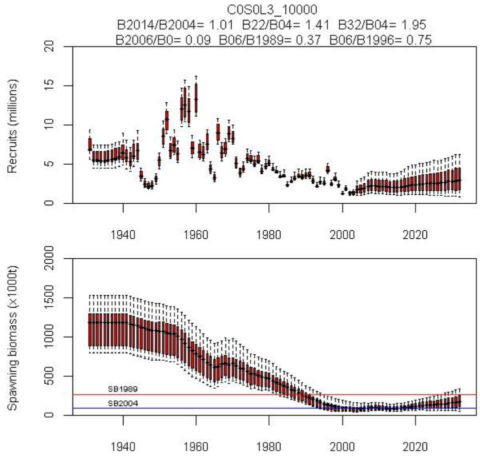


Figure 4. Estimated stock trajectories and constant catch projections for each scenario (left panels: current nominal catch 14925 tons, right panels: constant catch to satisfy a criterion B2014/B2004=1)

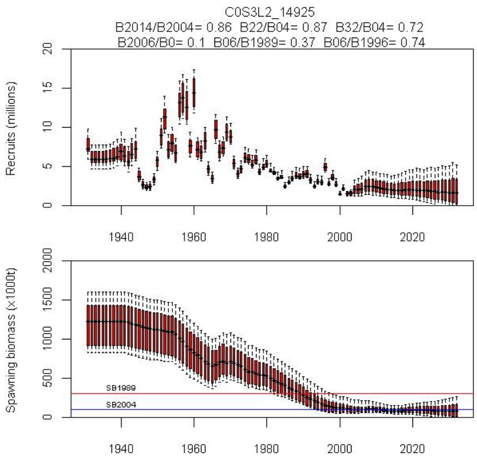
(d1)



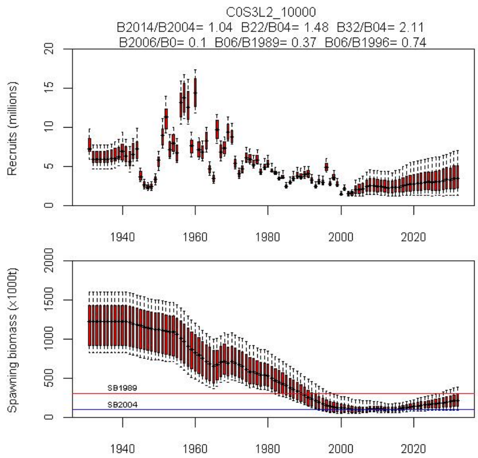
(d2)



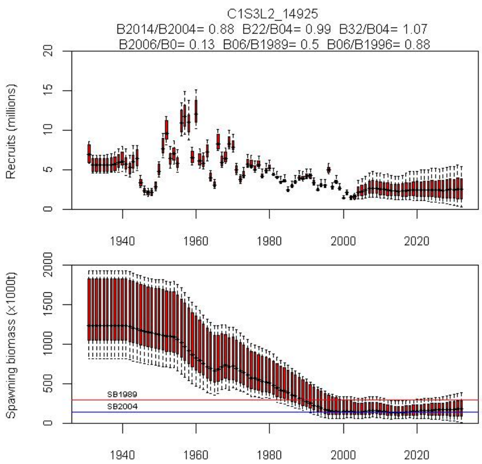
(e1)



(e2)



(f1)



(f2)

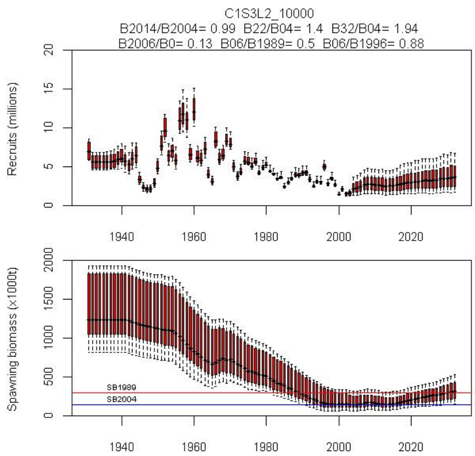
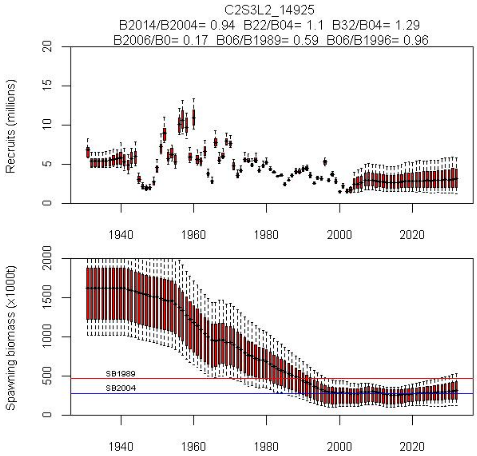
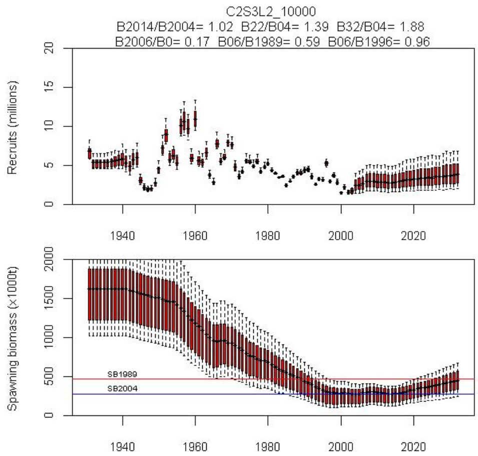


Figure 4. cont.

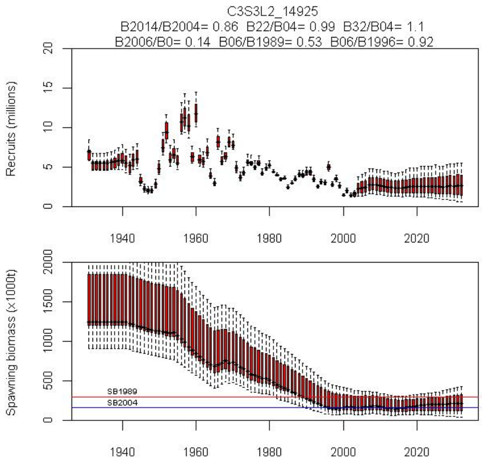
(g1)



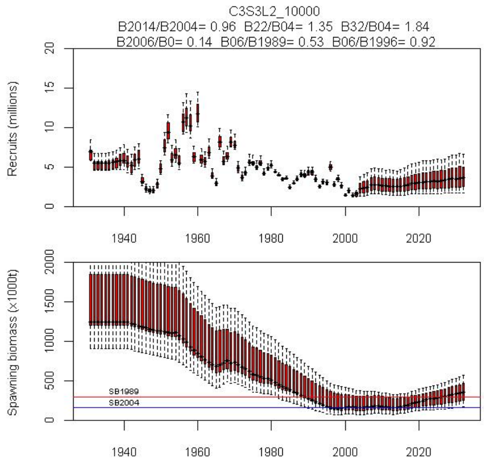
(g2)



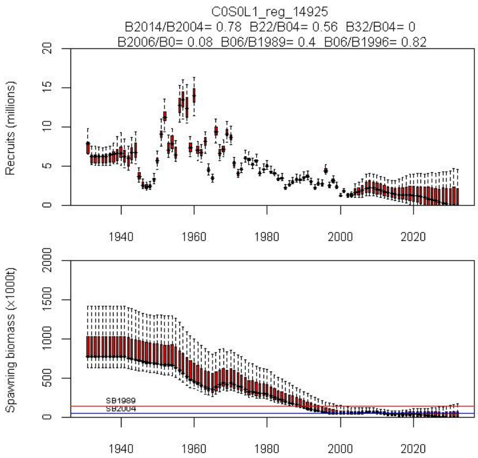
(h1)



(h2)



(i1)



(i2)

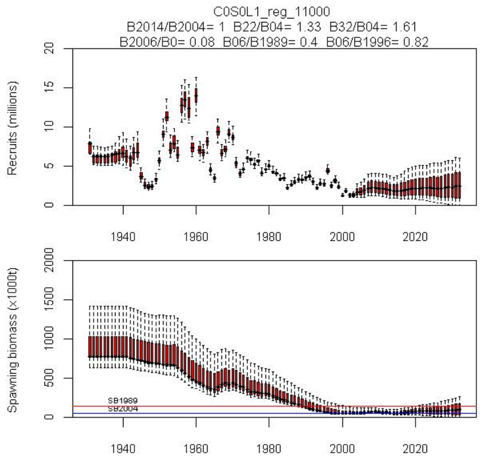
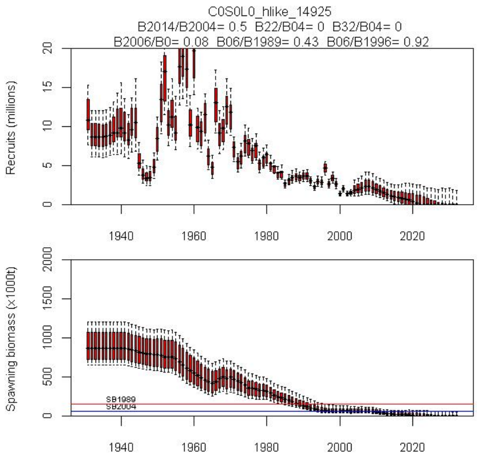
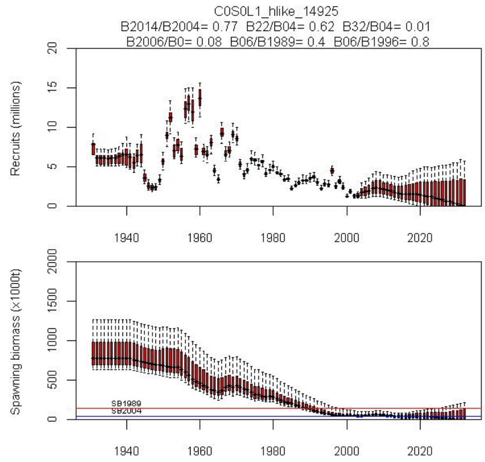


Figure 4. cont.

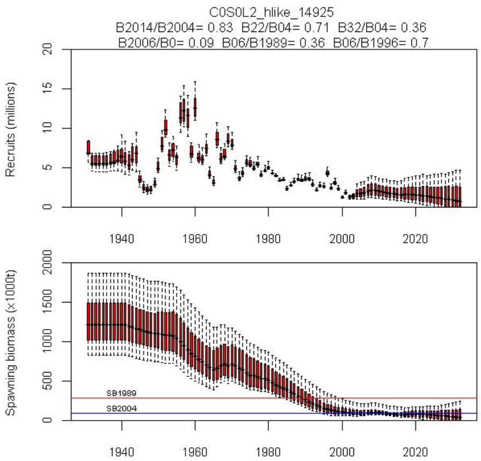
(a)



(b)



(c)



(d)

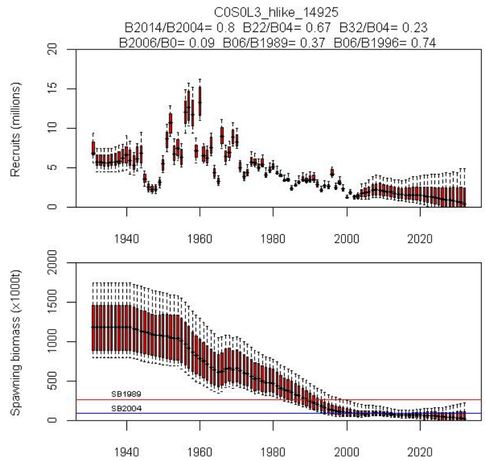
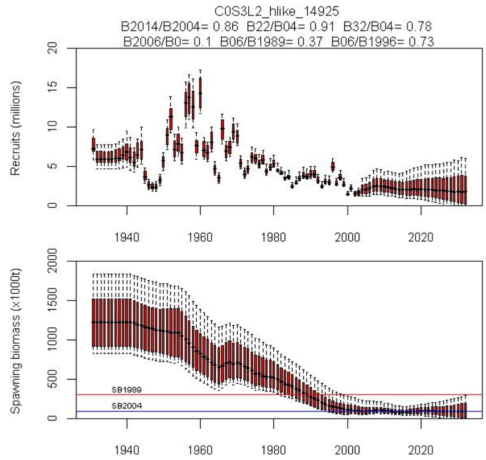
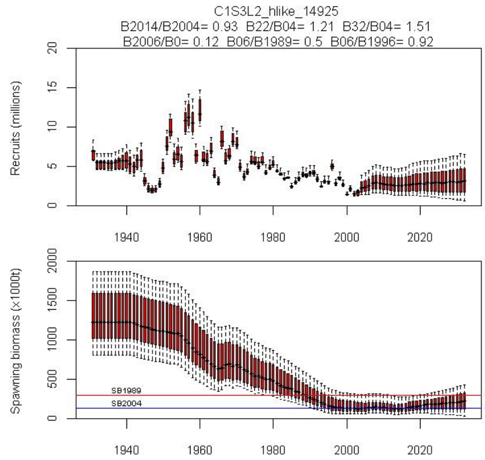


Figure 5. Estimated stock trajectories and constant catch projections (current nominal catch 14925 tons) for each scenario, in which steepness values are weighted based on likelihood

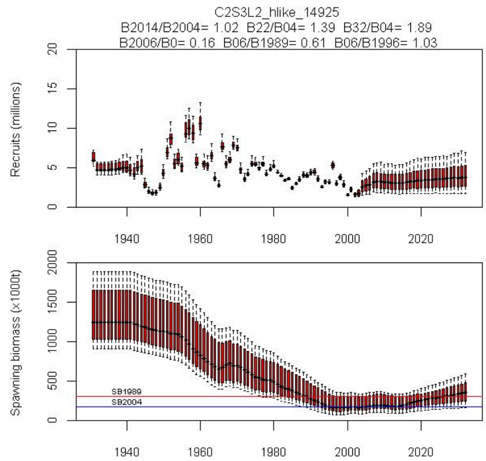
(e)



(f)



(g)



(h)

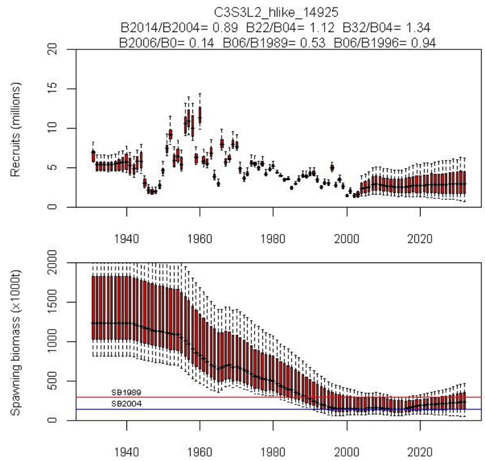


Figure 5. cont.

Appendix 1. Names of scenarios for each factor based on the Advisory Panel proposal.

C： CPUE adjustment

Case 0:	zero adjustment
Case 1:	Option A, S = 0.5
Case 2:	Option A, S = 1.0
Case 3:	Option B, S = 0.5
Case 4:	Option B, S = 1.0

S： Surface overcatch

Case 0:	zero adjustment
Case 1:	10% adjustment of farm component of surface catch (the purse seine component early in the series is not affected)
Case 2:	20% adjustment of farm catch
Case 3:	33% adjustment of farm catch.
Case 4:	UC from Table 7.18

L: Longline overcatch

Case 0:	Zero effect, kept for reference.
Case 1:	Based on market anomalies estimated by Lou and Hidaka for 1996-2005, lagged as above.
Case 2:	Based on market anomalies estimated by Bergen & Kageyama for 1985-2005, lagged as above
Case 3:	Based on market anomalies estimated as in Case 1 but including all estimates back to 1985 shown in pages 97-98 of the Market report, lagged as above.
Case 1_reg:	The market anomaly for 2006 and 2007 is based on a linear regression of the anomalies for 2003-2005 for case 1 extrapolated to 2006 and 2007.