Further examinations of the SBT operating model to explore new tagging model and grid specifications

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Stock assessments and constant catch projections were conducted using new Operating Models (OMs; sbtmod21 and sbtmod22, which have different tagging models) developed by the CCSBT ESC. The current analysis showed that:

1. a new candidate for the tagging model (incorporated in sbtmod22) led to higher M0 (natural mortality at age 0), lower M10 (natural mortality at age 10) and lower omega (non-linearity of the CPUE-abundance relationship) estimates than the previous tagging model which is used in sbtmod21, and estimated lower current stock abundance relative to the virgin unfished biomass,
2. a high *S* (*S*=0.5; *S* is the proportion of longline overcatch attributed to the reported effort) led to a lower M10, but the overall results were scarcely different from those for the base assumption (*S*=0.25), and
3. a slight change of assumptions regarding the Indonesian fishing selectivity impacted on M estimates substantially (leading to low M0 and high M10), which indicates poor ability to explain the Indonesian catch-at-age data when using a low M10 as pointed out during the 2008 SAG meeting.

Introduction

The CCSBT Extended Scientific Committee (ESC) meeting held in September 2008 decided to update the conditioning for the Operating Model (OM) to be used to provide the basis for advice on TACs in 2009 through consideration of constant-catch projections (CCSBT, 2008). In this paper, we report the results of OM conditionings using data updated to 2008 and a new candidate for the tagging model. The analysis concentrates mainly on issues of:

1. the tagging model specifications,
2. adjustments of Japanese longline CPUEs in relation to the longline overcatch (the so-called *S* issue), and
3. the high abundance of old ages when low natural mortalities are assumed, which seems inconsistent with Indonesian catch-at-age data.

In addition, some of the sensitivity tests that were determined to explore at the 2008 ESC meeting

((a) truncating CPUE series in 1992 and (b) including trolling survey data) were conducted.

Data and model specification

In this analysis, we have used several programs and input files (distributed on 26 June 2009): "sbtmod21.exe", "sbtmod22.exe" and "sbtdata2008.dat" for the conditioning, "sample_v4.exe" for the grid sampling, and "sbtprojv117.exe" for the projection. Constant catch projections have been conducted over 27 years (from 2009 to 2035) for the current TAC level (11810 t). The default quota allocation prepared for "sbtprojv117.exe" was applied without any modification (LL1: 4680t, LL2: 1133t, Indonesia 755t, Australia 5242t). The following grid specification was used along with a specification of prefixed weights provided by priors.

	levels	value			prior			simulation weight
steepness	3	0.385	0.55	0.73	0.2	0.6	0.2	prior
M0	3	0.3	0.4	0.5		uniform		posterior
M10	3	0.07	0.1	0.14		uniform		posterior
omega	2	0.75	1		0.4	0.6		posterior
cpue	2	w0.5	w0.8			uniform		prior
q age-range	2	4-18	8-12		0.67	0.33		prior
sample size	2	sqrt	orig.5			uniform		prior

In addition to the grid approach, parameters such as steepness, natural mortalities and omega were estimated directly in the conditioning process for several specific scenarios. The original settings for priors on estimated parameters were not changed.

Results and Discussion

Summary results are as follows.

1. At an early stage of this analysis, we found that estimation convergence could not be obtained for several scenarios. For the sbtmod22 OMs, 31 (for orig.5) and 4 (for sqrt) scenarios of the total of 216 scenarios did not converge (when the criterion that the maximum gradient component in the optimization was more than 1 was used), while all scenarios except for one (for orig.5) had converged for the sbtmod21 OMs. Most of the cases of non-convergence were high M scenarios (M0 and/or M10). Different *S* scenarios (C0 and C2) showed similar results as regards convergence.
2. As a reference to evaluate the impacts of incorporating tagging data, a scenario where tagging data was not incorporated was developed by modifying the sbtmod21 OMs (the "no tag" scenario). The base case for sbtmod21 with the previous tagging model led to a considerably lower M0 estimate than for this "no tag" scenario (Figs. 1a, c). This result was also noted previously (Kurota and Butterworth 2008). In general, the likelihood components for the

observed data did not change substantially except for the tagging data (Tables 1a, c). On the other hand, the sbtmod22 OMs with the new tagging model led to lower M0, M10 and omega estimates than the no tag scenario, though M0 was higher than that for the sbtmod21 case. Likelihood components indicated that incorporating this new tagging approach resulted in poorer fits to other data such as catch size composition of LL1, Indonesian and surface fisheries (Table 1b). This sbtmod22 case gave rise to much lower current stock abundance relative to a virgin unfished biomass, and more pessimistic future projections (Fig. 2b). It is notable that this scenario indicated a further decline of stock abundance even after 2000.

3. CPUE adjustment, the so-called *S* issue, had impact on M and omega estimates, based on comparisons among *S*=0% (C0), *S*=25% (C1) and *S*=50% (C2) (Tables 1d-g, Figs. 1d-g). When *S* was set at 50%, the model fit to CPUE was worse (Tables 1f, g) and the estimate of M10 became lower. Although past and current biomasses became larger (Figs. 2f, g), the overall stock trend was scarcely different from that for the base case.
4. To examine the “plus group” problem, that is high abundance of old fish for low natural mortalities, which seems inconsistent with the Indonesian catch-at-age data, an assumption that Indonesian fishing selectivity for age 29 is equal to that for age 30+ was explored. This subtle modification had a considerable impact on results, irrespective of tagging model applied (Tables 1h, i). Grid sampling based on the likelihood strongly preferred a combination of low M0 and high M10 (Figs. 2h, i). This alternative selectivity assumption influenced the value of the likelihood components for the LL1 CPUE as well as for the age composition of Indonesian catch.
5. When CPUE series was truncated in 1992, M10 and omega became larger, particularly in the sbtmod22 OMs (Figs. 1j, k). However, many scenarios for orig.5 of the sbtmod22 OMs did not converge (Table 1k). This assumption also showed very pessimistic future projection (Figs. 2j, k).
6. Recruitment indices from Japanese trolling surveys showed higher recent recruitment estimates (Figs. 2l, m). In particular, the recruitment estimates after 2005 were very high. The grid sampling of M10 for the sbtmod22 OMs showed a different pattern from the base case (Fig. 1m).
7. Grid sampling based on prefixed weights equal to the priors provided recruitment and stock abundance estimates with wider variances as expected (Figs. 2n, o). However, the general stock trend was not substantially different from that under the current default assumptions.
8. In general, specific scenario runs to directly estimate parameters showed similar results to those of the grid approach (Table 2). Figure 3 shows fits to the observed data (CPUE, catch size composition of LL1, Australia and Indonesia, and tag recapture) for different tagging models.

References

CCSBT 2008. Report of the Extended Scientific Committee for the 13th Meeting of the Scientific Committee. 5 - 12 September 2008, Rotorua, New Zealand.

Kurota, H., and Butterworth, D.S. 2008. Further examinations of the SBT operating model under overcatch scenarios to select critical uncertainty factors for the update. CCSBT-ESC/0809/35.

Table 1. Summary results for grid simulation. The base case was set as “steepness=0.55, M0=(0.3, 0.4, 0.5), M10=(0.07, 0.1, 0.14), CPUE=w0.5, omega=1.0, q age-range=4-18, sample size=orig.5”.

(a) sbtmod21 (base case)

	Name	C1S1L1orig.5_ h2m1M1O2C2a 1.rep	C1S1L1orig.5_ h2m1M2O2C2a 1.rep	C1S1L1orig.5_ h2m1M3O2C2a 1.rep	C1S1L1orig.5_ h2m2M1O2C2a 1.rep	C1S1L1orig.5_ h2m2M2O2C2a 1.rep	C1S1L1orig.5_ h2m2M3O2C2a 1.rep	C1S1L1orig.5_ h2m3M1O2C2a 1.rep	C1S1L1orig.5_ h2m3M2O2C2a 1.rep	C1S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note									
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	12.69%	8.39%	8.86%	9.69%	6.61%	8.60%	8.06%	5.73%	8.60%
	SSB 2008 / SSB2000	82.35%	95.30%	121.96%	79.15%	93.65%	117.63%	76.59%	92.17%	113.85%
Rho	1931-Y	0.63	0.59	0.63	0.61	0.60	0.63	0.61	0.61	0.64
	1965-1998	0.45	0.30	0.42	0.36	0.33	0.47	0.35	0.40	0.52
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.38	0.36	0.38	0.37	0.36	0.38	0.37	0.37	0.39
	1965-1998	0.29	0.26	0.29	0.27	0.27	0.30	0.27	0.29	0.32
CPUE	1969-Y	0.32	0.30	0.34	0.30	0.30	0.38	0.29	0.31	0.41
Autocorr.	1990-2000	0.41	0.46	0.52	0.46	0.52	0.57	0.52	0.59	0.60
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	471	466	464	471	468	471	475	474	482
	LL1	171.60	170.86	169.36	172.46	171.17	169.57	173.07	171.23	169.95
	LL2	47.65	47.63	47.85	47.60	47.64	47.98	47.66	47.74	48.12
	LL3	52.80	53.01	53.19	52.31	52.65	53.00	52.01	52.41	52.90
	LL4	102.07	102.88	103.13	102.47	103.26	102.99	102.71	103.42	102.82
	IND	53.32	52.20	50.10	53.56	51.99	50.31	53.75	51.82	50.58
	SURF	29.13	29.13	29.05	29.17	29.19	29.13	29.18	29.23	29.21
	CPUE	-49.85	-50.58	-50.10	-50.73	-51.01	-49.48	-51.17	-51.08	-48.88
	Tags	5.73	5.27	6.35	5.94	7.07	11.79	9.37	12.60	20.95
	Aerial	-0.57	-0.63	-0.68	-0.62	-0.61	-0.70	-0.65	-0.57	-0.72
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	58.41	57.69	56.35	57.81	56.99	55.97	57.44	56.51	55.80
	Sel.sm	25.63	24.84	24.03	26.37	25.31	24.19	27.02	25.73	24.91
	Sg.R	-24.86	-25.98	-24.56	-25.32	-25.45	-24.22	-25.11	-24.67	-23.80
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	20,520	23,677	27,197	21,204	24,807	28,618	22,098	26,051	29,984
	S(msy)	551,031	379,123	256,246	483,336	339,643	232,821	434,099	309,262	213,603
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(b) sbtmod22 (base case)

	Name	C1S1L1orig.5_ h2m1M1O2C2a 1.rep	C1S1L1orig.5_ h2m1M2O2C2a 1.rep	C1S1L1orig.5_ h2m1M3O2C2a 1.rep	C1S1L1orig.5_ h2m2M1O2C2a 1.rep	C1S1L1orig.5_ h2m2M2O2C2a 1.rep	C1S1L1orig.5_ h2m2M3O2C2a 1.rep	C1S1L1orig.5_ h2m3M1O2C2a 1.rep	C1S1L1orig.5_ h2m3M2O2C2a 1.rep	C1S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note									no convergence
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	15.46%	8.22%	6.17%	7.59%	4.01%	3.37%	4.88%	2.87%	0.40%
	SSB 2008 / SSB2000	81.40%	87.01%	91.82%	71.92%	72.18%	55.47%	61.20%	56.53%	7.94%
Rho	1931-Y	0.67	0.60	0.61	0.60	0.61	0.61	0.60	0.62	0.58
	1965-1998	0.56	0.35	0.38	0.32	0.32	0.40	0.28	0.36	0.48
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.40	0.36	0.37	0.36	0.37	0.37	0.37	0.38	0.36
	1965-1998	0.32	0.26	0.28	0.26	0.27	0.28	0.26	0.28	0.31
CPUE	1969-Y	0.30	0.29	0.49	0.30	0.44	0.79	0.43	0.61	0.92
Autocorr.	1990-2000	0.47	0.53	0.69	0.58	0.73	0.90	0.76	0.83	0.97
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	27233	27226	27228	27227	27229	27260	27249	27274	27333
	LL1	176.98	176.60	177.76	179.67	180.19	184.33	187.11	191.61	191.61
	LL2	49.09	48.91	48.96	49.16	49.16	49.42	49.83	50.26	51.65
	LL3	53.17	53.13	53.23	52.20	52.57	52.98	51.80	52.58	55.45
	LL4	101.59	102.82	103.76	103.17	104.46	103.81	104.40	104.98	108.42
	IND	55.98	54.73	53.23	56.22	55.19	56.41	59.17	59.80	53.79
	SURF	33.66	33.86	34.18	34.67	35.19	35.91	36.65	37.60	40.52
	CPUE	-50.41	-51.31	-47.73	-51.43	-49.33	-31.22	-49.55	-43.67	-8.47
	Tags	26751.00	26749.60	26748.40	26743.00	26743.30	26751.20	26747.30	26759.10	26771.40
	Aerial	-0.71	-0.71	-0.58	-0.54	-0.12	-0.01	-0.08	0.65	6.77
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	58.93	57.46	55.08	56.87	55.54	55.47	56.81	56.87	55.71
	Sel.sm	27.33	26.96	26.81	29.11	28.11	26.33	31.00	27.97	30.48
	Sg.R	-23.47	-25.89	-25.22	-25.56	-24.96	-24.98	-25.17	-23.97	-24.29
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	20,849	23,593	27,025	21,021	24,886	28,204	21,997	26,266	34,043
	S(msy)	559,962	377,156	253,987	477,164	339,403	228,161	429,372	310,614	246,523
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(c) sbtmod21 (no tag)

	Name	C1S1L1orig.5_ h2m1M1O2C2a 1.rep	C1S1L1orig.5_ h2m1M2O2C2a 1.rep	C1S1L1orig.5_ h2m1M3O2C2a 1.rep	C1S1L1orig.5_ h2m2M1O2C2a 1.rep	C1S1L1orig.5_ h2m2M2O2C2a 1.rep	C1S1L1orig.5_ h2m2M3O2C2a 1.rep	C1S1L1orig.5_ h2m3M1O2C2a 1.rep	C1S1L1orig.5_ h2m3M2O2C2a 1.rep	C1S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note									
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	11.39%	8.53%	9.93%	10.77%	7.96%	10.47%	10.60%	7.44%	11.04%
	SSB 2008 / SSB2000	81.25%	96.84%	129.66%	81.40%	98.53%	130.95%	82.13%	100.40%	131.83%
Rho	1931-Y	0.62	0.59	0.62	0.61	0.60	0.64	0.64	0.62	0.66
	1965-1998	0.41	0.30	0.43	0.40	0.35	0.50	0.43	0.42	0.55
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.37	0.36	0.38	0.37	0.37	0.39	0.39	0.37	0.40
	1965-1998	0.28	0.26	0.29	0.28	0.27	0.31	0.29	0.29	0.33
CPUE	1969-Y	0.32	0.31	0.31	0.31	0.30	0.32	0.30	0.29	0.32
Autocorr.	1990-2000	0.42	0.45	0.48	0.43	0.47	0.49	0.44	0.49	0.50
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	465	460	457	464	460	457	464	459	457
	LL1	171.86	170.65	168.96	171.81	170.47	168.62	171.66	170.29	168.24
	LL2	47.50	47.61	47.93	47.66	47.75	48.12	47.84	47.90	48.29
	LL3	52.65	53.01	53.29	52.40	52.75	53.12	52.40	52.53	52.92
	LL4	102.35	102.85	102.94	102.19	102.81	102.67	102.31	102.79	102.40
	IND	53.20	51.95	49.64	53.19	51.69	49.48	53.22	51.36	49.42
	SURF	28.64	28.54	28.38	28.46	28.40	28.27	28.21	28.28	28.17
	CPUE	-50.07	-50.43	-50.25	-50.29	-50.70	-50.12	-50.41	-50.95	-49.91
	Tags	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Aerial	-0.57	-0.63	-0.67	-0.64	-0.68	-0.70	-0.68	-0.72	-0.73
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	58.50	58.08	57.19	58.43	57.88	57.11	58.51	57.67	57.05
	Sel.sm	25.86	24.76	24.39	26.01	24.90	24.44	25.10	25.08	23.94
	Sg.R	-25.26	-25.97	-24.80	-25.08	-25.47	-24.13	-23.91	-24.74	-23.05
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	20,370	23,693	27,260	21,312	24,853	28,700	22,249	26,061	30,215
	S(msy)	546,338	379,508	257,057	486,496	340,762	233,715	438,334	309,944	215,381
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(d) sbtmod21 (C0)

	Name	C0S1L1orig.5_ h2m1M1O2C2a 1.rep	C0S1L1orig.5_ h2m1M2O2C2a 1.rep	C0S1L1orig.5_ h2m1M3O2C2a 1.rep	C0S1L1orig.5_ h2m2M1O2C2a 1.rep	C0S1L1orig.5_ h2m2M2O2C2a 1.rep	C0S1L1orig.5_ h2m2M3O2C2a 1.rep	C0S1L1orig.5_ h2m3M1O2C2a 1.rep	C0S1L1orig.5_ h2m3M2O2C2a 1.rep	C0S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note									
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	12.88%	7.82%	7.84%	10.27%	6.44%	7.74%	8.71%	5.65%	7.78%
	SSB 2008 / SSB2000	78.34%	87.95%	116.91%	75.77%	86.43%	112.83%	73.53%	84.76%	109.55%
Rho	1931-Y	0.66	0.59	0.62	0.64	0.61	0.63	0.62	0.61	0.65
	1965-1998	0.51	0.32	0.42	0.43	0.34	0.48	0.41	0.40	0.53
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.39	0.36	0.38	0.38	0.37	0.38	0.38	0.37	0.39
	1965-1998	0.30	0.26	0.29	0.29	0.27	0.30	0.28	0.28	0.32
CPUE	1969-Y	0.36	0.31	0.27	0.33	0.30	0.31	0.32	0.31	0.35
Autocorr.	1990-2000	0.50	0.61	0.69	0.59	0.69	0.73	0.67	0.75	0.75
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	469	463	459	469	465	466	473	471	476
	LL1	170.99	170.53	169.24	171.79	170.75	169.45	172.38	170.93	169.47
	LL2	47.53	47.48	47.68	47.52	47.52	47.82	47.59	47.62	47.97
	LL3	53.06	53.14	53.30	52.67	52.88	53.18	52.23	52.58	52.98
	LL4	101.80	102.28	102.56	102.03	102.56	102.36	101.76	102.48	102.14
	IND	53.60	52.39	50.06	53.93	52.40	50.29	54.16	52.32	50.62
	SURF	28.98	29.06	28.98	28.99	29.04	29.06	29.05	29.12	29.10
	CPUE	-52.10	-52.95	-53.36	-52.70	-53.14	-52.88	-52.79	-53.02	-52.23
	Tags	6.12	5.42	5.98	5.90	6.80	11.04	9.17	12.13	19.98
	Aerial	-0.43	-0.55	-0.61	-0.53	-0.57	-0.65	-0.59	-0.55	-0.67
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	58.56	57.77	56.29	58.24	57.32	56.00	58.02	56.96	55.80
	Sel.sm	24.71	24.70	23.83	25.19	24.27	24.56	26.65	25.43	24.17
	Sg.R	-23.71	-26.00	-24.77	-24.21	-25.11	-24.47	-24.62	-24.90	-23.41
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	20,533	23,693	27,311	21,204	24,760	28,691	22,111	25,984	30,126
	S(msy)	552,001	379,832	257,487	483,709	339,280	233,489	434,494	308,682	214,637
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(e) sbtmod22 (C0)

	Name	C0S1L1orig.5_ h2m1M1O2C2a 1.rep	C0S1L1orig.5_ h2m1M2O2C2a 1.rep	C0S1L1orig.5_ h2m1M3O2C2a 1.rep	C0S1L1orig.5_ h2m2M1O2C2a 1.rep	C0S1L1orig.5_ h2m2M2O2C2a 1.rep	C0S1L1orig.5_ h2m2M3O2C2a 1.rep	C0S1L1orig.5_ h2m3M1O2C2a 1.rep	C0S1L1orig.5_ h2m3M2O2C2a 1.rep	C0S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note									no convergence
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	16.84%	8.45%	5.83%	8.36%	4.14%	4.20%	5.66%	2.99%	0.47%
	SSB 2008 / SSB2000	78.50%	82.76%	90.43%	70.21%	68.50%	68.58%	61.25%	54.27%	8.35%
Rho	1931-Y	0.69	0.61	0.62	0.62	0.60	0.61	0.61	0.61	0.61
	1965-1998	0.62	0.39	0.39	0.39	0.31	0.41	0.34	0.36	0.53
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.41	0.37	0.37	0.37	0.36	0.38	0.37	0.38	0.38
	1965-1998	0.34	0.27	0.28	0.27	0.26	0.29	0.27	0.28	0.34
CPUE	1969-Y	0.39	0.32	0.43	0.33	0.43	0.65	0.46	0.59	0.91
Autocorr.	1990-2000	0.57	0.66	0.80	0.70	0.82	0.87	0.82	0.87	0.96
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	27239	27231	27228	27231	27231	27259	27253	27275	27334
	LL1	176.38	176.14	176.78	178.97	179.61	186.69	186.46	190.90	190.64
	LL2	49.28	49.00	48.96	49.27	49.16	49.71	49.92	50.22	51.47
	LL3	53.41	53.31	53.34	52.45	52.76	53.21	52.05	52.72	53.10
	LL4	101.11	102.05	102.91	102.13	103.26	102.96	102.85	103.64	108.03
	IND	56.17	54.86	53.19	56.47	55.57	57.40	59.72	60.25	53.80
	SURF	33.62	33.84	33.99	34.53	34.99	35.99	36.43	37.37	40.10
	CPUE	-51.65	-52.96	-51.28	-52.78	-51.23	-43.76	-50.30	-45.82	-10.23
	Tags	26751.80	26750.40	26748.30	26743.20	26743.10	26753.10	26747.20	26758.30	26770.90
	Aerial	5.92	5.90	6.01	5.96	6.25	6.32	6.17	6.70	12.02
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	58.41	57.01	54.57	56.91	55.54	55.60	57.49	57.00	56.31
	Sel.sm	27.07	26.74	25.93	28.69	27.71	26.35	30.10	27.65	30.97
	Sg.R	-22.11	-25.59	-24.91	-25.17	-25.43	-24.70	-25.00	-24.37	-23.16
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	21,224	23,599	27,027	20,986	24,610	28,404	21,777	25,914	31,143
	S(msy)	572,007	379,380	255,446	478,244	337,656	231,310	426,459	307,676	223,581
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(f) sbtmod21 (C2)

	Name	C2S1L1orig.5_ h2m1M1O2C2a 1.rep	C2S1L1orig.5_ h2m1M2O2C2a 1.rep	C2S1L1orig.5_ h2m1M3O2C2a 1.rep	C2S1L1orig.5_ h2m2M1O2C2a 1.rep	C2S1L1orig.5_ h2m2M2O2C2a 1.rep	C2S1L1orig.5_ h2m2M3O2C2a 1.rep	C2S1L1orig.5_ h2m3M1O2C2a 1.rep	C2S1L1orig.5_ h2m3M2O2C2a 1.rep	C2S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note									
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	13.33%	9.37%	10.04%	10.41%	7.30%	9.61%	8.07%	6.18%	9.45%
	SSB 2008 / SSB2000	86.72%	101.57%	125.16%	83.97%	100.19%	120.99%	80.26%	98.76%	117.16%
Rho	1931-Y	0.63	0.60	0.63	0.63	0.61	0.63	0.60	0.62	0.64
	1965-1998	0.44	0.32	0.43	0.37	0.34	0.47	0.33	0.42	0.51
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.37	0.36	0.38	0.38	0.37	0.38	0.37	0.38	0.39
	1965-1998	0.29	0.27	0.29	0.27	0.27	0.30	0.27	0.29	0.32
CPUE	1969-Y	0.33	0.34	0.41	0.33	0.35	0.44	0.33	0.37	0.47
Autocorr.	1990-2000	0.36	0.37	0.42	0.37	0.39	0.44	0.39	0.42	0.46
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	476	472	472	477	475	480	481	481	490
	LL1	171.99	171.15	169.70	172.75	171.46	170.17	173.54	171.53	170.51
	LL2	47.79	47.79	48.00	47.75	47.78	48.11	47.76	47.86	48.25
	LL3	52.75	52.97	53.14	52.45	52.58	52.97	51.89	52.32	52.78
	LL4	102.43	103.28	103.53	103.31	103.80	103.51	103.43	104.11	103.30
	IND	53.39	52.37	50.52	53.67	52.14	50.62	53.74	51.87	50.91
	SURF	29.18	29.16	29.09	29.14	29.24	29.21	29.27	29.30	29.26
	CPUE	-46.06	-46.43	-44.84	-46.78	-46.72	-44.11	-47.38	-46.70	-43.33
	Tags	5.37	5.26	6.86	6.23	7.55	12.66	9.79	13.29	21.98
	Aerial	-0.65	-0.69	-0.72	-0.67	-0.66	-0.74	-0.68	-0.61	-0.75
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	58.99	58.31	57.01	58.34	57.49	56.57	57.63	56.87	56.27
	Sel.sm	25.72	24.97	24.19	25.31	25.49	24.99	27.28	25.98	24.46
	Sg.R	-24.97	-25.75	-24.28	-24.54	-25.20	-24.33	-25.15	-24.40	-23.55
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	20,568	23,701	27,114	21,178	24,840	28,501	22,147	26,118	29,961
	S(msy)	552,253	379,345	255,439	483,090	340,054	231,875	435,192	310,063	213,448
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(g) sbtmod22 (C2)

	Name	C2S1L1orig.5_ h2m1M1O2C2a 1.rep	C2S1L1orig.5_ h2m1M2O2C2a 1.rep	C2S1L1orig.5_ h2m1M3O2C2a 1.rep	C2S1L1orig.5_ h2m2M1O2C2a 1.rep	C2S1L1orig.5_ h2m2M2O2C2a 1.rep	C2S1L1orig.5_ h2m2M3O2C2a 1.rep	C2S1L1orig.5_ h2m3M1O2C2a 1.rep	C2S1L1orig.5_ h2m3M2O2C2a 1.rep	C2S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note									no convergence
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	14.69%	8.30%	6.51%	7.29%	4.05%	2.24%	4.46%	2.01%	0.44%
	SSB 2008 / SSB2000	84.25%	91.08%	93.08%	74.10%	75.86%	37.73%	61.70%	41.47%	6.85%
Rho	1931-Y	0.65	0.60	0.62	0.60	0.62	0.62	0.61	0.62	0.65
	1965-1998	0.52	0.34	0.38	0.30	0.34	0.43	0.27	0.33	0.58
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.39	0.36	0.37	0.36	0.37	0.37	0.37	0.38	0.40
	1965-1998	0.31	0.27	0.28	0.26	0.28	0.29	0.26	0.28	0.34
CPUE	1969-Y	0.28	0.32	0.56	0.34	0.49	0.87	0.46	0.79	0.93
Autocorr.	1990-2000	0.37	0.40	0.53	0.43	0.56	0.91	0.61	0.87	0.97
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	27237	27232	27238	27232	27238	27266	27256	27282	27330
	LL1	177.48	177.02	178.62	180.24	180.81	180.57	187.74	188.39	191.09
	LL2	49.13	48.98	49.05	49.22	49.24	49.09	49.87	49.90	51.28
	LL3	53.01	53.01	53.11	52.04	52.43	52.89	51.61	52.48	55.86
	LL4	102.11	103.51	104.45	104.09	105.49	104.16	105.80	105.31	103.37
	IND	56.17	55.00	53.66	56.48	55.35	55.19	59.15	58.47	52.95
	SURF	33.73	33.92	34.32	34.82	35.39	35.72	36.84	37.45	39.56
	CPUE	-47.52	-47.66	-41.33	-47.94	-44.72	-17.61	-46.08	-27.75	-3.76
	Tags	26750.40	26749.20	26748.60	26742.80	26743.60	26748.20	26747.40	26756.00	26769.90
	Aerial	-0.79	-0.74	-0.62	-0.54	-0.10	0.65	0.01	1.25	7.38
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	59.65	58.17	55.71	57.32	55.98	55.38	56.57	56.55	56.41
	Sel.sm	27.56	27.19	27.02	29.49	28.55	26.25	31.93	27.77	28.43
	Sg.R	-24.22	-25.71	-24.93	-25.51	-24.39	-24.94	-24.91	-24.06	-22.05
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	20,676	23,576	26,905	21,063	25,016	27,941	22,168	25,979	27,492
	S(msy)	554,579	376,455	252,703	477,915	340,954	224,931	432,542	306,416	197,191
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(h) sbtmod21 (Indonesia29)

	Name	C1S1L1orig.5_ h2m1M1O2C2a 1.rep	C1S1L1orig.5_ h2m1M2O2C2a 1.rep	C1S1L1orig.5_ h2m1M3O2C2a 1.rep	C1S1L1orig.5_ h2m2M1O2C2a 1.rep	C1S1L1orig.5_ h2m2M2O2C2a 1.rep	C1S1L1orig.5_ h2m2M3O2C2a 1.rep	C1S1L1orig.5_ h2m3M1O2C2a 1.rep	C1S1L1orig.5_ h2m3M2O2C2a 1.rep	C1S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note									
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	18.92%	11.43%	9.74%	15.31%	9.26%	9.26%	13.40%	8.00%	9.10%
	SSB 2008 / SSB2000	85.68%	95.51%	119.48%	83.51%	94.03%	116.09%	81.86%	92.73%	112.74%
Rho	1931-Y	0.71	0.65	0.65	0.70	0.65	0.65	0.69	0.65	0.66
	1965-1998	0.63	0.48	0.46	0.59	0.45	0.50	0.58	0.47	0.55
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.43	0.39	0.39	0.42	0.39	0.40	0.43	0.40	0.40
	1965-1998	0.36	0.30	0.30	0.34	0.30	0.31	0.34	0.31	0.33
CPUE	1969-Y	0.46	0.44	0.44	0.46	0.44	0.48	0.46	0.46	0.51
Autocorr.	1990-2000	0.41	0.45	0.53	0.43	0.50	0.58	0.46	0.56	0.62
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	504	490	479	506	493	486	512	500	496
	LL1	169.77	169.52	168.86	170.54	170.02	169.25	171.17	170.39	169.73
	LL2	47.92	47.79	47.88	47.87	47.80	47.99	47.93	47.87	48.13
	LL3	52.87	52.83	52.88	52.42	52.48	52.68	52.25	52.25	52.53
	LL4	101.68	102.46	103.10	101.55	102.53	102.99	101.65	102.51	102.82
	IND	82.17	73.48	63.44	83.77	74.06	63.15	84.88	74.37	62.88
	SURF	28.50	28.67	28.83	28.57	28.75	28.94	28.61	28.80	29.03
	CPUE	-45.82	-47.18	-47.39	-46.31	-47.32	-46.51	-46.56	-47.14	-45.59
	Tags	5.33	5.37	6.54	7.00	7.93	12.06	11.67	13.90	21.20
	Aerial	-0.47	-0.60	-0.68	-0.52	-0.63	-0.70	-0.56	-0.63	-0.73
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	58.42	57.39	55.61	57.83	56.77	55.13	57.56	56.31	54.89
	Sel.sm	24.53	24.15	23.65	24.91	24.49	23.80	24.41	24.79	23.91
	Sg.R	-20.68	-23.52	-23.52	-21.21	-23.44	-23.22	-20.67	-22.96	-22.72
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	19,722	22,480	26,182	20,092	23,409	27,541	20,757	24,469	28,912
	S(msy)	533,094	361,242	246,940	460,661	321,454	224,232	409,866	291,322	206,089
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(i) sbtmod22 (Indonesia29)

	Name	C1S1L1orig.5_ h2m1M1O2C2a 1.rep	C1S1L1orig.5_ h2m1M2O2C2a 1.rep	C1S1L1orig.5_ h2m1M3O2C2a 1.rep	C1S1L1orig.5_ h2m2M1O2C2a 1.rep	C1S1L1orig.5_ h2m2M2O2C2a 1.rep	C1S1L1orig.5_ h2m2M3O2C2a 1.rep	C1S1L1orig.5_ h2m3M1O2C2a 1.rep	C1S1L1orig.5_ h2m3M2O2C2a 1.rep	C1S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note									no convergence
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	18.10%	9.81%	6.60%	10.58%	5.22%	2.65%	6.92%	2.59%	0.55%
	SSB 2008 / SSB2000	81.99%	86.23%	90.71%	74.51%	73.53%	42.31%	65.19%	43.72%	8.31%
Rho	1931-Y	0.72	0.66	0.65	0.69	0.65	0.66	0.67	0.65	0.67
	1965-1998	0.65	0.48	0.42	0.53	0.37	0.51	0.46	0.43	0.68
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.43	0.39	0.39	0.41	0.39	0.39	0.41	0.40	0.41
	1965-1998	0.36	0.30	0.29	0.32	0.28	0.32	0.30	0.30	0.38
CPUE	1969-Y	0.44	0.44	0.57	0.50	0.57	0.85	0.60	0.81	0.93
Autocorr.	1990-2000	0.49	0.55	0.71	0.58	0.72	0.94	0.71	0.91	0.97
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	27265	27250	27243	27266	27258	27273	27295	27303	27346
	LL1	176.25	175.88	177.32	179.14	180.10	180.93	187.45	188.13	191.37
	LL2	49.16	48.99	48.97	49.34	49.28	49.16	50.04	49.94	51.90
	LL3	52.91	52.82	52.82	52.18	52.32	52.50	51.84	52.05	57.08
	LL4	101.67	102.63	103.67	101.97	103.39	104.73	102.36	104.27	103.42
	IND	85.13	76.46	66.57	90.17	79.68	65.17	96.79	80.50	64.22
	SURF	33.16	33.45	33.96	34.25	34.83	35.61	36.26	36.98	40.21
	CPUE	-47.09	-47.94	-44.45	-46.61	-44.79	-22.58	-43.28	-28.37	-6.08
	Tags	26750.50	26749.30	26748.50	26743.20	26744.10	26749.10	26749.50	26756.50	26769.20
	Aerial	-0.63	-0.68	-0.58	-0.47	-0.24	0.40	-0.11	0.84	7.27
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	58.21	56.71	54.13	56.71	55.20	54.92	56.94	56.53	56.11
	Sel.sm	26.58	26.35	25.70	27.46	27.05	25.88	28.60	27.83	32.00
	Sg.R	-20.35	-23.49	-23.39	-21.72	-22.96	-23.02	-21.49	-22.43	-20.98
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	19,506	22,222	25,851	19,308	23,013	26,769	19,806	23,902	27,184
	S(msy)	525,617	356,080	243,135	440,189	314,553	215,953	388,242	282,521	195,263
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(j) sbtmod21 (truncated CPUE)

	Name	C1S1L1orig.5_ h2m1M1O2C2a 1.rep	C1S1L1orig.5_ h2m1M2O2C2a 1.rep	C1S1L1orig.5_ h2m1M3O2C2a 1.rep	C1S1L1orig.5_ h2m2M1O2C2a 1.rep	C1S1L1orig.5_ h2m2M2O2C2a 1.rep	C1S1L1orig.5_ h2m2M3O2C2a 1.rep	C1S1L1orig.5_ h2m3M1O2C2a 1.rep	C1S1L1orig.5_ h2m3M2O2C2a 1.rep	C1S1L1orig.5_ h2m3M3O2C2a 1.rep
)2-)	Note									
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	16.39%	9.59%	4.32%	11.43%	4.61%	3.17%	8.03%	2.58%	2.77%
	SSB 2008 / SSB2000	97.42%	100.56%	74.96%	85.04%	70.63%	54.48%	72.82%	47.74%	45.38%
Rho	1931-Y	0.60	0.59	0.60	0.60	0.59	0.62	0.61	0.61	0.65
	1965-1998	0.36	0.32	0.35	0.36	0.29	0.42	0.37	0.34	0.51
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.37	0.36	0.36	0.37	0.36	0.37	0.37	0.37	0.39
	1965-1998	0.27	0.26	0.27	0.27	0.26	0.29	0.27	0.27	0.31
CPUE	1969-Y	0.61	0.38	0.77	0.38	0.61	0.84	0.41	0.77	0.86
Autocorr.	1990-2000	0.64	0.40	0.86	0.43	0.77	0.93	0.57	0.92	0.94
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	462	459	455	464	461	458	469	465	467
0.647061	LL1	170.40	170.15	169.74	171.60	171.17	169.33	172.74	171.10	169.13
	LL2	47.82	47.60	47.40	47.61	47.35	47.53	47.53	47.38	47.75
	LL3	53.05	53.14	53.26	52.48	52.66	53.07	52.09	52.42	52.98
	LL4	101.93	102.45	102.67	102.08	102.85	102.33	102.22	102.95	102.00
	IND	53.08	52.33	49.95	53.57	52.24	50.55	54.05	52.02	51.07
	SURF	28.92	29.02	29.41	29.06	29.36	29.50	29.17	29.63	29.52
	CPUE	-56.65	-56.55	-56.82	-56.45	-56.52	-56.66	-56.36	-56.73	-56.51
	Tags	5.99	5.51	4.98	6.63	6.03	7.56	9.05	9.43	14.27
	Aerial	0.25	-0.45	-0.84	-0.31	-0.72	-0.60	-0.76	0.01	-0.46
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	57.16	57.31	56.10	57.30	57.11	56.06	57.53	56.82	56.24
	Sel.sm	25.71	24.84	24.49	26.22	25.30	24.12	26.90	25.76	24.33
	Sg.R	-25.57	-25.92	-25.73	-25.32	-25.79	-24.94	-24.92	-25.28	-23.71
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	21,302	23,845	27,102	21,521	24,614	28,349	22,033	25,546	29,478
	S(msy)	579,910	383,740	253,001	493,233	335,455	228,663	432,629	301,358	209,277
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(k) sbtmod22 (truncated CPUE)

	Name	C1S1L1orig.5_ h2m1M1O2C2a 1.rep	C1S1L2orig.5_ h2m1M2O2C2a 1.rep	C1S1L1orig.5_ h2m1M3O2C2a 1.rep	C1S1L1orig.5_ h2m2M1O2C2a 1.rep	C1S1L1orig.5_ h2m2M2O2C2a 1.rep	C1S1L1orig.5_ h2m2M3O2C2a 1.rep	C1S1L1orig.5_ h2m3M1O2C2a 1.rep	C1S1L1orig.5_ h2m3M2O2C2a 1.rep	C1S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note			no convergence		no convergence	no convergence	no convergence	no convergence	no convergence
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	15.18%	8.22%	0.72%	7.47%	1.36%	0.47%	3.72%	0.53%	0.79%
	SSB 2008 / SSB2000	85.94%	83.48%	15.83%	65.95%	23.19%	7.19%	43.02%	12.13%	8.20%
Rho	1931-Y	0.63	0.60	0.64	0.62	0.59	0.39	0.68	0.49	0.08
	1965-1998	0.47	0.37	0.34	0.41	0.33	0.55	0.48	0.34	0.73
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.38	0.36	0.36	0.37	0.36	0.43	0.42	0.36	0.56
	1965-1998	0.29	0.27	0.27	0.28	0.26	0.32	0.31	0.29	0.40
CPUE	1969-Y	0.40	0.37	0.91	0.54	0.90	0.94	0.86	0.89	0.95
Autocorr.	1990-2000	0.37	0.54	0.97	0.74	0.96	0.97	0.95	0.97	0.97
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	27233	27227	27220	27226	27218	27228	27239	27410	27318
	LL1	176.77	175.93	171.77	178.58	174.00	177.46	179.95	192.05	202.94
	LL2	49.29	48.93	48.39	49.04	49.14	49.44	49.82	51.30	51.75
	LL3	53.11	53.19	53.44	52.32	53.26	55.39	52.49	57.57	62.55
	LL4	101.80	102.44	104.21	102.44	102.98	100.84	102.29	190.96	97.90
	IND	56.26	54.83	48.43	56.09	48.54	47.63	52.44	54.02	54.59
	SURF	33.71	33.86	36.22	34.60	36.34	38.13	37.62	40.17	43.62
	CPUE	-56.63	-56.55	-54.85	-56.29	-56.19	-56.63	-56.30	-54.63	-56.05
	Tags	26751.70	26750.00	26747.40	26742.80	26740.20	26742.00	26742.40	26754.90	26765.10
	Aerial	5.96	5.85	10.19	5.89	10.14	11.88	9.64	10.92	12.00
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	57.76	57.12	53.07	57.14	57.22	54.81	59.54	56.20	58.10
	Sel.sm	27.63	26.96	26.73	28.87	27.62	26.23	30.29	81.55	30.59
	Sg.R	-24.73	-25.73	-25.36	-24.99	-25.34	-19.66	-21.01	-24.89	-5.56
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	20,901	23,506	29,315	20,790	22,717	24,976	20,262	24,638	21,717
	S(msy)	565,413	377,359	275,000	471,533	309,819	202,201	401,743	294,618	156,069
	S(msy)/Bo	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.33	0.33

(l) sbtmod21 (trolling)

	Name	C1S1L1orig.5_ h2m1M1O2C2a 1.rep	C1S1L1orig.5_ h2m1M2O2C2a 1.rep	C1S1L1orig.5_ h2m1M3O2C2a 1.rep	C1S1L1orig.5_ h2m2M1O2C2a 1.rep	C1S1L1orig.5_ h2m2M2O2C2a 1.rep	C1S1L1orig.5_ h2m2M3O2C2a 1.rep	C1S1L1orig.5_ h2m3M1O2C2a 1.rep	C1S1L1orig.5_ h2m3M2O2C2a 1.rep	C1S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note									
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	15.19%	9.53%	9.19%	11.32%	7.60%	8.90%	9.08%	6.36%	8.87%
	SSB 2008 / SSB2000	83.13%	95.16%	123.41%	80.37%	94.41%	119.68%	77.57%	93.32%	116.18%
Rho	1931-Y	0.73	0.60	0.64	0.66	0.61	0.65	0.63	0.62	0.67
	1965-1998	0.55	0.36	0.44	0.45	0.36	0.48	0.40	0.42	0.53
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.43	0.37	0.39	0.40	0.39	0.39	0.39	0.39	0.41
	1965-1998	0.31	0.27	0.29	0.28	0.27	0.30	0.28	0.29	0.32
CPUE	1969-Y	0.33	0.31	0.32	0.31	0.30	0.36	0.30	0.30	0.39
Autocorr.	1990-2000	0.41	0.44	0.51	0.44	0.49	0.55	0.49	0.55	0.58
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	486	482	480	487	485	487	492	492	498
0.672731	LL1	174.19	171.80	170.60	173.62	171.86	170.91	173.93	172.06	171.23
	LL2	47.93	47.58	47.74	47.58	47.60	47.86	47.60	47.67	48.01
	LL3	53.21	53.14	53.22	52.66	52.83	53.06	52.13	52.48	52.90
	LL4	101.89	102.56	103.07	102.42	103.00	102.99	102.40	103.14	102.80
	IND	53.25	52.29	50.02	53.55	52.20	50.11	53.71	51.92	50.35
	SURF	28.58	28.87	28.85	28.81	28.92	28.97	28.97	29.06	29.04
	CPUE	-49.42	-50.31	-50.28	-50.37	-50.80	-49.85	-50.91	-51.07	-49.29
	Tags	5.39	5.32	6.63	6.29	7.58	12.31	9.94	13.25	21.63
	Aerial	1.79	-0.25	-0.14	0.21	-0.51	-0.08	-0.23	-0.63	0.04
	Troll	2.10	11.92	11.15	10.00	13.09	10.82	11.89	13.64	10.17
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	64.04	59.72	58.55	60.54	58.72	58.33	59.37	58.07	58.37
	Sel.sm	25.29	24.96	24.33	25.42	24.48	25.11	26.95	25.75	25.29
	Sg.R	-22.48	-25.14	-23.90	-23.70	-24.00	-23.72	-24.05	-23.62	-23.00
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	23,416	25,170	28,819	22,654	25,789	29,956	23,107	26,817	31,120
	S(msy)	578,423	386,571	260,369	496,400	344,228	236,585	444,337	313,285	217,524
	S(msy)/Bo	0.32	0.33	0.33	0.32	0.33	0.33	0.32	0.33	0.33

(m) sbtmod22 (trolling)

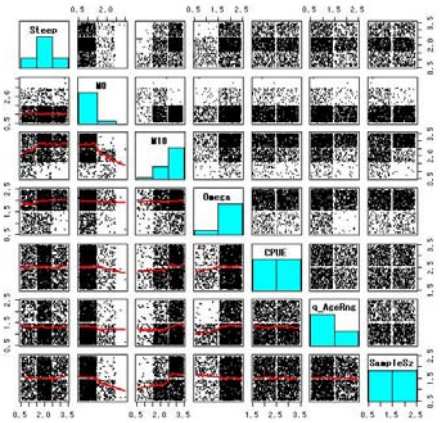
	Name	C1S1L1orig.5_ h2m1M1O2C2a 1.rep	C1S1L1orig.5_ h2m1M2O2C2a 1.rep	C1S1L1orig.5_ h2m1M3O2C2a 1.rep	C1S1L1orig.5_ h2m2M1O2C2a 1.rep	C1S1L1orig.5_ h2m2M2O2C2a 1.rep	C1S1L1orig.5_ h2m2M3O2C2a 1.rep	C1S1L1orig.5_ h2m3M1O2C2a 1.rep	C1S1L1orig.5_ h2m3M2O2C2a 1.rep	C1S1L1orig.5_ h2m3M3O2C2a 1.rep
	Note								no covergence	no covergence
Steepness	(0.385 or 0.55 or 0.73)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
M0	(0.3 or 0.4 or 0.5)	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
M10	(0.07 or 0.10 or 0.14)	0.07	0.1	0.14	0.07	0.1	0.14	0.07	0.1	0.14
	SSB 2008 / SSB0	15.95%	9.38%	6.44%	8.44%	4.30%	4.16%	5.18%	2.97%	0.35%
	SSB 2008 / SSB2000	80.62%	85.72%	95.10%	72.61%	74.03%	67.16%	62.27%	57.79%	6.89%
Rho	1931-Y	0.74	0.71	0.63	0.64	0.59	0.61	0.58	0.61	0.58
	1965-1998	0.59	0.43	0.40	0.38	0.32	0.40	0.30	0.36	0.53
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.44	0.41	0.39	0.39	0.38	0.39	0.38	0.38	0.37
	1965-1998	0.32	0.27	0.28	0.27	0.27	0.28	0.26	0.29	0.33
CPUE	1969-Y	0.30	0.30	0.47	0.31	0.42	0.72	0.42	0.60	0.92
Autocorr.	1990-2000	0.47	0.51	0.66	0.55	0.70	0.85	0.73	0.82	0.97
	Steepness	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Likelihood	Total	27252	27249	27251	27249	27255	27285	27274	27300	27352
	LL1	180.30	179.48	178.91	181.03	180.87	187.31	187.85	191.99	189.86
	LL2	49.47	49.24	49.05	49.29	49.25	49.69	49.93	50.32	51.14
	LL3	53.31	53.20	53.24	52.34	52.61	53.01	51.85	52.64	52.77
	LL4	101.56	102.54	103.71	102.89	104.29	103.80	104.32	104.86	106.82
	IND	56.05	55.23	53.42	56.60	55.51	57.10	59.36	59.94	52.64
	SURF	33.22	33.42	34.00	34.40	35.05	35.94	36.50	37.47	39.77
	CPUE	-50.49	-51.02	-48.39	-51.20	-49.67	-36.88	-49.66	-44.11	-8.67
	Tags	26750.70	26749.40	26748.80	26743.10	26743.70	26753.30	26747.70	26759.40	26771.80
	Aerial	7.25	6.69	5.97	6.14	5.94	5.96	6.00	6.41	11.67
	Troll	0.29	4.47	12.44	10.94	16.83	15.68	15.58	19.34	21.44
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	64.79	62.40	56.90	59.25	56.27	56.75	57.80	57.11	57.90
	Sel.sm	27.96	27.37	27.00	29.06	28.10	26.56	30.96	28.00	28.36
	Sg.R	-22.17	-23.64	-23.77	-24.34	-24.21	-23.43	-24.21	-23.77	-23.12
	M(0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M(10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Steepness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ref. Pts	msy	23,687	25,897	28,478	22,381	25,471	29,028	22,757	26,375	33,559
	S(msy)	582,695	384,593	257,494	489,130	342,208	231,069	438,150	310,872	241,134
	S(msy)/Bo	0.32	0.33	0.33	0.32	0.33	0.33	0.32	0.33	0.33

Table 2. Summary results for specific scenario runs. The base case was set as “steepness: estimate, M0: estimate, M10: estimate, CPUE=w0.5, omega: estimate, q age-range=4-18, sample size=orig.5”.

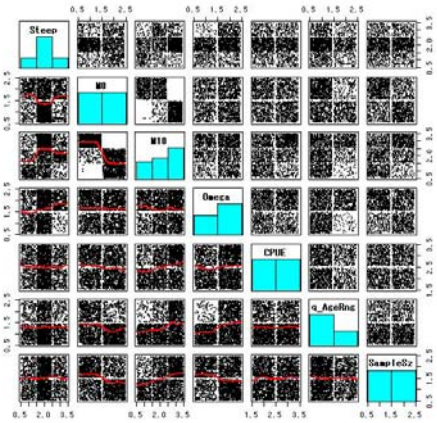
		a	b	c	f	g	h	i
	Name	sbtmod21 C1S1L1 base	sbtmod22 C1S1L1 base	sbtmod21 C1S1L1 notag	sbtmod21 C2S1L1	sbtmod22 C2S1L1	sbtmod21 C1S1L1 indon29	sbtmod22 C1S1L1 indon29
Steepness	(0.385 or 0.55 or 0.73)	0.658	0.664	0.618	0.684	0.691	0.617	0.647
M0	(0.3 or 0.4 or 0.5)	0.349	0.359	0.396	0.354	0.364	0.310	0.313
M10	(0.07 or 0.10 or 0.14)	0.117	0.104	0.128	0.110	0.098	0.147	0.128
Omega	(0.75 or 1)	0.913	0.869	0.933	0.901	0.859	0.959	0.888
	SSB 2008 / SSB0	6.59%	4.43%	8.67%	6.80%	4.55%	10.54%	6.20%
	SSB 2008 / SSB2000	108.94%	76.13%	124.59%	112.73%	79.82%	123.00%	86.83%
Rho	1931-Y	0.61	0.61	0.63	0.61	0.61	0.65	0.65
	1965-1998	0.37	0.34	0.45	0.36	0.34	0.51	0.49
SigmaR	Model SigR	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	1931-Y	0.37	0.37	0.38	0.37	0.37	0.39	0.39
	1965-1998	0.27	0.26	0.29	0.27	0.26	0.31	0.30
CPUE Autocorr.	1969-Y	0.31	0.36	0.31	0.37	0.41	0.48	0.55
	1990-2000	0.55	0.66	0.51	0.44	0.49	0.54	0.67
	Steepness	0.66	0.66	0.62	0.68	0.69	0.62	0.65
Likelihood	Total	465	27222	457	472	27228	482	27244
	LL1	171.00	178.37	169.63	171.67	178.92	169.27	176.60
	LL2	47.67	48.92	47.95	47.74	49.00	47.97	48.94
	LL3	52.73	52.63	52.89	52.48	52.36	52.79	52.67
	LL4	102.60	102.80	102.31	103.19	103.53	102.53	102.68
	IND	50.21	53.20	49.48	50.31	53.29	61.57	68.65
	SURF	29.11	34.34	28.30	29.17	34.45	28.86	33.82
	CPUE	-50.61	-50.45	-50.21	-45.80	-46.20	-46.24	-44.70
	Tags	5.98	26744.00	0.00	5.97	26743.80	7.30	26747.00
	Aerial	-0.72	-0.62	-0.72	-0.74	-0.67	-0.66	-0.72
	Troll	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Priors	Sel.Ch	56.30	55.58	56.91	56.53	55.87	55.12	54.19
	Sel.sm	25.03	27.72	24.62	25.45	28.27	23.70	26.53
	Sg.R	-25.14	-25.38	-24.49	-24.99	-25.14	-23.43	-23.71
	M(0)	0.81	0.52	0.00	0.65	0.40	2.54	2.36
	M(10)	0.04	0.00	0.11	0.01	0.00	0.30	0.11
	Steepness	0.06	0.07	0.03	0.10	0.11	0.02	0.05
Ref. Pts	msy	28,342	27,271	29,259	28,248	27,275	28,438	27,228
	S(msy)	229,258	252,368	218,875	227,324	248,014	194,396	206,612
	S(msy)/Bo	0.28	0.28	0.30	0.27	0.26	0.30	0.29

Figure 1. Estimated distributions for each uncertainty axis.

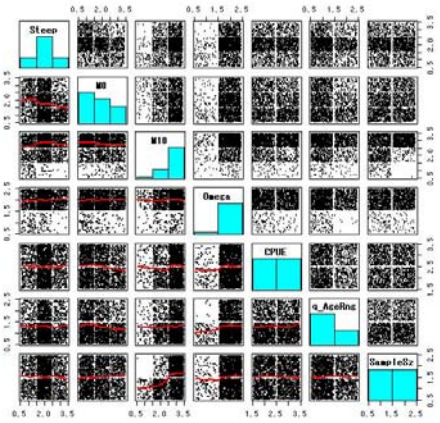
(a) sbtmod21 (base case)



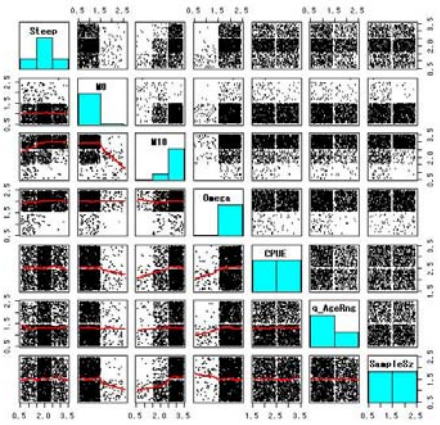
(b) sbtmod22 (base case)



(c) sbtmod21 (no tag)



(d) sbtmod21 (C0)



(e) sbtmod22 (C0)

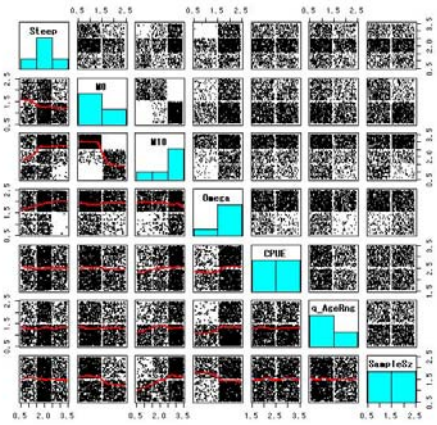
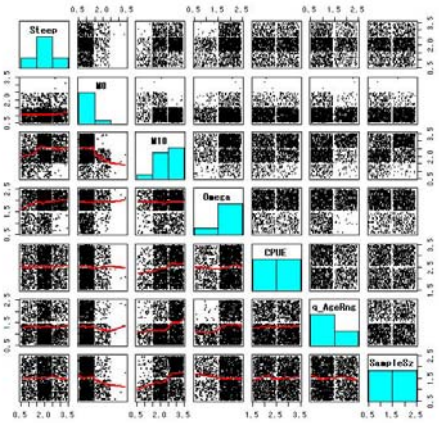
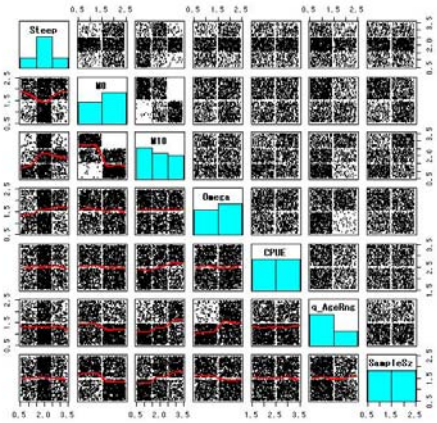


Figure 1 (cont.)

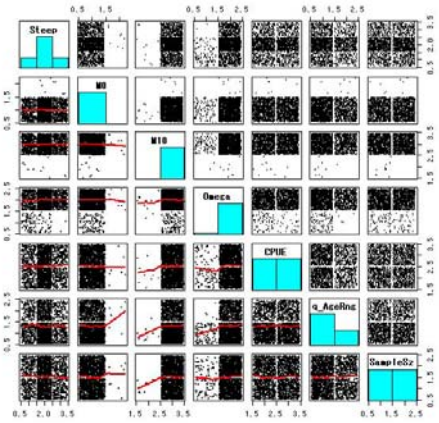
(f) sbtmod21 (C2)



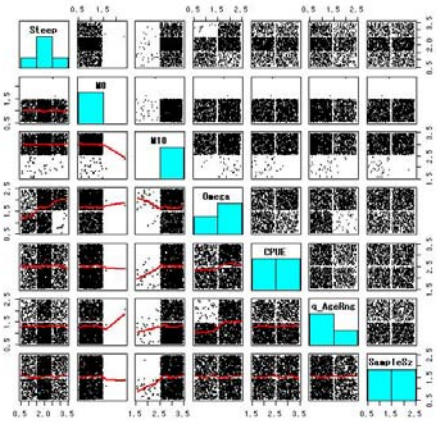
(g) sbtmod22 (C2)



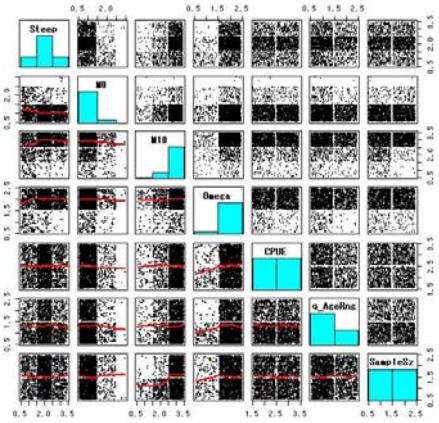
(h) sbtmod21 (Indonesia29)



(i) sbtmod22 (Indonesia29)



(j) sbtmod21 (truncated CPUE)



(k) sbtmod22 (truncated CPUE)

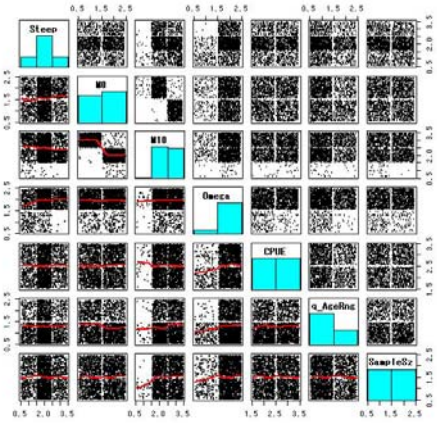


Figure 1 (cont.)

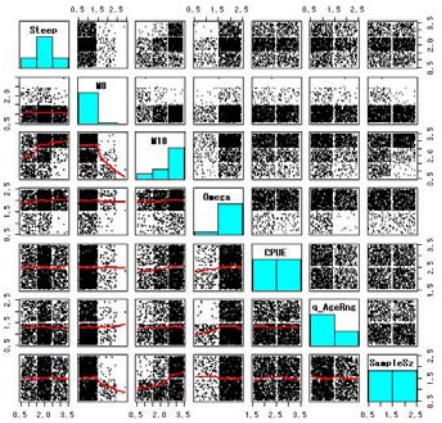
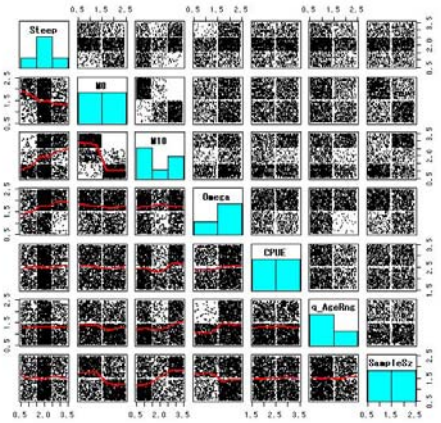
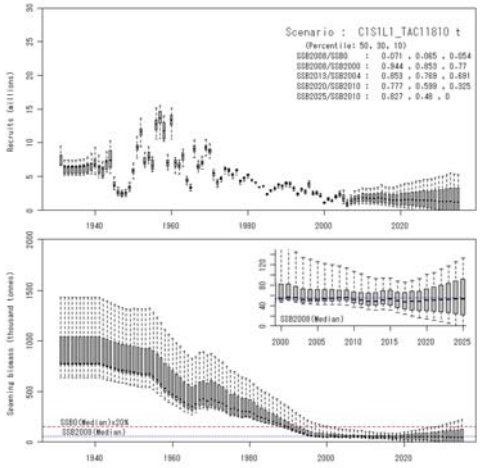
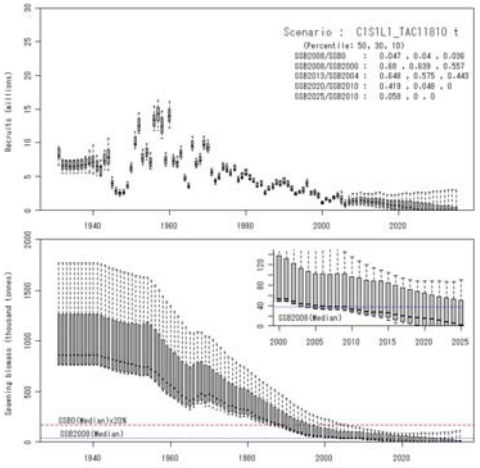
(l) sbtmod21 (trolling survey)	(m) sbtmod22 (trolling survey)
	

Figure 2. Recruitment and spawning biomass trajectories.

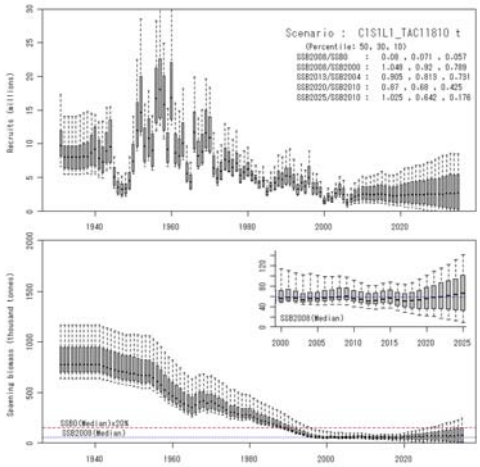
(a) sbtmod21 (base case)



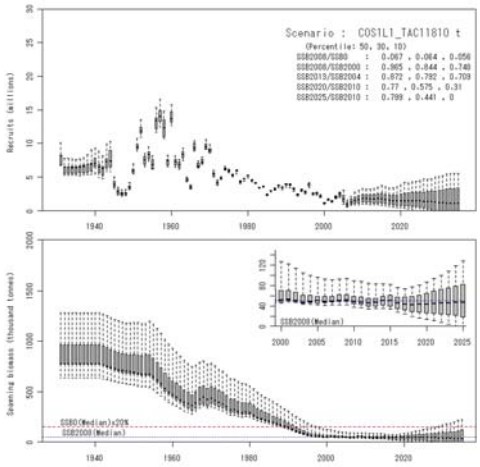
(b) sbtmod22 (base case)



(c) sbtmod21 (no tag)



(d) sbtmod21 (C0)



(e) sbtmod22 (C0)

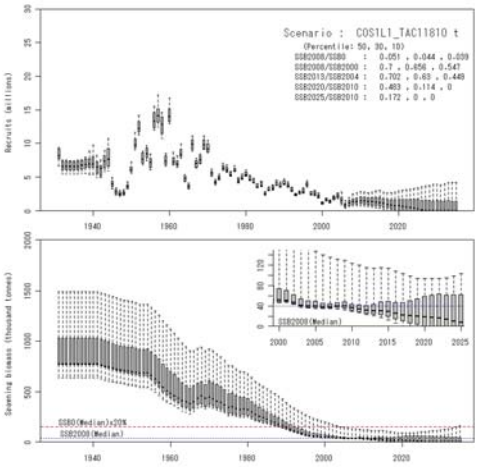
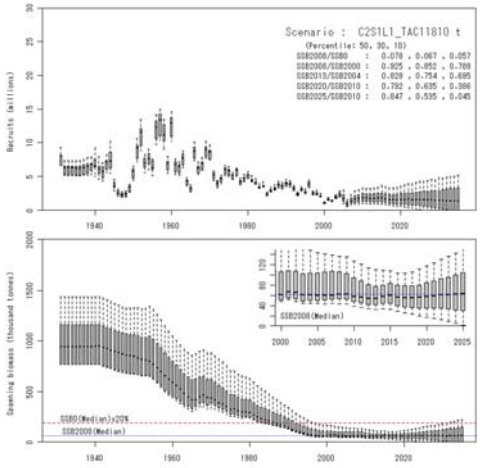
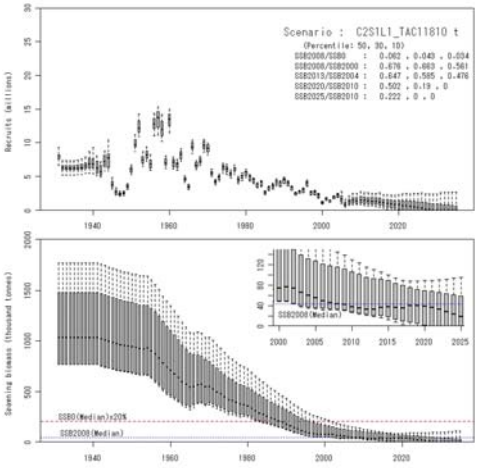


Figure 2. (cont.)

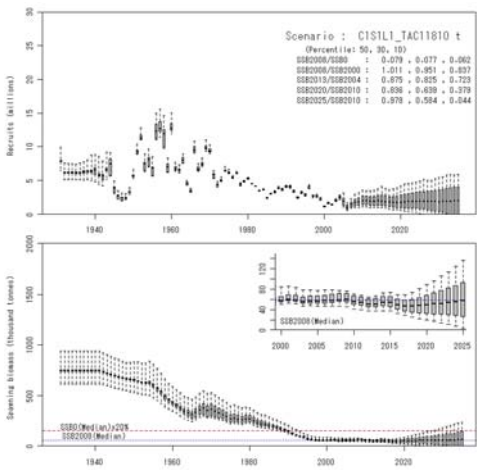
(f) sbtmod21 (C2)



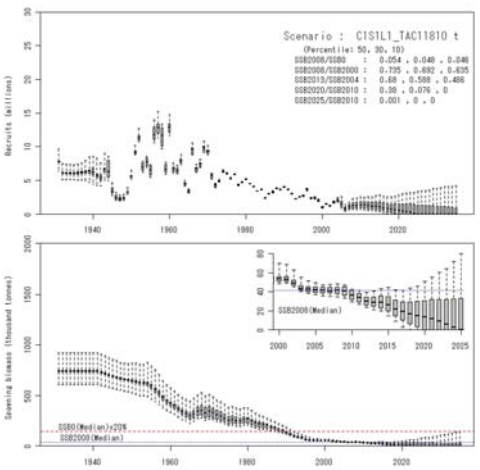
(g) sbtmod22 (C2)



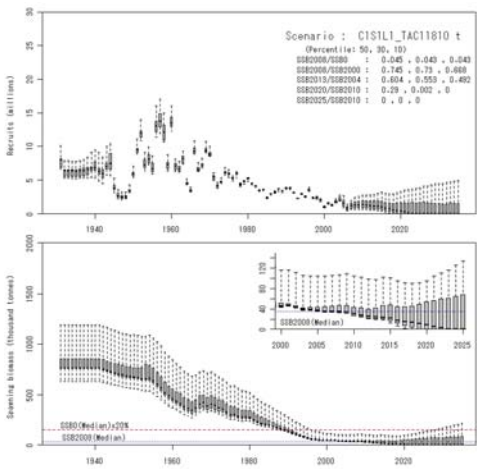
(h) sbtmod21 (Indonesia29)



(i) sbtmod22 (Indonesia29)



(j) sbtmod21 (truncated CPUE)



(k) sbtmod22 (truncated CPUE)

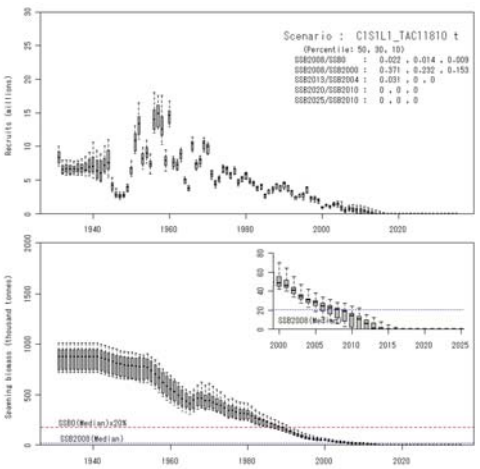
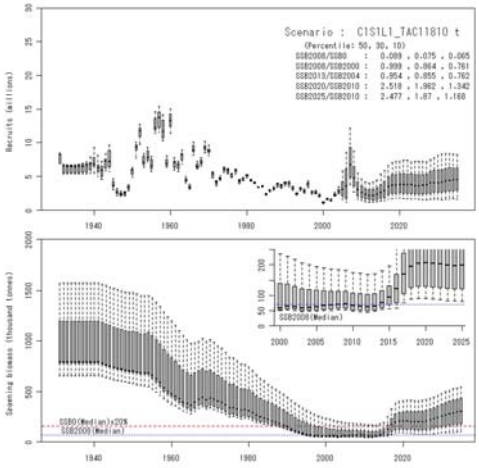
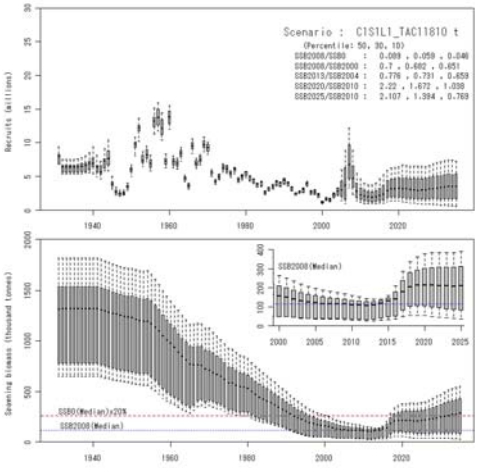


Figure 2. (cont.)

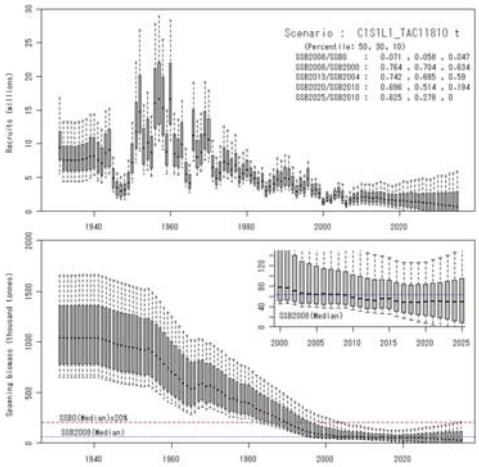
(l) sbtmod21 (trolling)



(m) sbtmod22 (trolling)



(n) sbtmod21 (base – equal sampling)



(o) sbtmod22 (base – equal sampling)

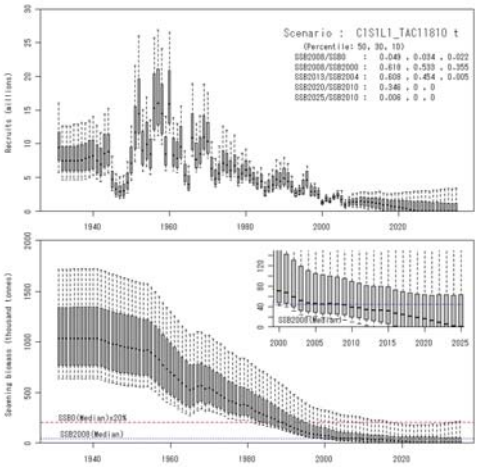
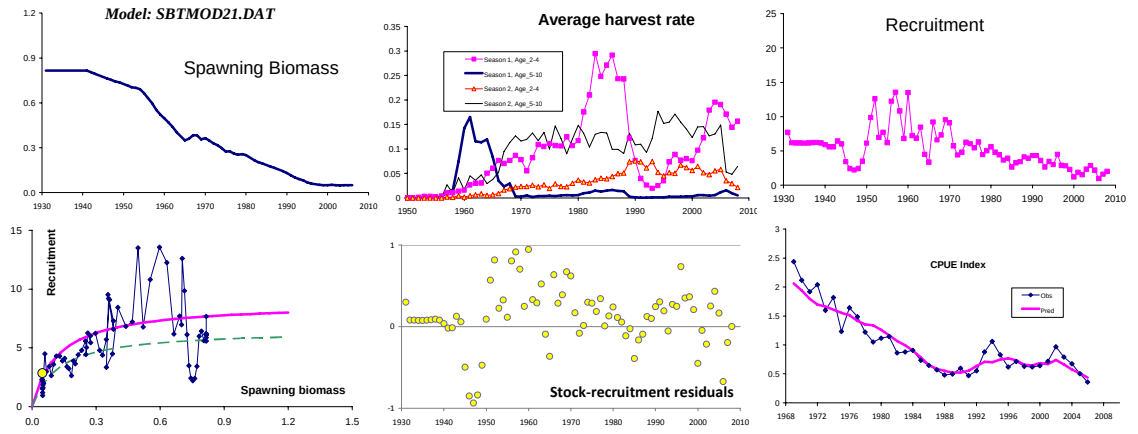


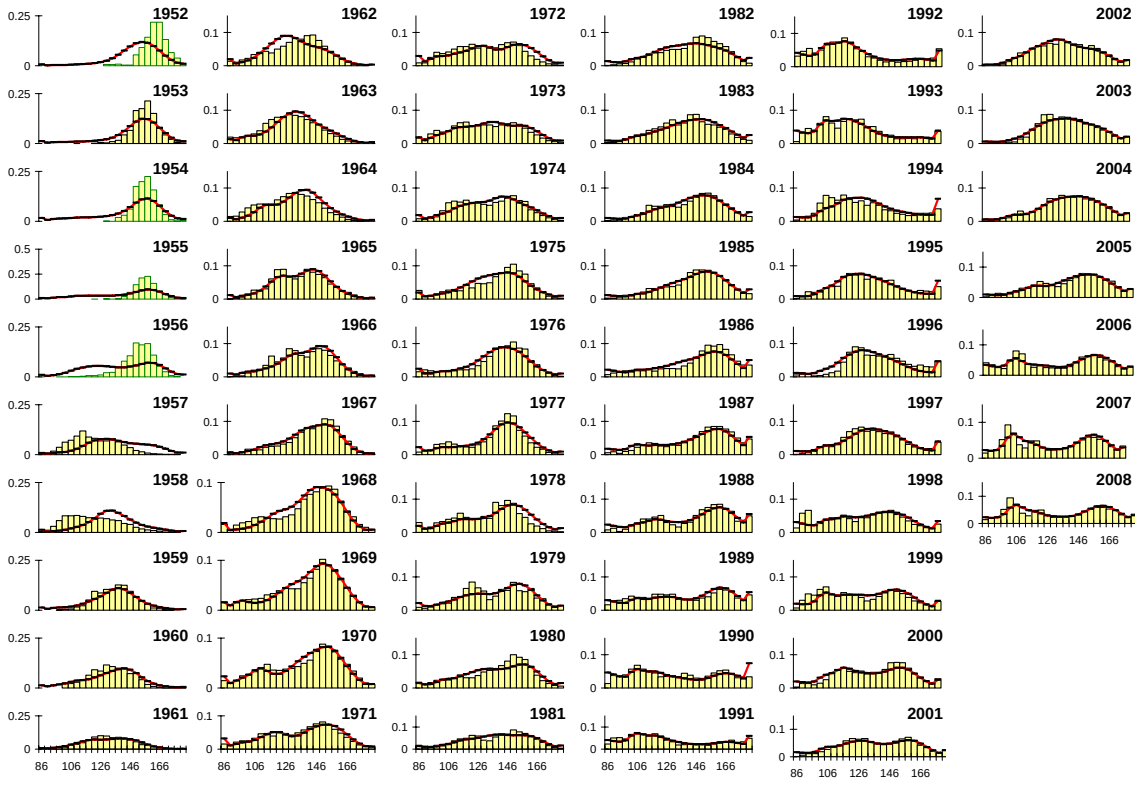
Figure 3. Conditioning results for certain specific scenarios (also see Table 2).

(a) sbtmod21 (base)

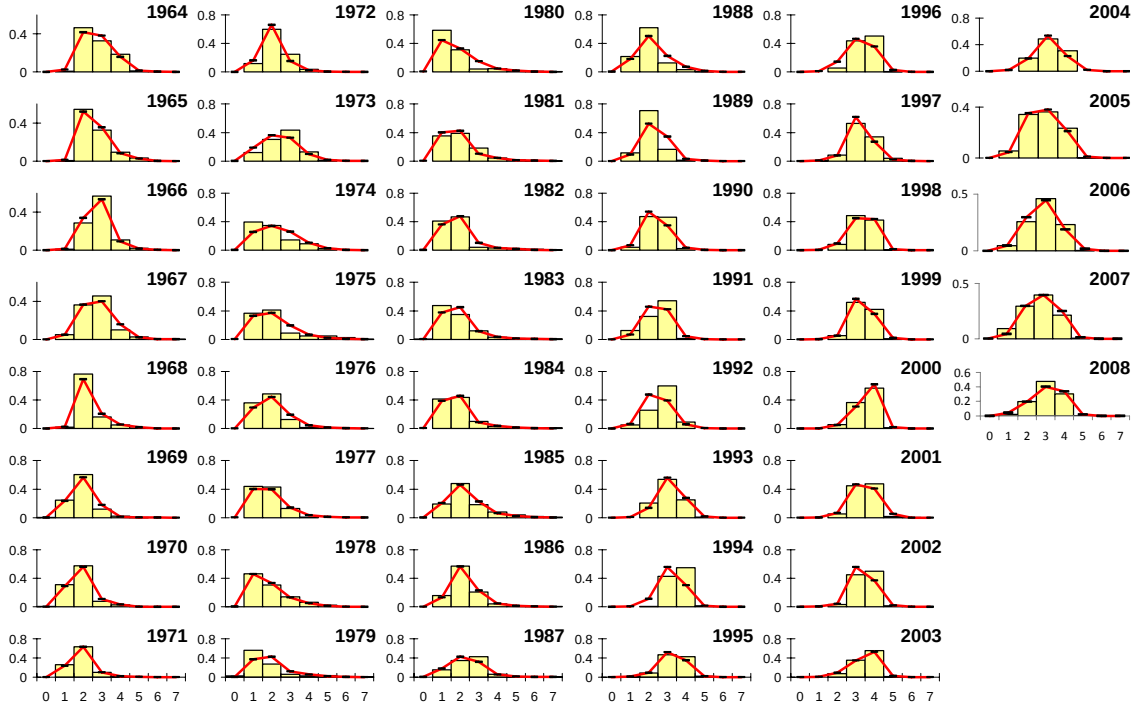
- summary



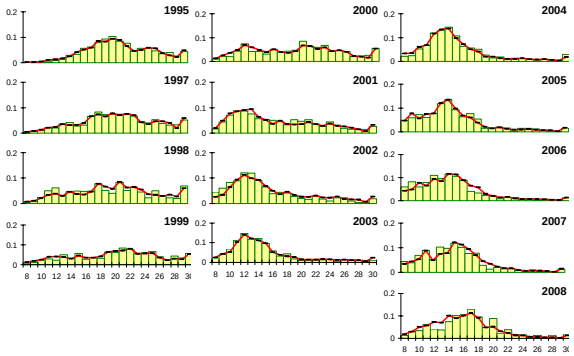
- catch-at-length of LL1



- catch-at-age of Australian fishery



- catch-at-age of Indonesian fishery



- tag recapture

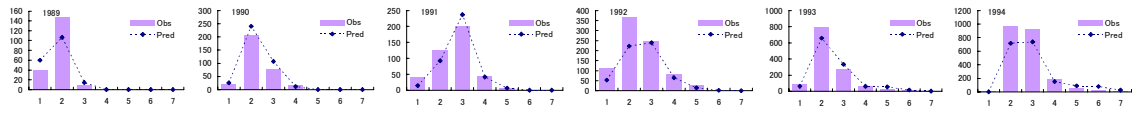
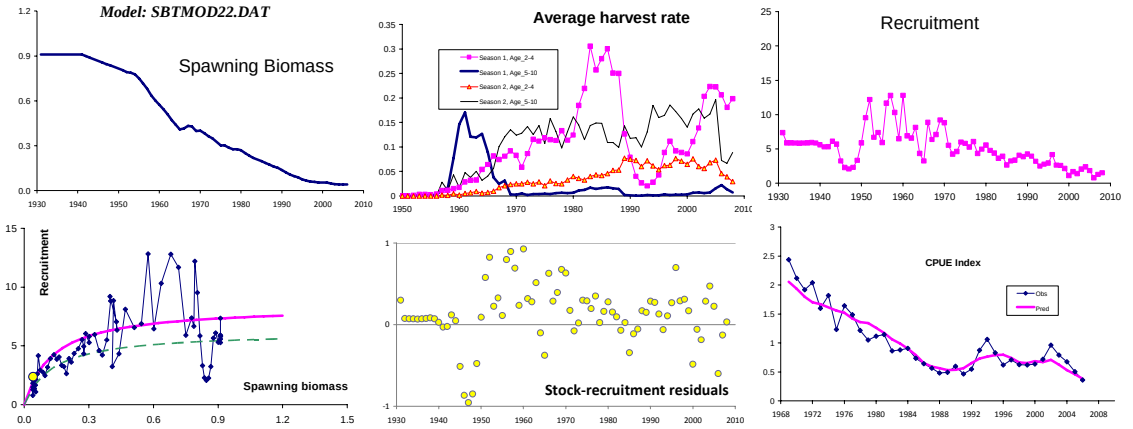


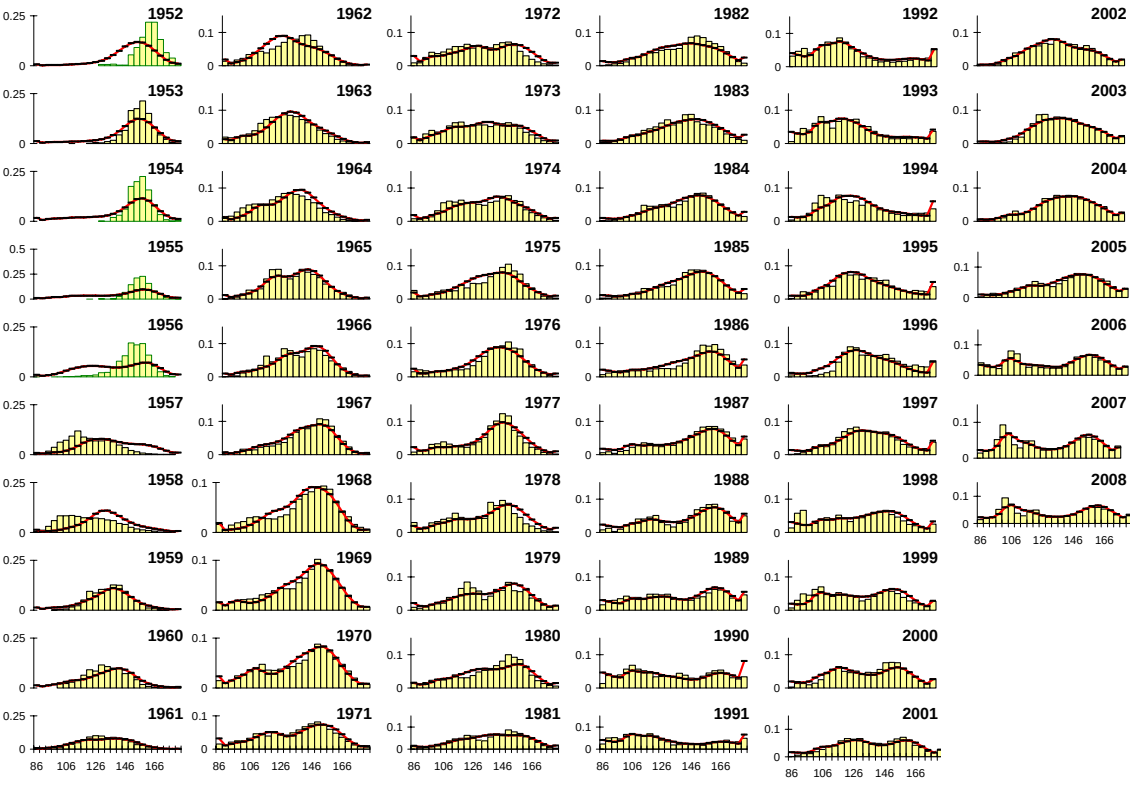
Figure 3. (cont.)

(b) sbtmod22

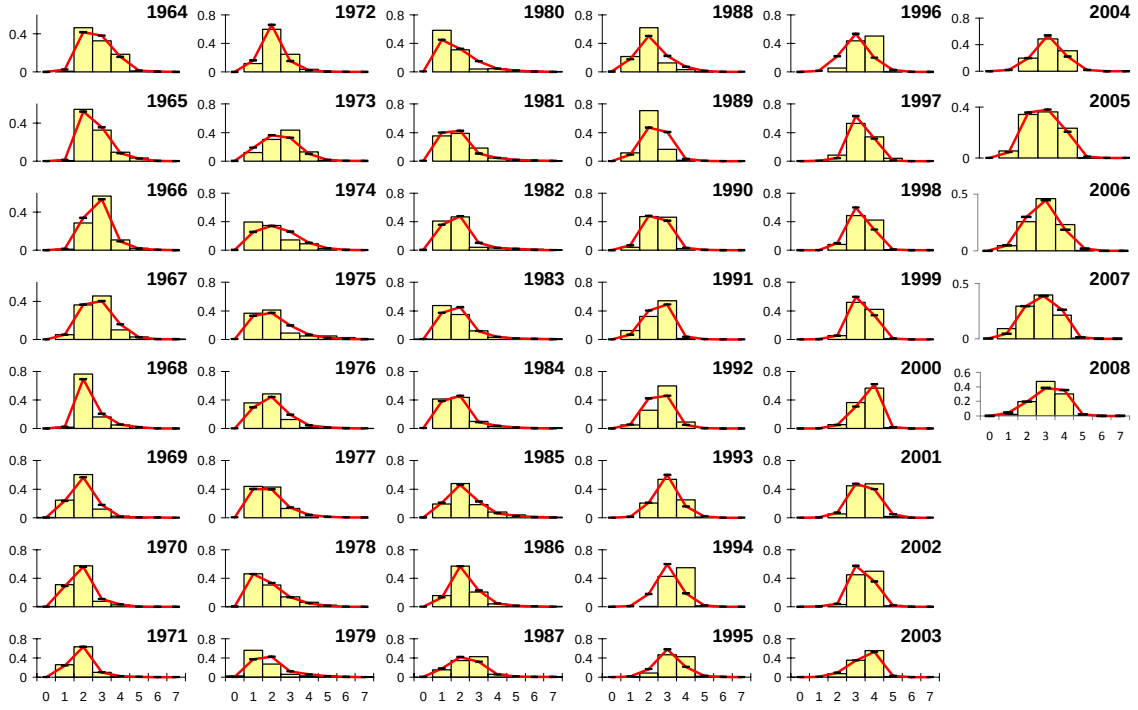
- summary



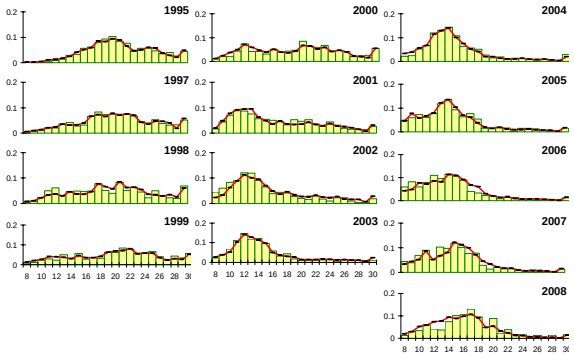
- catch-at-length of LL1



- catch-at-age of Australian fishery



- catch-at-age of Indonesian fishery



- tag recapture

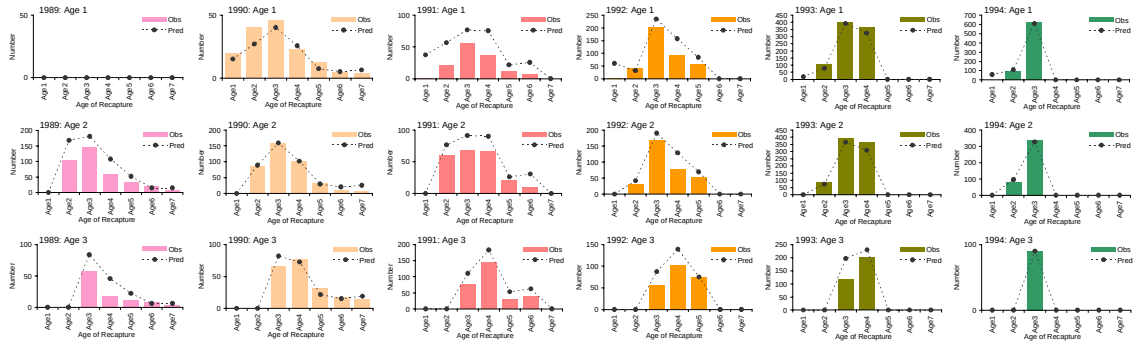
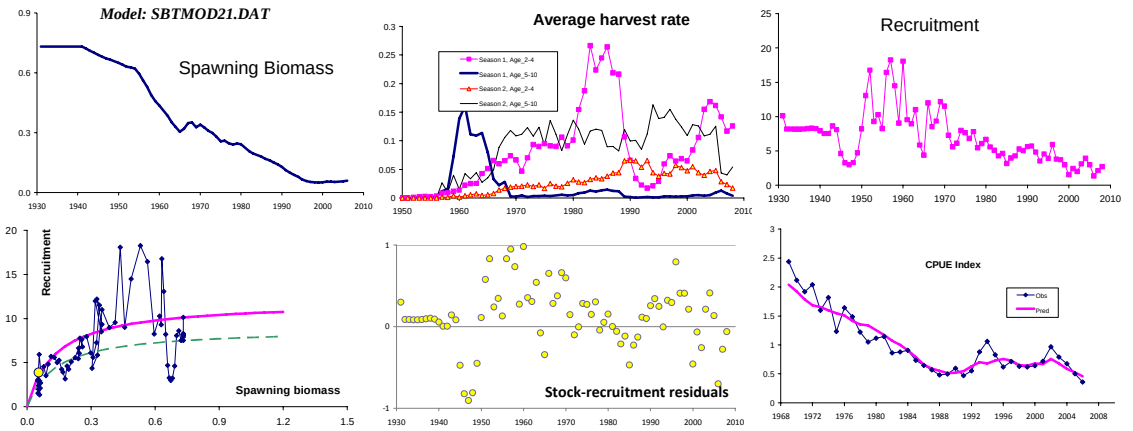


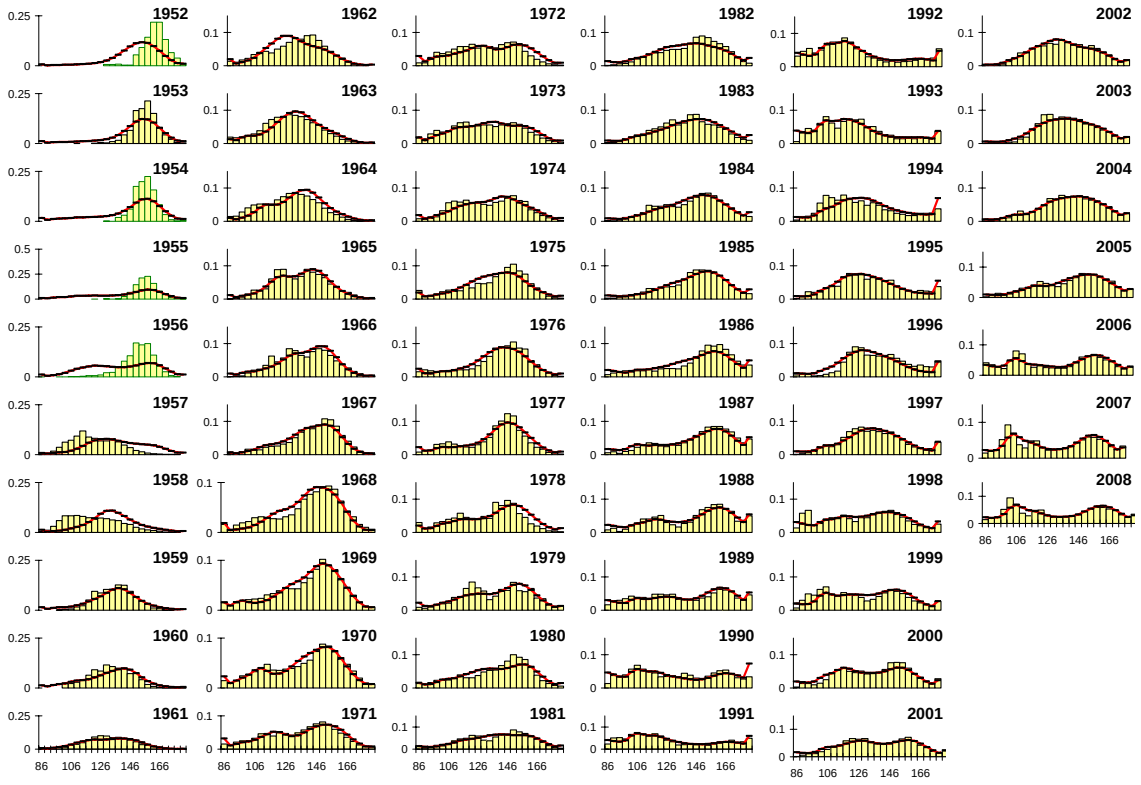
Figure 3. (cont.)

(c) sbtmod21 (no tag)

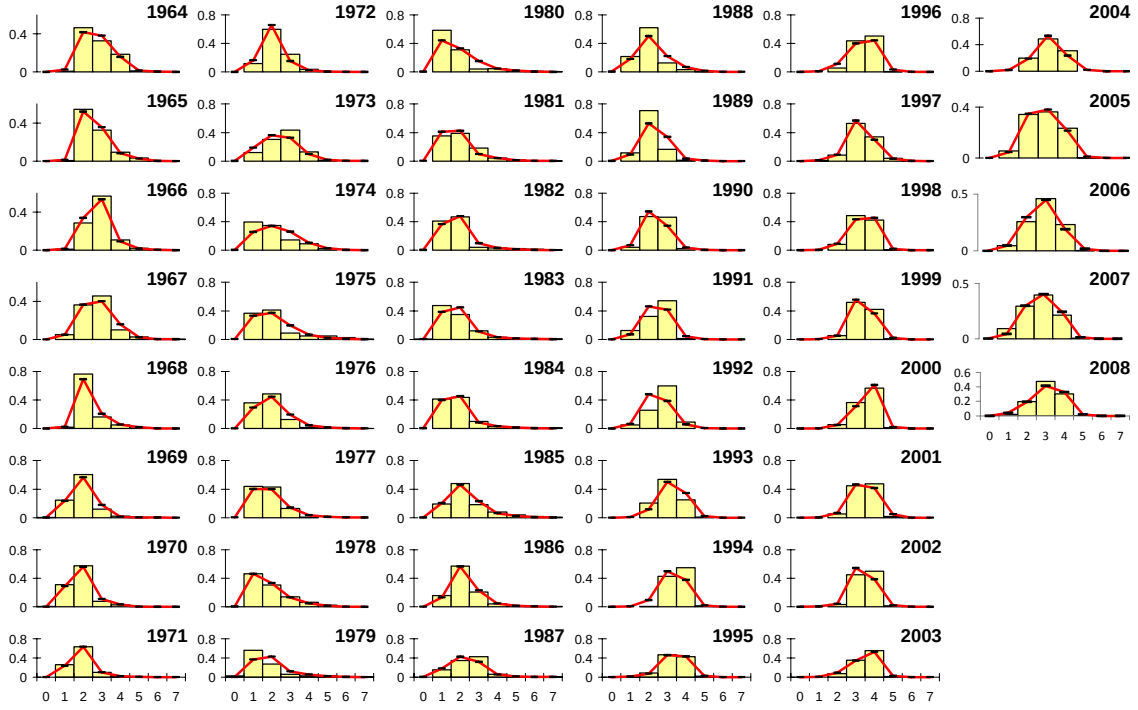
- summary



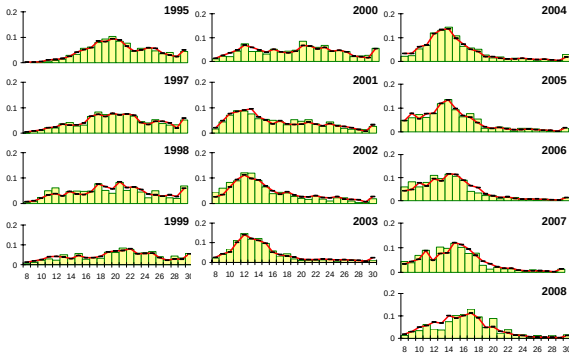
- catch-at-length of LL1



- catch-at-age of Australian fishery



- catch-at-age of Indonesian fishery



- tag recapture